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A NEW SPECIES OF *DORCADION* DALMAN, 1817 FROM IRAQ (COLEOPTERA: CERAMBYCIDAE)

Hüseyin Özdikmen*, Nashwan Dawood Sulaiman Al-Hamadani* and Mohammed Anwar Ali*

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[Özdikmen, H., Al-Hamadani, N. D. S. & Ali, M. A. 2013. A new species of *Dorcadion* Dalman, 1817 from Iraq (Coleoptera: Cerambycidae). Munis Entomology & Zoology, 8 (1): 1-3**]**

ABSTRACT: The following new taxon is described: *Dorcadion* (*Cribridorcadion*) *mosulense* sp. n. from Mosul (Iraq), close to *D. obtusum* Breuning, 1944.

KEY WORDS: Cerambycidae, Dorcadioninae, *Dorcadion*, new species, Iraq.

Dorcadion (*Cribridorcadion*) *mosulense* sp. n.

(Fig. 1)

Type serie. Holotype ♂: Iraq, Mosul, Sinjar Mountains, 13-15.IV.2012. Paratypes 5 ♂♂: from the same locality with holotype. The specimens are deposited in Gazi University (Turkey) (Map 1).

Female unknown.

Description:

Body length: 11.25 mm.

Body width: 4 mm.

Body black or blackish, covered with rather dense, recumbent, short white or whitish pubescence. Head with dense, white pubescence, two spots of dense brownish hairs on the internal part of scapus in sides of frons, on vertex with two triangular areas of brown ground hairs. Also head medially with very narrow, but distinct a glabrous line that extends from anterior margin of labrum to the end of head. Head with fine punctuation, but invisible in most of part. Antennae totally reddish-black (especially at the basal parts), with dense whitish pubescence.

Pronotum with three (2 lateral and 1 median) complete longitudinal bands of dense white hairs. Median band formed two lines clearly, in between of them with a distinct glabrous area. Each medio-lateral part on pronotum (between lateral and median hairy bands) with distinct longitudinal dark part that forms dense recumbent brown pubescence. They extends to the triangular areas on vertex. Punctuation of pronotum recognizable only in this part, rather densely and finely. Lateral process of pronotum rather short and obtuse.

Scutellum with rather dense white pubescence, small and triangular.

Elytra with dense recumbent brown ground pubescence and with patterns shaped as bands of dense recumbent white hairs.

Each elytron with 5 bands as lateral, humeral, dorsal, presutural and sutural. Lateral band rather thick, complete and not reach to elytral apex. In dorsal view, this band invisible. Humeral band complete, slightly thiner than lateral band and almost reach to elytral apex. Dorsal band complete, slightly thiner than humeral band, separated but joined with humeral band only at four fifth posterior part of elytra. Presutural band distinct, longitudinal, between dorsal and sutural bands at the basal part of elytra. Sutural band the thinnest band on elytra. Elytral apex without hairs or with very sparsely hairy, flattened and rounded, reddish or light brown colored.

Pygidium invisible in dorsal view.

Legs reddish-black.

Differential diagnosis. The new species is close related to *D. obtusum* Breuning, 1944. It is easily distinguished from *D. obtusum* by reddish-black antennal coloration (black in *D. obtusum*), rather short and obtuse lateral process of pronotum (shorter and more obtuse than *D. obtusum*), a glabrous area in between of median lines that form median band (without a glabrous area in *D. obtusum*), reddish colored elytral apex, thicker dorsal band, longitudinal presutural band (smaller and circular in *D. obtusum*).

Variability of paratypes. Body length changes between 11.25 mm and 12.75 mm. Body width changes between 3.625 mm and 5 mm. In one specimen, dorsal band on elytra joined with humeral band at the base of elytra. In one specimen, dorsal band on elytra not joined with humeral band at the posterior part of elytra, but extends to near. In three specimens, presutural band indistinct, but never circular.

Etymology. From the type locality "Mosul" (Iraq).

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Map 1. Location of Mosul and Sinjar in Iraq (from http://www.lonelyplanet.com).

Figure 1. *D. mosulense* sp. n. (holotype).

A NEW SPECIES OF THE GENUS *MIMOTETTIX* MATSUMURA, 1914 (HEMIPTERA: CICADELLIDAE: DELTOCEPHALINAE) FROM CHINA

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[Xing, J., Li, Z. & Song, Q. 2013. A new species of the genus *Mimotettix* Matsumura, 1914 (Hemiptera: Cicadellidae: Deltocephalinae) from China. Munis Entomology & Zoology, 8 (1): 4-8**]**

ABSTRACT: In this paper, a new species *Mimotettix articularis* Xing and Li sp. n. is described and illustrated. A check-list and a key to species of the genus from China is provided.

KEY WORDS: Homoptera, morphology, taxonomy, *Mimotettix*, China.

The leafhopper genus *Mimotettix,* belonging to tribe Athysanini of subfamily Deltocephalinae (Hemiptera: Cicadellidae), was established by Matsumura (1914) for a single species, *M. kawamurae* Matsumura, from Taiwan. Later, Kwon & Lee (1979) described another species, *M. curticeps* from South Korea. Webb & Heller (1990) transferred five species to *Mimotettix* from other genera from India. Recently, Li & Xing (2010) described another new species, *M. spinosus*, and made two new combinations: *M. slenderus* (Li & Wang, 2005) and *M. fanjingensis* (Li & Wang, 2005) from China. Dai, Zhang & Webb (2010) reviewed this genus base on examining the types of most species, and described seven new species, proposed five new synonyms and one new combinationmade one new combination. Up to the present, 15 species have been reported, and of these, 9 species occur in China.

Here, we described and illustrated a new species *Mimotettix articularis* Xing & Li sp. n. from Guizhou Province, China. The type specimens of the new species are deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC). This genus now contains 16 species, 10 species were known in China. A key to species from China is given. The morphological terminology used in the descriptions mainly follows Dai, Zhang & Webb (2011).

Mimotettix Matsumura, 1914

Mimotettix Matsumura, 1914: 197; Dai, Zhang & Webb, 2010: 2

Type species: *Mimotettix kawamurae* Matsumura 1914: 198, by original designation.

Remarks. The genus is similar to *Scaphomonus* Viraktamath (Dai et al., 2009) in having the forewings with scattered unpigmented areas, and the anterior margin of vertex with one or two cream transverse bands, but differs in having the aedeagus with a process arising apically on shaft.

Distribution. China, Japan and throughout the Old World tropics.

Check-list of the genus *Mimotettix* from China

M. alboguttulatus (Melichar, 1903)
  Distribution. China, Japan, India, Sri Lanka, Thailand, Vietnam, Africa.
M. articularis Xing & Li **sp. n.**
  Distribution. China.
M. curticeps Kwon & Lee, 1979
  Distribution. China, Japan, Korea, Russia..

M. distiflangentus Dai, Zhang & Webb, 2010
Distribution. China.
M. dorsocavatus Dai, Zhang & Webb, 2010
Distribution. China.
M. fanjingensis (Li & Wang, 2005)
Distribution. China.
M. robustistylus Dai, Zhang & Webb, 2010
Distribution. China.
M. spinosus Li & Xing, 2010
Distribution. China, Malaysia.
M. slenderus (Li & Wang, 2005)
Distribution. China, Thailand, Vietnam.
M. tibetensis Dai, Zhang & Webb, 2010
Distribution. China.

Key to Chinese species (male) of *Mimotettix*

1. Pygofer side without process..........2
- Pygofer side with process or articulated with process..........6

2. Aedeagal shaft with a pair of distal triangular-shape flanges on dorsal surface.......... **M. distiflangentus Dai, Zhang & Webb**
- Aedeagal shaft with or without a pair of narrow flanges on dorsal surface..........3

3. Aedeagal shaft deeply concave ventrally or dorsally..........4
- Aedeagal shaft not deeply concave ventrally or dorsally..........5

4. Aedeagal shaft deeply concave ventrally.......... ***M. slenderus* (Li & Wang)**
- Aedeagal shaft deeply concave dorsally.......... ***M. dorsocavatus* Dai, Zhang & Webb**

5. Aedeagal shaft broadest at mid-length in lateral view, process with length about 2/3 length of shaft.......... ***M. alboguttulatus* (Melichar)**
- Aedeagal shaft evenly tapered from base to apex in lateral view, process similar in length to that of shaft.......... ***M. curticeps* Kwon & Lee**

6. Pygofer side articulated with process.......... ***M. articularis* Xing & Li sp. n.**
- Pygofer side with process..........7

7. Pygofer side with process at dorsal margin. .... ***M. fanjingensis* (Li & Wang)**
- Pygofer side with process at ventral margin..........8

8. Aedeagal shaft without flanges on dorsal surface, pygofer side slightly protruding at ventroposterior angle.......... ***M. robustistylus* Dai, Zhang & Webb**
- Aedeagal shaft with narrow flanges on dorsal surface, pygofer side acutely rounded posteriorly..........9

9. Pygofer side with ventral process at mid margin...... ***M. tibetensis* Dai, Zhang & Webb**
- Pygofer side with ventral process near caudal margin.......... ***M. spinosus* Li & Xing**

Mimotettix articularis Xing & Li sp. n.

Figs. 1-11

Description. Length of male 5.6mm. Body reddish brown, vertex with two cream transverse bands anteriorly bordered with dark brown. Eyes black, ocelli pale yellow. Forewings brownish hyaline, with scattered unpigmented areas, veins dark brown. Legs dark brown.

Vertex roundly produced. Head including eyes slightly wider than pronotum, vertex slightly longer medially than next eyes. Ocelli located on lateral margin of vertex, separated from eyes by own diameter. Face slightly flattened, similar in length to width. Frontoclypeus narrow, longer than width between eyes. Anteclypeus slightly expanded apically. Antennae arising near lower corner of eye. Pronotum slightly longer than vertex, anterior margin roundly produced and posterior margin slightly concave. Scutellum triangular, equal in length to vertex, with transverse suture curved and depressed. Forewings with four apical cells and two subapical cells, outer subapical cell acute apically, inner subapical cell open basally.

Male genitalia. Pygofer side elongate, slightly narrowed caudally in lateral aspect, dorsoposterior area with many macrosetae, articulated with a long process on inner surface arising near ventral margin and directed caudally and dorsally (Fig. 9). Valve triangulate (Fig. 10). Subgenital plate elongate and triangulate, narrowly rounded apically, with uniseriate submarginal row of stout setae ventrolaterally and numerous hair-like setae laterally and apically (Fig. 11). Aedeagal shaft robust in lateral view, tapered to apex and curved dorsally, with a process arising apically, directed ventrally, gradually attenuate, apical process with length slightly more than 1/2 length of shaft; aedeagal shaft with a pair of triangular-shape dentate subapical flanges on each side, gonopore apical (Figs. 12, 13). Connective Y-shaped, articulating with aedeagus, its stem slightly longer than arms (Fig. 14). Style elongate, apophysis long, tapered to acute apex, turned laterally (Figs. 15, 16).

Type Material. Holotype ♂, China: Guizhou Province, Libo County, Maolan, 20 July 2011, coll. Qiongzhang Song (GUGC).

Remarks. This new species is similar to *Mimotettix tibetensis* Dai, Zhang & Webb, 2010 but can be distinguished by the pygofer side elongate, tapered posteriorly to rounded apical margin, and articulated with a long process on inner surface arising near ventral margin, connective stem less than twice length of arms, and the structure of the aedeagal shaft and location of gonopore are also different.

Etymology. The species name is derived from the Latin words *articularis*, indicating that the pygofer side articulated with a long process on inner surface arising near ventral margin.

ACKNOWLEDGEMENTS

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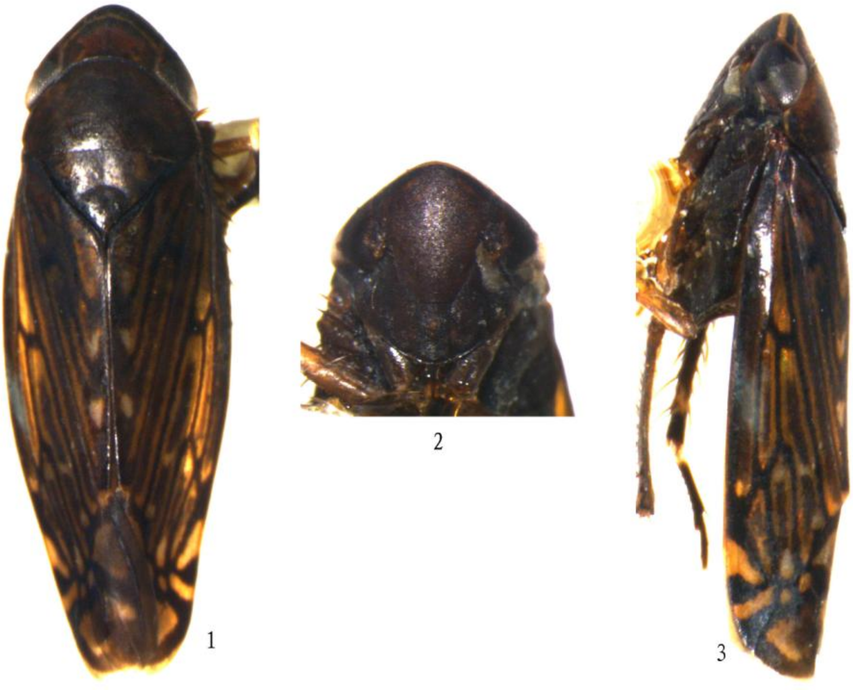
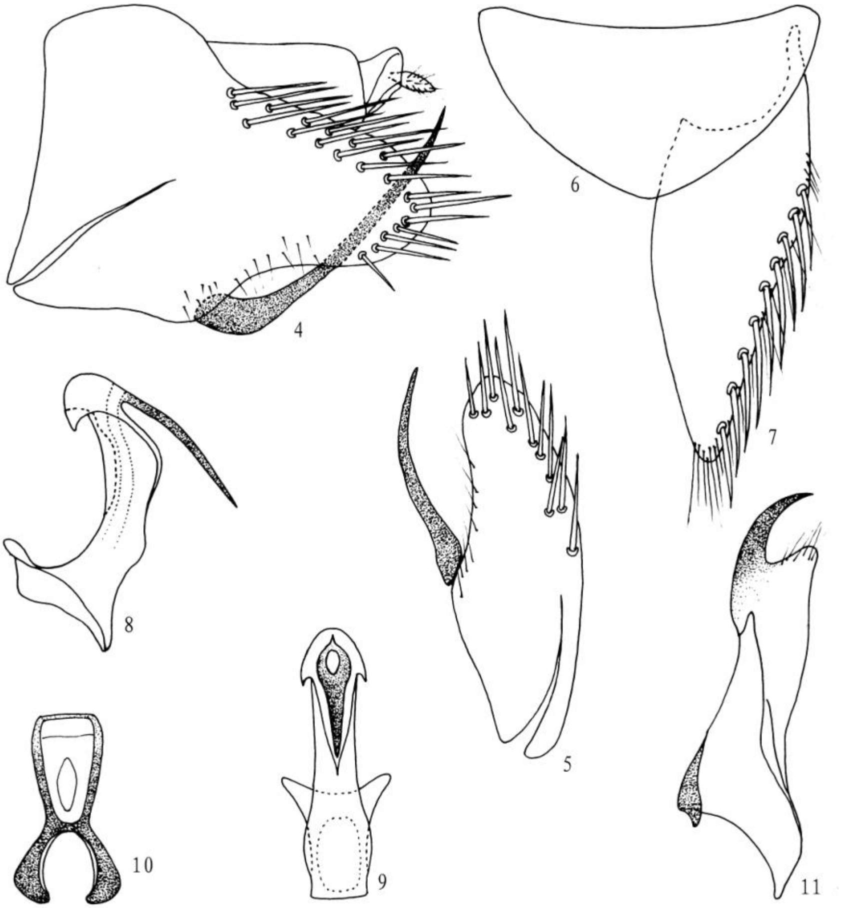


Figures 1-3. *Mimotettix articularis* sp. n. 1. ♂, dorsal view; 2. ♂, face; 3. ♂, lateral view;



Figures 4-11. *Mimotettix articularis* sp. n. 4. Male pygofer side, lateral view; 5. Male pygofer side, ventral view; 6. Valve, ventral view; 7. Subgenital plate, ventral view; 8. Aedeagus, lateral view; 9. Aedeagus, ventral view; 10.Connective; 11. Style, dorsal view.

TURKISH AGAPANTHIINI MULSANT, 1839 WITH IDENTIFICATION KEYS (COLEOPTERA: LAMIINAE)

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[Özdikmen, H. 2013. Turkish Agapanthiini Mulsant, 1839 with identification keys (Coleoptera: Lamiinae). Munis Entomology & Zoology, 8 (1): 9-40**]**

ABSTRACT: All taxa of the tribe Agapanthiini Mulsant, 1839 in Turkey are evaluated in detail. The main aim of this work is to clarify current status of the members of the tribe in Turkey. This work is the first attempt for this purpose. Keys for genera, subgenera and species are also given in the text.

KEY WORDS: Agapanthiini, Lamiinae, Cerambycidae, Coleoptera, keys, Turkey.

The tribe Agapanthiini Mulsant, 1839 includes approximately 81 genera and 693 species wordwide. According to Löbl & Smetana (2010), the tribe is represented by 16 genera and 183 species in the Palaearctic Region. With respect to this, the tribe is represented only by 4 genera and 21 species in Turkey as *Theophilea* Pic, 1895 (with 1 species), *Calamobius* Guérin-Méneville, 1847 (with 1 species), *Agapanthia* Audinet-Serville, 1835 (with 18 species) and *Agapanthiola* Ganglbauer, 1900 (with 1 species) according to Löbl & Smetana (2010). Besides, Özdikmen (2012) mentioned 4 genera and 33 species for Turkish Agapanthiini as *Theophilea* Pic, 1895 (with 1 species), *Calamobius* Guérin-Méneville, 1847 (with 1 species), *Agapanthia* Audinet-Serville, 1835 (with 30 species) and *Agapanthiola* Ganglbauer, 1900 (with 1 species).

As seen above, the differences between the two works are originated only from the numbers of *Agapanthia* species. Löbl & Smetana (2010) stated 18 species for Turkish *Agapanthia* fauna as *A. asphodeli* Latreille, 1804; *A. chalybaea* Faldermann, 1837; *A. coeruleipennis* Frivaldszky, 1878; *A. cynarae* Germar, 1817; *A. fallax* Holzschuh, 1974; *A. frivaldszkyi* Ganglbauer, 1884; *A. kindermanni* Pic, 1905; *A. kirbyi* Gyllenhal, 1817; *A. lais* Reiche & Saulcy, 1858; *A. lateralis* Ganglbauer, 1884; *A. osmanlis* Reiche & Saulcy, 1858; *A. schmidti* Holzschuh, 1975; *A. simplicicornis* Reitter, 1898; *A. subflavida* Pic, 1903; *A. suturalis* Fabricius, 1787; *A. verecunda* Chevrolat, 1882; *A. violacea* Fabricius, 1775 and *A. walteri* Reitter, 1898 alphabetically. In spite of that, Özdikmen (2012) gave 30 species (18 stated species + 12 unmentioned species) for Turkish *Agapanthia* fauna as *A. amitina* Holzschuh, 1989; *A. annularis* (Olivier, 1795); *A. cardui* (Linnaeus, 1767); *A. dahli* (Richter, 1820); *A. detrita* Kraatz, 1882; *A. intermedia* Ganglbauer, 1884; *A. irrorata* (Fabricius, 1787); *A. maculicornis* (Gyllenhal, 1817); *A. persicola* Reitter, 1894; *A. pesarinii* Sama & Rapuzzi, 2010; *A. subchalybaea* Reitter, 1898 and *A. villosoviridescens* (DeGeer, 1775) in addition to the stated species by Löbl & Smetana (2010).

Consequently, it is a necessity that makes a study to determine the real status of Turkish *Agapanthia* fauna with together the other genera due to the suspectable differences about numbers of species between the two works.

The present zoogeographical characterization is based on the chorotype classification of Anatolian fauna, recently proposed by Vigna Taglianti et al. (1999). In the text, as possible as one chorotype description can be identificated for each taxon.

Turkish Agapanthiini is presented as follows:

TRIBE AGAPANTHIINI Mulsant, 1839

It is characterized by long elongate body. Antennae thin, long, 12 segmented. The tribe is represented by 4 genera in Turkey.

A key for the genera

1. Scutellum glabrous, without pubescence; body cylindrical..............................***Theophilea***
-- Scutellum with dense pubescence; if scutellum glabrous, body not cylindrical..................**2**

2. Antennae so long, with only short hairs..***Calamobius***
-- Antennae not so long, with long erect hairs..**3**

3. Segments 1 to 3 of front tarsus together distinctly shorter than front tibia; prothorax transversal or a little (often indistinctly) longer than wide, with more or less long erect hairs. Antennal segments from third normally more or less clearly ringed. Lower half of the eyes large or moderately large...***Agapanthia***
-- Segments 1 to 3 of front tarsus together at least as long as front tibia; prothorax long and slim, much longer than wide. Antennae uniform, not clearly ringed. Lower half of the eyes very small.. ***Agapanthiola***

GENUS *THEOPHILEA* Pic, 1895: 39

Type sp.: *Theophilea cylindricollis* Pic, 1895

The Palaearctic genus *Theophilea* has only 2 species as *T. cylindricollis* Pic, 1895 and *T. subcylindricollis* Hladil, 1988 in the world fauna. It is represented only by the species, *T. cylindricollis,* in Turkey (only in Anatolian territory).

SPECIES *Theophilea cylindricollis* Pic, 1895: 39

Type loc.: Bitlis (Turkey)

Syn.: *erzurumensis* Önalp, 1974: 174 (*Agapanthia*)

Length: 8-14 mm.

Records from Turkey: (**W, N, E Anatolia**)
Bitlis prov. as the type loc. (Pic, 1895); **Bitlis prov.** (Aurivillius, 1921); **Erzurum prov.** and near as *A. erzurumensis* (Özbek, 1978); Turkey (Danilevsky & Miroshnikov, 1985; Lodos, 1998; Sama, 2002); **Erzurum prov.**: Aşkale (Adlbauer, 1992); **İzmir prov.**: Bozdağ, **Bitlis prov.**, **Bingöl prov.**, **Kars prov.** (Rejzek et al., 2001); **Bayburt prov.**, **Erzurum prov.**, **Gümüşhane prov.**, **Kars prov.** (Tozlu et al., 2003); **Kocaeli prov.**: İzmit (Beşkayalar Natural Park) (Özdikmen & Demirel, 2005); Anatolia (Özdikmen, 2006).

Range: Caucasus (Armenia, Azerbaijan, Georgia), Turkey.

Chorotype: SW-Asiatic

GENUS *CALAMOBIUS* Guérin-Méneville, 1847: XVIII

Type sp.: *Saperda filum* Rossi, 1790

The W Palaearctic genus *Calamobius* Guérin-Méneville, 1847 is monotypic. So, *C. filum* (Rossi, 1790) occurs also in Turkey (in both European Turkey and Anatolian territories).

SPECIES *Calamobius filum* (Rossi, 1790: 152)

Type loc.: "Etrusca" (Italy: Tuscany)

Orig. comb.: *Saperda filum* Rossi, 1790

Syn.: *hirtus* Fabricius, 1792: 317 (*Saperda*); *gracilis* Creutzer, 1799: 124 (*Saperda*); *marginellus* Fabricius, 1801: 332 (*Saperda*); *tenuis* Blanco-Fernández, 1859: 411 (*Saperda*); *magnini* Pic, 1931: 10; *decoloripes* Pic, 1945: 7.

Length: 5-11 mm.

Records from Turkey: (**European Turkey and Anatolia**)
İstanbul prov.: Çengelköy (Demelt & Alkan, 1962; Demelt, 1963); **Muğla prov.**: Bodrum (Karatoprak) (Gül-Zümreoğlu, 1975); **Kocaeli prov.**: İzmit (Hereke) (Sama, 1982); Turkey (Danilevsky & Miroshnikov, 1985); **Osmaniye prov.**: Nurdağı pass (Adlbauer, 1988); Turkey: Marmara Region (Althoff & Danilevsky, 1997); **İstanbul prov.**, **Bursa prov.**, **Çanakkale prov.**: Gökçeada, **Muğla prov.** (Lodos, 1998); Anatolia (Sama & Rapuzzi, 2000; Sama, 2002); **Isparta prov.**: Eğirdir (Akbelenli-Sütçüler, Aşağı Gökdere), **Antalya prov.**: Kemer (Olimpos Mt.), **Burdur prov.**: Bucak (Çamlık vill.) (Özdikmen & Hasbenli, 2004); **Kahramanmaraş prov.**: Göksun (Saraycık vill., Kireçköy, Göksun-Çardak road), Püren pass, Kahramanmaraş-Andırın road (Körsülü bridge env., Karbasan vill. env.), Pazarcık (Kocalar vill., Armutlu vill.), Kahramanmaraş-Kavaklı road, Campus of Sütçü İmam University, Türkoğlu (Araplar vill.) (Özdikmen & Okutaner, 2006); **Bolu prov.**: Kaynaşlı, **Sakarya prov.**: Sapanca (Özdikmen et al., 2005); **Hatay prov.**: İskenderun (Gediksaray, Güzelyayla road), Samandağı (Çevlik Rock Cemeteries, Fidanlı), İskenderun-Belen (Atik plateau), Kırıkhan (Alabeyli vill.), Hassa (Sögüt vill. road), **Gaziantep prov.**: Nurdağı (entry of Karaburçlu vill.), **Manisa prov.**: Turgutlu Çardağı (Aysekisi hill), **İzmir prov.**: Menderes (Efemçukuru vill.) (Özdikmen & Demirel, 2005); **Ankara prov.**: Kızılcahamam (Güvem: Yenimahalle, Aköz vill. (Özdikmen & Demir, 2006); **Adana prov.**: Pozantı-Mersin road, **İçel prov.**: Fındıkpınarı, Silifke-Uzuncaburç road (Özdikmen, 2006); **İçel prov.**: Çamlıyayla env., **Şanlıurfa prov.**: Halfeti (pers. comm. with J. Kurzawa, 2006); **Osmaniye prov.**: Kesmeburun village (Hierapolis), Kalecik-Hasanbeyli road, Karaçay, Bahçe (Central, Kızlaç vill.), Zorkun road (Çiftmazı), Akyar vill., Bahçe-İnderesi road, Yarpuz road (Forest store env.), Osmaniye-Gaziantep road 5th km, Toprakkale, Issızca vill., **Hatay prov.**: Samandağı (Nekropol), Kuzuculu, Akbez, Erzin-kaplıcalar district, Dörtyol-Yeniyurt, Belen, Entry of Belen (Çakallı), Güzeluşağı vill., **Gaziantep prov.**: Akbez (Gülpınarı plateau), Fevzipaşa-Islahiye road 1st km, Kilis- Gaziantep road (Oğuzeli return), **Kilis prov.**: Hassa–Kilis road (Hisar vill., Gözkaya vill.) (Ozdikmen, Güven & Gören, 2010); **Antalya prov.**: Alanya-Taşkent (Exit of Karapınar vill.), Alanya (Şıhlar vill. plateau, Karapınar vill., Dikmetaş plateau), Gündoğmuş, Akseki-Manavgat road (Gündoğmuş return), İbradı-Akseki road, İbradı (Central, Başlar vill. env.), **Konya prov.**: Hadim-Bozkır road (Yazdamı vill. env.), Gencek- Derebucak, Derebucak, Taşkent-Alanya (Çayarası district), (Ozdikmen & Turgut, 2010); **İçel prov.**: Çamlıyayla, **Tunceli prov.**: 14 km S of Tunceli (Sama, Rapuzzi & Özdikmen, 2012); **Antalya prov.**: Olimpos (pers. comm. with Y. Şenyüz, 2012).

Range: Europe, Caucasus (Armenia, Azerbaijan, Georgia), Turkey, Cyprus, Iran, Israel, Jordan, Lebanon, Syria, North Africa (Algeria, Morocco, Tunisia).

Chorotype: W-Plaearctic

GENUS *AGAPANTHIA* Audinet-Serville, 1835: 35

Type sp.: *Cerambyx cardui* Linnaeus, 1767

The Palaearctic and Oriental genus *Agapanthia* Audinet-Serville, 1835 includes approximately 75 species in the world fauna. Its members occur in both

European Turkey and Anatolian territories. But Turkish fauna has not been known entirely until the present work (see above).

A key for the subgenera and species*

1. Body blue, greenish or purple, metallic, more or less shiny or if body black, elytra leaden colored or more or less metallic shiny. Elytra without dense pubescence, more or less glabrous appearance, only with black tiny hairs (sometimes with white tiny hairs on the apex). Underside of the body more or less shiny, metallic..**2**
--. Body black or dark, sometimes slightly shiny, but not distinct metallic (blue or green). First antennal segment black. Elytra with regularly distributed or spotted ground pubescence, only seldom almost glabrous. Underside of the body only seldom slightly metallic..**14**

2. Pronotum with a small lateral process. 3rd antennal segment and the following segments clearly reddish (or yellowish) ringed, at the apex black..........Subgenus ***AGAPANTHOPLIA*** **...*A. coeruleipennis***
--. Pronotum behind the middle more or less widened, but without distinct lateral hump. Antennal segments black or dark blue, sometimes whitish ringed, under sides normally with whitish fine hairs, unicolored....................................Subgenus ***SMARAGDULA***................**3**

3. Antennae not ringed; 4th segment and the following segments at the base very fine and dense indistinctly whitish hairs; sometimes 3-6th segments with long ciliated........................**4**
--. Antennae from 4th segment above the bases up to half length with clear and distinctly ringed, under sides with whitish pubescence...**11**

4. Pronotum slightly longer than wide or as long as wide, but not transversal.......................**5**
--. Pronotum transversal, distinctly wider than long, dense and somewhat irregular punctuated, behind the middle more clearly widened (but without lateral process). Elytra much wider than pronotum, hardly 3 times longer than wide. Body large...........................**10**

5. Scutellum glabrous. First antennal segment outside with single very coarse and deep point. Lower part of the eye small, strongly arched. Pronotum slightly longer than wide, much dense and large wrinkled punctuated (even more roughly than the vertex). Elytra completely with regularly strong and dense, extraordinary large wrinkled punctuated. Head, pronotum and elytral base with long erect hairs. Metallic blue, brilliant; First antennal segment blue, the other segments blackish, fine and very thinly, hardly visible close whitish hairs, 3-6th segments insides long ciliated...***A. frivaldszkyi***
--. Scutellum with pubescence. Pronotum almost squarely, as long as wide, or slightly longer than wide, dense and regular punctuated. First antennal segment without large and deep punctuation. Lower part of the eyes much stronger arched..**6**

6. Elytra parallel, 3rd segment of tarsi very small..***A. pesarinii***
--. Elytra subparallel, humerus well developed, 3rd segment of tarsi not very small **7**

7. Body smaller and mostly a little more slender. Elytra with more or less regularly punctuated and semierect ground pubescence...***A. amitina***
--. Body larger. Elytra with more or less regularly punctuated **8**

8. Pronotum always with more or less complete, three distinct longitudinal lines (1 median + 2 lateral) of pubescence...***A. fallax***
--. Pronotum without complete, distinct longitudinal lines of pubescence, sometimes with incompletely, but distinctly..**9**

9. Elytra without distinctly contrasted pubescence...***A. violacea***
--. Elytra and antennae covered by whitish pubescence, therefore posterior part of elytra or elytral apex being contrast to the remaining part...***A. intermedia***

10. In front of pronotum considerably narrower than the base, behind the middle at the side strongly humped arched. Head in male and female only as wide as pronotum at the anterior edge. Frons in female dense and regularly punctuated..**11**
--. In front of pronotum not narrower than the base. Head often as wide as the pronotum (or anterior edge of pronotum). Frons in female, contrasted clypeus and the sides with only very much sparse punctuation, shiny..***A. lais***

11. Sides of metathorax and also episternum closed very dense and regular punctuation. Pronotum fine and exceptionally dense punctuated..***A. persicola***
--. Sides of metathorax with fine, unequal and slightly dense, to inside sparsely punctuation (as in *violacea*). Posterior one three part of elytra with distinct whitish-gray hairs...***A. chalybaea***

12. Scutellum with pubescence. Elytra only on the first half of the elytral length with long erect hairs. Body larger...**13**
--. Scutellum glabrous. Elytra with long erect hairs till the apex. Body smaller, entirely metallic very light green..***A. naciyae***

13. Body dark blue, only sometimes with greenish reflects, mainly on pronotum, body larger and stout. Elytral base wrinkled, On elytra, the absence of white pubescence on the first half and the very sparse white pubescence on the apical portion............................***A. ozdikmeni***
--. Body metallic blue-green. Elytral base with only dense but isolate points, On elytra, the pubescence is dense to the base and very dense towards the apex......................***A. osmanlis***

14. Pronotum with transversally wrinkled sculpture. Elytra with mottled whitish spots of pubescence, in typical form arranged into 4 longitudinal rows......Subgenus ***STICHODERA*** .... ***A. irrorata***
--. Pronotum without transversal folding, punctuation, long erect hairs, usually with three bands of light hairs (as a median and two lateral). Elytra with more or less dense pubescence (regularly or spotted)..**15**

15. Elytra at the apex more or less rounded, not strongly acuminated or into a long apex; without any sutural band..**16**
--. Elytra to back strongly constricted and here acuminated; at the apex individually long and sharpened; usually with band of white pubescence in the suture...................................... ....Subgenus ***AGAPANTHIA***............**31**

16. Thorax with more or less dense hairs, but without lateral bands or spots (sides of thorax with not different hairs than remaining parts of underside)..**17**
--. Sides of thorax with very dense white or yellowish-white hairs, formed stripes (or bands) of pubescence, the remaining part of underside with thinner hairs.. ....Subgenus ***HOMOBLEPHARA***.........***A. maculicornis***

17. Elytra on the upperside with regularly distributed ground pubescence. Body ordinary wide or quite wide...**18**
--. Elytra on the upperside with more or less distinctly spotted pubescence........................**22**

18. Pronotum and vertex without median band of pubescence.. ....Subgenus ***DROSOTRICHIA***.........***A. annularis***
--. Pronotum and vertex with median band of pubescence...**19**

19. First segment of hind tarsi short, 1st and 2nd segments together not longer than the claw segment..Subgenus ***SYNTHAPSIA***............***A. kirbyi***
--. First segment of hind tarsi long, longer than the claw segment; 1st and 2nd segments together not shorter than the claw segment.....................Subgenus ***EPOPTES***................. **20**

20. Elytra only up to the middle with long erect hairs, behind the middle only with short, semierect hairs. 1st antennal segment on the outside without hairs or only with sparser yellow or grayish hairs. 3rd antennal segment at the apex with a tuft of blackish hairs………………………………………………………………………………………………………***A. lateralis***
--. Elytra up to the apex or almost up to the apex with long erect hairs. 1st antennal segment on the outside with much denser yellow or grayish hairs; 3-5th segments without distinct tufts of hairs, only ciliated at the apex………………………………………………………………**21**

21. Tarsi black and dark pubescence, 1-3rd segments at the bases with fine grayish hairs. Elytra at the apex very acute (or very sharp), almost acuminated. Lower parts of eyes very large, genae short. Body wider and shorter, more flattened…………………………………………**22**
--. Tarsi with white-gray pubescence and short black decumbent hairs. Eyes smaller, genae larger. Elytra at the apex almost rounded. Body more elongated. Eyes very small, genae very large. Body more slender, to back more narrowed. Elytra at the base granulated, with long erect hairs, quite dense brownish-yellow pubescence. Epipleura with a lateral band; pubescence of sides usually compacted, a wider longitudinal band in inner part of epipleural band sometimes worn or weakly gray hairs. 3rd antennal segment and the following segments widely, reddish-yellow ringed and with whitish hairs, at the apex black; 1st segment on the outside with much denser yellow hairs, 3rd segment and the following segments (4th, 5th, 6th) on inside individually ciliated, at the apex without tuft of hairs………………………………………………………………………………………………………***A. asphodeli***

22. 3rd antennal segment at the apex with a tuft of hairs (only some varieties without that), 4th and 5th segments usually like a shrubbery (but less distinct) or at the apex dense black ciliated or 4-6th segment at the apex dense black ciliated or tufted. Pronotum distinctly transversal ………………………………………………………………………………………………**23**
--. 3rd antennal segment without tuft of hairs, sometimes at the apex only slightly ciliated. Pronotum indistinctly transversal, almost as long as wide, behind the middle slightly widened…………………………………………………………………………………………………**25**

23. Elytra with very large, strongly spotted of yellow pubescence, on the ground largish, fine punctuated; elytral base strongly granular, up to posterior one third with long erect hairs; elytra long, in male and female almost parallel………………………………………………***A. walteri***
--. Elytra with dense, spotted, more or less fine yellow or yellowish pubescence, upperside finely punctuated, the space between points narrow; elytra only at the base more rough (larger) punctuated, sometimes at the base also slightly granulated, elytra moderate length, in female parallel, in male to the apex slightly narrowed; only in posterior half with long erect hairs…………………………………………………………………………………………………**24**

24. 3rd-4th antennal segments (sometimes also 5th) at the apex with a tuft of hairs. Elytra with spotted pubescence of dense hairs……………………………………………………………***A. dahli***
--. 3rd-6th antennal segments at the apex with a tuft of hairs. Elytra with spotted pubescence of less dense hairs………………………………………………………………………***A. kindermanni***

25. 3rd antennal segment and the following segments at the bases more or less widely light ringed (yellow or reddish). Antennae black ciliated, but without tuft of hairs, 3rd and 4th segments usually denser ciliated than the following segments……………………………………**26**
--. Antennal segments more or less black, sometimes at the bases slightly lighter colored (brownish or dark reddish); 3rd segment and the following segments at the bases with whitish or whitish-gray fine close hairs, 3-5th segments at the apex downwards probably often strongly black ciliated, but without clear tuft of hairs. Pronotum almost squared……**28**

26. The yellow parts of antennal segments with notably dense gray hairs, so that the yellow ground color only visible by shining. Body elongated, parallel……………***A. simplicicornis***
--. The yellow parts of antennal segments with fine light hairs, so that the yellow ground color is quite clearly visible. Body not very elongated, more or less wide. Pronotum distinctly wider than long…………………………………………………………………………………………**27**

27. 3rd antennal segment with a small tuft of hairs. Thorax with very indistinctly lateral spot. Legs with gray and yellowish pubescence……………………………………………***A. subflavida***
--. Antennal segments without tuft of hairs. Thorax without lateral spot. Legs with whitish pubescence…………………………………………………………………………………***A. schmidti***

28. 3rd antennal segment at the base with widely, light (gray or grayish) hairs, only at the apex black, without lighter hairs (in some varieties of *A. subchalybaea* antennae almost or entirely black). Elytra with more or less distinct partly spotted ground pubescence…………**29**
--. 3rd antennal segment widely or narrowly brightly ringed. Elytral pubescence almost regularly distributed…………………………………………………………………………………**30**

29. Ground color black with leaden shiny or mineral ore shiny, yellowish or gray, quite dense spotted pubescence……………………………………………***A. villosoviridescens***
--. Black, slightly bluish, weakly submetallic shiny. Elytra with very sparse, often indistinctly spotted hairs, almost glabrous. Median line of pronotum very fine and narrow. Underside with very sparse and fine, gray or whitish pubescence. Scutellum with less dense pubescence. Usually slightly larger than *A. villosoviridescens*, wider and slightly robust. Antennae sometimes strongly expunged. Body with more or less yellowish pubescence…………………………………………………………………………………………***A. subchalybaea***

30. 3rd antennal segment only at the base narrowly (white or grayish) ringed, at the base black, brown or reddish. 3rd and the following segments up to middle brightly (white or reddish) ringed (black, at the bases sometimes reddish). 1st antennal segment on the outside with very thinner, whitish hairs. Vertex and pronotum with longitudinal lines of yellowish pubescence. Scutellum with yellow pubescence. Elytra with almost regularly partly yellowish or yellowish-gray ground pubescence, in the first half with long erect hairs. Epipleura with denser pubescence (with marginal line in the posterior half)…………………………***A. cynarae***
--. 3rd antennal segment very widely whitish ringed (almost up to posterior one third). 4th segment and the following segments brighter ringed than *A. cynarae*. Vertex and pronotum with yellow or yellowish pubescence. Scutellum with yellow or yellowish pubescence. Elytra with yellowish-gray or grayish-yellow pubescence. Pubescence on the epipleura is indistinctly condensed. Underside with distinctly denser pubescence than *A. cynarae*…………………………………………………………………………………………***A. verecunda***

31. Elytral apex more or less rounded……………………………………………………***A. cardui***
--. Elytral apex distinctly acuminate…………………………………………………***A. suturalis***

* The present key prepared on the base of Plavilstshikov (1930) and included all species (including incorrectly mentioned species + newly described species) for Turkey.

The members of Turkish *Agapanthia* are presented as follows:

SUBGENUS *SYNTHAPSIA* Pesarini & Sabbadini, 2004: 121

Type sp.: *Saperda kirbyi* Gyllenhal, 1817

The monotypic subgenus was originally described by Pesarini & Sabbadini (2004) as a separate genus. So, *A. kirbyi* (Gyllenhal, 1817) occurs also in Turkey (in both European Turkey and Anatolian territories).

SPECIES *Agapanthia kirbyi* (Gyllenhal, 1817: 186)

Type loc.: “Lusitania” (Portugal, probably a wrong locality)

Orig. comb.: *Saperda kirbyi* Gyllenhal, 1817

Syn.: *latipennis* Mulsant, 1862: 352; *zawadskyi* Fairmaire, 1866: 275

Length: 14-28 mm.

Löbl & Smetana (2010) reported the species only from European Turkey for Turkey. However, it is extensively distributed also in Anatolia for Turkey as seen below.

Records from Turkey: (**European Turkey and Anatolia**)
Hatay prov.: Akbez (Pic, 1892); **Bilecik prov.** (Bodemeyer, 1906); Anatolia (Aurivillius, 1921); **Adana prov.**: Toros Mts., Pozantı, Bolkar Mts. (Villiers, 1959); **İzmir prov.**: Efes (Demelt & Alkan, 1962; Demelt, 1963); **İçel prov.**: Alata (Breuning et Villiers, 1967); **Konya prov.**: Akşehir (Tuatay et al., 1972); **Ankara prov.**: Karagöl, **İzmir prov.**: Selçuk (Efes) (Gül-Zümreoğlu, 1975); **Niğde prov.**: Carayad pass (Sama, 1982); Turkey (Danilevsky & Miroshnikov, 1985; Lodos, 1998; Sama, 2002); **Bursa prov.**: Karacabey, **İçel prov.**: Kuzucubelen (Öymen, 1987); **Edirne prov.**, **Bursa prov.**: Uludağ, **Bilecik prov.**, **İzmir prov.**, **Eskişehir prov.**, **Ankara prov.**: Kızılcahamam (Azapderesi), Gölbaşı (Fen Lisesi), **Isparta prov.**: Eğirdir, **Konya prov.**: Akşehir, **Kayseri prov.**: Central, Yeşilhisar, **Amasya prov.**, **Niğde prov.**: Çamardı (Bulgar-Maden), **İçel prov.**: Çamalan, Toros Mts., **Adana prov.**: Cilicia, **Kahramanmaraş prov.**, **Bitlis prov.**, **Van prov.** (Önalp, 1988); **Burdur prov.**: Sagalassos, **İçel prov.**: Erdemli, **Osmaniye prov.**: Nurdağı pass, **Niğde prov.**: Çiftehan (Adlbauer, 1988); European Turkey: Marmara Region (Althoff & Danilevsky, 1997); **Adana prov.**, **Bingöl prov.**, **Bursa prov.**, **Erzincan prov.**, **Erzurum prov.**, **Kars prov.**, **Tokat prov.** (Tozlu et al., 2003); **Antalya prov.:** Kemer (Olimpos Mt.), Gömbe (Sütleğen, Sinekçibeli pass), **Burdur prov.:** Bucak (Çamlık vill.), **Isparta prov.:** Yalvaç (Sultan Mts.), Yarıkkaya vill., **Afyon prov.:** Sultandağı (Sultan Mts.) (Özdikmen & Hasbenli, 2004); **Niğde prov.**: Şıhlar, **Ankara prov.**: Kızılcahamam, **Isparta prov.**, **Siirt prov.** (Özdikmen et al., 2005); **Manisa prov.**: Turgutlu Çardağı (Aysekisi hill), **Kocaeli prov.**: İzmit (Beşkayalar Natural Park), **Kırşehir prov.**: Boztepe road (Özdikmen & Demirel, 2005); **Adana prov.**: Pozantı, **Ankara prov.**: Çal Mt. (Özdikmen & Demir, 2006); **Konya prov.**: Ayrancı (Dikenlidere), **Osmaniye prov.**: Zorkun, **Aksaray prov.**: between Aşağı-Yukarı Dikmen, **Niğde prov.**: exit of Ulukışla-Pozantı, **İçel prov.**: Silifke-Kırobası road, **Adana prov.**: Pozantı-Mersin road (Özdikmen, 2006); **Çorum prov.**: Kargı (Karagöl vill.) (Özdikmen, 2007); **Antalya prov.**: Gündoğmuş, Akseki (Güzelsu vill.), İbradı (Central, Başlar vill.), **Konya prov.**: Bozkır (Yalnızca env.), Gencek- Derebucak, Hadim (Korualan town env.) (Turgut & Ozdikmen, 2010); **Bolu prov.**: between Dereceören-Akçaalan (Abant), entry of Göynük-Mudurnu road (exit of Sarılar vill.), Yeniçağa-Mengen road, Abant road, Abant env. (Ozdikmen, 2011); **Kırıkkale prov.**: 5 km past to Delice, Hacılar-Küreboğazı vill. road, (Özdikmen, Mercan & Tunç, 2012); **Erzincan prov.**: 12 km west of the crossroad to Tunceli, Kızıldağı pass, **Tunceli prov.**: 40 km W of Tunceli (road to Ovacık), 16 km S of Pülümür, 15 km N of Pülümür (Sama, Rapuzzi & Özdikmen, 2012).

Range: Europe, Caucasus (Armenia, Azerbaijan, Georgia), Turkmenistan, Turkey, Iran, Israel, Syria.

Chorotype: Turano-European

SUBGENUS *EPOPTES* Gistel, 1857: 93

Type sp.: *Lamia asphodeli* Latreille, 1804
Syn.: *Agapanthiella* Pesarini & Sabbadini, 2004: 126 [Type sp. : *Cerambyx villosoviridescens* DeGeer, 1775]

According to Özdikmen (2012), the subgenus is represented by 13 species in Turkey. The species, *A. detrita* Kraatz, 1882, however, is distributed only in Central Asia (Kirgizia, Kazakhstan, Tadjikistan and Uzbekistan). So, it is impossible for Turkey. The other members (a total of 12 species) of subgenus occur in Turkey (in both European Turkey and Anatolian territories).

SPECIES *Agapanthia asphodeli* (Latreille, 1804: 282)

Type loc.: Bordeaux (France)

Orig. comb.: *Lamia asphodeli* Latreille, 1804

Syn.: *spencei* Gyllenhal, 1817: 187; *insularis* Gautier des Cottes, 1870: 263; *reyi* Mulsant & Godart, 1870: 27; *mimica* Pic, 1927: 1

Length: 14-22 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**W half of Anatolia**)
İzmir prov.: Bergama (Demelt & Alkan, 1962); **İzmir prov.**: Pergamon, **Hatay prov.**: İskenderun (Demelt, 1963); Turkey (Danilevsky & Miroshnikov, 1985; Lodos, 1998; Sama & Rapuzzi, 2000; Sama, 2002); **İzmir prov.**: Çamlık pass (Adlbauer, 1988); **Çanakkale prov.**, **İzmir prov.**, **Bilecik prov.**, **Ankara prov.**, **Antalya prov.**: Alanya, **Adana prov.**: Pozantı, **Hatay prov.**: Amanos (Akbez) (Önalp, 1989); **Isparta prov.:** Isparta-Burdur road (exit of Isparta), Yalvaç (Sultan Mts.), **Antalya prov.:** near Manavgat waterfall, Kemer (Olimpos Mt.), **Yozgat prov.:** Çiğdemli (Gökiniş vill.) (Özdikmen & Hasbenli, 2004); **Aydın prov.**, **Ankara prov.**: Gölbaşı (Özdikmen et al., 2005); **Ankara prov.**: Kızılcahamam (Işık Mt.: Keçikaya hill), Soğuksu National Park, Aköz vill., Anatolia (Özdikmen, 2006); **Osmaniye prov.**: Hasanbeyli (pers. comm. with J. Kurzawa, 2006).

Range: Europe, Caucasus (Armenia, Azerbaijan, Georgia), Kazakhstan, Turkey.

Chorotype: S and E-European

SPECIES *Agapanthia cynarae* (Germar, 1817: 222)

Type loc.: "bei Fiume und Arbe" (Croatia: Rijeka and Insel Rab)

Orig. comb.: *Saperda cynarae* Germar, 1817

Syn.: *boeberi* Fischer von Waldheim, 1805: 16; *decora* Krynicki, 1834: 170; *diversicornis* Pic, 1927: 1

Length: 14-23 mm.

This species has 2 subspecies as the nominotypical subspecies and *A. cynarae michaeli* Sláma, 1986 that is endemic to Crete. So it is represented only by the nominotypical subspecies in Turkey. Löbl & Smetana (2010) reported the species only from European Turkey for Turkey. However, it is extensively distributed also in Anatolia for Turkey as seen below.

Records from Turkey: (**European Turkey and N, W, SW Anatolia**)
Amasya prov. as *A. boeberi* (Villiers, 1959); Turkey (Danilevsky & Miroshnikov, 1985; Lodos, 1998); **Bilecik prov.**: Central (Öymen, 1987); **İçel prov.**: Erdemli (Adlbauer, 1988); **Edirne prov.**, **İstanbul prov.**, **Bursa prov.**: Uludağ, **Bilecik prov.**, **Erzurum prov.** as *A. boeberi* (Önalp, 1989); Turkey as *A. boeberi* (Lodos, 1998); European Turkey (Sama, 2002); **Konya prov.:** Akşehir (Engelli vill.) as *A. boeberi* (Özdikmen & Hasbenli, 2004); **Kocaeli prov.**: İzmit (Ballıkayalar Natural Park) as *A. boeberi* (Özdikmen & Demirel, 2005); **Çorum prov.**: Kargı (Kargı plateau road), **Amasya prov.**: Merzifon (Tavşan Mt.) (Özdikmen, 2007); **Konya prov.**: Beyşehir-Akseki road (Huğlu env.), Bozkır (Yalnızca) (Turgut & Ozdikmen, 2010); **Bolu prov.**: Gerede, Mudurnu-Göynük road (Sünnet Lake env.) (Özdikmen, 2011).

Range: Europe, Caucasus (Armenia, Azerbaijan, Georgia), Turkey.

Chorotype: S and E-European

SPECIES *Agapanthia dahli* (C. F. W. Richter, 1820: pl. 12)

Type loc.: Europa

Orig. comb.: *Saperda dahli* C. F. W. Richter, 1820

Syn.: *gyllenhali* Ganglbauer, 1883: 190; *tristriga* Reitter, 1913: 70

Length: 9.5-22 mm.

Löbl & Smetana (2010) never reported the species for Turkey. However, it is extensively distributed in both European Turkey and Anatolia for Turkey as seen below.

Records from Turkey: (**European Turkey and Anatolia**)
Hatay prov.: Yenişehir – Fuchs et Breuning, 1971 (Ex. Holzschuh, 1980); Turkey (Danilevsky & Miroshnikov, 1985; Lodos, 1998); **Adana prov.**: Toprakkale, Kozan (Feke), **Osmaniye prov.**: Nurdağı pass (Adlbauer, 1988); **Bursa prov.**: Uludağ, Anatolia, **Ankara prov.** (Önalp, 1989); European Turkey and W Anatolia (Sama, 2002); **Gümüşhane prov.:** Kelkit (Günyurdu vill.) (Özdikmen & Hasbenli, 2004); **Siirt prov.** (Özdikmen et al., 2005); **Gaziantep prov.**: Kuşçubeli pass (Özdikmen & Demirel, 2005); **Osmaniye prov.**: Karagedik vill., Kesmeburun vill. (Hierapolis), Kuşcubeli pass, **Gaziantep prov.**: Nurdağı (Exit of İslahiye 5th km) (Ozdikmen, Güven & Gören, 2010); **Bolu prov.**: Mengen (Mengen-Yedigöller road) (Ozdikmen, 2011); **Bursa prov.**: Mezitler valley (Yenikaracakaya district) (pers. comm. with Y. Şenyüz, 2012).

Range: Europe, Caucasus (Georgia), Siberia, Kazakhstan, Tadjikistan, Uzbekistan, Mongolia, N Korea, China, Turkey.

Chorotype: Sibero-European

SPECIES *Agapanthia detrita* Kraatz, 1882: 336

The species has only been recorded from Turkey by Önalp (1989) [from Ankara prov. and Erzurum prov.] and Özdikmen et al. (2005) [from Hatay prov.: İskenderun (Topboğazı)].

In fact the species is only distributed in Central Asia (Kirgizia, Kazakhstan, Tadjikistan and Uzbekistan). So it is impossible for Turkey.

Consequently, the old records from Turkey should be belong to the species *A. coeruleipennis*.

SPECIES *Agapanthia kindermanni* Pic, 1905: 13

Type loc.: "Syria" (Hatay: Amanos Mts. in Turkey, not Syria)

Syn.: *amicula* Holzschuh, 1989: 176

Length: 8.1-18 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**S Anatolia**)
Hatay prov.: Amanos Mts. As the type loc. (Pic, 1905); **Adana prov.**: Tekir, **İçel prov.**: Namrun (Çamlıyayla) as the type loc. of *A. amicula* (Holzschuh, 1989); **Adana prov.**: Kozan (Feke) (Adlbauer, 1992); **Osmaniye prov.**: Kalecik-Hasanbeyli road as *A. amicula* (Ozdikmen, Güven & Gören, 2010).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia lateralis* Ganglbauer, 1884: 541

Type loc.: İstanbul (Turkey)

Syn.: *orientalis* Pic, 1901: 83; *bilateralis* Pic, 1927: 1

Length: 12-24 mm.

Löbl & Smetana (2010) reported the species only from European Turkey for Turkey. However, it is extensively distributed also in Anatolia for Turkey as seen below.

Records from Turkey: (**European Turkey and Anatolia**)
İstanbul prov. as the type loc. (Ganglbauer, 1884); **Hatay prov.**: Akbez (Pic, 1892); Antalya prov.: Toros Mts.), Niğde prov.: Çamardı, Konya prov. (Bodemeyer, 1900); European Turkey and Anatolia (Aurivillius, 1921); Anatolia as *A. lateralis* a. *orientalis* (Winkler, 1924-1932); **Ağrı prov.**: NE Ararat, **İçel prov.**: Toros Mts. (Bolkar Mts.) (Villiers, 1959); **İstanbul prov.**: Polonez vill., Beykoz, Anadoluhisarı, Çengelköy, **İzmir prov.**: near Central, Kemalpaşa, Efes, Bergama, **Antalya prov.**: near Central, Belkıs (Aspendos, Cumali), Antitoros Mts. (Bey Mts., Korkuteli), Alanya and near, **Isparta prov.**: Eğirdir and near (Demelt & Alkan, 1962); **İstanbul prov.** (Demelt, 1963); Turkey (Fuchs et Breuning, 1971; Danilevsky & Miroshnikov, 1985; Lodos, 1998); **Konya prov.**: Akşehir (Tuatay et al., 1972); **Amasya prov.** (Gfeller, 1972); **Konya prov.**: Beyşehir, **Ankara prov.**: Kızılcahamam, **Çanakkale prov.**: İntepe, **Antalya prov.**: Kemer, Patara, **Afyon prov.**: Dinar, **İzmir prov.**: Çamlık pass, **Niğde prov.**: Çiftehan, **İçel prov.**: Güzeloluk, Erdemli, Silifke (Adlbauer, 1988); **İstanbul prov.**, **Bilecik prov.**, **Isparta prov.**: Central, Eğirdir/Taurus, **Tokat prov.**, **Amasya prov.**, **Ankara prov.**: Central, Gölbaşı, Baraj, Ayaş Beli, Kızılcahamam (Kargasekmez), Azapderesi, Elmadağ, Beynam Forest, **Nevşehir prov.**, **Konya prov.**: Alaşehir, **Antalya prov.** (Önalp, 1989); European Turkey: Marmara Region (Althoff & Danilevsky, 1997); **Zonguldak prov.:** Çaycuma-Safranbolu road (Ahmet Usta pass), **Antalya prov.**: Alanya (Demirtaş, Mahmutlar), Kalkan, **Isparta prov.:** Başkonak (Yalvaç road), Isparta-Burdur road, Eğirdir (Aşağı Gökdere), Yalvaç (Kuyucak vill., Çetince small town, Sultan Mts.), Keçiborlu (Yeditepe), **Afyon prov.:** Sultandağı (Sultan Mts.) (Özdikmen & Hasbenli, 2004); **Konya prov.**: Akşehir, Ilgın, **Kırşehir prov.**: Central, Arapzun, **Ankara prov.**: Central, Elmadağ, Kızılcahamam, Eymir Lake, Akyurt, **Çankırı prov.**: Çerkeş, Central, **Karaman prov.**, **Isparta prov.**: Eğirdir, Central, **Eskişehir prov.**: Sarıcakaya (Özdikmen et al., 2005); **Kahramanmaraş prov.**: Afşin (Tanır) (Özdikmen & Okutaner, 2006); **Manisa prov.**: Turgutlu Çardağı (Aysekisi hill) (Özdikmen & Demirel, 2005); **Ankara prov.**: Çal Mt., METU, Beştepe, Kızılcahamam (Soğuksu National Park), Kayaş (Bayındır dam env.), Beytepe, A.O.Ç., **Antalya prov.**: Kemer, (Özdikmen & Demir, 2006); **Ankara prov.**: Çal Mt., Kızılcahamam (Işık Mt., Güvem, Aköz vill.), Şereflikoçhisar, Şereflikoçhisar-Evren road, Kayaş (Bayındır dam), **Aksaray prov.**: entry of Nevşehir-Aksaray, Eskil (Eşmekaya), **Konya prov.**: Kulu, **Niğde prov.**: Çamardı (Bademdere-Elmalı), exit of Ulukışla, **İçel prov.**: Silifke-Kırobası road (Özdikmen, 2006); **İçel prov.**: Aydınlar env. (pers. comm. with J. Kurzawa, 2006); **Muğla prov.:** Dalyan, **Manisa prov.:** Gürdeş (Akhisar road 5th km), **Tekirdağ prov.:** Malkara (Yenidibek vill.-Kalealtı), **Afyon prov.:** Selkisaray, **Karabük prov.**: Safranbolu (Hızar Yanı place, Bulak vill., Konarı vill.); **Bolu prov.**: Entry of Gerede expressway, Gerede–Karabük road (entry of Koçumlar vill.), Yeniçağa, **Kastamonu prov.**: Entry of Tosya, S of Küre Mts. (Yaylagözü pass), Kastamonu-Ayancık road, Daday, Daday-Araç road, **Çorum prov.**: Kargı (Gölet Plateau env.), **Çankırı prov.**: Kurşunlu-Boyalı road (Özdikmen, 2007); **Ankara prov.**: A.O.Ç., Bayındır dam env., Beytepe, Bağlum, Şereflikoçhisar (Gülhöyük), İncek (Özdikmen, Turgut, Güzel, 2009); **Antalya prov.**: Güzelbağ-Alanya (Exit of Güzelbağ), **Konya prov.**: Derebucak, Bozkır-Hadim road (22 km to Hadim), Bozkır (Bayboğan vill. env., Kuruçay vill., Yalnızca village env.), Akseki (Güzelsu vill.) (Turgut & Ozdikmen, 2010); **Osmaniye prov.**: Kesmeburun vill. (Castabala castle), **Gaziantep prov.**: Nurdağı-Islahiye (Ozdikmen, Güven & Gören, 2010); **Kırıkkale prov.**: Border of Kırıkkale (Elmadağ-Kırıkkale road), Refinery, Kalecik-Çankırı return (Elmadağ-Kırıkkale

road), 1 km to entry of Bedesten, Hacılar-Küreboğazı vill. road (1 km to Küreboğazı) (Özdikmen, Mercan & Tunç, 2012); **Erzincan prov.**: Kızıldağı pass, **Sivas prov.**: 7 km east of the crossroad to Zara (Sama, Rapuzzi & Özdikmen, 2012); **Edirne prov.**: Havsa vill., **Antalya prov.**: Olimpos, **Kütahya prov.**: Felent basin (pers. comm. with Y. Şenyüz, 2012).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia schmidti* Holzschuh, 1975: 89

Type loc.: Sivas (Turkey)

Length: 11.3 mm.

The species is very close to *Agapanthia subflavida* Pic, 1903 clearly. But the species, *Agapanthia subflavida* Pic, 1903, unfortunately, has not been known from any exact locality of Turkey until now (see below). Therefore, I have not seen any specimen of *Agapanthia subflavida* Pic, 1903 including the type up to now. I think that, however, *Agapanthia schmidti* Holzschuh, 1975 that has been known from only the type locality, may be a synonym of *Agapanthia subflavida* Pic, 1903. For this reason, it is necessity that the type specimens of each species should be examined. Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**CNE Anatolia**)
Sivas prov.: Gürün (Holzschuh, 1975); Turkey (Lodos, 1998).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia simplicicornis* Reitter, 1898: 133

Type loc.: Mardin (Turkey)

Length: 12-19 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**E, SE Anatolia**)
Mardin prov. as the type loc. (Reitter, 1898); Anatolia (Aurivillius, 1921; Winkler, 1924-1932; Lodos, 1998; Sama & Rapuzzi, 2000); **Hakkari prov.**: Yüksekova in Fuchs et Breuning, 1971 (Ex. Holzschuh, 1980); **Muş prov.**: Buğlan pass (NW Muş) (Rejzek et al., 2003 (2002)); **Erzincan prov.**: Tanyeri, **Tunceli prov.**: 16 km south of Pülümür, **Muş prov.**: Buğlan pass (Sama, Rapuzzi & Özdikmen, 2012).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia subchalybaea* Reitter, 1898: 134

Type loc.: Kaukasus und Turkestan: Taschkend (only Caucasus, Taschkend probably a wrong locality)

Syn.: *subacuta* Pic, 1909: 106

Length: 10-17 mm.

Löbl & Smetana (2010) never reported the species for Turkey. However, it is distributed in Anatolia for Turkey as seen below.

Records from Turkey: (**E half of Anatolia**)
Konya prov.: Akşehir (Demelt, 1963); NE Turkey (Danilevsky & Miroshnikov, 1985).

Range: Caucasus (Azerbaijan, Georgia), European Russia, Turkey.

Chorotype: SW-Asiatic

SPECIES *Agapanthia subflavida* Pic, 1903: 163

Type loc.: Anatolia (Turkey)

Length: 14-16 mm.

Unfortunately, the species has not been known from any exact locality of Turkey until now. Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**Anatolia**)
Anatolia as the type loc. (Pic, 1903); Anatolia (Aurivillius, 1921; Winkler, 1924-1932; Önalp, 1989; Lodos, 1998).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia verecunda* Chevrolat, 1882: 63

Type loc.: “Syria, in montibus Drusarum” (S Syria: Druze Mountain, probably a wrong locality)

Syn.: *delagrangei* Pic, 1894: 75

Length: 14-20 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**S, SW, SE, CS, Anatolia**)
Muğla prov.: Marmaris, **Konya prov.**: Akşehir, **Mardin prov.**: Taurus, **Hatay prov.**: Akbez, **Bitlis prov.** (Önalp, 1989).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia villosoviridescens* DeGeer, 1775: 76 (*Cerambyx*)

Type loc.: not stated, undoubtedly in Europa

Orig. comb.: *Cerambyx villosoviridescens* DeGeer, 1775

Syn.: *viridescens* Gmelin, 1790: 864 (*Stenocorus*); *lineatocollis* Donovan, 1797: 71 (*Saperda*); *angusticollis* Gyllenhal, 1817: 189 (*Saperda*); *acutipennis* Mulsant, 1862: 357; *pyrenaea* C. Brisout de Barneville, 1863: 117; *nicaeensis* Chevrolat, 1881: xcvi

Length: 10-22 mm.

Löbl & Smetana (2010) never reported the species for Turkey. However, it is extensively distributed in both European Turkey and Anatolia for Turkey as seen below.

Records from Turkey: (**European Turkey and Anatolia**)
Hatay prov.: Akbez as *lineatocollis* (Fairmaire, 1884); **Hakkari prov.**: Yüksekova (Fuchs & Breuning, 1971); **Ankara prov.**: near Eymir lake, **Isparta prov.**: Keçiborlu, **Denizli prov.**: Tavas, **Aydın prov.**: Central (Gül-Zümreoğlu, 1975); **Erzurum prov.** and near (Özbek, 1978); **Edirne prov.**, **Bursa prov.**: Uludağ, **Sakarya prov.**: Sapanca (Önalp, 1989); European Turkey: Marmara Region (Althoff & Danilevsky, 1997); Turkey (Lodos, 1998); **Kahramanmaraş prov.**: Pazarcık (Kısık vill.) (Özdikmen & Okutaner, 2006); **Afyon prov.:** Erkmen valley (Özdikmen, 2006); **Düzce prov.:** Samandere vill. (Özdikmen, Mercan & Tunç, 2012).

Range: Europe, Siberia, Kazakhstan, Mongolia, N Korea, Turkey.

Chorotype: Sibero-European

SPECIES *Agapanthia walteri* Reitter, 1898: 132

Type loc.: Erzurum and Mardin (Turkey)

Syn.: *erivanica* Pic, 1900: 14; *theryi* Pic, 1908: 6

Length: 11-20 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**E Anatolia**)
Erzurum prov. and **Mardin prov.** as the type loc. (Reitter, 1898); Anatolia (Aurivillius, 1921; Winkler, 1924-1932; Danilevsky & Miroshnikov, 1985; Lodos, 1998); **Hakkari prov.**: Yüksekova, Şemdinli, **Tunceli prov.**: Central (Fuchs et Breuning, 1971); **Erzurum prov.** and near as *A. dahli* ssp. *erivanica* (Özbek, 1978); **Bingöl prov.**, **Hakkari prov.**: Yüksekova (Adlbauer, 1988); **Erzurum prov.**, **Amasya prov.**, **Tunceli prov.**: Ovacık, Munzur, **Kars prov.**: Kağızman (Önalp, 1989); **Erzurum prov.**: Hasankale (Çobanköprü) as *A. sicula* (Önalp, 1989); Turkey as *A. sicula* (Lodos, 1998); **Erzurum prov.**: Söylemez 50 km SE Erzurum (Rejzek et al., 2001); **Batman prov.**:Alanyurt E. Gerçüş (Rejzek et al., 2003 (2002)); **Hakkari prov.**: 12 km north of Bağışlı, **Tunceli prov.**: 40 km west of Tunceli (road to Ovacık) (Sama, Rapuzzi & Özdikmen, 2012).

Range: Caucasus (Armenia, Azerbaijan, Georgia), Turkey, Iran.

Chorotype: SW-Asiatic

SUBGENUS *HOMOBLEPHARA* Pesarini & Sabbadini, 2004: 128
Type sp.: *Saperda maculicornis* Gyllenhal, 1817

SPECIES *Agapanthia maculicornis* (Gyllenhal, 1817: 189)

The subgenus was originally described by Pesarini & Sabbadini (2004). It has 2 species as the type species *A. maculicornis* (Gyllenhal, 1817) and *A. orbachi* Sama, 1993. Only *A. maculicornis* has been reported from Turkey by Fuchs et

Breuning (1971), Önalp (1989), Lodos (1998) and Özdikmen & Okutaner (2005) until now. These records are very doubtful under current distribution of the species in Palaearctic region. For example, the old record of Fuchs et Breuning (1971) was corrected by Holzschuh (1980) as *A. fallax*. So, the old records from Turkey should be accept as wrong identifications.

SUBGENUS *AGAPANTHOPLIA* Pesarini & Sabbadini, 2004: 122

Type sp.: *Agapanthia coeruleipennis* Frivaldszky, 1878

The monotypic subgenus was originally described by Pesarini & Sabbadini (2004) as a separate genus. So, *A. coeruleipennis* Frivaldszky, 1878 occurs in Turkey (in only Anatolian territory).

SPECIES *Agapanthia coeruleipennis* Frivaldszky, 1878: 9

Type loc.: “Asia minore” (Turkey: Anatolia)

Syn.: *brevis* Pic, 1891: 1

Length: 10-15.5 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**S, E Anatolia**)
Anatolia as the type loc. (Frivaldszky, 1878); **Malatya prov.** (Heyden, 1888); **Hatay prov.**: Akbez as *A. brevis* (Pic, 1892); Anatolia (Aurivillius, 1921); Anatolia as *A. coeruleipennis brevis* (Winkler, 1924-1932); E Anatolia (Demelt, 1967); **Hakkari prov.**: Bajirgi, Yüksekova, Şemdinli, **Muş prov.**: Mountainous area, **Bingöl prov.**: Central (Fuchs et Breuning, 1971); **Erzurum prov.** and near (Özbek, 1978); **Isparta prov.**: Eğirdir, **Antalya prov.**, **İçel prov.**: Namrun in Demelt, 1963 (Ex. Önalp, 1988); **Hatay prov.**: Akbez as *A. annularis* (Önalp, 1988); **Kahramanmaraş prov.** (Önalp, 1988); **Kahramanmaraş prov.**: Püren pass (Göksun), **Kayseri prov.**: Pınarbaşı, Sarız (Adlbauer, 1992); Turkey (Lodos, 1998); Turkey as *A. annularis* (Lodos, 1998); **Adıyaman prov.**: Nemrut Mt. (Rejzek & Hoskovec, 1999); **Muş prov.**: Buğlan pass, **Kahramanmaraş prov.**: Göksun env., Torbuzek, **Adıyaman prov.**: Nemrut Mt., **İçel prov.**: Arslanköy (Rejzek et al., 2001); Tunceli prov. (Tozlu et al., 2003); **Isparta prov.:** Yalvaç (Sultan Mts.) as *A. annularis* (Özdikmen & Hasbenli, 2004); **Mardin prov., Şanlıurfa prov.** (Özdikmen et al., 2005); **Tunceli prov.**: 21 km S of Tunceli, **Bitlis prov.**: 20 km NW Tatvan, **Hatay prov.**: Akbez, Yayladağı, Harbiye, **Şanlıurfa prov.**: Dutluca (Sama, Rapuzzi & Özdikmen, 2012).

Range: Turkey, Iran, Syria.

Chorotype: SW-Asiatic

SUBGENUS *STICHODERA* Pesarini & Sabbadini, 2004: 126

Type sp.: *Saperda irrorata* Fabricius, 1787

SPECIES *Agapanthia irrorata* (Fabricius, 1787: 147)

The subgenus was originally described by Pesarini & Sabbadini (2004). It has 2 species as the type species *A. irrorata* (Fabricius, 1787) and *A. soror* Kraatz, 1882. Only *A. irrorata* has been reported from Turkey by Öymen (1987) and Lodos (1998) until now. The species, however, is impossible for Turkey. Because it is distributed only in W Europe (Portugal, Spain, France, Italy) and N Africa (Algeria, Morocco, Tunusia).

SUBGENUS *DROSOTRICHIA* Pesarini & Sabbadini, 2004: 126

Type sp.: *Saperda annularis* Olivier, 1795

SPECIES *Agapanthia annularis* (Olivier, 1795: 11)

The monotypic subgenus was originally described by Pesarini & Sabbadini (2004). So, *A. annularis* (Olivier, 1795) has been reported from Turkey by Önalp (1988), Lodos (1998) and Özdikmen & Hasbenli (2004) until now. The species, however, is impossible for Turkey. Because it is distributed only in W Europe (Portugal, Spain) and N Africa (Algeria, Egypt, Libya, Morocco, Tunusia). The old records of the species from Turkey should be belong to *A. coeruleipennis*.

SUBGENUS *AGAPANTHIA* Audinet-Serville, 1835: 35

Type sp.: *Cerambyx cardui* Linnaeus, 1767

The subgenus has 3 species as the type species *A. cardui* (Linnaeus, 1767), *A. suturalis* (Fabricius, 1787) and *A. ruficornis* Pic, 1918. Among them, *A. cardui* and *A. suturalis* occur in Turkey (in both European Turkey and Anatolian territories).

According to Sama (2002), *cardui* complex has two main phenotypes as northern phenotype" (elytra rounded at apex) and "southern phenotype" (elytra attenuate or even acuminate at apex). He regarded them into two species according to Carriere, 1998 and Svacha, 2001. So, he gave them in Löbl & Smetana (2010) as 2 separate species and he stated the distribution areas of the species according to his acception. Consequently, he never mentioned *A. cardui* for Turkey. Besides, he stated *A. suturalis* for only Anatolia (never European Turkey). However, the status of the species do not conform to actual information for Turkey.

I do not accept his opinion. Both species, *A. cardui* and *A. suturalis* ocur in Turkey. The status is clearly confirmed by my studies on Turkish specimens. Some specimens have clearly rounded elytral apex as *A. suturalis* and some specimens have clearly attenuate (to acuminate) elytral apex as *A. cardui*. Later occurs mostly in N Turkey and *A. suturalis* occurs mostly in the other parts of Turkey (especially W and S Turkey).

Moreover, also Tozlu et al. (2003) rightly mentioned that "there are two distinct taxons in specimens routinely determined as *A. cardui* (Linnaeus, 1767) from Turkey". But they regarded all old records from Turkey as *A. suturalis* (Fabricius, 1787) that has clearly attenuate (to acuminate) elytral apex, wrongly.

Consequently, all old records for Turkey need to be confirmed. For this reason, the old records from Turkey are given as the same data for both species in the present text now. The records are presented as follows:

Records from Turkey: (**European Turkey and Anatolia**)
Hatay prov.: Akbez as *A. cardui* (Pic, 1892); **İstanbul prov.**: Alem Mt. (Bodemeyer, 1906); **İstanbul prov.**: Çengelköy, **İzmir prov.**: Efes (Demelt & Alkan, 1962); **Ankara prov.**: Çubuk (Breuning et Villiers, 1967); **Hatay prov.**: Arsuz (Yenişehir), Antakya (Reyhanlı), **Osmaniye prov.**: Toprakkale, **Adana prov.**: Misis (Fuchs et Breuning, 1971); **Aydın prov.** (Tuatay et al., 1972); **Bursa prov.**: Karacabey (Gfeller, 1972); **Osmaniye prov.**, **Hatay prov.**: Antakya, **Siirt prov.**, **İzmir prov.**: Gümüşsu, Bergama (Central, Şakran), Dikili, Menemen (Central, Aliağa), Narlıdere, Urla, Kuşadası, Torbalı, Bornova,

Denizli prov.: Central, Sarayköy, **Çanakkale prov.**: Lapseki, **Aydın prov.**: Kuyucak, Germencik (Gül-Zümreoğlu, 1975); Turkey (Danilevsky & Miroshnikov, 1985; Sama & Rapuzzi, 2000); **Adana prov.**: Misis, **İçel prov.**: Erdemli (Kızkalesi), **Antalya prov.**: Manavgat (Şelale), **Burdur prov.**: Bucak (Adlbauer, 1988); **İstanbul prov.**: Central, Belgrad Forest, Alem Mt., **Bursa prov.**: Uludağ, **Kocaeli prov.**: İzmit, **Symra: ?İzmir prov.**, **Ankara prov.**: Çubuk Dam-I, Gölbaşı (Kepekli Boğazı), Ayaş Beli, **Konya prov.**, **İçel prov.**: Mut, **Adana prov.**: Cilicia, **Kars prov.**: Tuzluca (Önalp, 1989); European Turkey as *A. cardui pannonica* (Althoff & Danilevsky, 1997); **Edirne prov.**, **İstanbul prov.**, **Kırklareli prov.**, **Çanakkale prov.**: Gökçeada, **Manisa prov.**, **İzmir prov.**, **Denizli prov.**, **Aydın prov.**, **Adana prov.**, **Hatay prov.**: Antakya, **Elazığ prov.**, Marmara Region, Aegean Region (Lodos, 1998); **Adana prov.**: Balcalı, Ceyhan, **Antalya prov.**: Kumluca, **Artvin prov.**: Central (Ormanlı), Ardanuç (Akarsu), Şavşat (Çayağzı), **Bayburt prov.**: Maden, **Bilecik prov.**: Central, **Bingöl prov.**: Solhan (Buğlan pass), **Çanakkale prov.**: Central, **Diyarbakır prov.**: Silvan, **Erzincan prov.**: Central (Bahçe), Üzümlü, Bayırbağ, **Erzurum prov.**: Aşkale (Kop Mt.), Ilıca (Eğerti), İspir (Madenköprübaşı), Narman (Beyler), Oltu, Karakaban, Çamlıbel, Pasinler, Çalıyazı, Pazarroad, Kartal plateau, Şenkaya (İçmesuyu), Ormanlı, **Hatay prov.**: Erzin, İskenderun (Sarımazı), **Rize prov.**: Çamlıhemşin (Ayder), **Sivas prov.**: Central, Türkeşlik, Ümranlı (Kızıldağ) as *A. suturalis* (Fabricius, 1787) (Tozlu et al., 2003); **Antalya prov.**: Isparta road, **Muğla prov.**: Datça (Central, Kızlan vill.), **Gümüşhane prov.**: Kelkit (Güllüce vill.) (Özdikmen & Hasbenli, 2004); **Aydın prov.**, **Adana prov.**, **Hatay prov.**: İskenderun (Central, Esentepe), **İzmir prov.**: Kuşadası, Menemen, Central, Torbalı, **Osmaniye prov.**, **Aydın prov.**: Kuyucak, **Eskişehir prov.**: Central (Çavlum), **Ankara prov.**: Ayaş (İlhan, İlyakut, Ilıca), Central, Bağlum, Beypazarı, **Kırşehir prov.**: Kaman, **Çankırı prov.**: Korgun, Eldivan (Özdikmen et al., 2005); **Hatay prov.**: İskenderun (Güzelyayla road, entry of Kurtbağı vill.), Samandağı (Büyükkaya stream, Fidanlı, Uzunbağ), İskenderun-Belen (Atik plateau), Kırıkhan (Alabeyli vill.), Hassa (Akbez, Zeytinoba vill.), Belen (Müftüler vill.), **Osmaniye prov.**: entry of Nohutköy, Düziçi, Zorkun plateau road (Ürün plateau) (Özdikmen & Demirel, 2005); **Adana prov.**: Pozantı, **Ankara prov.**: Sincan (Mülk, Ayaş Mt.) (Özdikmen & Demir, 2006); **Ankara prov.**: Kızılcahamam (Güvem, Aköz vill.), **Adana prov.**: Pozantı-Mersin road (Özdikmen, 2006); **Kahramanmaraş prov.**: Afşin (Çardak-Afşin road), Pazarcık (Aksu bridge, Şahintepe vill., Armutlu vill.), Kahramanmaraş-Kavaklı road (entry of Kavaklı), Türkoğlu (Kılılı), Göksun (Kamışcık vill.), Central (Özdikmen & Okutaner, 2006). **Kastamonu prov.**: Ilgaz-Tosya road, Hanönü-Kastamonu road (Özdikmen, 2007); **Ankara prov.**: A.O.Ç., Bayındır dam env., Beytepe, Bağlum, between Ankara-Polatlı, Gölbaşı (Özdikmen, Turgut, Güzel, 2009) ; **Antalya prov.**: İbradı-Akseki road, İbradı, **Konya prov.**: Seydişehir-Antalya road (5th km) as *A. suturalis* (Turgut & Ozdikmen, 2010); **Osmaniye prov.**: Kalecik-Hasanbeyli road, Zorkun road (Çiftmazı), Karaçay, Kesmeburun village (Hierapolis), Bahçe, Osmaniye-Gaziantep road 5th km, Bıçakçı vill., Hasanbeyli, **Hatay prov.**: Samandağı (Nekropol), Kuzuculu, Akbez, Belen, Entry of Belen (Çakallı), Erzin-kaplıcalar district, **Gaziantep prov.**: Kilis-Gaziantep road (Oğuzeli return), Fevzipaşa-Islahiye road 1st km, **Kilis prov.**: Hassa–Kilis road (Deliosmanlı vill.) as *A. suturalis* (Ozdikmen, Güven & Gören, 2010); **Kırıkkale prov.**: Various localities as *A. cardui* (Özdikmen, Mercan & Tunç, 2012); **Kırıkkale prov.**: Various localities as *A. suturalis* (Özdikmen, Mercan & Tunç, 2012); **Erzincan prov.**: Kızıldağı pass, **Hakkari prov.**: 12 km N of Bağışlı, **Hatay prov.**: 4 km S of Şenköy, **Malatya prov.**: 10 km E Malatya, **İçel prov.**: Çamlıyayla, **Tunceli prov.**: 14 km S of Tunceli, 15 km N of Pülümür as *A. suturalis* (Sama, Rapuzzi & Özdikmen, 2012).

SPECIES *Agapanthia cardui* (Linnaeus, 1767: 632)

Type loc.: “Europa australis” (S France: Montpellier)

Syn.: *coerulescens* V. Petagna, 1787: 18 (*Saperda*); *trilineata* Schoenherr, 1817: 433 (*Saperda*); *marginalis* Mulsant, 1839: 179; *nigroaenea* Mulsant, 1839: 179; *consobrina* Chevrolat, 1840: 17; *peragalli* Mulsant, 1862: 364; *grossa* Pic, 1891: 63; *pannonica* Kratochvíl, 1985: 3

Length: 6-14 mm.

Löbl & Smetana (2010) never reported the species for Turkey. However, it is extensively distributed in both European Turkey and Anatolia for Turkey as seen above.

Records from Turkey: See above.

Range: Europe, Turkey.

Chorotype: European

SPECIES *Agapanthia suturalis* (Fabricius, 1787: 149)

Type loc.: "Europa australis" (S France: Montpellier)

Orig. comb.: *Saperda suturalis* Fabricius, 1787

Syn.: *annulata* Fabricius, 1792: 314 (*Saperda*); *subacutalis* Chevrolat, 1882: 63; *velox* Gistel, 1857: 560; *ruficornis* Pic, 1918: 5; *rufofemoralis* Pic, 1946: 8

Length: 6-14 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen above.
Records from Turkey: See above.

Range: Europe, Caucasus, Turkey, Cyprus, Middle East, Iran, N Africa (Algeria, Canary Islands, Libya, Morocco, Tunusia).

Chorotype: Mediterranean

SUBGENUS *SMARAGDULA* Pesarini & Sabbadini, 2004: 128

Type sp.: *Saperda violacea* Fabricius, 1775

The subgenus was originally described by Pesarini & Sabbadini (2004). According to Özdikmen (2012), the subgenus is represented by 10 species in Turkey. Among them, the species, *A. intermedia* Ganglbauer, 1884, however, has European chorotype (from France and Germany to Ukraine and Kazakhstan, not including Turkey). The species *A. intermedia* seems to be monophagous on *Knautia arvensis* with respect to the references. The plant genus *Knautia* is represented by 9 species in Turkey and *K. arvensis* (L.) Coult. that the host plant of *A. intermedia*, does not occur in Turkey (pers. comm. with a Turkish botanist Ass. Prof. Dr. M. Erkan Uzunhisarcıklı). So *A. intermedia* is impossible for Turkey. The other members (a total of 9 species) of subgenus occur in Turkey (in both European Turkey and Anatolian territories). Moreover, 2 new species were described by Rapuzzi & Sama (2012) from Turkey as *A. naciyae* and *A. ozdikmeni*. Hence the number of species belonging to the subgenus is 11 (9 mentioned species + 2 newly described species).

SPECIES *Agapanthia amitina* Holzschuh, 1989: 174

Type loc.: Ghazvin (N Iran)

Length: 6-11 mm.

Löbl & Smetana (2010) never reported the species for Turkey. However, it is distributed in Anatolia for Turkey as seen below.

Records from Turkey: (**S Anatolia**)
Osmaniye prov.: Zorkun plateau, **İçel prov.**: Tarsus (Çamlıyayla) (Adlbauer, 1992).

Range: Turkey, Iran.

Chorotype: SW-Asiatic

SPECIES *Agapanthia chalybaea* Faldermann, 1837: 303

Type loc.: Caucasus

Length: 10-17.5 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**Anatolia**)
Bilecik prov. (Bodemeyer, 1906); N Turkey (Plavilstshikov, 1968; Danilevsky & Miroshnikov, 1985); **İstanbul prov.**, **Bilecik prov.**, **Isparta prov.**: Eğirdir, **Konya prov.**: Akşehir, **Kahramanmaraş prov.** (Önalp, 1988); Turkey (Lodos, 1998).

Range: Caucasus (Armenia, Azerbaijan, Georgia), Turkey, Iran.

Chorotype: SW-Asiatic

SPECIES *Agapanthia fallax* Holzschuh, 1974: 95

Type loc.: Muş and Hakkari (Turkey)

Length: 7.8-12 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**C, SE Anatolia**)
Muş prov.: Buğlan pass, **Hakkari prov.**: Diz vill. As the type loc. (Holzschuh, 1974); **Hakkari prov.**: Yüksekova – Fuchs et Breuning, 1971 (Ex. Holzschuh, 1980); Turkey (Lodos, 1998); **Muş prov.**: Buğlan pass (NW Muş) (Rejzek et al., 2003 (2002)); **Ankara prov.** (Özdikmen et al., 2005).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia frivaldszkyi* Ganglbauer, 1884: 546

Type loc.: Anatolia (Turkey)

Length: 7.5-13 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**Anatolia**)
Anatolia as the type loc. (Ganglbauer, 1884); **Bilecik prov.** (Bodemeyer, 1906); Anatolia (Aurivillius, 1921; Winkler, 1924-1932); **Isparta prov.**: Eğirdir (Demelt & Alkan, 1962); **Amasya prov.** (Breuning et Villiers, 1967); **Isparta prov.**, **İçel prov.**: Namrun - Demelt, 1963 (Ex. Öymen, 1987; Önalp, 1988); **Niğde prov.**: Çamardı (Bulgar-Maden), **İstanbul**

prov., **Bilecik prov.**, **Ankara prov.**: A.O.Ç., ?**Denizli prov.**: Akbaş vill. (Önalp, 1988); **Sakarya prov.**: Adapazarı (Doğançay) (Adlbauer, 1992); Turkey (Lodos, 1998); **Muş prov.**: Buğlan pass (40 km NW Muş) (Rejzek et al., 2001); **Muş prov.**: Buğlan pass (40 km NW Muş) (Rejzek et al., 2003 (2002)).

Range: Europe (Bulgaria, Romania), Turkey, Syria, Israel, Jordan, Iraq, Iran.

Chorotype: Turano-Mediterranean (Balkano-Anatolian)

SPECIES *Agapanthia intermedia* Ganglbauer, 1884: 543

The species seems to be impossible for Turkey (see above).

SPECIES *Agapanthia lais* Reiche & Saulcy, 1858: 21

Type loc.: "Peloponnèse" (S Greece) (a wrong locality)

Length: 11-16 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**S, SE Anatolia**)
Osmaniye prov.: Nurdağı pass (Adlbauer, 1988); **Mardin prov.**, Kahramanmaraş prov.: Ahır Mt. (Önalp, 1988); Turkey (Lodos, 1998); **Hatay prov.**: Akbez (Güzeluşağı vill.) (Ozdikmen, Güven & Gören, 2010).

Range: Turkey, Syria, Israel, Jordan, Lebanon.

Chorotype: E-Mediterranean (Palaestino-Taurian)

SPECIES *Agapanthia naciyae* Rapuzzi & Sama, 2012: 676

Type loc.: Erzincan (Turkey)

Length: 9.5 mm.

The species was described from Turkey after Löbl & Smetana (2010).

Records from Turkey: (**NE Anatolia**)
Erzincan prov.: 12 km W Refahiye, **Turkey** as the type loc. (Rapuzzi & Sama, 2012).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia osmanlis* Reiche & Saulcy, 1858: 19

Type loc.: İstanbul (Turkey)

Length: 10-16 mm.

Löbl & Smetana (2010) reported the species only from Anatolia for Turkey. However, it is distributed in both European Turkey and Anatolia for Turkey as seen below.

Records from Turkey: (**European Turkey and Anatolia**)
İstanbul prov. as the type loc. (Reiche & Saulcy, 1858); Anatolia and European Turkey (Aurivillius, 1921; Winkler, 1924-1932); **Sivas prov.**: Suşehri, **Erzurum prov.**: Kandilli,

Samsun prov.: Havza (Breuning et Villiers, 1967); **İstanbul prov.**, Turkey (Önalp, 1988); Turkey (Lodos, 1998); **Gümüşhane prov.**: Kelkit, **Kars prov.**: 14 km SE Sarıkamış, Sarıkamış (80 km NE Horasan), **Erzincan prov.**: Gemecik W Refahiye, **Erzurum prov.**: N İspir (Rejzek et al., 2001); **Artvin prov.**, **Bayburt prov.**, **Bilecik prov.**, **Erzurum prov.**, **Hatay prov.** (Tozlu et al., 2003); **Kars prov.**: Sarıkamış (80 km NE Horasan), **Erzincan prov.**: Refahiye (Gemecik W Refahiye) (Rejzek et al., 2003 (2002)); **Sivas prov.**: 20 km E of the crossroad to Zara (Sama, Rapuzzi & Özdikmen, 2012).

Range: Europe (Bulgaria, Greece, Romania, Hungary, Serbia & Montenegro), Turkey.

Chorotype: E-European

SPECIES *Agapanthia ozdikmeni* Rapuzzi & Sama, 2012: 673

Type loc.: Tunceli (Turkey)

Length: 15 mm.

The species was described from Turkey after Löbl & Smetana (2010).

Records from Turkey: (**E Anatolia**)
Tunceli prov.: 46 km N Tunceli, 5 km NW of Pülümür, 2-7 km NW of Pülümür, 14 km N of Pülümür, 1 km S of Pülümür, **Turkey** as the type loc. (Rapuzzi & Sama, 2012).

Range: Turkey.

Chorotype: Anatolian

SPECIES *Agapanthia persicola* Reitter, 1894: 146

Type loc.: “Astrabad, Araxesthal” (Iran: Gorgan and Caucasus)

Syn.: *violaceipennis* Pic, 1904: 9

Length: 7-15 mm.

Löbl & Smetana (2010) never reported the species for Turkey. However, it is commonly distributed in Anatolia for Turkey as seen below.

Records from Turkey: (**Anatolia**)
High Fırat river (?**Tunceli prov.**, ?**Malatya prov.**) (Demelt, 1967); **Sakarya prov.**: Sapanca, **Eskişehir prov.** (Önalp, 1988).

Range: Caucasus (Armenia, Azerbaijan, Georgia), Turkmenistan, Turkey, Iran.

Chorotype: Turanian

SPECIES *Agapanthia pesarinii* Sama & Rapuzzi, 2010: 177

Type loc.: İçel, Adana, Tokat, Erzurum, Gaziantep, Kars, Jebel Ansarya mer. (passo E-SE Jablah) (Turkey and Syria)

Length: 8-12 mm.

The species was described from Turkey after Löbl & Smetana (2010).

Records from Turkey: (**Anatolia**)
Turkey: İçel prov.: Çamalan, Namrun, Çamlıyayla, S Pozantı, Sarıkavak, **Adana prov.**: Nur Mts. (Hasanbeyli), Pozantı, **Tokat prov.**: 6 km N Niksar, Central, **Erzurum prov.**: Erzurum env., 18 km NW Aşkale, **Gaziantep prov.**: Nur Mt. pass, **Kars prov.**: 14 km S Sarıkamış, **Syria:** Jebel Ansarya mer. (passo E-SE Jablah) as the type loc. (Sama, Rapuzzi & Kairuz, 2010); **Erzincan prov.**: Kızıldağı pass, **İçel prov.**: Çamlıyayla, **Tunceli prov.**: 14 km S of Tunceli (Sama, Rapuzzi & Özdikmen, 2012).

Range: Turkey, Syria.

Chorotype: SW-Asiatic or E-Mediterranean

SPECIES *Agapanthia violacea* (Fabricius, 1775: 187)

Type loc.: "Regio Pedemontana" (Italy: Piedmont)

Orig. comb.: *Saperda violacea* Fabricius, 1775

Syn.: *micans* Fuessly, 1775: 13 (*Cerambyx*); *cyanea* Herbst, 1784: 95 (*Saperda*); *janthina* Gmelin, 1790: 1842 (*Saperda*); *coerulea* Schoenherr, 1817: 437 (*Saperda*); *smaragdina* Krynicki, 1832: 161 (*Saperda*); *chalybaea* Mulsant, 1839: 177

Length: 7-13 mm.

Löbl & Smetana (2010) reported the species from both European Turkey and Anatolia for Turkey. The data conforms with the known records by me from Turkey as seen below.

Records from Turkey: (**European Turkey and Anatolia**)
Bilecik prov. (Bodemeyer, 1900); Anatolia (Aurivillius, 1921); Anatolia as *A. violocea cyanea* (Winkler, 1924-1932); **İstanbul prov.**: Anadoluhisarı (Demelt & Alkan, 1962); **Edirne prov.** (Breuning et Villiers, 1967); **Konya prov.**: Akşehir (Tuatay et al., 1972); **Denizli prov.**: Pamukkale, **Muğla prov.**: Milas (Yakaören vill.), **Manisa prov.**: Akhisar (Süleymanlı), **Manisa prov.**: Kırkağaç (Gül-Zümreoğlu, 1975); **Erzurum prov.** and near (Özbek, 1978); Turkey (Danilevsky & Miroshnikov, 1985); **Kırklareli prov.**: Dereköy, **İstanbul prov.**: Bahçeköy (Öymen, 1987); **Edirne prov.**, **İstanbul prov.**, **Bursa prov.**: Uludağ, **Bilecik prov.**, **İzmir prov.**, **Sakarya prov.**: Hendek, **Ankara prov.**: Dam, **Konya prov.**: Akşehir (Sultan Mt.), **Isparta prov.**: Eğirdir, **Kayseri prov.**, **Adana prov.** (Önalp, 1988); **İzmir prov.**: Çamlık pass (Adlbauer, 1988); European Turkey: Marmara Region (Althoff & Danilevsky, 1997); **İstanbul prov.**, **Konya prov.**, **Manisa prov.**, **İzmir prov.**, **Denizli prov.**, Aegean Region (Lodos, 1998); Anatolia and European Turkey (Sama, 2002); **Isparta prov.:** Yalvaç (Eleği vill., Sultan Mts.) (Özdikmen & Hasbenli, 2004); **Kahramanmaraş prov.**: Pazarcık (Armutlu vill.) (Özdikmen & Okutaner, 2006); **Konya prov.**: Akşehir, Beyşehir, **Ankara prov.**: Bağlum, **Niğde prov.**: Kolsuz, **Kırşehir prov.**: Özbağ, **Isparta prov.**: Gölcük, **Nevşehir prov.**: Hacıbektaş (Kurugöl), **Bolu prov.**: Seben (Özdikmen et al., 2005); **Hatay prov.**: İskenderun (Belen), **Kocaeli prov.**: İzmit (Beşkayalar Natural Park) (Özdikmen & Demirel, 2005); **Adana prov.**: Pozantı (Özdikmen & Demir, 2006); **Samsun prov.**, **Niğde prov.**: Bor (Altunova, Üstünkaya), Bor-Altunhisar, **Kayseri prov.**: Yahyalı (Derebağı), **Aksaray prov.**: Gülağaç (Aşıklı Höyük), **Konya prov.**: Kulu, **Adana prov.**: Pozantı (entry of Fındıklı), **İçel prov.**: Uzuncaburç road, Mut-Karaman road (Değirmenbaşı) (Özdikmen, 2006); **Düzce prov.**: Yığılca, exit of Dutlar vill., Karakaş vill., **Zonguldak prov.**: between Yedigöller–Devrek, **Karabük prov.**: Safranbolu (Balkuşu vill., Hızar Yanı place), Eflani–Daday (Karaağaç vill.), Hanköy (Aşağıbağ place), exit of Safranbolu (Kastamonu road), Eflani env., **Bolu prov.**: Gerede–Bolu road, Bolu-Gerede road (Susuz Kınık vill.), between Gerede–Kızılcahamam, Yeniçağa-Mengen road (Çamlık vill. env.), **Çorum prov.**: Kargı–Boyabat road (Karagöl vill.), **Afyon prov.**: Erkmen valley, **Kastamonu prov.**: Araç road (Kastamonu Police forest), Kastamonu–Araç road, between Araç–Karabük (Çıraklar vill.), Kanlıgöl, Ilgaz-Tosya road, Taşköprü-Kastamonu road, Kastamonu-İnebolu road, Pınarbaşı env., Seydiler-İnebolu road, Daday, Araç env., Boyalı (Özdikmen, 2007); **Ankara prov.**:

Gölbaşı (Özdikmen, Turgut, Güzel, 2009); **Osmaniye prov.**: Entry of Yarpuz, Haraz plateau, **Hatay prov.**: Akbez, Hassa–Kırıkhan road 20th km, **Gaziantep prov.**: Kilis Gaziantep road (Oğuzeli return) (Ozdikmen, Güven & Gören, 2010); **Bolu prov.**: Abant, Mudurnu-Göynük road (Karapınar return env.), Yeniçağa-Mengen road (Ozdikmen, 2011); **Kırıkkale prov.**: 5 km past to Delice, Kulaksız-Sulakyurt road (10 km to Sulakyurt), 3 km to Sulakyurt (Özdikmen, Mercan & Tunç, 2012); **Erzincan prov.**: Kızıldağı pass, 9 km E Kızıldağı pass (Sama, Rapuzzi & Özdikmen, 2012); **Düzce prov.:** Hasanlar Dam env., Hasanlar-Yığılca road (18 km to Yığılca), Düzce-Boludağı (Taşaltı district), Hasanlar Dam (Hasanlar-Yığılca road), Samandere vill., Hasanlar Dam (Hasanlar vill.), Kent forest return (Düzce-Yığılca road) (Özdikmen, Mercan & Tunç, 2012).

Range: Europe, Caucasus (Azerbaijan, Georgia), Siberia, Kazakhstan, Turkey.

Chorotype: Sibero-European

Note: After all, irrelevant records from Erzurum province belong to the Sicilian and Corsican endemic species, *A. sicula* Ganglbauer, 1884, of Önalp (1989) and Lodos (1998) for Turkey should be belong to the species *A. walteri* Reitter, 1898. So the records mentioned in the part of *A. walteri* in the present text.

GENUS *AGAPANTHIOLA* Ganglbauer, 1900: 139

Type sp.: *Saperda leucaspis* Steven, 1817

The W Palaearctic genus *Agapanthiola* Ganglbauer, 1900 has only 2 species in the world fauna as *A. leucaspis* (Steven, 1817) and *A. sinae* (Dahlgren, 1986). It is represented only by the species, *A. leucaspis,* in Turkey (in both European Turkey and Anatolian territories).

SPECIES *Agapanthiola leucaspis* (Steven, 1817: 184)

Type loc.: Caucasus

Orig. comb.: *Saperda leucaspis* Steven, 1817

Syn.: *cyanella* Dalman, 1817: 190 (*Saperda*); *pectoralis* Eschscholtz, 1818: 482 (*Saperda*); *euterpe* Ganglbauer, 1900: 139 (*Agapanthia*).

Length: 6-14 mm.

Records from Turkey: (**European Turkey and N Anatolia**)
Turkey (Danilevsky & Miroshnikov, 1985; Lodos, 1998); **Edirne prov.**, **İstanbul prov.**: Belgrad forest (Önalp, 1988); European Turkey: Marmara Region (Althoff & Danilevsky, 1997; Sama, 2002); **Çorum prov.** (Tauzin, 2000).

Range: Europe, Caucasus (Armenia, Azerbaijan, Georgia), Turkey, Kirgizia, Kazakhstan, Mongolia, Tadjikistan, Uzbekistan, Siberia.

Chorotype: Sibero-European

FAUNISTICAL ANALYSIS

According to Özdikmen (2012), Turkish *Agapanthia* includes 30 species of 8 subgenera. These are:

GENUS *AGAPANTHIA* Audinet-Serville, 1835: 35
  SUBGENUS *SYNTHAPSIA* Pesarini & Sabbadini, 2004: 121
    SPECIES *A. kirbyi* (Gyllenhal, 1817: 186)
  SUBGENUS *EPOPTES* Gistel, 1857: 93
    SPECIES *A. asphodeli* (Latreille, 1804: 282)
    SPECIES *A. cynarae* (Germar, 1817: 222)
      SUBSPECIES *A. c. cynarae* (Germar, 1817: 222)
    SPECIES *A. dahli* (Richter, 1820: 12)
    SPECIES *A. detrita* Kraatz, 1882: 336
    SPECIES *A. kindermanni* Pic, 1905: 13
    SPECIES *A. lateralis* Ganglbauer, 1884: 541
    SPECIES *A. schmidti* Holzschuh, 1975: 89
    SPECIES *A. simplicicornis* Reitter, 1898: 133
    SPECIES *A. subchalybaea* Reitter, 1898: 134
    SPECIES *A. subflavida* Pic, 1903: 163
    SPECIES *A. verecunda* Chevrolat, 1882: 63
    SPECIES *A. villosoviridescens* (DeGeer, 1775: 76)
    SPECIES *A. walteri* Reitter, 1898: 132
  SUBGENUS *HOMOBLEPHARA* Pesarini & Sabbadini, 2004: 128
    SPECIES *A. maculicornis* (Gyllenhal, 1817: 189)
      SUBSPECIES *A. m. maculicornis* (Gyllenhal, 1817: 189)
  SUBGENUS *AGAPANTHOPLIA* Pesarini & Sabbadini, 2004: 122
    SPECIES *A. coeruleipennis* Frivaldszky, 1878: 9
  SUBGENUS *AGAPANTHIA* Audinet-Serville, 1835: 35
    SPECIES *A. cardui* (Linnaeus, 1767: 632)
    SPECIES *A. suturalis* (Fabricius, 1787: 149)
  SUBGENUS *STICHODERA* Pesarini & Sabbadini, 2004: 126
    SPECIES *A. irrorata* (Fabricius, 1787: 147)
  SUBGENUS *DROSOTRICHIA* Pesarini & Sabbadini, 2004: 126
    SPECIES *A. annularis* (Olivier, 1795: 11)
  SUBGENUS *SMARAGDUL*A Pesarini & Sabbadini, 2004: 128
    SPECIES *A. amitina* Holzschuh, 1989; 174
    SPECIES *A. chalybaea* Faldermann, 1837: 303
    SPECIES *A. fallax* Holzschuh, 1974: 95
    SPECIES *A. frivaldszkyi* Ganglbauer, 1884: 546
    SPECIES *A. intermedia* Ganglbauer, 1884: 543
    SPECIES *A. lais* Reiche & Saulcy, 1858: 21
    SPECIES *A. osmanlis* Reiche & Saulcy, 1858: 19
    SPECIES *A. persicola* Reitter, 1894: 146
    SPECIES *A. pesarinii* Sama & Rapuzzi, 2010: 177
    SPECIES *A. violacea* (Fabricius, 1775: 187)

The following species and thereby some subgenera, however, are impossible for Turkey. So old records of the taxa from Turkey should be invalid.

GENUS *AGAPANTHIA* Audinet-Serville, 1835: 35
  SUBGENUS *EPOPTES* Gistel, 1857: 93
    SPECIES *A. detrita* Kraatz, 1882: 336
  SUBGENUS *HOMOBLEPHARA* Pesarini & Sabbadini, 2004: 128
    SPECIES *A. maculicornis* (Gyllenhal, 1817: 189)
      SUBSPECIES *A. m. maculicornis* (Gyllenhal, 1817: 189)
  SUBGENUS *STICHODERA* Pesarini & Sabbadini, 2004: 126
    SPECIES *A. irrorata* (Fabricius, 1787: 147)
  SUBGENUS *DROSOTRICHIA* Pesarini & Sabbadini, 2004: 126
    SPECIES *A. annularis* (Olivier, 1795: 11)
  SUBGENUS *SMARAGDUL*A Pesarini & Sabbadini, 2004: 128
    SPECIES *A. intermedia* Ganglbauer, 1884: 543

Turkish *Agapanthia* with together newly described 2 species, therefore, includes 27 species of 5 subgenera in real. The list is presented as follows:

- **GENUS** *AGAPANTHIA* Audinet-Serville, 1835: 35
  - **SUBGENUS** *SYNTHAPSIA* Pesarini & Sabbadini, 2004: 121
    - **SPECIES** *A. kirbyi* (Gyllenhal, 1817: 186)
  - **SUBGENUS** *EPOPTES* Gistel, 1857: 93
    - **SPECIES** *A. asphodeli* (Latreille, 1804: 282)
    - **SPECIES** *A. cynarae* (Germar, 1817: 222)
      - **SUBSPECIES** *A. c. cynarae* (Germar, 1817: 222)
    - **SPECIES** *A. dahli* (Richter, 1820: 12)
    - **SPECIES** *A. kindermanni* Pic, 1905: 13
    - **SPECIES** *A. lateralis* Ganglbauer, 1884: 541
    - **SPECIES** *A. schmidti* Holzschuh, 1975: 89
    - **SPECIES** *A. simplicicornis* Reitter, 1898: 133
    - **SPECIES** *A. subchalybaea* Reitter, 1898: 134
    - **SPECIES** *A. subflavida* Pic, 1903: 163
    - **SPECIES** *A. verecunda* Chevrolat, 1882: 63
    - **SPECIES** *A. villosoviridescens* (DeGeer, 1775: 76)
    - **SPECIES** *A. walteri* Reitter, 1898: 132
  - **SUBGENUS** *AGAPANTHOPLIA* Pesarini & Sabbadini, 2004: 122
    - **SPECIES** *A. coeruleipennis* Frivaldszky, 1878: 9
  - **SUBGENUS** *AGAPANTHIA* Audinet-Serville, 1835: 35
    - **SPECIES** *A. cardui* (Linnaeus, 1767: 632)
    - **SPECIES** *A. suturalis* (Fabricius, 1787: 149)
  - **SUBGENUS** *SMARAGDUL*A Pesarini & Sabbadini, 2004: 128
    - **SPECIES** *A. amitina* Holzschuh, 1989; 174
    - **SPECIES** *A. chalybaea* Faldermann, 1837: 303
    - **SPECIES** *A. fallax* Holzschuh, 1974: 95
    - **SPECIES** *A. frivaldszkyi* Ganglbauer, 1884: 546
    - **SPECIES** *A. lais* Reiche & Saulcy, 1858: 21
    - **SPECIES** *A. naciyae* Rapuzzi & Sama, 2012: 676
    - **SPECIES** *A. osmanlis* Reiche & Saulcy, 1858: 19
    - **SPECIES** *A. ozdikmeni* Rapuzzi & Sama, 2012: 673
    - **SPECIES** *A. persicola* Reitter, 1894: 146
    - **SPECIES** *A. pesarinii* Sama & Rapuzzi, 2010: 177
    - **SPECIES** *A. violacea* (Fabricius, 1775: 187)

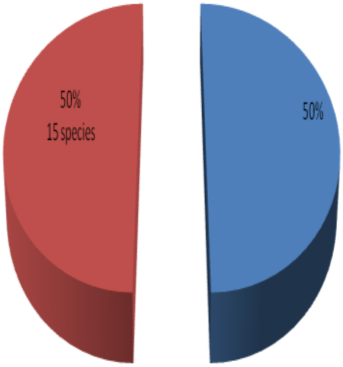
Finally, Turkish Agapanthiini comprise of 30 species of 4 genera [1 species of the genus *Theophilea*, 1 species of the genus *Calamobius*, 27 species of the genus *Agapanthia* and 1 species of the genus *Agapanthiola*]. The complete list is presented as follows:

- **TRIBE** AGAPANTHIINI Mulsant, 1839: 172
  - **GENUS** *THEOPHILEA* Pic, 1895: 39
    - **SPECIES** *T. cylindricollis* Pic, 1895: 39
  - **GENUS** *CALAMOBIUS* Guérin-Méneville, 1847: XVIII
    - **SPECIES** *C. filum* (Rossi, 1790: 152)
  - **GENUS** *AGAPANTHIA* Audinet-Serville, 1835: 35
    - **SUBGENUS** *SYNTHAPSIA* Pesarini & Sabbadini, 2004: 121
      - **SPECIES** *A. kirbyi* (Gyllenhal, 1817: 186)
    - **SUBGENUS** *EPOPTES* Gistel, 1857: 93
      - **SPECIES** *A. asphodeli* (Latreille, 1804: 282)
      - **SPECIES** *A. cynarae* (Germar, 1817: 222)
        - **SUBSPECIES** *A. c. cynarae* (Germar, 1817: 222)
      - **SPECIES** *A. dahli* (Richter, 1820: 12)
      - **SPECIES** *A. kindermanni* Pic, 1905: 13
      - **SPECIES** *A. lateralis* Ganglbauer, 1884: 541
      - **SPECIES** *A. schmidti* Holzschuh, 1975: 89
      - **SPECIES** *A. simplicicornis* Reitter, 1898: 133
      - **SPECIES** *A. subchalybaea* Reitter, 1898: 134
      - **SPECIES** *A. subflavida* Pic, 1903: 163
      - **SPECIES** *A. verecunda* Chevrolat, 1882: 63
      - **SPECIES** *A. villosoviridescens* (DeGeer, 1775: 76)
      - **SPECIES** *A. walteri* Reitter, 1898: 132

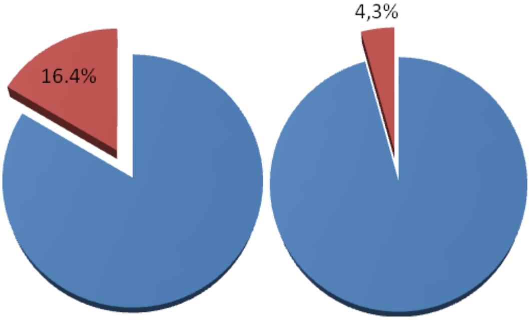
SUBGENUS *AGAPANTHOPLIA* Pesarini & Sabbadini, 2004: 122
  SPECIES *A. coeruleipennis* Frivaldszky, 1878: 9
SUBGENUS *AGAPANTHIA* Audinet-Serville, 1835: 35
  SPECIES *A. cardui* (Linnaeus, 1767: 632)
  SPECIES *A. suturalis* (Fabricius, 1787: 149)
SUBGENUS *SMARAGDUL*A Pesarini & Sabbadini, 2004: 128
  SPECIES *A. amitina* Holzschuh, 1989; 174
  SPECIES *A. chalybaea* Faldermann, 1837: 303
  SPECIES *A. fallax* Holzschuh, 1974: 95
  SPECIES *A. frivaldszkyi* Ganglbauer, 1884: 546
  SPECIES *A. intermedia* Ganglbauer, 1884: 543
  SPECIES *A. lais* Reiche & Saulcy, 1858: 21
  SPECIES *A. naciyae* Rapuzzi & Sama, 2012: 676
  SPECIES *A. osmanlis* Reiche & Saulcy, 1858: 19
  SPECIES *A. ozdikmeni* Rapuzzi & Sama, 2012: 673
  SPECIES *A. persicola* Reitter, 1894: 146
  SPECIES *A. pesarinii* Sama & Rapuzzi, 2010: 177
  SPECIES *A. violacea* (Fabricius, 1775: 187)
GENUS *AGAPANTHIOLA* Ganglbauer, 1900: 139
  SPECIES *A. leucaspis* (Steven, 1817: 184)

Among the members of Turkish Agapanthiini, a total of 14 species were described from Turkey originally. These are *Theophilea cylindricollis* Pic, 1895 from Bitlis (E Turkey), *Agapanthia kindermanni* Pic, 1905 from Hatay (S Turkey), *A. lateralis* Ganglbauer, 1884 from İstanbul (NW Turkey), *A. schmidti* Holzschuh, 1975 from Sivas (CNE Turkey), *A. simplicicornis* Reitter, 1898 from Mardin (SE Turkey), *A. subflavida* Pic, 1903 from Anatolia (Turkey), *A. walteri* Reitter, 1898 from Erzurum and Mardin (NE and SE Turkey), *A. coeruleipennis* Frivaldszky, 1878 from Anatolia (Turkey), *A. fallax* Holzschuh, 1974 from Muş and Hakkari (SE Turkey), *A. frivaldszkyi* Ganglbauer, 1884 from Anatolia (Turkey), *A. naciyae* Rapuzzi & Sama, 2012 from Erzincan (NE Turkey), *A. osmanlis* Reiche & Saulcy, 1858 from İstanbul (NW Turkey), *A. ozdikmeni* Rapuzzi & Sama, 2012 from Tunceli (E Turkey) and *A. pesarinii* Sama & Rapuzzi, 2010 from İçel, Adana, Tokat, Erzurum, Gaziantep, Kars (N, NE, S, SE Turkey).

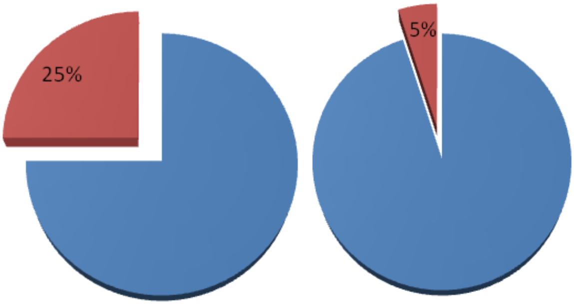
In addition to this, the species *A. verecunda* Chevrolat, 1882, has Anatolian chorotype, but the type locality of the species is given by Chevrolat (1882) as "Syria, in montibus Drusarum" (probably a wrong locality). So, the number of species that originally described from Turkey, should be 15.



The Turkish fauna constitutes 16.4% of the Palaearctic fauna and 4.3% of the world fauna in respect to the species level.



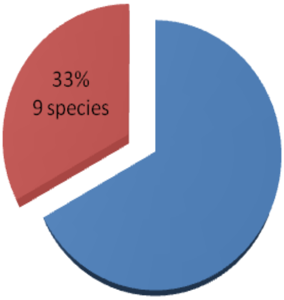
Besides it constitutes 25% of the Palaearctic fauna and 5% of the world fauna in respect to the genus level.



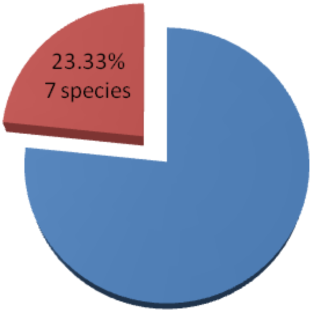
ZOOGEOGRAPHICAL ANALYSIS

Turkish Agapanthiini includes 30 species of 4 genera. 12 different chorotypes are determined for the members of Turkish Agapanthiini as Anatolian, E-European, European, E-Mediterranean, Mediterranean, S and E-European, Sibero-European, SW-Asiatic, Turanian, Turano-European, Turano-Mediterranean and W-Plaearctic.

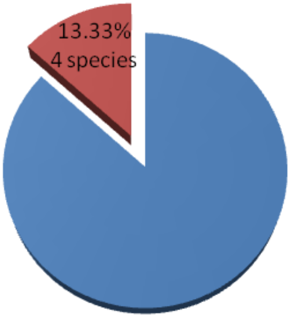
Among them, Anatolian is dominant chorotype with 9 species as *A. kindermanni* Pic, 1905; *A. lateralis* Ganglbauer, 1884; *A. schmidti* Holzschuh, 1975; *A. simplicicornis* Reitter, 1898; *A. subflavida* Pic, 1903; *A. verecunda* Chevrolat, 1882; *A. fallax* Holzschuh, 1974; *A. naciyae* Rapuzzi & Sama, 2012 and *A. ozdikmeni* Rapuzzi & Sama, 2012.



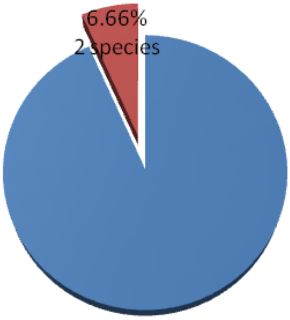
The following chorotype is SW-Asiatic with 7 species as *Theophilea cylindricollis* Pic, 1895; *A. subchalybaea* Reitter, 1898; *A. walteri* Reitter, 1898; *A. coeruleipennis* Frivaldszky, 1878 ; *A. amitina* Holzschuh, 1989; *A. chalybaea* Faldermann, 1837 and *A. pesarinii* Sama & Rapuzzi, 2010.



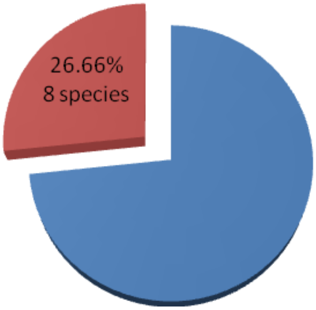
Also the members of Sibero-European chorotype provide an important contribution to form of the Turkish fauna. These 4 species are *A. dahli* (C. F. W. Richter, 1820); *A. villosoviridescens* DeGeer, 1775; *A. violacea* (Fabricius, 1775) and *Agapanthiola leucaspis* (Steven, 1817).



Moreover, S and E-European chorotype is represented by 2 species as *A. asphodeli* (Latreille, 1804) and *A. cynarae* (Germar, 1817).



The other chorotypes are represented by one each species as E-European: *A. osmanlis* Reiche & Saulcy, 1858; European: *A. cardui* (Linnaeus, 1767); E-Mediterranean: *A. lais* Reiche & Saulcy, 1858; Mediterranean: *A. suturalis* (Fabricius, 1787); Turanian: *A. persicola* Reitter, 1894; Turano-European: *A. kirbyi* (Gyllenhal, 1817); Turano-Mediterranean (Balkano-Anatolian): *A. frivaldszkyi* Ganglbauer, 1884 and W-Plaearctic: *Calamobius filum* (Rossi, 1790: 152)



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A NEW SPECIES OF THE GENUS *MIAGRAMMOPES* O. P. CAMBRIDGE, 1870 (ARANEAE: ULOBORIDAE) FROM INDIA

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[Sen, S., Saha, S. & Raychaudhuri, D. 2013. A new species of the genus *Miagrammopes* O. P. Cambridge, 1870 (Araneae: Uloboridae) from India. Munis Entomology & Zoology, 8 (1): 41-45**]**

ABSTRACT*: Miagrammopes apostrophus* sp. nov. recorded from Gorumara National Park, West Bengal, India is described and illustrated.

KEY WORDS: Taxonomy, spider, Uloboridae, *Miagrammopes apostrophus*, new species, Gorumara National Park, India.

Hackled web spiders (Uloboridae) are globally represented by 266 species under 18 genera (Platnick, 2012). This cosmopolitan family includes 22 Indian species belonging to 5 genera (Sebastian & Peter, 2009).

Nine of the 22 species are known to compose the genus *Miagrammopes* O. P. Cambridge, 1870 of India (Cambridge, 1870; Simon, 1889; Tikader, 1971; Raychaudhuri, 2004; Sebastian & Peter 2009; Platnick, 2012). Indian *Miagrammopes* are endemic with the exception of *M. thwaitesi* O. P. Cambridge (known from Sri Lanka also) (Platnick, 2012).

During our faunastic survey (2007-2010) for the spiders of the reserve forests of Dooars, West Bengal, we came across with a *Miagrammopes* species from Gorumara National park, West Bengal, India (for details visit www.westbengalforest.gov.in). The species after critical examination is considered as new to science and accordingly described and illustrated. [Note: We apologise for the erroneous mention of the Reg. no. for the species *Arctosa quinquedens* Dhali et al., 2012 (Mun. Ent. Zool., 7 (2): 1199-1213).The no. should read as EZC 0030-12].

MATERIAL AND METHODS

Uloborids were collected and preserved following Tikader (1987) and Barrion & Litsinger (1995). The material were studied using Stereo Zoom Binocular Microscope, model Zeiss SV-11. The measurements indicated in the text are in millimeters, made with an eye piece graticule. Leg measurements are shown as: total length (femur, patella, tibia, metatarsus, tarsus).

Abbreviations used: CL= Cephalothorax length, CW= Cephalothorax width, AL= Abdominal length, AW= Abdominal width, TL= Total length, PME= Posterior median eyes, PLE= Posterior lateral eyes; GNP= Gorumara National Park, WB= West Bengal.

TAXONOMY

Family Uloboridae Thorell, 1869

Genus *Miagrammopes* O. P. Cambridge, 1870

Miagrammopes apostrophus sp. nov.

(Figs. 1-6 & 7)

Type material: Holotype: female, Murti, GNP, WB, India, 21.ix.2009, coll. S. Sen; Paratype: 1 female, Murti, GNP, WB, India, 21.ix.2009, coll. D. Raychaudhuri.

Type deposition: Entomology Laboratory, Department of Zoology, University of Calcutta, registration no. **EZC 0031-12**.

Description:

Female (Holotype):

CL=1.53, CW=0.89, AL=3.67, AW=0.96, TL=5.20.

Cephalothorax (fig. 1) off white, elongate, rectangular, cephalic area medially raised, deeply depressed below the PME, appearing ‘**(**’ like pits, medially with a narrow ‘v’ shaped marking, thoracic area flat, with a posterior, basal, yellowish white band, fovea conspicuous, broad, clothed with fine hairs. Eyes 4, pearly white, ringed with black, arranged in a posterior recurved row, anterior row absent, PME largest, laterals on tubercles. Inter ocular distance: PME-PME=0.42, PLE-PME=0.14, PLE-PLE=0.82. Clypeus yellowish, wider than long. Chelicerae (fig. 2) yellowish white, only promargin with a minute tooth, fangs brown, curved. Both maxillae and labium (fig. 3) yellowish white, apical margins with small hairs, maxillae longer than wide, apically pointed and posteromedially fused with labium, labium longer than wide, apically lanceolate, posteromedially notched, basally fused with sternum. Sternum (fig. 3) yellowish, longer than wide, divided into 2 unequal halves between 2nd and 3rd coxa. Legs yellowish, long, clothed with hairs, metatarsus IV compressed, throughout with a row of calamistrum. Leg measurements: I 6.46 (2.41, 0.35, 1.41, 1.88, 0.41); II 3.21 (1.23, 0.41, 0.82, 0.52, 0.23); III 2.44 (0.82, 0.23, 0.58, 0.58, 0.23); IV 5.51(1.94, 0.35, 1.88, 1.05, 0.29). Leg formula 1423.

Abdomen (figs. 1 & 4) elongate, cylindrical, dorsum with silvery reticulations all over, basally with a median grey longitudinal marking, triradiate at posterior tip, midlongitudinally with 3 pairs of sigilla (muscular apodemes) arranged on either side of the grey marking; venter with silvery reticulations all over except epigynal and basal area of spinnerets, 2 yellowish brown, parallel, midlongitudinal band between epigastric furrow and spinnerets, spinnerets yellowish, cribellum brown, broad.

Epigynum - Internal genitalia (figs. 5-6): Spermatheca broadly ‘,’ shaped, atrium large, copulatory ducts long, ‘s’ shaped, copulatory openings small, circular, fertilization ducts small, outwardly curved.

Distribution: India: West Bengal (so far known only from the type locality).

Etymology: The species name is derived from the ‘turning away’ of spermatheca.

Remarks: The species appears to be closely allied to *Miagrammopes sutherlandi* Tikader 1971, but can be separated by i) spermatheca broadly ‘,’ shaped, atrium large, copulatory ducts long, ‘s’ shaped, (spermatheca and copulatory ducts never so, atrium small in *M. sutherlandi*); ii) cephalothorax with a narrow ‘v’ shaped marking between the PME (cephalothorax with ‘U’ shaped marking much below the PME in *M. sutherlandi*); iii) thoracic area with a posterior basal yellowish white band (such band completely absent in *M. sutherlandi*); iv) abdomen basally with a median grey longitudinal marking, triradiate at posterior tip, midlongitudinally with 3 pairs of sigilla (abdomen with a midlongitudinal brown, broad band extending from base to apex and without any sigilla in *M. sutherlandi*). Such differences appear to justify the erection of a new species.

ACKNOWLEDGEMENTS

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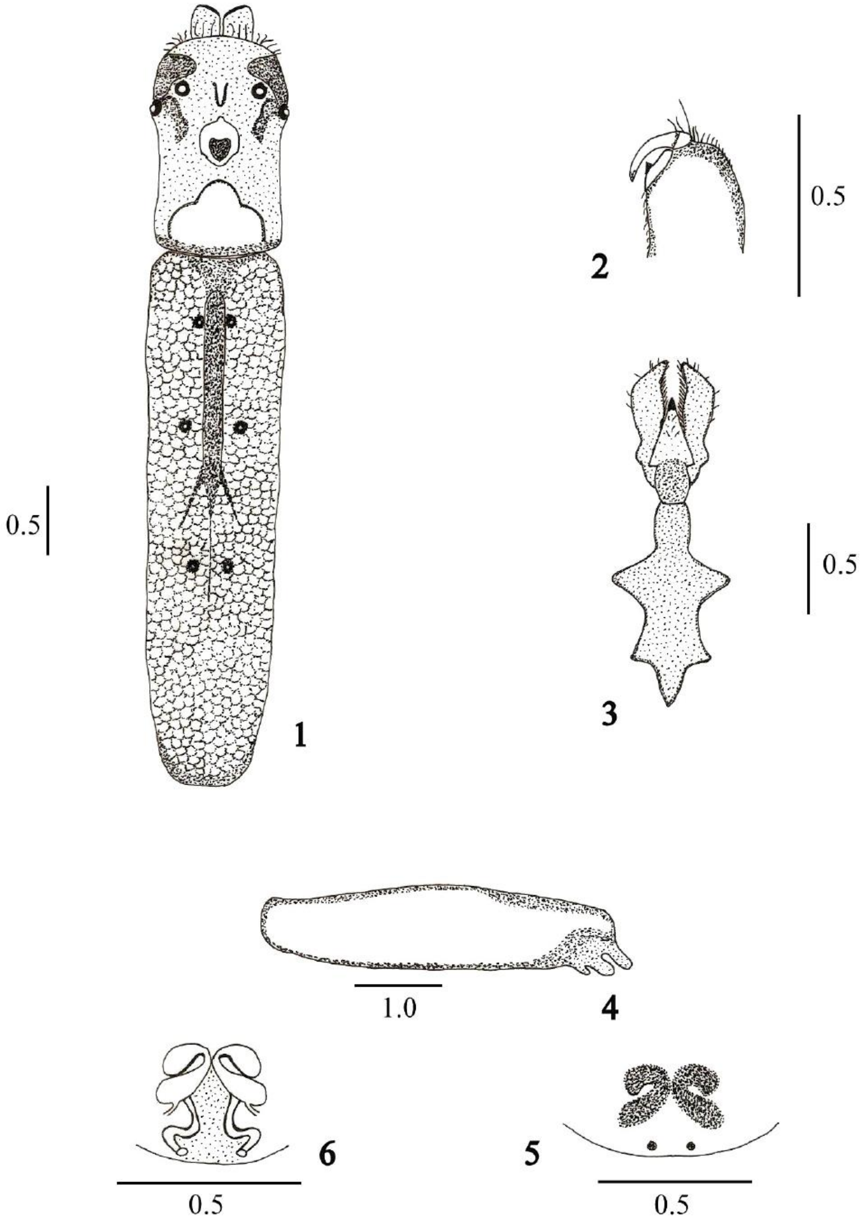

Figures 1-6. *Miagrammopes apostrophus* sp. nov. female (Holotype): 1. Cephalothorax and abdomen, dorsal view; 2. Chelicerae, ventral view; 3. Maxillae, labium and sternum, ventral view; 4. Abdomen, lateral view; 5. Epigynum, ventral view; 6. Internal genitalia, dorsal view.

Figure 7. Photographic image: General habitus of *Miagrammopes apostrophus* sp. nov., female (Holotype).

ON THE WATER BAT (*MYOTIS DAUBENTONII*) IN TURKEY

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[Albayrak, İ. 2013. On the Water Bat (*Myotis daubentonii*) in Turkey. Munis Entomology & Zoology, 8 (1): 46-49**]**

ABSTRACT: Of 5416 mammal species in the world, 1116 are bat species. Bats belong to the order Chiroptera, which has the meaning of hand winged. Bats feed on insects, fruits, nectar, blood, some invertebrate and vertebrate. It is determined that 36 bat species live in Turkey, one of which is frugivorous and others insectivorous. Water bat, *Myotis daubentonii* which was recorded first time from Bolu province generally feeds on water insects. Water bat is often located near bodies of water, because they hunt insects flying over water. It can be said that the distribution areas of this species changes with existing of water. This species was encountered inside small cracks and hollows on cave wall and ceiling, located adjacent to a small waterfall. Diagnostic characters, habitat, fur colour, morphometric data and distribution of this species in Turkey are given depending on one female and five male specimens. Bats feeding on insects, laying their eggs on water are affected adversely because of irregularity of water regimen.

KEY WORDS: Water bat, *Myotis daubentonii*, bioecology, distribution, Turkey.

Myotis daubentonii is an Eurasian bat which distributes from Britain to Japan. This species occurs in the woods and lives about 20 years. It prefers the areas near water sources such as rivers and water channels for roosting. Summer colonies occur in tunnels, vaults, mines, caves and underbridges, near sources of water. It usually hibernates between september and april. *Myotis daubentonii* is a kind of insectivorous bat and it gets out at dusk to hunt insects on the surface of water (Richarz & Limbrunner, 1993). Its main food is composed of flies, midges, mayflies and moths. This bat feeds during flying and returns to the roost after its weight increases of 60% in an hour. Mating happens in fall and fertilization occurs in following spring. Infants begin to fly after 3 weeks and they leave their parents at 6-8 weeks of age.

The purpose of this study is to emphasize the relationship between water resources and the distribution of *Myotis daubentonii.*

MATERIAL AND METHOD

This research is based on taxonomic characters and some biological features of *Myotis daubentonii* recorded in 1986 for the first time in Turkey. Six specimens which was captured using by arial net were prepared according to the traditional museum-type sample in the field by recording the weight and four standard external measurements according to Mursaloğlu (1965) (Figure 1).

Diagnostic characters, habitat, fur colour, some measurements and distribution of the species in Turkey were recorded.

RESULTS

Megachiroptera is only represented by family Pteropodidae and Microchiroptera family Emballonuridae, Rhinolophidae, Vespertilionidae and Molossidae. Until now, 36 bat species were recorded in Turkey. Ten species belong to the family Vespertilionidae have been identified in Turkey. *Myotis daubentonii* is known as one of the rare species in Turkey.

Diagnostic characters: There is a little notch at posterior border of ear, wing membrane extending to side of metatarsus, last caudal vertebra free, interfemoral membrane has densily scattered dots (Albayrak, 1988).

Habitat: Six specimens, one of which is female, were encountered inside hollows and cracks on walls and ceilings of little cave near a small waterfall on a slope (Figure 2).

Fur colour: Dorsal colour of six subadult specimens varies from brown to sligthly dark brown. Ventral colour is pale yellowish gray. Base of hair on dorsal and ventral is blackish brown, hair tip is similar to general colour tone.

Measurements and distribution: Some external and cranial measurements together with the weight of water bat were recorded (Table).

Water bat has been mostly recorded in the northern regions of Turkey (Albayrak, 1988, 1993; Helversen, 1989; Benda and Horáček, 1998) (Figure 3).

CONCLUSION

Some studies pointed out the resource limits and competition in bat communities. A bats are defined as successful desert mammals (Findley, 1995). In the deserts of North America and Australia, despite of an equal number of bats and rodents, the number of rodents is twice of bat numbers in the most arid regions of the Sahara and three times recorded in Namib desert also. There is a certain relationship between the degree of bat residence and kidney structure and function in arid environment (Findley, 1995).

It is determined that there is a correlation between the ratio of the inner medulla to renal cortex and urea concentration ability. Bats, such as *Pipistrellus hesperus* and *Antrozous pallidus*, which have the most developed iner medulla can make more concentration of urea. These species represent the most common species in southwestern region of America (Findley, 1995).

Arid western regions of America where surface water is limited, a very large number of bat have been seen at the same time on the water ponds. In these cases, it is stated that although it is reasonable that the physical access to the water supply is limited, there is a little evidence for temporal partitioning of watering (Findley, 1995). Jones (1965) reported that there is a few important differences in a study, concerning watering time of 19 bat species in New Mexico. It is reported that in many parts of the world it is not determined that water restricts bats in a way of affecting the community structure (Findley, 1995).

It is possible to classify the Turkish bats in point of habitat preferences. Taking into consideration of summer and winter roost sites, the species generaly inhabit caves, trees, buildings and cracks in rock. It has been determined that *Myotis daubentonii* lives in the areas which are close the water. In these regions some insect species show reproductive activity by leaving egg. Water bat hunts mainly mosquitoes and some insects like moths and flies by flying very close the water surface (Richarz & Limbrunner, 1993). As a result, water is one of the most important factors, which limits the distribution areas of the species. It is determined that roost sites of water bat were found to be very close to water resources (Figure4).

The water balance in animals is provided with relationships of variables such as humidity, body surface and diet (Rivera-Marchand and Rodriguez-Duran, 2001). It has not been encountered that the water bat lives in any ecosystem far away from water resurces. Thus, water bat is specialized to feed on aquatic insects.

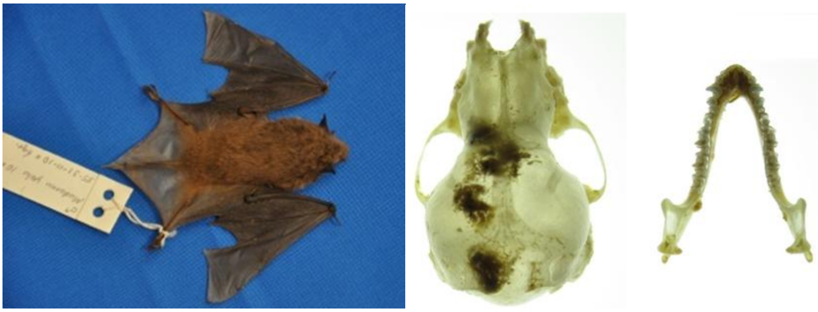

Figure 1. A museum material and head skeleton of *Myotis daubentonii*.

Figure 2. Habitat of *M.daubentonii* and its roost sites in a cave.

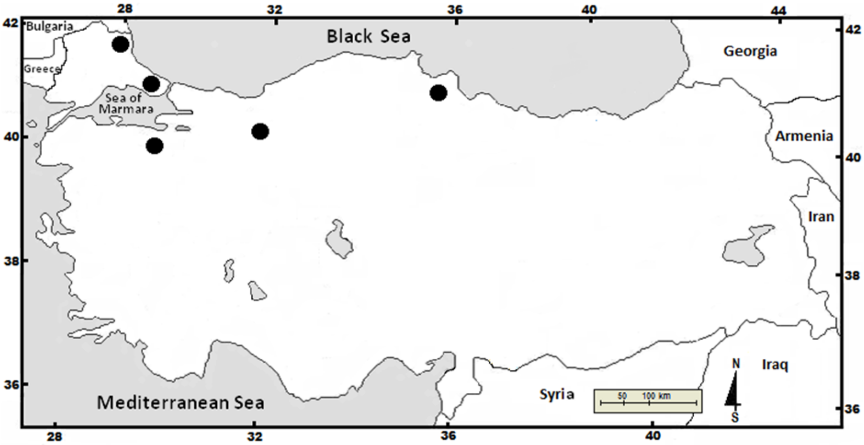

Figure 3. Distribution of *Myotis daubentonii* in Turkey.

Figure 4. A pond on which the aquatic insects are occured in water bat habitat.

Table. Some external measurements and weights of *M. daubentonii* specimens from Bolu province (n: sample size, r: range, m: mean, sd: standart deviation).

Measurements (♂♂, ♀)	n	r	m	±sd
Total length	6	83-85	84.8	1.32
Forearm length	6	33.0-35.6	34.5	0.95
Condylobasal length	4	12.3-13.2	13.0	0.12
Zygomatic breadth	1	8.9	-	-
Weight	6	5.5-6.0	5.6	0.40

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PRELIMINARY WORK ON LONGHORNED BEETLES FAUNA OF KAZ DAĞLARI (IDA MOUNTAIN) AND NEAR WITH TWO NEW SUBSPECIES (COLEOPTERA: CERAMBYCIDAE)

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[Küçükkaykı, E. C., Şirin, Ü., Çalışkan, H. & Şenyüz, Y. 2013. Preliminary work on Longhorned Beetles fauna of Kaz Dağları (Ida Mountain) and near with two new subspecies (Coleoptera: Cerambycidae). Munis Entomology & Zoology, 8 (1): 50-62**]**

ABSTRACT: This study is based on materials were collected from Kaz Dağları and near between May-September 2006-2008. A total of 30 species of 17 genera belonging to 5 subfamilies of Cerambycidae are recorded in the research area. All of them are the first record for fauna of Kaz Dağları. Two of them are described by Özdikmen as new subspecies from Balıkesir province (*Dorcadion pilosipenne kazdagense* Özdikmen ssp. n. and *Dorcadion scabricolle crassofasciatum* Özdikmen ssp. n.).

KEY WORDS: Cerambycidae, Kaz Dağları, new subspecies, Coleoptera, Turkey.

The main research area is Kaz Dağları or Ida Mountain. Kaz dağı (Mt. Ida in Greek mythology t. Ida) is situated in north-western Anatolia and forms a natural border between the Marmara and Aegean Regions of Turkey and the Canakkale and Balıkesir provinces (Uysal et al., 2011). The area is surrounded by Kalkım in the northwest, Edremit in the southeast, Küçükkuyu in the southwest and Bayramiç in the northwest, by covering an area of approximately 700 km. The highest part of the area reaches 1760 m from sea level at Karataş hill. Main annual temperature of the study area can be calculated as 15.7 °C. In summer season, daily temperature may be higher as 43.7 °C (in Edremit) and dry period can be long as six months from May to October (Erdağ, 1999). South-western part of Kaz Dağları (Mount Ida) was reserved as a national park because of biological diversity, geomorphologic characteristics, endemic species, abundant water resources, archeological, and cultural resources (Arı, 2004). This region supports diverse and distinct flora and fauna, consisting mainly of forests at elevations higher than 1000 m and pine forests at lower elevations. There are about 800 natural plant taxa in Kazdağı National Park and 68 of them are endemic to Turkey (Özhatay & Özhatay, 2005). So, fauna of Kazdağı is related with the fauna of Balıkesir and Çanakkale provinces. Both provinces are in the Marmara Region of Turkey.

Known fauna of longhorned beetles from Balıkesir province includes 33 species of 22 genera belonging to 7 subfamilies. The fauna of Çanakkale province comprises of 53 species of 29 genera belonging to 6 subfamilies. Both fauna with together includes totally 64 species of 34 genera belonging to 7 subfamilies. Namely, 22 species are common species in the fauna of both provinces.

Any information on fauna of Kaz Dağları has not been known yet. Thus, the study is based on materials that were collected from Kaz Dağları and near between May-September 2006-2008. As a result of this, a total of 30 species of 17 genera belonging to 5 subfamilies of Cerambycidae are recorded in the research area. All of them are the first record for Kaz Dağları. Two of them are described by

Özdikmen as new subspecies from Balıkesir province (*Dorcadion pilosipenne kazdagense* Özdikmen ssp. n. and *Dorcadion scabricolle crassofasciatum* Özdikmen ssp. n.). 16 species of them are the first record for Balıkesir province. 9 species of them are the first record for Çanakkale province. 1 species is the first record for Asian Turkey Part of Marmara Region and also 1 species is the first record for both Marmara Region and Northern half of Turkey. In addition to this, 5 species of them are endemic to Turkey.

MATERIAL AND METHODS

Specimens of Cerambycidae were collected from various habitats in Kaz Dağları and near between May-September in 2006-2008.

Sampling Localities

Local names, coordinates and altitudes of sampling localities are given below (Table 1). The information is used on Results section as site names. Sampling sites also are pointed in a map (Figure 1).

Collecting and Identification

Long horn beetles were collected from various habitats (e.g. dead decayed or living woods, under barks, on flowers) by using hand and aspirator, between May-September in 2006-2008. The catches were sieved on site, and stored in vials with 70% ethyl alcohol until sorting and identification in the laboratory. For identification, keys by Sama (2002) and Jenis (2001) were used, and specimens are deposited at the Department of Biology at Eskişehir Osmangazi University.

RESULTS AND DISCUSSION

In different habitats of the Kaz Dağları and near, 30 Cerambycidae species of 17 genera belonging to 5 subfamilies were recorded. The list of the collected species, associated with Turkey and World distribution, chorotypes and remarks, is given in below.

FAMILY CERAMBYCIDAE Latreille, 1802: 211

SUBFAMILY LEPTURINAE Latreille, 1802: 218
TRIBE LEPTURINI Latreille, 1802: 218
GENUS *ALOSTERNA* Mulsant, 1863: 576
SUBGENUS *ALOSTERNA* Mulsant, 1863: 576
SPECIES *A. tabacicolor* (DeGeer, 1775: 139)
SUBSPECIES *A. t. tabacicolor* (DeGeer, 1775: 139)

Material examined: Site 1, 20.V.07, 1 specimen; Site 2, 18.V.2006, 1 specimen.
Records in Turkey: Antalya, Artvin, Trabzon (Özdikmen, 2007, 2008b).
Records in World: Europe (from Spain and France to European Russia and European Kazakhstan),Western Siberia, Far East Russia, Mongolia, Korea, China, Japan, Caucasus, Turkey, Iran British Isles, Caucasus, Italy, Kazakhstan, Siberia, Spain, Turkey (Sama, 2002; Özdikmen, 2007).
Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Balıkesir province, and thereby Asian Turkey Part of Marmara Region.

GENUS *PSEUDOVADONIA* Lobanov, Danilevsky & Murzin, 1981: 787
SPECIES *P. livida* (Fabricius, 1777: 233)
SUBSPECIES *P. l. livida* (Fabricius, 1777: 233)

Material examined: Site 12, 06.VII.08, 2 specimens; 22.VI.2007, 1 specimen; Site 13, 21.VI.2007, 1 specimen; Site 5, 21.VI.2007, 8 specimens; Site 15, 20.V.2007, 1 specimen.

Records in Turkey: Adıyaman, Amasya, Ankara, Antalya, Artvin, Bilecik, Bolu, Bartın, Bursa, Bitlis, Bayburt, Cankırı, Erzincan, Erzurum, Gaziantep, Giresun, Gümüşhane, Hatay, Içel, Isparta, Istanbul, Izmir, Kars, Kırklareli, Kocaeli, Karabük, Kastamonu, Manisa, Niğde, Osmaniye, Rize, Samsun, Uşak, (Özdikmen, 2006, 207, 2008a; Özdikmen et al., 2009; Özdikmen, 2011).
Records in World: Europe (from Portugal and Spain to European Russia, European Kazakhstan), Western Siberia, China, Caucasus, Turkey, Iran, Lebanon, Syria, Israel (Sama, 2002; Özdikmen, 2007).
Chorotype: Sibero-European + E-Mediterranean.
Remark: New to Kaz Mts. fauna and Balıkesir province.

GENUS *ANOPLODERA* Mulsant, 1839: 285
SUBGENUS *ANOPLODERA* Mulsant, 1839: 285
SPECIES *A. rufipes* (Schaller, 1783: 296)
SUBSPECIES *A. r. rufipes* (Schaller, 1783: 296)

Material examined: Site 3, 20.V.2006,1 specimen; Site 5, 20.V.2007, 1 specimen; Site 4, 20.V.2006 1 specimen.
Records in Turkey: Ankara, Bingöl, Bolu, Burdur, Erzurum, Gümüşhane, Içel, Kırklareli, Kastamonu, Ordu, Rize, Trabzon (Özdikmen, 2008b).
Records in World: Europe (from Spain and France to European Russia and European Kazakhstan), Siberia, Caucasus, Turkey, Iran (Özdikmen, 2007).
Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Balıkesir and Çanakkale provinces.

GENUS *STICTOLEPTURA* Casey, 1924: 280
SUBGENUS *STICTOLEPTURA* Casey, 1924: 280
SPECIES *S. cordigera* (Fuessly, 1775: 14)
SUBSPECIES *S. c. cordigera* (Fuessly, 1775: 14)

Material examined: Site 6, 22.VI. 2007, 4 specimens; 06.VII.2008, 1 specimen; Site 7, 22.VI.2007, 1 specimen; 06.VII.2008, 7 specimens; Site 14, 19.V.2007, 1 specimen.
Records in Turkey: Adıyaman, Aksaray, Ankara, Antalya, Artvin, Balıkesir, Bingöl, Bolu, Bitlis, Burdur, Canakkale, Denizli, Edirne, Erzurum, Gaziantep, Gümüşhane, Hatay Içel, Isparta Izmir, Kahramanmaraş, Kırklareli, Konya, Kocaeli, Mugla, Manisa, Muş, Nevşehir, Niğde, Osmaniye, Tekirdağ, Tunceli, Yalova, (Özdikmen, 2007, 2008a; Özdikmen et al., 2009; Özdikmen et al., 2010).
Records in World: Europe (from Spain and France to European Turkey, Romania and Crimea), Caucasus, Turkey, Iran, Syria, Lebanon, Iraq, Israel (Sama, 2002; Özdikmen, 2007).
Chorotype: Turano-European + N-Africa (Libya).
Remark: New to Kaz Mts. fauna.

SPECIES *S. fulva* (DeGeer, 1775: 137)

Material examined: Site 6, 22.VI.2007, 2 specimens; Site 8, 22.VI.2007, 2 specimens; Site 26, 27.VII.2006, 3 specimens; Site 12, 29.VII. 2006, 1 specimen; 06.VII.2008, 1 specimen; 19.VII.2008; Site 2, 18.V.2006, 3 specimens; 18.IX.2006, 1 specimen; Site 27, 29.VII.2006, 1 specimen; Site 28, 06.VII.2008, 1 specimen; 19.VII.2008, 1 specimen; Site 15, 06.VII. 2008, 1 specimen; Site 16, 05.VII.2008, 2 specimens; Site 10, 05.VII.2008, 1 specimen.
Records in Turkey: Adana, Antalya, Artvin, Bolu, Bartın, Burdur, Çanakkale, Hatay, Içel, Isparta, Isparta Izmir, Kahramanmaraş, Kırklareli, Konya, Kocaeli, Karabük, Kastamonu, Manisa, Osmaniye, Zonguldak (Özdikmen, 2011).
Records in World: Europe (from Portugal and Spain to European Turkey, Romania and Ukraine), Turkey (Sama, 2002; Özdikmen, 2007).
Chorotype*:* European.
Remark: New to Kaz Mts. fauna and Balıkesir province. It has been known from Çanakkale province.

SPECIES *S. rufa* (Brullé, 1832: 263)

SUBSPECIES *S. r. rufa* (Brullé, 1832: 263)

Material examined: Site 5, 21.VI.07, 1 specimen.
Records in Turkey: Antalya, Bayburt, Bilecik, Erzincan, Erzurum, Gümüşhane, İçel, Tunceli (Özdikmen, 2007, 2011).
Records in World: Europe (from Italy and Albania to European Russia and Ukraine), Caucasus, Turkey, Iran, Iraq (Özdikmen, 2007).
Chorotype: Turano-Mediterranean (Turano-Apenninian).
Remark: New to Kaz Mts. fauna and Balıkesir province.

GENUS *JUDOLIA* Mulsant, 1863: 496

SPECIES *J. erratica* (Dalman, 1817: 490)

SUBSPECIES *J. e. erratica* (Dalman, 1817: 490)

Material examined: Site 28, 06.VII.2008, 1 specimen; Site 11, 05.VII.2008, 1 specimen.
Records in Turkey: Afyon, Amasya, Ankara, Antalya, Artvin, Bilecik, Bolu, Bartın, Bursa, Bitlis, Cankırı, Corum, Elazığ, Erzincan, Erzurum, Gaziantep, Gümüşhane, Hatay, Isparta, Istanbul, Izmir, Kars, Kırklareli, Kocaeli, Konya, Karabük, Kastamonu, Manisa, Muş, Rize, Samsun, Sinop, Sivas, Trabzon, Tokat, Tunceli, Yozgat, Zonguldak (Özdikmen, 2006, 2007, 2008a, 2011; Özdikmen & Demir, 2006; Özdikmen et al., 2009).
Distribution: Europe (Spain and France to European Russia), Siberia, China, Kazakhistan, Caucasus, Turkey, Iran, Syria (Sama, 2002; Özdikmen, 2007).
Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Balıkesir and Çanakkale provinces.

GENUS *RUTPELA* Nakani & Ohbayashi, 1957: 242

SPECIES *R. maculata* (Poda, 1761: 37)

SUBSPECIES *R. m. maculata* (Poda, 1761: 37)

Material examined: Site 28, 19.VII. 2008, 2 specimens; Site 17, 22.VI..2007, 1 specimen; 22.VI.2007, 1 specimen; Site 26, 27.VII.2006, 1 specimen; Site 16, 05.VII.2008, 1 specimen.
Records in Turkey: Adana, Rize Amasya, Antalya, Artvin, Balıkesir, Bingöl, Bolu, Bursa, Canakkale, Cankırı, Hatay, Içel, Istanbul, Kırklareli, Konya, Kocaeli, Karabük, Kastamonu, Malatya, Muş, Osmaniye, Rize, Samsun, Sinop, Sivas, Trabzon, Tokat, Tunceli, Van (Özdikmen & Demir, 2006; Özdikmen, 2011).
Records in World: Europe (from Portugal and Spain to European Russia and European Kazakhstan), Caucasus, Turkey, Iran (Sama, 2002; Özdikmen, 2007).
Chorotype: European.
Remark: New to Kaz Mts. fauna.

GENUS *STENURELLA* Villiers, 1974: 217

SPECIES *S. bifasciata* (Müller, 1776: 93)

SUBSPECIES *S. b. bifasciata* (Müller, 1776: 93)

Material examined: Site 8, 22.VI.07, 9 specimens; Site 18, 05.VII.2008, 1 specimen; Site 19, 22.VI.2007, 2 specimens; Site 29, 19.V.2007; Site 13, 19.V.2006, 2 specimens; 20.V.2007, 1 specimen; 21.VI.2007, 1 specimen; Site 15, 20.V.2007, 2 specimens; Site 6, 22.VI.2007, 1 specimen; Site 28, 22.VI.2007, 1 specimen; 06.VII.2008, 2 specimens; 19.VII.2008, 1 specimen; Site 2, 18.V.2006, 1 specimen; Site 1, 20.V.2007, 1 specimen; Site 26, 27.VII.2006, 1 specimen.
Records in Turkey: Adana, Afyon, Aksaray, Amasya, Ankara, Antalya, Artvin, Bilecik, Bingöl, Bolu, Bartın, Bursa, Bitlis, Burdur, Canakkale, Cankırı, Corum, Erzincan, Erzurum, Gaziantep, Gümüşhane, Hatay, Içel, Izmir, Kahramanmaraş, Kırklareli, Konya, Kocaeli, Karabük, Kastamonu, Kayseri, Muğla, Manisa, Nevşehir, Osmaniye, Rize, Samsun, Trabzon Uşak, Yalova, Yozgat, Zonguldak (Özdikmen, 2006; 2007, 2008a; Özdikmen et al., 2009; Özdikmen, 2011).
Records in World: Europe (from Portugal and Spain to European Russia, European Kazakhstan), Siberia, China, Caucasus, Turkey, Iran, Iraq, Lebanon, Syria (Sama, 2002; Özdikmen, 2007).
Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Balıkesir province. It has been recorded from Çanakkale province.

SPECIES *S. melanura* (Linnaeus, 1758: 397)

Material examined: Site 19, 22.VI.2007, 1 specimen.

Records in Turkey: Antalya, Artvin, Bolu, Bursa, Canakkale, Istanbul, Izmir, Kocaeli, Kastamonu, Ordu, Kahramanmaraş (Özdikmen, 2007, 2008).

Records in World: Europe (from Portugal and Spain to European Russia, European Kazakhstan), Siberia, Far East Russia, Mongolia, China, Japan, Caucasus, Turkey (Sama, 2002; Özdikmen, 2007).

Chorotype: Sibero-European.

Remark: New to Kaz Mts. fauna and Balıkesir province.

SPECIES *S. septempunctata* (Fabricius, 1792: 346)

SUBSPECIES *S. s. latenigra* (Pic, 1915: 5)

Material examined: Site 15, 20.V2007, 5 specimens; Site 13, 20.V.2007, 1 specimen; Site 20, 19.V.2006, 1 specimen; Site 21, 05.VII.2008, 1 specimen.

Records in Turkey: Afyon, Amasya, Ankara, Artvin, Bilecik, Bolu, Bursa, Canakkale, Erzurum, Gümüşhane, Istanbul, Izmir, Kırklareli, Kocaeli, Karabük, Kastamonu, Rize, Samsun, Sinop, Tokat, Trabzon, Yalova, Yozgat, Zonguldak (Özdikmen, 2006, 2007, 2008a; Özdikmen & Demir, 2006; Özdikmen et al., 2009).

Records in World: Europe (from Italy and Albania to European Turkey, Romania, Ukraine and Crimea), Caucasus, Turkey (Sama, 2002; Özdikmen, 2007).

Chorotype: Turano-European.

Remark: New to Kaz Mts. fauna and Balıkesir province. It has been recorded from Çanakkale province.

SUBFAMILY CERAMBYCINAE Latreille, 1802: 211

TRIBE HYLOTRUPINI Zagajkevich, 1991: 67

GENUS *HYLOTRUPES* Audinet-Serville, 1834: 77

SPECIES *H. bajulus* (Linnaeus, 1758: 396)

Material examined: Site 17, 28.VII.07, 1 specimen

Records in Turkey: Adana, Amasya, Ankara, Antalya, Artvin, Aydın, Bilecik, Bolu, Bartın, Bursa, Çanakkale, Denizli, Düzce, Erzincan, Erzurum, Giresun, Gümüşhane, Hatay, Içel, Isparta, Istanbul, Izmir, Kahramanmaraş, Kars, Konya, Karabük, Kastamonu, Kütahya, Kayseri, Rize, Sinop, Sivas, Trabzon, Uşak, Zonguldak (Özdikmen & Okutaner, 2006; Özdikmen,2007, 2008, 2011; Özdikmen et al., 2009).

Records in World: Europe (Portugal and Spain to Ukraine, Crimea and European Russia), North Africa (Morocco), Canary Islands, Madeira, South Africa, Madagascar, Siberia, China, Japan, Caucasus, Turkey, Iran, Syria, Lebanon, Israel, North America (Canada, Mexico), South America (Uruguay, Argentina, Chile, Brasil) (Sama, 2002; Özdikmen, 2007).

Chorotype: Subcosmopolitan.

Remark: New to Kaz Mts. fauna.

TRIBE CLYTINI Mulsant, 1839: 70

GENUS *CHLOROPHORUS* Chevrolat, 186: 290

SUBGENUS *CHLOROPHORUS* Chevrolat, 1863: 290

SPECIES *C. varius* (Müller, 1766: 188)

SUBSPECIES *C. v. varius* (Müller, 1766: 188)

Material examined: Site 15, 20.VII.2005, 1 specimen.

Records in Turkey: Adana, Adıyaman, Aksaray, Amasya, Ankara, Antalya, Artvin, Aydın, Bilecik, Balıkesir, Bolu, Bartın, Burdur, Canakkale, Cankırı, Denizli, Edirne, Erzincan, Eskişehir, Erzurum, Gümüşhane, Hakkari, Hatay, Içel, Iğdır, Isparta, Istanbul, Izmir, Kahramanmaraş, Kırıkkale, Kırşehir, Kırklareli, Karaman, Konya, Kocaeli, Karabük, Kastamonu, Kayseri, Malatya, Muğla, Manisa, Mardin, Muş, Nevşehir, Niğde, Osmaniye, Şanlıurfa, Trabzon, Tokat, Uşak, Zonguldak, Van (Özdikmen & Okutaner, 2006; Özdikmen, 2007, 2009, 2011).

Records in World: Europe (Spain and France to European Russia and European Kazakhstan), North Africa (Egypt), Siberia, China, Vietnam, Caucasus, Turkey, Iran, Jordan, Iraq, Israel, Lebanon, Syria (Sama, 2002; Özdikmen, 2007).

Chorotype: Palaearctic.

Remark: New to Kaz Mts. fauna.

SUBGENUS *CRASSOFASCIATUS* Özdikmen, 2011: 538

SPECIES *C. aegyptiacus* (Fabricius, 1775: 194)

Material examined: Site 5, 20.VII.2008, 1 specimen.
Records in Turkey: Amasya, Ankara, Balıkesir, Bolu, Bursa, Çanakkale, Denizli, Hatay, İstanbul, İzmir, Muğla, Manisa (Özdikmen, 2007).
Records in World: Europe (Macedonia, Greece, Crete, Bulgaria), Turkey (Özdikmen, 2007).
Chorotype: Turano-Mediterranean (Balkano-Anatolian).
Remark: New to Kaz Mts. fauna.

SUBFAMILY STENOPTERINAE Gistel, 1848: [9] (unnumbered section)

TRIBE STENOPTERINI Gistel, 1848: [9]

GENUS *STENOPTERUS* Illiger, 1804: 120

SPECIES *S. kraatzi* Pic, 1892: 21

Material examined: Site 13, 21.VIII.2007, 1 specimen.
Records in Turkey: Adana, Adıyaman, Antalya, Balıkesir, Hatay, Içel, Izmir, Kastamonu (Özdikmen, 2007, 2008a).
Records in World: Turkey (Özdikmen, 2012a).
Chorotype: Anatolian.
Remark: New to Kaz Mts. fauna. It is an endemic species.

TRIBE HYBODERINI Linsley, 1840: 367

GENUS *CALLIMUS* Mulsant, 1846: [5]

SUBGENUS *LAMPROPTERUS* Mulsant, 1862: 214

SPECIES *C. femoratus* (Germar, 1824: 519)

Material examined: Site 22, 03.V.2008, 1 specimen.
Records in Turkey: Adana, Adıyaman, Amasya, Ankara, Antalya, Artvin, Balıkesir, Bingöl, Bursa, Burdur, Canakkale, Diyarbakır, Edirne, Erzurum, Gaziantep, Hakkari, Hatay, Içel, İstanbul, Izmir, Kahramanmaraş, Kırıkkale, Kırklareli, Konya, Malatya, Muğla, Manisa, Muş, Niğde, Osmaniye, Yozgat, (Özdikmen, 2007, 2008b).
Records in World: Europe (Albania, Serbia, Macedonia, Greece, Bulgaria, European Turkey, Romania, Ukraine, Crimea), Caucasus, Turkey, Iran, Syria, Lebanon, Cyprus, Israel (Özdikmen,2007).
Chorotype: Turano-Mediterranean (Turano-E-Mediterranean).
Remark: New to Kaz Mts. fauna.

SUBFAMILY DORCADIONINAE Swainson, 1840: 290

TRIBE DORCADIONINI Swainson, 1840: 290

GENUS *DORCADION* Dalman, 1817: 397

SUBGENUS *CRIBRIDORCADION* Pic, 1901: 12

SPECIES *D. anatolicum* Pic, 1900: 12

Material examined: Site 20, 19.V.2006, 2 specimens.
Records in Turkey: Adana, Antalya, Isparta, Kahramanmaraş, Konya (Özdikmen & Okutaner, 2006; Özdikmen, 2010).
Records in World: Turkey (Endemic) (Özdikmen & Okutaner, 2006; Özdikmen, 2010).
Chorotype: Anatolian.
Remark: New to Kaz Mts. fauna and Çanakkale province, and thereby for Marmara Region and Northern half of Turkey. It is an endemic species.

SPECIES *D. quadripustulatum* Kraatz, 1873: 88

Material examined: Site 24, 14.IV.2006, 2 specimens.
Records in Turkey: Çanakkale (Özdikmen, 2010).
Records in World: Turkey.
Chorotype: Anatolian.
Remark: New to Kaz Mts. fauna. It is an endemic species.

SPECIES *D. pilosipenne* Breuning, 1943: 90

SUBSPECIES *D. pilosipenne kazdagense* **Özdikmen ssp. n.**

(Fig. 2)

As nominotypical form, but humeral band on elytra has a distinct spur that is close to humerus and heads to the end of basal whitish spot.

Holotype ♂: Turkey: Anatolia: Balıkesir prov.: Edremit, Yayla, 39° 39' N 26° 56' E, 784 m, 13.IV.2008. Paratypes 2 ♂♂: Balıkesir prov.: Edremit, Kocadüden, 39° 42' N 26° 52' E, 1635 m, 12.IV.2008. The specimens are deposited at the Department of Biology at Eskişehir Osmangazi University.

Remarks: *D. pilosipenne* has been known as endemic to Greece (Lesbos Island). According to Breuning (1962), it has 9 morphae from various parts of Lesbos Island as m. *pilosum* Breuning, 1943 [orig. comb.: *D. pilosum*]; m. *anticeclarior* Breuning, 1946 [orig. comb.: *D. pilosipenne* m. *anticeclarior*], m. *medioindicatum* Breuning, 1946 [orig. comb.: *D. pilosipenne* m. *medioindicatum*], m. *pseudocorpulentum* Breuning, 1962 [orig. comb.: *D. pilosipenne* m. *pseudocorpulentum*] which are based on female specimens and m. *basireductum* Breuning, 1962 [orig. comb.: *D. pilosipenne* m. *basireductum*]; m. *bihumerovittatum* Breuning, 1962 [orig. comb.: *D. pilosipenne* m. *bihumerovittatum*]; m. *dorsoapicale* Breuning, 1962 [orig. comb.: *D. pilosipenne* m. *dorsoapicale*]; m. *obscurior* Breuning, 1962 [orig. comb.: *D. pilosipenne* m. *obscurior*]; m. *rufoampliatum* Breuning, 1962 [orig. comb.: *D. pilosipenne* m. *rufoampliatum*] which are based on male specimens. The species has been known only from Lesbos Island until the present work. So, *D. pilosipenne kazdagense* Özdikmen **ssp. n.** is an eastern subspecies on the mainland of this species.

Etimology: From the type locality.

Records in Turkey: The species has not been recorded from Turkey until this work.
Records in World: The species has been known only from Greece (Lesbos Island) originally and Turkey (Balıkesir province) with the present work.
Chorotype: E-Mediterranean (Aegean).

SPECIES *D. scabricolle* (Dalman, 1817: 174)

SUBSPECIES *D. scabricolle crassofasciatum* **Özdikmen ssp. n.**

(Fig. 3, 4)

As nominotypical form, but humeral and sutural bands on elytra much wider (humeral band especially posterorly), magrin of bands extend straight or ragged. Moreover, elytra much shorter than the nominotypical form.

Holotype ♂: Turkey: Anatolia: Balıkesir prov.: Edremit, Sarıkız hill, 39° 42' N 26° 49' E, 1666 m, 20.V.2007. Paratypes 2 ♂♂: from the same locality with holotype. The specimens are deposited at the Department of Biology at Eskişehir Osmangazi University.

Remarks: This species has nine subspecies. The species distributes widely in Turkey. It is represented by five subspecies in Turkey. *D. scabricolle caramanicum* Daniel, 1903 (Southern subspecies) occurs in Cilician Taurus (South Turkey), *D. scabricolle paphlagonicum* Breuning, 1962 (Northern subspecies) occurs in Kastamonu province of North Turkey, *D. scabricolle balikesirense* Breuning, 1962 and *D. scabricolle uludaghicum* Breuning, 1970 (Western subspecies) occurs in Balıkesir and Bursa provinces of North-West Turkey and the nominative *D. scabricolle scabricolle* Dalman, 1817 occurs in Caucasus, Turkey and Iran. The other known subspecies of this species are *D. scabricolle elisabethpolicum* Suvorov, 1915, *D. scabricolle nakhiczevanum* Danilevsky, 1999 and *D. scabricolle paiz* Danilevsky, 1999 occur only in Azerbaijan. *D. scabricolle sevangense* Reitter, 1889 occurs only in Armenia. Anyway, *D. scabricolle crassofasciatum* Özdikmen **ssp. n.** is 10th and another Western subspecies of this species.

Etimology: From the Latin words "crassus" (meaning in English "thick") and "fascia" (meaning in English "band or bandage").

Records in Turkey: The species has been recorded from Adana, Afyon, Ağrı, Ankara, Antalya, Ardahan, Balıkesir, Bilecik, Bursa, Çorum, Erzincan, Erzurum, Gümüşhane, İçel, Kahramanmaraş, Kars, Kastamonu, Kayseri, Konya, Kütahya, Malatya, Niğde, Sivas, Uşak, Van, Yozgat (Özdikmen, 2010).
Records in World: The species has been known from Caucasus (Armenia, Azerbaijan, Georgia), Turkey, Iran.
Chorotype: SW-Asiatic.

SUBFAMILY LAMIINAE Latreille, 1825: 401
TRIBE MONOCHAMINI Gistel, 1848: [9]
GENUS *MONOCHAMUS* Dejean, 1821: 106
SUBGENUS *MONOCHAMUS* Dejean, 1821: 106
SPECIES *M. galloprovincialis* (Olivier, 1795: No. 67: 125)
SUBSPECIES *M. g. pistor* (Germar, 1842: 242)
Material examined: Site 6, 28.VII.2007, 2 specimens; 01.IX.2007, 2 specimens.
Records in Turkey: Adana, Antalya, Artvin, Aydın, Bolu, Bursa, Denizli, Içel, Isparta, Kars, Karabük, Kastamonu, Muğla, Ordu, Samsun, Sinop, Trabzon (Özdikmen, 2006, 2007, 2011).
Records in World: Europe (from Portugal and Spain to Crimea and European Russia), North Africa (Morocco, Algeria, Tunisia), Siberia, Far East Russia, Kazakhstan, Mongolia, Caucasus, Turkey.
Chorotype: Palearctic or Sibero-European + N-Africa.
Remark: New to Kaz Mts. fauna and Çanakkale province.

TRIBE LAMIINI Latreille, 1825: 401
GENUS *MORIMUS* Brullé, 1832: 258
SPECIES *M. orientalis* Reitter, 1894: 43
Material examined: Site 28, 20.V.2006, 1 specimen; Site 13, 20.V.2007, 1 specimen.
Records in Turkey: Erzurum, İstanbul, Sakarya (Özdikmen, 2008a).
Records in World: Europe (Bulgaria, European Turkey), Turkey (Özdikmen, 2008a).
Chorotype: Turano-Mediterranean (Balkano-Anatolian).
Remark: New to Kaz Mts. fauna and Balıkesir and Çanakkale provinces.

TRIBE ACANTHOCININI Blanchard, 1845: 154
GENUS *ACANTHOCINUS* Dejean, 1821: 106
SPECIES *A. griseus* (Fabricius, 1792: 261)
Material examined: Site 6, 28.VII.2007, 6 specimens; Site 7, 04.V.2008, 1 specimen.
Records in Turkey: Adana, Antalya, Bolu, Bursa, Denizli, Edirne, Erzurum, Hatay, Içel, İzmir, Kocaeli, Muğla, Manisa, Trabzon (Özdikmen, 2007, 2008, 2011).
Records in World: Caucasus, Cyprus, Japan, Siberia, Turkey (Sama, 2002).
Distribution: Europe (from Spain and France to European Russia and European Kazakhstan), Siberia, Mongolia, China, Caucasus, Turkey, Cyprus (Sama, 2002; Özdikmen, 2007).
Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Çanakkale province.

TRIBE PHYTOECIINI Mulsant, 1839: 191
GENUS *PHYTOECIA* Dejean, 1835: 351
SUBGENUS *PILEMIA* Fairmaire, 1864: 175
SPECIES *P. breverufonotata* (Pic, 1952: 2)
Material examined: Site 29, 20.V.2006, 1 specimen.
Records in Turkey: Adana, Bursa, İçel, Osmaniye (Özdikmen & Turgut, 2010; Özdikmen, 2012c).
Records in World: Turkey (Özdikmen & Turgut, 2010; Löbl & Smetana, 2010).
Chorotype: Anatolian.
Remark: New to Kaz Mts. fauna and Çanakkale province. It is an endemic species.

SUBGENUS *PHYTOECIA* Dejean, 1835: 351

SPECIES *P. caerulea* (Scopoli, 1772: 102)

SUBSPECIES *P. c. caerulea* (Scopoli, 1772: 102)

Material examined: Site 13, 14.IV.2007, 1 specimen; 28.IV.2007, 1 specimen.
Records in Turkey: Adana, Afyon, Aksaray, Ankara, Antalya, Aydın, Bilecik, Bolu, Burdur, Denizli, Düzce, Eskişehir, Erzurum, İçel, Isparta, İstanbul, İzmir, Kahramanmaraş, Karaman, Konya, Karabük, Kastamonu, Kayseri, Kütahya, Muğla, Manisa, Nevşehir, Niğde, Osmaniya, Samsun, Sivas, Yozgat (Özdikmen, 2006, 2007, 2008a; Özdikmen & Demir, 2006; Özdikmen et al., 2009).
Records in World: Europe (Portugal and Spain to European Russia and European Kazakhstan), Central Asia, Caucasus, Turkey, Iran, Palestine, Jordan, Syria, Lebanon, Israel (Sama, 2002; Özdikmen, 2007).
Chorotype: Turano-European.
Remark: New to Kaz Mts. fauna and Balıkesir province.

SPECIES *P. geniculata* Mulsant, 1862: 420

Phytoecia icterica yazılmış
Material examined: Site 20, 13.IV.2006, 1 specimen.
Records in Turkey: Adana, Ankara, Antalya, Aydın, Bilecik, Bursa, Burdur, Denizli, Edirne, Gaziantep, Hatay, İçel, Istanbul, İzmir, Kahramanmaraş, Kastamonu, Manisa, Osmaniye (Özdikmen, 2007, 2011).
Records in World: Europe (Greece, Bulgaria), Turkey, Cyprus, Palestine, Jordan, Lebanon, Syria, Israel, Iraq, Iran (Özdikmen, 2007).
Chorotype: Turano-Mediterranean.
Remark: New to Kaz Mts. fauna and Çanakkale province.

TRIBE AGAPANTHIINI Mulsant, 1839: 172

GENUS *AGAPANTHIA* Audinet-Serville, 1835: 35

SUBGENUS *SYNTHAPSIA* Pesarini & Sabbadini, 2004: 121

SPECIES *A. kirbyi* (Gyllenhal, 1817: 186)

Material examined: Site 28, 19.V.2007, 1 specimen.
Records in Turkey: (Adana, Afyon, Aksaray, Amasya, Ankara, Antalya, Bilecik, Bursa, Bitlis, Burdur, Corum, Edirne, Erzincan, Eskişehir, Erzurum, Içel, Isparta, Izmir, Kahramanmaraş, Kars, Kırşehir, Konya, Kocaeli, Kayseri, Manisa, Niğde, Osmaniye, Siirt, Tokat, Van, (Özdikmen et al., 2008, 2009; Özdikmen, 2007, 2011).
Records in World: Europe (Spain and France to Crimea and European Russia), Central Asia, Kazakhstan, Caucasus, Turkey, Iran, Syria, Israel (Sama, 2002; Özdikmen, 2007).
Chorotype: Turano-European.
Remark: New to Kaz Mts. fauna and Çanakkale province.

SUBGENUS *EPOPTES* Gistel, 1857: 93

SPECIES *A. lateralis* Ganglbauer, 1884: 541

Material examined: Site 5, 21.VI.2007, 2 specimens; Site 23, 18.V.2006, 2 specimens.
Records in Turkey: Afyon, Ağrı, Aksaray, Amasya, Ankara, Antalya, Bilecik, Bolu, Çanakkale, Çankırı, Çorum, Eskişehir, Içel, Isparta, İstanbul, Izmir, Kahramanmaraş, Kırşehir, Karaman, Konya, Karabük, Kastamonu, Muğla, Manisa, Nevşehir, Niğde, Tekirdağ, Tokat, Zonguldak (Özdikmen, 2006, 2007, 2008, 2011; Özdikmen & Demir, 2006; Özdikmen et al., 2009).
Records in World: Turkey (Özdikmen, 2011).
Chorotype: Anatolian.
Remark: New to Kaz Mts. fauna and Balıkesir province. It is an endemic species.

SPECIES *A. villosoviridescens* (DeGeer, 1775: 76)

Material examined: Site 12, 22.VI.2007, 1 specimen.
Records in Turkey: Afyon, Ankara, Aydın, Bursa, Denizli, Edirne, Erzurum, Hakkari, Hatay, Isparta, Kahramanmaraş, Sakarya (Özdikmen et al., 2009; Özdikmen, 2011).
Records in World: Europe (Spain and Portugal to European Russia and European Kazakhstan), Siberia, Mongolia, China, Russian Far East, Korea, Caucasus, Turkey (Sama, 2002; Özdikmen, 2008a).

Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Balıkesir province.

SUBGENUS *SMARAGDULA* Pesarini & Sabbadini, 2004: 128
SPECIES *A. violacea* (Fabricius, 1775: 187)

Material examined: Site 15, 13.IV.2008, 1 specimen; Site 13, 20.V.2007, 2 specimens.
Records in Turkey: Adana, Afyon, Aksaray, Ankara, Bilecik, Bolu, Bursa, Çorum, Denizli, Düzce, Edirne, Erzurum, Hatay, Içel, Isparta, Istanbul, Izmir, Kahramanmaraş, Kırşehir, Kırklareli, Konya, Kocaeli, Karabük, Kastamonu, Kayseri, Muğla, Manisa, Nevşehir, Niğde Sakarya, Zonguldak (Özdikmen, 2006, 2007, 2011; Özdikmen & Demir, 2006; Özdikmen et al., 2009).
Records in World: Europe (Spain and France to Ukraine, Crimea and European Russia), Siberia, Kazakhstan, Caucasus, Turkey (Sama, 2002; Özdikmen, 2007).
Chorotype: Sibero-European.
Remark: New to Kaz Mts. fauna and Balıkesir province.

ACKNOWLEDGEMENTS

We would like to thank to Dr. Hüseyin ÖZDİKMEN (Gazi University Faculty of Science Department of Biology, Ankara) for his scientific helps both in the confirmation of species and preparing the text.

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Table 1. Study areas, local names, coordinate and altitude.

Study Sites	**Localities**	**Province**	**District**	**Latitude**	**Longitude**	**Altitude**
Site 1	Ayıderesi	Balıkesir	Edremit	39° 40’	26° 57’	734 m
Site 2	Hasan Boğuldu	Balıkesir	Edremit	39° 38’	26° 55’	232 m
Site 3	Çınardere	Çanakkale	Bayramiç	39° 44’	26° 49’	450 m
Site 4	Ayazma	Çanakkale	Bayramiç	39° 44’	26° 51’	605 m
Site 5	Yayla	Balıkesir	Edremit	39° 39’	26° 56’	784 m
Site 6	Elmalı	Çanakkale	Bayramiç	39° 45’	26° 50’	1019 m
Site 7	Güreş Alanı	Çanakkale	Bayramiç	39° 46’	26° 45’	265 m
Site 8	Cevizli Tarla	Çanakkale	Bayramiç	39° 44’	26° 47’	699 m
Site 9	Kırlangıç Başı	Çanakkale	Bayramiç	39° 42’	26° 43’	790m
Site 10	Tuzlu	Balıkesir	Edremit	39° 38’	26° 45’	631 m
Site 11	Yumurta pınar	Balıkesir	Edremit	39° 41’	26° 48’	1195 m
Site 12	Küçük Düden	Balıkesir	Edremit	39° 42’	26° 54’	734 m
Site 13	Şahin Deresi	Balıkesir	Edremit	39° 35’	26° 45’	80 m
Site 14	Eşek Deresi	Balıkesir	Edremit	39° 41’	26° 48’	1254 m
Site 15	Pınarbaşı	Balıkesir	Edremit	39° 37’	26° 52’	506 m

Site 16	Beypınar	Balıkesir	Edremit	39° 38’	26° 55’	300 m
Site 17	Karaca Deresi	Çanakkale	Bayramiç	39° 44’	26° 55’	798 m
Site 18	Çeyiz Deresi	Çanakkale	Bayramiç	39° 42’	26° 48’	1257 m
Site 19	Şelaleli Dere	Balıkesir	Edremit	39° 38’	26° 46’	584 m
Site 20	Ayvacık	Çanakkale	Ayvacık	39° 41’	26° 39’	97m
Site 21	At Alanı	Çanakkale	Bayramiç	39° 42’	26° 48’	1270 m
Site 22	Kışla Dağı	Çanakkale	Ayvacık	39° 36’	26° 38’	450 m
Site 23	Edremit	Balıkesir	Edremit	39° 36’	27° 00’	100m
Site 24	Yeniköy	Çanakkale	Bayramiç	39° 46’	26° 41’	217 m
Site 25	Sarıkız Tepesi	Balıkesir	Edremit	39° 42’	26° 49’	1666 m
Site 26	Aç öldüren	Balıkesir	Edremit	39° 42’	26° 53’	1485 m
Site 27	Kocadüden	Balıkesir	Edremit	39° 42’	26° 52’	1635 m
Site 28	Yosunlu	Çanakkale	Bayramiç	39° 43’	26° 47’	730 m
Site 29	Evciler	Çanakkale	Bayramiç	39° 46’	26° 41’	154 m

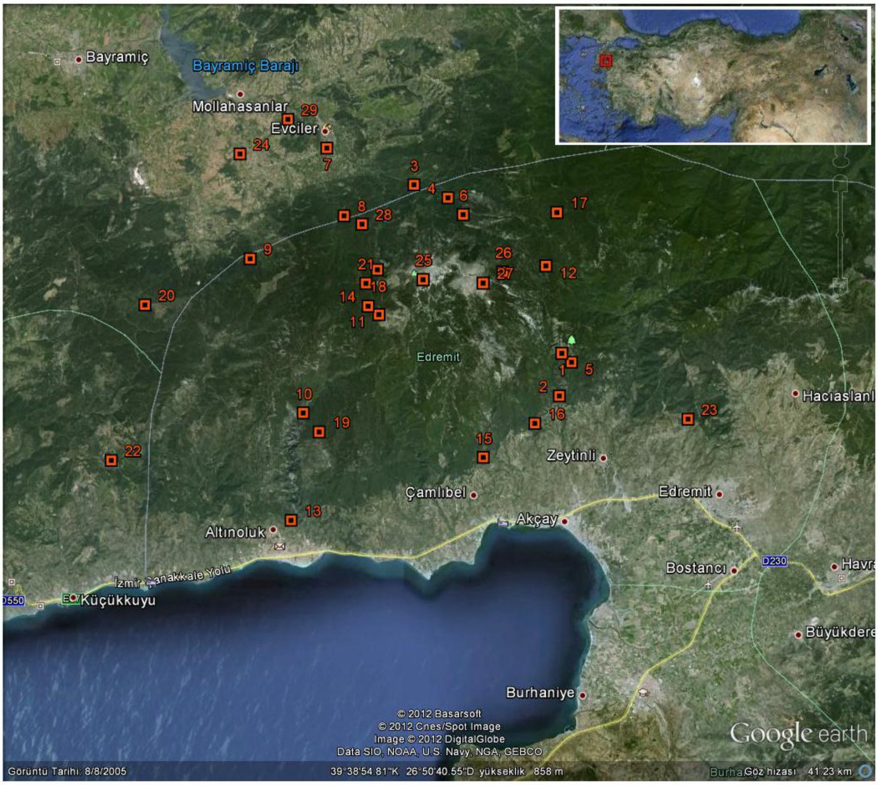

Figure 1. Map of the study area.

Figure 2. *Dorcadion pilosipenne kazdagense* Özdikmen ssp. n. (holotype).

(3) **(4)**

Figure 3-4. *Dorcadion scabricolle crassofasciatum* Özdikmen ssp. n. (holotype).

NEW SPECIES OF *YAGINUMAELLA* PROSZYNSKI FROM INDIA (ARANEAE: SALTICIDAE)

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[Sunil, J. K. 2013. New species of *Yaginumaella* Proszynski from India (Araneae: Salticidae). Munis Entomology & Zoology, 8 (1): 63-66**]**

ABSTRACT: A new species of spider namely *Yaginumaella aishwaryi* sp. nov. (Fam.: Salticidae), is described from Kerala, India. Detailed morphological characters and illustrations of body and copulatory organs of the species are presented.

KEY WORDS: *Yaginumaella aishwaryi* sp. nov., new species, Salticidae, Kerala, India.

Salticids are the largest and most diverse family in India with nearly 181 described species (Siliwal, 2005). Even though their number is larger, they are one of the least studied families among Indian spiders. Previous works on Indian salticids are that of Tikader (1967, 1973, 1974, 1975, 1976, 1977), Zabkha (1981), Prosynski (1992a,b, 2000, 2003, 2012)**.** In this paper I report the discovery of a new species of *Yaginumaella* found in India. The *Yaginumaella* is a tropical genus with nearly 38 described species from Bhutan, Nepal, Myanmar, India, China, Taiwan, Korea, Russia and Japan. Prószyn'ski, has reported that *Yaginumaella* is closely similar to, and may well be synonymous with, *Ptocasius*. Only *Yaginumaella* species reported from India is *Y. senchalensis* Prószyn'ski, 1992.

MATERIALS AND METHODS

The present species were collected during a study on the diversity of spiders in Kerala. Spiders were collected by methods described by Tikader (1987). Collected spiders were preserved in 70% ethyl alcohol and studied under Stereomicrosocope, Leica S4E. Drawings were made with the aid of a drawing tube. All measurements are in mm taken with an eyepiece graticule. Palps were studied by clearing in 10% KOH. The species is identified by referring to Proszynski (2003). The type material is preserved in 80% alcohol and deposited in a reference collection housed at the Department of Zoology, Deva Matha College, Kuravilangad, Kerala, India. (Voucher No AR00103).

Abbreviations used are as follows: AME = Anterior median eyes, ALE = Anterior lateral eyes, PME = Posterior median eyes, PLE = Posterior lateral eyes, L = Length, W = Width, H = Height.

RESULTS

Yaginumaella aishwaryi sp. nov.

(Fig. a-f)

CARAPACE: Rectangular in outline; dorsum with two lateral dark brown bands, mid dorsal region yellowish brown and narrowed posteriorly; an oblique yellowish band present on lateral sides. Carapace highest at PLE, slightly sloping forwards and abruptly at backwards. *Eyes*: AME pearly white, ALE less pearly white. *Sternum*: Elongated and oval, slightly convex, whitish, mostly free of hairs.

Clypeus dark brown, broader, almost half the diameter of AME and equal to the diameter of ALE in width; sparsely clothed with white hairs. *Chelicerae*: Dark brown with two promarginal teeth, one retromarginal one. *Palp*: Dark brown, sperm duct clearly visible, embolus very long and circulates around bulbus, with distal end directed proximally. The tibial apophysis large and prominent. *Legs*: Black; spines long and strong, first leg dark brown, femur broader, distal half of tarsus yellowish, tibia with two distal spines; hairs on tibia, metatarsus and trochanter longer and blackish; coxae I & II dark brown, III & IV whitish. Leg formula: 4123

ABDOMEN: Elliptical and dark brown with a yellowish brown mid-dorsal patch. Anterior margin bears a tuft of white hairs. Ventrum pale yellow with a thin median dark line; posterior portion bears a pair of longitudinal dark brown patches. Lateral sides and spinnerets dark brown.

Colour in living specimens: Generally blackish, carapace and abdomen with whitish median and black lateral bands. Lateral margins of carapace also bear whitish bands. Legs black. Ocular area black, clothed with brownish hairs. All eyes black. Ventrum of abdomen clothed with whitish hairs. Book lung's region greenish yellow. Anterior coxa black, posterior coxae paler. Sternum pale, lateral margin clothed with white hairs. Maxillae black. Distal and inner margin paler, clypeus clothed with white hairs.

Measurements (in mm): Total length: 5.5L, Cephalothorax: 2.1L, 1.9W, 2.0H; Abdomen: 3.1L, 1.4W.

Measurements of the leg segments (Male).

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.0	0.7	1.3	1.3	0.8	6.1
II	1.8	0.6	1.1	1.1	0.6	5.2
III	1.5	0.5	1.0	1.0	0.5	4.5
IV	2.1	0.8	1.4	1.5	0.8	6.6

Etymology: The species name is derived from the name of the collector, Aishwarya Sunil K.

Holotype: Male: Moolampilly Island, Cochin, Kerala, India, N 9° 56' 21.2382", E 76° 15' 34.5738". Coll. Aishwarya Sunil K, 20.XI.2004.

Type deposition: Deposited at the Arachnological Collections of Department of Zoology, Deva Matha College, Kuravilangad, Kottayam, Kerala, India. (Voucher No AR00103).

Distribution: *India*: Ernakulam

DIAGNOSIS: Similar to *Y. thakkholaica* Zabkha, 1980 but distinguished by the following characters:

1) Longer embolus circulating around bulbus in *Y. aishwaryi*.
2) Abdomen oval and narrower in *Y. aishwaryi* compared to *Y. thakkholaica*
3) Darker eye field region present in *Y. thakkholaica* is absent in *Y. aishwaryi*.

Because of these differences this species is described as new to science.

CONCLUSION

The characters of *Y. aishwaryi* shows some differences from generic characters of *Yaginumaella* especially in the very long embolus circulating around bulbus. It is also similar to the closely related genus *Ptocasius*. Many authors like Proszynski (2003) suggested that both *Yaginumaella* and *Ptocasius* may be synonymous with each other but this is yet to be proved conclusively. While identifying the species, Proszynski also suggested that it is possible that *Y. aishwaryi* may belong to a new genus. But in the absence of a female a new genus can not be erected. If female of this species is collected at some later time species may perhaps be transferred to a new genus if female also differs strikingly from the generic characters of *Yaginumaella*.

ACKNOWLEDGEMENTS

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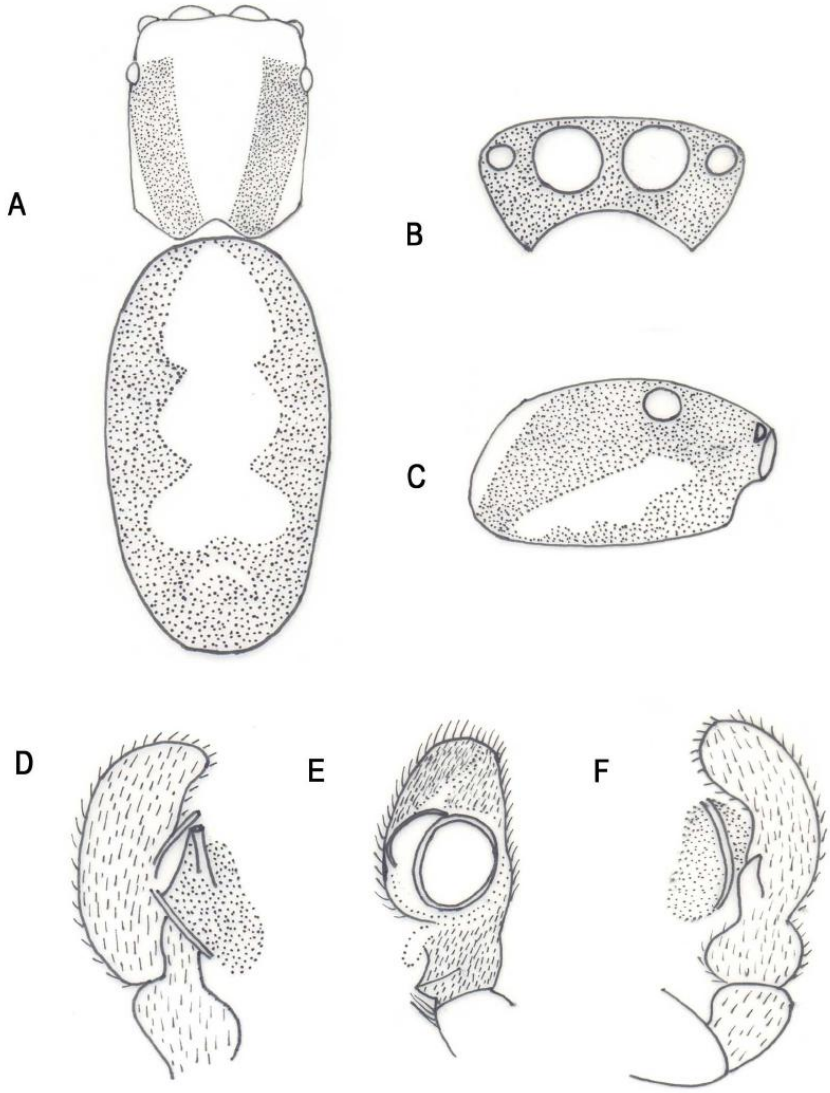

Figure 1. *Yaginumaella aishwaryi* sp. nov. male, A. Dorsal view, B. Eyes, frontal view, C. Carapace, lateral view, D–F. Palp.

THE LONGICORN BEETLES OF TURKEY (COLEOPTERA: CERAMBYCIDAE) PART V – SOUTH-EASTERN ANATOLIAN REGION

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[**Özdikmen, H.** 2013. The Longicorn Beetles of Turkey (Coleoptera: Cerambycidae) Part V – South-Eastern Anatolian Region. Munis Entomology & Zoology, 8 (1): 67-123**]**

ABSTRACT: The paper gives faunistical, nomenclatural, taxonomical and zoogeographical review of the longicorn beetles of South-Eastern Anatolian Region in Turkey.

KEY WORDS: Cerambycidae, Fauna, Nomenclature, Zoogeography, Taxonomy, South-Eastern Anatolian Region, Turkey.

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Clearly, there is no work, except Parts I-IV of the series, on Turkish Cerambycidae related to the whole territories of Turkey or regions of Turkey at present. Previous works were either short notes on short-lived expeditions or about at most a province and its environment. Also, works including description of new taxons are sometimes encountered. As opposed to this, European fauna has almost been investigated entirely as mentioned in Sama (2002) and Russian fauna has also been given mainly in Danilevsky (2012).

As known, a series work was planned with the aim to expose Turkish Cerambycidae fauna with as much detail as possible and entirely by beginning from the Black Sea Region (see Part I). The present study is an attempt at the fifth step of this aim. The South-Eastern Anatolian Region will be evaluated into two divisions as Central Fırat Part and Dicle Part with regard to some interesting properties.

Finally, with the desire to be useful for entomologists studying on Turkish fauna, longicorn beetles of South-Eastern Anatolian Region are evaluated and interpreted with respect to their nomenclatural, taxonomical, faunistical and zoogeographical features.

COVERED GEOLOGICAL AREA OF THE PRESENT WORK

The research area of the present work covers the South-Eastern Anatolian Region. As see below, the South-Eastern Anatolian Region has two parts. 1. Central Fırat Part including three provinces, namely Adıyaman, Gaziantep and Şanlıurfa bordered by Mediterranean Region in the West, Dicle Part of South-Eastern Anatolian Region of Turkey in the East, Eastern Anatolian Region in the North and Syria in the South. 2. Dicle Part including forth provinces as Batman, Diyarbakır, Mardin and Siirt bordered by Central Fırat Part of South-Eastern Anatolian Region of Turkey in the West, Eastern Anatolian Region in the North and East and Syria and Iraq in the South.

As given in Part I, Turkey is divided into seven regional parts commonly. The South-Eastern Anatolian Region includes two parts as follows:

South-Eastern Anatolian Region

1. Central Fırat Part (including Gaziantep, Adıyaman and Şanlıurfa provinces)
2. Dicle Part (including Diyarbakır, Mardin, Batman and Siirt provinces)

ARRANGEMENT OF INFORMATION

Information in the present text is given in the following order:

The subfamily and the tribe names are given simply.

For the genus and subgenus names, the type species are provided under the taxon names.

For each species, the reported South-Eastern Anatolian Region as connected with the geological area covered by the present work using the symbols **(*CFP)**, **(*DP)** are given just under the taxon names.

For each species, except examined species in Parts I-IV, the whole subspecies are provided under the taxon names.

The data, except examined species in Parts I-IV, **Other names, Material examined, Records in Turkey, Distribution, Remarks** and **Chorotype** under the title for each taxon is given. The data of examined species occur in both Parts I-IV, **Records in Turkey, Records in South-Eastern Anatolian Region, Remarks** and **Chorotype** under the title for each taxon is given.

Other names. In these parts, as possible as the whole other names including all infraspecific names (synonym, variety, morpha, form, aberration etc.) are provided.

Records in Turkey. Except the examined species in Parts I-IV, on the first line are given in paranthesis abbreviations of the provinces and lands in Turkey. These parts include previous records that have been given by various authors in different literatures. The whole records are evaluated as only concerning province and locality in the related reference. Each record is accompanied by the author's name and publication date of the related reference. For the examined species in Parts I-IV, on the first line are given (in paranthesis) only abbreviations of the provinces and lands in Turkey.

Records in South-Eastern Anatolian Region. Under this title, for the examined species in Parts I-IV, the distributions data only related to the South-Eastern Anatolian Region among the records in the whole of Turkey which presented in Parts I-IV.

Distribution. In these parts, the whole distribution areas in the world are provided for each taxon except the examined species in Parts I-IV.

Remarks. In these parts, taxonomical and nomenclatural problems are discussed for some taxons and are given regional and general distribution range in Turkey chiefly, except the examined species in Parts I-IV.

Chorotype. The present zoogeographical characterization is based on the chorotype classification of Anatolian fauna, recently proposed by Vigna Taglianti et al. (1999). In the text, as far as possible one chorotype description can be identificated for each taxon. But this kind of description can not be possible for some taxons, so two or more chorotypes are used for them.

Maps. The maps are given in the Appendix. For each taxon, a map showing distribution patterns in Turkey is used. On the maps, the black colored parts are represented the European Turkey records in Althoff & Danilevsky (1997). So Edirne province is black colored representatively. The other distribution patterns in Turkey are shown with simple black colored parts as seen on maps.

CLASSIFICATION

In this paper, classification and nomenclature of the longhorned beetles suggested by Löbl & Smetana (2010), Danilevsky (2012) and Özdikmen (2012) are followed chiefly. Within the subfamilies all genera are listed in the same order in Özdikmen (2012). Within the genera the species are listed alphabetically. Each name of a species or subspecies is accompanied by the author's name and description date.

ABREVIATIONS OF THE PROVINCES AND LANDS IN TURKEY

ADANA (AD)
ADIYAMAN (ADY)
AFYON (AF)
AĞRI (AG)
AKSARAY (AK)
AMASYA (AM)
ANKARA (AN)
ANTALYA (ANT)
ARDAHAN (AR)
ARTVİN (ART)
AYDIN (AY)
BALIKESİR (BL)
BARTIN (BR)
BATMAN (BA)
BAYBURT (BY)
BİLECİK (BI)
BİNGÖL (BN)
BİTLİS (BT)
BOLU (BO)
BURDUR (BU)
BURSA (BS)
ÇANAKKALE (CA)
ÇANKIRI (CN)
ÇORUM (CO)
DENİZLİ (DE)
DİYARBAKIR (DI)
DÜZCE (DU)
EDİRNE (ED)
ELAZIĞ (EL)
ERZİNCAN (ER)
ERZURUM (EZ)
ESKİŞEHİR (ES)
GAZİANTEP (GA)
GİRESUN (GI)
GÜMÜŞHANE (GU)
HAKKARİ (HA)
HATAY (HT)
IĞDIR (IG)
ISPARTA (IP)
İÇEL (IC)
İSTANBUL (IS)
İZMİR (IZ)
KAHRAMANMARAŞ (KA)
KARABÜK (KR)
KARAMAN (KM)
KARS (KAR)
KASTAMONU (KS)
KAYSERİ (KY)
KIRIKKALE (KI)
KIRKLARELİ (KK)
KIRŞEHİR (KIR)
KİLİS (KL)
KOCAELİ (KO)
KONYA (KN)
KÜTAHYA (KU)
MALATYA (MA)
MANİSA (MN)
MARDİN (MR)
MUĞLA (MG)
MUŞ (MU)
NEVŞEHİR (NE)
NİĞDE (NI)
ORDU (OR)
OSMANİYE (OS)
RİZE (RI)
SAKARYA (SA)
SAMSUN (SM)
SİİRT (SI)
SİNOP (SN)
SİVAS (SV)
ŞANLIURFA (SU)
ŞIRNAK (SK)
TEKİRDAĞ (TE)
TOKAT (TO)
TRABZON (TB)
TUNCELİ (TU)
UŞAK (US)
VAN (VA)
YALOVA (YA)
YOZGAT (YO)
ZONGULDAK (ZO)
THRACE (EUROPEAN TUR.) (TRA)
TURKEY (TUR)

Family CERAMBYCIDAE

Subfamily LEPTURINAE

Tribe RHAGIINI

Cortodera Mulsant, 1863

[Type sp.: *Grammoptera spinosula* Mulsant, 1839
= *Leptura humeralis* Schaller, 1783]

Cortodera colchica Reitter, 1890
(*CFP)

Records in Turkey: (AD-ADY-AK-AN-ANT-ART-BN-BU-BY-EZ-HA-KAR-KY-KN-SV-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: plateaus under the peak region of Nemrut Mountain (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mountain (Karadut village env.) (Rejzek et al., 2001).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Cortodera syriaca Pic, 1901
(*CFP)

Records in Turkey: (ADY-AK-HA-IC-KA-MU-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: the peak region of Nemrut Mountain (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Tribe LEPTURINI

Vadonia Mulsant, 1863
[Type sp.: *Leptura unipunctata* Fabricius, 1787]

Vadonia instigmata Pic, 1889
(*CFP)

Other names: Absent.
Records in Turkey: (ADY-BT-KAR-MU-TUR)
Bitlis prov. (Pic, 1889); Adıyaman prov.: Arsameia (Old Kahta) and peak region of Nemrut Mt. (Rejzek & Hoskovec, 1999); Muş prov.: Buğlan pass (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Turkey.
Remarks: It has been reported from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey. This species is accepted by some authors as a synonym of *Vadonia bitlisiensis* (Chevrolat, 1882). *Vadonia instigmata* (Pic, 1889) differs from it mainly by completely red eltra and having any black point on elytra. So it is evaluated as a separate species in this work.
Chorotype: Anatolian.

Pseudovadonia Lobanov, Danilevsky et Murzin, 1981
[Type sp.: *Leptura livida* Fabricius, 1777]

Pseudovadonia livida (Fabricius, 1777)
(*CFP)

Records in Turkey: (ADY-AM-AN-ANT-ART-BI-BO-BR-BS-BT-BY-CN-DU-ER-EZ-GA-GI-GU-HT-IC-IP-IS-IZ-KAR-KI-KK-KO-KR-KS-MN-NI-OR-OS-RI-SM-US-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Nurdağı (plateau of Kazdere village) / Kuşçubeli pass (Özdikmen & Demirel, 2005); Adıyaman prov.: Nemrut Mt. (Malmusi & Saltini, 2005); Gaziantep prov.: Akbez (Özdikmen et al., 2010).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Sibero-European.

Stictoleptura Casey, 1924
[Type sp.: *Leptura cribripennis* LeConte, 1859]

Subgenus *Stictoleptura* Casey, 1924
[Type sp.: *Leptura cribripennis* LeConte, 1859]

Stictoleptura cordigera (Füsslins, 1775)
(*CFP)

Records in Turkey: (ADY-AK-AN-ANT-ART-BL-BN-BO-BT-BU-CA-DE-ED-EZ-GA-GU-HT-IC-IS-IZ-KA-KI-KK-KN-KO-MG-MN-MU-NE-NI-OS-TE-TU-YA-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Besni (Şambayat) (Özdikmen et al., 2005); Gaziantep prov.: Kuşçubeli pass (Özdikmen & Demirel, 2005).

Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European.

Stictoleptura tripartita (Heyden, 1889)
(*CFP)

Records in Turkey: (ADY-BN-ER-EZ-HA-KA-KAR-KY-MA-RI-TU-YO)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Arsameia (old Kahta) (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic (Irano-Anatolian + Irano-Palaestinian + Mesopotamian + Syro-Anatolian).

Pedostrangalia Sokolov, 1897
[Type sp.: *Pedostrangalia kassjanovi* Sokolov, 1897
= *Leptura imberbis* Menetries, 1832]

Subgenus *Neosphenalia* Löbl, 2010
[Type sp.: *Leptura verticalis* Germar, 1822]

Pedostrangalia emmipoda (Mulsant, 1863)
(*CFP)

Records in Turkey: (AD-ADY-ANT-BN-BT-BU-CA-EL-GA-HA-HT-IC-IP-IZ-KA-KN-MA-MN-MU-NI-OS-TU- US-VA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Gaziantep prov.: Kuşçubeli pass (Özdikmen & Demirel, 2005).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Syro-Anatolian).

Pedostrangalia kurda Sama, 1996
(*CFP, DP)

Other names: Absent.
Records in Turkey: (ADY-BN-BT-DI-EL-HA-KA-MR-SI-TU-TUR)
Type localities: Tunceli prov.: Pülümür, Munzur Mt. or. (Pülümür passage), NE Central, Bitlis prov.: Yolbilen, Bingöl prov.: 30/40 km E Bingöl (Sama, 1996); Diyarbakır prov.: Silvan (Tozlu et al., 2002); Adıyaman prov.: Nemrut Mt. (Malmusi & Saltini, 2005) ; Adıyaman prov.: Nemrut Mt., Siirt prov.: Meşindağı pass, Tunceli prov.: 16 km S of Pülümür (Sama, Rapuzzi & Özdikmen, 2012); Bingöl prov.: 20 km E of Bingöl, Elazığ: Karga Mt., Hakkari prov.: Akçalı, Kahramanmaraş prov.: 40 km SE of Kahramanmaraş, Mardin prov.: Haberli, Alanyurt E of Gercüş, Hop pass, Siirt prov.: Meşindağı pass, Tunceli prov.: 15 km N of Pülümür, 16 km S of Pülümür (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Turkey.
Remarks: It has been reported from Central Fırat Part and Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).
Chorotype: Anatolian.

Judolia Mulsant, 1863
[Type sp.: *Leptura sexmaculata* Linnaeus, 1758]

Judolia erratica (Dalman, 1817)
(*CFP)

Records in Turkey: (AF-AM-AN-ANT-ART-BI-BO-BR-BS-BT-CN-CO-DU-EL-ER-EZ-GA-GU-HT-IP-IS-IZ-KAR-KI-KK-KO-KN-KR-KS-MN-MU-RI-SM-SN-SV-TB-TO-TU-YO-ZO-TRA-TUR)

Records in South-Eastern Anatolian Region: Gaziantep prov. (Lodos, 1998).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Sibero-European.

Stenurella **Villiers, 1974**

[Type sp.: *Leptura melanura* Linnaeus, 1758]

Stenurella bifasciata **(Müller, 1776)**
(*CFP)

Records in Turkey: (AD-ADY-AF-AK-AM-AN-ANT-ART-BI-BN-BO-BR-BS-BT-BU-CA-CN-CO-DU-ER-EZ-GA-GU-HT-IC-IP-IZ-KA-KI-KK-KN-KO-KR-KS-KY-MG-MN-NE-OS-RI-SM-TB-US-YA-YO-ZO-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: the lower valley regions in the environs of Karadut village (petrol station) (Rejzek & Hoskovec, 1999); Gaziantep prov.: Nurdağı (plateau of Kazdere village), Kuşçubeli pass (Özdikmen & Demirel, 2005).
Remarks: It belongs to the subspecies *S. bifasciata nigrosuturalis*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Sibero-European + SW-Asiatic chorotypes.

Subfamily ASEMINAE

Tribe ASEMINI

Arhopalus **Serville, 1834**

[Type sp.: *Cerambyx rusticus* Linnaeus, 1758]

Arhopalus syriacus **(Reitter, 1895)**
(*CFP)

Records in Turkey: (AD-ANT-ART-GA-HT-IC-IZ-MG-NE-OS-SU)
Records in South-Eastern Anatolian Region: South parts of Gaziantep prov. and Şanlıurfa prov. (Lodos, 1998).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Mediterranean.

Subfamily CERAMBYCINAE

Tribe HESPEROPHANINI

Trichoferus **Wollaston, 1854**

[Type sp.: *Trichoferus senex* Wollaston, 1854
= *Trichoferus fasciculatus senex* Wollaston, 1854]

Trichoferus fasciculatus **(Faldermann, 1837)**
(*DP)

Records in Turkey: (AN-ANT-BR-BS-IZ-MG-MN-SI-TB-TUR)
Records in South-Eastern Anatolian Region: Siirt prov.: 7 km SE Eruh (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean.

Trichoferus griseus (Fabricius, 1792)
(*CFP)

Records in Turkey: (AD-ANT-AY-GA-HT-IC-IZ-KN-MN-OS-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part III in the section dealing with the Aegean Region.
Chorotype: Mediterranean.

Trichoferus lunatus (Szallies, 1994)
(*DP)

Other names: Absent.
Records in Turkey: (MR-SK-TUR)
Type loc.: Mardin prov.: Hop pass (Szallies, 1994); Turkey (Kadlec & Rejzek, 2001); Mardin prov.: Midyat (Haberli 33 km SE) (Rejzek et. al., 2003 (2002)); Mardin prov.: Hop pass, 6 km E of Arıçlı, 11 km E of Midyat, Şırnak prov.: Meşindağı pass, Uludere env. (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Turkey, Iran.
Remarks: It has been reported from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The species has been known only from SE Turkey.
Chorotype: SW-Asiatic (Irano-Anatolian).

Trichoferus preissi (Heyden, 1894)
(*CFP, DP)

Records in Turkey: (AD-ANT-IC-MR-SU-AER-TUR)
Records in South-Eastern Anatolian Region: Type loc.: Mardin prov. (Heyden, 1894); Şanlıurfa prov. (Tozlu et al., 2002).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region. But according to Löbl & Smetana (2010), it is known only from Turkey, not Syria and Iran. So it is endemic to Turkey.
Chorotype: Anatolian.

Trichoferus samai Kadlec & Rejzek, 2001
(*CFP)

Other names: Absent.
Records in Turkey: (ADY)
Adıyaman prov.: Nemrut Mountain (20 km NW of Kahta) (Kadlec & Rejzek, 2001).
Distribution: Turkey.
Remarks: It has been reported from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The species has been known only from the type locality in Turkey.
Chorotype: Anatolian.

Stromatium Audinet-Serville, 1834
[Type sp.: *Callidium barbatum* Fabricius, 1775]

Stromatium unicolor (Olivier, 1795)
(*CFP)

Records in Turkey: (AD-AF-AM-AN-ANT-BL-BS-CA-DE-EL-ER-EZ-GA-GI-GU-HT-IC-IS-IZ-KA-KK-MA-MG-MN-OR-OS-SM-TB-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Central (Tozlu et al., 2002).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Subcosmopolitan.

Tribe PHORACANTHINI

Phoracantha Newman, 1840
[Type sp.: *Stenocorus semipunctatus* Fabricius, 1775]

Phoracantha semipunctata (Fabricius, 1775)
(*CFP)

Records in Turkey: (AD-ANT-HT-IC-KL-MG-OS-SU-TUR)
Records in South-Eastern Anatolian Region: Şanlıurfa prov. (Çanakçıoğlu, 1983; Kanat, 1998).
Remarks: It was treated in detail in Part III in the section dealing with the Aegean Region.
Chorotype: Cosmopolitan.

Tribe CERAMBYCINI

Cerambyx Linnaeus, 1758
[Type sp.: *Cerambyx cerdo* Linnaeus, 1758]

Subgenus *Cerambyx* Linnaeus, 1758
[Type sp.: *Cerambyx cerdo* Linnaeus, 1758]

Cerambyx cerdo Linnaeus, 1758
(*CFP)

Records in Turkey: (AD-ADY-AN-ANT-ART-BN-BR-BS-CA-DE-DU-HT-IC-IS-IZ-KA-KK-KN-KO-KS-KY-MG-MU-NI-OS-SA-SK-SM-SN-TU-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It belongs to the subspecies *C. cerdo acuminatus*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Europeo-Mediterranean.

Cerambyx dux (Faldermann, 1837)
(*CFP)

Records in Turkey: (AD-ADY-AN-ANT-BI-BN-BS-BU-DE-EL-ER-EZ-GA-HT-IC-IP-IS-IZ-KA-KAR-KK-KN-KS-KY-MA-MG-MU-NI-OS-TO-TU-VA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999); Gaziantep prov.: Kuşçubeli pass, Islahiye (Kabaklar village, Köklü village) (Özdikmen & Demirel, 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-Balkan).

Cerambyx miles Bonelli, 1812
(*CFP, DP)

Records in Turkey: (AD-ADY-AF-ANT-BT-ED-DE-DI-IC-IS-KA-KN-NI-OS-US-TRA-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. (Gül-Zümreoğlu, 1975); Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: S-European.

Cerambyx nodulosus Germar, 1817
(*CFP, DP)

Records in Turkey: (AD-ADY-ANT-ART-BN-BS-BT-EZ-IC-IP-IS-IZ-KA-KN-MG-MN-MR-OS-US-TRA-TUR)
Records in South-Eastern Anatolian Region: Mardin prov.: Hop pass (Adlbauer, 1992); Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-Apenninian) + Turano-European (Turano-Sarmato-Pannonian).

Cerambyx welensii (Küster, 1846)
(*CFP)

Records in Turkey: (ADY-ANT-IC-IS-KA-KM-KN-OS-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: S-European.

Tribe TRACHYDERINI

Purpuricenus Dejean, 1821
[Type sp.: *Cerambyx kaehleri* Linnaeus, 1758]

Subgenus *Purpuricenus* Dejean, 1821
[Type sp.: *Cerambyx kaehleri* Linnaeus, 1758]

Purpuricenus apicalis Pic, 1905
(*DP)

Other names: *tommasoi* Sama, 2001
Records in Turkey: (HA-MR-SI-VA)
Siirt prov.: Central, Baykan, Eruh (Fuchs & Breuning, 1971); Siirt prov.: Eruh as *P. dalmatinus* (Adlbauer, 1988); Van prov.: Çatak (Dalbastı) (Koçak & Kemal, 2009); Hakkari prov.: 5 km E of the crossroad to Çukurca, Mardin prov.: Haberli (33 km SE Midyat) (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Turkey, Iran, Iraq.
Remarks: It has been reported from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).
Chorotype: SW-Asiatic.

Purpuricenus budensis (Götz, 1783)
(*CFP, DP)

Records in Turkey: (AD-ADY-AF-AM-AN-ANT-ART-AY-BL-BN-BO-BS-BU-CA-CO-DE-ED-EZ-GA-GU-HT-IC-IP-IS-IZ-KA-KI-KN-KO-MG-MN-MU-NI-OS-RI-SI-SM-SN-TO-TU-YO-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Gül-Zümreoğlu, 1975); Gaziantep prov.: Fevzipaşa (Sama, 1982); Siirt prov. (Lodos, 1998); Adıyaman prov. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Europeo-Mediterranean.

Purpuricenus cornifrons Sabbadini & Pesarini, 1992
(*CFP)

Other names: Absent.

Records in Turkey: (ADY-BN-BT-MU)
Bingöl prov., Muş prov. (Sabbadini & Pesarini, 1992); Adıyaman prov.: Karadut village, Nemrut Mountain (Rejzek & Hoskovec, 1999); Muş prov.: Buğlan pass (Malmusi & Saltini, 2005); Bitlis prov.: Tatvan (personel communication with Tomas Tichy, 2011 30th December); Bingöl prov.: 30/36 km E of Bingöl, Muş prov.: Buğlan pass (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Turkey.
Remarks: It has been reported from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).
Chorotype: Anatolian.

Purpuricenus dalmatinus Sturm, 1843
(*CFP, DP)

Records in Turkey: (ADY-ANT-AY-BN-HT-IC-IZ-KA-MG-MN-MR-MU-OS-TU-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Malmusi & Saltini, 2005); Mardin prov. (Özdikmen, et al., 2005).
Remarks: It was treated in detail in Part III in the section dealing with the Aegean Region. The record, Siirt prov.: Eruh as *P. dalmatinus* (Adlbauer, 1988), belongs to the species *P. apicalis*.
Chorotype: E-Mediterranean.

Purpuricenus wachanrui Levrat, 1858
(*CFP, DP)

Records in Turkey: (AD-ADY-BN-BT-DI-MA-MU-TU-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. (Adlbauer, 1988); Adıyaman prov.: Karadut village, Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Rejzek et al., 2001).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Irano-Anatolian).

Calchaenesthes Kraatz, 1863
[Type sp.: *Callidium oblongomaculatum* Guèrin, 1844]

Calchaenesthes oblongomaculata (Guèrin, 1844)
(*CFP)

Records in Turkey: (ADY-AM-GA-IC-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Islahiye as *Purpuricenus oblongomaculatus* (Demelt, 1963); Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Tribe CALLICHROMATINI

Aromia Audinet-Serville, 1833
[Type sp.: *Cerambyx moschatus* Linnaeus, 1758]

Aromia moschata (Linnaeus, 1758)
(*CFP)

Records in Turkey: (AD-ADY-AN-ANT-ART-AY-BI-BL-BN-BS-BU-CA-DU-EZ-HT-IC-IP-IS-IZ-KA-KN-KO-MN-OS-SM-TO-TU-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).

Remarks: It belongs to the subspecies *A. moschata ambrosiaca*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Palearctic.

Osphranteria Redtenbacher, 1850

[Type sp.: *Osphranteria suaveolens* Redtenbacher, 1850]

Osphranteria coerulescens Redtenbacher, 1850
(*CFP, DP)

Other names: Absent.
Records in Turkey: (ADY-DI-EL-ER-HA-SI-VA-TUR)
Diyarbakır prov. (İren & Ahmed, 1973); Type loc.: Hakkari prov.: Sat Mountain, Oramar (Dağlıca) as *O. coerulescens inaurata* (Holzschuh, 1981); Siirt prov.: Kuzluca, Hakkari prov.: Çığlısuyu valley, Suvarihalil pass (Adlbauer, 1992); Elazığ prov.: Harput, Hakkari prov.: Şemdinli (Central, Derecik), Yüksekova (Önalp, 1988b); Turkey (Lodos, 1998); Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999); Van prov.: Çatak (Özdikmen, et al., 2005); Erzincan prov.: Eğin (pers. comm. Selma Seven, 2007).
Distribution: Turkey, Iran, Iraq, Pakistan.
Remarks: It belongs to the subspecies *O. coerulescens inaurata*. It has been reported from Central Fırat Part and Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).
Chorotype: SW-Asiatic.

Tribe CERTALLINI

Certallum Dejean, 1821

[Type sp.: *Saperda ruficollis* Fabricius, 1787
= *Cerambyx ebulinus* Linnaeus, 1767]

Certallum ebulinum (Linnaeus, 1767)
(*CFP, DP)

Records in Turkey: (AD-ADY-AK-AM-AN-ANT-AY-BI-BL-BS-CA-CN-DE-DI-ER-GA-HT-IC-IP-IS-IZ-KA-KI-KIR-KN-KY-MG-MN-MR-NE-NI-OS-SN-SU-TB-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village and adjacent urban areas as *Certallum ebulinum ruficolle* (Rejzek & Hoskovec, 1999); Diyarbakır prov.: Silvan (Tozlu et al., 2002); Şanlıurfa prov.: Ceylanpınar, Gaziantep prov.: Nizip, Islahiye (Özdikmen, et al., 2005); Adıyaman prov.: Kahta, Siverek, Mardin prov.: Hop pass (Pınardere) (Malmusi & Saltini, 2005); Gaziantep prov.: Nurdağı (Exit of İslahiye) (Ozdikmen, Güven & Gören, 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Europeo-Mediterranean.

Certallum thoracicum Sharp, 1880
(*CFP)

Records in Turkey: (GA-IZ-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Demelt, 1963).
Remarks: It was treated in detail in Part III in the section dealing with the Aegean Region.
Chorotype: Turano-Mediterranean (Turano-Apenninian).

Tribe CALLIDIINI

Ropalopus Mulsant, 1839

[Type sp.: *Callidium clavipes* Fabricius, 1775]

Subgenus *Ropalopus* Mulsant, 1839

[Type sp.: *Callidium clavipes* Fabricius, 1775]

Ropalopus clavipes (Fabricius, 1775) (*CFP)

Records in Turkey: (AD-ADY-AN-BL-BO-CN-CO-DE-ED-ER-HT-IC-IS-IZ-KO-KU-MN-MU-NI-OS-US-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: European or Sibero-European.

Ropalopus ledereri (Fairmaire, 1866) (*CFP)

ssp. *ledereri* Fairmaire, 1866
ssp. *wittmeri* Demelt, 1970

Other names: Absent.
Records in Turkey: (ADY-OS-TUR)
Type loc.: Asia minor: ? İzmir prov. (Fairmaire, 1866); Kahramanmaraş prov., Osmaniye prov. As the type loc. of *R. ledereri wittmeri* (Demelt, 1970); Osmaniye prov.: Nurdağı pass (Adlbauer, 1988);Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999); Asia Minor (Sama & Rapuzzi, 2000).
Distribution: Turkey, Syria, Jordan, Israel.
Remarks: It has been reported from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). Probably, the subspecies *R. ledereri wittmeri* is distributed only in Amanos Mts. from Turkey and Syria.
Chorotype: E-Mediterranean (Palaestino-Taurian).

Phymatodes Mulsant, 1839

[Type sp.: *Cerambyx variabilis* Linnaeus, 1760
= *Cerambyx testaceus* Linnaeus, 1758]

Subgenus *Phymatodes* Mulsant, 1839

[Type sp.: *Cerambyx variabilis* Linnaeus, 1760
= *Cerambyx testaceus* Linnaeus, 1758]

Phymatodes testaceus (Linnaeus, 1758) (*CFP)

Records in Turkey: (ADY-ANT-ART-BN-BO-CA-DU-GU-HT-IC-IS-KI-NI-OS-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Holarctic.

Tribe CLYTINI

Plagionotus Mulsant, 1842

[Type sp.: *Leptura detrita* Linnaeus, 1758]

Subgenus *Echinocerus* Mulsant, 1863

[Type sp.: *Cerambyx floralis* Pallas, 1773]

Plagionus floralis (Pallas, 1773) (*CFP)

Records in Turkey: (AD-ADY-AF-AG-AM-AN-ANT-AR-ART-BI-BN-BO-BS-BT-BU-BY-CA-CN-CO-DE-EL-ER-ES-EZ-GI-GU-HA-IC-IG-IP-IZ-KA-KAR-KI-KIR-KK-KM-KN-KO-KR-KS-KY-MA-MN-MU-NI-OS-SM-SN-SV-TB-TO-TU-US-YO-ZO-TRA-TUR)

Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Sibero-European.

Subgenus *Neoplagionotus* Kasatkin, 2005

[Type sp.: *Clytus bobelayei* Brullé, 1832]

Plagionotus bobelayei (Brullé, 1832)
(*CFP)

Records in Turkey: (ADY-AG-ANT-ART-BN-EZ-GU-HT-IC-IP-IZ-KAR-KI-KN-MA-MU-SM-SU-TU-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Malmusi & Saltini, 2005); Şanlıurfa prov.: Halfeti env. (pers. comm. with J. Kurzawa, 2006).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European (Turano-Sarmato-Pannonian).

Chlorophorus Chevrolat, 1863

[Type sp.: *Callidium annulare* Fabricius, 1787]

Subgenus *Chlorophorus* Chevrolat, 1863

[Type sp.: *Callidium annulare* Fabricius, 1787]

Chlorophorus varius (Müller, 1766)
(*CFP, DP)

Records in Turkey: (AD-ADY-AK-AM-AN-ANT-ART-AY-BI-BL-BO-BR-BU-CA-CN-DE-DU-ER-ES-EZ-GU-HA-HT-IC-IG-IP-IS-IZ-KA-KI-KIR-KK-KM-KN-KO-KR-KS-KY-MA-MG-MN-MR-MU-NE-NI-OS-SU-TB-TO-TU-US-ZO-VA-TRA-TUR)
Records in South-Eastern Anatolian Region: Şanlıurfa prov., Mardin prov. (Lodos, 1998); Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Şanlıurfa prov.: Ceylanpınar (Özdikmen et al., 2005); Gaziantep prov.: Nurdağı (plateau of Kazdere village), Islahiye (Esenli village) (Özdikmen & Demirel, 2005); Adıyaman prov.: Nemrut Mt. (Malmusi & Saltini, 2005).
Remarks: It belongs to the subspecies *C. varius damascenes*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Palearctic.

Subgenus *Crassofasciatus* Özdikmen, 2011

[Type sp.: *Callidium trifasciatus* Fabricius, 1781]

Chlorophorus hungaricus Seidlitz, 1891
(*CFP)

Records in Turkey: (AD-AN-BO-BR-GA-IC-KA-KN-KO-KR-KS-NI-OS-SV-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Kuşçubeli pass (Özdikmen & Demirel, 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European (Ponto-Pannonian).

Subgenus *Perderomaculatus* Özdikmen, 2011

[Type sp.: *Cerambyx sartor* Müller, 1766]

Chlorophorus sartor (Müller, 1766)
(*CFP)

Records in Turkey: (AD-AM-AN-ANT-ART-AY-BI-BL-BO-BR-BS-BU-CA-CN-DE-DU-EL-ES-EZ-GA-GU-HT-IC-IP-IS-IZ-KA-KI-KK-KN-KR-KS-KY-MG-MN-OS-RI-SM-SN-TE-TO-YO-TRA-TUR)

Records in South-Eastern Anatolian Region: Gaziantep prov.: Fevzipaşa (Sama, 1982); Gaziantep prov.: Nurdağı (plateau of Kazdere village) (Özdikmen & Demirel, 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European.

Pseudosphegesthes **Reitter, 1913**

[Type sp.: *Clytus cinereus* Laporte De Castelnau & Gory, 1836]

Pseudosphegesthes longitarsus **Holzschuh, 1974**
(*CFP)

Records in Turkey: (ADY-ANT-IP-MU-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

Clytus **Laicharting, 1784**

[Type sp.: *Leptura arietis* Linnaeus, 1758]

Clytus rhamni **Germar, 1817**
(*CFP)

Records in Turkey: (AD-ADY-AM-AN-ANT-ART-BI-BO-BS-BT-BY-CA-CN-DU-EL-GA-GU-HT-IC-IP-IS-IZ-KA-KK-KN-KO-KR-KS-KY-MA-OS-RI-SM-SN-SV-TO-TU-YA-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Fevzipaşa as *C.rhamni temesiensis* (Sama, 1982); Adıyaman prov.: Karadut village env. as *C. rhamni temesiensis* (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: European.

Subfamily STENOPTERINAE

Tribe STENOPTERINI

Stenopterus **Illiger, 1804**

[Type sp.: *Necydalis rufa* Linnaeus, 1767]

Stenopterus kraatzi **Pic, 1892**
(*CFP)

Records in Turkey: (AD-ADY-ANT-BL-HT-IC-IZ-KS-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Anatolian.

Stenopterus rufus **(Linnaeus, 1767)**
(*CFP)

Records in Turkey: (ADY-AM-AN-ANT-ART-BI-BO-BR-BS-CA-CN-CO-DU-EZ-GA-GU-HT-IC-IS-IZ-KA-KI-KK-KN-KO-KR-KS-KY-MN-MU-NI-OR-OS-RI-SM-SN-TB-TO-TU-YA-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Fevzipaşa (Sama, 1982); Adıyaman prov.: Karadut village as *S. rufus syriacus* Pic, 1892 (Rejzek & Hoskovec, 1999).

Remarks: It belongs to the subspecies *S. rufus syriacus*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European.

Tribe HYBODERINI

Callimus Mulsant, 1846

[Type sp.: *Callimus bourdini* Mulsant, 1846
= *Saperda angulata* Schrank, 1789]

Subgenus *Callimus* Mulsant, 1846

[Type sp.: *Callimus bourdini* Mulsant, 1846
= *Saperda angulata* Schrank, 1789]

Callimus angulatus (Schrank, 1789)
(*CFP)

Records in Turkey: (ADY-ANT-BO-HT-IC-IS-KK-OR-SM-TO-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Malmusi & Saltini, 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Europeo-Mediterranean.

Subgenus *Lampropterus* Mulsant, 1862

[Type sp.: *Necydalis femoratus* Germar, 1824]

Callimus femoratus (Germar, 1824)
(*CFP, DP)

Records in Turkey: (AD-ADY-AM-AN-ANT-ART-BL-BN-BS-BT-BU-CA-DI-ED-EL-EZ-GA-HA-HT-IC-IS-IZ-KA-KI-KK-KN-MA-MG-MN-MR-MU-NI-OS-TO-TU-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Diyarbakır prov.: Silvan (Tozlu et al., 2002); Gaziantep prov.: Nurdağı (plateau of Kazdere village) (Özdikmen & Demirel, 2005); Mardin prov.: Hop pass (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-E-Mediterranean).

Subfamily DORCADIONINAE

Tribe DORCADIINI

Dorcadion Dalman, 1817

[Type sp.: *Cerambyx glycyrrhizae* Pallas, 1773]

Subgenus *Cribridorcadion* Pic, 1901

[Type sp.: *Dorcadion mniszechi* Kraatz, 1873]

Dorcadion accola Heyden, 1894
(*DP)

Other names: *mardinense* Pic, 1900; *glabrolineatum* Pic, 1927.
Records in Turkey: (DI-MR-TUR)
Mardin prov. (Heyden, 1894); Turkey (Winkler, 1924-1932; Lodos, 1998); Mardin prov. as *D. accola* a. *mardinense* Pic, 1900 (Winkler, 1924-1932); Mardin prov. (Breuning, 1962); Diyarbakır prov.: Karacadağ (Braun, 1978); Mardin prov. (Önalp, 1990); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Turkey.

Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey.
Chorotype: Anatolian.

Dorcadion albolineatum Küster, 1847
(*DP)

Records in Turkey: (BI-DI-IS-KO-TRA-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. (Tuatay et al., 1972); Diyarbakır prov. (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: Anatolian.

Dorcadion carinipenne Pic, 1900
(*CFP)

Records in Turkey: (GA-HT-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Breuning, 1962).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

Dorcadion cingulatum Ganglbauer, 1884
(*DP)

Other names: *invicinum* Pic, 1902; *persianum* Breuning, 1943; *nigrobivittatum* Breuning, 1946; *clarocaudatum* Plavilstshikov, 1958; *superobscuratum* Plavilstshikov, 1958.
Records in Turkey: (DI-TUR)
Diyarbakır prov. (Aurivillius, 1921); Diyarbakır prov. as *D. invicinum* (Aurivillius, 1921; Breuning, 1962); Turkey (Winkler, 1924-1932; Lodos, 1998); Turkey as *D. invicinum* (Lodos, 1998); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Iran, Turkey.
Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The species has been known only from SE Turkey.
Chorotype: SW-Asiatic (Irano-Anatolian).

Dorcadion confluens Fairmaire, 1866
(*DP)

Other names: *subobscuripes* Pic, 1914.
Records in Turkey: (DI-IZ-TUR)
İzmir prov.: Bozdağ (Fairmaire, 1866; Aurivillius, 1921; Pesarini & Sabbadini, 1998); Diyarbakır prov. as *D. divisum* v. *confluens* (Ganglbauer, 1884); İzmir prov.: Bozdağ, Diyarbakır prov. as *D. divisum* v. *confluens* (Aurivillius, 1921); Anatolia as *D. divisum* v. *confluens* Fairmaire, 1866 (Winkler, 1924-1932); Turkey as *D. subobscuripes* Pic, 1914 (Winkler, 1924-1932; Lodos, 1998); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). This species is endemic to Turkey. It probably is distributed from W to SE Turkey. This species was described by Fairmaire (1866) as a separate species. Then it was regarded by some authors (e.g. Breuning, 1962) as a morpha of *D. divisum*. Finally, it was accepted by Pesarini & Sabbadini (1998) as a distinct species again.
Chorotype: Anatolian.

Dorcadion delagrangei Pic, 1894
(*CFP)

Records in Turkey: (GA-HT-KL-OS-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. as *D. accola* (Breuning, 1962).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

Dorcadion divisum Germar, 1839
(*CFP, DP)

Records in Turkey: (AD-ADY-AN-BL-BS-BU-CA-DI-ES-IC-IP-IZ-KN-MN-MR-NI-OS-SV- TRA-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. as *D. divisum* v. *intercisum* (Aurivillius, 1921); Diyarbakır prov. as *D. divisum* v. *intercisum* Kraatz, 1873 (Winkler, 1924-1932); Mardin prov.: Ahreski pass, Adıyaman prov.: Börgenek as *D. divisum* m. *intercisum* (Braun, 1978).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Dorcadion formosum Kraatz, 1870
(*CFP)

Records in Turkey: (GA-GI-TO-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Breuning, 1962).
Remarks: It probably belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic (Syro-Anatolian) (see Özdikmen, 2010).

Dorcadion halepense (Kraatz, 1873)
(*CFP)

Records in Turkey: (GA-HT-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Breuning, 1962); Gaziantep prov.: Sakçagözü (Braun, 1978); Gaziantep prov.: Toros Mountains (Önalp, 1990).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region. The subspecies, *D. halepense sehitkamilense*, was described by Özdikmen et al, 2012 from Gaziantep prov.: Şehitkamil and Kilis prov.: Kesmelik district. So the records of South-Eastern Anatolian Region belongs to the subspecies, *D. halepense sehitkamilense*.
Chorotype: SW-Asiatic (Syro-Anatolian).

Dorcadion hellmanni Ganglbauer, 1884
(*DP)

Other names: *ingens* Breuning, 1946; *postjunctum* Breuning, 1946; *chrysum* Plavilstshikov, 1958.
Records in Turkey: (HA-MR-MU-TU-VA-TUR)
NE Turkey (Plavilstshikov, 1958); Van prov.: Gürpınar, Hakkari prov.: Bajirgi (Fuchs et Breuning, 1971 ex Holzschuh, 1980); Turkey (Lodos, 1998); Anatolia (Danilevsky in Löbl & Smetana, 2010); Mardin prov.: Hop pass, Tunceli prov.: 15 km west of Ovacık, Muş prov.: Buğlan pass (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Armenia, Iran, Turkey.
Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The species has been known only from SE Turkey.

Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Dorcadion infernale Mulsant & Rey, 1863
(*DP)

Records in Turkey: (AM-AN-ANT-BI-BU-CO-DI-ES-IC-IZ-KA-KN-NI-SV-US-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. as *D. infernale asperatum* (Breuning, 1962).
Remarks: It belongs to the subspecies *D. infernale asperatum*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Anatolian.

Dorcadion kurdistanum Breuning, 1944
(*CFP, DP)

Other names: *rufulipes* Breuning, 1963.
Records in Turkey: (ADY-BN-DI-TUR)
Type loc.: Turkey: Diyarbakır prov. (Breuning, 1962); Bingöl prov. as *D. kurdistanum rufulipes* (Fuchs & Breuning, 1971); Anatolia (Danilevsky in Löbl & Smetana, 2010); Adıyaman prov.: Nemrut Mt. (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Turkey.
Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey. *D. kurdistanum* m. *rufulipes* Breuning, 1963 was given by Fuchs & Breuning (1971) as an eastern subspecies of this species. However, the taxonomic status of the taxon needs to be clarified.
Chorotype: Anatolian.

Dorcadion mesopotamicum Breuning, 1944
(*CFP, DP)

Other names: *submardinense* Breuning, 1946.
Records in Turkey: (MR-SU-TUR)
Mardin prov. as *D.* (*P.*) *mesopotamicum* m. *submardinense* Breuning, 1946 (Breuning, 1962); Şanlıurfa prov.: Siverek (Braun, 1978); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported only from Central Fırat Part and Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey.
Chorotype: Anatolian.

Dorcadion micans Thomson, 1867
(*CFP)

Records in Turkey: (AM-AN-BS-CA-CO-IC-IZ-KM-SV-SU-TO-YO-TUR)
Records in South-Eastern Anatolian Region: Şanlıurfa prov. as *D. sericatum micans* (Gül & Zümreoğlu, 1972).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

Dorcadion obtusum Breuning, 1944
(*CFP, DP)

ssp. *obtusum* Breuning, 1944
ssp. *marashense* Breuning, 1948

Other names: Absent.
Records in Turkey: (ADY-DI-HA-VA)

Kahramanmaraş prov. as the type locality of *D. obtusum marashense* (Breuning, 1962); Hakkari prov.: Bajirgi, Van prov.: Gürpınar (Fuchs et Breuning, 1971); Diyarbakır prov. (Braun, 1978); Adıyaman prov.: Nemrut Mt. (Narince) (Rejzek & Hoskovec, 1999); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported only from Central Fırat Part and Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey. It has two subspecies. *D. obtusum marashense* Breuning, 1948 is western subspecies. This species is endemic to SE Turkey.
Chorotype: Anatolian.

***Dorcadion oezdurali* Önalp, 1988**
(*CFP)

Records in Turkey: (ADY-KA)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

***Dorcadion punctulicolle* Breuning, 1944**
(*DP)

Other names: *submardinense* Breuning, 1946.
Records in Turkey: (DI-TUR)
Diyarbakır prov. (Breuning, 1962); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey.
Chorotype: Anatolian.

***Dorcadion saulcyi* Thomson, 1865**
(*CFP)

Records in Turkey: (AD-GA-HT-IC-MA-OS-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Islahiye (Özdikmen et al., 2005).
Remarks: It probably belongs to the subspecies *D. saulcyi javeti*. Since, İslahiye is in East of Gaziantep prov. (near Amanos Mts.). It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

***Dorcadion schultzei* Heyden, 1894**
(*DP)

Other names: Absent.
Records in Turkey: (MR-TUR)
Type loc.: Turkey: Mardin prov. (Heyden, 1894); Turkey (Aurivillius, 1921; Winkler, 1924-1932; Lodos, 1998); Mardin prov. (Breuning, 1962); Mardin prov.: Mazıdağı (Braun, 1978); Anatolia (Danilevsky in Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported only from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey.
Chorotype: Anatolian.

Dorcadion septemlineatum Waltl, 1838
(*CFP)

Records in Turkey: (AF-AN-BI-BL-BO-BS-BU-CA-ES-GA-IP-IS-KN-KO-KR-KU-SA-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Islahiye (Özdikmen et al., 2005).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Dorcadion sturmii Frivaldsky, 1837
(*DP)

Records in Turkey: (DI-ED-TRA-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. (Önalp, 1990).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region. This species is distributed mostly in European Turkey for Turkey. The Diyarbakır (SE Turkey) record of Önalp (1990) needs to be confirmed.
Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Dorcadion variegatum Ganglbauer, 1884
(*CFP)

Records in Turkey: (GA-KA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. (Breuning, 1962).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Syro-Anatolian).

Subfamily LAMIINAE

Tribe SAPERDINI

Saperda Fabricius, 1775
[Type sp.: *Cerambyx carcharias* Linnaeus, 1758]

Subgenus *Compsidia* Mulsant, 1839
[Type sp.: *Cerambyx populneus* Linnaeus, 1758]

Saperda quercus Charpentier, 1825
(*CFP)

Records in Turkey: (AD-ADY-ANT-HT-IC-KA-OS-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. as *S. quercus ocellata* (Rejzek & Hoskovec, 1999).
Remarks: It belongs to the subspecies *S. quercus ocellata*. It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: E-Mediterranean or Turano-Mediterranean (Balkano-Anatolian) + E-Mediterranean (Palaestino-Taurian).

Tribe PHYTOECIINI

Oberea Dejean, 1835
[Type sp.: *Cerambyx linearis* Linnaeus, 1760]

Subgenus *Oberea* Dejean, 1835
[Type sp.: *Cerambyx linearis* Linnaeus, 1760]

Oberea oculata (Linnaeus, 1758)
(*CFP)

Records in Turkey: (AD-ADY-AN-ANT-DE-EZ-HT-IC-IP-IZ-KA-KN-KO-MG-NI-TU-TRA-TUR)
Records in South-Eastern Anatolian Region: Şanlıurfa prov. (Çanakçıoğlu, 1993; Çanakçıoğlu & Mol, 1998); Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Palaearctic.

Oxylia Mulsant, 1862
[Type sp.: *Phytoecia languida* Ménétriés, 1839]

Oxylia argentata (Ménétriés, 1832)
(*CFP, DP)

Records in Turkey: (ADY-AG-AN-ANT-ART-BN-BT-BY-CO-DI-EL-ER-EZ-GI-GU-HT-IC-IP-IZ-KA-KAR-KI-KN-KS-NI-SI-SN-TU-YO-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Diyarbakır prov.: Silvan (Tozlu et al., 2003); Siirt prov.: Central as *O. argentata languida* (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region. It probably belongs to the subspecies *O. argentata languida*. However, subspecific status needs to be cleared.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Pteromallosia Pic, 1900
[Type sp.: *Phytoecia albolineata* Hampe, 1852]

Pteromallosia albolineata (Hampe, 1852)
(*CFP)

Other names: *fulvolineata* Reitter, 1891.
Records in Turkey: (ADY-BT-EZ-MU-VA-TUR)
Van prov.: Erciş (Sama, 1982); Bitlis-Van prov.: Kuzgunkıran pass (Adlbauer, 1992); Turkey (Lodos, 1998); Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Karadut env.), Erzurum prov.: Köprüköy-Söylemez (50 km SE Erzurum), Muş prov.: Buğlan pass (40 km NW Muş) (Rejzek et al., 2001); Erzurum prov. (Tozlu et al., 2003).
Distribution: Turkey, Iran, Caucasus (Armenia, Azerbaijan, Georgia).
Remarks: It has been reported only from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The species has been known only from SE and E Turkey.
Chorotype: SW-Asiatic.

Mallosia Mulsant, 1862
[Type sp.: *Saperda graeca* Sturm, 1843]

Subgenus *Eumallosia* Danilevsky, 1990
[Type sp.: *Mallosia herminae* Reitter, 1890]

Mallosia imperatrix Abeille de Perrin, 1885
(*CFP)

Records in Turkey: (ADY-BN-BT-EZ-HA-OS-VA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Nemrut Mt.) as ssp. *tauricola* Daniel, 1904 (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.

Chorotype: SW-Asiatic (Irano-Anatolian).

Micromallosia Pic, 1900

[Type sp.: *Micromallosia theresae* Pic, 1900]

Micromallosia heydeni (Ganglbauer, 1888)
(*CFP)

Other names: Absent.
Records in Turkey: (ADY-MA-TUR)
Malatya prov. as *Phytoecia* (*Coptosia*) *heydeni* (Ganglbauer, 1888); Kurdistan (Winkler, 1924-1932); Turkey (Lodos, 1998); Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Turkey (Sama & Löbl in Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported only from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SCE Turkey.
Chorotype: Anatolian.

Coptosia Fairmaire, 1864

[Type sp.: *Phytoecia languida* Fairmaire, 1864
= *Phytoecia albovittigera* Heyden, 1863]

Subgenus *Coptosia* Fairmaire, 1864

[Type sp.: *Phytoecia languida* Fairmaire, 1864
= *Phytoecia albovittigera* Heyden, 1863]

Coptosia albovittigera (Heyden, 1863)
(*CFP)

Records in Turkey: (ADY-AN-BI-MA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov. Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Coptosia bithynensis (Ganglbauer, 1884)
(*CFP, DP)

Records in Turkey: (AD-ADY-ANT-BI-BS-BT-DI-EL-ER-EZ-HT-IC-IP-IZ-KN-MU-OS-SV-TU-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Karadut env.) (Rejzek et al., 2001); Diyarbakır prov. (Tozlu et al., 2003).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-Balkan).

Coptosia compacta (Ménétriés, 1832)
(*CFP, DP)

Records in Turkey: (ADY-ANT-BT-EZ-KAR-MA-MU-SI-TO-VA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Karadut env.) (Rejzek et al., 2001); Siirt prov. as *C. sancta* (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region. According to Sama & Löbl in Löbl & Smetana (2010), *C. sancta* Reiche, 1877 is a subspecies of *C. compacta*. So, this species is represented by two subspecies in Turkey as *C. compacta*

compacta Ménétriés, 1832 (Caucasus, NE Turkey, Iran) and *C. compacta sancta* Reiche, 1877 (Middle East and SE Turkey).
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

***Coptosia ganglbaueri* Pic, 1936**
(*CFP)

Records in Turkey: (ADY-HA-MA-OS-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: E-Mediterranean (Palaestino-Taurian).

***Coptosia minuta* (Pic, 1891)**
(*DP)

Other names: *mardinensis* Pic, 1901; *kurda* Jakobson, 1924.
Records in Turkey: (HT-MR-TUR)
Type loc.: Hatay prov.: Akbez not Syria (Pic, 1891); Kurdistan as *C. mardinensis* (Aurivillius, 1921); Mardin prov. as *C. kurda mardinensis* (Winkler, 1924-1932); Turkey (Lodos, 1998; Löbl & Smetana, 2010).
Distribution: Turkey.
Remarks: It has been reported from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).The endemic species has been known only from S and SE Turkey.
Chorotype: Anatolian.

***Pygoptosia* Reitter, 1895**
[Type sp.: *Phytoecia speciosa* Frivaldszky, 1884]

***Pygoptosia speciosa* (Frivaldszky, 1884)**
(*CFP, DP)

Records in Turkey: (ADY-DI-KA-MR-SU-TUR)
Records in South-Eastern Anatolian Region: Type loc.: Diyarbakır prov. (Frivaldszky, 1884); Adıyaman prov.: Karadut village, Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Rejzek et al., 2001); Adıyaman prov.: Nemrut Mt., Mardin prov.: Hop pass (Çınaraltı village) (Rejzek et al., 2003); Şanlıurfa prov.: Halfeti env. (pers. comm. with J. Kurzawa, 2006).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic.

***Phytoecia* Dejean, 1835**
[Type sp.: *Cerambyx cylindricus* Linnaeus, 1758]

Subgenus *Pilemia* Fairmaire, 1864
[Type sp.: *Phytoecia tigrina* Mulsant, 1851]

***Phytoecia annulata* Hampe, 1862**
(*CFP)

Records in Turkey: (ADY-HT-KAR-OS-SV-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. as *P. annulata wawerkana* (Rejzek & Hoskovec, 1999).
Remarks: It belongs to the subspecies *P. annulata wawerkana*. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Phytoecia hirsutula (Frölich, 1793)
(*CFP)

Records in Turkey: (ADY-AF-ANT-BI-BY-EZ-HA-HT-IC-IP-IZ-KAR-KN-MU-OS-SK-TU-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-E-Mediterranean).

Subgenus *Cardoria* Mulsant, 1862
[Type sp.: *Saperda scutellata* Fabricius, 1792]

Phytoecia scutellata (Fabricius, 1792)
(*CFP)

Other names: *obscuricolor* Pic, 1952.
Records in Turkey: (ADY-AR-ES-EZ-KI-KN-KAR-TUR)
Eskişehir prov. (Bodemeyer, 1906); Asia Minor (Winkler, 1924-1932; Sama, 2002); Konya prov.: Akşehir (Demelt, 1963); Erzurum prov. and near (Özbek, 1978); Turkey (Danilevsky & Miroshnikov, 1985; Löbl & Smetana, 2010); Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Ardahan prov., Erzurum prov., Kars prov. (Tozlu et al., 2003); Kırıkkale prov.: Balışeyh-Sulakyurt road (25 km to Sulakyurt) (Özdikmen, Mercan & Tunç, 2012).
Distribution: C and E Europe, Turkey, Iran, Caucasus (Armenia, Azerbaijan, Georgia).
Remarks: It has been reported from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).
Chorotype: E-European.

Subgenus *Helladia* Fairmaire, 1864
[Type sp.: *Saperda flavescens* Brullé, 1832]

Phytoecia adelpha Ganglbauer, 1886
(*CFP, DP)

Records in Turkey: (AD-GA-HT-IC-MR-OS-SU-TUR)
Records in South-Eastern Anatolian Region: Şanlıurfa as *Helladia edessensis* v. *urfanensis* Reitter, 1898 (Reitter, 1898; Winkler, 1924-1932); Mardin prov.: Sultan (Fuchs et Breuning, 1971 ex Holzschuh, 1980); Gaziantep prov. as *P. orbicollis* Reiche et Saulcy, 1858 (Demelt, 1963 ex Öymen, 1987).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Syro-Anatolian).

Phytoecia alziari Sama, 1992
(*CFP, DP)

Records in Turkey: (ADY-ANT-HT-KA-MU-OS)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); South-East Anatolia (Sama & Rapuzzi, 2000).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region under the title *H. millefolii*.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Syro-Anatolian).

Phytoecia armeniaca Frivaldszky, 1878
(*CFP, DP)

Records in Turkey: (ADY-ANT-BT-DI-EZ-KA-KAR-KN-MA-MU-NI-TUR)

Records in South-Eastern Anatolian Region: Type loc.: Turkey: Diyarbakır prov. (Frivaldszky, 1878); Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); East Turkey (?Diyarbakır prov.) (Rejzek et al., 2001).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region. Moreover, it has two subspecies now as nominotypical subspecies and *Phytoecia* (*Helladia*) *armeniaca testaceovittata* (Pic, 1934). It is represented only by the nominotypical subspecies in S and E Turkey.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Phytoecia fatima Ganglbauer, 1884
(*CFP, DP)

Other names: Absent.
Records in Turkey: (BA-MR-SI-SU)
Mardin prov.: Hop pass, Batman prov.: Gercüş (Rejzek et al., 2003); Siirt prov. (Özdikmen et al., 2005); Mardin prov., Siirt prov., Şanlıurfa prov. as *Helladia pretiosa* (Sama et al., 2007); Mardin prov.: 6 km E of Arıçlı, Şırnak prov.: Meşindağı pass (Sama, Rapuzzi & Özdikmen, 2012).
Distribution: Caucasus (Azerbaijan), Iran, Turkey.
Remarks: It has been reported from Central Fırat Part and Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). This species probably is distributed only in eastern half of Anatolia (especially SE Anatolia) for Turkey. SE Anatolian records of Sama et al. (2007) and Sama et al. (2012) very likely belong to this species.
Chorotype: SW-Asiatic.

Phytoecia ferrugata Ganglbauer, 1884
(*DP)

Records in Turkey: (HT-MR-TUR)
Records in South-Eastern Anatolian Region: Mardin prov.: Sultan as - *houskai* Heyrovsky (Fuchs & Breuning, 1971).
Remarks: It belongs to the subspecies *P. ferrugata dilaticollis*. It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: E-Mediterranean (Palaestino-Taurian).

Phytoecia humeralis (Waltl, 1838)
(*CFP, DP)

Records in Turkey: (AD-ADY-AK-AM-AN-ANT-AY-BO-BU-DE-DI-ED-ES-GA-HA-HT-IC-IP-IZ-KA-KI-KN-KU-MA-MN-NI-OS-SI-US-YO-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Fevzipaşa (Adlbauer, 1988); Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Şanlıurfa prov.: Halfeti, Mardin prov.: Hop pass (Çınaraltı village) (Rejzek et. al., 2003(2002)); Diyarbakır prov.: Silvan (Tozlu et al., 2003); Gaziantep prov.: Akbez (Gülpınarı plateau), Fevzipaşa–Islahiye road (Ozdikmen, Güven & Gören, 2010); Siirt: 7 km SE Eruh, 1400 m, 16.V.2011 (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It probably belongs to the subspecies *P. humeralis caneri* (Amanos Mts. and near) and the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic or E-Mediterranean.

Phytoecia imperialis (Sama & Rejzek, 2001)
(*DP)

Other names: Absent.
Records in Turkey: (BA-MR)
Batman prov.: Gercüş (Alanyurt E Gercüş), Mardin prov.: Hop pass (Çınalaltı village) (Rejzek et. all., 2003(2002)).

Distribution: Turkey, Iran.
Remarks: It has been reported from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*).
Chorotype: SW-Asiatic.

Subgenus *Musaria* Thomson, 1864

[Type sp.: *Leptura affinis* Harrer, 1784]

Phytoecia astarte Ganglbauer, 1886

(*CFP)

Records in Turkey: (AD-ADY-AG-ANT-HA-IC-KAR-NI-OS-TU-VA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Karadut env.) (Rejzek et al., 2001).
Remarks: It belongs to the subspecies *P. astarte lederi.* It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Phytoecia puncticollis Faldermann, 1837

(*DP)

Records in Turkey: (BN-BT-DI-ER-EZ-HA-MA-VA-TU-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. (Tozlu et al., 2003).
Remarks: It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic.

Phytoecia wachanrui Mulsant, 1851

(*CFP, DP)

Records in Turkey: (ANT-BI-GA-KA-KN-MR-OS-TRA-TUR-YO)
Records in South-Eastern Anatolian Region: Mardin prov. as *M. waschanrui* a. *mardinensis* Heyden, 1894 (Winkler, 1924-1932); Gaziantep prov.: Islahiye – Demelt, 1963 (Ex. Öymen, 1987).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: SW-Asiatic or E-Mediterranean.

Subgenus *Neomusaria* Plavilstshikov, 1928

[Type sp.: *Saperda balcanica* Frivaldszky, 1835]

Phytoecia balcanica (Frivaldsky, 1835)

(*DP)

Records in Turkey: (AM-AN-HA-KR-KS-MR-TU-TRA-TUR)
Records in South-Eastern Anatolian Region: Mardin prov. (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Phytoecia merkli Ganglbauer, 1884

(*CFP)

Records in Turkey: (AD-ADY-AM-AN-ES-IC-KN-NI-OS-TU-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Karadut env.) (Rejzek et al., 2001).
Remarks: It was treated in detail in Part II in the section dealing with the Marmara Region.
Chorotype: SW-Asiatic.

Subgenus *Phytoecia* Dejean, 1835

[Type sp.: *Cerambyx cylindricus* Linnaeus, 1758]

Phytoecia bangi Pic, 1897

(*DP)

Records in Turkey: (IC-KY-MR-NI-OS-TUR)
Records in South-Eastern Anatolian Region: Mardin prov. as the type loc. (Pic, 1897; ex Holzschuh, 1975).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Irano-Anatolian).

Phytoecia caerulea (Scopoli, 1772)

(*CFP)

Records in Turkey: (AD-AF-AK-AN-ANT-AY-BI-BO-BU-DE-DU-ES-EZ-GA-HT-IC-IP-IS-IZ-KA-KI-KM-KN-KR-KS-KU-KY-MG-MN-NE-NI-OS-SM-SV-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Nurdağı (Exit of İslahiye) (Ozdikmen, Güven & Gören, 2010).
Remarks: It probably belongs to the *P. caerulea baccueti.* It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European.

Phytoecia croceipes Reiche & Saulcy, 1858

(*DP)

Records in Turkey: (AD-DI-HT-IC-IZ-KN-MR-NI-OS-TU-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov.: Lice (Özdikmen et al., 2005); Mardin prov.: 6 km east of Arıçlı (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It was treated in detail in Part III in the section dealing with the Aegean Region.
Chorotype: SW-Asiatic (Irano-Anatolian + Syro-Anatolian).

Phytoecia geniculata Mulsant, 1862

(*CFP, DP)

Records in Turkey: (AD-AN-ANT-AY-BI-BS-BU-DE-ED-GA-HT-IC-IS-IZ-KA-KI-KS-MN-OS-SI-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov. – Demelt, 1963 (Ex. Gül-Zümreoğlu, 1975); Gaziantep prov.: Akbez (Gülpınarı plateau) (Ozdikmen, Güven & Gören, 2010); Siirt prov.: 10 km N Meşindağı pass (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-Balkan).

Phytoecia icterica (Schaller, 1783)

(*CFP)

Records in Turkey: (AF-AN-ANT-BO-BT-BY-CO-DU-EZ-GA-HT-IS-KA-KAR-KL-KN-KS-KU-OS-YO-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Nurdağı (Exit of İslahiye), Islahiye (Ozdikmen, Güven & Gören, 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region. Moreover, According to Sama & Löbl in Löbl & Smetana (2010), *P. annulipes* is a separate species.
Chorotype: European or Turano-European.

Phytoecia manicata Reiche & Saulcy, 1858
(*DP)

Records in Turkey: (AD-DI-HT-IP-IZ-KA-KI-KN-OS-SI-TUR)
Records in South-Eastern Anatolian Region: Siirt prov.: Tillo, Diyarbakır prov.: Lice (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part III in the section dealing with the Aegean Region.
Chorotype: E-Mediterranean (Palaestino-Taurian) + Turano-Mediterranean (Balkano-Anatolian).

Phytoecia pubescens Pic, 1895
(*DP)

Records in Turkey: (AD-AM-AN-BO-DI-EZ-HT-IC-IS-KO-TUR)
Records in South-Eastern Anatolian Region: Diyarbakır prov. (Tozlu et al., 2003).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean (Turano-E-Mediterranean).

Phytoecia rufipes (Olivier, 1795)
(*CFP)

Records in Turkey: (AD-ADY-AK-HT-IC-KA-KI-MA-NI-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village (Rejzek & Hoskovec, 1999).
Remarks: It probably belongs to the *P. rufipes latior*. It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Sibero-European or Turano-European.

Phytoecia virgula (Charpentier, 1825)
(*CFP)

Records in Turkey: (AD-ADY-AK-AM-AN-BI-BN-BO-BR-BU-BY-DE-ER-ES-EZ-GU-HT-IP-IS-IZ-KA-KAR-KI-KN-KR-KS-KU-MN-NE-NI-OS-SM-TU-VA-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Kahta (Öymen, 1987).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European.

Subgenus *Opsilia* Mulsant, 1862
[Type sp.: *Opsilia flavicans* Mulsant, 1862
= *Leptura coerulescens* Scopoli, 1763]

Phytoecia coerulescens (Scopoli, 1763)
(*CFP, DP)

Records in Turkey: (AD-ADY-AK-AM-AN-ANT-AR-ART-AY-BO-BS-BU-BY-CN-CO-DE-DI-DU-ER-ES-EZ-GA-GU-IC-IP-IS-IZ-KA-KAR-KI-KIR-KK-KM-KN-KS-KU-KY-MA-MG-MN-NE-NI-OS-SM-SN-SV-TB-TU-YO-ZO-TRA-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999); Diyarbakır prov.: Silvan (Tozlu et al., 2003); Gaziantep prov.: Islahiye (Yağızlar village, Altınüzüm), Nurdağı (Belpınar village) (Özdikmen & Demirel, 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Palaearctic.

Subgenus *Blepisanis* Pascoe, 1866

[Type sp.: *Saperda bohemani* Pascoe, 1858]

Phytoecia vittipennis Reiche, 1877

(*CFP)

Records in Turkey: (AD-ADY-AN-ANT-BU-DE-ER-EZ-IZ-KA-KN-MN-NI-OS-YO-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Karadut village env. (Rejzek & Hoskovec, 1999).
Remarks: It has 5 subspecies now (Özdikmen, 2012). It belongs to the nominotypical subspecies. It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Mediterranean.

Phytoecia volkovitshi Danilevsky, 2010

(*CFP)

Other names: Absent.
Records in Turkey: (SU)
Şanlıurfa prov.: near Birecik as the type loc. (Danilevsky, 2010).
Distribution: Turkey.
Remarks: It has been reported from Central Fırat Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from the type locality.
Chorotype: Anatolian.

Tribe AGAPANTHIINI

Calamobius Guérin-Méneville, 1847

[Type sp.: *Saperda gracilis* Creutzer, 1799
= *Saperda filum* Rossi, 1790]

Calamobius filum (Rossi, 1790)

(*CFP)

Records in Turkey: (AD-AN-ANT-BO-BS-BU-CA-GA-HT-IC-IP-IS-IZ-KA-KL-KN-KO-MG-MN-OS-SA-TU-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Nurdağı (entry of Karaburçlu village) (Özdikmen & Demirel, 2005); Şanlıurfa prov.: Halfeti (pers. comm. with J. Kurzawa, 2006); Gaziantep prov.: Akbez (Gülpınarı plateau), Fevzipaşa-Islahiye road 1st km, Kilis- Gaziantep road (Oğuzeli return) (Ozdikmen, Güven & Gören, 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-Europeo-Mediterranean.

Agapanthia Audinet-Serville, 1835

[Type sp.: *Cerambyx cardui* Linnaeus, 1767]

Subgenus *Synthapsia* Pesarini & Sabbadini, 2004

[Type sp.: *Saperda kirbyi* Gyllenhal, 1817]

Agapanthia kirbyi (Gyllenhal, 1817)

(*DP)

Records in Turkey: (AD-AF-AK-AM-AN-ANT-BI-BN-BO-BS-BT-BU-CO-ED-ER-ES-EZ-HT-IC-IP-IZ-KA-KAR-KI-KIR-KN-KO-KY-MN-NI-OS-SI-TO-TU-VA-TRA-TUR)
Records in South-Eastern Anatolian Region: Siirt prov. (Özdikmen et al., 2005).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Turano-European.

Subgenus *Epoptes* Gistel, 1857

[Type sp.: *Lamia asphodeli* Latreille, 1804]

Agapanthia dahli (Richter, 1821)

(*CFP, DP)

Records in Turkey: (AD-AN-BO-BS-EZ-GA-GU-HT-OS-SI-TUR)
Records in South-Eastern Anatolian Region: Siirt prov. (Özdikmen et al., 2005); Gaziantep prov.: Kuşçubeli pass (Özdikmen & Demirel, 2005); Gaziantep prov.: Nurdağı (Exit of İslahiye 5th km) (Ozdikmen, Güven & Gören, 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Sibero-European or Turano-European.

Agapanthia lateralis Ganglbauer, 1884

(*CFP)

Records in Turkey: (AF-AG-AK-AM-AN-ANT-BI-BO-CA-CN-CO-ED-ER-ES-GA-HT-IC-IP-IS-IZ-KA-KI-KM-KN-KR-KS-KU-MG-MN-NE-NI-OS-SV-TE-TO-ZO-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Nurdağı-Islahiye (Ozdikmen, Güven & Gören, 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Anatolian.

Agapanthia simplicicornis Reitter, 1898

(*DP)

Other names: Absent.
Records in Turkey: (ER-HA-MR-MU-TU-TUR)
Anatolia: Mardin prov. as the type loc. (Reitter, 1898); Asia Minor (Winkler, 1924-1932); Hakkari prov.: Yüksekova - Fuchs et Breuning, 1971 (Ex. Holzschuh, 1980); Turkey (Lodos, 1998; Sama & Rapuzzi, 2000); Muş prov.: Buğlan pass (Rejzek et. al., 2003 (2002)).
Distribution: Turkey.
Remarks: It has been reported from Dicle Part of South-Eastern Anatolian Region as connected with the geological area covered by the present work (*). The endemic species has been known only from SE Turkey.
Chorotype: Anatolian.

Agapanthia verecunda Chevrolat, 1882

(*DP)

Records in Turkey: (BT-HT-KN-MG-MR-TUR)
Records in South-Eastern Anatolian Region: Mardin prov.: Taurus (Önalp, 1989).
Distribution: Turkey.
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: Anatolian.

Agapanthia walteri Reitter, 1898

(*DP)

Records in Turkey: (AM-BN-EZ-HA-HT-KAR-MR-TU-TUR)
Records in South-Eastern Anatolian Region: Turkey: Erzurum prov. and Mardin prov. as the type loc. (Reitter, 1898); Batman prov.: Alanyurt E Gerçüş (Rejzek et. al., 2003(2002)).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: SW-Asiatic (Anatolo-Caucasian + Irano-Caucasian + Irano-Anatolian).

Subgenus *Agapanthoplia* Pesarini et Sabadini, 2004

[Type sp.: *Agapanthia coeruleipennis* Frivaldszky, 1878]

Agapanthia coeruleipennis Frivaldszky, 1878
(*CFP, DP)

Records in Turkey: (ADY-ANT-BN-BT-EZ-HA-HT-IC-IP-KA-KY-MA-MR-MU-SU-TU-TUR)
Records in South-Eastern Anatolian Region: Adıyaman prov.: Nemrut Mt. (Rejzek & Hoskovec, 1999); Adıyaman prov.: Nemrut Mt. (Rejzek et al., 2001); Mardin prov. (Özdikmen et al., 2005); Şanlıurfa prov.: Dutluca (Sama, Rapuzzi & Özdikmen, 2012).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: SW-Asiatic (Irano-Anatolian + Syro-Anatolian).

Subgenus *Agapanthia* Audinet-Serville, 1835

[Type sp.: *Cerambyx cardui* Linnaeus, 1767]

Agapanthia suturalis (Fabricius, 1787)
(*CFP, DP)

Records in Turkey: (AD-AN-ANT-ART-AY-BI-BN-BS-BU-BY-CA-CN-DE-DI-ED-EL-ER-ES-EZ-GA-GU-HA-HT-IC-IS-IZ-KA-KAR-KI-KIR-KK-KL-KN-KO-KS-MA-MG-MN-OS-RI-SI-SV-TU-TRA-TUR)
Records in South-Eastern Anatolian Region: Siirt prov. as *A. cardui* (Gül-Zümreoğlu, 1975); Diyarbakır prov. (Tozlu et al., 2003); Gaziantep prov.: Kilis-Gaziantep road (Oğuzeli return), Fevzipaşa-Islahiye road 1st km (Ozdikmen, Güven & Gören, 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region
Chorotype: Mediterranean.

Subgenus *Smaragdula* Pesarini & Sabbadini, 2004

[Type sp.: *Saperda violacea* Fabricius, 1775]

Agapanthia lais Reiche & Saulcy, 1858
(*DP)

Records in Turkey: (HT-KA-MR-OS-TUR)
Records in South-Eastern Anatolian Region: Mardin prov. (Önalp, 1988).
Remarks: It was treated in detail in Part IV in the section dealing with the Mediterranean Region.
Chorotype: E-Mediterranean (Palaestino-Taurian).

Agapanthia violacea (Fabricius, 1775)
(*CFP)

Records in Turkey: (AD-AF-AK-AN-BI-BO-BS-CO-DE-DU-ED-ER-EZ-GA-HT-IC-IP-IS-IZ-KA-KI-KIR-KK-KN-KO-KR-KS-KY-MG-MN-NE-NI-OS-SA-ZO-TRA-TUR)
Records in South-Eastern Anatolian Region: Gaziantep prov.: Kilis-Gaziantep road (Oğuzeli return) (Özdikmen et al., 2010).
Remarks: It was treated in detail in Part I in the section dealing with the Black Sea Region.
Chorotype: Sibero-European.

ZOOGEOGRAPHICAL REMARKS

The present zoogeographical characterization is based on the chorotype classification of Anatolian fauna, recently proposed by Vigna Taglianti et al. (1999). In this part, the taxons which have same chorotype(s) are arranged into a single paragraph. Chorotypes are given alphabetically.

The species that has the Cosmopolitan chorotype is *Phoracantha semipunctata* (Fabricius, 1775).

The species that has the E-European chorotype is *Phytoecia scutellata* (Fabricius, 1792).

The species that have the E-Mediterranean chorotype are *Purpuricenus dalmatinus* Sturm, 1843; *Ropalopus ledereri* (Fairmaire, 1866); *Saperda quercus* Charpentier, 1825; *Coptosia ganglbaueri* Pic, 1936; *Phytoecia ferrugata* Ganglbauer, 1884; *Phytoecia manicata* Reiche & Saulcy, 1858 and *Agapanthia lais* Reiche & Saulcy, 1858.

The species that have the European chorotype are *Ropalopus clavipes* (Fabricius, 1775); *Clytus rhamni* Germar, 1817 and *Phytoecia icterica* (Schaller, 1783).

The species that has the Holarctic chorotype is *Phymatodes testaceus* (Linnaeus, 1758).

The species that have the Mediterranean chorotype are *Arhopalus syriacus* (Reitter, 1895); *Trichoferus griseus* (Fabricius, 1792) and *Agapanthia suturalis* (Fabricius, 1787).

The species that have the Palaearctic chorotype are *Aromia moschata* (Linnaeus, 1758); *Chlorophorus varius* (Müller, 1766); *Oberea oculata* (Linnaeus, 1758) and *Phytoecia coerulescens* (Scopoli, 1763).

The species that have the Sibero-European chorotype are *Pseudovadonia livida* (Fabricius, 1777); *Judolia erratica* (Dalman, 1817); *Stenurella bifasciata* (Müller, 1776); *Plagionus floralis* (Pallas, 1773); *Phytoecia rufipes* (Olivier, 1795); *Agapanthia dahli* (Richter, 1821) and *Agapanthia violacea* (Fabricius, 1775).

The species that has the Subcosmopolitan chorotype is *Stromatium unicolor* (Olivier, 1795).

The species that have the S-European chorotype are *Cerambyx miles* Bonelli, 1812 and *Cerambyx welensii* (Küster, 1846).

The species that have the SW-Asiatic chorotype are *Cortodera colchica* Reitter, 1890; *Cortodera syriaca* Pic, 1901; *Stictoleptura tripartita* (Heyden, 1889); *Pedostrangalia emmipoda* (Mulsant, 1863); *Trichoferus lunatus* (Szallies, 1994); *Purpuricenus apicalis* Pic, 1905; *Purpuricenus wachanrui* Levrat, 1858; *Osphranteria coerulescens* Redtenbacher, 1850; *Dorcadion cingulatum* Ganglbauer, 1884; *Dorcadion formosum* Kraatz, 1870; *Dorcadion halepense* (Kraatz, 1873); *Dorcadion hellmanni* Ganglbauer, 1884; *Dorcadion variegatum* Ganglbauer, 1884; *Oxylia argentata* (Ménétriés, 1832); *Pteromallosia albolineata* (Hampe, 1852); *Mallosia imperatrix* Abeille de Perrin, 1885; *Coptosia compacta* (Ménétriés, 1832); *Pygoptosia speciosa* (Frivaldszky, 1884); *Phytoecia annulata* Hampe, 1862; *Phytoecia adelpha* Ganglbauer, 1886; *Phytoecia alziari* Sama, 1992; *Phytoecia armeniaca* Frivaldszky, 1878; *Phytoecia fatima* Ganglbauer, 1884; *Phytoecia humeralis* (Waltl, 1838); *Phytoecia imperialis* (Sama & Rejzek, 2001); *Phytoecia astarte* Ganglbauer, 1886; *Phytoecia puncticollis* Faldermann, 1837; *Phytoecia wachanrui* Mulsant, 1851; *Phytoecia merkli* Ganglbauer, 1884; *Phytoecia bangi* Pic, 1897; *Phytoecia croceipes* Reiche & Saulcy, 1858; *Agapanthia walteri* Reitter, 1898 and *Agapanthia coeruleipennis* Frivaldszky, 1878.

The species that have the Turano-European chorotype are *Stictoleptura cordigera* (Füsslins, 1775); *Plagionotus bobelayei* (Brullé, 1832); *Chlorophorus hungaricus* Seidlitz, 1891; *Chlorophorus sartor* (Müller, 1766); *Stenopterus rufus* (Linnaeus, 1767); *Phytoecia caerulea* (Scopoli, 1772); *Phytoecia virgula* (Charpentier, 1825) and *Agapanthia kirbyi* (Gyllenhal, 1817).

The species that have the Turano-Europeo-Mediterranean chorotype are *Cerambyx cerdo* Linnaeus, 1758; *Purpuricenus budensis* (Götz, 1783); *Certallum ebulinum* (Linnaeus, 1767); *Callimus angulatus* (Schrank, 1789) and *Calamobius filum* (Rossi, 1790).

The species that have the Turano-Mediterranean chorotype are *Trichoferus fasciculatus* (Faldermann, 1837); *Cerambyx dux* (Faldermann, 1837); *Calchaenesthes oblongomaculata* (Guèrin, 1844); *Certallum thoracicum* Sharp, 1880; *Callimus femoratus* (Germar, 1824); *Dorcadion divisum* Germar, 1839; *Dorcadion septemlineatum* Waltl, 1838; *Dorcadion sturmii* Frivaldsky, 1837; *Coptosia albovittigera* (Heyden, 1863); *Coptosia bithynensis* (Ganglbauer, 1884); *Phytoecia hirsutula* (Frölich, 1793); *Phytoecia balcanica* (Frivaldsky, 1835); *Phytoecia geniculata* Mulsant, 1862; *Phytoecia pubescens* Pic, 1895 and *Phytoecia vittipennis* Reiche, 1877.

The species that has the Turano-Mediterranean + Turano-European chorotype is *Cerambyx nodulosus* Germar, 1817.

On the other hand, following 27 taxa are endemic to Turkey:

The species that have the Anatolian chorotype are *Vadonia instigmata* Pic, 1889; *Pedostrangalia kurda* Sama, 1996; *Trichoferus preissi* (Heyden, 1894); *Trichoferus samai* Kadlec & Rejzek, 2001; *Purpuricenus cornifrons* Sabbadini & Pesarini, 1992; *Pseudosphegesthes longitarsus* Holzschuh, 1974; *Stenopterus kraatzi* Pic, 1892; *Dorcadion accola* Heyden, 1894; *Dorcadion albolineatum* Küster, 1847; *Dorcadion carinipenne* Pic, 1900; *Dorcadion confluens* Fairmaire, 1866; *Dorcadion delagrangei* Pic, 1894; *Dorcadion infernale* Mulsant & Rey, 1863; *Dorcadion kurdistanum* Breuning, 1944; *Dorcadion mesopotamicum* Breuning, 1944; *Dorcadion micans* Thomson, 1867; *Dorcadion obtusum* Breuning, 1944; *Dorcadion oezdurali* Önalp, 1988; *Dorcadion punctulicolle* Breuning, 1944; *Dorcadion saulcyi* Thomson, 1865; *Dorcadion schultzei* Heyden, 1894; *Micromallosia heydeni* (Ganglbauer, 1888); *Coptosia minuta* (Pic, 1891); *Agapanthia lateralis* Ganglbauer, 1884; *Agapanthia simplicicornis* Reitter, 1898; *Agapanthia verecunda* Chevrolat, 1882 and *Phytoecia volkovitshi* Danilevsky, 2010.

CONCLUSIONS

Apparently, Turkey has continental properties. Turkey is the origin of many taxons. It is a refigium for effected living creatures from geological and climatical changes that have more biological importance than any land in the world. As seen in the whole world, incredible variations have also been seen among the insects which are the most influenced living creatures from these changes occurring in the past in Turkey. As a result of this, Turkey has a rich biodiversity. Resulting from this biodiversity faunistical richness can be virtually accepted to the same degree as Continental Europe.

As a result of this study, totally 119 species of 37 genera of 6 subfamilies are also determined in the whole territories of the South-Eastern Anatolian Region of Turkey [Central Fırat Part = CFP (including Adıyaman, Gaziantep and Şanlıurfa provinces), Dicle Part = DP (including Batman, Diyarbakır, Mardin and Siirt provinces)]. A simple faunistical list of determined species is given below.

A LIST OF LONGICORN BEETLES FROM SOUTH-EASTERN ANATOLIAN REGION IN TURKEY

Subfamily LEPTURINAE

1. ***Cortodera colchica* Reitter, 1890**
2. ***Cortodera syriaca* Pic, 1901**
3. ***Vadonia instigmata* Pic, 1889**
4. ***Pseudovadonia livida* (Fabricius, 1777)**
5. ***Stictoleptura cordigera* (Füsslins, 1775)**
6. ***Stictoleptura tripartita* (Heyden, 1889)**
7. ***Pedostrangalia emmipoda* (Mulsant, 1863)**
8. ***Pedostrangalia kurda* Sama, 1996**
9. ***Judolia erratica* (Dalman, 1817)**
10. ***Stenurella bifasciata* (Müller, 1776)**

Subfamily ASEMINAE

1. ***Arhopalus syriacus* (Reitter, 1895)**

Subfamily CERAMBYCINAE

1. ***Trichoferus fasciculatus* (Faldermann, 1837)**
2. ***Trichoferus griseus* (Fabricius, 1792)**
3. ***Trichoferus lunatus* (Szallies, 1994)**
4. ***Trichoferus preissi* (Heyden, 1894)**

5. ***Trichoferus samai*** **Kadlec & Rejzek, 2001**
6. ***Stromatium unicolor*** **(Olivier, 1795)**
7. ***Phoracantha semipunctata*** **(Fabricius, 1775)**
8. ***Cerambyx cerdo*** **Linnaeus, 1758**
9. ***Cerambyx dux*** **(Faldermann, 1837)**
10. ***Cerambyx miles*** **Bonelli, 1812**
11. ***Cerambyx nodulosus*** **Germar, 1817**
12. ***Cerambyx welensii*** **(Küster, 1846)**
13. ***Purpuricenus apicalis*** **Pic, 1905**
14. ***Purpuricenus budensis*** **(Götz, 1783)**
15. ***Purpuricenus cornifrons*** **Sabbadini & Pesarini, 1992**
16. ***Purpuricenus dalmatinus*** **Sturm, 1843**
17. ***Purpuricenus wachanrui*** **Levrat, 1858**
18. ***Calchaenesthes oblongomaculata*** **(Guèrin, 1844)**
19. ***Aromia moschata*** **(Linnaeus, 1758)**
20. ***Osphranteria coerulescens*** **Redtenbacher, 1850**
21. ***Certallum ebulinum*** **(Linnaeus, 1767)**
22. ***Certallum thoracicum*** **Sharp, 1880**
23. ***Ropalopus clavipes*** **(Fabricius, 1775)**
24. ***Ropalopus ledereri*** **(Fairmaire, 1866)**
25. ***Phymatodes testaceus*** **(Linnaeus, 1758)**
26. ***Plagionus floralis*** **(Pallas, 1773)**
27. ***Plagionotus bobelayei*** **(Brullé, 1832)**
28. ***Chlorophorus varius*** **(Müller, 1766)**
29. ***Chlorophorus hungaricus*** **Seidlitz, 1891**
30. ***Chlorophorus sartor*** **(Müller, 1766)**
31. ***Pseudosphegesthes longitarsus*** **Holzschuh, 1974**
32. ***Clytus rhamni*** **Germar, 1817**

Subfamily STENOPTERINAE

1. ***Stenopterus kraatzi*** **Pic, 1892**
2. ***Stenopterus rufus*** **(Linnaeus, 1767)**
3. ***Callimus angulatus*** **(Schrank, 1789)**
4. ***Callimus femoratus*** **(Germar, 1824)**

Subfamily DORCADIONINAE

1. ***Dorcadion accola*** **Heyden, 1894**
2. ***Dorcadion albolineatum*** **Küster, 1847**
3. ***Dorcadion carinipenne*** **Pic, 1900**
4. ***Dorcadion cingulatum*** **Ganglbauer, 1884**
5. ***Dorcadion confluens*** **Fairmaire, 1866**
6. ***Dorcadion delagrangei*** **Pic, 1894**
7. ***Dorcadion divisum*** **Germar, 1839**
8. ***Dorcadion formosum*** **Kraatz, 1870**
9. ***Dorcadion halepense*** **(Kraatz, 1873)**
10. ***Dorcadion hellmanni*** **Ganglbauer, 1884**
11. ***Dorcadion infernale*** **Mulsant & Rey, 1863**
12. ***Dorcadion kurdistanum*** **Breuning, 1944**
13. ***Dorcadion mesopotamicum*** **Breuning, 1944**
14. ***Dorcadion micans*** **Thomson, 1867**
15. ***Dorcadion obtusum*** **Breuning, 1944**
16. ***Dorcadion oezdurali*** **Önalp, 1988**
17. ***Dorcadion punctulicolle*** **Breuning, 1944**
18. ***Dorcadion saulcyi*** **Thomson, 1865**
19. ***Dorcadion schultzei*** **Heyden, 1894**
20. ***Dorcadion septemlineatum*** **Waltl, 1838**
21. ***Dorcadion sturmii*** **Frivaldsky, 1837**

22. ***Dorcadion variegatum* Ganglbauer, 1884**

Subfamily LAMIINAE

1. ***Saperda quercus* Charpentier, 1825**
2. ***Oberea oculata* (Linnaeus, 1758)**
3. ***Oxylia argentata* (Ménétriés, 1832)**
4. ***Pteromallosia albolineata* (Hampe, 1852)**
5. ***Mallosia imperatrix* Abeille de Perrin, 1885**
6. ***Micromallosia heydeni* (Ganglbauer, 1888)**
7. ***Coptosia albovittigera* (Heyden, 1863)**
8. ***Coptosia bithynensis* (Ganglbauer, 1884)**
9. ***Coptosia compacta* (Ménétriés, 1832)**
10. ***Coptosia ganglbaueri* Pic, 1936**
11. ***Coptosia minuta* (Pic, 1891)**
12. ***Pygoptosia speciosa* (Frivaldszky, 1884)**
13. ***Phytoecia annulata* Hampe, 1862**
14. ***Phytoecia hirsutula* (Frölich, 1793)**
15. ***Phytoecia scutellata* (Fabricius, 1792)**
16. ***Phytoecia adelpha* Ganglbauer, 1886**
17. ***Phytoecia alziari* Sama, 1992**
18. ***Phytoecia armeniaca* Frivaldszky, 1878**
19. ***Phytoecia fatima* Ganglbauer, 1884**
20. ***Phytoecia ferrugata* Ganglbauer, 1884**
21. ***Phytoecia humeralis* (Waltl, 1838)**
22. ***Phytoecia imperialis* (Sama & Rejzek, 2001)**
23. ***Phytoecia astarte* Ganglbauer, 1886**
24. ***Phytoecia puncticollis* Faldermann, 1837**
25. ***Phytoecia wachanrui* Mulsant, 1851**
26. ***Phytoecia balcanica* (Frivaldsky, 1835)**
27. ***Phytoecia merkli* Ganglbauer, 1884**
28. ***Phytoecia bangi* Pic, 1897**
29. ***Phytoecia caerulea* (Scopoli, 1772)**
30. ***Phytoecia croceipes* Reiche & Saulcy, 1858**
31. ***Phytoecia geniculata* Mulsant, 1862**
32. ***Phytoecia icterica* (Schaller, 1783)**
33. ***Phytoecia manicata* Reiche & Saulcy, 1858**
34. ***Phytoecia pubescens* Pic, 1895**
35. ***Phytoecia rufipes* (Olivier, 1795)**
36. ***Phytoecia virgula* (Charpentier, 1825)**
37. ***Phytoecia coerulescens* (Scopoli, 1763)**
38. ***Phytoecia vittipennis* Reiche, 1877**
39. ***Phytoecia volkovitshi* Danilevsky, 2010**
40. ***Calamobius filum* (Rossi, 1790)**
41. ***Agapanthia kirbyi* (Gyllenhal, 1817)**
42. ***Agapanthia dahli* (Richter, 1821)**
43. ***Agapanthia lateralis* Ganglbauer, 1884**
44. ***Agapanthia simplicicornis* Reitter, 1898**
45. ***Agapanthia verecunda* Chevrolat, 1882**
46. ***Agapanthia walteri* Reitter, 1898**
47. ***Agapanthia coeruleipennis* Frivaldszky, 1878**
48. ***Agapanthia suturalis* (Fabricius, 1787)**
49. ***Agapanthia lais* Reiche & Saulcy, 1858**
50. ***Agapanthia violacea* (Fabricius, 1775)**

The following species which are 94 species of 37 genera of 6 subfamilies occur only in Central Fırat Part (= CFP) of South-Eastern Anatolian Region (including Adıyaman, Gaziantep and Şanlıurfa provinces):

A LIST OF LONGICORN BEETLES FROM CENTRAL FIRAT PART (*CFP) OF SOUTH-EASTERN ANATOLIAN REGION IN TURKEY

Subfamily LEPTURINAE

1. ***Cortodera colchica* Reitter, 1890 (*CFP)**
2. ***Cortodera syriaca* Pic, 1901 (*CFP)**
3. ***Vadonia instigmata* Pic, 1889 (*CFP)**
4. ***Pseudovadonia livida* (Fabricius, 1777) (*CFP)**
5. ***Stictoleptura cordigera* (Füsslins, 1775) (*CFP)**
6. ***Stictoleptura tripartita* (Heyden, 1889) (*CFP)**
7. ***Pedostrangalia emmipoda* (Mulsant, 1863) (*CFP)**
8. ***Pedostrangalia kurda* Sama, 1996 (*CFP, DP)**
9. ***Judolia erratica* (Dalman, 1817) (*CFP)**
10. ***Stenurella bifasciata* (Müller, 1776) (*CFP)**

Subfamily ASEMINAE

1. ***Arhopalus syriacus* (Reitter, 1895) (*CFP)**

Subfamily CERAMBYCINAE

1. ***Trichoferus griseus* (Fabricius, 1792) (*CFP)**
2. ***Trichoferus preissi* (Heyden, 1894) (*CFP, DP)**
3. ***Trichoferus samai* Kadlec & Rejzek, 2001 (*CFP)**
4. ***Stromatium unicolor* (Olivier, 1795) (*CFP)**
5. ***Phoracantha semipunctata* (Fabricius, 1775) (*CFP)**
6. ***Cerambyx cerdo* Linnaeus, 1758 (*CFP)**
7. ***Cerambyx dux* (Faldermann, 1837) (*CFP)**
8. ***Cerambyx miles* Bonelli, 1812 (*CFP, DP)**
9. ***Cerambyx nodulosus* Germar, 1817 (*CFP, DP)**
10. ***Cerambyx welensii* (Küster, 1846) (*CFP)**
11. ***Purpuricenus budensis* (Götz, 1783) (*CFP, DP)**
12. ***Purpuricenus cornifrons* Sabbadini & Pesarini, 1992 (*CFP)**
13. ***Purpuricenus dalmatinus* Sturm, 1843 (*CFP, DP)**
14. ***Purpuricenus wachanrui* Levrat, 1858 (*CFP, DP)**
15. ***Calchaenesthes oblongomaculata* (Guèrin, 1844) (*CFP)**
16. ***Aromia moschata* (Linnaeus, 1758) (*CFP)**
17. ***Osphranteria coerulescens* Redtenbacher, 1850 (*CFP, DP)**
18. ***Certallum ebulinum* (Linnaeus, 1767) (*CFP, DP)**
19. ***Certallum thoracicum* Sharp, 1880 (*CFP)**
20. ***Ropalopus clavipes* (Fabricius, 1775) (*CFP)**
21. ***Ropalopus ledereri* (Fairmaire, 1866) (*CFP)**
22. ***Phymatodes testaceus* (Linnaeus, 1758) (*CFP)**
23. ***Plagionus floralis* (Pallas, 1773) (*CFP)**
24. ***Plagionotus bobelayei* (Brullé, 1832) (*CFP)**
25. ***Chlorophorus varius* (Müller, 1766) (*CFP, DP)**
26. ***Chlorophorus hungaricus* Seidlitz, 1891 (*CFP)**
27. ***Chlorophorus sartor* (Müller, 1766) (*CFP)**
28. ***Pseudosphegesthes longitarsus* Holzschuh, 1974 (*CFP)**
29. ***Clytus rhamni* Germar, 1817 (*CFP)**

Subfamily STENOPTERINAE

1. ***Stenopterus kraatzi* Pic, 1892 (*CFP)**
2. ***Stenopterus rufus* (Linnaeus, 1767) (*CFP)**
3. ***Callimus angulatus* (Schrank, 1789) (*CFP)**
4. ***Callimus femoratus* (Germar, 1824) (*CFP, DP)**

Subfamily DORCADIONINAE

1. ***Dorcadion carinipenne* Pic, 1900 (*CFP)**
2. ***Dorcadion delagrangei* Pic, 1894 (*CFP)**
3. ***Dorcadion divisum* Germar, 1839 (*CFP, DP)**
4. ***Dorcadion formosum* Kraatz, 1870 (*CFP)**
5. ***Dorcadion halepense* (Kraatz, 1873) (*CFP)**
6. ***Dorcadion kurdistanum* Breuning, 1944 (*CFP, DP)**
7. ***Dorcadion mesopotamicum* Breuning, 1944 (*CFP, DP)**
8. ***Dorcadion micans* Thomson, 1867 (*CFP)**
9. ***Dorcadion obtusum* Breuning, 1944 (*CFP, DP)**
10. ***Dorcadion oezdurali* Önalp, 1988 (*CFP)**
11. ***Dorcadion saulcyi* Thomson, 1865 (*CFP)**
12. ***Dorcadion septemlineatum* Waltl, 1838 (*CFP)**
13. ***Dorcadion variegatum* Ganglbauer, 1884 (*CFP)**

Subfamily LAMIINAE

1. ***Saperda quercus* Charpentier, 1825 (*CFP)**
2. ***Oberea oculata* (Linnaeus, 1758) (*CFP)**
3. ***Oxylia argentata* (Ménétriés, 1832) (*CFP, DP)**
4. ***Pteromallosia albolineata* (Hampe, 1852) (*CFP)**
5. ***Mallosia imperatrix* Abeille de Perrin, 1885 (*CFP)**
6. ***Micromallosia heydeni* (Ganglbauer, 1888) (*CFP)**
7. ***Coptosia albovittigera* (Heyden, 1863) (*CFP)**
8. ***Coptosia bithynensis* (Ganglbauer, 1884) (*CFP, DP)**
9. ***Coptosia compacta* (Ménétriés, 1832) (*CFP, DP)**
10. ***Coptosia ganglbaueri* Pic, 1936 (*CFP)**
11. ***Pygoptosia speciosa* (Frivaldszky, 1884) (*CFP, DP)**
12. ***Phytoecia annulata* Hampe, 1862 (*CFP)**
13. ***Phytoecia hirsutula* (Frölich, 1793) (*CFP)**
14. ***Phytoecia scutellata* (Fabricius, 1792) (*CFP)**
15. ***Phytoecia adelpha* Ganglbauer, 1886 (*CFP, DP)**
16. ***Phytoecia alziari* Sama, 1992 (*CFP, DP)**
17. ***Phytoecia armeniaca* Frivaldszky, 1878 (*CFP, DP)**
18. ***Phytoecia fatima* Ganglbauer, 1884 (*CFP, DP)**
19. ***Phytoecia humeralis* (Waltl, 1838) (*CFP, DP)**
20. ***Phytoecia imperialis* (Sama & Rejzek, 2001) (*DP)**
21. ***Phytoecia astarte* Ganglbauer, 1886 (*CFP)**
22. ***Phytoecia wachanrui* Mulsant, 1851 (*CFP, DP)**
23. ***Phytoecia merkli* Ganglbauer, 1884 (*CFP)**
24. ***Phytoecia caerulea* (Scopoli, 1772) (*CFP)**
25. ***Phytoecia geniculata* Mulsant, 1862 (*CFP, DP)**
26. ***Phytoecia icterica* (Schaller, 1783) (*CFP)**
27. ***Phytoecia rufipes* (Olivier, 1795) (*CFP)**
28. ***Phytoecia virgula* (Charpentier, 1825) (*CFP)**
29. ***Phytoecia coerulescens* (Scopoli, 1763) (*CFP, DP)**
30. ***Phytoecia vittipennis* Reiche, 1877 (*CFP)**
31. ***Phytoecia volkovitshi* Danilevsky, 2010 (*CFP)**
32. ***Calamobius filum* (Rossi, 1790) (*CFP)**
33. ***Agapanthia dahli* (Richter, 1821) (*CFP, DP)**
34. ***Agapanthia lateralis* Ganglbauer, 1884 (*CFP)**

35. *Agapanthia coeruleipennis* Frivaldszky, 1878 (*CFP, DP)
36. *Agapanthia suturalis* (Fabricius, 1787) (*CFP, DP)
37. *Agapanthia violacea* (Fabricius, 1775) (*CFP)

The following species which are 56 species of 14 genera of 5 subfamilies occur only in Dicle Part (= DP) of South-Eastern Anatolian Region (including Batman, Diyarbakır, Mardin and Siirt provinces):

A LIST OF LONGICORN BEETLES FROM DİCLE PART (*DP) OF SOUTH-EASTERN ANATOLIAN REGION IN TURKEY

Subfamily LEPTURINAE

1. *Pedostrangalia kurda* Sama, 1996 (*CFP, DP)

Subfamily CERAMBYCINAE

1. *Trichoferus fasciculatus* (Faldermann, 1837) (*DP)
2. *Trichoferus lunatus* (Szallies, 1994) (*DP)
3. *Trichoferus preissi* (Heyden, 1894) (*CFP, DP)
4. *Cerambyx miles* Bonelli, 1812 (*CFP, DP)
5. *Cerambyx nodulosus* Germar, 1817 (*CFP, DP)
6. *Purpuricenus apicalis* Pic, 1905 (*DP)
7. *Purpuricenus budensis* (Götz, 1783) (*CFP, DP)
8. *Purpuricenus dalmatinus* Sturm, 1843 (*CFP, DP)
9. *Purpuricenus wachanrui* Levrat, 1858 (*CFP, DP)
10. *Osphranteria coerulescens* Redtenbacher, 1850 (*CFP, DP)
11. *Certallum ebulinum* (Linnaeus, 1767) (*CFP, DP)
12. *Chlorophorus varius* (Müller, 1766) (*CFP, DP)

Subfamily STENOPTERINAE

1. *Callimus femoratus* (Germar, 1824) (*CFP, DP)

Subfamily DORCADIONINAE

1. *Dorcadion accola* Heyden, 1894 (*DP)
2. *Dorcadion albolineatum* Küster, 1847 (*DP)
3. *Dorcadion cingulatum* Ganglbauer, 1884 (*DP)
4. *Dorcadion confluens* Fairmaire, 1866 (*DP)
5. *Dorcadion divisum* Germar, 1839 (*CFP, DP)
6. *Dorcadion hellmanni* Ganglbauer, 1884 (*DP)
7. *Dorcadion infernale* Mulsant & Rey, 1863 (*DP)
8. *Dorcadion kurdistanum* Breuning, 1944 (*CFP, DP)
9. *Dorcadion mesopotamicum* Breuning, 1944 (*CFP, DP)
10. *Dorcadion obtusum* Breuning, 1944 (*CFP, DP)
11. *Dorcadion punctulicolle* Breuning, 1944 (*DP)
12. *Dorcadion schultzei* Heyden, 1894 (*DP)
13. *Dorcadion sturmii* Frivaldsky, 1837 (*DP)

Subfamily LAMIINAE

1. *Oxylia argentata* (Ménétriés, 1832) (*CFP, DP)
2. *Coptosia bithynensis* (Ganglbauer, 1884) (*CFP, DP)
3. *Coptosia compacta* (Ménétriés, 1832) (*CFP, DP)
4. *Coptosia minuta* (Pic, 1891) (*DP)
5. *Pygoptosia speciosa* (Frivaldszky, 1884) (*CFP, DP)
6. *Phytoecia adelpha* Ganglbauer, 1886 (*CFP, DP)

7. ***Phytoecia alziari* Sama, 1992 (*CFP, DP)**
8. ***Phytoecia armeniaca* Frivaldszky, 1878 (*CFP, DP)**
9. ***Phytoecia fatima* Ganglbauer, 1884 (*CFP, DP)**
10. ***Phytoecia ferrugata* Ganglbauer, 1884 (*DP)**
11. ***Phytoecia humeralis* (Waltl, 1838) (*CFP, DP)**
12. ***Phytoecia imperialis* (Sama & Rejzek, 2001) (*DP)**
13. ***Phytoecia puncticollis* Faldermann, 1837 (*DP)**
14. ***Phytoecia wachanrui* Mulsant, 1851 (*CFP, DP)**
15. ***Phytoecia balcanica* (Frivaldsky, 1835) (*DP)**
16. ***Phytoecia bangi* Pic, 1897 (*DP)**
17. ***Phytoecia croceipes* Reiche & Saulcy, 1858 (*DP)**
18. ***Phytoecia geniculata* Mulsant, 1862 (*CFP, DP)**
19. ***Phytoecia manicata* Reiche & Saulcy, 1858 (*DP)**
20. ***Phytoecia pubescens* Pic, 1895 (*DP)**
21. ***Phytoecia coerulescens* (Scopoli, 1763) (*CFP, DP)**
22. ***Agapanthia kirbyi* (Gyllenhal, 1817) (*DP)**
23. ***Agapanthia dahli* (Richter, 1821) (*CFP, DP)**
24. ***Agapanthia simplicicornis* Reitter, 1898 (*DP)**
25. ***Agapanthia verecunda* Chevrolat, 1882 (*DP)**
26. ***Agapanthia walteri* Reitter, 1898 (*DP)**
27. ***Agapanthia coeruleipennis* Frivaldszky, 1878 (*CFP, DP)**
28. ***Agapanthia suturalis* (Fabricius, 1787) (*CFP, DP)**
29. ***Agapanthia lais* Reiche & Saulcy, 1858 (*DP)**

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APPENDIX

1. Map of Turkey's regions and adjacent areas.
2. Map of Turkey's provinces and adjacent areas.
3. Map of the provinces of Turkey.
4. *Cortodera colchica*: Distribution patterns in Turkey.
5. *Cortodera syriaca*: Distribution patterns in Turkey.
6. *Vadonia instigmata*: Distribution patterns in Turkey.
7. *Pseudovadonia livida*: Distribution patterns in Turkey.
8. *Stictoleptura cordigera*: Distribution patterns in Turkey.
9. *Stictoleptura tripartita*: Distribution patterns in Turkey.
10. *Pedostrangalia emmipoda*: Distribution patterns in Turkey.
11. *Pedostrangalia kurda*: Distribution patterns in Turkey.
12. *Judolia erratica*: Distribution patterns in Turkey.
13. *Stenurella bifasciata*: Distribution patterns in Turkey.
14. *Arhopalus syriacus*: Distribution patterns in Turkey.
15. *Trichoferus fasciculatus*: Distribution patterns in Turkey.
16. *Trichoferus griseus*: Distribution patterns in Turkey.
17. *Trichoferus lunatus*: Distribution patterns in Turkey.
18. *Trichoferus preissi*: Distribution patterns in Turkey.
19. *Trichoferus samai*: Distribution patterns in Turkey.
20. *Stromatium unicolor*: Distribution patterns in Turkey.
21. *Phoracantha semipunctata*: Distribution patterns in Turkey.
22. *Cerambyx cerdo*: Distribution patterns in Turkey.
23. *Cerambyx dux*: Distribution patterns in Turkey.
24. *Cerambyx miles*: Distribution patterns in Turkey.
25. *Cerambyx nodulosus*: Distribution patterns in Turkey.
26. *Cerambyx welensii*: Distribution patterns in Turkey.
27. *Purpuricenus apicalis*: Distribution patterns in Turkey.
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29. *Purpuricenus cornifrons*: Distribution patterns in Turkey.

30. *Purpuricenus dalmatinus*: Distribution patterns in Turkey.
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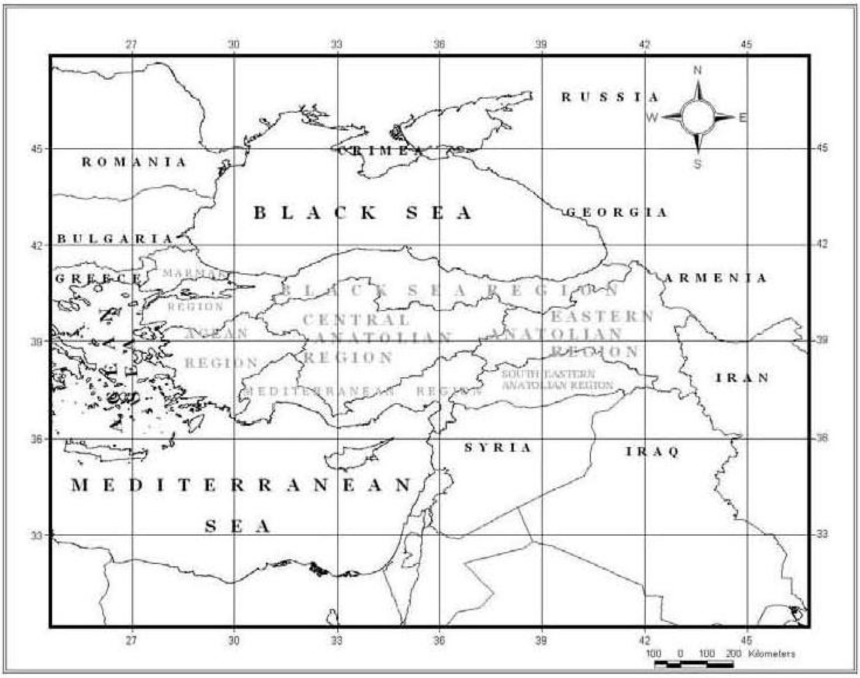
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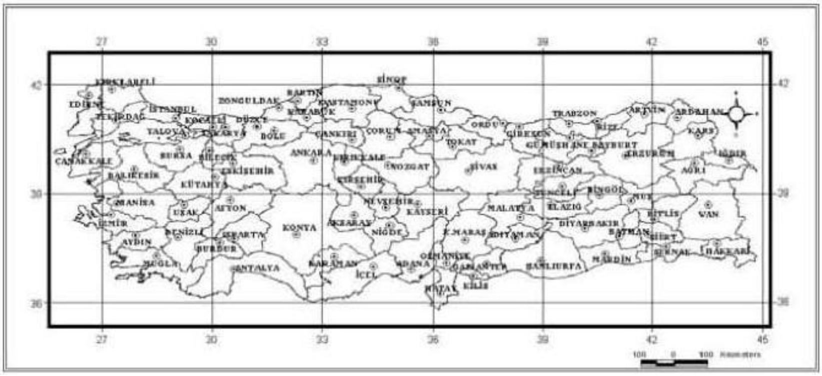

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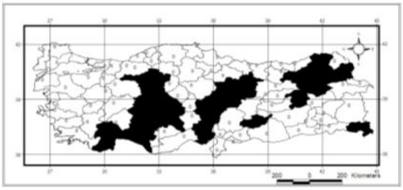

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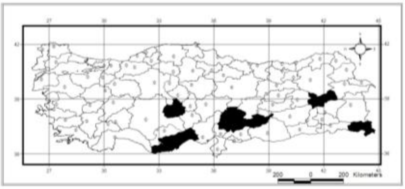

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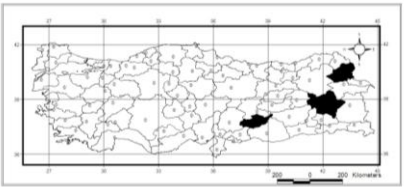

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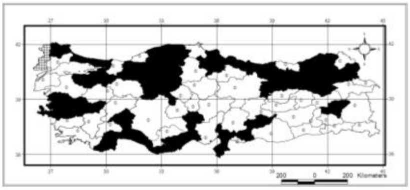

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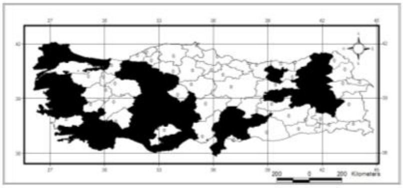

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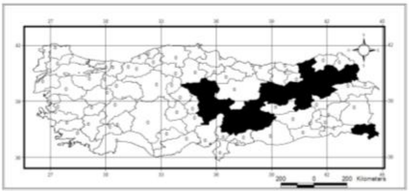

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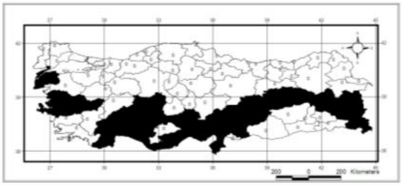

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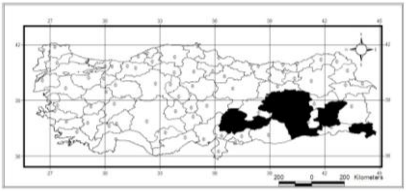

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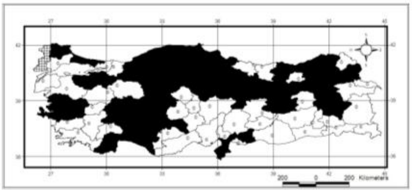

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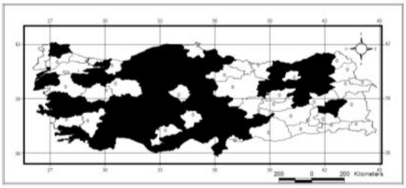

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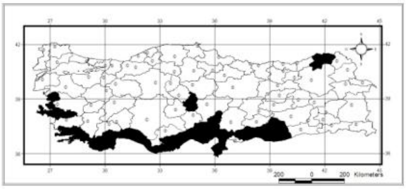

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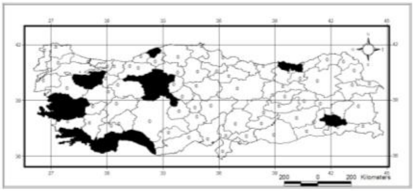

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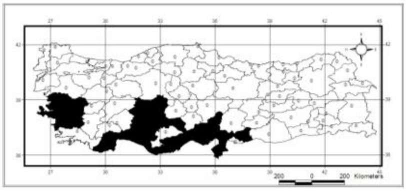

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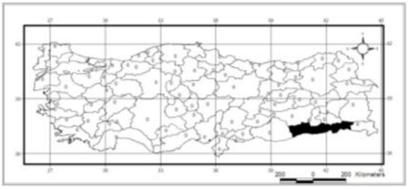

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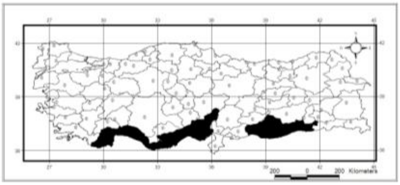

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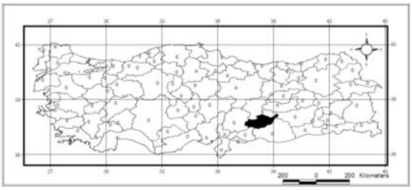

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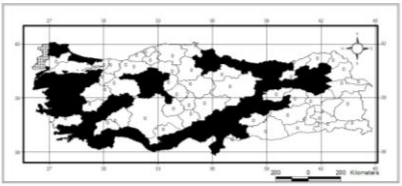

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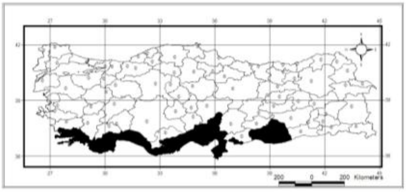

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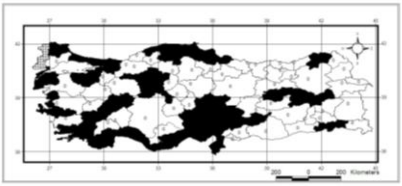

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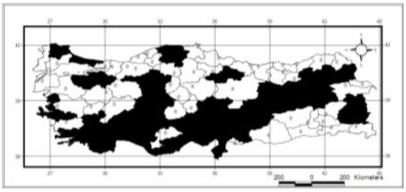

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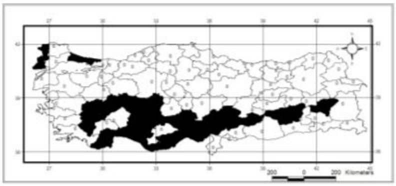

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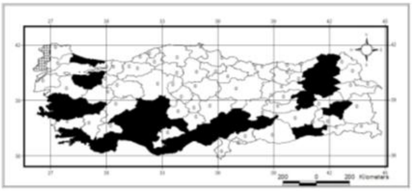

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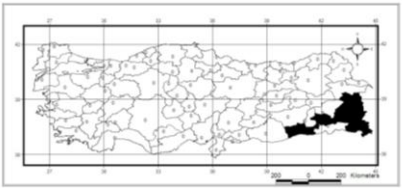

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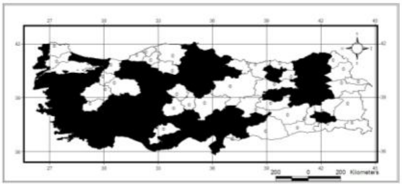

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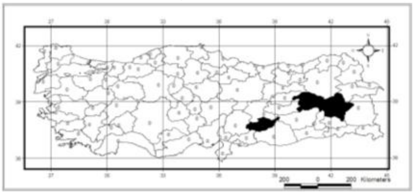

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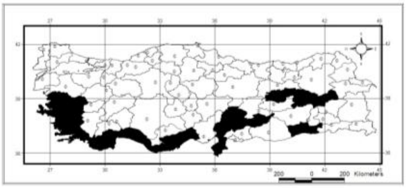

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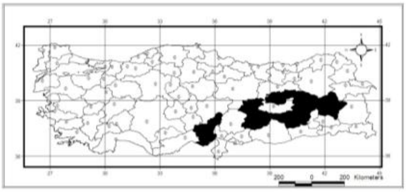

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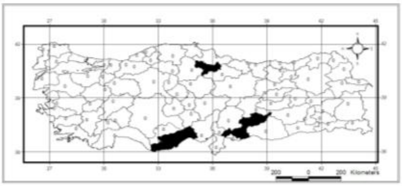

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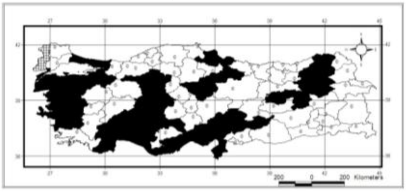

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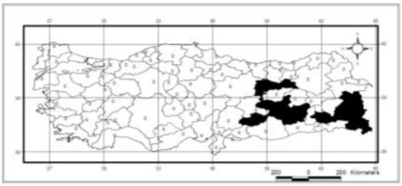

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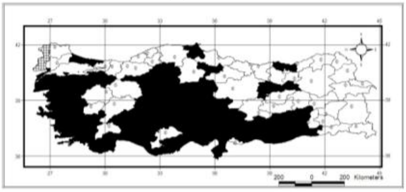

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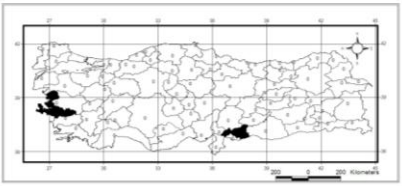

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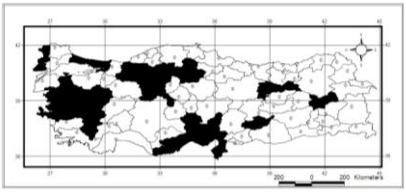

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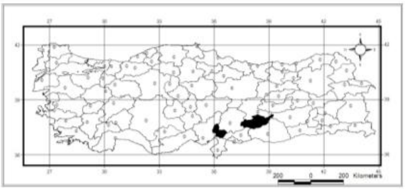

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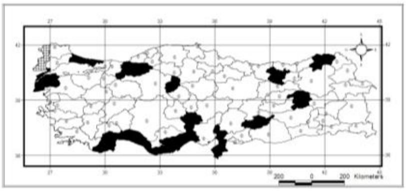

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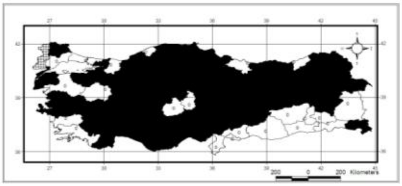

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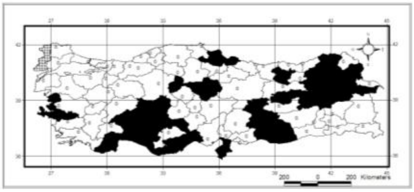

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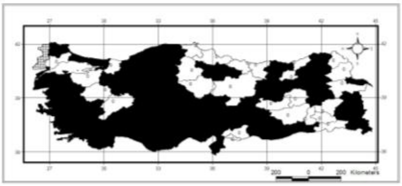

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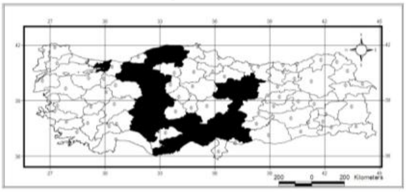

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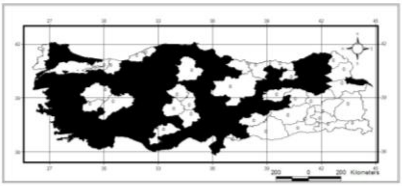

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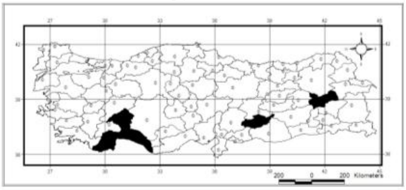

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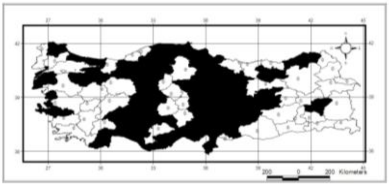

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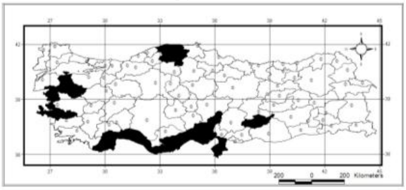

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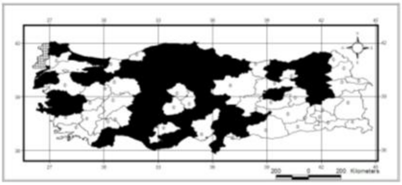

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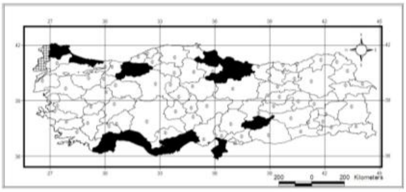

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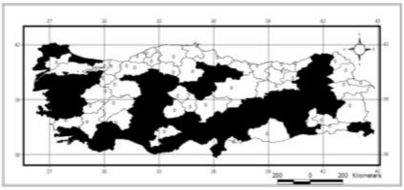

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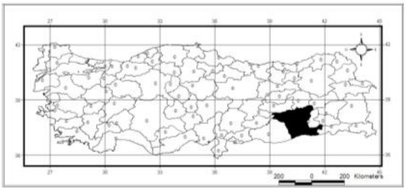

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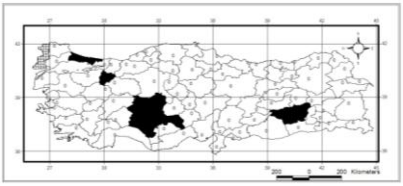

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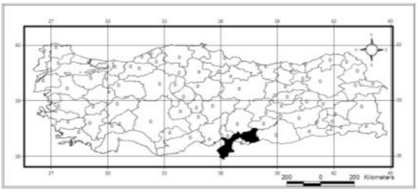

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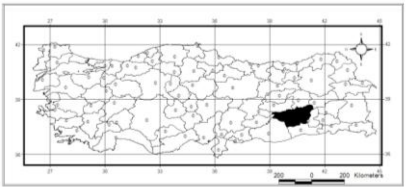

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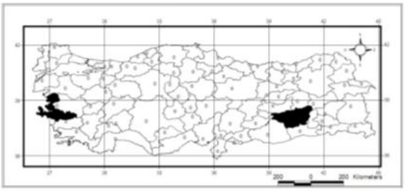

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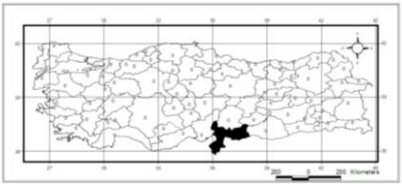

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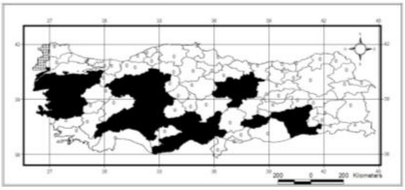

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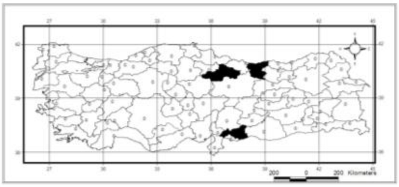

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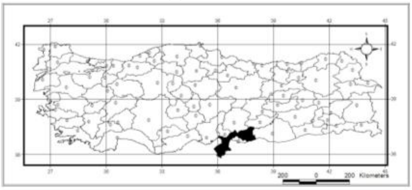

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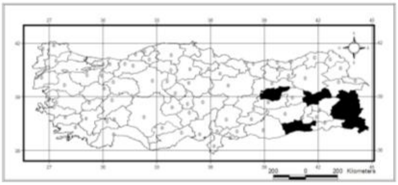

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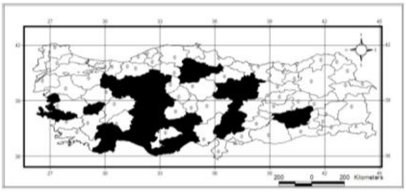

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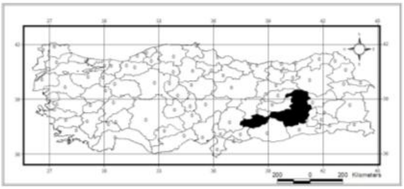

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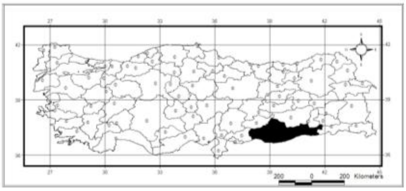

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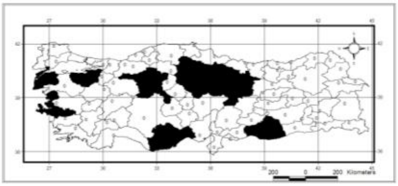

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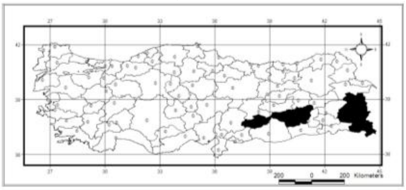

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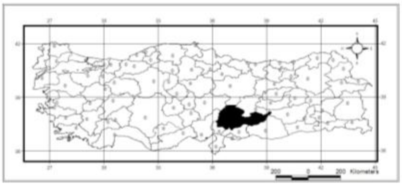

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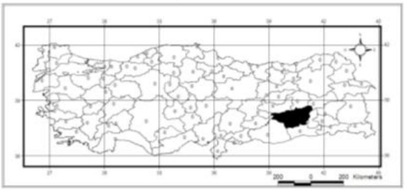

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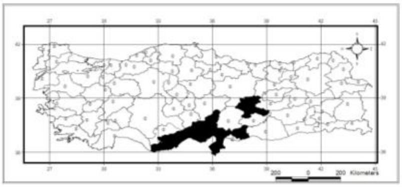

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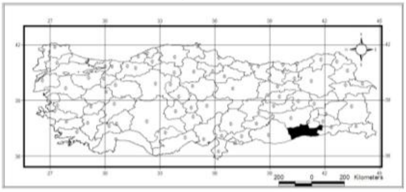

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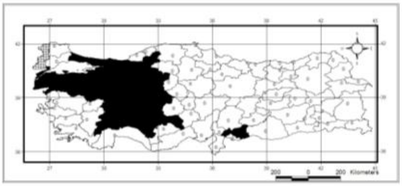

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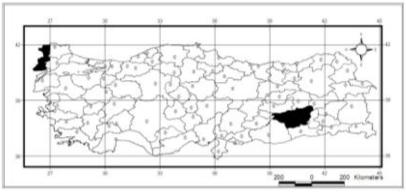

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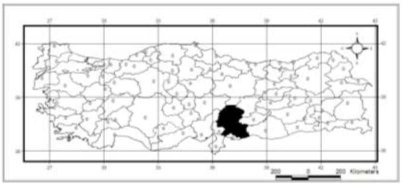

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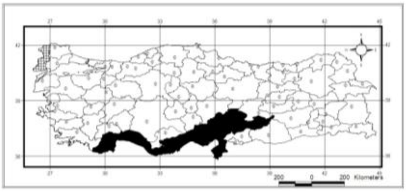

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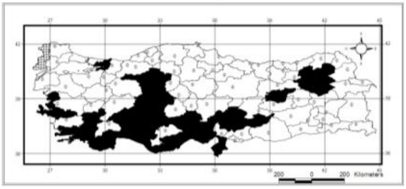

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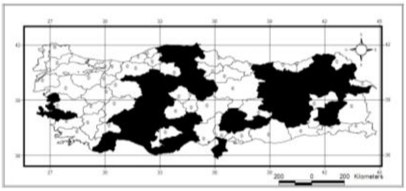

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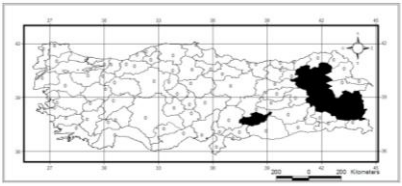

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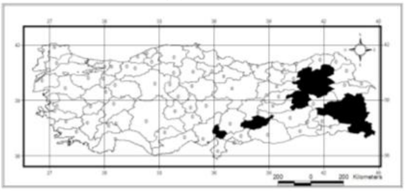

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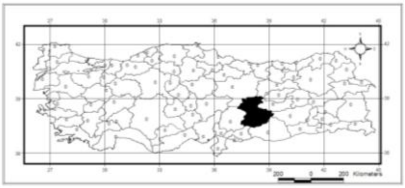

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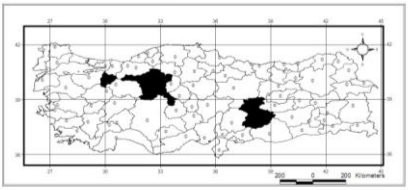

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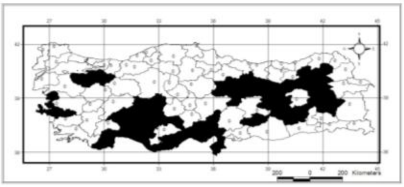

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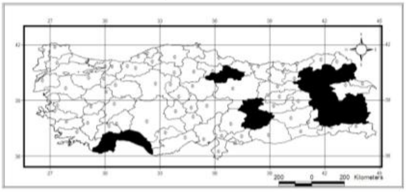

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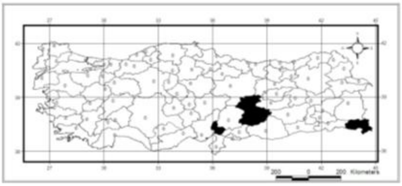

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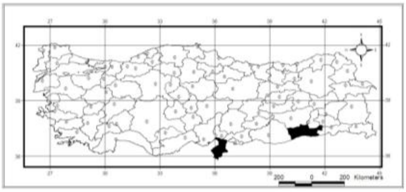

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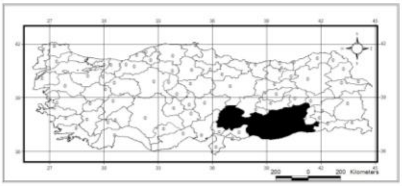

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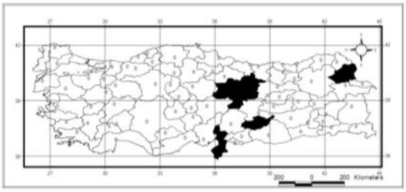

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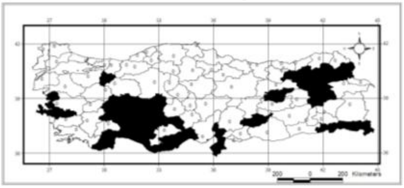

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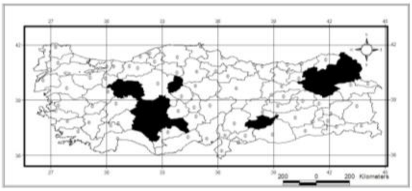

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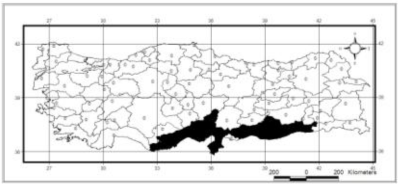

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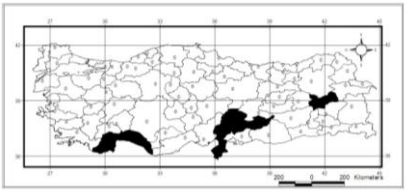

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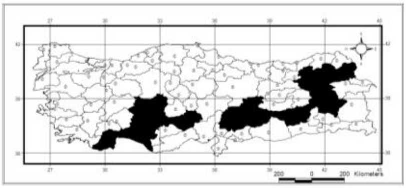

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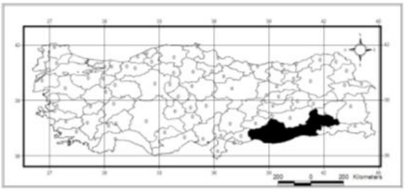

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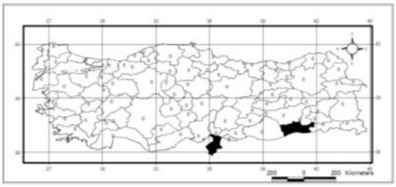

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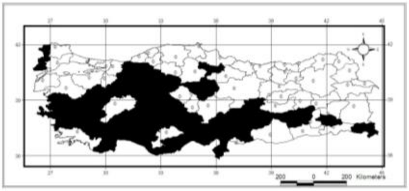

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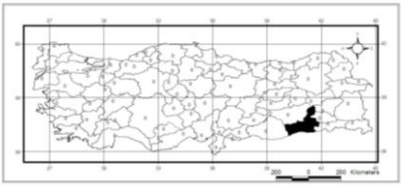

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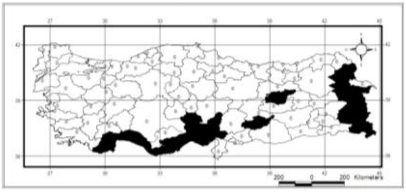

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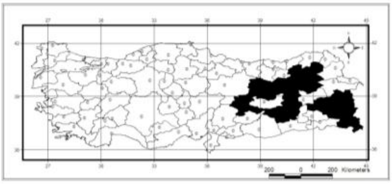

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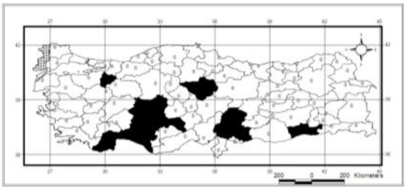

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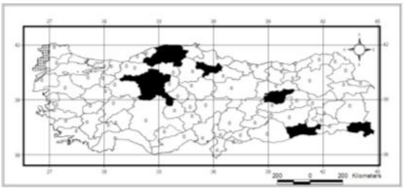

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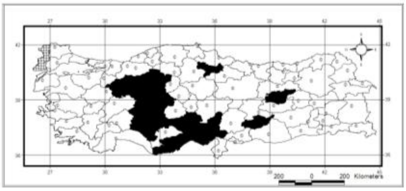

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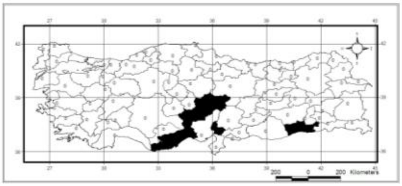

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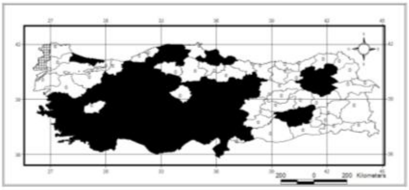

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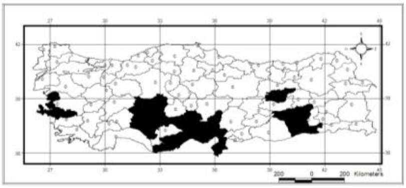

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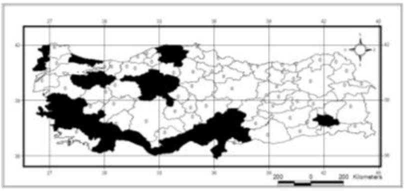

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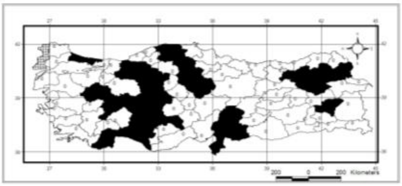

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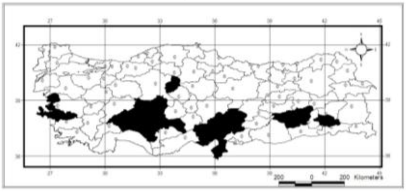

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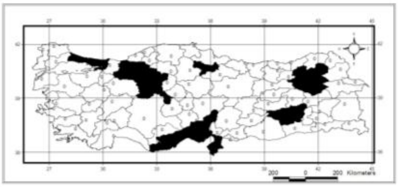

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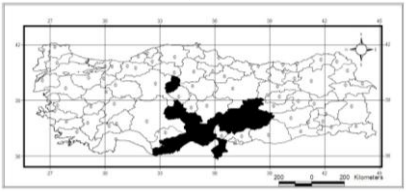

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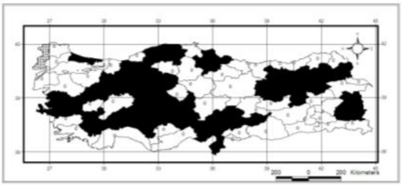

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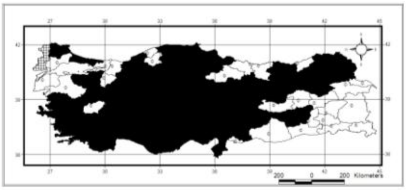

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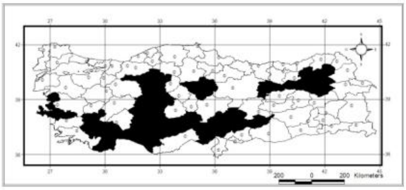

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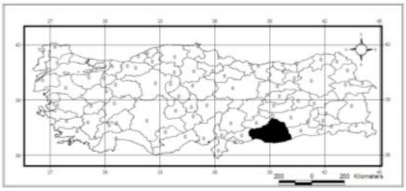

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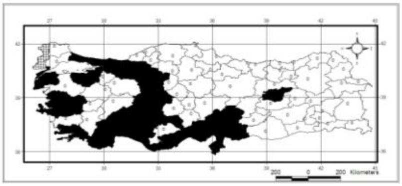

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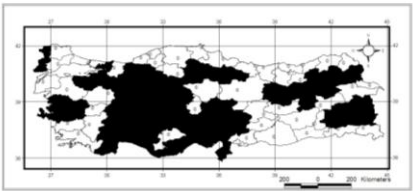

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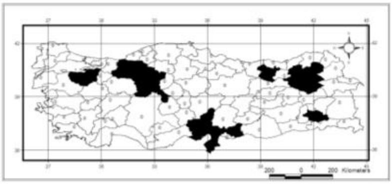

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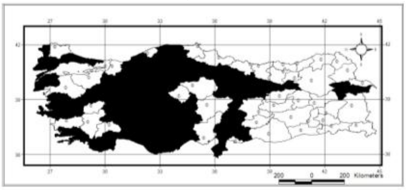

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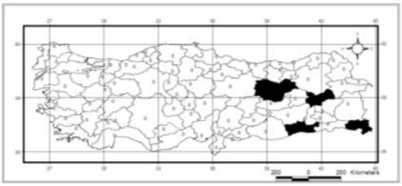

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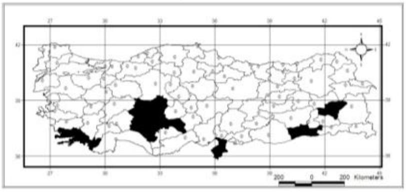

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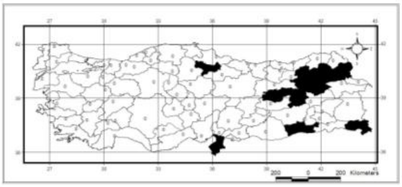

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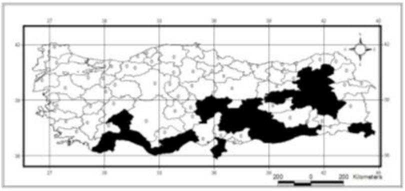

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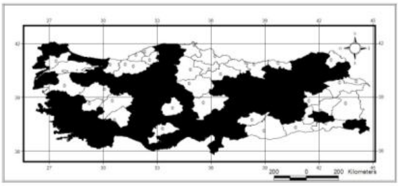
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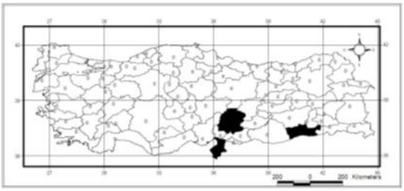
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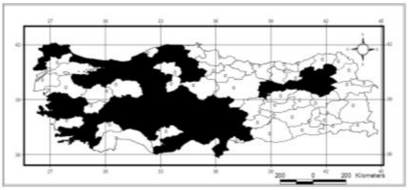
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RAPHIGNATHID MITES OF MARAGHEH ORCHARDS (NORTHWEST OF IRAN) WITH A NEW RECORD FOR IRAN FAUNA

Hamed Ghorbani*, Mohammad Bagheri*,
Ali Mehrvar* and Moosa Saber*

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ABSTRACT: Raphignathid soil mite fauna of Maragheh orchards in Northwest of Iran was studied. One genus and five species were identified and illustrated. *Raphignathus aciculatus* is recorded for first time in Iran. A key to all known species of *Raphignathus* in Iran is also provided.

KEY WORDS: Raphignathid, fauna, Maragheh, Iran, *Raphignathus acciculatus*.

Members of the family Raphignathidae are predacious. They can be found under tree bark, in lichens, in moss, in leaf litter, in pigeon nests, in soil, on a wide range of plants and in house dusts (Fan & Yin, 2000; Khanjani & Ueckermann, 2003). This family are easily recognized by the fused cheliceral bases, forming a stylophore; cervical peritremes not embedded in dorsal surface of stylophore and confluent coxae (Meyer & Ueckermann, 1989). The genus *Raphignathus* Dugés is the oldest genus in this family and has a worldwide distribution with more than 60 species of witch seven are known from Iran, namely: *R. collegiatus* Atyeo, Baker & Crossley, 1961; *R. gracilis* (Rack, 1962); *R. giselae* Meyer & Ueckermann, 1989; *R. zaoi* Hu, Jing & Liang, 1995; *R. aciculatus* Fan, 2000; *R. hecmatanaensis* Khanjani & Ueckermann, 2003; *R. protaspus* Khanjani & Ueckermann, 2003; *R. aethiopicus* Meyer & Ueckermann, 1989 (Khanjani & Ueckermann, 2003; Ghorbani et al., 2010; Shirinbeik Mohajer, 2010). In this paper we review the genus *Raphignathus* from Maragheh orchards and add one new record for raphignathid fauna of Iran.

MATERIALS AND METHODS

The litter and soil samples were taken from Maragheh orchards in Northwest of Iran. Mites were extracted from the soil using a Berlese funnel and were collected in 70 ethanol, then mounted on slides in modified Hoyer's medium. The length of idiosoma was measured from the base of chelicerae to the posterior margin of opisthosomal shield, the width of idiosoma at the broadest part of the idiosoma and setae were measured from their insertion to their tip. The terminology and abbreviations are based on Kethley (1990). All measurements are given in micrometers (*μm*).

RESULTS

Family Raphignathidae Kramer, 1877
Type genus: *Raphignathus* Dugés, 1833

Genus *Raphignathus* Dugés, 1833

Idiosoma oval in dorsoventral view; gnathosoma projecting anterior to prodorsum; cheliceral bases fused to form a conical stylophore; peritremes arising from midbasal part of stylophore, extending along anterior margin of idiosoma; palptibial claw small; subcapitulum with two pairs of subcapitular setae and two pairs of adoral setae; dorsum with 11–12 pairs of setae in adult (*d2* and *f2* absent); propodosoma with three shields; one pair of eyes on lateral propodosomal shields present, opisthosoma with a large shield; venter with two pairs of aggenital setae, genitial shield with three or four and anal shield with three pairs of setae; leg empodial axis directly producing two rows of tenet hairs and coxae II and III contiguous.

Key to Iranian species of *Raphignathus* Dugés

1- Interscutal membrane dorsomedially with 3 pair of setae..........***R. aethiopicus***
- Interscutal membrane dorsomedially with 1-2 pair of setae.................................2

2- Palpfemur with 2 setae..3
- Palpfemur with 3 setae..5

3- Endopodal shield associated with coxae III-IV, without small shield on interscutal membrane..4
- Endopodal shield associated with coxae I-IV, with small shield on interscutal membrane..***R. hecmatanaensis***

4- Median prodorsal shield adjacent to peritremes interiorly ; dorsal setae e_1 reach anterior margin of opisthosomal shield, *f1* on anterior margin of opisthosomal shield..***R. gracilis***
- Median prodorsal shield widely separated from peritremes interiorly; dorsal setae e_1 don't reach anterior margin of opisthosomal shield, *f1* far away of anterior margin of opisthosomal shield..***R. giselae***

5- Interscutal membrane dorsomedially with 2 pairs of setae..........***R. aciculatus***
- Interscutal membrane dorsomedially with 1 pair of setae....................................6

6- Femur IV with 2 setae..***R. zhaoi***
- Femur IV with 4 setae..7

7- Setae e_1 close to anterior margin of opisthosomal shield, cupules *im* on integument; 2 small shields on interscutal integument very small..***R. collegiatus***
- Setae e_1 well behind anterior margin of opisthosomal opisthosomal shield, cupule *im* on shield; 2 shields on interscutal integument much larger..***R. protaspus***

***Raphignathus aciculatus* Fan, 2000**

(Figs. 1-7)

FEMAL (n=2): Dimension: length of body 452 (including gnathosoma), width 215.

Dorsum (Fig. 1). Podosoma with one median and two lateral shields; opisthosoma with a large shield, all these shields punctuated; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane with two pair of setae (*d1* and *e1*), one pair of cupules (*im*) and one pair of small shields near setae *d1*; four pairs of setae (*f1*, *h1*, *h2* and *h3*) and one pair of cupules (*ip*) are located on large opisthosomal shield. Measurements of setae as follows: *vi* 35; *ve* 36; *sci* 34; *sce* 35; *c1* 24; *c2* 28; *d1* 27; *e1* 25; *f1* 26; *h1* 26; *h2* 24 and *h3* 25.

Venter (Fig. 2). Setae *1a* between coxae I, *3a* and *4a* between coxae III and IV; aggenital area with two pairs of setae (*ag1* and *ag2*); genital shields punctuated and bearing three pairs of setae (*g1*, *g2* and *g3*). Measurements of setae: *1a* 37, *3a* 33, *4a* 34, *ag1* 30, *ag2* 27, *g1* 19, *g2* 20, *g3* 18 , *ps1* 19, *ps2* 18 and *ps3* 18.

Gnathosoma. Palp (Fig. 3) five segmented; palp chaetotaxy (femur-tarsus) as follows: 3, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Figs. 4-7). Length of legs I-IV: 307- 268- 283- 336. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)-5(+φ)- 5(+φ)- 4(+φ) tarsi 19(+ω+ωρ)- 16(+ω)- 13(+ω)- 13.

***Examined materials*:** Tow females from soil of apricot (*Prunus armeniaca*) orchard, Eusofabad village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

***Remarks*:** This species resembles *R. hecmatanaensis* but differs in that the palpfemur bears three setae. The Iranian specimens resemble the type specimens of *Raphignathus acciculatus* (Fan & Yin, 2000) in all respects. Body size of *R. aciculatus* is 367 and width 254, but 452 long and 215 wide in the Iranian specimens, our specimens were therefore smaller than the type specimen. This is the first record of this species from Iran.

***Raphignathus giselae* Meyer & Ueckermann, 1989**

(Figs. 8-14)

FEMAL (n=5) Dimension: length of body 357 (including gnathosoma), width 170.

Dorsum (Fig. 8). Podosoma with one median and two lateral plates separated by finely striated areas and small plates posteriorly; median prodorsal shield widely separated from peritremes interiorly; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane with two pairs of setae (*d1* and *e1*) and one pair of cupules (*im*), dorsal setae e_1 don't reach anterior margin of opisthosomal shield; opisthosomal shield with four pairs of setae (*f1*, *h1*, *h2* and *h3*) and on pair of cupules (*ip*). Measurements of setae as follows: *vi* 24; *ve* 23; *sci* 23; *sce* 25; *c1* 20; *c2* 20; *d1* 20; *e1* 21; *f1* 23; *h1* 24; *h2* 20 and *h3* 20.

Venter (Fig. 9). Endopodal shield around legs coxae of III-IV; anogenital area with two pairs of aggenital setae (*ag1* and *ag2*) and three pairs of genital setae (*g1*, *g2* and *g3*); one pair of cupules (*ih*) located laterally to genital shields. Measurements of setae: *1a* 32, *3a* 30, *4a* 28, *ag1* 21, *ag2* 19, *g1* 18, *g2* 17, *g3* 17, *ps1* 17, *ps2* 17 and *ps3* 15.

Gnathosoma. Subcapitulum with two pairs of subcapitular setae (*m* and *n*) and two pairs of adoral setae (*or1* and *or2*); palp (Fig 10) chaetotaxy (femur-tarsus) as follows: 2, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.
Legs (Figs. 11-14). Length of legs I-IV: 255- 215- 237- 290. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)-5(+φ)- 5(+φ)- 4(+φ); tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13.
***Examined materials*:** Five females from soil of apricot orchard, Ghalekhalese village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

***Remarks*:** General features of Iranian specimens like that given by Meyer & Ueckermann, 1989; but the body size of Iranian specimens are smaller (357 long and 170 width) than those of the type specimens (408 and width 231 (Meyer & Ueckermann, 1989)); length of dorsal setae are about 20-25 *µm* in the Iranian specimens, but 23-34*µm* in the original description of *R. giselae.* Chaetotaxy of coxae are 3-2-3-1 in the original description, that we found one more seta on coxae IV and leg chaetotaxy in our specimens is as 3-2-3-2. This is the second record for the province. Previous records: Moghan plain (Haddad Irani-Nejad, 1996); East Azerbaijan (Bagheri, 2007).

Raphignathus gracilis **(Rack, 1962)**

(Figs. 15-21)

FEMAL (n=5) Dimension: length of body 317 (excluding gnathosoma) width 175.
Dorsum (Fig. 15). Podosoma with one median and two lateral shields separated by finely striated areas, and small plates posteriorly; median prodorsal shield adjacent to peritremes interiorly; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane dorsomedially with two pairs of setae (*d1* and *e1*) and one pair of cupules (*im*); dorsal setae e_1 reach anterior margin of opisthosomal shield; opisthosomal shield with four pairs of setae (*f1*, *h1*, *h2* and *h3*) and one pair of cupules (*ip*), setae *f1* on anterior margin of opisthosomal shield. Dimension of setae as follows: *vi* 35; *ve* 33; *sci* 33; *sce* 32; *c1* 23; *c2* 28; *d1* 24; *e1* 24; *f1* 25; *h1* 28; *h2* 25 and *h3* 23.
Venter (Fig. 16). Endopodal shield around legs coxae of III-IV present; genital shields with three pairs of setae (*g1-g3*). Measurements of setae: *1a* 32, *3a* 31, *4a* 27, *ag1* 23, *ag2* 20, *g1* 21, *g2* 20, *g3* 20 and *g4* 15.
Gnathosoma. Palp (Fig. 17) five segmented, palp chaetotaxy (femur-tarsus) as follows: 2, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.
Legs (Figs. 18-21). Length of legs I-IV: 275- 250- 238- 290. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)- 5(+φ)- 5(+φ)- 4(+φ), tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13.
***Examined materials*:** Five females from soil of apple orchard, Khangah village, Maragheh, East Azerbaijan province, 27 July, 2009, H. Ghorbani.

***Remarks*:** This species resembles *R. giselae* but differs in that median prodorsal shield adjacent to pritremes, dorsal setae *e1* reach anterior margin of opisthosomal shield and *f1* on anterior margin of opisthosomal shield. This is the first record of this species for the province.

Raphignathus hecmatanaensis Khanjani & Ueckermann, 2002

(Figs. 22-28)

FEMAL (n=5). Dimension: length of body 387 (including gnathosoma), width 200.

Dorsum (Fig. 22). Dorsum typically covered with four shields, one median and two lateral podosomal shields and one opisthosomal shield; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane dorsomedially with two pairs of setae (*d1* and *e1*), one pair of small plates and one pair of cupules (*im*); opisthosomal shield with four pairs of setae and one pair of cupules (*ip*). Dimension of setae as follows: *vi* 30; *ve* 25; *sci* 26; *sce* 25; *c1* 17; *c2* 24; *d1* 21; *e1* 23; *f1* 23; *h1* 23; *h2* 22 and *h3* 20.

Venter (Fig. 23). Endopodal shields narrow and associated with coxae I-IV; aggenital area with two pairs of setae (*ag1* and *ag2*), genital shields with three pairs of setae (*g1*, *g2* and *g3*). Measurements of setae: *1a* 32, *3a* 24, *4a* 21, *ag1* 12, *ag2* 15, *g1* 14, *g2* 16, *g3* 16, *ps1* 16, *ps2* 15 and *ps3* 15.

Gnathosoma. Palp (Fig. 24) five segmented palp chaetotaxy (femur-tarsus) as follows: 2, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Fig. 25-28). Length of legs I-IV: 287- 236- 249- 302. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)- 5(+φ)- 5(+φ)- 4(+φ), tarsi 19(+ω+ωρ)- 15(+ω)-13(+ω)- 13.

***Examined materials*:** Five females from soil of apple orchard, Narjabad village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

***Remarks*:** This is the first record of this species from East Azerbaijan province. Previous record: Hamedan (Ueckermann & Khanjani, 2003).

Raphignathus zhaoi Hu, Jing & Liang, 1995

(Figs. 29-35)

FEMAL (n=4) Dimension: length of body 305 (including gnathosoma), width 233.

Dorsum (Fig. 29). Podosoma with one median and two lateral shields, median shield with three pairs of setae and separated from lateral shields by finely striated areas, each lateral shields with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane dorsomedially with one pair of setae (*d1*), one pair of cupules (*im*) and one pair of small shields; opisthosomal shield with finely punctuations, five pairs of setae and one pair of cupules (*ip*). Dimension of setae as follows: *vi* 35; *ve* 43; *sci* 45; *sce* 36; *c1* 35; *c2* 37; *d1* 36; *e1* 37; *f1* 44; *h1* 40; *h2* 40 and *h3* 30.

Venter (Fig. 30). Endopodal shields finely punctuated , around inner sides of coxae I-II and coxae III-IV; anogenital area with two pairs of aggenital setae (*ag1* and *ag2*) and 3 pair of genital setae (*g1*, *g2* and *g3*). Measurements of setae: *1a* 39, *3a* 25, *4a* 26, *ag1* 23, *ag2* 18, *g1* 21, *g2* 20 and *g3* 20.

Gnathosoma. Subcapitulum with two pairs of subcapitular setae (*m* and *n*) and two pairs of adoral setae (*or1* and *or2*); dorsal stylophore with striate;; palp (Fig. 31) chaetotaxy (femur-tarsus) as follows: 3, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Figs. 32-35). Length of legs I-IV: 282- 244- 250- 332. Counts of setae: coxae 2-2-2-1, trochantera 1-1-2-1, femora 6-5-3-2, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)- 5(+φ)- 5(+φ)- 4(+φ), tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13(+ω).
***Examined materials*:** Four females from soil of apple orchard, Khangah village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

***Remarks*:** Ensiform dorsal body setae, 3 setae on palp femur, 1 pair of setae on the interscutal membrane and 14 setae on tarsi IV are diagnostic characters of *R. zhaoi*. General features of Iranian specimens like that given by Fan & Yin, 2000.

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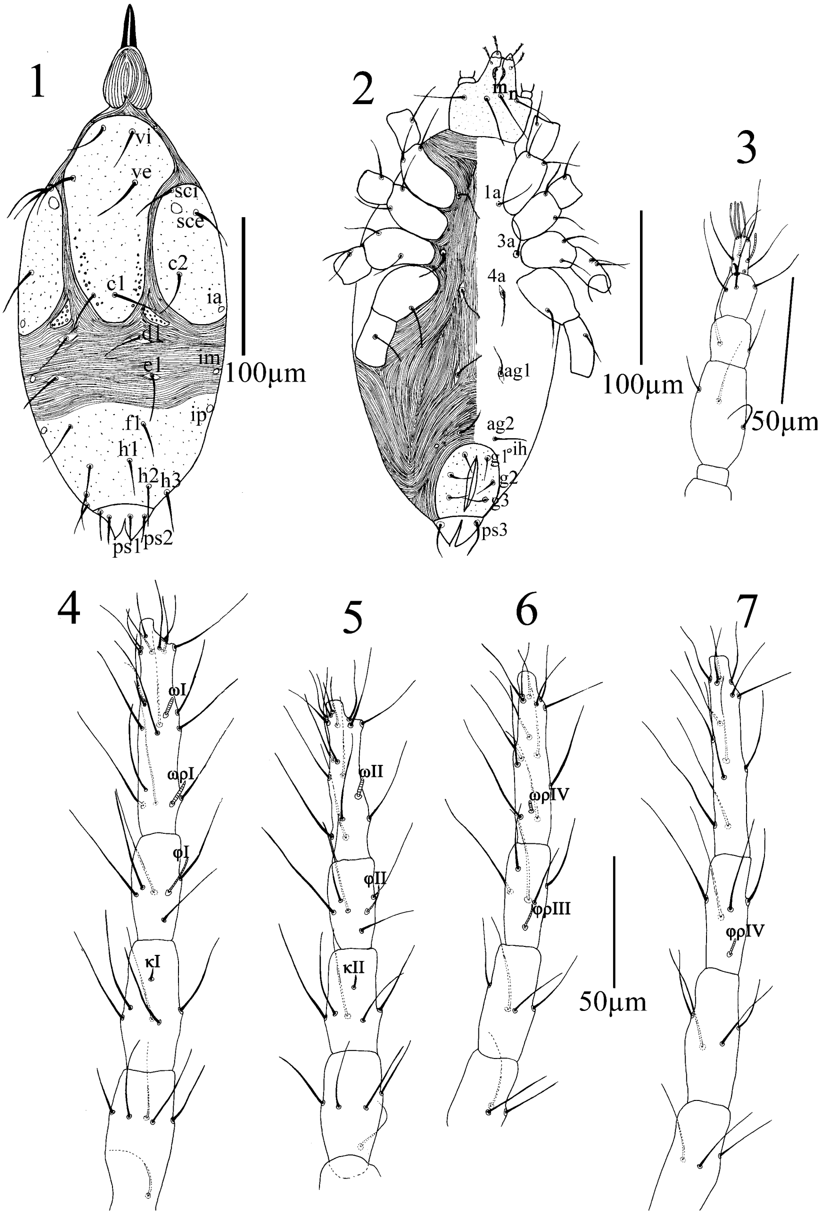
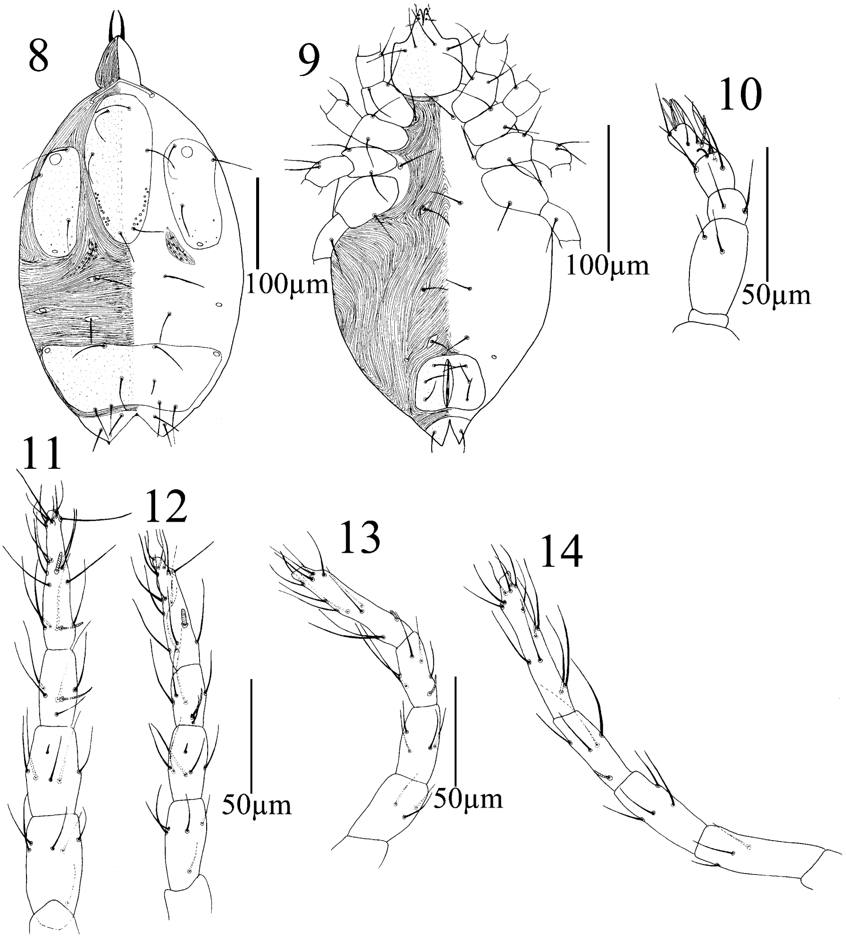
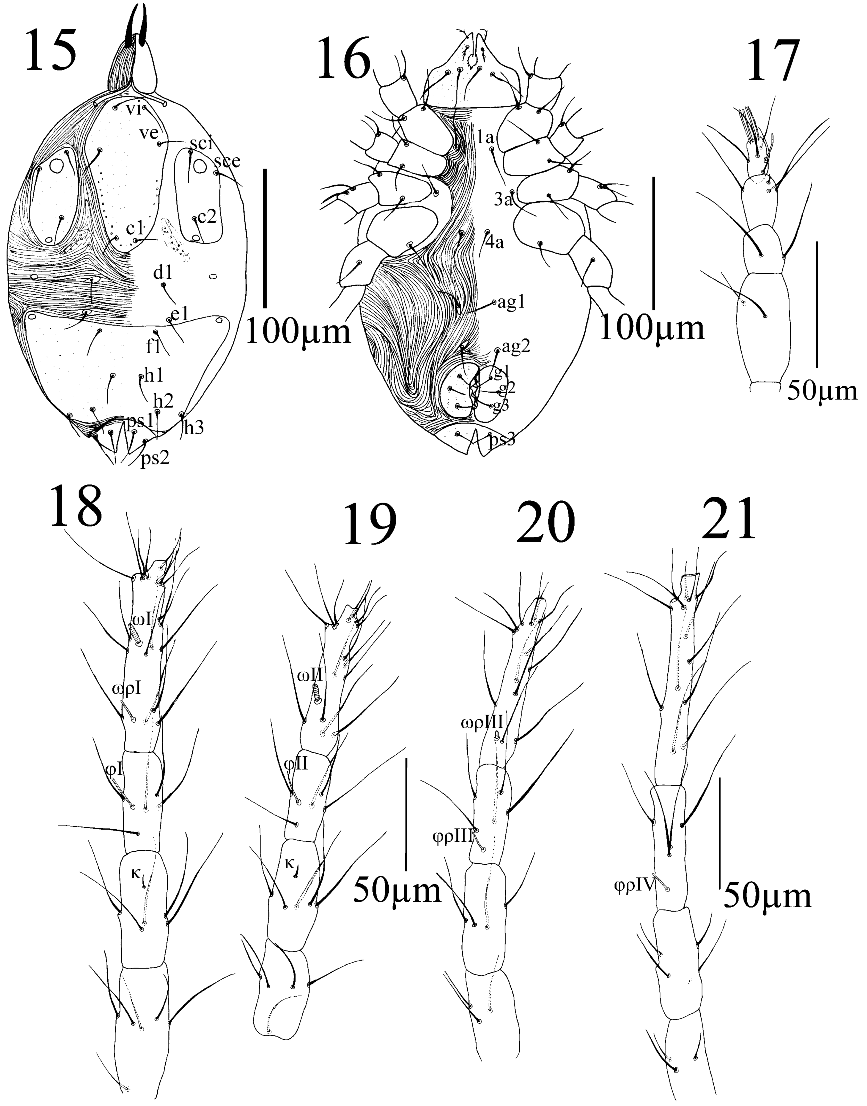


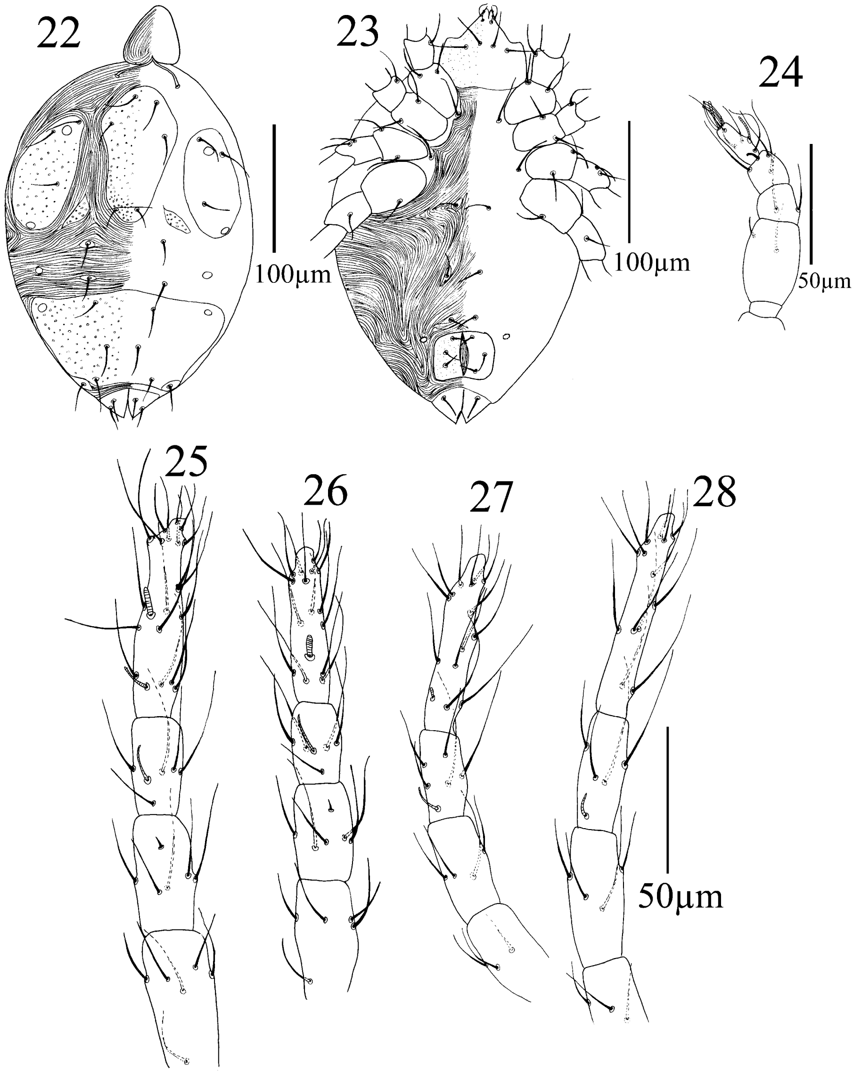
Figures 1-7. *Raphignathus aciculatus* (female): 1. dorsal view, 2. ventral view, 3. Palp, 4. leg I, 5. leg II, 6. leg III, 7. leg IV.



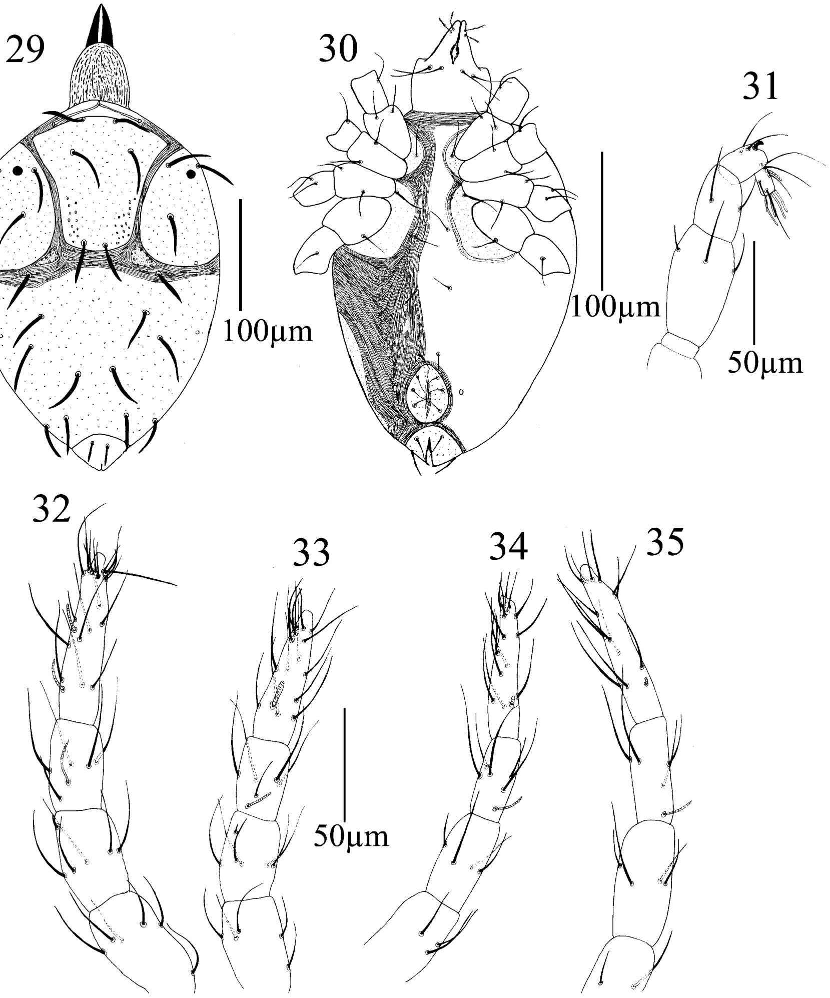
Figures 8-14. *Raphignathus giselae* (female): 8. dorsal view, 9. ventral view, 10. Palp, 11. leg I, 12. leg II, 13. leg III, 14. leg IV.



Figures 15-21. *Raphignathus gracilis* (female): 15. dorsal view, 16. ventral view, 17. Palp, 18. leg I, 19. leg II, 20. leg III, 21. leg IV.



Figures 22-28. *Raphignathus hecmatanaensis* (female): 22. dorsal view, 23. ventral view, 24. Palp, 25. leg I, 26. leg II, 27. leg III, 28. leg IV.



Figures 29-35. *Raphignathus zhaoi* (female): 29. dorsal view, 30. ventral view, 31. Palp, 32. leg I, 33. leg II, 34. leg III, 35. leg IV.

NEW AND LITTLE KNOWN SOME ICHNEUMONIDAE SPECIES (HYMENOPTERA) FROM TURKEY

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[Çoruh, S. & Özbek, H. 2013. New and little known some Ichneumonidae species (Hymenoptera) from Turkey. Munis Entomology & Zoology, 8 (1): 135-138**]**

ABSTRACT: The present contribution is based upon the ichneumonids collected from two different localities (Bayburt and Erzurum) of Turkey (Anatolia), in 1999 and 2003. A total of six species have been recorded in the subfamilies, Banchinae and Ichneumoninae. One genus (*Aoplus*) and five species were new records for the Turkish fauna.

KEY WORDS: Ichneumonidae, Banchinae, Ichneumoninae, new records, Turkey.

The Ichneumonidae (Hymenoptera), is a widespread and extremely large family, with an estimated 60 000 extant species in 35 genera worldwide (Townes, 1969). The Ichneumoninae has a worldwide distribution and is the second largest subfamily of Ichneumonidae with 373 genera and about 1700 species in Palaearctic Region. The species in this subfamily are koinobiont or idiobiont endoparasitoids of Lepidoptera (Rasnitsyn & Siitan, 1981). The Banchinae is another subfamily of the family Ichneumonidae with about 1,500 species worldwide. The tribes Banchini, Glyptini and Lissonotini are distributed worldwide (Townes & Townes, 1978). All Bachinae species are koinobiont endoparasites of Lepidoptera.

The first paper on Turkish Ichneumoninae was published by Fahringer (1922). Kolarov (1995) listed 66 Ichneumoninae species in his catalogue of Turkish Ichneumonidae. Recently, several contributions have been conducted on the Ichneumoninae fauna of Turkey (Özbek et al., 2003; Çoruh et al., 2005; Riedel, 2008a,b; Riedel et al., 2010; Çoruh & Özbek, 2011; Çoruh et al., 2011; Riedel et al., 2011) and the number of Ichneumoninae species occurring in Turkey reached to 178.

The Banchinae fauna of Turkey has not been enough studied. The first data on Turkish Banchinae were published by Kohl (1905). In the catalogue of Kolarov (1995) only 29 species were listed. With recent studies (Özdemir, 1996; Kolarov et al., 1997a,b; Pekel, 1999; Pekel et al., 2000; Kolarov & Gürbüz, 2006; Çoruh, 2008; Çoruh & Çoruh, 2008; Gürbüz et al., 2009) the number of Turkish Banchinae species reached to 78. Despite these contributions on the both subfamilies there are still many localities in the country, where no material has yet been collected.

MATERIAL AND METHODS

Materials were collected by sweeping on flowering plants in the north-eastern Turkish provinces (Bayburt and Erzurum) during 1999 and 2003. All examined material was determined by M. Riedel (Germany) and deposited in the Entomology Museum Erzurum, Turkey (EMET).New records of species are marked by an asterisk (*). General distributions of the species were taken from Yu et al. (2005).

RESULTS

Subfamily Banchinae

******Exetastes crassus*** **Gravenhorst, 1829**

Material examined: Erzurum-Oltu, Aksuyayla, 14.07.1999, 1 female, leg. E. Yıldırım.

Distribution: New record for the Turkish fauna. It is a widely distributed species (Eastern Palaearctic and Western Palaearctic).

Remarks: Although *Aoplus castaneus, Obtusodonta equitatoria, Limerodops subsericans* and *Exetastes crassus* have very large distribution area (Eastern Palaearctic and Western Palaearctic) were recorded from Turkey for the first time. With this contribution, the species of Ichneumoninae occurring in Turkey have increased to 182 in 53 genera and those of Banchinae to 79 species.

Subfamily Ichneumoninae

******Aoplus castaneus*** **(Gravenhorst, 1820)**

Material examined: Erzurum:Ilıca, Rizekent, 2200 m, 10.07.1999, 1 male , leg. Ö. Çalmaşur.

Distribution: New record for the Turkish fauna (as both species and genus). It has wide distribution (Eastern Palaearctic and Western Palaearctic).

******Coelichneumon erythromerus*** **(Rudow, 1888)**

Material examined: Erzurum: Atatürk University Fields, 1850 m, 06.06.2001, 1 male, leg. S. Çoruh.

Distribution: New record for the Turkish fauna. It is distributed in Russia and Ukraine. Erzurum Province is the southternmost distribution record for this species.

Eutanyacra ruficornis **(Berthoumieu, 1894)**

Material examined: Erzurum: Atatürk University Field, 1850 m, 14.07.2003, 1 female, leg. S. Çoruh.

Distribution: New record for the Turkish fauna as well Asia Continent. It has been known only from Algeria. After type locality and since 1894 Turkey (Erzurum Province) is the second record of this rare species.

Limerodops subsericans **(Gravenhorst, 1820)**

Material examined: Erzurum: Oltu, Tutmaç and Başaklı border, 1900 m, 01.07.2000, 1 female, leg. H. Özbek.

Distribution: New record for the Turkish fauna. It has large distribution area (Eastern Palaearctic and Western Palaearctic).

Obtusodonta equitatoria **(Panzer, 1786)**

Material examined: Bayburt: Maden, 1650 m, 16.06.2000, 1 male, leg. S. Çoruh.

Distribution: It is known from Turkey (Istanbul, Ankara, Edirne, and Erzurum provinces) (Kolarov, 1989; Özdemir, 1996; Yurtcan et al., 1999; Riedel et al., 2010). It has wide distribution (Eastern Palaearctic). In the present study Bayburt Province was added to the distribution area.

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BIONOMICS OF *HYBLAEA PUERA* (LEPIDOPTERA: HYBLAEIDAE), A SERIOUS PEST OF TEAK (*TECTONA GRANDIS*) FROM JAMMU (INDIA)

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[Sharma, S., Tara, J. S. & Bhatia, S. 2013. Bionomics of *Hyblaea puera* (Lepidoptera: Hyblaeidae), a serious pest of teak (*Tectona grandis*) from Jammu (India). Munis Entomology & Zoology, 8 (1): 139-147**]**

ABSTRACT: *Hyblaea puera* (Lepidoptera: Hyblaeidae), commonly known as teak defoliator, is recognized as the most serious pest of teak (*Tectona grandis*) in the area under study. Outbreaks of this insect which feeds on young tender leaves occur during the early part of the growth season, soon after the trees have put forth the new flush of leaves. The observations were recorded on the biology of the pest in Jammu under laboratory conditions. The pre-mating period of both sexes of moth was one to three days after emergence. Mating occurred during night and lasts for about an hour. A characteristic courtship behavior was exhibited by the adult moths. Pre-oviposition period was 20- 24 hours and the mean oviposition period was 6 days. It was revealed that the incubation period varies from 1.5 to 3.05 days with an average of 2.51±0.648 days. The larvae passed through five instars and total larval period varies from 15.2 to 20.15 days with an average of 17.62±1.64 days. Pupal period ranges from 6.2 to 8.4 days with an average of 7.16±0.85 days. Total life cycle varied from 21.4 to 28.15 days with an average of 24.79±2.42 days. Pest completed 7 generations in a year from June to November.

KEY WORDS: Biology, *Hyblaea puera*, Lepidoptera, *Tectona grandis*, Jammu, India.

Teak (*Tectona grandis* Linn. f.) is one of the most important and valuable timber trees of the world. It is predominantly tropical or sub-tropical in distribution. Teak forests occur naturally in India, Myanmar, Thailand and Laos and cover an area of about 23 million ha. Teak is also grown in plantations in at least 36 countries throughout the tropics and about 5.7 million ha of teak plantations are recorded (Bhat and Ma 2004) Teak constitutes about 75% of the world's high-quality tropical hardwood plantations (FAO 2001). About 43% of all teak plantations are located in India, 31% in Indonesia, 7% in Thailand, 6% in Myanmar and 5% in tropical Africa. In Africa, teak plantations are mainly concentrated in Côte d'Ivoire, Nigeria, Ghana, Sudan, Togo, Benin and Tanzania. Teak is one of the few woods in the world that has a natural oil to retard water and keeps teak from wrapping, cracking or becoming brittle. It is extensively used in ship building, house building, bridge and wharf construction, furniture, railway carriages, carving, wheel spokes and numerous other purposes. Teak faces many challenges, among which is its susceptibility to insect pests, in particular the defoliators. About 174 species of insects are reported associated with teak (Mathur 1960), but most of them are minor or occasional pests. However, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) is considered as major pest as defoliation caused by them often affects the plant growth adversely (Mathur and Singh, 1960). The present study deals with occurrence, nature of damage and life cycle of the pest on teak in Jammu (J&K) as no report on these aspects from the region is available in order to plan a suitable control measure.

MATERIALS AND METHODS

Larvae and pupae were collected from teak plantations from four different sites viz. Vijaypur, Janipur, Narwal and Arnia. Studies were conducted during the period 2009-2011 when the occurrence of the pest was at peak. Potted teak (*Tectona grandis*) plants were used for the oviposition by the adult females. After oviposition the adults were removed from the cage and eggs were counted by using the stereomicroscope. Eggs laid on the potted plants were allowed to hatch in situ and then the freshly hatched larvae were transferred individually with the help of fine brush to young tender leaves and reared till the adult emergence by changing the food daily. Larvae were reared in normal room temperature and observations were recorded daily to determine the incubation period, number of moultings, number of larval instars, pupal period and total developmental period. The sex of the adults that emerged from the cage was recorded. Number of moultings was determined based on the casted head capsule. The culture was maintained continuously till last generation to know the number of generations completed in one year by the insect pest.

OBSERVATIONS AND DISCUSSION

Distribution

The results revealed the distribution in Jammu and Samba districts of Jammu (J&K); In India pest is found in Dehra Dun – Uttarakhand (Mathur, 1960); Faizabad–U.P. (Pandey et al., 2007); Kerala (Sudheendrakumar, 2003; Nair & Mohandas, 1996; Mathew et al., 1990); Madhya Pradesh (Mishra & Joseph, 1982; Roychoudhary et al., 2003); Coimbatore–Tamil Nadu (Murugan & Kumar, 1996); Mandya–Karnataka (Patil & Naik, 1997) Andhra Pradesh (Pawar & Bhatnagar, 1989) and Port Blair–Andaman (Veenakumari & Mohanraj, 1996).

Hyblea puera is distributed across the tropics and subtropics, covering Asia-Pacific, Africa, Central America, the Caribbean and South America. Pinhey (1979) reported its wide spread in Asia, Australia and America.

Hosts

It is oligophagous pest with teak (*Tectona grandis*) as its principal food plant. Other known food plants, on which it breeds regularly, belong chiefly to the family Verbenaceae (13 species) Bignoniaceae (13 species) and a few other families, such as Araliaceous, Juglandaceae and Oleaceae (1 species each) (Beeson, 1941; Mathur, 1960).

Seasonal occurrence

For most of the year there is no visible defoliator activity. The teak trees put forth a new flush of leaves, generally by April-May, following a brief deciduous period. Then about a month later, usually between June and July, a widespread infestation occurs suddenly, with hundreds of similar aged caterpillars gregariously on the teak canopy. During these outbreaks, each tender leaf of the infested trees may harbor some 30-50 larvae they remain in the field upto the first week of November. When the outbreak is in progress, the faecal pellets falling on dry leaves on the ground can be heard. Larvae descend on silk threads from defoliated trees and are wafted to adjacent trees still holding green leaves. Mature larvae pupate on the ground under litter. Within a week or two, extensive areas of plantations are left totally Leafless. Large-scale outbreaks are common in Myanmar, Thailand, Bangladesh, Sri Lanka and Indonesia during the main flushing period of teak. (Beeson, 1941; Hutcharern, 1990; Tilakaratna, 1991; Nair, 2000).

Nature of damage

Only the larvae feed voraciously and cause significant damage to the tree thereby affecting growth and vigour of the plant. The first instar larva feeds first on the soft parenchyma of the young leaves but acquires soon the power of biting through the smaller veins and cuts a small semicircular or rectangular flap out of the edge of the leaf which it pulls over and fastens to the upper leaf surface, thus forming a small shelter inside which it lies and feeds under the folded or curled leaf edge. As the second and third instar larvae grow, the shelter is to be made large to accommodate within. The whole of the green leaf tissue is destroyed by the larvae, only the largest ribs being left, with small portions of uneaten green tissue.

The fourth and fifth instar larvae prepare shelters everyday by folding over side. The larva feeds within the protection and all the tissues of infested leaves are consumed except larger veins but more veins are left in older leaves. The last instar larvae are voracious feeders. In Jammu conditions, the larvae remain active in field from June to November with peak activity period observed during mid July to September. During this period, it causes maximum damage to the tree. Katagall (1991) reported first and second instar larvae were found to skeletonise the leaf, whereas third instar larvae consume the tender leaves entirely. The fourth and fifth instar larvae were found to feed entire leaf leaving only veins. Further, the observations made by Beeson (1941) indicated that under certain conditions the terminal buds of the tender and lateral shoots are gnawed or wholly destroyed by the larva. This usually occurs only under compulsion of extreme hunger and after complete stripping the leaves. Later forking symptoms are observed because of the death of the terminal bud.

LIFE CYCLE

Premating and mating behavior

Before mating, sexually active adults exhibited characteristic courtship behavior which involves rapid movements within the cage including running or flying, periodic fluttering of wings and raising of body on legs. The female courtship behavior included lifting of wings, curving of abdomen and protrusion and retraction of terminal abdominal segments. At the end of the courtship the mating took place within one to three days after emergence at night only. The male approached the female and exhibited either a clockwise or anticlockwise circling movements and finally remained quite facing the back of the female. At this stage, the male kept its wings raised up. The male then took a 90 degree anticlockwise turn and extended and curved its abdomen towards the female genitalia and established genital contact. Subsequently the male took another 90 degree anticlockwise turn and closed its wings and took the normal position. Thus in copulation the male and female assumed a back-to-back position. On an average the duration of mating was about an hour.

Pre-oviposition and oviposition behavior

A female *Hyblea puera,* which mated during the early morning hours of a particular day, laid its first batch of eggs on the same day evening; the preoviposition period lasted for 18-24 h after mating. Oviposition continued upto a maximum of six days. The moths found to lay eggs in the evening hours. The eggs were usually laid singly near the veins sticking to the lower side of leaf, particularly on young tender foliage. The number of eggs laid was maximum on the first day of oviposition and thereafter decreased. A single female moth lies between 230-300 eggs. Katagall (1991) reported fecundity of moths to vary from 52-686 with an average of 308 eggs whereas Sudheendrakumar (2003) reported that total number of eggs laid by Hyblea puera to vary from 287-606 in the laboratory.

Incubation period and hatching

Freshly laid eggs were small, oval, flat and white in color and measured 0.91 mm in length and 0.53 mm in width. One day prior to hatching, the dark head of the young larva was observed inside the egg shell before hatching. The incubation period varied from 1.5 to 3.05 days with an average of 2.51±0.648. Almost all the eggs laid by a single female were found to hatch when laid during monsoon and post monsoon and was reduced considerably when laid during late October. Chen and Wu (1984) recorded the incubation period as 1.5-5.0 days, Nair (1988) reported 2.0 days and Katagall (1991) recorded 2.0-3.0 days in the laboratory.

Larva and the number of instars

Newly hatched larva was active and pale-reddish or greenish-yellow in color with a black head. It was found to move briskly all over the cage in the laboratory and the first instar fed mainly on the leaf surface. They make shallow depressions on the surface of tender leaf and protect themselves with the strands of silk. The later instar larvae cuts a leaf flap, usually at the edge of the leaf, folds it over, fasten it with silk and feeds from within. There is considerable color variation in the fourth and fifth instars, the body either wholly black or dark grayish to black with longitudinal colored bands that may include a dorsal orange or ocherous band and lateral white lines. The dark and light forms occur together in the same populations. The larva irrespective of the instar, when disturbed wriggled themselves quickly and climbed down the threads from the leaves on which they were feeding. The larvae especially the fourth and fifth instar, when irritated, emitted a dark green fluid, ejected to a considerable distance from its mouth. The larvae were found to undergo ecdysis within the leaf fold. Larvae stop feeding before moulting. Under laboratory conditions, the number of larval instars has been observed to be five on *Tectona grandis*. The total larval duration varies from 15.2 to 20.15 days with an average of 17.62±1.64 days. Katagall (1991) observed five larval instars and total life cycle occupied 17 to 20 days in the laboratory.

Pupation

The full grown larva constructed normally a loose silken cocoon in a triangular leaf fold after stopping feeding but was also observed to construct silken cocoon inside the faecal pellets and parts of eaten leaves inside the cage. The color of the prepupa was pale yellowish. The normal prepupal period lasts for one day in all the seasons. The last larval exuvium and head capsule remained inside the cocoon. The freshly formed obtect pupa was yellowish and gradually reached to dark brown. The total pupal duration ranged between 6.2 to 8.4 days with an average of 7.16±0.85 days in the laboratory. Chen and Wu (1984) recorded the pupal period 6 to 15 days, Nair (1988) 6-8days and Katagall (1991) 5.0 and 9.5 days during May and July under laboratory conditions.

Adult emergence

Emergence of the adult took place during night and early morning hours. Emergence process took about 7-10 minutes where in the males emerged earlier to female moth remained inactive till the wings are fully stretched and dried.

Natural enemies

The investigations helped to recover a total of 9 natural enemies which, consisted of two species of parasitoids, three species of spiders, three species of birds and one species of insect predator. Present observations are more or less in accordance with the reports of Beeson (1934), Beeson and Chatterjee (1935), Garthwaite and Desai (1939), Mathur(1960) who recorded different species of parasites on *Hyblaea puera*.

Number of generations

It was observed that the *Hyblaea puera* completed 7 to 8 overlapping generations in a year in Jammu on *Tectona grandis*. Beeson (1928; 1941) indicated the occurrence of 13 to 15 generations in a year in South India with no resting period either in winter or summer and about 8-10 generations in North India.

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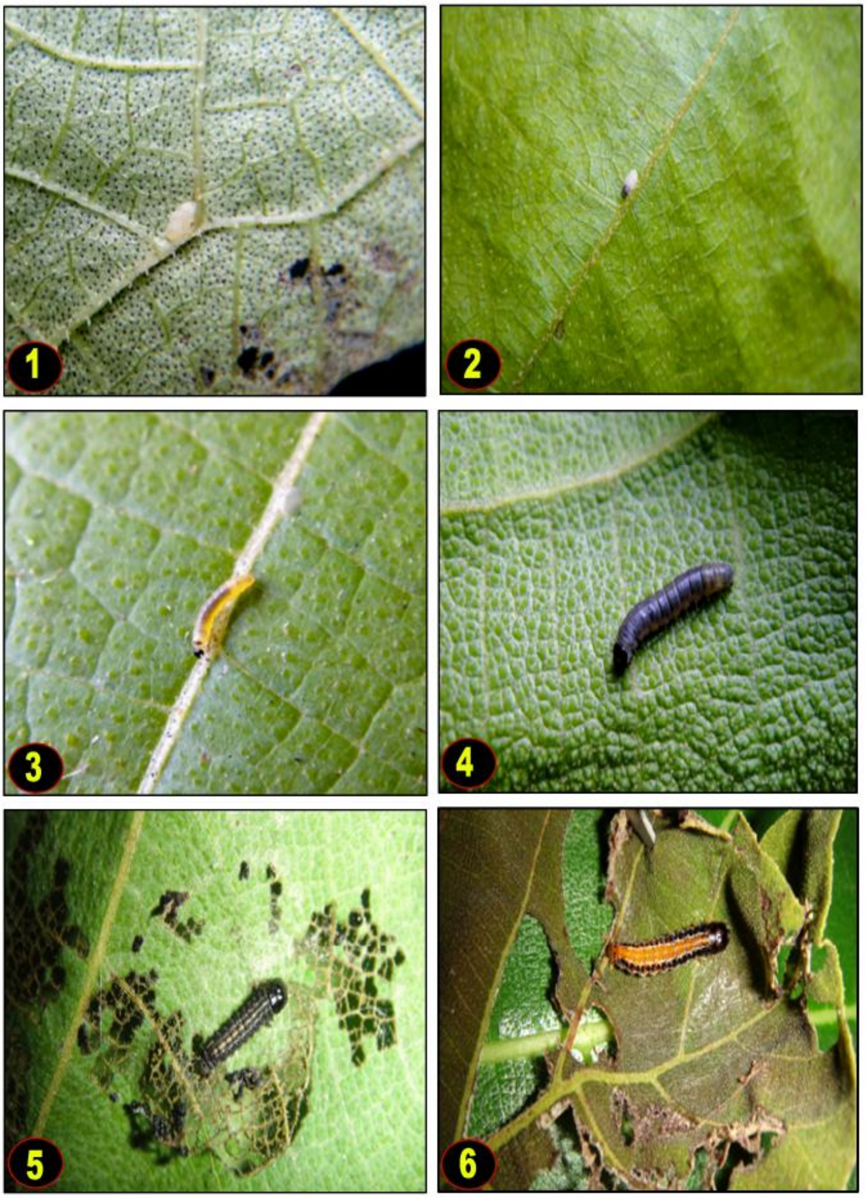
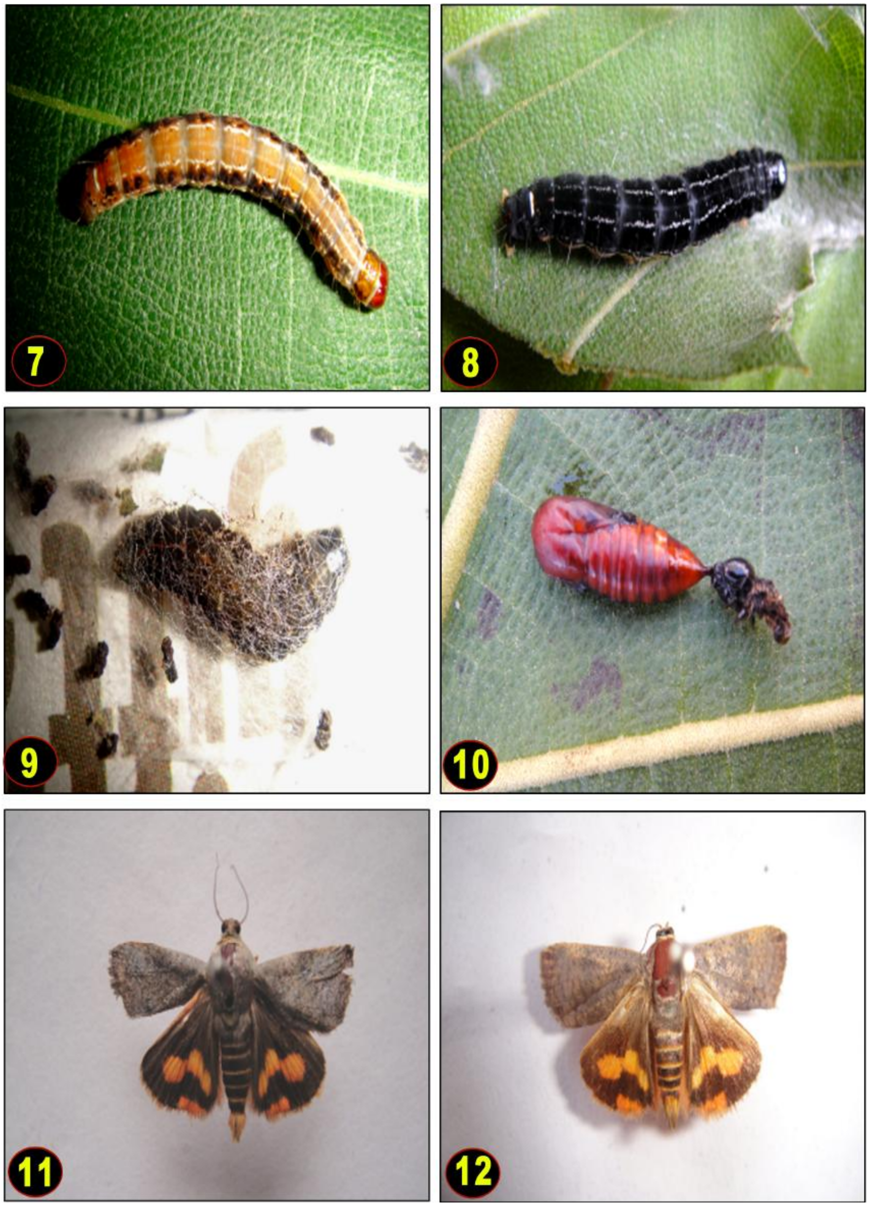
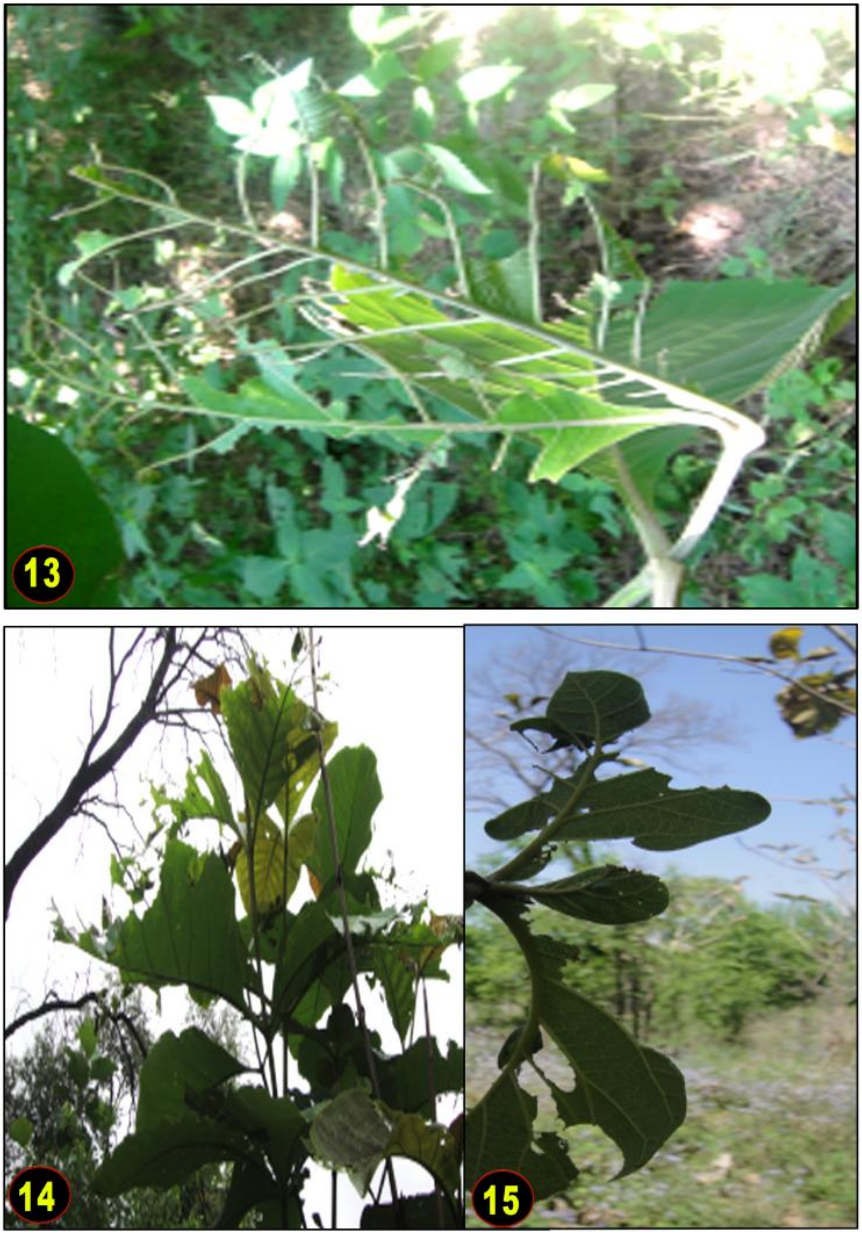


1. Freshly laid egg of *Hyblaea puera,* 2. Egg prior to hatch, 3. 1st instar larva, 4. 2nd instar larva, 5. 3rd instar larva, 6. 4th instar larva.



7 & 8. Two color forms of 5th instar larva, 9. Prepupation, 10. Pupation, 11. Adult male, 12. Adult female.



13 to 15. Damage caused by the pest to *Tectona grandis*.

A SYNOPSIS OF PALEARCTIC GENUS *CALCHAENESTHES* KRAATZ, 1863 WITH A NEW SPECIES OF *C. PRIMIS* SP. N. FROM TURKEY (CERAMBYCIDAE: CERAMBYCINAE)

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[**Özdikmen, H., Aytar, F., Cihan, N., Şamlı, N., Özbek, H. & Kaya, G.** 2013. A synopsis of Palearctic genus *Calchaenesthes* Kraatz, 1863 with a new species of *C. primis* sp. n. from Turkey (Cerambycidae: Cerambycinae). Munis Entomology & Zoology, 8 (1): 148-153]

ABSTRACT: All taxa of the genus *Calchaenesthes* Kraatz, 1863 in the world and Turkey are evaluated. A new species, *Calchaenesthes primis*, is described from S Turkey in the present text. A short identification key of *Calchaenesthes* species is also given in the text.

KEY WORDS: Coleoptera, Cerambycidae, *Calchaenesthes, C. primis*.

The genus is distributed only in Palearctic Region. According to Löbl & Smetana (2010), *Calchaenesthes* Kraatz, 1863 includes only 4 species in the world fauna as *C. diversicollis* Holzschuh, 1977 that occurs in Iran, Iraq and Turkey; *C. oblongomaculata* (Guérin-Méneville, 1844) that occurs in Bulgaria, Greece, Romania, Cyprus, Jordan and Turkey; *C. pistacivora* Holzschuh, 2003 that occurs only in Iran and *C. sexmaculata* Reiche, 1861 that occurs Spain and North Africa (Algeria, Morocco, Tunisia). So the genus is represented only two species in Europe as *C. Oblongomaculata* and *C. sexmaculata*. Also it is represented only two species in Turkey as *C. diversicollis* and *C. oblongomaculata*.

The distribution patterns of members of the genus, however, are relatively local (rather narrow) in real as the following information.

Fifth species of the genus is described here as *C. primis* Özdikmen sp. n.

The members of the genus *Calchaenesthes* Kraatz, 1863 are presented with a new species from Turkey as follows alphabetically:

Calchaenesthes Kraatz, 1863

Type sp.: *Callidium oblongomaculatum* Guérin-Méneville, 1844

Calchaenesthes diversicollis Holzschuh, 1977

Original combination: *Calchaenesthes oblongomaculata diversicollis* Holzschuh, 1977.

Type loc.: W Iran (Luristan).

Range: Iran, ?Iraq.

Chorotype: SW-Asiatic.

Remarks: The species was described by Holzschuh (1977) from Iran: Luristan as a subspecies of *C. oblongomaculata*. According to Holzschuh (2003), *C.*

diversicollis Holzschuh, 1977 is a distinct species. It has been only known from the type locality in Iran. The old W Iranian records of *C. oblongomaculata* [Kermanshah: Ham (Abai, 1969; Awal, 1997); Ilam (Hashemi et al., 2000; Borumand, 2004); Lorestan: Khorram-Abad (Abaii, 2004)], however, should be belong to the species *C. diversicollis*. Also according to Sama (2012), it occurs in Zagros Mts. (15 km SW Dorud) and currently also known of Iraq.

G. Sama is the real author for the genus in Löbl & Smetana (2010). According to the catalogue, the species is distributed in Iran, Iraq and Turkey. However, it has not been any published record from Iraq in real. So the record of Iraq based on the unpublished data of G. Sama.

In addition to this, the records of Turkey should be belong to new species *C. primis* Özdikmen.

Consequently, the species is not known from Turkey. Moreover, the record of Iraq need to be confirmed.

***Calchaenesthes oblongomaculata* (Guérin-Méneville, 1844)**

Original combination: *Callidium oblongomaculata* Guérin-Méneville, 1844.

Type loc.: Greece.

Synonym: *Callidium nogeli* Frivaldszky von Frivald, 1845

Range: E Europe (Balkan peninsula: Bulgaria, Greece, Romania), ?Cyprus, ?Jordan, European Turkey.

Chorotype: Turano-Mediterranean (Balkano-Anatolian).

Remarks: The species was described by Guérin-Méneville (1844) from Greece. As mentioned above, G. Sama is the real author for the genus in Löbl & Smetana (2010). According to the catalogue, the species is distributed in Balkan peninsula, Turkey, Cyprus and Jordan.

The species is very likely distributed only in European Turkey. Since, the synonym taxon *Callidium nogeli* Frivaldszky von Frivald, 1845 was desribed from İstanbul province. However, *C. oblongomaculata* is not distributed in Anatolia for Turkey. Since old records of the species from Anatolia should be belong to new species *C. primis* Özdikmen. Moreover, the records of Cyprus and Jordan need to be confirmed.

***Calchaenesthes pistacivora* Holzschuh, 2003**

Original combination: Same.

Type loc.: SE Iran (Kerman: Sirjan).

Range: Iran.

Chorotype: Iranian endemic.

Remarks: The endemic species was described by Holzschuh (2003) from Iran. It has been only known from the type locality. After description, it was also recorded by Abai (2004) from Kerman: Institu of Sirjan. The old SE Iranian records of *C.*

oblongomaculata [Kerman: Sirjan as *C. oblongomaculata* (Hashemi et al., 2000; Borumand, 2004)], however, should be belong to the species *C. pistacivora*.

Calchaenesthes primis **Özdikmen sp. n.**

(Figs. 1, 2)

Material examined. Holotype ♂. Turkey: İçel prov.: Mut, Erosion area, 05.IV.2006, *Quercus coccifera*, leg. Fatih Aytar. Allotype ♀. The same locality. The specimens are conserved in Entomology Department of Eastern Mediterranean Forestry Research Institute (İçel province, TURKEY).

Description of the holotype ♂.
Length: 10.125 mm.
Body black with rather regular, long, black hairs (including head, pronotum and elytra). Body with dense, deep punctation completely (the punctation like a honeycomb especially on head, pronotum and elytra). Head black. Pronotum black with regular, uninterrupted, reddish colored edges except posterior angle and near. Pronotum with relatively strong medio-lateral dental extensions on sides. Anterior and posterior angles distinct. So the lateral sides of pronotum extend almost linear between angles and medio-lateral extension. Pronotum wider than long (1.23 : 1). Scutellum black. Elytra with four black spots. A pair of spots placed on basal half of elytra. These spots are longitudinal, large, oblong and never reaching the suture. The another pair of spots placed on postmedian part of elytra. These spots are almost circular and never reaching the suture too.

Variability: The body length varies from 8.875 (female) to 10.125 (male) mm. Pronotum wider than long (1.23 : 1 in male; 1.26 : 1 in female). Female differ from male by shorter antennae and completely black postero-lateral sides of pronotum.

Discussion: The new species close to *C. diversicollis* and *C. oblongomaculata*. The new species differs from *C. oblongomaculata* by medio-lateral extension on pronotum, very small postmedian spots on elytra. Moreover, pronotum wider than long 1.4 : 1 (according to Holzschuh, 1977) in *C. oblongomaculata,* but 1.23-1.26 : 1 in *C. primis*.The new species differs from *C. diversicollis* only by basal black spots on elytra that never reaching the suture. So the new species more close to *C. diversicollis* than *C. oblongomaculata*.

Distribution: The known old records from Anatolia should be belong to the new species [Gaziantep prov.: Islahiye as *Purpuricenus oblongomaculatus* (Demelt, 1963); Niğde prov.: Cilician Taurus, Çiftehan, Siirt prov.: Şirvan as *C. oblongomaculata* (Holzschuh, 1977); Adıyaman prov.: Karadut village env. as *C. oblongomaculata* (Rejzek & Hoskovec, 1999); İçel prov.: Erdemli- Güzeloluk, Amasya prov.: Aydınca, İnegöl Mt. as *C. oblongomaculata* (Malmusi & Saltini, 2005); İçel prov.: Erdemli as *C. oblongomaculata* (Hoskovec & Rejzek, 2012); Mardin prov.: 33 km SE Midyat, Haberli as *C. oblongomaculata diversicollis* (Hoskovec & Rejzek, 2012) (Map 1).

Calchaenesthes sexmaculata **(Reiche, 1861)**

Original combination: *Anoplistes oblongomaculatum* var. *sexmaculatum* Reiche, 1861.

Type loc.: Algeria.

Synonyms: *Calchaenesthes quadrimaculata* Pic, 1912; *Calchaenesthes juncta* Pic, 1922; *Purpuricenus parvimaculata* Rungs, 1947.

Range: W Europe (Spain), North Africa (Algeria, Morocco, Tunisia).

Chorotype: N-African + W-Europe.

Remarks: The species was described by Reiche (1861) from Algeria as a variety of *C. oblongomaculata*.

A short key for identification of *Calchaenesthes* members

1. Pronotum without any medio-lateral extension; postmedian spots on elytra large and oblong……………….***C. oblongomaculata* (Guérin-Méneville, 1844)**

--- Pronotum with more or less distinct, medio-lateral dental extensions; postmedian spots on elytra small……………………………………………………………**2**

2. Elytra with six black spots……………………….***C. sexmaculata* (Reiche, 1861)**

--- Elytra with four black spots…………………………………………………………………**3**

3. Pronotum almost completely black (except reddish anterior angles)……………… ……………………………………………………………***C. pistacivora* Holzschuh, 2003**

--- Pronotum with reddish edges at least in anterior half…………………………………**4**

4. Basal black spots on elytra always reaching the suture…………………………………… ……………………………………………………………***C. diversicollis* Holzschuh, 1977**

--- Basal black spots on elytra never reaching the suture…………………………………… ……………………………………………………………………………***C. primis* Özdikmen sp. n.**

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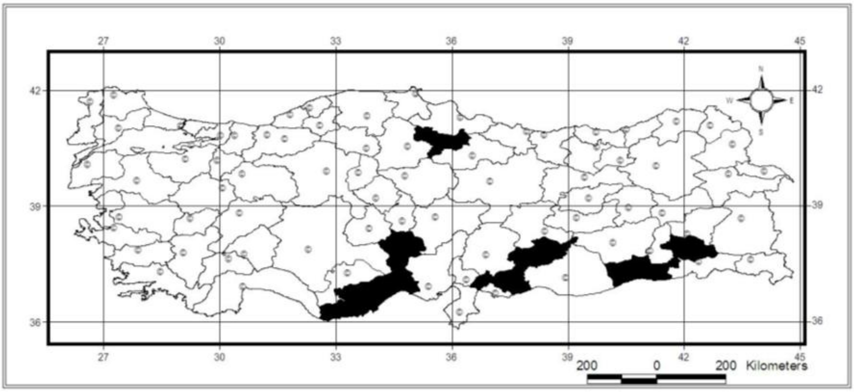

Map 1. The known distribution area of *Calchaenesthes primis* Özdikmen sp. n.

Figure 1. General habitus of *Calchaenesthes primis* Özdikmen sp. n. (Holotype).

Figure 2. General habitus of *Calchaenesthes primis* Özdikmen sp. n. (Allotype).

SURVEY OF MORPHOMETRIC FEATURES OF PALM SQUIRREL, *FUNAMBULUS PENNANTII* WROUGHTON, 1905 IN IRAN

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[Yousefi, S., Izadian, M. & Kheradpir, N. 2013. Survey of morpho-metric features of Palm Squirrel (*Funambulus pennantii* Wroughton, 1905) in Iran. Munis Entomology & Zoology, 8 (1): 154-161**]**

ABSTRACT: Species data recording and echo-niche characteristics of Palm squirrel, as one of the unique species in Iranian fauna (Sistan-Balouchestan province) were conducted in Chabahar, Nikshahr and Sarbaz states throughout a year, February 2008-February 2009. Two trapping stations have been considered for each state. Of forty animal trapped, number of palm squirrel males and females were 23 and 7 respectively with the sex ratio of 1:1.3. There was no significant difference in measured features between males and females. The highest weight was recorded as 123.5 g. and the lowest as 50 g.. Moreover; the longest body length of animal and the shortest were 292 and 127 centimeter, respectively. Two features, head-body length and ear size showed significant difference among animals caught from three states. Regression analysis among features showed correlation between head-body length and leg length. On the other hand, ear size and leg length had significant correlation.

KEY WORDS: Palm Squirrel, *Funambulus pennantii,* Iran, Biology.

Palm Squirrel, *Funambulus pennantii* Wroughton, 1905 is a rodent species in Sciuridae family, suborder Sciuromorpha and the order Rodentia. It is naturally found in south-east Iran, Pakistan, India and Nepal (Nowak, 1999).

Distribution pattern of the species has been studied in Australia, also data about its niche and behaviour are provided (Barrett, 1934; Sedgwick, 1968; Watts & Aslin, 1981; Seebeck, 1984) and moreover, in addition to the mentioned academic study, it was analyzed out of Australia especially in India and Pakistan (Wright, 1972).

Dense hairs and wooly- thick tail are the major morphological features of the species. Also, this species can be distinguished by its considerable flat head and neck, big eyes and triangular or circular sensitive ears. Five light-colored lines on their back, three from neck to the end of the tail and the other two externals are seen till leg. Head color is grey from auricle to their ear-backs and conjugate with dark back lines.

Sometimes there are some yellow spots is some parts of the body especially on back. Ventral section goes to white, legs are grey on back and white on internal parts. They have long and shaggy tail covered by white and black hairs. Dorsal part of the tail is blacker and inclines to grey in ventral part. Long hairs cover the end of the tail, mostly black in color and turn to white at the end. Auricles are medium sized, rarely there is any ungula on legs, if there is, they are dark on the base and light to the end.

***Feeding*:** This species is mainly herbivorous but some carnivorous feature has been reported as its feeding preference. They strip of the bark especially in farms with fig and plane trees which lead to considerable damage. Sometimes insect larvae and pupae are fed in small amount, also. Madso (1964) reported that insects comprise to four percent of their food regime. Squirrels pray on eggs and young of birds, frogs and lizards. In addition, they provide and absorb some vitamins through feeding on soil and mines. D vitamin is produced by sunshine in their furry skin and absorbed during self-cleaning process (Barkalow & Shorten, 1973). Although squirrels provide their needed water via food, they drink. They are mainly gallinaceous throughout the year, but it is seen that they feed on leaves and soft and sweet fruits in autumn and insects especially grasshoppers in summer. They never save food and mostly rehabilitate close to human and consume on kitchen remains especially bread. Scalan et al. (1978) reported the fruit, tree leaves and food remains are among their diet.

***Reproduction*:** Male squirrels gather around females to find their own mate. Reproduction starts by chasing and perusing and leads to tail-biting by several males. Males engage in a battle for 10-20 minutes to obtain their own female. Polygamous females mate with one or several males for 3-4 times in a day. In suitable weather and abundant food, they reproduce in most of the months.

Males are sexually inactive from November to January. Females usually try to make a nest within a week after mating and cover inside with dry herbs, plant fibers, cotton and feather. Normally, the bests time for birth is late-winter to summer. Pregnancy period lasts about 42 days and generally 2-3 babies (up to 5) can be born in a nest full of fiber and herbs on a tree or wall. They usually get milk to the tenth month old, although maturity occurs in 8-9 months old. Adult females can give birth to their children twice a year. Older females, more annual accouchements. Totally, pregnancy depends on food availability and climate condition through reproduction season.

Growth and development: Pal squirrels are pink and naked at birth, however their back-lines are hardly visible. Sensory hairs (around nose and mouth) exist and they have closed eyes and curly auricles. Head and body length is about 50 mm, tail up to 30 mm, legs 12.5 mm and they weigh 5-8 grams. They can open their eyes in 15-25 days old; the auricles unfold in 7-10 days after birth. They furry skins grow monotonously and their back lines are embossed in the second week, as the animal turns to adult colors in 8-10 weeks old. Teeth's are hardly visible at birth but bicuspid teeth can be seen in one week old babies. Teeth` structure of adults is completed in 12-13 weeks and more than 70% of development occurs within eight weeks after birth.

MATERIAL AND METHODS

Sampling and bioassay: To bioassay palm squirrels in considered area, animal sampling method by preying and trapping them was chosen. Trapping was done in (Sistan-Balouchestan Province) throughout in Chabahar, Nikshahr and Sarbaz states in a year, February 2008-Feb. 2009. Geographical features of each state are provided in table as below. Selection of the sampling units was upon the residents' reports and field observation. During sampling in summer and autumn, total number of 40 squirrels was trapped.

To bioassay the captured animals, digital balance and caulis for measuring head and body length, tail length, leg length, ear length and head width. Samples were released after biometry, sex determination and taking photo.

Geographical features of the sampling units

	state	Station (village)	Height (m)	N °	E°
1	Chabahar	Delgan	2.5	25°47'3″	61°24'92″
2	Chabahar	Mandirou	10	25°59'23″	61°7'83″
3	Sarbaz	Kahir	59	25°90'73″	61°51'57″
4	Sarbaz	Rasak	403	26°23'49″	61°39'4″
5	Nikshahr	Zirak Abad	449	26°21'71″	60°23'23″
6	Nikshahr	Shagim Bala	864.5	26°45'3″	60°18'26″

RESULTS

Sampling started on February 2007 and continued to February 2008. totally forty palm squirrels were trapped that 23 were male and the others, female. Complete biometry test was conducted on samples and the results are shown in Table 1.

As the results reveal, the weightiest and lightest squirrel was measured as 123.5 g. and 50 g, respectively. Mean weight of squirrels was about 96 g. The longest and shortest head and body length were measured as 292 mm and 127 mm, respectively; mean length of head and body was equal to 222 mm among captured samples. In tail length, the longest tail was recorded as 157 mm and the shortest as 90 mm, the mean length of tail was measured as 133 mm. Maximum length of leg in trapped samples was recorded as 41 mm and the minimum observed sample was 25.6 mm; mean length of leg was 36.5 mm. The most stretched ear was 20 mm and the smallest one as 12 mm; mean length of ear was equal to 16.5 mm. The widest and thinnest head was recorded as 22 mm and 20 mm, respectively; mean head width was measured as 21 mm among samples. Traits frequencies were measured for each trait and are shown in figure 1-6.

Mean differences for all traits between sexes: T-test was used to obtain significant difference for all traits between sexes and the results showed there were no significant differences between sexes in any trait (Table 2). The frequency of traits observed in two sexes are shown in figure 7.

Mean differences for all traits among sampling units: Two main traits, head and body length and ear size, showed significant difference among sampling units; the difference among the other traits was not significant. The results of ANOVA test are given in Table 3.

Correlation among the morphological traits: According to regression analysis, there were significant correlation between head-body length, ear size and leg length. On the other hand, there was significant correlation between ear size and leg length. Differences between the other regression indices were not significant (Table 4).

DISCUSSION

As among total 40 trapped samples, 23 were male and 17 were females, sex ratio was calculated as 1:1.3 which can be accorded to previous data in India (1966-1967) that males squirrels occupy the most portion of adult population. Purohit et al. have stated that longevity can be more in isolated males than females, they reported sex ration as 1:1 at birth but females mortality through life span makes it to 1:2.3 (Purohit et al., 1966; Prasad et al., 1966; Chaudry & Beg, 1977).

The comparison of the obtained results in this study with Wright (1972) and Watts & Aslin (1981), the mean weight of palm squirrel was reported as 135 g which can get to 200 g.; variation in habitat and food availability and other environmental features would lead to these differences. Scalan et al. (1978) studied nine squirrels and reported their mean body length as 243 mm (in 200-300 mm range). One sample in west Australia measure as 292 mm in its head-body length. Available reports based on rare previous studies in Iran indicated: head-body length 133-143 mm, tail length 145-185 mm, leg length 32-37 mm, ear size 13-18 mm (Ziaee, 1997; Etemad, 1977). So the results obtained in this study have several similarities to the previous data.

As there was no significant difference among two sexes in traits, there is no difference in their developmental rate and difference in measurement can be due to their feeding diet and there is no relation to sexuality.

Significant difference in just two traits, head-body length and ear size, among sampling units could be also related to variation in plant canopy and food availability which would lead to different growth rate in squirrels.

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1

2

Pictures 1-2. 1. Palm squirrel in nature, 2.Palm squirrel in urban area.

3

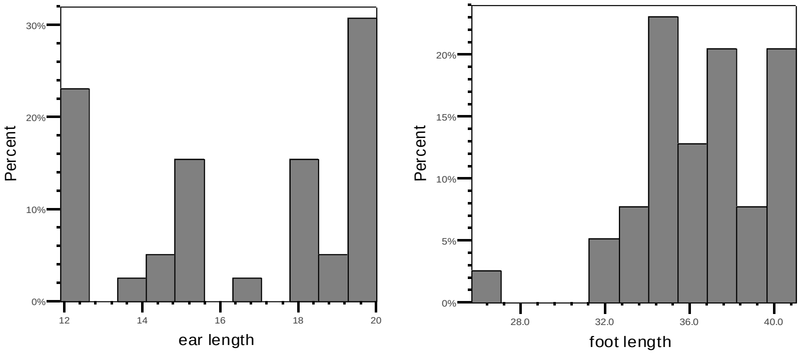
4

Pictures 3-4. 3.Male and female squirrel on a palm tree, 4. Trapping palm squirrels by net.

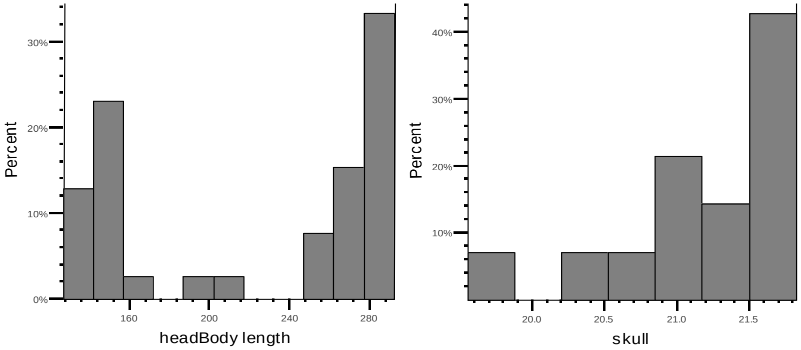
Picture 5. Sampling palm squirrels by trap.

Table 1- Data obtained through biometery (measurements are given in mm).

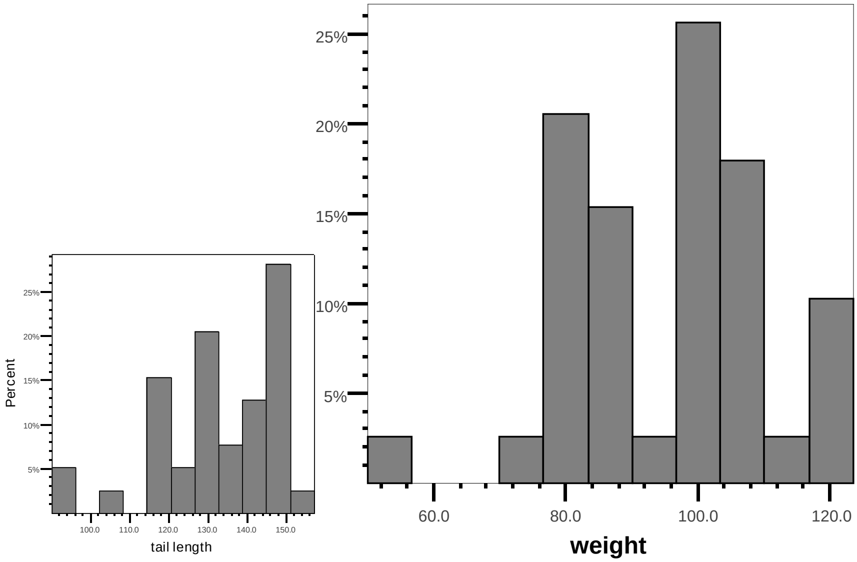
trait	Minimum	Maximum	Mean		Standard deviation
			measurement	Standard error	
Weight	50.0	123.5	96.244	2.4614	15.3712
Head-body length	127	292	222.26	10.418	65.060
Tail	90.0	157.0	133.098	2.5668	16.0299
Leg	25.6	41.0	36.516	.4745	2.9632
Ear size	12	20	16.57	.497	3.103
Head width	20	22	21.19	.164	.613



Figures1-2. 1. Ear size frequency, 2. Foot length frequency.



Figures 3-4. 3. Head-body length frequency, 4. Head width frequency.



Figures 5-6. 5. Tail length frequency, 6. Body weight frequency.

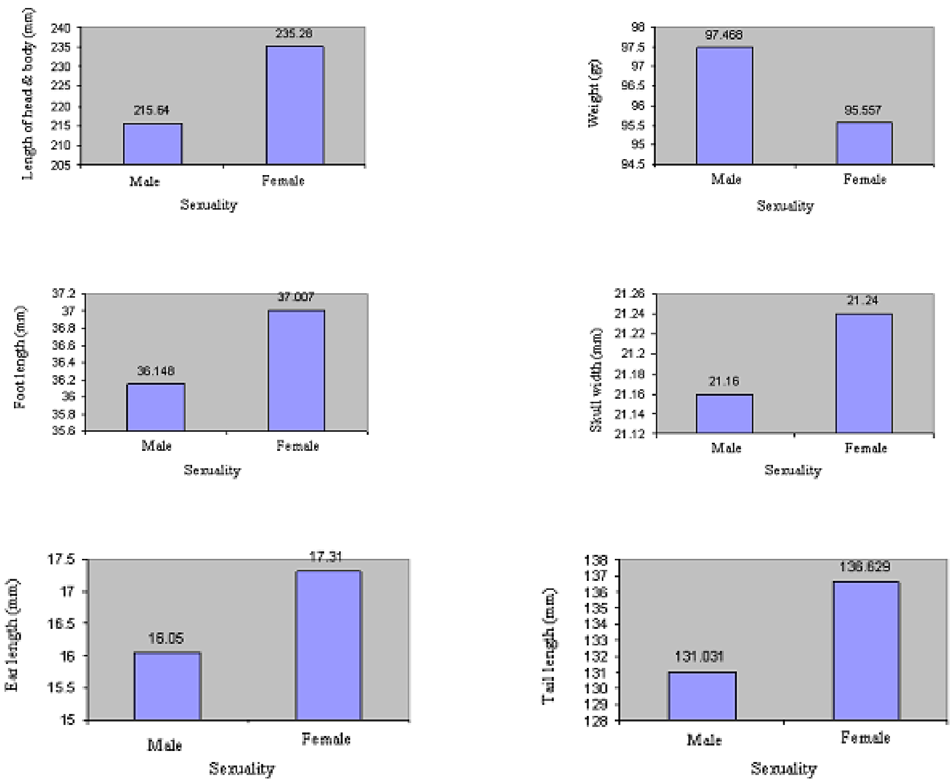


Figure 7. The frequency of traits observed in two sexes.

Table 2. The differences in traits between sexes.

Trait	**sex**	**Mean**	**Standard deviation**	**Standard error mean**
Weight	Male	97.468	17.4362	3.8049
	female	95.557	12.8968	3.1279
Head-body length	Male	215.64	69.496	15.165
	female	235.28	57.924	14.049
Tail	Male	131.031	16.1661	3.5277
	female	136.629	15.7329	3.8158
foot length	Male	36.148	3.4690	.7570
	female	37.007	2.3138	.5612
Ear size	Male	16.05	3.203	.699
	female	17.31	2.992	.726
Head width	Male	21.16	.742	.247
	female	21.24	.340	.152

Table 3. ANOVA results.

Traits	**sampling site**	**SS**	**df**	**MS**	**F**	**P**
Head-body length	Intra-sampling sites	107615.032	5	21523.006	56.922	.000
	Inter-sampling sites	10587.216	28	378.115		
	total	118202.248	33			
Ear size	Intra-sampling sites	246.359	5	49.272	22.570	.000
	Inter-sampling sites	61.126	28	2.183		
	total	307.484	33			

Table 4. Regression analysis of the traits.

Trait		weight	Head-body length	Tail length	Foot length	Ear size	Head width
Weight	Regression index	1	-.020	.216	-.145	-.093	.392
	P		.903	.187	.380	.572	.166
	n.	39	39	39	39	39	14
Head-body length	Regression index	-.020	1	.300	.342(*)	.856(**)	.338
	P	.903		.063	.033	.000	.237
	n.	39	39	39	39	39	14
Tail length	Regression index	.216	.300	1	.100	.259	-.107
	P	.187	.063		.545	.111	.715
	n.	39	39	39	39	39	14
Foot length	Regression index	-.145	.342(*)	.100	1	.323(*)	-.473
	P	.380	.033	.545		.045	.088
	n.	39	39	39	39	39	14
Ear size	Regression index	-.093	.856(**)	.259	.323(*)	1	-.015
	P	.572	.000	.111	.045		.960
	n.	39	39	39	39	39	14
Head width	Regression index	.392	.338	-.107	-.473	-.015	1
	P	.166	.237	.715	.088	.960	
	n.	14	14	14	14	14	14

FIELD TRIAL OF TWO PROMISING CASTOR GENOTYPES FOR ERI SILKWOM, *SAMIA RICINI* (DONOVAN) REARING

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[Sarmah, M. C., Basumatary, B. K., Saikia, S., Das, G. & Khanikar, D. 2013. Field trial of two promising castor genotypes for Eri Silkwom, *Samia ricini* (Donovan) rearing. Munis Entomology & Zoology, 8 (1): 162-166**]**

ABSTRACT: A study was made to evaluate promising genotype of castor for eri silkworm, *Samia ricini* (Donovan) rearing. Finally, two accessions Acc.003 and Acc 004 showed an average of 344.70 g and 334.50 g of leaf biomass/plant respectively and the yield was stable in three conjugative years. Howe ever to study its performance in different geographical zones the field trial was conducted in four locations Mangaldoi, Lakhimpur, Kokrajhar and Diphu of Assam in the North East Region of India. In the field study both the varieties showed conformity with institute's result.

KEY WORDS: Castor, Eri silkworm, locations, field trial.

The North East region of India is surrounded by the Himalayan ranges and flanked by the river Brahmaputra and Barak valleys. The region lies between 22–29◦ N latitude and 90–97^{0} E longitude with a geographical area of 2.55 lakhs km2. The altitude varies from 30 to 4500 m in different parts of the region. Many parts of the region are geographically different with foothills to marshy lands, dry lands, urban and flood affected areas. The state experiences a very hot-humid weather during summer with an average temperature of 30 ^{o}C (7–38.5 ^{o}C). The annual rainfall ranges between 1500 and 2600 mm with average moderate humidity (75%). The congenial climate of this region made it as natural reservoir of floral and faunal biodiversity. Eri-silkworm *Samia ricini* (Donovan) is multivoltine and polyphagous in nature feeding on a number of host plants namely Castor, *Ricinus communis* L.; Kesseru, *Heteropanax fragrans* (Roxb.) Seem; Tapioca, *Manihot esculanta* Crantz; Korha, *Sapium eugeniifolium* Buch-Ham; Payam, *Evodia flaxinifolia* Hook; Borpat, *Ailanthus grandis* Prain; Borkesseru, *Ailanthus excelsa* Roxb; Gulancha, *Plumeria acutifolia* (Poir); Papaya, *Carica papaya*; Bangali era, *Jetropa curacus* L. and several others (Sarmah, 2005). Castor (*Ricinus communis* L.) is an economically important plant for production of industrial oil as well as used as primary food plant for rearing of eri silkworm, *Samia ricini* (Donovan). A total 72 accessions of castor were maintained at CMER&TI, Lahdoigarh, collected from different parts of North East India under NATP programme. The accessions were characterized based on descriptor and 7 promising accessions *viz.*, Acc 003, Acc 004, Acc 011, Acc 020, Acc 030, Acc, 036, Acc 056 were preliminarily selected on the basis of higher leaf yield (Gogoi, 2006). The biomass yield of seven selected castor accessions were studied to find out a promising castor genotype in terms of growth and biomass yield, nutrient status, disease and pest resistant together with eri silkworm rearing performance and compared with control Acc 001. During the study the accessions, Acc.003 and Acc 004 yielded an average of 344.70 g and

334.50 g of leaf biomass/plant respectively and the yield was stable in three conjugative years (Sarmah *et al.*, 2011). Further, to study its performance in different geographical zones a field trial was conducted during 2010-11 in four locations Mangaldoi, Lakhimpur, Kokrajhar and Diphu of North East Region of India.

MATERIALS AND METHODS

The accessions Acc-003 and Acc-004 which has been evaluated as promising castor genotype were utilized for filed trial. 40 nos. of plants were raised from each accession with 3 replications following standard Package of Practices (Sarmah, 2004) at 4 (four) locations *viz.*, Mangaldoi, Lakhimpur, Kokrajhar and Diphu.

PLANTING PROCEDURE

Land preparation

Land was pulverized by 2-3 times ploughing and cross ploughing to a depth of 20-25 cm and leveled for facilitating good root penetration and easy weeding.

Spacing

For sowing of seeds, pits of 20x25x25cm size were prepared maintaining 1x1m spacing. In each pit, 1 kg FYM was added as basal dose and incorporated with soil.

Seed sowing

Two seeds per pit at a depth of 2.5–3.0 cm were sown. Only one healthy seedling per pit was allowed for vigorous growth after germination.

Application of fertilizer

Chemical fertilizer NPK @ 90:40:20 kg /hectare was applied as 1st dose of fertilizer after completion of one month of the germination of the seeds. As 2nd dose, 30 kg nitrogen/ha was applied after attaining the age of three months.

Weeding & inter-culture operation

Ploughing, hoeing, weeding, *etc.* was carried out timely after and before application of fertilizer for healthy growth and better leaf yield.

Growth parameters

The all growth data were collected from centrally located plants by plants of avoiding boardering area of the experimental plantation.

1. Plant height (cm) up to spike
2. No. of branches/plant at mature stage
3. Internodal distance (cm) measurement at mature stage
4. No. of node on main stem mature stage
5. No. of leaf at each harvest time
6. Leaf yield/plant (kg) after 2.5-3.0 months of plantation at 4 seasons at February, March, May, June.
7. Seed yield/plant (g) at 1 season.

RESULTS

The plant height was recorded 0.942 m. in the institute's showed the range of 0.98m to 1.11 m in field study, with less deviation of result. Likewise the internodal distance was ranging from 0.36 cm to 0.42 cm in field trial in relation to 0.38 in institute observation. Other data such as number of node, number of branch, seed yield data of field trial was att par with institute data. Most important data leaf biomasss yield was ranging from 335.00 g in Acc 003 and 326.67 g in Acc 004 field trial was at par with institute observation i.e., 344.70 g and 334.50 g of leaf biomass/plant respectively in both the accessions.

DISCUSSION

During field study in four different geographical locations different growth parameters like Plant height, No. of branches, Internodal distance, No. of node, No. of leaf and Leaf yield/plant were recorded at 4 seasons at February, March, May, June showed less variation with institute's result. Like wise Seed yield/plant was also at par with institute result.

CONCLUSION

From the overall study it may be concluded that the both variety Acc 003 and Acc 004 may be recommended for commercial exploitation.

ACKNOWLEDGEMENT

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Figure 1. Experimental plot of field trial of castor accessions.

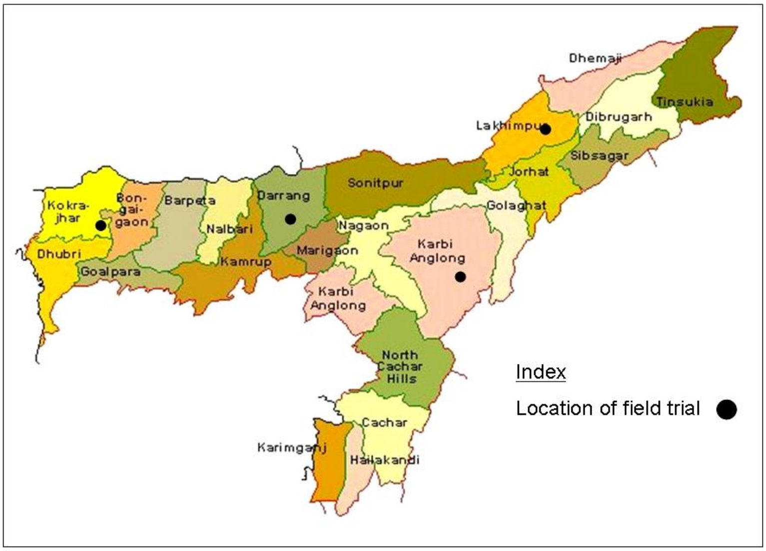

Figure 2. Map showing four locations of field trial in Assam.

Figure 3. Eri silkworm feeding on castor leaves.

Table 1. Growth parameters of castor varieties in the field trial.

Castor Acc.	Plant height (m)	Internodal distance (cm)	No. of node	No of Branch	No. of leaf	Seed yield/ plant (g)	Leaf biomass/plant /harvestyear (Av. 4 harvest) (g)
Mangaldai, Darang, Assam							
Acc-003	1.01	0.38	24.33	3	32.67	56.67	340.33
Acc-004	1.11	0.40	25.00	2.67	31.00	53.00	326.67
Diphu, Karbi Anlong, Assam							
Acc-003	1.09	0.41	26.33	3	34.00	60.67	354.33
Acc-004	1.14	0.42	26	3	30.67	51.33	328.33
Lakhimpur, North Lakhimpur, Assam							
Acc-003	0.96	0.36	22.67	2.67	31.33	53.33	341.67
Acc-004	1.10	0.39	25.67	3.33	32.67	53.67	328.33
Kokrajhar, BTAD, Assam							
Acc-003	1.07	0.38	25.67	3	33	52.33	335.00
Acc-004	0.98	0.39	25.33	3.33	31.67	51.67	332.33
Institute’s data							
Acc 003	0.942	0.38	24.17	4.83	31.83	53.67	344.70
Acc 004	1.05	0.37	27.00	3.00	25.83	35.00	334.50
Mean	1.05	0.39	25.22	3.18	31.47	52.13	336.62
Standard Error	0.02	0.01	0.39	0.20	0.70	2.09	2.75
St.Deviation	0.07	0.02	1.24	0.62	2.22	6.62	8.69
Confidence Level(95.0%)	0.05	0.01	0.89	0.44	1.59	4.74	6.22

EVALUATION OF EFFECTS OF DIFFERENT EXPERIMENTAL COMPOUNDS ON MIDGUT LIPASE ACTIVITY IN *GALLERIA MELLONELLA* L. (LEPIDOPTERA: PYRALIDAE)

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[**Alipour, E., Farsbaf Pour Abad, R., Valizadeh, M. & Mohammadi, D.** 2013. Evaluation of effects of different experimental compounds on midgut lipase activity in *Galleria mellonella* L. (Lepidoptera: Pyralidae). Munis Entomology & Zoology, 8 (1): 167-174]

ABSTRACT: In insects, lipase enzymes have key roles in utilizing, storing and transmitting lipids. Experimental compounds such as metal salts like potassium phosphate, magnesium nitrate and NaCl, buffers like EDTA and Tris, SDS and ethanol are commonly used in laboratory studies, and lack of knowledge to their possible effects on enzyme activity can lead to inaccurate conclusions in studies involve these enzymes. In this study, effects of these compounds on midgut lipase activity of *Galleria mellonella* that is an ideal insect for physiologic researchs for It's simple rearing and large larvae, are evaluated. In order to this, The last instar larvae were dissected, samples were obtained and the effects of these compounds on enzyme activity were measured spectrophotometrically in 5 different concentrations. As obtained results, enzyme activity was reduced by 75% ethanol, 5 mMol magnesium nitrate and various concentrations of SDS, and was increased by NaCl and potassium phosphate in 5 mMol concentration. Concentrations up to 4 mMol of NaCl, potassium phosphate and magnesium nitrate, and also concentrations of 25, 50, 85 and 96 % of ethanol had no effect on enzyme activity.

KEY WORDS: Lipase, Enzyme activity, Metal ions, Ethanol, *Galleria mellonella*.

Lipase enzymes generally are defined as triacylglycerol hydrolases (EC 3.1.1.3) that break carboxylester bonds in diacylglycerols, galactolipids and phospholipids and more specially in triacylglycerols, So, they play a key role in controlling the absorption, transport and utilization of lipids (Horn et al., 2009). In fact, lipases are a group of enzymes that hydrolyse triacylglycerols to di and monoacylglycerols with free fatty acids as coproducts (Mrdakovic et al., 2008; Sharma et al., 2001).

In addition, lipases also catalize esterification and degradation of acids, bases and amins (Hasan et al., 2009).

In insects, these enzymes have key roles in utilizing, storing and transmitting lipids and also they are important in basic physiological prosseses of reproduction, development, defending against pathogens and oxidative stress, and pheromone signalling (Horn et al., 2009). Although many researchs have been carried out on animal, microorganism and plant lipases there are little information about insect lipases and most of researchs performed on insect lipase focused on fat bodies (Orscelik et al., 2008). There has been considerable interest in the investigation on midgut enzymes since larval midgut is a possible target for insect control, as a primary interface between insect and environment (Mrdakovic et al., 2008).

Greater wax moth, *Galleria mellonella*, is present in everywhere bees are kept. Their spread in areas with low tempretures mainly is limited (Vosughi & Nabian, 1374). Most damages occur in tropical areas, because they can be active longer in this areas (Esmaeeli, 1372). This insect is used commonly in physiologic, toxicologic and pathologic investigations and also as a artificial host in mass rearing of diptera and hymenoptera, and at the same time, is almost the most important pest of bee products and makes serious losses to commercially beekeeping (Vosughi & Nabian, 1374). It's simple rearing and large larvae made it ideal insect for physiologic researchs.

Experimental compounds such as metal salts like potassium phosphate, magnesium nitrate and NaCl, buffers like EDTA and Tris, SDS and ethanol are commonly used in laboratory studies, and lack of knowledge to their possible effects on enzyme activity can lead to inaccurate conclusions in studies involve these enzymes. In this experiment, effects of these compounds on midgut lipase activity of *G. mellonella* are evaluated.

MATERIAL AND METHODS

Insect rearing

Egg masses of *G. mellonella* were prepared from a colony in department of plant protection of Tabriz university in the amount needed to form a new colony and were transferred to the rearing unit and rearing of insects was performed feeding on artificial diet prepared according to the method presented by Poinar (1975). insects purificated for 3 generations and then used in the experiments. labratory conditions in the rearing prosses were temperature of 26±2 °c, relative humidity of 50±5% and photoperiod of 16:8 (L:D).

Enzyme specimen preparation

Last instar larvae were dissected according to the method presented by Cohen (1993) in order to separate midguts for use in the experiments. removed midguts were transferred to 1.5 ml microtubes containing 1 ml cold phosphate buffer after being washed in the same buffer. microtubes were transferred to the refrigerator (-20 °c) after homogenization and kept there to be used in the next steps.

In order to preparation of enzyme specimens, the mentioned microtubes were centrifugated at 4 °c and 10^4 round/min for 5 min, then their supernatants were transferred to other microtubes and were employed in the enzyme activity assays.

Enzyme activity assays

Lipase enzyme activity was measured by related detection kit (lipase kit, pars azmun iran co.) spectrophotometrically according to the method presented by manufacturer of kit.

Evaluating effects of various compounds on enzyme activity

In order to this evaluation, various concentrations of these compounds (1-5 mMol) were prepared with distilled water and pH set at 6.5 using HCl and NaOH. Then 300 µl of each above solutions mixed with 30 µl of enzyme solution in the 0.5 ml tubes and enzyme activity was measured 5 min after mixing of solutions. 300 µl of distilled water mixed with 30 µl of enzyme solution was considered as control. Possible effects of ethanol were evaluated in 5 various concentrations 96, 85, 75, 50 and 25 % as well using distilled water as control. 50 µl of enzyme solution added to each microtubes containing 0.5 ml of ethanol and to the control and enzyme activity was measured after 10 min incubation at the room temperature (23-25 °c). All experiments were conducted in a completely randomized design. four replications was used for each treatment and each replication included 2 midguts.

Statistical analisis

Analisis of variance was conducted using software MStat-C. mean comparisions were performed with duncan's multiple range test method using this software at levels 1 and 5 %. Excel software was used for drawing diagrams. Data normality test was also performed and appropriate data convertion was performed in cases was required.

RESULTS AND DISCUSSION

Effect of various concentrations of ethanol on enzyme activity

The effects of different concentrations of ethanol on enzyme activity showed significant differences at 5 %. Enzyme activity was reduced with decreasing concentrations of ethanol down to 75 % as ethanol 75 % made the most reduction in the enzyme activity. The enzyme activity showed an increasing trend with next reductions in ethanol concentration as ethanol 25 % had minimum effect on enzyme activity (Fig. 1).

Given that ethanol 75 % among different concentrations of ethanol releases the most oH into environment and released oH reduces enzyme activity, results of this study that show the most reduction in the enzyme activity for ethanol 75 % can be justified.

There are little investigations in this field. In the study of Castro-ochoa et al. (2005) on properties of lipase enzyme produced by bactria, *Bacillus thermoleovorans* CCR11 the enzyme activity was consistent in the presence of organic solvents except butanol.

Effect of various concentrations of NaCl on enzyme activity

Significant differences was obtained between the effects of different concentrations of NaCl on enzyme activity. Concentrations of 1, 2, 3 and 4 mMol NaCl did not show any significant effect on enzyme activity but 5 mMol NaCl increased enzyme activity significantly (Fig. 2).

Effect of metal ions on various enzymes have been studied by many researchers. Metal ions can enhance or reduce enzyme activity depending on its type (Hasan et al., 2009). Metal ions generally form complexes with ionized fatty acids, changing their solubility and behavior at interfaces. Release of fatty acids to the medium is rate determining and could be affected by metal ions. However, the effects of metal ions depend on particular lipase (Hasan et al., 2009).

In the study of Zibaee et al. (2008) on lipase enzyme activity of midgut and salivary glands of *Chilo suppressalis*, adding NaCl reduced activity of this enzyme. In the study performed by Grillo et al. (2007) on lipid metabolism and midgut triacylglycerol lipase role in *Rodnius prolixus*, activity of this enzyme was affected by NaCl concentration as it was more activated by increasing its concentration. Studies of Hiol et al. (1999) on properties of extracellular lipase of mold *Hiemalis f. hiemalis* showed that Na^+ ion enhances activity of this enzyme. In the investigations of Kumar et al. (2005) on properties of lipase of bacteria *Bacillus coagulans* BTS-3 was shown that Na^+ ion has not any effect on its activity.

Effect of various concentrations of Tris on enzyme activity

Figure 3 shows comparision of means and change trend of effects of this treatment. Difference between effects of various concentrations of Tris on enzyme activity was insignificant.

Effect of various concentrations of potassium phosphate on enzyme activity

Effects of different concentrations of potassium phosphate on enzyme activity had significant differences at 5 %. Concentrations up to 4 mMol had not any significant effect on enzyme activity, although they had an increasing trend, while concentration of 5 mMol significantly increased enzyme activity (Fig. 4).

Results of this study showed some differences and similarities compared to previous researches in this field. In the work of Zibaee et al. (2008) on midgut and salivary gland lipase activity in *C. suppressalis* it was showed that its activity was decreased in presence of KCl which released K^+ ion after being ionized. Researches of Kumar et al. (2005) on lipase properties of bactria *Bacillus coagulans* BTS -3 showed that K^+ ion increases its activity.

Effect of various concentrations of magnesium nitrate on enzyme activity

Effects of different concentrations of magnesium nitrate on enzyme activity showed significant differences at 1%. Concentrations up to 4 mMol had not any significant effect on enzyme activity while it's 5 mMol concentration decreased enzyme activity significantly (Fig. 5).

There are considerable differences between the studies of other researchers. In the work of Zibaee et al. (2008) on midgut and salivary gland lipase of *C. suppressalis* Mg^{2+} ion released from magnesium nitrate decreased this enzyme's activity. In the studies of Hiol et al. (1999) on properties of extracellular lipase of *Hiemalis f. hiemalis* was shown that Mg^{2+} ion increases enzyme activity. Investigations of Kumar et al. (2005) on properties of lipase of bactria *B. coagulans* BTS-3 showed that Mg^{2+} ion increases it's activity. In the researches performed by Cote & Shareck (2008) on two lipase enzyme produced by bactria *Streptomyces coelicolor* was not shown any significant reduction by Mg^{2+} ion on their activity. In the work of Karadzic et al. (2006) on properties of alkalin lipase produced by *Pseudomonas aeruginosa* was shown that this enzyme is inhibited slightly by Mg^{2+}.

Effect of varius concentrations of SDS on enzyme activity

Effects of different concentrations of SDS on enzyme activity showed significant differences at 1%. Enzyme activity has a decreasing trend with increase in SDS concentration. There was not any significant difference between SDS concentration of 1 mMol and control and also between its concentrations 4 and 5 mMol (Fig. 6).

SDS, sodium dodecyl sulphate, is an anionic surfactant with chemical formula of $C_{12}H_{25}SO_4Na$ that has amphipatic property because of carrying 12 carbon bound to sulphate group, and can act as detergent. Since the lipase enzymes act at the water–lipid interface, presence of a detergent in the environment can affect enzyme activity.

Most of previous studies performed in this case show reduction in lipase activity in presence of SDS like results of this study. In the study of Zibaee et al. (2008) it was found that relative enzyme activity is reduce by SDS. In the investigations of Castro-Ochoa et al. (2005) on properties of lipase produced by bactria *Bacillus thermoleovorans* CCR11 it was shown that SDS had inhibitory effect on this enzyme activity. Studies of Hiol et al. (2000) on properties of extrasellular lipase produced by bactria *Rhizopus oryzae* showed that this enzyme activity was inhibited by SDS. During study of Wang et al. (2009) on properties of lipase of *Bukholderia cepacia* ATCC25416 inhibition of this enzyme activity found in presence of SDS. The results of study of Yu et al. (2007) on properties of lipase 2 of *Yarrowia lipolitica* also indicated prohibition of enzyme activity by SDS. In the researches of Demir & Tukel (2010) on properties of lipase of *Spirulina platensis*, enzyme activation was shown in presence of SDS.

Effect of various concentrations of EDTA on enzyme activity

There were no significant differences between the effects of different concentrations of EDTA on enzyme activity (Fig. 7).

EDTA, ethylene di amin tetra acetic acid, is a chelating agent of metals that removes metal ions from compounds carrying them. thus, being insignificant of reduction made by this compound on lipase activity can be an evidence on that there is no need to presence of metal ions at the catalytic site of this enzyme.

The results of most studies in this field also indicates no effect of EDTA on enzyme activity. In the study of Hiol et al. (1999) it was found that relative enzyme activity was not affected by EDTA. This not being affected of enzyme activity by EDTA was also resulted in the study of Gaur et al. (2008). In the mentioned research of Wang et al. (2009), inhibitory effect of EDTA on enzyme activity was resulted. Yu et al. (2007) through investigation on properties of lipase 2 of *Y. lipolitica* showed that EDTA has no effect on enzyme activity. Study of Li & Zhang (2005) on properties of lipase of bactria *Geobacillus* sp.. TW1 also showed that this enzyme was stable in presence of EDTA. The results of mentioned study performed by Demir & Tukel (2010) indicated that relative enzyme activity was inhibited by EDTA.

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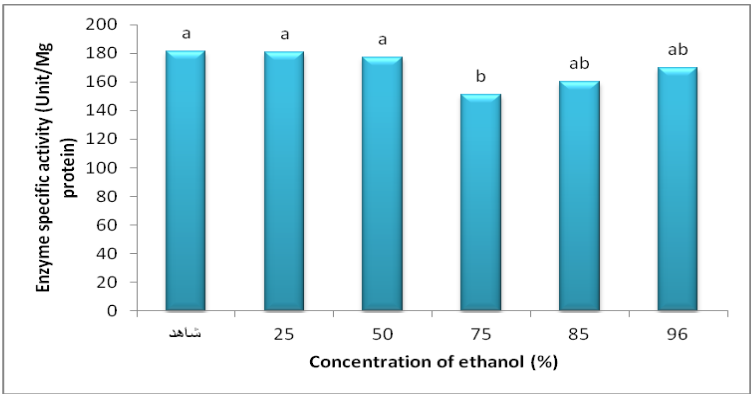

Figure 1. Change trend of effects of different concentrations of ethanol on enzyme activity and mean comparisions (different letters indicate significant differences).

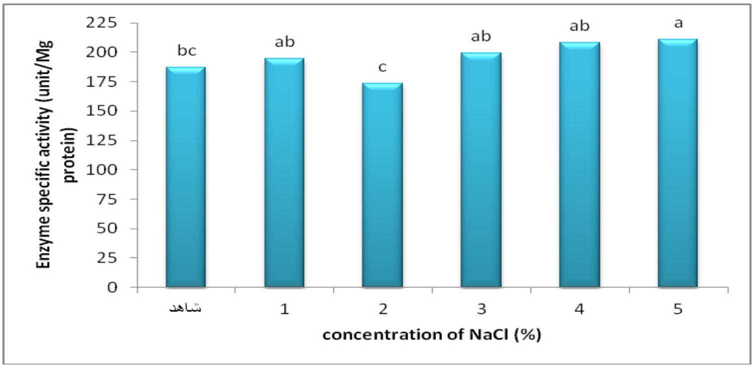

Figure 2. Trend of effects of different concentrations of NaCl on enzyme activity and mean comparisions (different letters indicate significant differences).

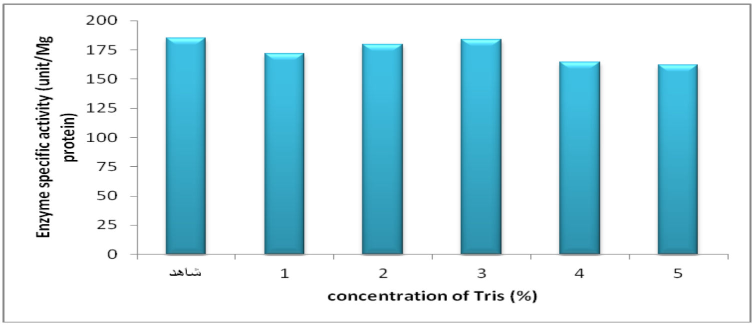

Figure 3. Trend of effects of different concentrations of Tris on enzyme activity and mean comparisions (different letters indicate significant differences).

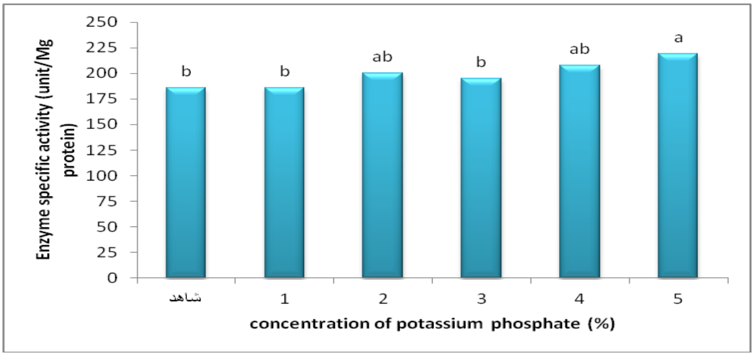

Figure 4. Trend of effects of different concentrations of potassium phosphate on enzyme activity and mean comparisions (different letters indicate significant differences).

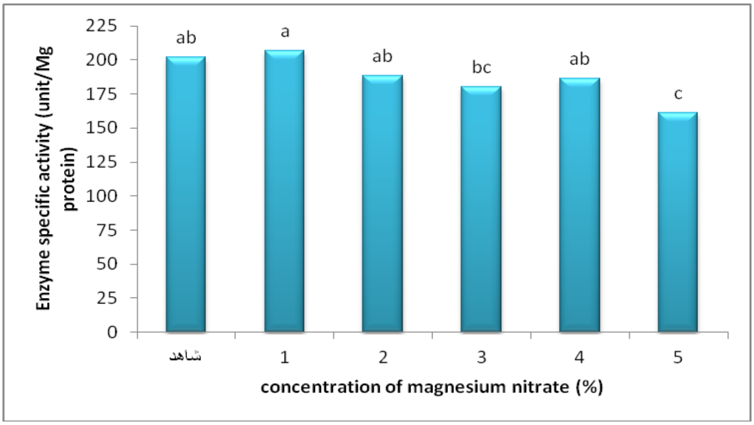

Figure 5. Trend of effects of different concentrations of magnesium nitrate on enzyme activity and mean comparisions (different letters indicate significant differences).

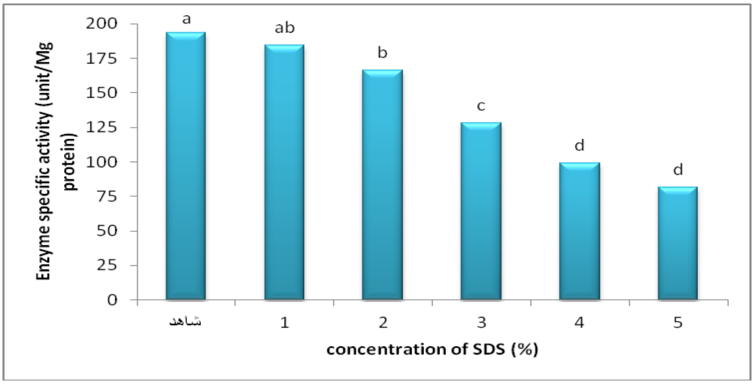

Figure 6. Trend of effects of different concentrations of SDS on enzyme activity and mean comparisions (different letters indicate significant differences).

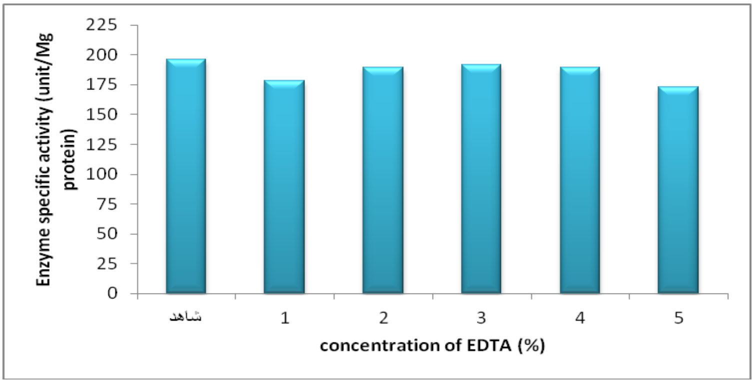

Figure 7. Trend of effects of different concentrations of EDTA on enzyme activity and mean comparisions (different letters indicate significant differences).

SELECTION OF POLYVOLTINE BREEDS AND POLYVOLTINE × BIVOLTINE HYBRIDS OF THE SILKWORM, *BOMBYX MORI* L.

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[Singh, R. & Nirupama, R. 2013. Selection of polyvoltine breeds and polyvoltine × bivoltine hybrids of the Silkworm, *Bombyx mori* L.. Munis Entomology & Zoology, 8 (1): 175-179**]**

ABSTRACT: Selection of polyvoltine breeds and polyvoltine × bivoltine hybrids of the silkworm, *Bombyx mori* L. was carried out utilizing subordinate function indices method of Gower (1971). Out of six polyvoltine breeds, AGL_5 ranked first exhibiting maximum cumulative subordinate function indices value of 10.95 for eleven characters followed by AGL_3 which exhibited higher cumulative subordinate function indices value of 7.45 whereas among thirty polyvoltine × bivoltine hybrids, AGL_5 × CSR_2 ranked first exhibiting maximum cumulative subordinate function indices values of 10.40 followed by AGL_3 × CSR_2 exhibiting cumulative subordinate function indices values of 9.70. Seven polyvoltine × bivoltine hybrids *viz*., AGL_2 × CSR_{12}, AGL_4 × CSR_2, AGL_2 × CSR_4, AGL_3 × CSR_3, AGL_2 × CSR_2, AGL_5 × CSR_{12} and AGL_1 × CSR_2 were also found promising which exhibited cumulative subordinate function indices values of 7.47, 7.44, 7.43, 7.30, 7.29, 7.27 and 7.15, respectively. Importance of application of subordinate function indices method for the identification of silkworm breeds and hybrids has been discussed.

KEY WORDS: *Bombyx mori,* performance, polyvoltine × bivoltine hybrids, silkworm breed, subordinate function indices.

Silkworm breeds and hybrids are judged on the basis of cumulative effect of several economic characters (Narayanaswamy et al., 2002). In the mulberry silkworm, *Bombyx* mori L., subordinate function index method of Gower (1971) has been employed for the identification of promising silkworm hybrids (Ramesh Babu et al., 2002; Rao et al., 2001, 2004, 2006; Lakshmi & Chandrashekharaiah, 2007; Nirupama et al., 2008). In the present study, an attempt has been made to identify promising polyvoltine breeds developed utilizing androgenesis coupled with conventional breeding techniques and polyvoltine × bivoltine hybrids through subordinate function index method.

MATERIALS AND METHODS

In the present study, six polyvoltine breeds *viz*., AGL_1, AGL_2, AGL3, AGL_4, AGL_5 and Pure Mysore (PM) and thirty polyvoltine × bivoltine hybrids were prepared utilizing five bivoltine breeds *viz*., CSR_2, CSR_3, CSR_4, CSR_{12} and NB_4D_2. Three replications were reared in each hybrid and 250 larvae were retained after IIIrd moult. The performance of polyvoltine breeds is presented in Table 1. Data were recorded for eleven characters *viz,* fecundity, hatching percentage, pupation percentage, cocoon yield/10,000 larvae by weight, cocoon weight, cocoon shell weight, cocoon shell percentage, filament length, reelability, raw silk percentage and neatness. Data were analyzed through subordinate function index method (Gower, 1971). Subordinate function index method **is** used to short list breeds / hybrids showing a character with a small range of variation contribute as much as another character with a large variation range. In ranging the smallest value for the character is subtracted from each value and the results are divided by range. The subordinate function is calculated by utilizing the following formula -

Xu = (Xi – Xmin) / (Xmax – Xmin)

Where,

Xu = Sub ordinate function,

Xi = Measurement of trait of tested breed,

Xmin =Minimum value of the trait among all the tested breeds,

Xmax =Maximum value of the trait among all the tested breeds.

RESULTS

Data presented in Table 1 showed variation for various characters among the different polyvoltine breeds. Two breeds AGL_5 and AGL_3 recorded higher values for all the eleven characters. Subordinate function index values in polyvoltine breeds for eleven characters are given in Table 2. AGL_5 and AGL_3 showed their superiority by exhibiting cumulative subordinate function index value of 10.95 and 7.45 respectively. Mean rearing performance of thirty polyvoltine × bivoltine hybrids is given in Table 3. Two hybrids namely, $AGL_3 \times CSR_2$ and $AGL_5 \times CSR_2$ exhibited higher performance for most of the economic characters. It was interesting to note that ten out of thirty hybrids recorded significant increase for three characters namely, cocoon shell weight, cocoon shell percentage and neatness. As per the subordinate function index method, $AGL_5 \times CSR_2$ exhibited maximum cumulative index value (10.40) followed by $AGL_3 \times CSR_2$ (9.70)). In addition, seven polyvoltine × bivoltine hybrids *viz.*, $AGL_2 \times CSR_{12}$, $AGL_4 \times CSR_2$, $AGL_2 \times CSR_4$, $AGL_3 \times CSR_3$, $AGL_2 \times CSR_2$, $AGL_5 \times CSR_{12}$ and $AGL_1 \times CSR_2$ were also found promising which exhibited cumulative subordinate function indices values of 7.47, 7.44, 7.43, 7.30, 7.29, 7.27 and 7.15, respectively.

DISCUSSION

Perusal of data revealed superiority of two hybrids $AGL_3 \times CSR_2$ and $AGL_5 \times CSR_2$ exhibiting significant increase in most of the characters over the control PM × CSR_2. No hybrid excelled in all the characters under study. Therefore, it is necessary to adopt reliable statistical method to identify promising breeds / hybrids which give weight-age to all the economic characters. In this direction, efforts have been made to identify promising silkworm hybrids utilizing subordinate function index method (Ramesh Babu et al., 2002; Rao et al., 2001, 2004, 2006; Lakshmi & Chandrashekharaiah, 2007; Nirupama et al., 2008).

In the present study, the indices obtained from subordinate function index method were worked out both for polyvoltine silkworm breeds and polyvoltine × bivoltine hybrids. The results demonstrated the superiority of two breeds AGL_3 and AGL_5 among six breeds and two hybrids $AGL_5 \times CSR_2$ and $AGL_3 \times CSR_2$ which excelled among thirty hybrids. The hybrids exhibited high subordinate cumulative index values (10.40 and 9.70). In view of the results obtained, AGL_3 and AGL_5 can be further utilized in future breeding programmes for the development of outstanding polyvoltine breeds and two promising polyvoltine × bivoltine hybrids $AGL_5 \times CSR_2$ and $AGL_3 \times CSR_2$ may be recommended for commercial exploitation.

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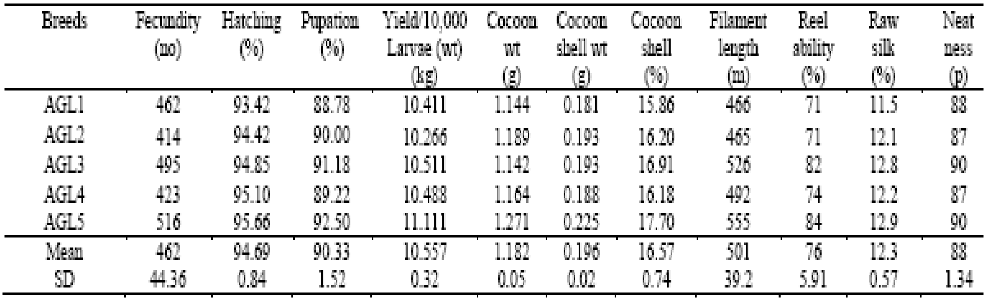
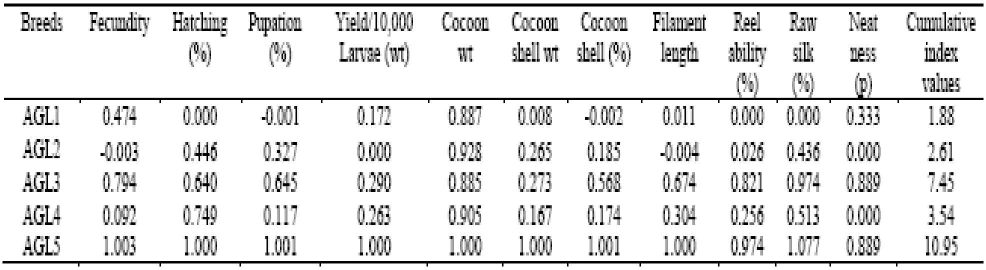
Table 1. Mean rearing performance of polyvoltine silkworm breeds.



Breeds	Fecundity (no)	Hatching (%)	Pupation (%)	Yield/10,000 Larvae (wt) (kg)	Cocoon wt (g)	Cocoon shell wt (g)	Cocoon shell (%)	Filament length (m)	Reel ability (%)	Raw silk (%)	Neat ness (p)
AGL1	462	93.42	88.78	10.411	1.144	0.181	15.86	466	71	11.5	88
AGL2	414	94.42	90.00	10.266	1.189	0.193	16.20	465	71	12.1	87
AGL3	495	94.85	91.18	10.511	1.142	0.193	16.91	526	82	12.8	90
AGL4	423	95.10	89.22	10.488	1.164	0.188	16.18	492	74	12.2	87
AGL5	516	95.66	92.50	11.111	1.271	0.225	17.70	555	84	12.9	90
Mean	462	94.69	90.33	10.557	1.182	0.196	16.57	501	76	12.3	88
SD	44.36	0.84	1.52	0.32	0.05	0.02	0.74	39.2	5.91	0.57	1.34

Table 2. Subordinate function index values of polyvoltine silkworm breeds.



Breeds	Fecundity	Hatching (%)	Pupation (%)	Yield/10,000 Larvae (wt)	Cocoon wt	Cocoon shell wt	Cocoon shell (%)	Filament length	Reel ability (%)	Raw silk (%)	Neat ness (p)	Cumulative index values
AGL1	0.474	0.000	-0.001	0.172	0.887	0.008	-0.002	0.011	0.000	0.000	0.333	1.88
AGL2	-0.003	0.446	0.327	0.000	0.928	0.265	0.185	-0.004	0.026	0.436	0.000	2.61
AGL3	0.794	0.640	0.645	0.290	0.885	0.273	0.568	0.674	0.821	0.974	0.889	7.45
AGL4	0.092	0.749	0.117	0.263	0.905	0.167	0.174	0.304	0.256	0.513	0.000	3.54
AGL5	1.003	1.000	1.001	1.000	1.000	1.000	1.001	1.000	0.974	1.077	0.889	10.95

Table 3. Mean rearing performance of polyvoltine × bivoltine hybrids

Hybrids	Fecundity (no)	Hatching (%)	Pupation (%)	Yield/10,000 Larvae (wt) (kg)	Cocoon wt (g)	Cocoon shell wt (g)	Cocoon shell (%)	Filament length (m)	Reel ability (%)	Raw silk (%)	Neat ness (p)
$AGL_1 \times CSR_2$	506	94.00	95.20	17.421	1.866	0.371	19.88	811	79	14.9	90
$AGL_1 \times CSR_3$	413	94.67	95.73	17.421	1.729	0.354	20.50	752	79	14.7	89
$AGL_1 \times CSR_4$	422	96.61	95.87	16.275	1.744	0.333	19.07	813	78	14.4	90
$AGL_1 \times CSR_{12}$	417	96.88	97.20	16.490	1.664	0.335	20.11	688	72	14.9	88
$AGL_1 \times NB_4D_2$	418	96.89	96.27	16.307	1.712	0.338	19.74	817	83	14.7	90
$AGL_2 \times CSR_2$	487	95.34	97.73	16.137	1.782	0.369	20.70	781	78	14.6	89
$AGL_2 \times CSR_3$	460	96.64	97.73	17.038	1.755	0.354	20.15	727	79	14.6	90
$AGL_2 \times CSR_4$	484	96.30	94.80	16.841	1.756	0.359	20.46	814	81	14.5	90
$AGL_2 \times CSR_{12}$	473	94.57	97.33	16.966	1.775	0.377	21.22	808	79	15.1	90
$AGL_2 \times NB_4D_2$	435	94.55	97.73	16.602	1.722	0.330	19.16	777	75	13.4	88
$AGL_3 \times CSR_2$	493	96.21	96.60	18.322	1.928	0.412	21.38	870	82	16.2	91
$AGL_3 \times CSR_3$	490	95.44	97.47	16.862	1.764	0.364	20.62	766	79	15.4	88
$AGL_3 \times CSR_4$	505	95.58	94.33	16.605	1.751	0.356	20.34	739	74	15.1	86
$AGL_3 \times CSR_{12}$	513	94.62	97.47	16.472	1.703	0.340	19.99	737	76	14.7	85
$AGL_3 \times NB_4D_2$	468	95.50	93.87	15.363	1.655	0.319	19.28	772	79	13.9	88
$AGL_4 \times CSR_2$	427	96.87	97.60	16.982	1.782	0.365	20.50	808	80	14.3	90
$AGL_4 \times CSR_3$	465	95.49	96.13	16.054	1.694	0.334	19.73	794	80	13.9	86
$AGL_4 \times CSR_4$	450	94.96	94.53	16.165	1.734	0.333	19.22	772	80	13.4	86
$AGL_4 \times CSR_{12}$	440	96.05	95.20	15.455	1.643	0.326	19.85	739	76	14.5	88
$AGL_4 \times NB_4D_2$	424	96.14	95.60	15.611	1.659	0.314	18.95	727	76	13.2	86
$AGL_5 \times CSR_2$	499	96.00	97.20	19.692	2.041	0.438	21.44	885	84	15.5	91
$AGL_5 \times CSR_3$	431	95.82	96.13	16.439	1.713	0.353	20.59	762	76	14.3	88
$AGL_5 \times CSR_4$	416	95.35	93.60	15.348	1.669	0.316	18.92	786	78	13.9	90
$AGL_5 \times CSR_{12}$	431	95.49	96.27	16.599	1.749	0.367	21.01	786	80	15.7	90
$AGL_5 \times NB_4D_2$	438	96.20	96.00	16.350	1.707	0.328	19.21	766	80	14.3	89
$PM \times CSR_2$	422	94.53	97.60	16.917	1.762	0.336	19.05	778	81	13.7	87
$PM \times CSR_3$	423	94.70	97.33	15.605	1.611	0.312	19.39	749	76	13.9	86
$PM \times CSR_4$	397	94.05	88.13	14.766	1.636	0.297	18.18	736	75	13.3	87
$PM \times CSR_{12}$	366	92.92	90.40	13.242	1.626	0.286	17.61	592	76	12.8	85
$PM \times NB_4D_2$	409	94.18	95.61	13.690	1.544	0.281	18.22	654	77	12.8	86
Mean	448	95.42	2.31	16.302	1.729	0.343	19.82	767	78	14.4	88
SD	37.29	0.99	97.73	1.20	0.10	0.03	0.96	57.35	2.77	0.84	1.73

Table 4. Sub-ordinate function index values of polyvoltine × bivoltine hybrids

Hybrids	Fecundity	Hatching (%)	Pupation Rate	Yield/10,000 wt.	Cocoon wt	Cocoon shell wt	Cocoon shell (%)	Filament length	Reel ability (%)	Raw silk (%)	Neat ness (p)	Cumulative index values
$AGL_1 \times CSR_2$	0.950	0.272	0.736	0.648	0.648	0.573	0.594	0.749	0.583	0.618	0.778	7.15
$AGL_1 \times CSR_3$	0.317	0.441	0.792	0.470	0.372	0.467	0.754	0.547	0.556	0.559	0.667	5.94
$AGL_1 \times CSR_4$	0.383	0.929	0.806	0.504	0.402	0.329	0.382	0.755	0.500	0.461	0.833	6.28
$AGL_1 \times CSR_{12}$	0.347	0.997	0.945	0.475	0.242	0.342	0.652	0.329	0.028	0.627	0.556	5.54
$AGL_1 \times NB_4D_2$	0.356	1.000	0.848	0.449	0.339	0.363	0.556	0.768	0.889	0.559	0.778	6.90
$AGL_2 \times CSR_2$	0.825	0.610	1.000	0.589	0.480	0.561	0.807	0.644	0.528	0.529	0.722	7.29
$AGL_2 \times CSR_3$	0.639	0.938	1.000	0.558	0.425	0.463	0.663	0.462	0.583	0.539	0.778	7.05
$AGL_2 \times CSR_4$	0.800	0.851	0.695	0.495	0.427	0.499	0.744	0.759	0.778	0.490	0.889	7.43
$AGL_2 \times CSR_{12}$	0.728	0.415	0.959	0.577	0.464	0.609	0.944	0.737	0.583	0.676	0.778	7.47
$AGL_2 \times NB_4D_2$	0.469	0.411	1.000	0.521	0.359	0.312	0.405	0.633	0.278	0.167	0.444	5.00
$AGL_3 \times CSR_2$	0.864	0.828	0.882	0.788	0.773	0.837	0.985	0.950	0.861	0.990	0.944	9.70
$AGL_3 \times CSR_3$	0.846	0.636	0.973	0.561	0.443	0.527	0.785	0.594	0.611	0.765	0.556	7.30
$AGL_3 \times CSR_4$	0.946	0.670	0.646	0.521	0.416	0.478	0.712	0.501	0.139	0.667	0.222	5.92
$AGL_3 \times CSR_{12}$	1.002	0.427	0.973	0.501	0.319	0.378	0.621	0.494	0.333	0.569	0.000	5.62
$AGL_3 \times NB_4D_2$	0.694	0.651	0.598	0.329	0.223	0.242	0.436	0.615	0.611	0.314	0.500	5.21
$AGL_4 \times CSR_2$	0.415	0.995	0.986	0.580	0.480	0.537	0.754	0.737	0.667	0.451	0.833	7.44
$AGL_4 \times CSR_3$	0.676	0.648	0.834	0.436	0.302	0.340	0.554	0.688	0.667	0.314	0.222	5.68
$AGL_4 \times CSR_4$	0.571	0.514	0.667	0.453	0.383	0.333	0.420	0.613	0.639	0.186	0.167	4.95
$AGL_4 \times CSR_{12}$	0.503	0.789	0.736	0.343	0.199	0.287	0.584	0.502	0.333	0.510	0.444	5.23
$AGL_4 \times NB_4D_2$	0.392	0.811	0.778	0.367	0.232	0.212	0.350	0.461	0.306	0.108	0.222	4.24
$AGL_5 \times CSR_2$	0.907	0.776	0.945	1.000	1.001	0.998	1.000	0.999	1.028	0.804	0.944	10.40
$AGL_5 \times CSR_3$	0.444	0.730	0.834	0.496	0.340	0.456	0.778	0.580	0.306	0.451	0.444	5.86
$AGL_5 \times CSR_4$	0.342	0.612	0.570	0.327	0.251	0.221	0.341	0.661	0.528	0.324	0.833	5.01
$AGL_5 \times CSR_{12}$	0.444	0.648	0.848	0.520	0.412	0.550	0.887	0.663	0.667	0.853	0.778	7.27
$AGL_5 \times NB_4D_2$	0.490	0.826	0.820	0.482	0.328	0.299	0.419	0.594	0.639	0.441	0.667	6.00
$PM \times CSR_2$	0.383	0.406	0.986	0.570	0.439	0.348	0.376	0.635	0.722	0.275	0.333	5.47
$PM \times CSR_3$	0.390	0.449	0.959	0.366	0.134	0.200	0.465	0.537	0.306	0.314	0.167	4.29
$PM \times CSR_4$	0.209	0.284	0.334	0.236	0.184	0.104	0.149	0.490	0.222	0.137	0.333	2.68
$PM \times CSR_{12}$	0.002	0.001	0.000	0.000	0.166	0.034	-0.001	0.001	0.306	-0.010	0.056	0.55
$PM \times NB_4D_2$	0.295	0.318	0.236	0.069	0.001	0.002	0.159	0.210	0.417	0.000	0.167	1.87

BACTERIA ISOLATED FROM THE STEM BORER *SESAMIA NONAGRIOIDES* (LEPIDOPTERA: NOCTUIDAE) IN IRAN

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[Esfandiari, M. & Motamedi, H. 2013. Bacteria isolated from the stem borer *Sesamia nonagrioides* (Lepidoptera: Noctuidae) in Iran. Munis Entomology & Zoology, 8 (1): 180-184**]**

ABSTRACT: *Sesamia nonagrioides* (Lef.) is a major insect pest of sugarcane in southwestern Iran. It also damages maize and rice in this area. Using bacterial pathogens of insects as a biological control agent in an IPM program could be advantageous. In this study, the bacterial flora of *S. nonagrioides* were investigated in dead larvae with appearance of some bacterial disease. Samples were collected from maize and sugarcane fields of Khuzestan province as well as rice fields in Fars province. A total of 11 isolates were characterized from dead larvae of *S. nonagrioides*, according to morphology, spore formation, nutritional features, physiological and biochemical characteristics: *Acinetobacter calcoaceticus, A. baumanii, A. radioresistens* and *A. lwoffii, Enterococcus casseliflavus*, *E. gergoviae*, *Cedecea lapagei*, *Kurthia gibsonii*, *Staphylococcus auricularis*, *Listeria ivanoii* and *Erwinia herbicula*. This is the first report on the bacteria other than Bt from larvae of the stem borer *S. nonagrioides*. May be one or more of these bacteria are causative agents of death in *S. nonagrioides* and are natural suppressors of this stem borer in the fields.

KEY WORDS: *Sesamia nonagrioides*, bacterial flora, microbial control, Iran.

The stem borer *Sesamia nonagrioides* (Lef.), is considered a major insect pest of maize in southern European countries from Spain to Turkey (Moyal et al., 2011). Larval feeding of *S. nonagrioides* causes yield losses in economically significant level. This stem borer is an important pest of sugarcane, maize and rice in Khuzestan province, southwestern Iran, and has 4-5 annual generations. It attacks several cultivated and non-cultivated graminaceous species (Daniali, 1985; Jemsi & Kamali, 1992; Esfandiari et al., 2011a,b). It also damages maize and rice in some regions of Fars province, South Iran, where it has 3-4 annual generations (Fazeli, 1992).

Apart from the hazardous effects of chemical pesticides on the health and environment, chemical control of stem borers is generally not recommended because the larvae tunnel throughout the stem from the first instar. Using bacterial pathogens of insects as a biological control agent in an IPM program may be advantageous. Studies on bacterial pathogens of *S. nonagrioides* have been focused on *Bacillus thuringiensis* (Bt) (e.g. Farinós et al., 2004; González-Cabrera et al., 2006; Andreadis et al., 2007). Nevertheless, investigating a new pathogen against a target pest is always desirable. It is also known that the success of control can be higher when native isolates are used against the target insect (Sevim et al., 2010). However, very little is known about other bacterial pathogens limiting *S. nonagrioides* populations. In this paper, we present results of a study on the isolation and identification of bacteria from *S. nonagrioides* in southern parts of Iran.

MATERIAL AND METHODS

In order to isolation and identification of the bacteria from *S. nonagrioides*, infected larvae which were soft and flaccid were collected in late summer and autumn 2007, exhibiting symptoms of some bacterial disease (e.g. lack of appetite, failure in movement, and discoloration: blackish color). Collected localities are as follows:

In Khuzestan province: from sugarcane fields of Karun (32°10´N 48°36´E) agro-industriy, as well as adjacent maize fields. In Fars province: from rice fields of Mahkuyeh village in Firuzabad (29°00´N 52°30´E). Larvae were selected and transported to the laboratory in plastic boxes.

A tissue suspension from these larvae were prepared in saline 0.9% after surface sterilization with 70 % alcohol and triturating whole larvae body in a sterile container. After filtration of this suspension through sterile, two layers cheesecloth, 100µl suspension was streaked on nutrient agar and incubated for 2 days at 25°C and 37°C. Isolates were identified based on color and morphology of colonies, gram staining, catalase, oxidase and biochemical tests.

RESULTS

In this study, a total of 11 isolates were finally selected and characterized from dead larvae of *S. nonagrioides*, according to morphology, spore formation, nutritional features, physiological and biochemical characteristics (Tables 1).

DISCUSSION

All of the isolates in our study were determined for the first time from the bacterial flora of *S. nonagrioides*. Although several of the species of *Acinetobacter* spp., *Staphylococcus* spp. and *Enterococcus casseliflavus* have been reported as pathogens for humans and/or other mammals, nevertheless, they have been previously reported from insects. For example; such species have been reported from *Hylesia metabus* Crammer (Lep.: Saturniidae), (Osborn et al., 2002), as well as the cotton bollworm *Helicoverpa armigera* (Hübner) (Lep.: Noctuidae) (Xiang et al., 2006). *Acinetobacter lowffii* has been found in *Lutzomyia longipalpis* (Dip. Psychodidae) (Oliveira et al., 2000) and the oil fly *Helaeomyia petrolei* (Coquillett) (Dip.: Ephydridae) (Kadavy et al., 1999). *Acinetobacter baumanii* was also reported from *Bemisia argentifolii* Bellows & Perrin (Hom.: Aleyrodidae) (=*B. tabaci* B biotype) (Davidson et al., 2000).

Enterococcus casseliflavus is one of the most common enterococci in a large variety of insects, including beetles, flies, bees and termites (Willems, 2010). These bacteria are not regarded as primary pathogens, but they are generally recognized as nosocomial pathogens worldwide (Linden & Miller, 1999). *Enterococcus casseliflavus* has been found previously among locusts gut microbiota (Dillon et al., 2010). Channaiah et al. (2010) also showed that *E. casseliflavus* was the most common enterococcal isolate among 95 stored-product insects.

The bacterium *Cedecea lapagei* (Enterobacteriaceae) has found to be pathogenic to the tick *Boophilus microplus*; this bacterium infects ticks via the genital opening and under laboratory conditions can produce up to 100% mortality (Samish et al., 2001). *E. herbicola* bacteria have been found in different insect species. In their studies, Takahashi et al. (1995) and Watanabe et al. (1998) showed that this bacterial species is present in brown planthoppers, mulberry pyralids, and silkworms, and originate from their host plants. *E. herbicola* was isolated from the majority of populations and biotypes of *T. tabaci* examined by De Vries et al. (2008). We isolated *Enterobacter gergoviae* as well. Several species of *Enterobacter* have been isolated from several insect species and used for biological control purposes (Sandra & Douglas, 2004; Bahar & Demirbag, 2007).

In conclusion, we determined members of the bacterial flora of *S. nonagrioides* larvae. We didn't test the pathogenicity of these bacteria on *S. nonagrioides*, but since all of the tested larvae were showing bacterial disease symptoms in different crop fields with distances up to 500 kms, maybe one or more are causative agents of death in *S. nonagrioides* and are natural suppressors of *S. nonagrioides* populations and could be a promising biocontrol agent for use against this pest. Laboratory experiments are necessary to determine insecticidal activities and pathogenicity of these bacteria and their potential as a biocontrol agent against *S. nona*grioides.

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Table 1. Results of identification of bacteria isolates from *S. nonagrioides* larvae collected in agricultural fields of SW Iran.

Identified species	Sampling locality	Field crop
Acinetobacter calcoaceticus	Karun Agro-industry	Maize + Sugarcane
Acinetobacter baumanii	Karun Agro-industry	Maize
Acinetobacter radioresistens	Karun Agro-industry	Maize
Acinetobacter lwoffii	Karun Agro-industry	Maize
Enterococcus casseliflavus	Mahkuyeh + Karun Agro-industry	Rice + Sugarcane
Enterobacter gergoviae	Karun Agro-industry	Sugarcane
Cedecea lapagei	Mahkuyeh + Karun Agro-industry	Rice + Sugarcane
Kurthia gibsonii	Mahkuyeh	Rice
Staphylococcus auricularis	Karun Agro-industry	Sugarcane
Listeria ivanoii	Mahkuyeh	Rice
Erwinia herbicula	Mahkuyeh + Karun Agro-industry	Rice + Sugarcane

LABORATORY EVALUATION OF ETHANOLIC AND METHANOLIC EXTRACTS OF *OCIMUM GRATISSIMUM* AGAINST LARVA OF *ANOPHELES GAMBIAE* AND NON-TARGET ORGANISMS

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[**Ofoegbu, P. U., Onyedineke, N. E., Nwokeji, C., Esie, N. G. & Isibor, N. G.** 2012. Laboratory evaluation of ethanolic and methanolic extracts of *Ocimum gratissimum* against larva of *Anopheles gambiae* and non-target organisms. Munis Entomology & Zoology, 8 (1): 185-190]

ABSTRACT: Methanolic and ethanolic extracts of *Ocimum gratissimum* leaves were evaluated for larvicidal activity against larva of *Anopheles gambiae* and non target organisms in the laboratory. Photochemical analysis of leaf showed presence of tannins, alkaloids, flavonoid, cyanogenic glycosides, cardiac glycosides and saponin. The organisms were exposed to different test concentrations ranging from 20mg/ml to 100mg/ml for 96hours. Larvae of *A. gambiae* were susceptible to the extracts. Ethanolic extracts of the leaf was more active with LC_{50} and LC_{90} of 60.9mg/ml and 464.4 mg/ml respectively while the LC_{50} and LC_{90} of methanolic extracts of leaf were 73.6mg/ml and 1021mg/ml respectively. The extracts exhibited insect growth regulating activity and were found to be safe to non target organisms. Results showed that larvicidal effect of the methanolic extract can be compared to that of neem leaf extracts.

KEY WORDS: *Ocimum gratissimum* leaves, methanolic and ethanolic extract, larvicidal activity, *Anopheles gambiae,* non target organisms.

Mosquitoes are important vectors of diseases and nuisance pests (Azhari et al., 2009). Mosquito-borne diseases remain a major problem in the world particularly in tropical and subtropical regions (Bernard, 1999). Over two million people are at risk of diseases caused by mosquitoes (Odalo et al., 2005). Repeated use of synthetic insecticides for mosquito control has resulted into development of resistance in many vector species, undesirable effects on non-target organisms, environmental and human health concerns (Das et al*.,* 2007). These problems coupled with high cost of the insecticides have revived interest in exploiting the pest control potentials of plants (Grainge & Ahmed, 1988). Despite their application as general toxicants against immature stages of mosquito, their phytochemicals may have potential uses as growth and reproduction inhibitors, repellants and oviposition deterrents (Savignaname & Kalyanasundaram, 2004).

Many species of *Ocimum* belonging to the Family Lamiaceace and Order Lamiales (USDA, 2008) a perennial scented shrub with lime fizzy (Wagner et al*.,* 1999) have been reported to have larvicidal activity, *O. basilicum (*Azhari et al*.,* 2009) *O. sanctum* (Vinayagam et al., 2008) and *O. americana* (Cavalcanti et al., 2004). Oil extracts of *O. gratissimum* leaves have been reported to have repellant effect on adult mosquitoes (Oparaocha, 2008). Traditionally, its fresh leaves are placed on a lighted lamp and the fumes have been reported to repel adult mosquitoes from target organisms. *Ocimum gratissimum* have been reportedly used in the treatment of fever and diarrhea (Oliver, 1980), convulsion, stomach pains and catarrh (Oparaocha, 2008) among many other uses. However, there is still dearth of information on its effects on immature stages of mosquitoes. This study examines the effects of *O. gratissimum* on the larvae of *Anopheles gambiae* and other non-target organisms.

MATERIAL AND METHODS

Preparation of stock solution of plant leaf extract

Fully developed leaves of *O. gratissimum* were collected in the month of June, 2011. The leaves were thoroughly washed, shade dried and ground with the warring blender. Ground leaves were sieved to get fine powder. Methanolic and ethanolic extracts were obtained by soaking 100gm of finely ground plant material in 500ml of 70% methanol and ethanol respectively for 24hr with periodic shaking. The content of each set up was filtered using Whatmann's No 1 filter paper and the residue evaporated to dryness using the soxhtet apparatus. After this, the extract was allowed to cool and then each… was put into a container and labeled accordingly. 20mg, 40mg, 60mg, 80mg and 100mg of each of these were mixed with 100ml of ethanol or methanol as the case may be to get test concentrations to be used.

Effects of plant leaf extract on mosquito larva

Ten active larva were put into 500ml transparent containers which have 249ml of dechlorinated water, fed with glucose and allowed to acclimatize. 1ml of each test concentration was added to each container and labeled accordingly. Two replicates for each test concentration ranging from 20mg/ml, 40mg/ml, 60mg/ml, 80mg/ml, 100mg/ml and a control(made up of 249ml of dechlorinated water and 1ml of ethanol(or methanol) were setup and observed under room temperature of 30°C ± 2°C.

Mortality of larvae were observed at 6hr intervals for 96hr. the larvae were also observed for effect of extract on their growth, other abnormalities like sluggishness and reduced swimming activity in each container of the different test concentration for 96hrs.

Effect on non-target organisms

The experimental set-up for the larvae was also used against non-target organisms. The organisms used were water skater, water strider (*Alierris remigis*) and tadpole of toad (*Bufo regularis*). One organism per container was used to avoid predation and each set-up observed for mortality and other abnormalities like reduced swimming activity, sluggishness etc for 24hrs.

Phytochemical screening of plant leaf material

Phytochemical screening of leaf material for saponins, tannins, flavonoids, alkaloids, cynogenic and cardiac glycosides was carried out according to Amadi et al. (2004).

RESULTS

Methanolic and ethanolic extracts of leaves of *O. gratissimum* showed some larvicidal activity on *A. gambiae* tested at concentrations ranging from 40mg/ml to 100mg/ml. No mortality was recorded for each at test concentrations less than 40mg/ml. The results are as shown in tables 1 and 2.

Ethanolic extract of leaf material was more effective than methanolic extract of leaf material of *O. gratissimum* as shown in table 3.

It was observed that the leave extracts tested on the mosquito larva affected the growth rate and swimming activities negatively. Sluggishness and other morphological abnormalities were observed. The time onset of observed behavioral changes reduced with increasing extract concentration (table 4).

The effect of the plant extract increased with increasing test concentration. No abnormal behavior was observed in the control. Pupal emergence occurred after 4days in the control while it occurred after 5days in the 20mg/ml test concentration experiment and there were no other observed effects. Pupal emergence in the 40mg/ml assay emerged 6days for ethanol extract and 7days in methanol but the emerged pupa were not as active as those emerging in the control, they could not molt to the imago stage but died later on. Those that survived in 60mg/ml, 80mg/ml and 100mg/ml (methanol) after 96hr could not molt to pupa but also die later on.

Phytochemical screening result revealed the presence of tannins, saponins, alkaloid, flavonoid, cyanogenic and cardiac glycosides in varying concentrations / ranges (table 5).

Saponins occurred in trace amounts while flavonoids concentrations were high.

There were no observed adverse effects on non-target organisms. No abnormality or mortality was observed on the non-target organisms after 24hr exposure to different test concentrations of both methanolic and ethanolic extracts of *O. gratissimum* leaf.

DISCUSSION

The study has shown that methanolic and ethanolic extracts of *O. gratissimum* leaf have growth and larvicidal effects at high concentrations have growth regulatory and larvicidal effect on *Anopheles gambiae*. The result has shown that *O. gratissimum* leaf extracts have larvicidal effects on *A. gambiae* with 100% mortality at 100mg/ml of leaf extract. Larvicidal effects of other species of *Ocimum* such as *O. basilicum* on *Anopheles gambiae* (Azhari et al., 2009), *O. sanctum* on *A. stephesi* (Vinayagam et al., 2008) and *O. americana* on *Aedes aegypti* (Cavalcanti et al., 2004) have been reported. Mortality could not be linked to the solvents ethanol and methanol as no death was recorded in the control containers. The Larvicidal effect could be linked to phytochemicals present in the leaf. The presence of alkaloids in plants may be associated to their biological activities (Basu & Basa, 1972). Crude extracts of saporium from fruit pods of *Sivartzia madagascarinsis* produced high mortality in *Anopheles gambiae* larvae (Minija & Sarda, 1986).

The phytochemicals may also be responsible for the growth abnormalities and delay in the pupal emergence observed in the course of the study. Sivagnaname & Kalyanasundariam (2004) and Mohtar et al., (1999) reported prolonged pre-imago period, for *Aedes aegypti* larva exposed to methanol extract of *Nerium indicum*. The test concentrations recorded larvicidal activities in concentrations from 40 mg/ml and above while concentrations below 40mg/ml were sub lethal. The LC_{50} and LC_{90} for ethanolic extracts were 60.9mg/ml and 464. 1 mg/ml respectively while those for methanol extracts were 73.6mg/ml for LC_{50} and 1021mg/ml for LC_{90}. Some plant extracts have been shown to exhibit larvicidal activity or insect growth regulatory activity against mosquito larvae at concentration above 10mg/ml (Deshmukh & Renapurka, 1987; Thangam&

Kathiresan, 1988). Sivagnaname & Kalyanasundaran (2004) reported LC_{50} values less than 0.2mg/ml for methanolic extracts of Atlantia *monophylla* against larvae and pupae of *Anopheles aegypti* and *Culex quinquefasciatus*. Nevertheless the LC_{50} of 60.9mg/ml of ethanolic extracts of *O. gratissimum* can be compared to LC_{50} of 55-65mg/ml for some Neem extracts as reported by Ascher & Meisner (1989).

CONCLUSION

Ethanolic extracts may be superior to methanolic extracts considering their LC_{50} and LC_{90} values. It could be that ethanol as a solvent extracted more of the phytochemical components than the methanol. It could also be that the more the concentration of leaf materials the more the larvicidal and growth inhibitory activities of the leaf extract. The result revealed that the leaf extract was safe for non-target organisms as no adverse effects or mortality was recorded. This shows that the extract if used in the field where these organisms co-inhabit with the mosquito larvae will only kill the larvae and not harm other organisms.

Resistance of mosquito vectors to synthetic insecticides , high cost of these insecticides and their adverse effects on non-target organisms and environment has been a major concern in vector control. Botanical insecticides are reported to be effective against insect pests, eco-friendly with reduced effect on non-target organisms, cheap, readily available, biodegradable and safe, they may serve as alternative to synthetic ones (Sivagnaname & Kalyanasundaram, 2004; Dehghan et al., 2012; Mufutau, 2012).

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Table 1. Mortality rate of Ethanolic leaf extract of *O. gratissimum* on larvae of *A. gambiae.*

Concentration mg/ml	Total no	No dead	% mortality	Log $_{10}$ concentration	Probit
0.0	10	0	0	0	0
20.0	10	0	0	1.301	0
40.0	10	2	20	1.602	4.16
60.0	10	5	50	1.778	5.0
80.0	10	7	70	1.903	5.52
100.0	10	10	100	2.0	8.09

Table 2. Mortality rate of Ethanolic leaf extract of *O. gratissimum* on larvae of *A. gambiae.*

Concentration mg/ml	Total no	No dead	% mortality	Log $_{10}$ concentration	Probit
0.0	10	0	0	0	0
20.0	10	0	0	1.301	0
40.0	10	2	20	1.602	4.16
60.0	10	3	30	1.778	4.48
80.0	10	6	60	1.903	5.52
100.0	10	8	80	2.0	5.84

NB: Total number and number dead were average of the two replicates for each test concentration.

Table 3. LC_{50} and LC_{90} values of methanolic and ethanolic leaf extracts.

Extract	Y	R^2	LC_{50}	LC_{90}
Methanol	Y=3.502x – 1.538	0.893	73.6mg/ml	1021mg/ml
Ethanol	Y=4.534x – 3.092	0.998	60.9mg/ml	464.4mg/ml

Table 4. Observation time of the abnormalities in *A. gambiae* larvae in different test extract concentrations.

Test concentration (mg/ml)	Time of observation (Hours)	
	Methanol	Ethanol
0.0	nil	Nil
20.0	nil	nil
40.0	84	72
60.0	66	48
80.0	36	24
100.0	18	12

Table 5. Presence of Photochemical in the leaf extract of *O. gratissimum.*

Phytochemical	Range
Flavonoid	++++
Alkaloid	+++
Cyanogenic glycoside	+++
Tannin	++
Cardiac glycoside	++
Saponin	+

- Absence, ++++ High concentration, +++ & ++ Moderate concentration, + Trace concentration.

CONTRIBUTIONS TO THE KNOWLEDGE OF THE GENUS *HARPALUS* LATREILLE, 1802 FAUNA OF TURKEY (COLEOPTERA: CARABIDAE: HARPALINAE)

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ABSTRACT: In this study, specimens of the genus *Harpalus* Latreille, 1802 were collected from different localities of Turkey in 2000 and 2007. A total of 30 species and subspecies belonging to this genus were recorded. *Harpalus* (s.str.) *affinis* (Schrank, 1781), *H.* (s.str.) *angulatus* Putzeys, 1878, *H.* (s.str.) *distinguendus* (Duftschmid, 1812), *H.* (*Harpalophonus*) *hospes armenus* (Daniel, 1904), *H.* (s.str.) *serripes* (Quensel, 1806) and *H.* (s.str.) *smaragdinus* (Duftschmid, 1812) are the most abundant and widespread species. The first exact locality record for *H.* (s.str.) *convexus* Faldermann, 1836 is provided. In addition, the distributions of the species and subspecies in Turkey are provided with new locations for some species.

KEY WORDS: Coleoptera, Carabidae, Harpalinae, *Harpalus*, Fauna, Turkey.

The Carabidae, or ground beetles, is a huge family distributed worldwide and is an exceptionally interesting subject for various biological observations. There are more than 40 000 described species, including 2 700 species from Europe (Turin, 1981; Lövei & Sunderland, 1996). They have very variable shape and colouration and are commonly found under stones, logs, leaves, bark, debris, or foraging on the ground. Although they usually feed on insects, worms, slugs, snails, caterpillars, grubs and maggots as predators (Thiele, 1977; Stork, 1990; Luff et al., 1992), some species are omnivorous or phytophagous (Larsen et al., 2003; Löbl & Smetana, 2003). More than 1 100 species of the Carabidae have been recorded in Turkey (Casale & Taglianti, 1999) and new species are still being added to the list.

The genus *Harpalus* is one of the most speciose genera of the subfamily Harpalinae of the family Carabidae, with almost 400 species worldwide (Hurka, 1996), and 150 species in Europe (Trautner & Geigenmüller, 1987). Most species of this genus are partly or preferably phytophagous, at least as the imago (Trautner & Geigenmüller, 1987). They are found in unshaded habitats, including steppe, vineyards, fields, fallows; and lowlands and hills (Hurka, 1996). Turkey is a rich area in respect to species of this genus. A list of 56 species was provided by Casale & Taglianti (1999).

Many researchers have worked on the genus *Harpalus* in Turkey, including Kataev (1993), Kataev & Wrase (1995), Kataev & Wrase (1997), Casale & Taglianti (1999), Kesdek & Yıldırım (2003), Kocatepe & Mergen (2004) and Avgin & Emre (2007). The aim of this study was to compile a list of species of the genus *Harpalus* in Turkey with locality information.

MATERIALS AND METHODS

The carabid material was collected from different localities and altitudes in Turkey, including from under stones and on open ground by hand and with an insect aspirator in 2000 and 2007. Material was identified by Dr. Claude Jeanne in France, Dr. David W. Wrase in Germany and the author. Provinces where the specimens were collected are given in alphabetical order. The specimens are deposited in the Entomology Museum, Erzurum, Turkey (EMET) and in the collection of the author at the Ali Sıtkı Mefharet Koçman Vocational School in Fethiye, Muğla, Turkey.

RESULTS

In this study, a total of 30 species and subspecies belonging to the genus *Harpalus* are reported from Turkey. Among them, *Harpalus* (s.str.) *affinis* (Schrank, 1781), *H.* (s.str.) *angulatus* Putzeys, 1878, *H.* (s.str.) *distinguendus* (Duftschmid, 1812), *H.* (*Harpalophonus*) *hospes armenus* (Daniel, 1904), *H.* (s.str.) *serripes* (Quensel, 1806) and *H.* (s.str.) *smaragdinus* (Duftschmid, 1812) are the most abundant and widespread species. An exact locality record for *H.* (s.str.) *convexus* Faldermann, 1836 is also reported for the first time. The species and subspecies of *Harpalus* are given in alphabetical order in the following list:

GENUS *HARPALUS* LATREILLE, 1802

***Harpalus* (s.str.) *affinis* (Schrank, 1781)**
Material examined: Ardahan: 20 km North, 2445 m, 2 exs., 11.VI.2005; 1 ex., 18.VIII.2004; Göle, 13 km South, 1870 m, 2 exs., 18.VIII.2004; 20 km West, 1900 m, 2 exs., 11.VI.2005; Türkeşin, 1970 m, 5 exs., 25.VII.2005; Hanak, 1820 m, 1 ex., 15.X.2005; Posof, Aşıkzülali, 1960 m, 7 exs., 26.VII.2005; Ilgar Pass, 2350 m, 2 exs., 18.VIII.2004. **Artvin:** Genya Mountain, 1780 m, 1 ex., 10.VI.2005; 1 ex., 2.VII.2004; Şavşat, Çamlıbel Pass, 2250 m, 2 exs., 4.VIII.2005; Düzenli, 1700 m, 9 exs., 11.VI.2005; Yavuzköy, 1680 m, 1 ex., 11.VI.2005. **Erzurum:** Dadaşkent, 1840 m, 1 ex., 11.VI.2005; Dadaşköy, 1800 m, 2 exs., 8.VI.2005; 2 exs., 17.VI.2004; 6 exs., 14.VIII.2004; 4 exs., 18.VIII.2004; Dutçu, 1900 m, 1 ex., 21.VII.2004; Konaklı, 2150 m, 2 exs., 2.VII.2004; Palandöken Mountain, 2050 m, 1 ex., 7.VII.2005; 1 ex., 26.VIII.2004; Tepeköy, 1900 m, 2 exs., 19.IX.2005; Umudum Plateau, 2100 m, 1 ex., 26.VII.2004; Aşkale, Pırnakapan, 1920 m, 1 ex., 14.X.2004; Oltu, 1350 m, 1 ex., 8.V.2006; Pasinler, Hamamderesi, 1800 m, 1 ex., 7.V.2006; Şenkaya, Çakırbaba Pass, 2450 m, 1 ex., 4.IX.2004; 1 ex., 12.X.2005; Tortum, Aksu, 1800 m, 1 ex., 17.V.2004; Güzelyayla Pass, 2128 m, 1 ex., 4.X.2005; Kazandere, 1990 m, 1 ex., 18.VII.2004; Uzundere, Yayla Pass, 2350 m, 2 exs., 13.V.2005. **Kars:** 3 km North, 1910 m, 1 ex., 3.VIII.2005; Digor, Değirmendere, 1800 m, 2 exs., 17.VII.2005; Kağızman, Yukarısultanlı, 1300 m, 1 ex., 17.V.2005; Sarıkamış, 3 km East, 1360 m, 1 ex., 7.X.2005; Karakurt, 1550 m, 1 ex., 18.IV.2004; Karaurgan, 1760 m, 1 ex., 2.VI.2005; Şeytangeçmez, 1775 m, 1 ex., 14.VI.2004; Yenigazi, 1920 m, 1 ex., 16.X.2005; Yeniköy, 2200 m, 1 ex., 12.X.2005; Susuz, 20 km North, 1975 m, 4 exs., 25.VII.2005. **Trabzon:** Beşikdüzü, 1 ex., 15.X.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Ardahan, Artvin, Kars, Trabzon (Kesdek & Yıldırım, 2003); Ankara (Kocatepe & Mergen, 2004).

***Harpalus* (s.str.) *albanicus* Reitter, 1900**
Material examined: Erzurum: Aşkale, Kop Pass, 2150 m, 1 ex., 6.VI.2006; Oltu, Çamlıbel, 1750 m, 1 ex., 17.V.2004. **Kars:** Sarıkamış, Karakurt, 1775 m, 1 ex., 20.IV.2006. **Yalova:** 1 ex., 24.VII.2003.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Kahramanmaraş (Avgın & Emre, 2007).

***Harpalus* (s.str.) *anatolicus* Tschitschérine, 1898**
Material examined: Erzurum: Dadaşkent, 1840 m, 1 ex., 11.VI.2005; Uzundere, Yayla, 1800 m, 5 exs., 17.V.2004; 1 ex., 28.IX.2004. **Kars:** Sarıkamış, Karakurt, 1550 m, 2 exs., 18.IV.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).
This species is endemic to Asiatic Turkey.

***Harpalus* (s.str.) *angulatus* Putzeys, 1878**
Material examined: Ardahan: Posof, Aşıkzülali, 1960 m, 1 ex., 26.VII.2005. **Artvin:** Şavşat, Yavuzköy, 1680 m, 2 exs., 11.VI.2005. **Bayburt:** Aşağı Kop, 1950 m, 5 exs., 25.VI.2006. **Erzurum:** Tekederesi, 2150 m, 1 ex., 12.VI.2006; 4 exs., 13.VI.2005; 1 ex., 1.X.2004; Atatürk University field, 1850 m, 1 ex., 29.IV.2004; Aşkale, 1600 m, 1 ex., 27.IV.2004; Hınıs, Ömerli, 1780 m, 1 ex., 22.VII.2005; Köprüköy, Kayabaşı, 1450 m, 1 ex., 14.VI.2004; Oltu, Çamlıbel, 1430 m, 1 ex., 17.V.2004; Pazaryolu, 25 km South, 1930 m, 2 exs., 14.X.2004; 2 exs., 21.X.2004; Şenkaya, Çakırbaba Pass, 2450 m, 1 ex., 9.VIII.2005; Uzundere, Yayla Pass, 2350 m, 2 exs., 13.V.2005. **Kars:** Digor, Yeniköy, 1695 m, 1 ex., 4.V.2004; Sarıkamış, 10 km East, 1460 m, 1 ex., 7.X.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *anxioides* Kataev, 1991**
Material examined: Erzurum: Abdurrahmangazi, 2170 m, 4 exs., 8.VIII.2005; Horasan, 1760 m, 2 exs., 13.V.2005; Uzundere, Yayla Pass, 2350 m, 3 exs., 13.V.2006. **Yalova:** 1 ex., 23.VII.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Erzurum (Kesdek & Yıldırım, 2003).
This species is endemic to Asiatic Turkey.

***Harpalus* (s.str.) *attenuatus* Stephens, 1828**
Material examined: Artvin: Şavşat, Yavuzköy, 1680 m, 1 ex., 11.VI.2005. **Bayburt:** Aşağı Kop, 1870 m, 1 ex., 25.VI.2006. **Erzurum:** Narman, 20 km Southeast, 1780 m, 1 ex., 16.IV.2004; Oltu, Başaklı, 1730 m, 1 ex., 13.VII.2005; Subatık, 1330 m, 1 ex., 28.III.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Bingöl, Erzurum, Sinop (Kesdek & Yıldırım, 2003); Kahramanmaraş (Avgın & Emre, 2007); İzmir (Anlaş & Tezcan, 2010; Tezcan et al., 2011).

***Harpalus* (s.str.) *caspius* Steven, 1806**
Material examined: Ardahan: 2 km East, 1890 m, 1 ex., 25.VII.2005. **Bayburt:** Kop Pass, 1950 m, 3 exs., 25.VI.2006. **Erzurum:** Dadaşköy, 1800 m, 1 ex., 17.VII.2004; Atatürk University field, 1850 m, 1 ex., 3.IV.2004; Uzundere, Yayla, 1800 m, 2 exs., 17.V.2004; 3 exs., 28.IX.2004. **Iğdır:** Tuzluca, Üçkaya, 1010 m, 2 exs., 29.VI.2003. **Kars:** Sarıkamış, Karaçuha, 1900 m, 1 ex., 27.V.2003; Karakurt, 5 km South, 1780 m, 1 ex., 16.V.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Kahramanmaraş (Avgın & Emre, 2007).

***Harpalus* (*Harpalophonus*) *circumpunctatus* (Chaudoir, 1846)**
Material examined: Bayburt: Aşağı Kop, 1950 m, 1 ex., 25.VI.2006. **Erzurum:** Çat, 1800 m, 1 ex., 12.IV.2004; Karayazı, Karaağıl, 1875 m, 1 ex., 26.X.2005.
Distribution in Turkey: Kayseri, Konya (Ganglbauer, 1905); Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *convexus* Faldermann, 1836**
Material examined: Erzurum: Palandöken Mountain, 2200 m, 1 ex., 23.IV.2005; 2 exs., 15.V.2005; 1 ex., 23.V.2005; 1 ex., 12.VI.2005; Tekederesi, 1900 m, 2 exs., 13.VI.2005; Tuzcu, 1910 m, 3 exs., 17.VII.2004; 1 ex., 8.IX.2004; Atatürk University field, 1850 m, 1 ex., 27.V.2004; 5 exs., 4.VI.2005; Aşkale, Ortabahçe, 1790 m, 1 ex., 1.IX.2004; Pırnakapan, 1900 m, 1 ex., 30.IV.2005; 1 ex., 27.V.2004; Köprüköy, 2 km East, 1750 m, 3 exs., 27.V.2004; Oltu, Çamlıbel, 1750 m, 1 ex., 17.V.2004; Sarısaz, 1720 m, 1 ex., 18.IV.2005; Pasinler, 4 km East, 1730 m, 1 ex., 16.X.2004; Hamamderesi, 1850 m, 1 ex., 20.IV.2005. **Kars:** Digor, 20 km South, 1730 m, 1 ex., 17.V.2005; Yeniköy, 1695 m, 1 ex., 4.V.2004; Kağızman,

Aydınkavak, 1500 m, 1 ex., 3.VI.2004; Değirmendere, 1370 m, 1 ex., 17.V.2005; Sarıkamış, Akkurt, 1350 m, 3 exs., 4.VI.2004; Karakurt, 1670 m, 1 ex., 18.V.2005; 1450 m, 1 ex., 3.VI.2004; 1575 m, 1 ex., 19.VI.2004; Şeytangeçmez, 2 exs., 14.VI.2004.
Distribution in Turkey: East of Turkey (No locality) (Kataev, 2002).
This species is widely distributed in Transcaucasia from East Turkey to West Kopetdagh (Kataev, 2002). Thus, The first exact locality record for this species is provided in this study.

***Harpalus* (s.str.) *distinguendus* (Duftschmid, 1812)**
Material examined: Ardahan: Göle, 20 km West, 1900 m, 1 ex., 11.VI.2005. **Erzincan:** 5 km East, 1325 m, 1 ex., 8.VIII.2004. **Erzurum:** Dadaşköy, 1800 m, 2 exs., 4.VI.2005; 2 exs., 16.VII.2004; 2 exs., 14.VIII.2004; Dutçu, 1910 m, 1 ex., 21.VI.2004; Atatürk University field, 1850 m, 1 ex., 11.V.2005; 2exs., 17.V.2004; Aşkale, Pırnakapan, 1870 m, 2 exs., 3.VI.2006; Karayazı, Yeniköy, 1820 m, 1 ex., 26.X.2005; Şenkaya, Çakırbaba Pass, 2450 m, 1 ex., 18.VIII.2008; Uzundere, Yayla Pass, 1800 m, 1 ex., 17.V.2004. **Iğdır:** 4 km South, 1250 m, 1 ex., 4.VI.2004. **Kars:** Sarıkamış, Şeytangeçmez, 1755 m, 1 ex., 14.VI.2004. **Konya:** Güneysınır, Gürağaç, 1020 m, 1 ex., 11.VII.2007.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Ankara, Antalya, Erzurum, Trabzon (Kesdek & Yıldırım, 2003, Kocatepe & Mergen, 2004); Gaziantep, Kahramanmaraş, Sivas (Avgın & Emre, 2007); İzmir (Tezcan et al., 2011).

***Harpalus* (s.str.) *flavicornis* Dejean, 1829**
Material examined: Erzurum: Umudum Plateau, 2100 m, 1 ex., 26.VII.2003; Tuzcu, 1910 m, 1 ex., 21.VI.2004; Oltu, Başaklı, 2050 m, 1 ex., 13.VII.2005; Uzundere, Yayla Pass, 2340 m, 1 ex., 12.V.2005; 2 exs., 14.V.2006.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *fuscicornis* Ménétriés, 1832**
Material examined: Erzurum: Dutçu, 1900 m, 1 ex., 21.VI.2004; Palandöken Mountain, 2150 m, 1 ex., 19.V.2005; Şenkaya, Çakırbaba Pass, 2450 m, 1 ex., 9.VIII.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Artvin, Denizli, Erzurum (Kesdek & Yıldırım, 2003).

***Harpalus* (s.str.) *fuscipalpis* Sturm, 1818**
Material examined: Bingöl: Karlıova, Köklü, 1600 m, 1 ex., 6.VI.2003. **Erzurum:** Atatürk University field, 1850 m, 1 ex., 12.V.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Artvin, Erzurum, Konya (Kesdek & Yıldırım, 2003).

***Harpalus* (s.str.) *honestus* (Duftschmid, 1812)**
Material examined: Artvin: Genya Mountain, 2150 m, 1 ex., 12.VII.2004; Şavşat, 1300 m, 1 ex., 19.VIII.2004. **Trabzon:** 1 ex., 20.VII.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (*Harpalophonus*) *hospes armenus* (Daniel, 1904)**
Material examined: Ardahan: Göle, Türkeşin, 1970 m, 1 ex., 25.VII.2005. **Bayburt:** Aşağı Kop, 1950 m, 4 exs., 25.VI.2006; Kop Pass, 1970 m, 1 ex., 7.IX.2004. **Erzurum:** Dadaşköy, 1800 m, 1 ex., 16.VII.2004; 1 ex., 17.VII.2004; Aşkale, Pırnakapan, 1950 m, 1 ex., 27.V.2004;1920 m, 1 ex., 14.X.2004; Çat, 1970 m, 4 exs., 28.III.2005; Yavi, 1850 m, 8 exs., 21.V.2004; Yukarıçat, 1840 m, 2 exs., 21.V.2004; Hınıs, Söylemez, 1750 m, 1 ex., 28.VI.2005; Ilıca, Yoncalık, 1730 m, 1 ex., 21.X.2004; Oltu, Çamlıbel, 1750 m, 1 ex., 17.V.2004; Şenkaya, Çakırbaba Pass, 2450 m, 1 ex., 18.VIII.2004; Tortum, Esendurak, 1150 m, 1 ex., 10.V.2006; Uzundere, Yayla, 1800 m, 5 exs., 10.IV.2004; 1 ex., 28.IX.2004. **Kars:** 3 km North, 1910 m, 1 ex., 3.VIII.2005; Kağızman, Aydınkavak, 1500 m, 1 ex., 3.VI.2004; Sarıkamış, Akkurt, 1350 m, 2 exs., 4.VI.2004; Karakurt, 1575 m, 1 ex., 19.VI.2004; Şeytangeçmez, 2 exs., 14.VI.2004; Susuz, Taşlıdere, 1890 m, 1 ex., 25.VII.2005. **Konya:** Güneysınır, Örenboyalı, 1050 m, 1 ex., 28.II.2007.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Adıyaman, Kahramanmaraş (Avgın & Emre, 2007).

***Harpalus* (s.str.) *kazanensis* Jedlicka, 1958**
Material examined: Erzurum: Atatürk University field, 1850 m, 1 ex., 6.VII.2005; Çat, Yavi, 1870 m, 12 exs., 21.V.2004; 12 exs., 18.IX.2004; Uzundere, Yayla Pass, 2350 m, 1 ex., 13.V.2006.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *latus* (Linnaeus, 1758)**
Material examined: Ardahan: Çamlıbel Pass, 2445 m, 1 ex., 11.VI.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *pulvinatus lubricus* Reitter, 1900**
Material examined: Kars: Sarıkamış, Çardakçatı, 1350 m, 1 ex., 17.V.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (*Actephilus*) *pumilus* (Sturm, 1818)**
Material examined: Ardahan: Posof, Ilgar Pass, 2450 m, 1 ex., 13.VII.2004. **Erzurum:** Haydarlı, 1900 m, 1 ex., 4.VII.2005; Tekederesi, 1900 m, 1 ex., 13.VI.2005; Umudum Plateau, 2100 m, 2 exs., 26.VII.2003. **Gümüşhane:** Kale, 5 km South, 1 ex., 2.IV.2002. **Kars:** Sarıkamış, Karakurt, 10 km West, 1770 m, 1 ex., 20.IV.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *pygmaeus* Dejean, 1829**
Material examined: Erzurum: Umudum Plateau, 2100 m, 8 exs., 26.VII.2003; Oltu, Başaklı, 1700 m, 2 exs., 28.III.2005.
Distribution in Turkey: Kocaeli (Bodemeyer, 1900); Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *quadratus* Chaudoir, 1846**
Material examined: Erzurum: Dadaşkent, 1800 m, 1 ex., 11.V.2004; Çat, Yukarıçat, 1890 m, 1 ex., 21.V.2004; Karayazı, Karaağıl, 1875 m, 1 ex., 26.X.2005.
Distribution in Turkey: Kars (first recorded, col., Lodos) (Öncüer, 1991); Anatolia (No locality) (Casale & Taglianti, 1999); Ardahan (Kesdek & Yıldırım, 2003).

***Harpalus* (s.str.) *reflexus reflexus* Putzeys, 1878**
Material examined: Bayburt: Kop Pass, 1950 m, 1 ex., 25.VI.2006. **Erzurum:** Tekederesi, 1900 m, 1 ex., 13.VI.2005; 1 ex., 1.X.2004; Tuzcu, 1910 m, 1 ex., 17.VII.2004; Oltu, Çamlıbel, 1750 m, 1 ex., 17.V.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *rubripes* (Duftschmid, 1812)**
Material examined: Erzurum: Oltu, Sarısaz, 1720 m, 1 ex., 16.VI.2006; Şenkaya, Sındıran, 1950 m, 1 ex., 24.V.2005; Tortum, Söğütlü, 1750 m, 1 ex., 12.V.2004; Uzundere, Yayla Pass, 2450 m, 3 exs., 13.V.2006. **Iğdır:** Tuzluca, Üçkaya, 1500 m, 2 exs., 29.VI.2003. **Kars:** Sarıkamış, Karakurt, 1775 m, 1 ex., 2.VIII.2005.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Ardahan, Erzurum, Kars (Kesdek & Yıldırım, 2003).

***Harpalus* (s.str.) *saxicola* Dejean, 1829**
Material examined: Erzurum: Aşkale, Pırnakapan, 1870 m, 3 exs., 3.VI.2006. **Iğdır:** 10 km Southeast, 1250 m, 1 ex., 4.VI.2004. **Konya:** Güneysınır, Örenboyalı, 1060 m, 1 ex., 28.III.2002.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *serripes* (Quensel, 1806)**
Material examined: Artvin: Şavşat, Yavuzköy, 1680 m, 1 ex., 11.VI.2005. **Erzincan:** Tercan, Yaylacık, 1650 m, 2 exs., 25.V.2005; Üzümlü, Akyazı, 1350 m, 1 ex., 26.V.2005. **Erzurum:** Atatürk University field, 1850 m, 1 ex., 14.IV.2005; 2 exs., 21.V.2005; Börekli, 2125 m, 1 ex., 7.VII.2005; Dutçu, 2100 m, 2 exs., 19.V.2005; Konaklı, 2150 m, 1 ex., 2.VII.2004; Aşkale, Ortabahçe, 1965 m, 1 ex., 4.VII.2005; Köprüköy, 2 km East, 1750 m, 1

ex., 27.V.2004; Tortum, Aksu, 1800 m, 2 exs., 17.V.2004; Tuzluk, 1750 m, 1 ex., 24.V.2005. **Iğdır:** Tuzluca, Gaziler, 1020 m, 1 ex., 16.V.2005. **Kars:** Digor, Bostanlı, 1780 m, 1 ex., 17.VII.2005; Kağızman, Yukarısultanlı, 1300 m, 1 ex., 17.VI.2005; Sarıkamış, 10 km West, 1770 m, 2 exs., 20.IV.2005; Çardakçatı, 1350 m, 1 ex., 17.V.2005. **Konya:** Bozkır, Belören, 1100 m, 2 exs., 21.VII.2007; Güneysınır, Gürağaç, 1020 m, 2 exs., 13.VII.2007.
Distribution in Turkey: Eskişehir (Türktan, 1998); Anatolia (No locality) (Casale & Taglianti, 1999); Amasya, Ankara, Erzincan, Erzurum, Kars, Kayseri, Konya, Muğla (Ganglbauer, 1905; Kesdek & Yıldırım, 2003); Adıyaman, Kahramanmaraş, Sivas (Avgın & Emre, 2007).

***Harpalus* (s.str.) *smaragdinus* (Duftschmid, 1812)**
Material examined: Ardahan: Çamlıbel Pass, 2445 m, 2 exs., 11.VI.2005. **Artvin:** Genya Mountain, 1780 m, 3 exs., 10.VI.2005; Şavşat, 1300 m, 1 ex., 19.VIII.2004; Yusufeli, Zeytinlik, 280 m, 1 ex., 10.VI.2005. **Erzurum:** Tekederesi, 1900 m, 4 exs., 13.VI.2005; Umudum Plateau, 2100 m, 1 ex., 26.VII.2003; Çat, Yavi, 1850 m, 1 ex., 21.V.2004; Karayazı, Çatalören, 1840 m, 1 ex., 26.X.2005; Tortum, Esendurak, 1150 m, 1 ex., 10.VIII.2004. **Iğdır:** Doğubeyazıt, 10 km Southeast, 1250 m, 1 ex., 4.VI.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999); Ardahan, Artvin, Erzurum (Kesdek & Yıldırım, 2003); Kahramanmaraş, Malatya, Sivas (Avgın & Emre, 2007); İzmir (Anlaş & Tezcan, 2010; Tezcan et al., 2011).

***Harpalus* (s.str.) *smymensis medicus* Kataev, 1993**
Material examined: Erzurum: Tepeköy, 1900 m, 1 ex., 19.IX.2005; Umudum Plateau, 2100 m, 1 ex., 26.VII.2003; Aşkale, Kop Pass, 2300 m, 1 ex., 14.X.2004; Pırnakapan, 1920 m, 1 ex., 14.X.2004; Çat, Yavi, 1850 m, 1 ex., 21.V.2004; Yukarıçat, 1900 m, 2 exs., 21.V.2004; Ilıca, Atlıkonak, 1950 m, 1 ex., 11.VI.2004; Pasinler, 1 ex., 2.VIII.2004; 4 km Southwest, 1800 m, 1 ex., 2.VII.2005; Hamamderesi, 1800 m, 1 ex., 20.IV.2003; 1 ex., 7.X.2004; Şenkaya, Çakırbaba Pass, 1 ex., 12.VII.2005; Tortum, Güzelyayla Pass, 2128 m, 2 exs., 4.X.2005. **Kars:** Kağızman, 15 km East, 1115 m, 1 ex., 17.V.2005; Sarıkamış, Karakurt, 1550 m, 1 ex., 18.IV.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).
This subspecies is endemic to Asiatic Turkey.

***Harpalus* (s.str.) *smymensis raddei* Tschitschérine, 1897**
Material examined: Artvin: Genya Mountain, 1780 m, 1 ex., 12.VII.2004. **Bayburt:** Aşağı Kop, 1950 m, 1 ex., 25.VI.2006.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).
This subspecies is endemic to Asiatic Turkey.

***Harpalus* (s.str.) *subcylindricus* Dejean, 1829**
Material examined: Erzincan: Üzümlü, Günebakan, 1350 m, 2 exs., 25.V.2005. **Erzurum:** Tekederesi, 1950, 1 ex., 26.VI.2005; Tuzcu, 1900 m, 1 ex., 17.VII.2004; Umudum Plateau, 2100 m, 5 exs., 26.VII.2003; Aşkale, Pırnakapan, 1750 m, 3 exs., 2.IV.2005; 3 exs., 27.V.2004; 1 ex., 17.VI.2006; Çat, Yukarıçat, 1870 m, 1 ex., 21.V.2004; Köprüköy, 2 km East, 1 ex., 17.V.2005; Uzundere, 1520 m, 1 ex., 12.V.2006. **Kars:** Sarıkamış, Karakurt, 1775 m, 2 exs., 20.IV.2006; Şeytangeçmez, 1755 m, 1 ex., 14.VI.2004.
Distribution in Turkey: Anatolia (No locality) (Casale & Taglianti, 1999).

***Harpalus* (s.str.) *zabroides* Dejean, 1829**
Material examined: Erzurum: Atatürk University field, 1850 m, 1 ex., 27.V.2004; Dutçu, 2100 m, 1 ex., 19.V.2005; Uzundere, Yayla, 1800 m, 1 ex., 17.V.2004.
Distribution in Turkey: Kars (first recorded, col., Lodos) (Öncüer, 1991); Anatolia (No locality) (Casale & Taglianti, 1999).

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IDENTIFICATION OF SPECIES LIXINI TRIBE FROM SOUTH OF KERMAN REGION, IRAN (COLEOPTERA: CURCULIONIDAE: LIXINAE: LIXINI)

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[Shahriyari, S., Fathi, S. A. A. & Asadi, M. 2013. Identification of species Lixini tribe from South of Kerman region (Coleoptera: Curculionidae: Lixinae: Lixini). Munis Entomology & Zoology, 8 (1): 199-202**]**

ABSTRACT: During 2010-2011 tribe of Lixini was investigated in South of Kerman region. In total 9 species belonging to 3 genera were determined. Among them identificated for first time in world main host plant of species *Larinus affinis* that this species compeleted its generation on this host plant.

KEY WORDS: Curculionidae, Lixinae, Lixini, *Echinops aucheri*, Kerman.

Kerman is a width region in Iran (with total area 175069 km^2) that including 16 towns. This is area linked with six provinces including Southern Khorasan, Yazd, Systan and Baluchistan, Hormozgan and Fars. Cuculionidae is currently the largest family of insects in the world with at least 3600 genera and 41000 species (Spangler, 1982). Lixinae is a subfamily of true weevils, including two tribes Cleonini and Lixini (Ter-Minassian, 1967). Main characteristics of the subfamily include tarsal claws are fused at the base, and labial palps are short and telescoping. In addition, their body is elongated shape as for some other weevils, tibiae bear and uncus on its distal end and the rostrum is forwardly directed (Boothe et al., 1990). The species of Lixinae are mainly root feeder and thus several of those are used in biological control of invasive weeds, namely Knapweeds (Zwolfer et al., 1971; Coombs et al., 2004). Main characteristic of tribe of Lixini that separate it from tribe of Cleonini is antennary groove. Antennary groove in tribe of Cleonini extending almost to the apex of rostrum but in tribe of Lixini antennary groove is not usually teaching the apex of rostrum (Ter-Minassian, 1967). Several species from tribe of Lixini to make trehala that used as drug (Gultekin, 2008). The objective of this study is the identification of Lixini species in South of Kerman region.

MATERIALS AND METHODS

The material was collected during 2010-2011 on the different host plants in the pastures, agriculture field and grass land. The specimens were collected either directly by hand. All samples were lodge in killing jar (Ethanol 75%) and transferred to the laboratory and then pinned as well labeled. The specimens were sent to Dr. Levent Gultekin in Ataturk University in Erzrum-Turkey to identify or confirm. All species are deposited in the Entomology collection of Plant Protection Department college of Agriculture, Mohaghegh Ardabili university of Ardabil-Iran.

RESULTS

In the research 9 species belonging to 3 genera and from Lixini tribe are presented. In this research reported for first time in world distribution and main host plant of *Larinus affinis* weevil that this species showed by an aster.

Family Curculionidae Laterille, 1802
Subfamily Lixinae Schonherr, 1823
Tribe Lixini Schonherr, 1823
Genus *Larinus* Dejean, 1821

Larinus nidificans Guibourt, 1858

Material: Baft, 1 sample, June 2010; Dehsard, 3 sample, April 2011.
Host plant: *Echinops longipenicillatus* Mozaff. & Ghahr.
Literatures: Hanbury, 1859; Csiki, 1934; Voss, 1960; Ter-Minassian, 1967; Fremuth, 1987; Modarres Awal, 1997; Gultekin, 2008; Modarres Awal, 2010; Legalove, 2010.
Iranian distribution: Birjand.
General distribution: Turkey, Syria, Turkmenistan, Transcaucasia, Afghanistan.

Larinus onopordi Fabricius, 1787

Material: Baft. 1 sample, July 2010.
Host plant: *Echinops lalesarensis* Bornm.
Literatures: Adnani et al., 2004; Gultekin, 2006; Legalove, 2010.
Iranian distribution: Ardabil, Bushehr, East Azarbaijan, Fars, Guilan, Isfahan, Kermanshah, Lorestan, Kohkiluyeh & Boyer-Ahmad, Khuzestan, Markazi, mazandaran, Qom, Semnan, Tehran, West Azarbaijan.
General distribution: Western Palaearctic.

**Larinus affinis* Fremuth, 1987

Material: Dehsard-baft, 2 samples, June 2010, 9 samples, July 2010, 15 samplee, April 2011, Dalfard-Jiroft, 4 samples, May 2011, 6 samples, June 2011.
*Host plant: *Echinops aucheri* Boiss.
Literature: Fremuth, 1987.
Iranian distribution: Chashmeh-ye Sargaz.
Genaral distribution: Unknown.

Larinus syriacus Gyllenhal, 1835

Material: Dehsard, 5 samples, May 2011, Baft, 8 samples, May 2011.
Host plant: *Carthamus oxyachantha* M. Bies.
Literatures: Winkler, 1930-1932; Csiki, 1934a; Ter-Minassian, 1946-1967; Broumand, 1976-1998, Modarres Awal, 1997.
Iranian distribution: Ardabil, Fars, Golestan, Kermanshah, Mazandaran, West Azarbaijan.
General distribution: Southern Europe, Caucasus, Middle Asia, Asia minor.

Larinus grisescens Gyllenhal, 1835

Material: Dehsard, 3 samples, May 2011, Baft, 4 samples, May 2011.
Host plant: *Carthamus oxyachantha* M. Bieb.
Literatures: Csiki, 1934a; Ter-Minassian, 1967; Legalov, 2010.
Iranian distribution: Iran.
General distribution: Southern Europe, Asia minor.

Larinus liliputanus Faust, 1890

Material: Dehsard-Baft, 3 samples, April 2011.
Host plant: *Cousinia stocksii* Winkler.
Literatures: Broumand, 1976; Modarres Awal, 1997; Broumand, 1998, Nematollahi, 2010.
Iranian distribution: Esfahan, Fars, Kohkiluyeh & Boyer-Ahmad, Golestan, Ilam, Khuzestan, Mazandaran, Tehran, West Azarbaijan.
General distribution: Middle Asia, Iran, China.

Genus *Lixus* Fabricius, 1801

Lixus cardui Olivier, 1801

Material: Dehsard-Baft, 10 samples, April 2011, Baft, 16 samples, May 2011.
Host plant: *Onopordon leptolepis* DC.
Literatures: Winkler, 1930-1932; Csiki, 1934a; Ter-Minassian, 1946; Afshar, 1994; Broumand, 1998; Modarres Awal, 1997-2010; Legalove, 2010.
Iranian distribution: Ardabil, East Azarbaijan, Fars, Golestan, Esfehan, Kermanshah, Khorasan, Khuzestan, Kohkiluyeh & Boyer-Ahmad, Mazandaran, Qom, Tehran, West Azarbaijan.
General distribution: Western & Central Palaearctic.

Lixus albomarginatus Boheman, 1843

Material: Dehsard-Baft, 2 samples, April 2011.
Host plant: *Onopordon leptolepis* DC.
Literatures: Dieckman, 1980, 1983; Broumand, 1998.
Iranian distribution: East Azarbaijan, Sistan & Baluchestan, Tehran.
General distribution: Western and Cetral Palaearctic.

Genus *Bangasternus* Gozis, 1882

Bangasternus planifrons Brulle, 1843

Material: Dehsard- Baft, 5 samples, April 2011.
Host plant: *Carthamus oxyachantha* M. Bieb.
Literatures: Ghahari et al., 2010; Modarres Awal & pour Hossain, 2010a.
Iranian distribution: Khorasan, Chaharmahal & Bachtiari.
General distribution: Southern Europe, Middle Asia, Asia Minor.

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IDENTIFICATION OF BIVOLTINE BREEDS AND HYBRIDS OF THE MULBERRY SILKWORM, *BOMBYX MORI* L.

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[**Singh, R. & Gangopadhyay, D.** 2013. Identification of bivoltine breeds and hybrids of the Mulberry Silkworm, *Bombyx mori* L.. Munis Entomology & Zoology, 8 (1): 203-207]

ABSTRACT: Identification of promising bivoltine breeds and hybrids of the mulberry silkworm, *Bombyx mori* L. was carried out utilizing three different statistical tools namely, multiple traits evaluation indices, combining ability and hybrid vigour. Out of six bivoltine silkworm breeds, DNB_1 was found promising exhibiting maximum values based on its performance and multiple traits evaluation indices exhibiting maximum values for six characters v*iz.,* hatching %, pupation rate, cocoon shell %, filament length, raw silk percentage and neatness followed by DNB_6 which exhibited higher values for three characters *viz.*, cocoon yield/10,000 larvae by weight, cocoon weight and cocoon shell weight. DNB_1 showed its superiority by exhibiting maximum GCA effects for seven characters. Among twenty four hybrids, DNB_1 × CSR_2 recorded maximum rearing performance values for four characters *viz.,* cocoon shell weight, cocoon shell %, filament length and raw silk % followed by two hybrids DNB_6 × CSR_2 and DNB_7 × CSR_2 exhibiting maximum values for two characters each. Different hybrids exhibited higher values for special combining ability (SCA). DNB_4 × CSR_4 manifested higher hybrid vigour for pupation rate, cocoon yield/10,000 larvae by weight and cocoon shell weight.

KEY WORDS: *Bombyx mori,* Combining ability, Hybrid vigour, Multiple traits evaluation indices, Performance, Bivoltine silkworm breeds and hybrids.

Attempts to identify promising silkworm breed / hybrids have been carried out based on multiple traits evaluation indices (Vidyunmala et al.,1998; Kariappa & Rajan, 2005; Gangopadhyay et al., 2006; Nazia Choudhary & Ravindra Singh, 2006a) and multiple traits evaluation indices (Ramesh Babu et al., 2002; Rao et al., 2006; Nirupama & Ravindra Singh, 2007; Nirupama et al., 2008a;b) and through analysis of combining ability and hybrid vigour (Datta et al., 2001; Gangopadhyay & Ravindra Singh, 2006; Nazia Choudhary & Ravindra Singh, 2006b; Ravindra Singh et al., 2000; 2001; 2010). It is important to identify breeds/hybrids based on cumulative effect of several characters (Narayanaswamy et al., 2002). Recently, Ravindra Singh and Nirupama (2012) have short-listed promising multivoltine breeds and multivoline × bivoltine hybrids utilizing various statistical tools. The present study has been undertaken to identify promising bivoltine breeds and hybrids based on the performance, other statistical methods like multiple traits evaluation indices method of Mano et al. (1993), analysis of combining ability method of Kempthorne (1957) and hybrid vigour.

MATERIALS AND METHODS

Six bivoltine silkworm breeds namely, DNB_1, DNB_2, DNB_3, DNB_4, DNB6 and DNB7 and twenty four bivoltine hybrids were utilized in this study. Rearing of both silkworm breeds and hybrids was conducted with three replications in each and 250 larvae were retained after III moult. Data were recorded for eleven economic characters namely, fecundity, hatching %, pupation rate, yield/10,000 larvae by weight, cocoon weight, cocoon shell weight, cocoon shell percentage, filament length, reelability, raw silk percentage and neatness. Data were analyzed based on rearing performance, multiple traits evaluation index method, combining ability and hybrid vigour.

RESULTS AND DISCUSSION

In order to shortlist promising bivoltine silkworm breeds / hybrids, average rearing performance, values based on multiple traits evaluation indices, general combining ability (GCA) of parents, specific combining ability (SCA) of hybrids and hybrid vigour for 11 economic characters namely, fecundity, hatching, pupation rate, yield/10,000 larvae by weight, cocoon weight, cocoon shell weight, cocoon shell percentage including post cocoon parameters like filament length, reelability, raw silk and neatness have been given in Table 1. DNB_1 showed distinct superiority based on its performance and multiple traits evaluation indices exhibiting maximum values for six characters v*iz.,* hatching % (96.28% and 56.91), pupation rate (91.33% and 68.79), cocoon shell % (21.22% and 64.84), filament length (870m and 63.62), raw silk percentage (15.70% and 60.03) and neatness (92p and 59.52) respectively followed by DNB_6 which exhibited higher values for three characters *viz.*, cocoon yield/10,000 larvae by weight (15.630 kg and 61.43), cocoon weight (1.973g and 64.78) and cocoon shell weight (0.380g and 63.01). DNB_1 exhibited maximum GCA effects for seven characters. Three characters namely, cocoon yield/10,000 larvae by weight (15.630 kg and 61.43), cocoon weight (1.973g and 64.78), cocoon shell weight (0.380g and 63.01) were maximum in DNB_6 based on average performance and evaluation index value whereas fecundity in that breed was found highest when the GCA effects for that particular character was compared with other breeds.

Among twenty four hybrids, DNB_1 × CSR_2 was found promising showing highest values for four characters namely, cocoon shell weight, cocoon shell percentage, filament length and raw silk based on average performance. DNB_1 × CSR_2 revealed its superiority for four characters namely, cocoon shell weight (63.96), cocoon shell % (78.33), filament length (65.91) and raw silk % (74.25) based on evaluation index values. Two characters namely, pupation rate (98.80) and cocoon yield/10,000 larvae by weight (17.227 kg) in DNB_6 × CSR_2 and two characters hatching (97.32%) and reelability (86.10%) in DNB_7 × CSR_2 were found comparatively higher performance values. DNB_6 × CSR_2 exhibited higher index values for pupation rate (76.81) and cocoon yield/10,000larvae by weight (63.99) whereas DNB_7 × CSR_2 exhibited highest values for 2 characters namely, hatching (65.50) and reelability (68.24). Different hybrids expressed higher SCA effects for different characters. DNB_3 × CSR_{17} for cocoon and cocoon shell weight, DNB_4 × CSR_4 for pupation rate and cocoon yield/10,000 larvae by weight and DNB_4 × $NB4D_4$ for fecundity and reelability. On the basis of hybrid vigour studies, DNB_4 × CSR_4 manifested higher hybrid vigour over mid paren values for 3 characters namely, pupation rate (14.08), cocoon yield/10,000 larvae by weight (28.30) and cocoon shell weight (21.46) whereas DNB_3 was poor combiner.

Selection of promising silkworm breeds and hybrids based on cumulative effect of several characters is important in silkworm breeding (Narayanaswamy et al., 2002).Extensive studies have been carried out to select silkworm breeds / hybrids through multiple traits evaluation index method (Ramesh Babu et al., 2002; Gangopadhyay et al., 2006; Nazia Choudhary; Ravindra Singh, 2006a, Rao et al., 2006; Lakshmi and Chandrashekharaiah, 2007; Nirupama and Ravindra Singh, 2007; Nirupama et al., 2008a;b) and through analysis of combining ability and hybrid vigour (Datta et al., 2001; Gangopadhyay and Ravindra Singh, 2006;

Nazia Choudhary and Ravindra Singh, 2006b; Nazia Choudhary and Ravindra Singh, 2006b; Ravindra Singh et al., 2000; 2001; 2010;). Ravindra Singh and Nirupama (2012) have short-listed promising silkworm breeds and hybrids utilizing evaluation index, subordinate function values, combining ability and hybrid vigour. The identified breeds DNB_1 and DNB_6 may be further utilized in future breeding programmes for the development of superior bivoltine silkworm breeds. The promising bivoltine hybrids $DNB_1 \times CSR_2$ $DNB_6 \times CSR_2$ may be exploited for commercial exploitation.

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Plate I: 1 - Larvae of DNB$_1$, 2 - Cocoons of DNB$_1$, 3 - Larvae of DNB$_6$ and 4 - Cocoons of DNB$_6$

1

2

3

4

Plate II: 1 - Larvae of $DNB_1 \times CSR_2$, 2 - Cocoons of $DNB_1 \times CSR_2$, 3 - Larvae of $DNB_6 \times CSR_2$ and 4 - Cocoons of $DNB_6 \times CSR_2$

Table 1. Short-listing of bivoltine silkworm breeds / hybrids based on various statistical measures.

Character	Parents			Hybrids			
	Based on average performance	Based on Evaluation Index values	Based on General Combining Ability	Based on average performance	Based on Evaluation Index values	Based on Specific Combining Ability	Based on Hybrid Vigour
Fecundity (no)	DNB_2 (644)	DNB_2 (64.29)	DNB_6 (76.33)	$DNB_6 \times NB_4D_2$ (630)	$DNB_6 \times NB_4D_2$(70.21)	$DNB_4 \times NB_4D_2$(51.97)	-
Hatching (%)	DNB_1 (96.28)	DNB_1 (56.91)	-	$DNB_7 \times CSR_2$ (97.32)	$DNB_7 \times CSR_2$ (65.50)	$DNB_7 \times CSR_2$ (2.65)	$DNB_7 \times CSR_2$ (36.62)
Pupation rate	DNB_1 (91.33)	DNB_1 (68.79)	DNB_1 (2.60)	$DNB_6 \times CSR_2$ (98.80) $DNB_7 \times CSR_2$ (97.73)	$DNB_6 \times CSR_2$ (67.81) $DNB_7 \times CSR_2$ (65.57)	$DNB_4 \times CSR_4$ (5.68) $DNB_7 \times CSR_2$ (5.13)	$DNB_4 \times CSR_4$ (14.08)
Cocoon yield/10,000 larvae by wt (kg)	DNB_6 (15.63)	DNB_6 (61.43)	DNB_1 (1.19)	$DNB_6 \times CSR_2$ (17.227) $DNB_3 \times CSR_2$ (17.107)	$DNB_6 \times CSR_2$ (63.99) $DNB_3 \times CSR_2$ (62.98)	$DNB_4 \times CSR_4$ (1.46) $DNB_3 \times CSR_2$ (0.91)	$DNB_4 \times CSR_4$ (28.30) $DNB_2 \times CSR_4$ (19.81)
Cocoon weight (g)	DNB_6 (1.973)	DNB_6 (64.78)	DNB_4 (0.04)	$DNB_3 \times CSR_{17}$ (1.962) $DNB_7 \times CSR_{17}$ (1.913)	$DNB_3 \times CSR_{17}$(65.73) $DNB_7 \times CSR_{17}$(60.79)	$DNB_3 \times CSR_{17}$ (0.12) $DNB_6 \times CSR_2$ (0.10)	$DNB_3 \times CSR_{17}$(21.50) $DNB_4 \times CSR_4$ (16.79)
Cocoon shell weight (g)	DNB_6 (0.380)	DNB_6 (63.01)	DNB_1(0.024)	$DNB_1 \times CSR_2$ (0.390) $DNB_3 \times CSR_{17}$ (0.383)	$DNB_1 \times CSR_2$ (63.93) $DNB_3 \times CSR_{17}$(60.97)	$DNB_3 \times CSR_{17}$(0.029) $DNB_6 \times CSR_2$ (0.025)	$DNB_4 \times CSR_4$ (21.46) $DNB_3 \times CSR_{17}$(18.94)
Cocoon shell %	DNB_1 (21.22)	DNB_1 (64.84)	DNB_1 (0.94)	$DNB_1 \times CSR_2$ (21.54) $DNB_1 \times CSR_4$ (21.00)	$DNB_1 \times CSR_2$ (78.33) $DNB_1 \times CSR_4$ (58.39)	$DNB_2 \times NB_4D_2$ (0.71) $DNB_1 \times CSR_2$ (0.65)	$DNB_7 \times CSR_4$ (5.81) $DNB_1 \times CSR_2$ (5.73) $DNB_1 \times CSR_4$ (5.00)
Filament length (m)	DNB_1 (870)	DNB_1 (63.62)	DNB_1(44.54)	$DNB_1 \times CSR_2$ (977) $DNB_6 \times CSR_2$ (963)	$DNB_1 \times CSR_2$ (65.91) $DNB_6 \times CSR_2$ (63.67)	$DNB_2 \times CSR_4$ (89.21) $DNB_7 \times NB_4D_2$(79.32)	$DNB_7 \times NB_4D_2$(23.50) $DNB_2 \times CSR_4$ (20.63)
Reelability (%)	DNB_7 (83.5)	DNB_7 (60.84)	DNB_4 (2.35)	$DNB_7 \times CSR_2$ (86.1) $DNB_6 \times CSR_2$ (84.9)	$DNB_7 \times CSR_2$ (68.24) $DNB_6 \times CSR_2$ (65.38)	$DNB_4 \times NB_4D_2$ (3.89) $DNB_2 \times CSR_{17}$ (3.66)	$DNB_4 \times CSR_2$ (8.79) $DNB_3 \times CSR_2$ (8.44)
Raw silk %	DNB_1 (15.70)	DNB_1 (65.03)	DNB_1 (1.14)	$DNB_1 \times CSR_2$ (17.10) $DNB_1 \times CSR_4$ (17.05)	$DNB_1 \times CSR_2$ (74.25) $DNB_1 \times CSR_4$ (73.68)	$DNB_1 \times CSR_4$ (0.69) $DNB_1 \times CSR_2$ (0.67)	$DNB_1 \times CSR_4$ (12.61) $DNB_1 \times CSR_2$ (9.71)
Neatness	DNB_1 (92)	DNB_1 (59.52)	DNB_1 (0.68)	$DNB_1 \times CSR_4$ (93) $DNB_1 \times CSR_2$ (92)	$DNB_1 \times CSR_4$ (65.91) $DNB_1 \times CSR_2$ (60.39)	$DNB_3 \times NB_4D_2$ (2.51) $DNB_4 \times CSR_{17}$ (2.21)	$DNB_4 \times CSR_{17}$ (3.94) $DNB_3 \times NB_4D_2$ (2.03)

NEW REPORT OF SUBORDER SYMPHYPLEONA SPECIES (COLLEMBOLA) FROM KOHGILOYEH PROVINCE (IRAN)

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[Falahati Hossein Abad, A., Kheirodin, A. & Bretfeld, G. 2013. New report of suborder Symphypleona species (Collembola) from Kohgiloyeh province (Iran). Munis Entomology & Zoology, 8 (1): 208-212**]**

ABSTRACT: Six species of suborder Symphypleona are recorded from Kohgiloyeh province (South-Western Iran): *Dicyrtomina ornata* (Nicolet, 1842) (Dicyrtomidae), *Sminthurides aquaticus* (Bourlet, 1842) (Sminthurididae , *Sminthurinus signatus* (Krausbauer, 1898), *Sminthurinus transvernalis* Axelson, 1905, *Sminthurinus reticulatus* Cassagnau, 1964, *Sminthurinus elegans* (Fitch, 1863) (Katiannidae). Apart from *Sminthurinus elegans*, all species are new for Iran.

KEY WORDS: Collembola, Symphypleona, Dicyrtomidae, Sminthurididae, Katiannidae, Iran.

Suborder of Symphypleona is one of the biggest groups of collembola species which are recognized by globular body and long antennae. Most species are Epedaphic and live in soil and leaf litter mostly. They feed on algae, lichens and plant derived tissues. Fauna of the family of some territories of Asia remains. However, poorly studied Iran, a big country with diverse nature conditions, was paid very little (if not the least) attention by collembologists. Cox (1982), was the first to publish the list of Collembola recorded in Iran, 70 species (with 7 of which belonging to the family Sminthuridae from the North-Western and Northern provinces of the country was recorded by him. Moravvej et al. (2003) reported 3 species of Sminthuridae family. Falahati Hossein Abad et al. (2012) reported 1 species of Katiannidae family and so far the fauna of the suborder of Symphypleona comprises 16 members.

The fauna of Iran is still poorly studied and no keys to species are available.

MATERIALS AND METHODS

Collection springtails:

Soil and leaf litter samples were collected mainly from Choram areas, during 2011 and 2012. All samples were retained in white plastic boxes and then were transferred to the Entomology Laboratory of Gorgan University of Agricultural Sciences and Natural Resources

Extracted Springtails:

The Collembola were extracted by our patent (Designing and manufacturing portable and rechargeable separator of terrestrial Arthropods of the soil) (Fig. 1). Afterwards transferred to small vials with camel hair brush, and were preserved in 75% alcohol for further study.

Preparation of slides:

Specimens were cleared in a Nesbitt solution and mounted on slides with Hoyer medium. Afterwards the slides were transferred to oven for 3-5 day. The slides were examined under Olympus BX51-TF microscope.

Identification:

The monograph of Fjellberg (2007) was primarily applied to identify the genera and species.

RESULTS

Six species of suborder Symphypleona belonging to three families Dicyrtomidae, Sminthurididae and Katiannidae comes from three genera *Dicyrtomina, Sminthurides and Sminthurinus* are discovered in our materials (Table 1). The region that collembola are collected (Fig. 2).

DISCUSSION

Five species, *Dicyrtomina ornata*, *Sminthurides aquaticus*, *Sminthurinus signatus*, *Sminthurinus transvernalis*, *Sminthurinus reticulatus* are new for Iranian fauna. *Sminthurinus elegans* was already recorded by (Cox, 1982; Falahati Hossein Abad et al., 2012; Moravvej et al., 2003).

Dicyrtomina ornata was recorded from Norway and Syria. General distribution: Palaearctic.

Sminthurides aquaticus is common and widely distributed in ponds and along shores of atrophic lakes. General distribution: Holarctic.

Sminthurinus signatus is mainly finds in moss and litter of the forest floor, and also in damp ground. Few records from other Nordic countries. General distribution: Palaearctic.

Sminthurinus transvernalis is common, no recent Nordic records. General distribution: Palaearctic.

Sminthurinus reticulatus (Fig. 3) specimens were swept from lush meadow vegetation in slopes surrounding the old greenhouse. General distribution: Palaearctic.

Sminthurinus elegans is one of the most populated species of colembola in Kohgiloyeh province. The color pattern distinguished this specie from others (Fig. 4). Probably widely distributed, but mostly scattered records from dry meadows and moss/litter in forests.

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Figure 1. Designing and manufacturing portable and rechargeable separator of terrestrial Arthropods of the soil.

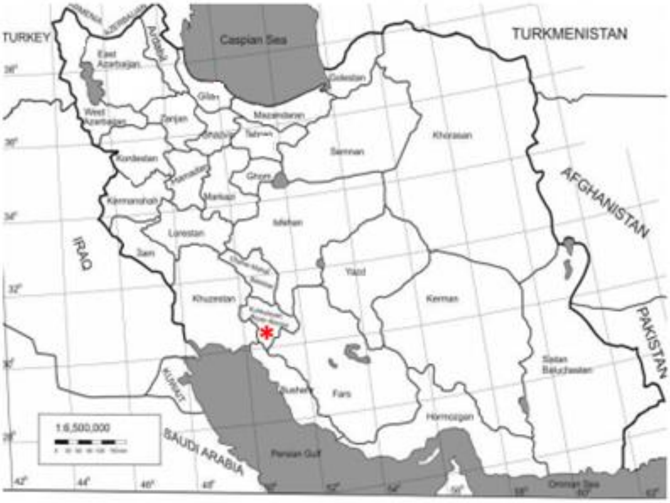

Figure 2. Map of Iran showing the Province (*) from which Collembola have been collected.

Figure 3. *Sminthurinus reticulatus* (orginal).

Figure 4. *Sminthurinus elegans* (orginal).

Table 1. Recorded species of suborder Symphypleona.

Species	habitat	location	coordinate	Altitude (m)	date
Dicyrtomina ornata (Nicolet,1842)	Soil and Moss	Elghechin village	N 36 65 59 E 56 62 20	325	2011/9/29
Sminthurides aquaticus (Bourlet, 1842)	Soil	Forest-choram	N 36 57 50 E 57 23 30	645	2011/12/2
*Sminthurinus signatus (*Krausbauer, 1898)	Soil	Elghechin village	N 36 57 33 E 56 23 29	500	2012/1/14
Sminthurinus transvernalis Axelson, 1905	Soil and Moss	Forest-Elghechin village	N 36 47 53 E 56 23 29	350	2011/12/18
Sminthurinus reticulatus Cassagnau, 1964	Soil and Moss	Vegetable-garden	N 36 49 33 E 57 35 59	412	2012/11/12
Sminthurinus elegans (Fitch, 1863)	Soil and Moss	Forest-Elghechin village	N 36 47 53 E 56 23 29	350	2011/12/18

EFFECT OF NEEM KERNAL AQUEOUS EXTRACT (NKAE) IN TEA MOSQUITO BUG *HELOPELTIS THEIVORA* (WATERHOUSE, 1886) (HETEROPTERA: MIRIDAE)

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ABSTRACT: Aqueous extract of neem seed kernel (NKAE) was tested in laboratory condition to evaluate its antifeedant, ovicidal, nymphl duration and hatching performance on tea mosquito bug (*Helopeltis theivora*).Different concentrations of NKAE used were 1,2,3,4and 5%. In F1 population NKAE was significantly superior in antifeedant activity, hatching percentage ,oviposition period and nymphal duration @ 5% (248.2), (50%) , (8days) (5 day in 4th inster). The number of eggs laid by female was significantly less in 5% (23.33 Nos.) compared to other treatments.

KEY WORDS: Antifeedant, Ovicidal, *Helopeltis theivora*

Pests of tea are important among the biological components of the ecosystem, which are responsible for considerable crop loss (Muraleedharan, 1991). More than 167 species of insect pests have been reported to inflict damage to the tea plant (Das, 1965). All parts of the plant, leaf, stem, root, flower and seed are feed upon by at least one pest resulting in an 11-55% loss of yield if left unchecked. China (4.73 million tones) is the largest producers of tea followed by the, India (805,180 tones in 2008) Kenya, Sri Lanka, and Turkey. The reduction of productivity is due to destruction by different tea pests like tea mosquito bug, *Helopeltis theivora* (Hemiptera: Miridae).

Assam is crucial to India's US $1.5 billion tea industry and accounts for about 55 per cent of the total annual production. India's tea industry was facing a crisis with prices dropping in the weekly auctions since 1998 and exports plummeting as well.

Tea production has been hit with rampant pests eating away the crop, adding to the woes of the cash-strapped tea industry in the North eastern state of Assam. As per the tea planters and industry officials, tea mosquito bug, *Helopeltis theivora* (Hemiptera: Miridae) was observed in 200 plantations out of 800 in Assam. There has been a sudden outbreak of blisters on tea plants and the attack has been spread like a wild fire to scores of gardens in Eastern Assam causing 10-15% loss in the tea production was reported during main production season (May-July).

Among different insects pests reported in tea, tea mosquito bug, *Helopeltis theivora* (Hemiptera: Miridae) is most destructive sucking pest of tea causing significant reduction in the production and productivity of tea in North East India.Bugs tend to attack plantations during the winter when the young leaves are brown.

Neem based pesticides have excellent potential in view of the low cost, abundant availability of raw material and eco-friendly nature of the product. Neem with its multifaceted biological activity coupled with its discriminative, preventive and efficient eco-friendly nature offers a viable alternative to chemical pesticide. The usage of neem based pesticides which manage the pests successfully. In order to reduce the pesticide load and their residues on tea ecosystem, this study was carried out in the laboratory to evaluate different dose of Neem Kernel Aqueous Extract against *H. theivora*.

MATERIALS AND METHODS

The Study Area: Assam is the world's largest tea-growing region, lying on either side of the Brahmaputra River, and bordering Bangladesh and Burma (Myanmar). This part of India experiences high precipitation; during the monsoon period as much as 10 to 12 inches (250-300 mm) of rain per day. The daytime temperature rises to about 103F (40 °C), creating greenhouse-like conditions of extreme humidity and heat. This tropical climate contributes to Assam's unique malty taste, a feature for which this tea is well known.

Mass culture of test insect: The field collected tea mosquito bug, *Helopeltis theivora* was reared under the laboratory condition at the room temperature (28 ± 4°C) and relative humidity (80-90%) on tea shoots inside the rearing cages for experimental purpose.

Preparation of Neem Kernal Aqueous Extract (NKAE): One day before spraying the neem seeds were decorticated i.e. removal of seed shell to obtain neem kernel. The obtained neem kernels were powdered by an electric grinder. The powder was mixed with water to get required concentrations and soaked overnight. In the next day,the extract was filtrated through muslin cloth then filterate was used for the experimental purpose (Saxena et al., 1980).

Effect of Neem Kernal Aqueous Extract (NKAE) on hatching and oviposition of *Helopeltis theivora* on tea in the laboratory (F1 populations): The experiment was conducted under laboratory conditions at Tocklei Experiment Station; Jorhat, Assam. For each treatment 10-15 fresh tea shoots were inserted in conical flasks containing water and sprayed with different concentrations of NKAE by a pre calibrated atomizer and allowed to dry for about 5 minutes prior to the exposure of experimental insects. Each conical flask was kept inside a chimney and 10 newly hatched nymphs of *H. theivora* were released into treated tea shoots and were changed at 3 days interval till attaining adult stage. The adults laid eggs on tea shoots. The percentage of egg hatching and oviposition period was recorded in F1 populations. The data was analyzed statistically (ANOVA) to draw the conclusion. The per cent reduction in hatching was calculated.

Per cent reduction of hatching = Per cent hatching in control - Per cent hatching in treatment/Per cent egg hatching in control x 100

Antifeedant property of Neem Kernal Aqueous Extract (NKAE): Nymphs of *H. theivora* from F1 generation (treated with different concentrations of NKAE) were selected to study the antifeedant property. Fresh undamaged tea leaves of TV1 genotype were collected from unsprayed tea plantation. For each treatment three fresh tea shoots were inserted in conical flasks containing water.

Each conical flask was kept inside a chimney and one nymph of *H. theivora* was released in each chimney and allowed to feed for 24 hours. The feeding spots produced by the bug were counted visually and presented. There were five treatments and each treatment was replicated five times. The data was analyzed statistically to draw the conclusion.

The percentage of reduction in feeding was calculated with the following formula-

Per cent reduction = No of spots in control - No. of spots in treatment / No. of spots in control X 100

RESULTS

Anti feedent activity of Neem Kernal Aqueous Extract (NKAE) against different instars of *H. theivora:*

First and second instar nymphs: Among different concentrations of NKAE tested against H*elopeltis theivora*. NKAE at 5% was significantly superior to other treatments as compared to control.The no of feeding spots were less in NKAE of 5% both in 1st and 2nd instar (104.20 & 155.00) respectively followed by NKAE at 4% (134.60 & 212.20). NKAE at 3% and 2% the feeding activity was at par as compared to NKAE at 1% & control (Table 1).

Third and fourth instars nymphs: NKAE @ 5% & 4% was significantly superior to other treatments. At NKAE 5% & 4% the number of feeding spots was less (110.6 & 248.2) in III & IV instar nymph respectively followed by NKAE 4% as (131 & 274), NKAE 3% (143.8 & 326.8) and NKAE 2% (155 & 354.8). In control the number of feeding spots was significantly higher compared to other treatments.

Among different concentrations of NKAE tested against nymphs of *H. theivora* in the laboratory, all the concentrations of NKAE showed antifeedent activity against different stages of nymphs. The number of feeding spots were less in different instar of nymph in NKAE at 5% (104.20 to 248.2 spots) as compared to control (265.8 - 460) and was followed by NKAE 4% (131 to 274), NKAE 3% (143.8 to 326.8) NKAE 2% (155 to 354.8). Based on present results NKAE 4% is effective and can be recommended for the management of nymphs of *H. theivora*.

Effect of Neem Kernal Aqueous Extract on oviposition, hatching performance and nymphal duration of *H. theivora*:

Oviposition: Results showed that NKAE had oviposition deterrent effect on nymph of *H. theivora*. The number of eggs laid by female is significantly less in NKAE 5% (23.33 Nos.) and was at par with NKAE at 4% (26.66 Nos.) followed by NKAE 3% (30 Nos.) compared to other treatments. In control the number of eggs laid by the female is significantly higher (40 Nos.). The oviposition period is also prolonged in NKAE at 5% & 4% (8 days) followed by other treatments (7 days) compared to control (6 days) (Table 2).

Hatching performance of eggs: Among different concentrations, the number of eggs hatched in the NKAE at 5% was significantly less (11.66 Nos.) and at par with NKAE 4% (14.33) followed by NKAE 3% (18.33) as compared to other treatments. The number of eggs hatched in control was significantly more (36.0 nos) compared to other treatments (Table 2).

Nymphal duration: Based on the results, it is clearly showed that the nymphal duration of *H. theivora* is almost same in all the treatments (3 days) in first and second instar nymph but in third and fourth instar, the nymphal period is prolonged to five days in NKAE at 5 % and 4% as compared to control (3 days).

DISCUSSION

Today, the environmental safety of an insecticide is considered to be of paramount importance due to their biodegradable nature (Bhattacharya, 1994). An insecticide does not have to cause high mortality on target organisms in order to be acceptable. Antifeedant activity reduces pest damages to products even without killing the pest. This antifeedant activity can therefore be incorporated into other insect control techniques in the strategy of integrated pest management (IPM).

Neem trees are found throughout India with a myriad of uses in medicine, as well as pest control (D.C 1992).Neem-based pesticides are now extensively used in agriculture practices all over the world. It contains azadirachtin, which is a predominant insecticidal active ingredient, having antefeedent, ovipositional deterrence repellency, growth disruption, sterility and larvicidal action against insects (Schmutterer, 1990).Similar result were found in case of *H. theivora* after applying NKAE in F1 population mostly effective on antifeedent, ovipositional and larval duration.

Kreutzweiser (1997) and Goektepe et al. (2004) find out that neem-based biopesticides and neem extracts have a wide range of effects against insect pests including repellence, feeding, toxicity, sterility and growth regulator activity and present result corroborate the foregoing observation, and possibly that is why a reduction in infestation, hatching in higher concentration of NKAE in *H. theivora* was evident.

Further study is required to isolate antifeedant compound from *Heliotropium indicum* and Spilanthes calva which may be similar to antifeedunt compounds present in *Azadirachta indica* (Rembold, 1984; Schmutterer, 1995).

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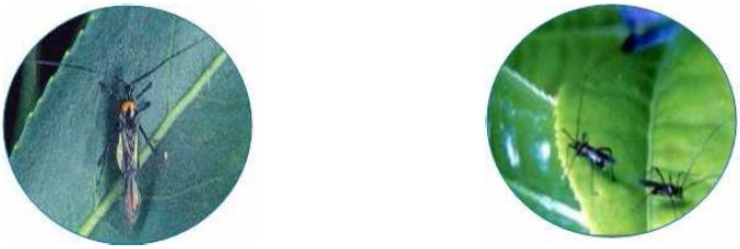
Table 1. Antifeedent properties of Neem Kernal Aqueous Extract against nymphs of *H. theivora* under laboratory conditions.

Treatments	1st instar	2nd instar	3rd instar	4th instar
NKAE 1%	249.00	284.20	169.4	382.6
NKAE 2%	199.80	262.00	155	354.8
NKAE 3%	178.80	246.60	143.8	326.8
NKAE 4%	134.60	212.20	131	274.0
NKAE 5%	104.20	155.00	110.6	248.2
Control	265.80	441.40	170	460.0
CD at 5% (P=0.05)	26.52	35.17	10.79	57.31

Table 2. Effect of Neem Kernal Aqueous Extract on hatching and oviposition of *H. theivora* on tea in the laboratory (F1 populations).

Treatments	Oviposition	Hatching	Percentage of hatching	Percentage of un hatched eggs	Oviposition period (Days)
NKAE 1%	35.00	29.33	83.80	16.20	7
NKAE 2%	31.00	22.66	73.09	26.91	7
NKAE 3%	30.00	18.33	61.10	46.25	7
NKAE 4%	26.66	14.33	53.75	46.25	8
NKAE 5%	23.33	11.66	50.00	50.00	8
Control	40.00	36.00	90.00	10.00	6

Eggs **Nymph**



Adult female **Adult males**

Figure 1. Life stages of Tea Mosquito bug, *Helopeltis theivora*.

Figure 2. Antifeedent properties of Neem Kernal Aqueous Extract against nymphs of *H. theivora* of different concentration under laboratory conditions.

NEW FAMILY AND GENUS NAMES, NOVACAROCERATIDAE NOM. NOV. AND *NOVACAROCERAS* NOM. NOV., FOR ACAROCERATIDAE AND *ACAROCERAS* CHEN, QI & CHEN, 1979 (MOLLUSCA: CEPHALOPODA)

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ABSTRACT: A junior homonym was detected among the cephalopod genus group names and the following replacement name is proposed: *Novacaroceras* nom. nov. for *Acaroceras* Chen, Qi & Chen, 1979. Accordingly, new combinations are herein proposed for the species currently included in this genus. *Novacaroceras altocameratum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras changshanense* (Li, 1984) comb. nov.; *Novacaroceras dadoushanense* (Li, 1984) comb. nov.; *Novacaroceras densum* (Chen & Zou, 1979) comb. nov.; *Novacaroceras duibianense* (Li, 1984) comb. nov.; *Novacaroceras elegantum* (Li, 1984) comb. nov.; *Novacaroceras endogastrum* (Chen, Qi & Chen, 1979) comb. nov.; *Novacaroceras jiagouense* (Chen & Qi, 1980) comb. nov.; *Novacaroceras magnitubulatum* (Li, 1984) comb. nov.; *Novacaroceras minus* (Li, 1984) comb. nov.; *Novacaroceras minutum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras minysiphonatum* (Li, 1984) comb. nov.; *Novacaroceras multiseptatum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras rectoconum* (Chen, Qi & Chen, 1979) comb. nov.; *Novacaroceras rectum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras semicollum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras shanbeilingense* (Li, 1984) comb. nov.; *Novacaroceras stenotubulum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras subcircinatum* (Chen & Qi, 1980) comb. nov.; *Novacaroceras taozhuangense* (Chen & Qi, 1980) comb. nov.; *Novacaroceras xiyangshanense* (Li, 1984) comb. nov.; *Novacaroceras ventrolobatum* (Chen & Qi, 1980) comb. nov. and *Novacaroceras zhejiangense* (Li, 1984) comb. nov.. In addition, I propose the replacement name Novacaroceratidae new name for the family name Acaroceratidae.

KEY WORDS: nomenclatural change, homonymy, replacement name, Acaroceratidae, *Acaroceras*.

Remarks on nomenclatural change

Firstly, the genus name *Acaroceras* was proposed by Grandjean (1936) with the type species *Acaroceras odontotus* Grandjean, 1936 by original designation from Venezuela in Acari (Oribatida: Microzetidae). The valid genus *Acaroceras* Grandjean, 1936 has at least 3 subgenera as the nominotypical subgenus (18 spp.), *Trichacaroceras* S. Mahunka, 1991 with the type species *Acaroceras africanus* S. Mahunka, 1991 from Cape Verde (only 1 sp.) and *Malgoceras* S. Mahunka, 1993 with the type species *Acaroceras helleri* S. Mahunka, 1993 from Madagascar (only 1 sp.).

Subsequently, the fossil genus *Acaroceras* was described by Chen, Qi & Chen (1979) with the type species *Acaroceras endogastrum* Chen, Qi & Chen, 1979 by original designation from China in Mollusca (Cephalopoda: Nautiloidea: Ellesmerocerida: Acaroceratidae). The name is currently used as a valid generic name in Ellesmerocerida as the type genus of the family Acaroceratidae Chen, Qi & Chen, 1979.

However, the name *Acaroceras* Chen, Qi & Chen, 1979 is invalid under the rule of homonymy, being a junior homonym of *Acaroceras* Grandjean, 1936. Under the International Code of Zoological Nomenclature (ICZN 1999) it must be rejected and replaced. In accordance with article 60 of the International Code of Zoological Nomenclature, fourth edition (1999), I propose to substitute the junior homonym *Acaroceras* Chen, Qi & Chen, 1979 for the nomen novum *Novacaroceras*. As a result of this, *Acaroceras* Chen, Qi & Chen, 1979 is replaced with *Novacaroceras* new name. The following new combination is established: *Novacaroceras endogastrum* (Chen, Qi & Chen, 1979) new combination, along with twenty-two other new combinations for all twenty-three valid species currently included in *Acaroceras* Chen, Qi & Chen, 1979.

In addition to this, I herein propose the replacement name Novacarocetidae new name for the family name Acaroceratidae because its type genus *Acaroceras* Chen, Qi & Chen, 1979 is invalid and the type genus of a family-group name must be valid.

SYSTEMATICS

Order Ellesmerocerida
Family **Novacaroceratidae** new name

Acaroceratidae Chen, Qi & Chen, 1979
Type genus.— *Novacaroceras* new name.
Remarks.—The name *Acaroceras* has been used in Ellesmerocerida as a stem for a family-group name, and should be automatically replaced with the new name.

Genus ***Novacaroceras*** new name

Acaroceras Chen, Qi & Chen, 1979, junior homonym of *Acaroceras* Grandjean, 1936.

Acaroceras Chen, Qi & Chen, 1979. Acta palaeont. sin. 18 (2): 115. (Mollusca: Cephalopoda: Nautiloidea: Ellesmerocerida: Acaroceratidae). Preoccupied by *Acaroceras* Grandjean, 1936. Bull. Soc. zool. Fr., 61: 77. (Acari: Oribatida: Microzetidae).

Type species.— *Acaroceras endogastrum* Chen, Qi & Chen, 1979 by original designation.

Etymology.— from the current generic name *Acaroceras*.

Species account and distribution. — Twenty-three species; known from China.

The following new combinations are proposed and the species is removed from *Georgina*:

Novacaroceras altocameratum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras altocameratum* Chen & Qi, 1980

Novacaroceras changshanense (Li, 1984) **new combination**
Syn.: *Acaroceras changshanense* Li, 1984

Novacaroceras dadoushanense (Li, 1984) **new combination**
Syn.: *Acaroceras dadoushanense* Li, 1984

Novacaroceras densum (Chen & Zou, 1979) **new combination**
Syn.: *Acaroceras densum* Chen & Zou, 1979

Novacaroceras duibianense (Li, 1984) **new combination**
Syn.: *Acaroceras duibianense* Li, 1984

Novacaroceras elegantum (Li, 1984) **new combination**
Syn.: *Acaroceras elegantum* Li, 1984

Novacaroceras endogastrum (Chen, Qi & Chen, 1979) **new combination**
Syn.: *Acaroceras endogastrum* Chen, Qi & Chen, 1979

Novacaroceras jiagouense (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras jiagouense* Chen & Qi, 1980

Novacaroceras magnitubulatum (Li, 1984) **new combination**
Syn.: *Acaroceras magnitubulatum* Li, 1984

Novacaroceras minus (Li, 1984) **new combination**
Syn.: *Acaroceras minus* Li, 1984

Novacaroceras minutum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras minutum* Chen & Qi, 1980

Novacaroceras minysiphonatum (Li, 1984) **new combination**
Syn.: *Acaroceras minysiphonatum* Li, 1984

Novacaroceras multiseptatum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras multiseptatum* Chen & Qi, 1980

Novacaroceras rectoconum (Chen, Qi & Chen, 1979) **new combination**
Syn.: *Acaroceras rectoconum* Chen, Qi & Chen, 1979

Novacaroceras rectum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras rectum* Chen & Qi, 1980

Novacaroceras semicollum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras semicollum* Chen & Qi, 1980

Novacaroceras shanbeilingense (Li, 1984) **new combination**
Syn.: *Acaroceras shanbeilingense* Li, 1984

Novacaroceras stenotubulum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras stenotubulum* Chen & Qi, 1980

Novacaroceras subcircinatum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras subcircinatum* Chen & Qi, 1980

Novacaroceras taozhuangense (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras taozhuangense* Chen & Qi, 1980

Novacaroceras xiyangshanense (Li, 1984) **new combination**
Syn.: *Acaroceras xiyangshanense* Li, 1984

Novacaroceras ventrolobatum (Chen & Qi, 1980) **new combination**
Syn.: *Acaroceras ventrolobatum* Chen & Qi, 1980

Novacaroceras zhejiangense (Li, 1984) **new combination**
Syn.: *Acaroceras zhejiangense* Li, 1984

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BIONOMICS AND FERTILITY LIFE TABLE OF THE YELLOW MITE, *POLYPHAGOTARSONEMUS LATUS* (BANKS) (ACARI: TARSONEMIDAE) IN JUTE (*CORCHORUS OLITORIUS* L.) AT DIFFERENT TEMPERATURE-HUMIDITY

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ABSTRACT: The jute yellow mite *Polyphagotarsonemus latus* constitutes one of the major pests of jute crop in Bangladesh. The objective of this work was to study the bioecology of the *P. latus*, to determine its temperature-humidity responces and its fertility life table in jute (*Corchorus olitorius* L.) var. O-9897. The incubation period of yellow mite on the variety O-9897 was 2.17 days for female and 1.98 days for male; larval period of 0.95 days for female and 0.80 days for male; Pupal period of 0.81 days for female and 0.70 days for male and egg to adult stage being 3.93 days for female and 3.48 days for male were highest in the 1st generation with temperature at 24.92 ± 0.27 °C & 46.78 ± 1.28 % relative humidity among three generations. After a pre-oviposition period of 0.99 days, the females deposited 2.30 eggs per day during 13 days, i.e., 29.86 eggs per female at similar condition in 1st generation. The highest longevity was observed 14.35 days for females in the 1st generation with temperature at 24.92°C ± 0.27°C & 46.78 ± 1.28% and 10.44 days for males in the 2nd generation with temperature at 28.51 ± 0.26°C and 66.65 ± 1.27% relative humidity. In 2nd generation the intrinsic rate of increase (rm) was highest (0.389); finite rate of increase (λ) was 1.48 individuals per female per day in 2nd generation. The mean generation time (T) was greater in first generation (8.12) and net reproductive rate (Ro) was observed 14.12 in second generation.

KEY WORDS: Jute, Tarsonemid, *Polyphagotarsonemus latus*, bioecology, life table of fertility.

The genus *Corchorus* is the most important family Tiliaceae, highlighting the jute (*Corchorus capsularis* L. and *Corchorus olitorius* L.) is the most important cash crop and one of the foreign currency earning sources of Bangladesh as the culture of higher expression of economy. Among the non-insect pests yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) is one of the most common and destructive pests of both the cultivated species of jute (*C. capsularis* L. & *C. olitorius* L.), which has been expanded in recent years in Bangladesh. It is a plague of frequent occurrence in various crops in tropical and subtropical regions, reported in more than 60 families of plants (Schoonhoven et al., 1978; Gerson, 1992; Peña & Bullock, 1994; De Coss-Romero & Peña, 1998). Infesta, preferably, the softer portions of the plants such as cotton (Cividanes et al., 1987), eggplant (Queiroz & Oliveira, 1992), jute (Hath, 2000) and grape (Haji et al., 2001) and is known by a number of common names. It is found in Australia, Asia, Africa, Europe, North America, South America, and the Pacific Islands. In India and Sri Lanka it is called the "yellow tea mite," while those in Bangladesh call it as "yellow jute mite." In some European countries it is called the "broad spider." In parts of South America it is called the "tropical mite" or the "broad rust mite"

(Anon., 2005), a very notorious pest and cause damage to both fibre and seed crops. It is spread by wind, plant structure infested and transported from one area to another, so the natural contact between the foliage of plants (Hugon, 1983), and also by Phoretic relationship with the aphid, *Myzus persicae* Schulzer and the whitefly Bemisia the genera and Trialeurodes (Fan & Petitt, 1998; Palevsky et al., 2001).

The damage is often termed as 'Telenga' or 'Telchita' disease in Bangladesh. It appears at the end of April but more active in mid May (Kabir, 1975). Generally, they suck the sap from the apical leaves of the plants, as a result, the young leaves wrinkle and curl down, color changes to copper or purplish, finally dry up and fall down (Siddique & Kabir, 1979). Due to the attack of this pest, the vertical growth of the internodes is suppressed thereby side branches are enhanced (Kabir, 1975). Moreover, they attack flower buds, thus, flowers can not bloom properly, and infested pods fail to form seeds (Kabir, 1975). Both yield and quality of fibre are reduced due to the attack of this pest. It was reported that about 38% of fibre yield is decreased by the attack of yellow mite under field condition (Anon., 1990).

The biology of *P. latus* was studied in some plants host, with the development of life tables fertility, as in lime (*Citrus* sp.) (Hugon, 1983), pepper (*Capsicum annuum* L.) (Silva et al., 1998), cotton (*Gossypium hirsutum* L.) (Vieira & Chiavegato, 1998) and lemon (*Citrus limon* Burmman) (Vieira & Chiavegato, 1999). However, there are few studies on jute (*Corchorus* sp.) of this pest at the national and international.

Tossa jute, *Corchorus olitorius* occupies 80 per cent of the jute growing area as opposed to 20 per cent by the white jute, *Corchorus capsularis* (Saha, 2000), but unfortunately the incidence of major pests is more on *C. olitorius* than on *C. capsularis*.

As a result, and to permit take appropriate measures for their control, are necessary detailed studies of its biology, to avoid the loss of production, where frequent use of pesticide to increase the cost of cultivation. In this work, held to study the bioecology and life table of jute yellow mite, *Polyphagotarsonemus latus* on jute (*Corchorus olitorius* L. var. O-9897).

MATERIALS AND METHODS

The study was conducted in the laboratory of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) of Gazipur during the period from March 2009 to June 2010.

Collection and rearing of *P. latus*

Polyphagotarsonemus latus were collected from the infested jute plant of the research field of Bangladesh Jute Research Institute, Dhaka in April 2009. The collected mites from infested leaves were transferred into the potted jute plants kept outside the laboratory. Fifteen plants were infested to have constant supply of mite for the study. New plants were contaminated through direct contact with plants used previously when necessary.

Biology of *P. latus*

The duration of developmental stages was studied on the variety O-9897 leaf in laboratory. Excised leaves were made with mite free fresh jute leaf (*C. olitorius*). Each excised leaf pieces was square in appearance with 2 cm^2 area. The leaf pieces were placed on cotton bed in petri dish (9 cm dia.) facing under surface upward.

Two adult female *P. latus* was transferred to each piece for laying eggs. The adult female mites were collected from lab culture of *P. latus* maintained at the laboratory of the Department of Entomology by rearing infesting potted jute plants for more than three months.

The leaf squares containing adult females were checked after two hours of mite transfer. The mites were removed if at least one egg was found. In this way more than 30 eggs were collected on excised leaf square. One leaf square was maintained in each petri dish with a single egg. The petridishes were covered by lead and excessive moisture inside the petridish was removed naturally. The petridishes containing leaf square with egg were placed on laboratory shelf and leaves were checked after every 6 hours, until the emergence of the larvae. Then, they were transferred individually to new excised leaf square by camel hairbrush and observed at an interval of 6 hours which helped to determine the duration of the larval stages and pupae. The cotton beds were moistened with distilled water at each observation for moistening the excised leaves. Excised leaves were replaced by new one at every two days.

After emergence, males were observed separately at every 24 hours for determining their longevity. The females were allowed to mate with males obtained from the laboratory culture and observed at the same interval. The period of pre-oviposition, oviposition and post-oviposition, longevity, fecundity, sex ratio and fertility are determined. Males that died were replaced by fresh from the stock in excised leaf square. The room temperature and relative humidity content were recorded at 9.00 am and 5.00 pm. The experiment was conducted in three generations viz., 1st, 2nd and 3rd at mean temperature and relative humidity 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87% respectively.

The duration of different developmental stages were recorded for three generations, corresponding temperature and RH were noted. Study was laid out in completely randomized design (CRD). The results were subjected to analysis of variance. Regression analysis for different variables was also performed. The means were compared by Turkeys' test (P = 0.05) and 't' test (P = 0.05), using the program MSTAT software (Steel and Torrie 1960).

Life table of fertility of *P. latus*

The life table of *P. latus* at different generations was constructed from the life history and fecundity data. The actual death occurred at mature and immature stages were taken into account. The female survival rate at different room temperature and relative humidity was determined. Life tables were constructed using the survival data of a specific age class (l_x) and the female offspring produced per female in each age class (m_x). The net reproductive rate (R_o), the mean generation time (T), the intrinsic rate of increase (r_m), the doubling time (D_t), and the finite rate of increase (λ) were calculated using the method recommended by Birch (1948):

$R_o = \sum(l_x \times m_x)$

$T = \sum(x \times l_x \times m_x) / \sum(l_x \times m_x)$

$r_m = Ln(R_o)/T$

$D_t = Ln\ (2)/r_m$

$\lambda = \exp\ (r_m)$

Here x is age l_x, the cumulative female survivorship, and m_x, the number of female descendants per female at x. Calculation of a corrected r_m value was performed by iteration. The method, aiming to find r_m for which $(1-\sum \exp\ (-r_m \times x) \times l_x \times m_x)$ is minimal, was given by Maia et al. (2000), where the base of natural logarithms, x is the age of individuals in days, l_x is the age-specific survival rate and m_x is the age-specific fecundity rate. The population doubling time and the population trend index were also calculated. Different life table parameters of *P. latus* was calculated using the adult survival (l_x), number of female progeny per day (m_x) and female sex ratio with the help of QBASIC software (Jervis & Copland, 1996).

RESULTS AND DISCUSSION

Bioecology of *P. latus*

P. latus passes through 4 biological stages; egg, larva, pupa or quiescent nymph and adult stages (Plate 1). The eggs are white, spherical and covered with tubers give rise to larvae hexapod opaque white color. After a period of activity, the larvae become motionless, resulting in the pupae from which adults emerge, translucent white soon after hatching and thereafter, with a bright yellow color. In females, the fourth pair of legs is reduced to a simple structure and elongated, while the male is strong and robust (Jeppson et al., 1975). Reproduction is sexual, but the occurrence of arrhenotokous parthenogenesis. The male has the habit of carrying the future of female pupa, holding it to the genital papilla. In this operation, the fourth pair of legs only serves as a lever when you lift it from the substrate (Vieira & Chiavegato, 1998). The duration of the stages of egg, larva, pupa and egg-adult period for females and males were higher in mean temperature and relative humidity at 24.92°C ± 0.27°C and 46.78 ± 1.28%, dropping to 28.51 ± 0.26°C and 66.65 ± 1.27%. However, in 3_{rd} generation the mean temperature and relative humidity of 30.28 ± 0.21°C and 60.78 ± 0.87% there were small increases in the duration these phases, except larval & pupal period. The length of the period egg to adult was 3.93 ± 0.02, 2.97 ± 0.03 & 3.10 ± 0.06 days for females and 3.48 ± 0.02, 2.66 ± 0.02 & 2.90 ± 0.02 days for males at mean temperature and relative humidity of 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87% during 1st, 2nd and 3rd generations, respectively (Table 1, 2, P=0.05). The developmental period decreased linearly (negetive) and significant (P=0.05) with those increasing temperature and relative humidity (Figure 1, 2, 3, 4).

Rodrigo et al. (2006) obtained incubation, larval, pupal and egg-adult period of 2.4, 1.0, 0.8 & 4.5; 1.6, 0.9, 0.7 & 3.5 and 1.8, 0.9, 0.6 & 3.5 days for females and 2.2, 0.8, 0.7 & 4.1; 1.5, 0.7, 0.6 & 3.1 and 1.8, 0.7, 0.6 & 3.4 days for males in grape at 25 °C, 28 °C and 32 °C, respectively with relative humudity of 65 ± 10%. The present result may be discussed with the findings of other authors. Vieira (1995) in young fruits of lemon (*Citrus limon*) (T = 27.2 ± 0.5°C and RH = 68.2 1.2%), obtained values of egg, larva, pupa and egg to adult 2.2, 0.8, 0.7 and 3.7 days for females and 2.2, 0.7, 0.7 and 3.6 days for males, respectively.

The duration of egg, larva, pupa and egg to adult females and males of *P. latus* were differed significantly (Table 3, P=0.05) at the mean temperature and relative humidity of 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87% in three generations, respectively except egg and pupal period of 3rd generation.

Silva et al. (1998) found reduction of duration between egg to adult for males and females of *P. latus* infesting peppers with increasing temperature from 20°C to 30°C, and the results were similar to those obtained in the present study. In lime, the duration of egg to adult period was 8.5 days at 25°C (Hugon, 1983), 4.1 days on cotton (Vieira & Chiavegato, 1998) at 28.5°C and 3.6 days for males and 3.7 days for females at 27.1°C in lemon zest (Vieira & Chiavegato, 1999).

The pre-oviposition, oviposition and post-oviposition were also affected by temperature and humidity, differing significantly between the mean temperature and relative humidity of 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87% in three generations and the same happened with the parameter longevity of female and male. The fecundity was 29.86, 26.14 & 13.86 eggs/female decreased significantly at temperature and relative humidity of 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87% in 1st, 2nd and 3rd generations, respectively (Table 4). The regression analysis, the oviposition period decreased linearly (negetive) with increasing temperature-RH (Figure 5).

Rodrigo et al. (2006) reported that the pre-oviposition, oviposition and post-oviposition period was 1.8, 26.3, 1.8; 0.3, 14.5, 1.1 and 1.1, 5.8, 0.9 days, respectively at 18 °C, 25 °C and 32 °C in grape with relative humudity of 65 ± 10%.

Vieira (1995) obtained identical results when *P. latus* was grown on leaves of cotton (*Gossypium hirsutum*) and young fruits. He found pre-oviposition period of 1.1 & 0.9 days, oviposition duration of 6.8 & 8.9 days, rate of fertility of 29.6 & 24.9 eggs and longevity of female 10.0 & 13.6; male 8.8 & 12.0 days. In lemon Sicilian, at 27.1°C, the periods of pre-oviposition, oviposition, fecundity and longevity of male and female were 1.0, 10.5 days, 58.9 eggs per female, 12.0 and 13.4 days, respectively (Vieira & Chiavegato, 1999).

The graph of rhythm and posture oviposition and survival rate of female *P. latus* is shown in figure 6. After pre-oviposition period oviposition peak of 3.29 eggs/in the 6th day at temperature 25.75°C & 50.00% RH. In the 1st generation with corresponding temperature and relative humidity of 24.92°C ± 0.27°C and 46.78 ± 1.28%. The survivorship of female was 50% at 13th days, 54% at 13th days and 49% at 7th days in the 1st, 2nd and 3rd generations, where corresponding mean temperature and relative humidity was 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87%, respectively. The maximum oviposition of 3.29 eggs obtained on the 6th day with temperature at 25.75°C & 50.00% RH, 3.14 eggs on the 6th day with temperature at 28.75°C & 66.00% RH and 2.71 eggs on the 5th day with temperature at 30.75°C & 60.50% RH in the 1st, 2nd and 3rd generations, respectively with corresponding temperature and RH of 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ± 1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87%. In bean, at temperatures between 22°C and 28°C, Schoonhoven et al. (1978) found peak oviposition of 4.9 eggs / female for nine days. In pepper at 25°C, the maximum oviposition of 5.0 eggs was obtained on the eighth day and 54% of survival of females at 13 days (Silva, 1995). In cotton at 28.5°C, Vieira & Chiavegato (1998) recorded 4.8 eggs on the fifth day and 50% survival at 11 days. In lemon zest, Vieira & Chiavegato (1999) found 6.5 eggs / female for four days and 50% survival at 15 days at a temperature of 27.1°C.

Life table of *P. latus*

The sex ratio of *P. latus* of 1: 4 (male : female) was used for the life table calculation and the life table parameters are given in table 6. The gross reproductive rate (GRR) was 23.88, 20.90 and 11.08; net reproductive rate (R_o) 14.00, 14.12 and 3.94; capacity for increase (r_c) 0.28, 0.28 and 0.16; intrinsic rate of increase (r_m) 0.325, 0.389 and 0.207; cohort generation time (T_c) 9.34, 8.11 and 7.65 days; mean generation time(T) 8.12, 6.81and 6.62 days; finite capacity for increase (λ) 1.38, 1.48 and 1.23; doubling time (DT) 2.13, 1.78 and 3.35 days in the 1st, 2nd and 3rd generations, respectively. The mean temperature and relative humidity was 24.92°C ± 0.27°C and 46.78 ± 1.28%, 28.51 ± 0.26°C and 66.65 ±

1.27%, 30.28 ± 0.21°C and 60.78 ± 0.87% in 1st , 2nd and 3rd generations, respectively.

The values of gross reproductive rate (GRR), cohort generation time (T_c) and mean generation time (T) decreased with the increasing temperature from 24.92°C ± 0.27°C to 28.51 ± 0.26°C and 30.28 ± 0.21°C. The net reproductive rate (R_o), intrinsic rate of increase (r_m) and finite capacity for increase (λ) was increased with increment of temperature from 24.92°C ± 0.27°C to 28.51 ± 0.26°C, then decreased in 3rd generation with the temperature of 30.28 ± 0.21°C, although the average length of generation was lower at 30.28 ± 0.21°C. Capacity for increase (r_c) is same in 1st & 2nd generations with the temperature at 24.92°C ± 0.27°C & 28.51 ± 0.26°C, then decreased in 3rd generation with the temperature of 30.28 ± 0.21°C and doubling time (DT) of *P. latus* was decreased with the increased temperature from 24.92°C ± 0.27°C to 28.51 ± 0.26°C, then increased in 3rd generation with the temperature of 30.28 ± 0.21°C (Table 5).

The values of r_m and λ to 25 °C these studies were similar to those found by Silva et al. (1998), on pepper. There was also similarity with the results found in cotton (Vieira & Chiavegato, 1998) and lemon zest (Vieira & Chiavegato, 1999), but the work was carried out at temperatures of 27.1 and 28.5 °C. Hugon (1983) built a table for fertility life at 25°C, with values of R_o, T, r_m and λ of 17.58, 6.71, 0.427 and 1.53, respectively. Li & Li (1986), in pepper, determined values of R_o from 18.06 to 20°C, 30.9 to 25°C and 13.54 to 30°C, which was well above but Hugon (1983), in citrus, observed a reducing the value of R_o 4.66 at 30°C, and a value of 17.58 to 25°C, similar that obtained in this study. These authors also confirmed the reduction in the duration a generation with increase of temperature. Values of r_m obtained by Li & Li (1986) was 0.18 at 20°C and 0.32 at 25°C were almost consistent with the present results, however discordant, to the value of 0.29 obtained in temperature of 30°C. Hugon (1983) observed also a small reduction in the values of λ (finate capacity of incresse) between the temperatures of 25 (1.53) and 30°C (1.39).

The temperature and relative humidity affected directly the biological parameters of the immature stages and the adult stage of *P. latus*, influencing consequently the parameters of life table. The result of present investigation agreed with the findings of the above results. All above results shows the great effect of temperature and relative humidity on the development and fecundity of *P. latus* and other species of tarsonemid. This experiment also found the significant effect of temperature and relative humidity on the developmental stages of *P. latus*. The higher temperature reduced the duration of developmental stages. By analyzing the parameters obtained the life table of fertility *P.latus*, noted that the jute was an extremely favorable to the population development of the species in which high rates of increase (r_m and λ) were associated with longer duration of generation (T). However, due to a lower survival, resulted in lower rates net reproduction.

So the present results suggest that favourable temperature of *P.latus* was 24.92 ± 0.27°C to 28.51 ± 0.26°C, which is very similar to the findings of other investigators on different species of yellow mites.

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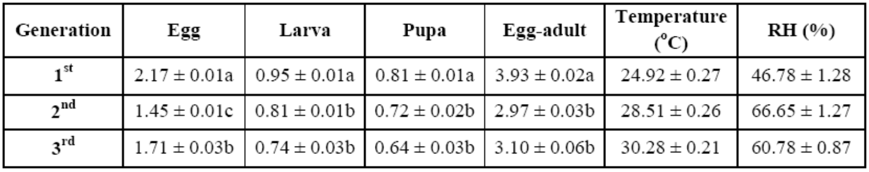
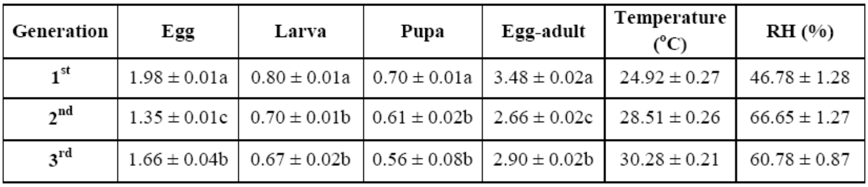
Table 1. The mean length (days ± SE) of immature stages and duration from egg to adult of female *P. latus* in three generations under laboratory condition.



Generation	Egg	Larva	Pupa	Egg-adult	Temperature (°C)	RH (%)
1st	2.17 ± 0.01a	0.95 ± 0.01a	0.81 ± 0.01a	3.93 ± 0.02a	24.92 ± 0.27	46.78 ± 1.28
2nd	1.45 ± 0.01c	0.81 ± 0.01b	0.72 ± 0.02b	2.97 ± 0.03b	28.51 ± 0.26	66.65 ± 1.27
3rd	1.71 ± 0.03b	0.74 ± 0.03b	0.64 ± 0.03b	3.10 ± 0.06b	30.28 ± 0.21	60.78 ± 0.87

Means followed by same letter in column do not differ by Tukey's test (P = 0.05).

Table 2. The mean length (days ± SE) of immature stages and duration from egg to adult of male *P. latus* in three generations under laboratory condition.



Generation	Egg	Larva	Pupa	Egg-adult	Temperature (°C)	RH (%)
1st	1.98 ± 0.01a	0.80 ± 0.01a	0.70 ± 0.01a	3.48 ± 0.02a	24.92 ± 0.27	46.78 ± 1.28
2nd	1.35 ± 0.01c	0.70 ± 0.01b	0.61 ± 0.02b	2.66 ± 0.02c	28.51 ± 0.26	66.65 ± 1.27
3rd	1.66 ± 0.04b	0.67 ± 0.02b	0.56 ± 0.08b	2.90 ± 0.02b	30.28 ± 0.21	60.78 ± 0.87

Means followed by same letter in column do not differ by Tukey's test (P = 0.05).

Table 3. The mean length (days± SE) of immature stages and duration from egg to adult in female and male *P. latus* for three generations under laboratory condition.

Generation	Sex	Egg	Larva	Pupa	Egg-adult	Temperature (°C)	RH (%)
1st	♀	2.17 ± 0.01a	0.95 ± 0.01a	0.81 ± 0.01a	3.93 ± 0.02a	24.92 ± 0.27	46.78 ± 1.28
	♂	1.98 ± 0.01b	0.80 ± 0.01b	0.70 ± 0.01b	3.48 ± 0.02b		
2nd	♀	1.45 ± 0.01a	0.81 ± 0.01a	0.72 ± 0.02a	2.97 ± 0.03a	28.51 ± 0.26	66.65 ± 1.27
	♂	1.35 ± 0.01b	0.70 ± 0.01b	0.61 ± 0.02b	2.66 ± 0.02b		
3rd	♀	1.71 ± 0.03a	0.74 ± 0.03a	0.64 ± 0.03a	3.10 ± 0.06a	30.28 ± 0.21	60.78 ± 0.87
	♂	1.66 ± 0.04a	0.67 ± 0.02b	0.56 ± 0.08a	2.90 ± 0.02b		

Means followed by same letter in column do not differ by Tukey's test (P = 0.05).

Table 4. The mean length (days± SE) of pre-oviposition, oviposition, fecundity and longevity of female and male *P.latus* for three generations under laboratory condition.

Generation	pre-oviposition	oviposition	post-oviposition	fecundity	longevity(♀)	longevity(♂)	Temperature (°C)	RH (%)
1st	0.68 ± 0.01 b	12.68 ± 0.02 a	0.99 ± 0.01 b	29.86 ± 0.18 a	14.35 ± 0.04 a	8.89 ± 0.19 b	24.92 ± 0.27	46.78 ± 1.28
2nd	0.99 ± 0.02 a	11.08 ± 0.05 b	1.78 ± 0.08 a	26.14 ± 0.17 b	13.85 ± 0.08 b	10.44 ± 0.14 a	28.51 ± 0.26	66.65 ± 1.27
3rd	0.93 ± 0.01 a	5.53 ± 0.13 c	0.91 ± 0.04 b	13.86 ± 0.19 c	7.38 ± 0.13 c	4.66 ± 0.16 c	30.28 ± 0.21	60.78 ± 0.87

Means followed by same letter in column do not differ by Tukey's test (P = 0.05).

Table 5. Life table parameters of *Polyphagotarsonemus latus* during 1st, 2nd and 3rd generations.

Life table parameters	Generations		
	1st	2nd	3rd
Gross reproductive rate ($GRR = \sum m_x$)	23.88	20.90	11.08
Net reproductive rate ($R_o = \sum l_x m_x$)	14.00	14.12	3.94
Capacity for increase ($r_c = [\log_e R_o]/T_c$)	0.28	0.28	0.16
Intrinsic rate of increase (r_m)	0.325	0.389	0.207
Cohort generation time ($T_c = \sum x l_x \times m_x / \sum l_x m_x$)	9.34	8.11	7.65
Generation time($T=[\log_e R_o]/ r_m$) days	8.12	6.81	6.62
Finite capacity for increase (λ=anti $\log_e r_m$)	1.38	1.48	1.23
Doubling time ($DT = \log_e 2/r_m$) days	2.13	1.78	3.35
Temperature (°C)	24.92 ± 0.27	28.51 ± 0.26	30.28 ± 0.21
RH (%)	46.78 ± 1.28	66.65 ± 1.27	60.78 ± 0.87

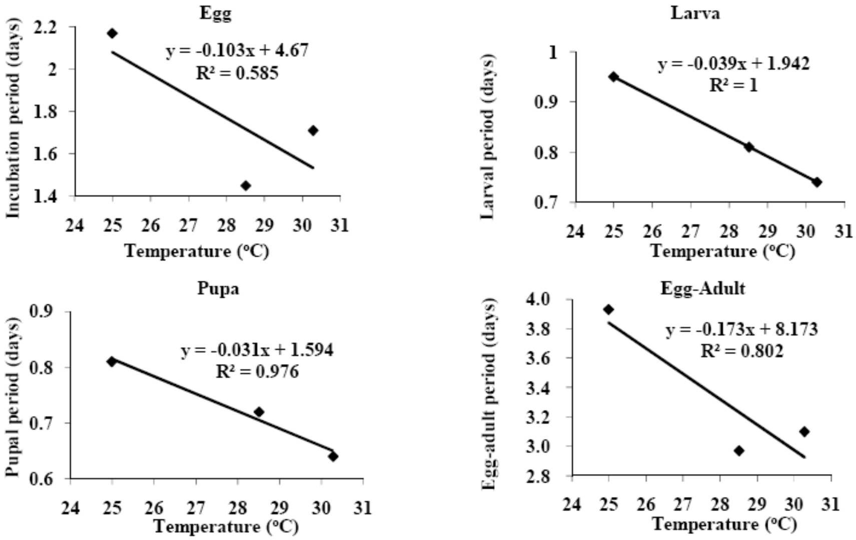


Figure 1. Regression between temperature (oC) on egg, larval,pupal and egg to adult period of female *Polyphagotarsonemus latus*.

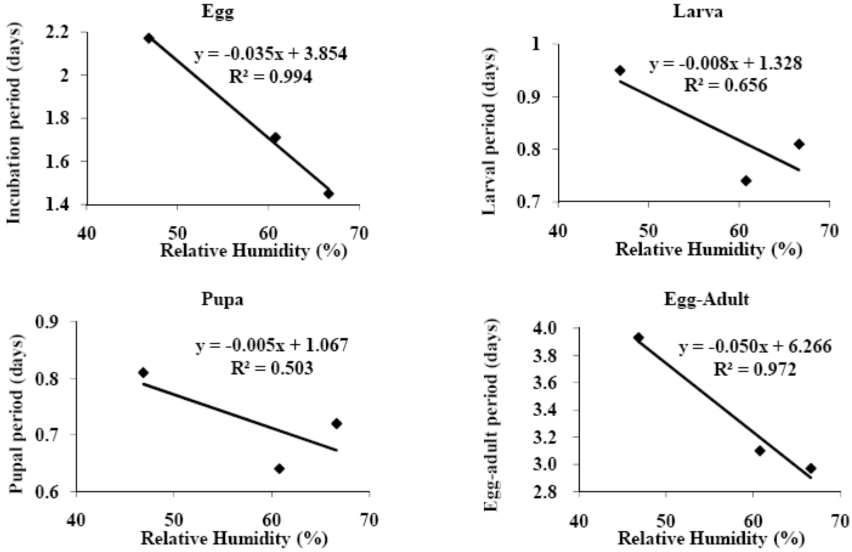


Figure 2. Regression between relative humidity (%) on egg, larval,pupal and egg to adult period of female *Polyphagotarsonemus latus*.

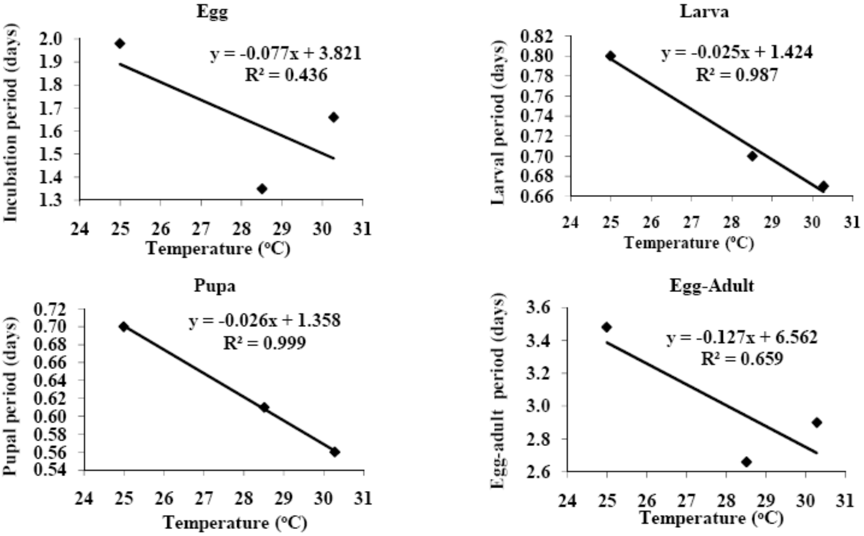


Figure 3. Regression between temperature (oC) on egg, larval,pupal and egg to adult period of male *Polyphagotarsonemus latus*.

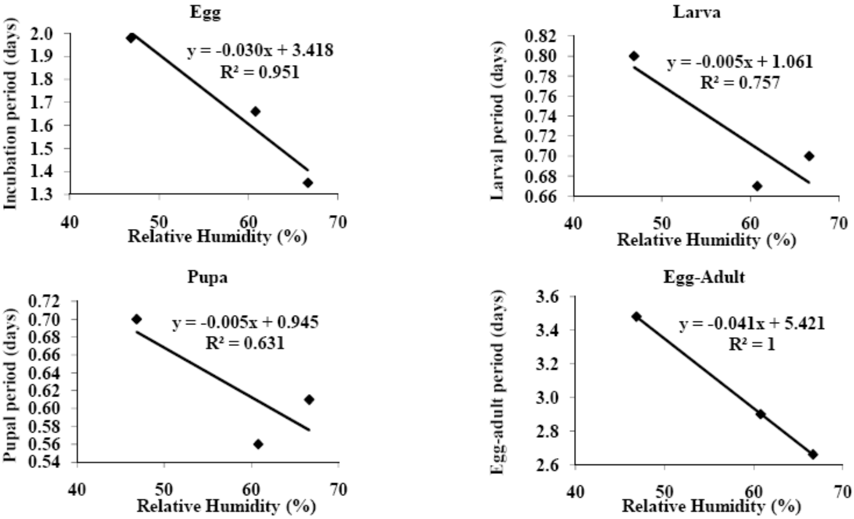


Figure 4. Regression between Relative humidity (%) on egg, larval,pupal and egg to adult period of male *Polyphagotarsonemus latus*.

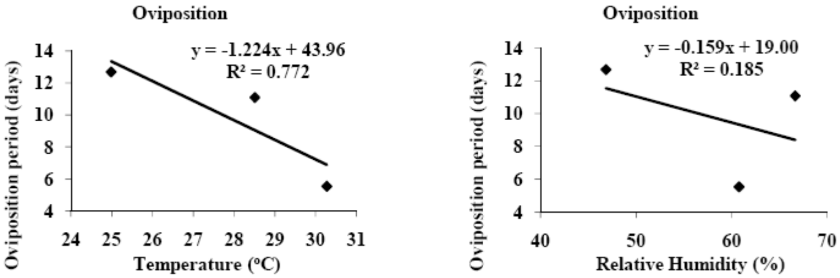


Figure 5. Regression between temperature (oC) and relative humidity (%) on oviposition period of *Polyphagotarsonemus latus*.

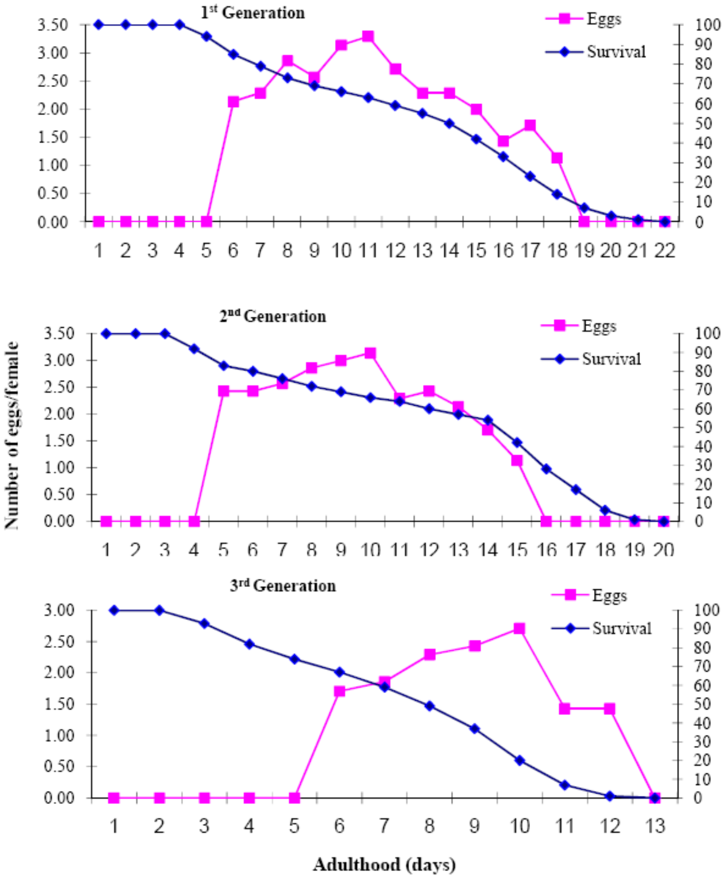


Figure 6. Oviposition and survival rate of female in three generations under laboratory condition.

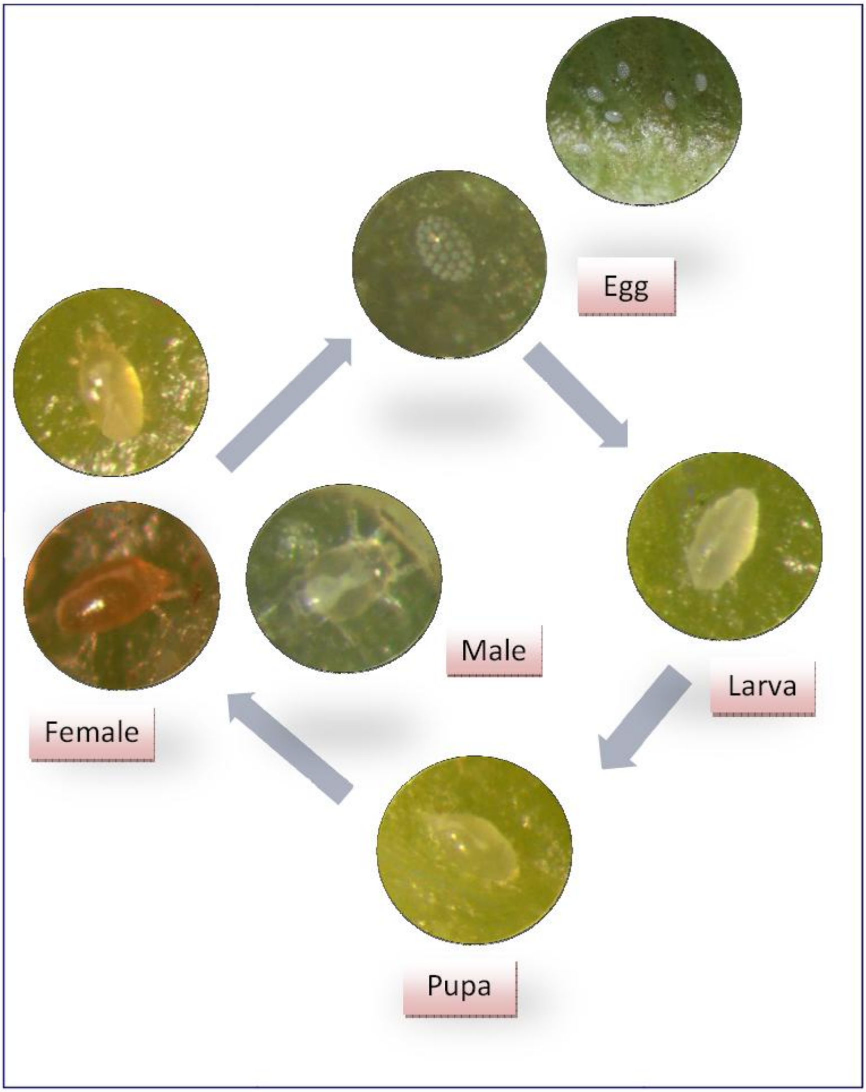


Plate I. Developmental stages of *P. latus*.

NEW RECORDS OF ISOTOMIDAE (COLLEMBOLA) FROM GOLESTAN PROVINCE (IRAN)

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[Falahati Hossein Abad, A., Potapov, M., Sarailoo, M. H., Mehr, M. S. & Yazdanian, M. 2013. New records of Isotomidae (Collembola) from Golestan province (Iran). Munis Entomology & Zoology, 8 (1): 236-238**]**

ABSTRACT: Family of Isotomidae belongs to the order of Collembola. These springtails with elongate and high cover of setae on surface of the body and equal abdomen segments differenced from others. In faunaistic study of Isotomidae family, several samples were taken from soil and leaf litter in different locations from Gorgan regions during 2010-2011. The specimens were extracted by heat in Berlese funnel and mounted on microscopic slides using Hoyer's medium. Totally, Six species of the family Isotomidae are recorded from Gorgan area (Northern Iran): *Anurophorus coiffaiti, Folsomia penicula, Isotomurus punctiferus, Isotomurus maculatus, Isotomurus* sp. (aff. *palustris-unifasciatus*) and *Isotoma* sp. (aff. *decorata-spinicauda*). Apart from *F. penicula*, all species are new for Iran. Two species are possibly new for science.

KEY WORDS: Collembola, Arthropleona, Isotomidae, Golestan, Gorgan, Iran.

Isotomidae is one of the largest families in Holarctic (Hopkin, 2005). Most of species of this family live in soil and are the primary and secondary consumers (Chahartaghi et al., 2005). Fauna of the family of some territories of Asia remains, however, poorly studied. Iran, a big country with diverse nature conditions, was paid very little (if not the least) attention by collembologists. Cox (1982), was the first to publish the list of Collembola recorded in Iran. 70 species (with 17 of which belonging to the family Isotomidae) from the Northwestern and Northern Provinces of the country was recorded by him. Moravvej et al. (2007) reported 5 isotomid species and so far the fauna of the family comprises 19 members. Our material was collected by the first author and is deposited in the insect collections of the Gorgan University of Agricultural Sciences and Natural Resources, Iran, and the Moscow State Pedagogical University, Russia. The fauna of Iran is still poorly studied, no keys to species is available, and new species are waiting their examination in future.

MATERIALS AND METHODS

Collection springtails: Soil and leaf litter samples were collected mainly from Gorgan areas, during 2010 and 2011. All samples were retained in white plastic boxes and then were transferred to the Entomology Laboratory of, Department of plant protection, of Gorgan University of Agricultural Sciences and Natural Resources

Extracted Springtails: The Collembola were extracted by Tullgren funnels. Afterwards transferred to small vials with camel hair brush, and were preserved in 75% alcohol for further study.

Preparation of slides: Specimens were cleared in a Nesbitt solution and mounted on slides with Hoyer medium. Afterwards the slides were transferred to oven for 3-5 day. The slides were examined under Olympus BX51-TF microscope.

Identification: The monograph of Potapov (2001) was primarily applied to identify the genera and species.

RESULTS

Six species of Isotomidae belonging to four genera are discovered in our material (Table 1).

DISCUSSION

Three species, *A. coiffaiti*, *I. punctiferus* and *I. maculatus*, are new for Iranian fauna. Two ones, *Isotomurus* sp. & *Isotoma* sp. probably new for science. Members of the genus *Isotomurus* are very similar in chaetotaxy and differ mostly by coloration and special ecological and molecular study call for ultimate decision on status of the species. *Folsomia penicula* was already recorded by Cox (1982) under the name *F. multiseta*

Anurophorus coiffaiti. Species was recorded in Lebanon, Syria, E Egypt (new), and Armenia. The records of *A. sylvaticus* from Azerbaijan possibly refers to this species.

Folsomia penicula. It is a common European forest mountain species. It is also abundant in Caucasus (including area of S Azerbaijan).

Isotomurus punctiferus. The species was described from Japan, recorded in Pakistan.

Isotomurus maculatus. It is common in Europe. The species is possibly distributed wider and is artificially introduced in many countries.

Isotomurus sp. (aff. *palustris-unifasciatus*). It belongs to "palustris" group. The species shares the color pattern with these two species but male ventral organ is developed only on Abdomen. IV like in *I. italicus*. *Isotoma* sp. (aff. *decorata-spinicauda*). Only one specimen with damaged furca was found.

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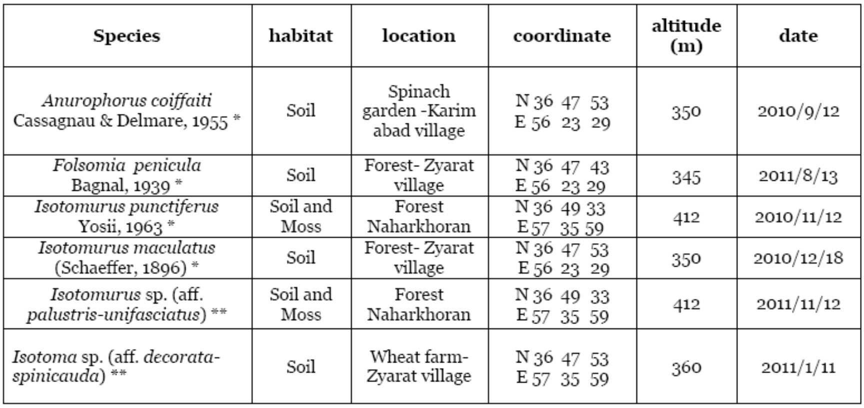
Table 1. Species of Isotomidae recorded.



Species	habitat	location	coordinate	altitude (m)	date
Anurophorus coiffaiti Cassagnau & Delmare, 1955 *	Soil	Spinach garden -Karim abad village	N 36 47 53 E 56 23 29	350	2010/9/12
Folsomia penicula Bagnal, 1939 *	Soil	Forest- Zyarat village	N 36 47 43 E 56 23 29	345	2011/8/13
Isotomurus punctiferus Yosii, 1963 *	Soil and Moss	Forest Naharkhoran	N 36 49 33 E 57 35 59	412	2010/11/12
Isotomurus maculatus (Schaeffer, 1896) *	Soil	Forest- Zyarat village	N 36 47 53 E 56 23 29	350	2010/12/18
Isotomurus sp. (aff. *palustris-unifasciatus*) **	Soil and Moss	Forest Naharkhoran	N 36 49 33 E 57 35 59	412	2011/11/12
Isotoma sp. (aff. *decorata-spinicauda*) **	Soil	Wheat farm- Zyarat village	N 36 47 53 E 57 35 59	360	2011/1/11

A REPLACEMENT NAME, *ALCIDIA* ROLLIER, 1913 FOR PREOCCUPIED GENUS *PARALCIDIA* SPATH, 1928 (AMMONOIDEA: HAPLOCERATINA: OPPELIIDAE)

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[Özdikmen, H. 2013. A replacement name, *Alcidia* Rollier, 1913, for preoccupied genus *Paralcidia* Spath, 1928 (Ammonoidea: Haploceratina: Oppeliidae). Munis Entomology & Zoology, 8 (1): 239-242**]**

ABSTRACT: One proposed genus name, *Paralcidia* Spath, 1928 in Ammonoidea is nomenclaturally invalid, as the genus group name has already been used by a different author in Lepidoptera. In accordance with Article 60 of the International Code of Zoological Nomenclature, I propose a substitute name, *Alcidia* Rollier, 1913, for this genus name.

KEY WORDS: Replacement name, *Paralcidia, Alcidia,* Ammonoidea.

Family OPPELIIDAE

Subfamily OPPELIINAE

Genus *ALCIDIA* Rollier, 1913 repl. name

Paralcidia Spath, 1928. Pal. Indica, (N.S.) 9, mem. 2, pt. 2, 79. (Mollusca: Cephalopoda: Ammonoidea: Ammonitida: Haploceratina: Oppeliidae: Oppeliinae). Preoccupied by *Paralcidia* Warren, 1906. Novit. zool., 13, 145. (Insecta: Lepidoptera: Geometroidea: Geometridae: Ennominae).

Remarks on nomenclatural change: The genus *Paralcidia* was erected by Warren (1906) with the type species *Paralcidia errabunda* Warren, 1906 by original designation from Papua New Guinea. It is still used as a valid genus name in Lepidoptera. It includes 7 species.

Subsequently, the extinct genus *Paralcidia* was described by Spath (1928) with the type species *Paralcidia khengari* Spath, 1928 from India. Also, it is still used as a valid genus name in Ammonoidea.

Thus the genus *Paralcidia* Spath, 1928 is a junior homonym of the valid genus name *Paralcidia* Warren, 1906. Under the International Code of Zoological Nomenclature (ICZN 1999) it must be rejected and replaced. *Paralcidia* Spath, 1928 has a synonym as *Alcidia* Rollier, 1913. The latter name is not used as valid name due to being junior homonym of the generic names *Alcidia* Westwood, 1879 in Lepidoptera, *Alcidia* Bourguignat, 1889 in Gastropoda, *Alcidia* Monterosato, 1890 in Gastropoda.

Alcidia Westwood, 1879 with together *Alcidis* Hübner, 1923 and *Alcidis* Scudder, 1875 is junior objective synonym of *Alcides* Hübner, 1922 in Lepidoptera (Geometroidea: Uraniidae: Uraniinae). So, it is invalid name.

Alcidia Bourguignat, 1889 with together *Artemon* Beck, 1837 is a junior synonym of *Streptaxis* Gray, 1837 in Mollusca (Gastropoda: Streptaxoidea: Streptaxiidae). So, it is also invalid name.

Alcidia Monterosato, 1890 with together many generic names (only senior names as *Turbona* Leach in Gray, 1847; *Zacanthusa* Leach, 1852; *Acinopsis* Monterosato, 1884; *Actonia* Monterosato, 1884; *Alvinia* Monterosato, 1884; *Flemingia* Jeffreys, 1884; *Galeodina* Monterosato, 1884; *Punctulum* Jeffreys, 1884; *Thapsia* Monterosato, 1884 and *Thapsiella* Fischer, 1885) is a junior synonym of *Alvania* Risso, 1826 in Mollusca (Gastropoda: Prosobranchia: Neotaenioglossa: Rissoidae). So, it is also invalid name.

Finally, I suggest here that *Paralcidia* Spath, 1928 should be replaced with the available replacement name *Alcidia* Rollier, 1913.

Summary of nomenclatural changes:

Alcidia Rollier, 1913 **repl. name**
pro *Paralcidia* Spath, 1928 (non Warren, 1906)

Alcidia alberti (R. Douville, 1914) **comb. nov.**
from *Paralcidia alberti* (R. Douville, 1914)

Alcidia brangeri (Cariou & Sequeiros, 1987) **comb. nov.**
from *Paralcidia brangeri* Cariou & Sequeiros, 1987

Alcidia calloviensis (Parona & Bonarelli, 1895) **comb. nov.**
from *Paralcidia calloviensis* (Parona & Bonarelli, 1895)

Alcidia concomitans (Kuhn, 1939) **comb. nov.**
from *Paralcidia concomitans* (Kuhn, 1939)

Alcidia couffoni (Gerard & Contaut, 1936) **comb. nov.**
from *Paralcidia couffoni* Gerard & Contaut, 1936

Alcidia cualacensis (Sandoval & Westermann, 1990) **comb. nov.**
from *Paralcidia cualacensis* (Sandoval & Westermann, 1990)

Alcidia davaicensis (Lissajous, 1923) **comb. nov.**
from *Paralcidia davaicensis* (Lissajous, 1923)

Alcidia dubia (Spath, 1928) **comb. nov.**
from *Paralcidia dubia* (Spath, 1928)

Alcidia ernii (Cariou et Sequeiros, 1987) **comb. nov.**
from *Paralcidia ernii* (Cariou et Sequeiros, 1987)

Alcidia exotica (Steinmann, 1881) **comb. nov.**
from *Paralcidia exotica* (Steinmann, 1881)

Alcidia flector (Waagen, 1869) **comb. nov.**
from *Paralcidia flector* (Waagen, 1869)

Alcidia fuscoides (Kuhn, 1939) **comb. nov.**
from *Paralcidia fuscoides* (Kuhn, 1939)

Alcidia glabella (Leckenby, 1859) **comb. nov.**
from *Paralcidia glabella* (Leckenby, 1859)

Alcidia guebhardi (Petitclerc, 1915) **comb. nov.**
from *Paralcidia guebhardi* (Petitclerc, 1915)

Alcidia inconspicua (Loriol, 1898) **comb. nov.**
from *Paralcidia inconspicua* (Loriol, 1898)

Alcidia inflata (Spath, 1928) **comb. nov.**
from *Paralcidia inflata* (Spath, 1928)

Alcidia inflexa (Grossouvre, 1888) **comb. nov.**
from *Paralcidia inflexa* (Grossouvre, 1888)

Alcidia khengari (Spath, 1928) **comb. nov.**
from *Paralcidia khengari* Spath, 1928

Alcidia lateumbilicata (Roemer, 1911) **comb. nov.**
from *Paralcidia lateumbilicata* (Roemer, 1911)

Alcidia latilobata (Waagen, 1869) **comb. nov.**
from *Paralcidia latilobata* (Waagen, 1869)

Alcidia mamertensis (Waagen, 1869) **comb. nov.**
from *Paralcidia mamertensis* (Waagen, 1869)

Alcidia mariorae (Popovici- Hatzeg, 1905) **comb. nov.**
from *Paralcidia mariorae* (Popovici- Hatzeg, 1905)

Alcidia mimetica (Spath, 1928) **comb. nov.**
from *Paralcidia mimetica* (Spath, 1928)

Alcidia nodosa (F. Douville, 1940) **comb. nov.**
from *Paralcidia nodosa* (F. Douville, 1940)

Alcidia nurrhaensis (Waagen, 1871) **comb. nov.**
from *Paralcidia nurrhaensis* (Waagen, 1871)

Alcidia obsoleta (Rollier, 1911) **comb. nov.**
from *Paralcidia obsoleta* (Rollier, 1911)

Alcidia obsoletoides (Riccardi, Westermann & Elmi, 1989) **comb. nov.**
from *Paralcidia obsoletoides* (Riccardi, Westermann & Elmi, 1989)

Alcidia oxynota (Leanza, 1946) **comb. nov.**
from *Paralcidia oxynota* (Leanza, 1946)

Alcidia pattei (Gerard & Contaut, 1936) **comb. nov.**
from *Paralcidia pattei* Gerard & Contaut, 1936

Alcidia prahequence (R. Douville, 1913) **comb. nov.**
from *Paralcidia prahequence* (R. Douville, 1913)

Alcidia preauberti (Gerard & Contaut, 1936) **comb. nov.**
from *Paralcidia preauberti* Gerard & Contaut, 1936

Alcidia rigida (Collignon, 1958) **comb. nov.**
from *Paralcidia rigida* Collignon, 1958

Alcidia subcostaria (Oppel, 1862) **comb. nov.**
from *Paralcidia subcostaria* (Oppel, 1862)

Alcidia subdisca (Orbigny,1847) **comb. nov.**
from *Paralcidia subdisca* (Orbigny,1847)

Alcidia subtililobata (Waagen, 1869) **comb. nov.**
from *Paralcidia subtililobata* (Waagen, 1869)

Alcidia tenuistriata (Grossouvre, 1888) **comb. nov.**
from *Paralcidia tenuistriata* (Grossouvre, 1888)

Alcidia voultensis (Lissajous in Elmi, 1967) **comb. nov.**
from *Paralcidia voultensis* (Lissajous in Elmi, 1967)

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FIRST RECORD ON THE BIOLOGY OF *AEOLESTHES HOLOSERICEA* FABRICIUS, 1787 (COLEOPTERA: CERAMBYCIDAE), AN IMPORTANT PEST ON APPLE PLANTATIONS (*MALUS DOMESTICA* BORKH.) IN INDIA

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[Gupta, R. & Tara, J. S. 2013. First record on the biology of *Aeolesthes holosericea* Fabricius, 1787 (Coleoptera: Cerambycidae), an important pest on apple plantations (*Malus domestica* Borkh.) in India. Munis Entomology & Zoology, 8 (1): 243-251**]**

ABSTRACT: Detailed bionomics of Apple longicorn borer, *Aeolesthes holosericea* Fabricius has been recorded for the first time in India on apple plantations. The insects were reared in the laboratory at temperature ranging between 10.84°C-32.87°C and relative humidity of 26%-80% on apple billets. Larvae being wood borers cause considerable damage to apple trees. There are seven instar stages. Larvae of apple longicorn beetle while feeding on the apple trees took about 17.23±0.21 months and 13.66±3.31 days to develop from first instar to mature larva. This period included the overwintering period of 4-5 months. Adult longevity for male and females were 10.55±0.44 days, 17.23±0.21 months and 13.66±3.31 days and days respectively. The pest has a total life span of approximately two years (25.16±1.83 months). So far, no report is available on culture of *Aeolesthes holosericea* Fabricius under laboratory conditions to facilitate evaluation of developmental stages against known control measures and the life cycle and ethology of this insect pest is indispensible for developing its control measures in the present area of study. It is also impractible to study the complete life cycle of *Aeolesthes holosericea* in its natural condition because regular tracking of feeding and boring larvae within the tree trunk and cutting of the tree for each observation till the completion of life cycle is not feasible. Therefore a need was felt to develop a simple method of rearing *Aeolesthes holosericea* in laboratory conditions in order to identify susceptible stages to effective control methods.

KEY WORDS: *Aeolesthes holosericea*, longicorn, *Malus domestica*, biology, new, stem borer.

Aeolesthes holosericea (Fabr.) is recorded as a polyphagous pest infesting wide variety of forest plants and trees. Stebbing (1914) reported it from eight host plant species and Beeson (1941) reported thirty seven species as its host plants. Rahman and Khan (1942) described bionomics of this pest on cherry plant. Ambethgar (2003) studied the infestation and development of *Aeolesthes holosericea* on neem (*Azadirachta indica*) by inoculation of the grubs on its live stems in laboratory and Tara et al. (2008) reported it from apples in District Doda of J&K State. *Aeolesthes holosericea* Fabricius is one of the most destructive borers of apple plantations causing severe damage to the apple trees in Jammu, India. Realizing the importance of the problem, detailed study of biology of apple stem borer was taken into consideration.

MATERIALS AND METHODS

Collection of borer infested logs of apple trees were made from different localities of Jammu province to record the borer attack and damage. Infested and collected logs were caged in the laboratory as well as in the fields to record the emergence of adults and for recording other related observations about the pest life cycle. The emerging adults were released in pairs for mating and for recording the fecundity and longevity of females in the laboratory. Eggs laid by each female was counted and kept for hatching in Petri plates. The grubs were reared on freshly cut twigs (billets) of apple trees by releasing them in artificially made slits on the bark and the later instars in artificially prepared galleries in the sapwood of apple trees. Grubs were transferred to fresh billets every month. Duration of each grub stage was calculated accordingly for each instar by changing the size of wood according to the size of growing instar stages. Similar method of studying biology of another allied species *Aeolesthes sarta* on poplar has been adopted by Ahmad et al. (1977). Morphometric measurements were recorded for all life stages of *Aeolesthes holosericea* using standard graphic paper method. Since the pest under study is a borer and though the author has tried to determine the number of larval instars by rearing the pest in artificially prepared galleries and channels in the sapwood of apple trees but despite rearing them under laboratory conditions, Dyar's law has also been applied to confirm the number of larval instars passed by *Aeolesthes holosericea* on apple plantations (*Malus domestica* Borkh.) in the area of investigator. Duration of different stages in the lifecycle was also calculated and analyzed statistically.

RESULTS AND DISCUSSION

BIOLOGICAL STUDIES:

Emergence of the pest: Adult beetles start emerging in the field through an oval emergence hole from the pupal chamber during April and continued to June in the area under investigation on apple plantations. Though earlier observations of Stebbing (1914), Rahman & Khan (1942) and Atwal & Dhaliwal (1999) reported the emergence of this beetle on *Shorea robusta*, apple and cherry from April to October, April to July, May to October and in their respective fields. However the emergence of *Aeolesthes holosericea* on *Hardwickia binata* and *Terminalia belerica* in Madhya Pradesh occurred during February- March (Khan, 1989).

Pairing: In *Aeolesthes holosericea*, males approached females directly, recognized them by visual clues. In laboratory during rearing, it was observed that there exists a competition among males for the possession of female. Males run swiftly, waving their antennae and fight among themselves. Females usually preferred large males to mate and their preference decreased from larger to smaller sized males. It is also seen that a single male mates with more than one female. In the longicorn under present investigation in Jammu region, male and female copulate and start egg laying after 3.20±0.20 (2-4 days) days after emergence. Copulation lasts for an average of 66.5±3.94 minutes which ranged from a minimum of 55.0 minutes to a maximum of 80.0 minutes. However, Stebbing (1914) recorded that the beetles copulate for one to two minutes.

Oviposition: Selection of oviposition site by female *Aeolesthes holosericea* is a tedious job as larval host selection by females of *Aeolesthes holosericea* is very critical, as the grubs are legless and incapable of locating the host trees, thus females located suitable oviposition site by olfaction. It selects crevices and injured areas on the bark and more often previously attacked parts of the stem for egg laying. Similar behaviour was also recorded by Rahman & Khan (1942) on cherry plants.

Females make minute incisions on the injured edges of the bark into which they push their eggs. Single female lays 62.50±4.16 eggs under laboratory conditions. Number of eggs ranged from a minimum of 45.0 to a maximum of

83.0. Eggs are laid singly or in pair of two to five under the cracks and crevices of the bark. Earlier observations on egg laying behaviour of female *Aeolesthes holosericea* given by Rahman and Khan (1942) reveals that the eggs are laid under the cracks or crevices in the bark in clusters of 4 to 8 on cherry plant which is contrary to females of same species that lay about 200-300 eggs on *Hardwikia binata* and *Terminalia belerica* in Madhya Pradesh as reported by Khan (1989).

Eggs are laid in a longitudinal pattern with the surface having petiole facing outwards. Eggs are oval, creamy yellow translucent, of paper like consistency and measures 2.21 ±0.12 mm (mean±SE) in length and 0.75-1.15 mm in width.

Incubation and Hatching: The incubation period of *Aeolesthes holosericea* Fabricius was observed to ranged between 09.0-12.0 days with an average of 10.55±0.44 days. Present observations are in accordance with those of Hanks (1999), who reported that eggs of most Lamiine species hatch in 10.9±1.3 days. Secretions of incubated grubs moisten the egg shell which helped in grub eclosion. Moisture played an important role in the hatching of grubs, as eggs removed from egg sites when placed in glass tubes shrinked and failed to hatch. The movement of the grubs resulting in the bursting of egg shell from the micropylar end and crawled out leaving the egg shell in the main stem without exposing themselves and made their way into the main stem through the pith of primary branches. The incubation period of *Aeolesthes holosericea* Fabricius, was observed to range between 7-12 days and 2-3 days by Rahman & Khan (1942) on cherry plants and Khan (1989) on *Hardwickia binata* and *Terminalia belerica* in Pakistan and Madhya Pradesh respectively.

Feeding and Tunneling behavior of grubs: Newly hatched grubs small, few mm in length, delicate and possesses needle like Mandibular region. Immediately after hatching the grubs start feeding on phloem and cambium while the later instars made their way into the heartwood through sap, excavating a zig-zag round feeding tunnel downwards. Grubs chew several sub tunnels from the main feeding tunnel to expel the excreta and to aerate it for physiological processes. These sub tunnels open to the exterior through a circular hole, often covered with extruded frass. Cell sap is always oozing out through circular holes. Grubs excavate large numbers of sub tunnels in the main stem as compared to thin branches of infested trees. Feeding tunnel is filled with large amount of fibrous matter/ chewed wood.

Larval instars and development: Determination of number of larval instars of *Aeolesthes holosericea* Fabricius on apple trees (*Malus domestica* Borkh) in Jammu Province was made difficult by the almost continuous range of head capsule width measurement ranging between 1.20-12.0 mm. On the basis of data recorded in the field and larvae reared in the laboratory, seven larval instars were identifiable on apple trees. Larvae of apple longicorn beetle while feeding on the apple tree in the area of present author took about 17.23±0.21 months and 13.66±3.31 days to develop from first instar to mature larva. This period included the overwintering period of 4-5 months. The developmental period of each larval instar was progressively longer than the preceding instar. Rahman & Khan (1942) observed the larval period of *Aeolesthes holosericea* ranged between 27 to 32 months at Lyallpur on cherry and apple plants whereas Singh et al. (1987) observed 9-10 months of larval period in *Aeolesthes holosericea* Fabricius on *Shorea robusta* respectively. In contrast, observations regarding larval duration of *Aeolesthes holosericea* by Khan (1989) recorded an average larval duration of 27-32 days on teak and *Hardwikia binata*.

Pupal duration: Pupae of *Aeolesthes holosericea* take 1.50±0.22 (mean±SE) months and 11.16±3.36 (mean±SE) days respectively. The matured larvae widened the central feeding tunnel, prepared an elliptical chamber (Pupal cell) in the wood at a distance of about 12-16mm from the surface, measuring about 56.60±2.56 mm in length and 30.20±3.0 mm in width and block the larval gallery opening into the pupal cell with fibrous frass. Pupa is naked. Pupation takes place during September and October. The imago thus formed remains quiescent inside the same pupal chamber throughout winter. However the observations of Rahman & Khan (1942) revealed that pupation in *Aeolesthes holosericea* on cherry and apple in Pakistan takes place either in October- November or in March- April and the beetles that emerged from the puparia formed in October, remained with in the tunnels throughout the winter and in spring while those beetles that emerge from puparia in April, rest for only six weeks and duration of pupal period was observed as 3 to 150 days on apple and cherry in Pakistan, however on *Hardwikia binata* and *Terminalia belerica*, Khan (1989) reported pupal duration of 40-100 days in *Aeolesthes holosericea* in Madhya Pradesh and about 40 to 100 days on cherry (Atwal and Dhaliwal, 1999).

Winter rest: Larvae and immature adults have been observed to undergo rest during winter months from November to March on apple plantations as a host in the area of the author. While the first year larvae undergo rest for overwintering only whereas in the second year, the imago thus formed remains quiescent inside the same pupal chamber throughout winter to avoid harsh weather conditions which prevailed in the study region. For the purpose it uses an elliptical chamber prepare by the larva itself in the core of wood by enlarging the depth of its gallery. Mouth of the chamber is plugged with coarse wood fibres. Average winter rest duration in *Aeolesthes holosericea* in present study area is 4.45±0.16 months and 10.55±0.44 days . Similar winter rest observations with some variations in case of *Batocera rufomaculata* (another cerambycid beetle) has been recorded earlier by Beeson & Bhatia (1939), Hussain & Khan (1940) and Palaniswamy et al. (1979). Adults start emerging from the trees after mid March.

The resting period of the imago of the pest under consideration as observed in the field may coincide with the emergence of adults with favourable field conditions prevailed in the area of author whereas during November, December, January and February (winter months), apple plantations remains without foliage and the temperature of the area even falls down below O°C because of heavy snowfall. This observation of the author has been substantiated by the earlier recorded findings of Rahman & Khan (1942) for *Aeolesthes holosericea* on cherry in Pakistan. These authors further found that if the larvae of this beetle attained its full maturity by October they underwent rest for 3 to 25 days only but if they obtain maturity during November, the larvae underwent a hibernation period of 4½ to 5 months before pupating (i.e. it would pupate in March- April of the subsequent year). Similar resting period in *Aeolesthes sarta* has been recorded by Ahmad et al. (1977) in Pakistan on Poplar and for *Carilia virginea* (another cerambycid) by Starzyk (1977) in Poland.

Adult emergence: The total life cycle of the borer, till emergence of adults, gets completed in approximately two years (25.16±1.83 months) in Jammu and

Kashmir. Longevity of adult male and female longicorn is recorded as 32.8±2.65 days and 15.8±1.6 days respectively.

Adult: Beetle large, stout and elongate measuring 38.0 to 45.0 mm with an average of 39.20± 1.87 (mean±SE) mm in length and 10.0 to 13.0 mm with an average of 10.65± 0.71 (mean±SE) mm in width; mostly dark brown or reddish brown densely covered with a golden brown pubescence when the elytra of the beetle are presented in different positions to the light, it gives them the appearance of being coated in the silk.

Sexual dimorphism distinct as males are smaller in size than females and possesses very long antennae, much longer than the general body length whereas the antennae of females are shorter. Similar observations regarding sexual dimorphism in *Aeolesthes holosericea* have been reported by Khan (1989) on *Hardwikia binata* and *Terminalia belerica* in Madhya Pradesh.

Contrary to this, Rahman & Khan (1942) have quoted that males are smaller in size with small antennae as compared to females that are larger in size and possess big antennae. However author's observations are in support of those on the sexual dimorphism in *Aeolesthes sarta*, another longicorn on poplar given by Ahmad et al. (1977), who also recorded that males are smaller and possessed much larger antennae than females that have smaller antennae.

Damage: Present investigator during her studies on apple plantations in Jammu region of J&K State found that *Aeolesthes holosericea* is a destructive pest of apple trees. Frass coming out of the live holes on the trunk and branches is the main symptom of attack. The nature and extent of damage caused by grubs and adults to host plants is entirely different from each other. Grubs, being wood borers excavated tunnels in the wood and lead the infested plants to die; however adult beetles debark the tender twigs of plant only. Adults are nocturnal and do not cause much damage to the apple plantations. They just feed upon the bark of the trees. The most serious and harmful stage of *Aeolesthes holosericea* is the grub or the larval stage that causes irreparable damage to apple plantation in the area of the investigator . Larvae make longitudinal or transverse galleries. The pest can be located easily from the frass that comes out of the holes in the branches or in the main trunk. Rahman and Khan (1942) have also recorded similar type of mode of damage caused by *Aeolesthes holosericea*. They reported that larvae make galleries inside the tree and feed on sapwood. The op. cited authors even observed that a single larva could kill the young apple tree. Stebbing (1914) also recorded that as soon as the mandibles of the larva become stronger, they eat out the sapwood and make large, broad and flat, irregularly shaped longitudinal or transverse galleries.

Galleries made by the pest under study are about 12 inches or more in length, 3 inches in width and about an inch deep. Present author further recorded that the grub makes two to four openings or aeration holes on the main trunkor branches. When the larva is about half grown, it leaves outer sapwood and bores down into heartwood, from where it enters into older heartwood and carves out a chamber, more or less parallel to the long axis of the tree, which is wider than the tunnel leading to it. This chamber is wider and forms the pupal chamber. Infestation caused by this pest in apple growing areas of Jammu and Kashmir has been found to be high at some places **.** The author during her studies has recorded 65 to 70 larvae in a single robust branch of an apple tree.

As a result of larval feeding and the consequential damage to the woody tissue, vitality of the apple trees thus reduces greatly. During severe infestation, parts of the attacked apple tree start drying and ultimately become unproductive which at last lead to the death of the tree. The continuous flow of cell sap through the bores made by grubs deprived the plants from minerals/ nutrients and water; altered host plant physiology and finally affect growth and yield of apple plants in the area of the author. Current observation reveals that the damaged apple trees are vulnerable to attack by other insects and infestation of the borer spreads to adjoining trees also. The intensity of damage caused by an insect species in general varies among different host plant species (Solomon, 1974; Yang et al., 1995) and the damage inflicted by cerambycid borers to host plants is well documented by some earlier workers viz. Linsley (1959, 1961), Donley (1978), Donley & Terry (1977), Sharma & Tara (1984), Goodwin & Petit (1994) and Goodwin (2005a,b).

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Table 1. Duration of different stages in the life cycle of *Aeolesthes holosericea* Fabricius on apple plantations in Jammu province.

STAGE	DURATION	
	MONTHS	DAYS
Incubation period		10.55±0.44
Larval period	17.33±0.21	13.66±3.31
Pupal period	1.50±0.22	11.16±3.36
Winter rest	4.45±0.16	5.56±0.29
Total life cycle	25.16±1.83	
Adult longevity (Male)		32.8±2.65
Adult longevity (Female)		15.8±1.6

Table 2. Morhometric measurements of different stages of *Aeolesthes holosericea* Fabricius.

STAGE	BODY LENGTH (Mean±SE)	BODY WIDTH (Mean±SE)	
		Anterior width	Middle Width
Egg	2.21 ±0.12	0.95±0.05	
First instar	4.70±0.47	1.10±0.06	0.58±0.08
Second instar	13.42±0.52	5.42±0.61	3.85±0.34
Third instar	22.33±0.76	8.0±0.36	6.0±0.36
Fourth instar	28.28±0.28	9.0±0.57	7.0±0.48
Fifth instar	34.25±0.81	11.87±0.95	8.37±0.46
Sixth instar	43.50±2.67	12.50±1.43	9.10±0.96
Final instar	59.73±1.42	13.12±0.44	9.5±0.56
Pupa	40.81 ± 1.54	14.75±0.95	-
Adult male	33.0± 1.34	9.2 ±0.40	-
Adult female	39.20± 1.59	10.25±0.33	-

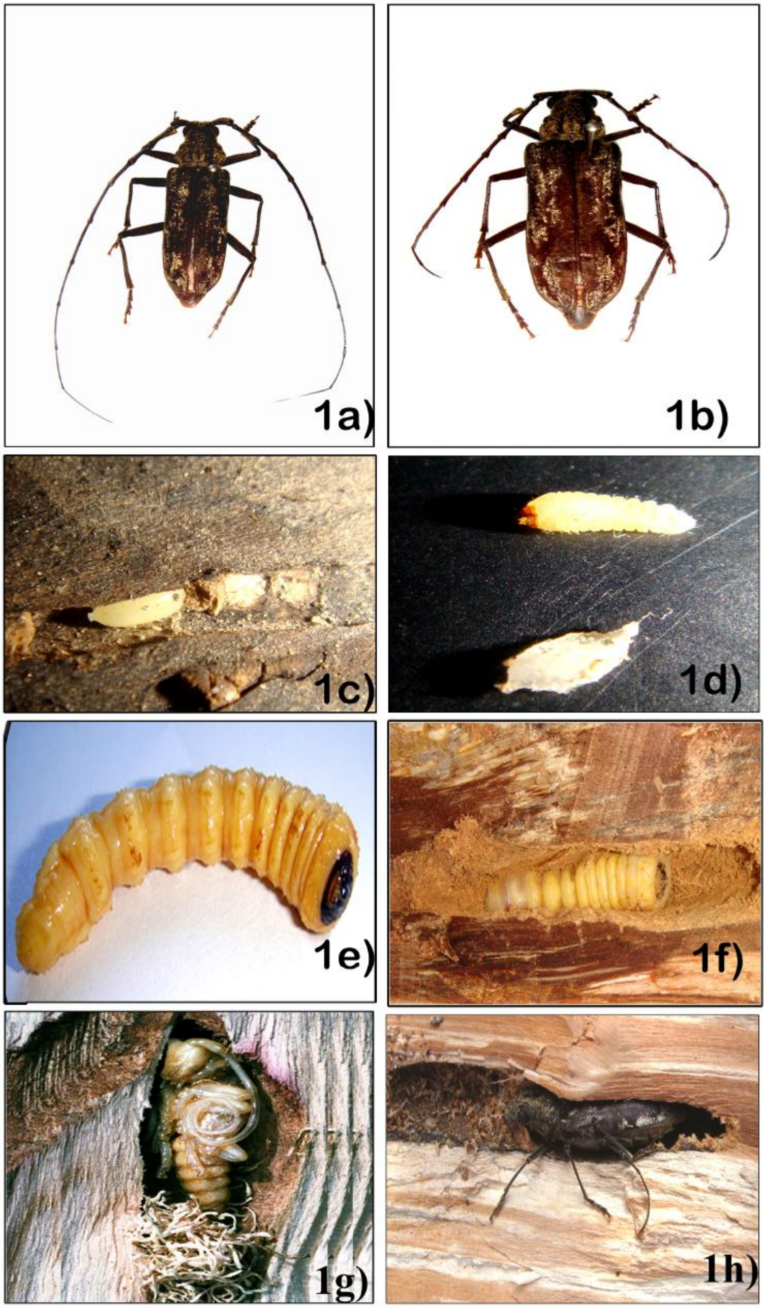

Figure 1. a) Adult male, b) Adult female, c) Freshly laid egg, d) First instar larva, e) Mature larva, f) Prepupa, g) Pupa, h) Imago.

SUBSTITUTE NAMES FOR THREE PREOCCUPIED GENERIC NAMES IN GASTROPODA

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ABSTRACT: Three proposed genus names in Gastropoda are nomenclaturally invalid, as the genus group names have already been used by different authors in Lepidoptera, Brachiopoda and Diptera respectively. In accordance with Article 60 of the International Code of Zoological Nomenclature, I propose substitute names for these genus names.

KEY WORDS: Replacement names, *Herbertina, Lowenstamia, Mesophora, Criophora,* Gastropoda.

Family CALLIOSTOMATIDAE
Subfamily THYSANODONTINAE
Genus *BRUCEINA* nom. nov.

Herbertina Marshall, 1988. J. Molluscan Stud., 54 (2): 223. (Mollusca: Gastropoda: Vetigastropoda: Trochoidea: Calliostomatidae: Thysanodontinae). Preoccupied by *Herbertina* Schaus, 1901. Trans. ent. Soc. London, 1901, 329. (Insecta: Lepidoptera: Noctuoidea: Notodontidae).

Remarks on nomenclatural change: The neotropical monotypic genus *Herbertina* was erected by Schaus (1901) with the type species *Lophopteryx eumeta* Druce , 1900 by monotypy from Sierra del Libano (Colombia). It is still used as a valid genus name in Lepidoptera.

Subsequently, the gastropod genus *Herbertina* was described by Marshall (1988) with the type species *Herbertina eos* Marshall, 1988 by original designation from South Africa. Also, it is still used as a valid genus name in Gastropoda.

Thus the genus *Herbertina* Marshall, 1988 is a junior homonym of the valid genus name *Herbertina* Schaus, 1901. So I propose here that *Herbertina* Marshall, 1988 should be replaced with the new name *Bruceina*, as a replacement name.

Etymology: From the first name of the current author, Bruce A. Marshall, of the genus *Herbertina* in Gastropoda.

Summary of nomenclatural changes:

Bruceina **nom. nov.**
pro *Herbertina* Marshall, 1988 (non Schaus, 1901)

Bruceina cognata (Marshall, 1988) **comb. nov.**
from *Herbertina cognata* Marshall, 1988

Bruceina eos (Marshall, 1988) **comb. nov.**
from *Herbertina eos* Marshall, 1988

Bruceina hayesi (Herbert, 1995) **comb. nov.**
from *Herbertina hayesi* Herbert, 1995

Family MURICIDAE

Genus *SOHLIINA* nom. nov.

Lowenstamia Sohl, 1964. Prof. Pap. U.S. geol. Surv. 331B: 182. (Mollusca: Gastropoda: Neogastropoda: Muricidae). Preoccupied by *Lowenstamia* Stehli, 1961. J. Paleont. 35: 460. (Brachiopoda: Rhynchonellata: Terebratulida: Gillediidae).

Remarks on nomenclatural change: The Cretaceus extinct genus *Lowenstamia* was described by Sohl (1964) with the type species *Lowenstamia funiculus* Sohl, 1964 from America. It is still used as a valid genus name in Gastropoda.

Nevertheless the name *Lowenstamia* is already occupied. Since the name *Lowenstamia* was erected by Stehli (1961) with the type species *Lowenstamia texana* Stehli, 1961 from Texas (America). The Permian extinct genus is known from America and China. It includes 3 species as *Lowenstamia ampla* Cooper & Grant, 1976; *Lowenstamia gegyaiensis* Sun, 1991 and *Lowenstamia texana* Stehli, 1961. Also, it is still used as a valid genus name in Brachiopoda.

Thus the genus *Lowenstamia* Sohl, 1964 is a junior homonym of the valid genus name *Lowenstamia* Stehli, 1961. So I suggest here that *Lowenstamia* Sohl, 1964 should be replaced with the new name *Sohliina*, as a replacement name.

Etymology: The genus is named after the current author of *Lowenstamia,* N. F. Sohl.

Summary of nomenclatural changes:

Sohliina **nom. nov.**
pro *Lowenstamia* Sohl, 1964 (non Stehli, 1961)

Sohliina cucullata (Sohl, 1964) **comb. nov.**
from *Lowenstamia cucullata* Sohl 1964

Sohliina funiculus (Sohl, 1964) **comb. nov.**
from *Lowenstamia funiculus* Sohl 1964

Sohliina liratus (Wade, 1926) **comb. nov.**
from *Lowenstamia liratus* (Wade, 1926)
Hippocampoides liratus Wade, 1926

Family TRIPHORIDAE

Genus *CORIOPHORA* Laseron, 1958 repl. name

Mesophora Laseron, 1958. Aust. J. mar. Freshwat. Res. 9: 592. (Mollusca: Gastropoda: Caenogastropoda: Triphoroidea: Triphoridae). Preoccupied by *Mesophora* Borgmeier, 1937. Rev. Ent., Rio de J., 7, 209. (Insecta: Diptera: Cyclorrhapha: Platypezoidea: Phoridae: *Apocepahus*).

Remarks on nomenclatural change: Firstly, the genus group name *Mesophora* was proposed by Borgmeier (1937) as a subgenus of the genus *Apocephalus* Coquillett, 1901 with the type species *Apocephalus* (*Mesophora*) *mortifer* Borgmeier, 1937 by original designation from Brazil in Diptera. The valid genus *Apocephalus* Coquillett, 1901 has 2 subgenera as the nominotypical subgenus and *Mesophora* Borgmeier, 1937. Both subgenera includes many species.

Subsequently, the genus *Mesophora* was described by Laseron (1958) with the type species *Mesophora bowenensis* Laseron, 1958 that is a synonym of *Mesophora fusca* (Dunker 1860) by original designation. The name is currently used as a valid generic name in Gastropoda

Thus the genus *Mesophora* Laseron, 1958 is a junior homonym of the valid genus group name *Apocephalus* (*Mesophora*) Borgmeier, 1937. Under the International Code of Zoological Nomenclature (ICZN 1999) it must be rejected and replaced. *Mesophora* Laseron, 1958 has a synonym as *Coriophora* Laseron, 1958. So, I suggest here that *Mesophora* Laseron, 1958 should be replaced with the available replacement name *Coriophora* Laseron, 1958.

Summary of nomenclatural changes:

Coriophora Laseron, 1958 **repl. name**
pro *Mesophora* Laseron, 1958 (non Borgmeier, 1937)

Coriophora albocaelarea (Laseron, 1958) **comb. nov.**
from *Mesophora albocaelarea* Laseron, 1958

Coriophora arafura (Laseron, 1958) **comb. nov.**
from *Mesophora arafura* Laseron, 1958

Coriophora calcara (Laseron, 1958) **comb. nov.**
from *Mesophora calcara* Laseron, 1958

Coriophora capricornia Laseron, 1958
from *Mesophora capricornia* (Laseron, 1958)

Coriophora cnodax (Jousseaume, 1884) **comb. nov.**
from *Mesophora cnodax* (Jousseaume, 1884)
Mastonia cnodax (Jousseaume, 1884

Coriophora continens (Laseron, 1958) **comb. nov.**
from *Mesophora continens* Laseron, 1958

Coriophora cybaea (Kosuge, 1963) **comb. nov.**
from *Mesophora cybaea* (Kosuge, 1963)

Coriophora dolicha (Watson, 1886) **comb. nov.**
from *Mesophora dolicha* (Watson, 1886)
Triforis dolicha Watson, 1886

Coriophora eximia Laseron, 1958
from *Mesophora eximia* (Laseron, 1958)

Coriophora fulva Laseron, 1958
from *Mesophora fulva* (Laseron, 1958)

Coriophora fusca (Dunker, 1860) **comb. nov.**
from *Mesophora fusca* (Dunker, 1860)
Triforis fusca Dunker, 1860

Coriophora granosa (Pease, 1871) **comb. nov.**
from *Mesophora granosa* (Pease, 1871)
Triphorus granosus Pease, 1871

Coriophora hungerfordi (Sowerby III, 1914) **comb. nov.**
from *Mesophora hungerfordi* (Sowerby III, 1914)
Cautor hungerfordi Sowerby III, 1914

Coriophora inconspicua Laseron, 1958
from *Mesophora inconspicua* (Laseron, 1958)

Coriophora iniqua (Laseron, 1958) **comb. nov.**
from *Mesophora iniqua* Laseron, 1958

Coriophora mellita (Laseron, 1958) **comb. nov.**
from *Mesophora mellita* Laseron, 1958

Coriophora mistura Laseron, 1958
from *Mesophora mistura* (Laseron, 1958)

Coriophora monilifera (Hinds, 1843) **comb. nov.**
from *Mesophora monilifera* (Hinds, 1843)
Triphora monilifera Hinds, 1843

Coriophora montuosa Laseron, 1958
from *Mesophora montuosa* (Laseron, 1958)

Coriophora negrita Laseron, 1958
from *Mesophora negrita* (Laseron, 1958)

Coriophora novem (Nowell-Usticke, 1969) **comb. nov.**
from *Mesophora novem* (Nowell-Usticke, 1969)
Triphora novem Nowell-Usticke, 1969

Coriophora pallenta (Laseron, 1958) **comb. nov.**
from *Mesophora pallenta* Laseron, 1958

Coriophora pura (Laseron, 1958) **comb. nov.**
from *Mesophora pura* Laseron, 1958

Coriophora purpurea (Laseron, 1958) **comb. nov.**
from *Mesophora purpurea* Laseron, 1958

Coriophora retusa Laseron, 1958
from *Mesophora retusa* (Laseron, 1958)

Coriophora rufosutura (Laseron, 1958) **comb. nov.**
from *Mesophora rufosutura* Laseron, 1958

Coriophora shihi (Chang & Wu, 2005) **comb. nov.**
from *Mesophora shihi* Chang & Wu, 2005

Coriophora tigris Laseron, 1958
from *Mesophora tigris* (Laseron, 1958)

Coriophora torpedo (Laseron, 1958) **comb. nov.**
from *Mesophora torpedo* Laseron, 1958

Coriophora tryoni (Chang & Wu, 2005) **comb. nov.**
from *Mesophora tryoni* Chang & Wu, 2005

Coriophora ustulata (Hervier, 1897) **comb. nov.**
from *Mesophora ustulata* (Hervier, 1897)
Triphora ustulata (Hervier, 1897)

Coriophora vermicula Laseron, 1958
from *Mesophora vermicula* (Laseron, 1958)

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A CHECKLIST OF IRANIAN COLLEMBOLA (INSECTA: APTERYGOTA)

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[Falahati Hossein Abad, A., Mehr, M. S. & Kheirodin, A. 2013. A checklist of Iranian Collembola (Insecta: Apterygota). Munis Entomology & Zoology, 8 (1): 257-261**]**

ABSTRACT: A checklist of the species of springtails (Collembola) recorded from Iran is presented. The present list contains 87 species.

KEY WORDS: Collembola, checklist, Iran.

Springtails (Collembola) form the three hexapods group that are widespread and abundant terrestrial microarthropods. They are small, enthognathus, wingless hexapods with antenna always present. About 7500 species of Collembola were described Worldwide. Notably, however, all information on taxonomy of these cute animals comes from European and American countries, while little attention has been paid to investigate Asian fauna such as Iran. Due to, there is no reliable taxonomic key for Asian Collembola.

The Collembola fauna of several countries in the world was already overwied in the recent past (Babenko & Fejellberg, 2006), Kaprus et al. (2004) on the Ukraine. In fact, the fauna of Iran is virtually unknown, no keys to species, as very few species are known, last comprehensive article on the Iranian springtail fauna was published about 30 years ago (Cox, 1982).

MATERIAL AND METHODS

The present catalogue is reported for the first time from Iran. Citations of already published data morravej et al (2007), Cox (1982), Yahyapoor et al. (2011) and Falahati Hossein Abad et al. (2011).

Species are listed according to the system of Deharveng (2007), marking the suborders, the families, the subfamilies and the genera. For each species is reported: the Latin name, the complete name of the author and year of publication.

RESULTS

The present catalogue is reported for the first time in Iran that including 4 suborders (Entomobryomorpha, Poduromorpha, Neelipleona, Symphypleona), 15 families, 15 subfamilies, 35 genera and 87 species.

List of Collembola species from Iran
Suborder Entomobryomorpha
Family Isotomidae

Subfamily Anurophorinae
***Anurophorus* Nicolet, 1842**
Anurophorus *coiffaiti* Cassagnau and Delamare, 1955

***Cryptopygus* Willem, 1901**
Cryptopygus gibbosa (Bagnal, 1940)

Subfamily Proisotominae
***Folsomia* Willem, 1902**
Folsomia cf. *brevifurca* (Bagnall, 1949)
Folsomia quadrioculata (Tullberg, 1871)
Folsomia penicula Bagnall, 1939
Folsomia candida Willem, 1902
Folsomia multiseta Stach, 1947
Folsomia fimetaria (Linnaeus, 1758)
Folsomia litsteri Bagnall, 1939
Folsomia simile Bagnall, 1939
***Folsomides* Stach, 1922**
Folsomides parvulus Stach, 1922
***Proisotoma* Borner, 1901**
Proisotoma subminuta Denis, 1931
Proisotoma minuta (Tullberg, 1871)
Proisotoma schoetti (Dalla Torre, 1895)

Subfamily Isotominae
***Isotomurus* Börner, 1903**
Isotomurus maculatus (Schäffer, 1896)
Isotomurus palustris (Müller, 1776)
Isotomurus punctiferus Yossi, 1963
***Isotoma* Bourlet, 1839**
Isotoma viridis Bourlet, 1839
Isotoma notabilis Schäffer, 1896
Isotoma olivacea Tullberg, 1871
***Parisotoma* Bagnall, 1940**
Parisotoma notabilis (Schäffer, 1896)
***Isotomiella* Bagnall, 1939**
Isotomiella minor (Schäffer, 1896)
***Isotomina* Borner, 1903**
Isotomina pontica Stach, 1947
Isotomina orientalis Stach, 1947
Isotomina thermophila (Axelson, 1947)

Family Entomobryidae

Subfamily Entomobryinae
***Entomobrya* Rondani, 1861**
Entomobrya multifasciata (Tullberg, 1871)
Entomobrya atrocincta Schött, 1897
Entomobrya lanuginosa (Nicolet, 1841)
Entomobrya corticalis (Nicolet, 1842)
Entomobrya handschini Stach, 1922
Entomobrya unostrigata Stach, 1922
Entomobrya lindbergi Stach, 1960
***Pseudosinella* Schäffer, 1897**
Pseudosinella duodecimpunctata Denis, 1931
Pseudosinella octopunctata Börner, 1901
Pseudosinella imparipunctata Gisin, 1953
***Sinella* Brook, 1882**
Sinella curviseta Brook, 1882
Sinella tenebricosa Folsom, 1902

Subfamily Lepidocyrtinae
***Lepidocyrtus* Bourlet, 1839**
Lepidocyrtus cyaneus Tullberg, 1871

Lepidocyrtus lanuginosus (Gmelin, 1788)
Lepidocyrtus ruber Schött, 1902

Subfamily Orchesellinae
***Heteromurus* Wankel, 1860**
Heteromurus major (Moniez, 1889)
Heteromurus sexoculatus Brown, 1926

Family: Cyphoderidae

Subfamily Cyphoderinae
***Cyphoderus* Nicolet, 1842**
Cyphoderus ambigua Christiansen, 1957

Family Tomoceridae

Subfamily Tomocerinae
***Tomocerus* Nicolet, 1842**
Tomocerus minor (Lubbock, 1862)
Tomocerus vulgaris (Tullberg, 1871) Brook, 1883

Suborder Poduromorpha

Family Hypogastruridae

Subfamily Hypogastrurinae
***Hypogastrura* Bourlet, 1839**
Hypogastrura manubrialis (Tullberg, 1869)
Hypogastrura tullbergi (Schäffer, 1900)
Hypogastrura vernalis (Carl, 1901)
Hypogastrura denticulata (Bagnal, 1941)
***Ceratophysella* Börner, 1932**
Ceratophysella gibbosa (Bagnal, 1940)
Ceratophysella stercoraria (Stach, 1963)
***Willemia* Börner, 1901**
Willemia anophthalma Börner, 1901
***Xenylla* Tullberg, 1869**
Xenylla maritima Tullberg, 1869
Xenylla welchi Folsom, 1916
Xenylla humicola (Fabricius, O., 1780)

Family Brachystomellidae

***Brachystomella* Ågren, 1903**
Brachystomella parvula (Schäffer, 1896)
Brachystomella pubila Gisin, 1957

Family Poduridae

Subfamily Poduridae
Podura Linnaeus, 1758
Podura aquatica Linnaeus, 1758

Family Neanuridae

Subfamily: Frieseinae
***Friesea* Dalla Torre, 1895**
Friesea mirabilis (Tullberg, 1871)

Subfamily Neanurinae
***Neanura* MacGillivray, 1893**
Neanura muscorum (Templeton, 1835)
Neanura decolarata Gisin, 1964
Neanura aurantiaca Caroli, 1912
Neanura echinata echinata (Kos, 1940)

Subfamily Pseudachorutinae
***Anurida* Laboulbène, 1865**
Anurida ellipsoids Stach, 1949
Anurida sensillata Gisin, 1953
Anurida thalasophila (Bagnall, 1939)
***Pseudachorutes* Tullberg, 1871**
Pseudachorutes dubius Krausbauer, 1898
Pseudachorutes subcrassus Tullberg, 1871
Pseudachorutes parvulus Börner, 1901

Subfamily Odontellidae
***Xenyllodes* Axelson, 1903**
Xenyllodes lamellifera (Axelson, 1903)
Xenyllodes bayeri Kseneman, 1935

Family Onychiuridae

Subfamily Onychiurinae
***Onychiurus* Gervais, 1841**
Onychiurus bicampatus Gisin, 1956
Onychiurus fimatus Gisin, 1952
Onychiurus granulosus Stach, 1930
Onychiurus quadriocellatus Gisin, 1947
Onychiurus rectapapillatus Stach, 1933
Onychiurus sibricus (Tullberg, 1876)

Family Tullbergiidae

Subfamily Tullbergiinae
***Tullbergia* Lubbock, 1876**
Tullbergia krausbaueri (Börner, 1901)
Tullbergia callipygosa Börner, 1901
Tullbergia affinis Börner, 1901

Suborder Neelipleona

Family Neelidae

***Neelus* Folsom, 1896**
Neelus murinus Folsom, 1896

Suborder Symphypleona

Family Dicyrtomidae

Subfamily Dicyrtominae
***Dicyrtoma* Bourlet, 1842**
Dicyrtoma minuta (O. Fabricius, 1783)

Family Arrhopalitidae

***Arrhopalites* Börner, 1906**
Arrhopalites caecus (Tullberg, 1871)

Family Katiannidae

***Sminthurinus* Börner, 1901**
Sminthurinus bimaculatus Axelson, 1902
Sminthurinus elegans (Fitch, 1863)

Family Sminthurididae

***Sminthurides* Borner, 1900**
Sminthurides malmgreni (Tullberg, 1877)
Sminthurides pumilis (Krausbauer, 1898)

DISCUSSION

Our review revealed 87 Collembola species recorded so far from Iran. Iran is situated in the south western corner of Asia. Most authors, for example Dasmann (1974) and Darlington (1957), consider Iran as part of the Palearctic region. The fauna of Iran is virtually unknown, no keys to species, as very few species are known, we can highly expect to find even many further species new to the fauna of Iran in the future.

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We also wish to express my sincerest thanks to many people who assisted me in various ways, directly or indirectly, My appreciations are to: Prof. Skarzynski, Dr. Potapov, Prof. Deharveng, Dr. Kaprus for species identification and confirmation and Dr. Bretfeld and specially Prof. Christiansen for worthful instructions and information.

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REVISION OF GENUS *BRACHYCAUDUS* AND NEW RECORD SPECIES ADDED TO APHID FAUNA OF EGYPT (HEMIPTERA: STERNORRHYNCHA: APHIDIDAE)

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[**Amin, A. H., Draz, K. A. & Tabikha, R. M.** 2013. Revision of genus *Brachycaudus* and new record species added to aphid fauna of Egypt (Hemiptera: Sternorrhyncha: Aphididae). Munis Entomology & Zoology, 8 (1): 262-266]

ABSTRACT: A new aphid species, *Brachycaudus (Appelia) shwartzi* (Borner) was recorded for the first time in Egypt during the present work. This species was heavily infested leaves of apricot, *Prunus armeniaca* and peaches *Prunus persica* during May, 2006 at El-Tahrir, El- Behera Governorate. Identification procedure was confirmed by Prof. R. Blackman at British Museum, in London. Brief verbal and drafting description for alate viviparous female of this new recorded species was carried out. Moreover a simple bracket key was constructed to identify the three recorded species of genus *Brachycaudus* in Egypt.

KEY WORDS: *Brachycaudus,* Aphididae, Egypt.

Family Aphididae is one of the most important groups of Aphidoidea which contain more than 4400 aphid species placed in 493 genera, and is considered as one of the most prolific groups of insects. They are capable not only rapid increase of population though parthenogenesis but also transmission of plant viral diseases and secreting honey dew which become suitable media for sooty moulds, so they are regarded as one of the most important groups of agricultural pests. In addition aphid attack many economic important host plants such as horticultural, forest trees and field crops (Minks & Harrewijn, 1989).

In Egypt, Willcocks (1922) recorded many Egyptian aphid species and stated that both color and host plant of specimen are very important in aphid taxonomy. Theoblad (1922) presented a survey for African aphid species with morphological description and illustration figures of collected materials from Egypt and other African countries. Moreover, he recorded genus *Brachycaudus* in Egypt for the first time then recorded *Brachycaudus helichrysi* (Kaltenbach) on artichoke under the name *Anuraphis cinerarae* and on cornflower under the name *Anuraphis cyani*. Hall (1926) found that both species are synonyms to *Anuraphis helichrysi*. Also, the same author recorded another species belonging to this genus (*Brachycaudus amygdalinus*) on *Rumex* sp. under the name *Anuraphis aegyptiaca*.

Habib & El-Kady (1961) constructed a key for the Egyptian aphid fauna, including 80 species with biometric data and drafting for most of these species. They surveyed two species of Genus *Brachycaudus i.e. B. amygdalinus* and *B. helichrysi*. El-Kady et al. (1969) surveyed aphid species, which attack stone fruit trees (apricot, peach and plum) in Giza. They found that *Pterochloroides persicae* infested the stems and branches of peach and plum trees, while *Hyalopterus pruni* infested the upper surface of apricot and peach leaves. They couldn't record *Myzus persicae* from the stone fruit trees.

Stoetzel & Miller (1998) gave a brief summary of taxonomic characters, food plants and world distribution of *Brachycaudus helichrysi, B. schwartzi, Hyalopterus pruni,* and *Myzus persicae*, and constructed pictorial and dichotomous keys to identify of aphid species associated with peach trees in USA. While in central Poland Strazynski (2003) surveyed aphid species on plum orchard and recorded four species *i. e. Hyalopterus pruni, Rhopalosiphum nymphaeae, Brachycaudus cardui* and *B. helichrysi.*, during 1999. Finely, Andreev (2004) reviewed the main characters, which were used in the taxonomy of *Brachycaudus*.

The present work aims to revise genus *Brachycaudus* in Egypt and recorded a new species belonging to this genus, which is added to aphid fauna of Egypt. Verbal and drafting description for this species was given. Moreover a simple bracket key was constructed to identify the three aphid species belonging to this genus.

MATERIAL AND METHODS

Specimens (alate and apterus forms) of aphid species were collected from their host plants and put in glass jar covered with muslin cloth and transferred to the laboratory. Data about host plant, date of collection, locality and color of fresh specimen were recorded. In laboratory, five clones of aphid species with a part of host plant were preserved in glass gar covered with muslin under dark condition till alate forms appear. Alate forms of collected species were preserved in 70% ethyl alcohol and stored till mounting.

Preserved alate forms of aphid species were cleaned with distillated water for several times, then macerated in sodium hydroxide solution 10 % overnight (in cases of black specimens, the specimens were boiled in water bath 80–90 ^{o}C for 15 minutes). After maceration, the specimens were washed with distillated water, for several times then dehydrated in ascending concentrations series of ethyl alcohol (30, 50, 60, 70, 80, 85, 90 and 95%). For clearing specimen, it was socked in freshly chloral phenol (1 Phenol: 1 Choral hydrate) for 15 min. cleared specimen was transferred to clean slide glass with 2 drops of Swan's gum chloral media (20 ml distillated water + 60 Chloral hydrate + 10 ml Glucose + 5 ml Glacial acetic acid + 15 gm Gum Arabic), then covered with clean cover slip. Slides were left on hot plate for few days till drying.

Mounted specimens were identified by using professional taxonomic keys of aphids such as (Habib & El-Kady, 1961, Blackman & Eastop, 1984 and 2000) to identify species. Identification procedure of this new recorded species was confirmed by. Prof. Roger Blackman, Professor of Aphidology, Natural History Museum, London, UK. Moreover a simple bracket key was constructed to identify different species of Genus *Brachycaudus* in Egypt.

Genus *Brachycaudus* van der Goot, 1913

The genus containing 44 palaearctic and one American species. It was characterized by the rounded spiracular apterus, short cauda, and subapical annular incision below the siphuncular flange. Fourteen species live on or alternate from *Prunus*. Each of species *B. helichrysi* and *B. cardui* alternate from *Prunus* to Compositae and Boraginaceae.

Brachycaudus (Appelia) shwartzi (Borner, 1931)

During the present work, this species was recorded for the first time in Egypt on apricot, *Prunus armeniaca* and peaches *Prunus persicae* with high density, attacking their leaves during May, 2006 at El-Tahrir, El- Behera Governorate.

Fresh material:

Adult apterae shiny yellow brown to dark, while alate forms dark brown; immature stages yellow brown, body oval shape; attacking peach and apricot leaves during spring season, causing curling and distortion of leaves; length of alate ranging 1.54-1.80 mm, and apterae ranging 1.71-2.20 mm.

Mounted Material (Plate, I):

Head: Frontal tubercles not developed; compound eyes with triommatidium; apical rostal segment blunt nearly as long as siphunculi; antennal formula 6-3-4-5, unguis about 4.4 (3.3 - 5.5) times as long as basal part, secondary rhinariae circular in shape, number of secondary rhinariae on 3rd antennal segment 23 (20-29), on 4th antennal segment 9 (7-12) and on 5th antennal segment 1 (0-2).

Thorax: Medium vein of fore wings twice branched; first hind tarsal segment bearing two hairs; second tarsal segment about as long as each of siphunculi or apical rostal segment.

Abdomen: with well developed dorsal black patches, sclerotization partly divided segments and not extended to laterally spiracles especially on anterior abdomen tergites, lateral sclerites especially pre and post siphunculi sclerites present and attached with dorsal patches; siphunculi cylinder in shape with dark color, and longer than cauda in length; cauda helmet – shape, almost its basal width longer than its length, bearing six hairs.

Material: Ten specimens were collected from leaves of apricot, *Prunus armeniaca* and peaches *Prunus persica*, during May, 2006 at El-Tahrir, El-Behera Governorate. (Author collection).

Identification key of Species of Genus *Brachycaudus* in Egypt

Genus *Brachycaudus* represented in Egypt by two species *i.e. B. amygdalinus* and *B. helichrysi* (Habib & El-Kady, 1961). During the present work *B. schwartzi* was recorded for the first time in Egypt. So the following key was constructed to identify three different species belonging to genus *Brachycaudus*.

Key to species of genus *Brachychaudus* in Egypt.

1. Siphunculi shorter than cauda in length……………………………… ***amygdalinus***
-- Siphunculi longer than cauda in length……………………………………………**2**

2. Basal width of cauda longer than its length; siphunculi cylinder shape……………
…………………………………………………………………………………***schwartzi***
-- Basal width of cauda shorter than or as long as its length; siphunculi tapering to its tip………………………………………………………………………………***helichrysi***

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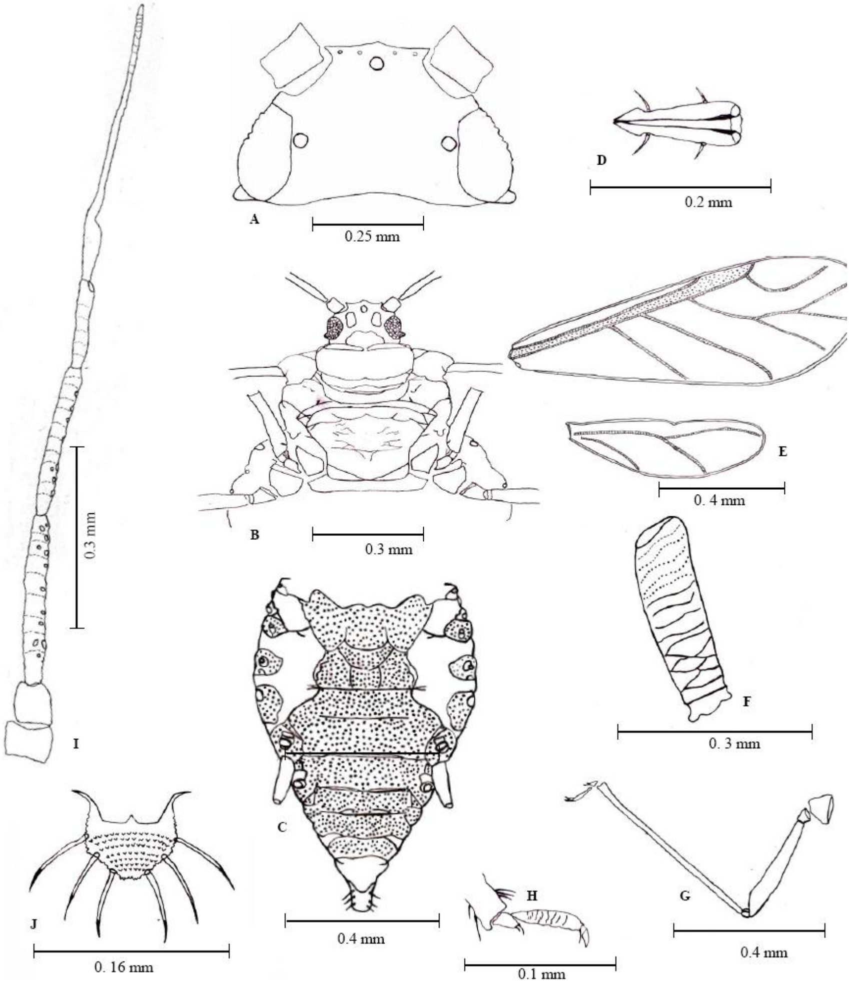

Plate I. Alate Viviparous female of *Brachycaudus (Appelia) shwartzi* (Borner). A. Head (Dorsal view); B. Head and thorax (Ventral view); C. Abdomen (Dorsal view); D. Apical rostal segment (Dorsal view); E. Fore and Hind wings; F. Siphunculi; G.2Hind leg; H. Hind tarsus; I. Antenna; J. Cauda (Dorsal view).

EFFECT OF FEEDING VARIOUS DIET FORMULATIONS TO HONEY BEE COLONIES DURING DEARTH PERIOD UNDER GWALIOR (INDIA) CONDITIONS

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[**Kumar, R., Rajpoot, G. S., Mishra, R. C. & Agrawal, O. P.** 2013. Effect of feeding various diet formulations to honey bee colonies during dearth period under Gwalior (India) conditions. Munis Entomology & Zoology, 8 (1): 267-272**]**

ABSTRACT: Six protein rich artificial diets were formulated keeping in mind the nutritional requirements of honeybees. Diets were prepared with the help of various protein rich ingredients *viz.* defatted soy flour, parched gram, brewer's yeast, soy protein hydrolysate, spirulina, skimmed milk powder and natural pollen. These diets were fed to *Apis mellifera* colonies in the form of patties on top bars of hive during summer dearth periods, 2010. The results on the preference of bees for the formulated diets showed that diet 3 (defatted soy four, brewer's yeast and soy protein hydrolysate powder) proved to be most effective with 723.4 cm^2 sealed brood area, 5.8 total bee covered frames and 9138.6 bee population. The performance of all experimental colonies was found to be better as compared to control colonies.

KEY WORDS: *Apis mellifera*, Gwalior, diet formulation, dearth period, brood, protein hydrolysate.

In India, major problem in beekeeping is to maintain good strength of honeybee colonies during dearth periods. In tropical and subtropical parts of our country, summers are very harsh for honey bees as enough bee flora is not available during this period. The condition is more severe in central parts of our country where dearth periods are little longer as compared to other parts. The periodical dearth periods may results into dwindling and even death of bee colonies. Therefore during these periods, special care should be taken in management of bees. The first option is migration of bee colonies but it also includes lots of labour, time and money. The other option is to feed the bee colonies with protein rich artificial diet so that brood rearing activity can be enhanced and strength of colonies is maintained. The necessity of artificial diets to honey bees has been long standing interest to the beekeeping industry (Haydak, 1935, 1936). Different type of artificial diets have been formulated and their effect on various colony parameters were observed by many researchers (Haydak, 1967; Standifer et al., 1960; Doull, 1968; Stranger & Gripp 1972; Herbert & Shimanuki, 1978; Chhuneja et al., 1993, Saffari et al., 2006, DeGrandi-Hoffman et al., 2008, Sihag et al., 2011). In India, work on the artificial diet formulation has been carried by some workers (Chhuneja et al., 1992; Srivastava, 1996; Sihag et al., 2011) and various substitutes have been suggested with different compositions. In the present study, an attempt has been made to compare the effect of various diet formulations fed to bee colonies during dearth periods on colony parameters like brood rearing, bee strength and number of bee covered frames, so that suitable pollen substitute can be developed to improve beekeeping practice in India.

MATERIAL AND METHODS

Experiment was conducted on the colonies of *Apis mellifera* during dearth periods (April to September, 2010) in the apiary maintained in Charak Udyan, Jiwaji University, Gwalior (India). The experimental colonies were manipulated to equalize six frames strength. One group was kept as control to which no any artificial diet was provided. The various diet formulations tested during the course of studies are mentioned below:

Diet 1: SF (16.7%) + PG (16.7%) + BY (16.7%) + S (33.3%) + G (16.7%)
Diet 2: DSF (20.7%) + BY (20.7%) + SP (8.3%) + S (33.3%) + G (16.7%)
Diet 3: DSF (16.7%) + BY (16.7%) + SPH (16.7%) + S (33.3%) +G (16.7%)
Diet 4: DSF (16.7%) +BY (16.7%) + SPH (8.3%)+P (8.3%)+S (33.3%)+G (16.7%)
Diet 5: SP (16.7%) + H (83.3%)
Diet 6: DSF (30%) + BY (10%) + SMP (10%) + S (50%)

(DSF: Defatted Soy Flour, PG: Parched Gram, BY: Brewer's Yeast, SKM: Skimmed Milk Powder, SPH: Soy Protein Hydrolysate, SP: Spirulina, P: Pollen, S: Sugar, G: Glucose, H: Honey)

Diet formulations were continuously fed to the colonies in the form of patties by placing them on the top bars of hive (Fig. I). The worker brood area in the colonies was recorded for every 21 days interval with the help of measuring frame (wire grid) consisting of squares, each of one inch^2 (Seeley & Mikhetev, 2003; Amir & Peveling; 2004) (Fig. II). The values thus obtained were then converted into cm^2 by multiplying with a factor of 6.45. The bee strength in the colonies was recorded by the photographic method (Jeffree, 1951). The collected data was tabulated, transformed and subjected to statistical analysis (ANOVA) following Randomized Block Design (RBD).

RESULTS AND DISCUSSION

Brood area: The maximum (peak) amount of sealed brood area was observed in the colonies given diet 3 (723.4 cm^2 per colony) followed by the colonies given diet 4 (658.8 cm^2 per colony). The differences with regards to these two diets were statistically at par. Significant differences was observed in the sealed brood area in the colonies given diet no. 2, 6 and 1; values being 640.5, 521.4, 485.7 cm^2 per colony respectively. Minimum sealed brood area (330.1 cm^2 per colony) was recorded in the control colonies (Table I). Findings of the present study that the colonies fed on the artificial diets reared significantly more brood than control colonies, are endorsed by the observation of Chhuneja et al. (1993a); Nabors (2000); and Castangnino et al. (2004) who reported an increase in brood rearing by bees fed pollen substitutes and supplements.

Number of frames covered by bees: The effect of feeding diet formulations was observed and recorded for the number of frames covered by bees. The results revealed that irrespective of different feeding periods, maximum number of frames covered by bees was recorded in the colonies given diet 3 and 4 respective values being 5.81in both the cases (differences statistically at par). Lowest number of frames (5.0) covered by bees per colony was recorded in the control colonies (Table II). The results are in close agreement with the result obtained by Abbas et al. (1995); Guler (1999) who reported that number of bee covered frames are positively affected by feeding protein-rich diet to the bees.

Bee strength: Bee strength was observed by counting the number of bees present on the frames inside the bee colonies. The results revealed that, irrespective of different periods of colony development, maximum bee population was observed in the colonies given diet no. 3 (9138 bees per colony) which was significantly different from all other treatments, followed by the colonies given diet 4, 6, 1, 2 and 5; values being 8501.6, 8193.3, 8122.7, 8054.3 and 7850 bees per colony respectively (Table III). Inferences from the present investigations that the bee population is increased by supplementing the pollen substitute with pollen or its extracts are in line with the observation of Peng et al. (1984), Saffari et al. (2006), DeGrandi-Hoffman et al. (2008) who reported that colonies fed on protein patties had significantly higher adult bee population than the unfed control colonies.

At the end of study, it can be concluded that protein rich artificial diets must be provided to bee colonies during dearth periods so that strength of colonies can be maintained for the next honey flow season.

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Table I. Effect of feeding diet formulations on amount of brood area (cm^2) in *Apis mellifera* colonies.

Treatment **Period**	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**	**Control**	**MEAN**
18th April	1607.7 (3.20)*	1687.3 (3.22)	1213.0 (3.08)	1033.3 (3.01)	1193.7 (3.07)	1250.0 (3.08)	1421.7 (3.15)	1344.6 (3.11)
9th May	918.0 (2.96)	1473.3 (3.16)	960.0 (2.98)	730.7 (2.85)	748.3 (2.87)	1027.0 (3.01)	740.3 (2.86)	942.5 (2.95)
30th May	327.0 (2.50)	564.0 (2.73)	422.0 (2.62)	369.7 (2.56)	213.3 (2.32)	288.0 (2.45)	155.3 (2.17)	334.2 (2.48)
20th June	120.3 (2.03)	101.0 (2.00)	278.3 (2.44)	356.7 (2.55)	26.0 (1.02)	147.3 (2.11)	28.7 (1.42)	151.1 (1.94)
11th July	118.7 (2.06)	128.7 (2.10)	402.0 (2.60)	356.0 (2.54)	38.3 (1.48)	136.0 (2.12)	0.0 (0.00)	169.3 (1.90)
1st Aug	107.3 (2.02)	231.0 (2.35)	459.0 (2.66)	435.0 (2.63)	125.7 (2.05)	368.0 (2.55)	16.7 (0.91)	249.0 (2.17)
22nd Aug	231.3 (2.32)	412.0 (2.57)	756.0 (2.87)	747.7 (2.86)	140.0 (2.13)	437.0 (2.61)	108.0 (2.02)	404.6 (2.48)
12th Sept	456.7 (2.65)	527.3 (2.71)	1297.0 (3.11)	1242.0 (3.09)	240.0 (2.36)	518.0 (2.71)	165.0 (2.21)	635.0 (2.69)
MEAN	485.7 (2.47)	640.5 (2.61)	723.4 (2.79)	658.8 (2.76)	340.6 (2.16)	521.4 (2.58)	330.1 (1.89)	
$CD_{0.05}$	T (Treatment) I (Brood cycle) T X I (Treatment X Brood cycle)				0.13 0.14 0.36			

*Values in parentheses are log transformed values

Table II. Effect of feeding diet formulations on number of frames covered by bee colonies.

Treatment Period	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Control	MEAN
18th April	6.0 (2.44)*	6.0 (2.44)	6.0 (2.44)	6.0 (2.44)	6.0 (2.44)	6.0 (2.44)	6.0 (2.44)	6.0 (2.44)
9th May	5.8 (2.41)	6.0 (2.44)	5.7 (2.39)	5.9 (2.44)	5.7 (2.39)	5.8 (2.41)	5.8 (2.41)	5.8 (2.41)
30th May	5.5 (1.36)	5.6 (2.37)	5.8 (2.41)	5.9 (2.43)	5.3 (2.30)	5.6 (2.37)	5.7 (2.39)	5.6 (2.37)
20th June	5.2 (2.28)	5.1 (2.26)	5.6 (2.37)	5.5 (2.35)	4.9 (2.22)	5.0 (2.25)	5.2 (2.29)	5.2 (2.29)
11th July	4.7 (2.17)	4.9 (2.21)	5.5 (2.35)	5.6 (2.37)	4.5 (2.12)	4.7 (2.18)	4.9 (2.21)	5.0 (2.23)
1st Aug	4.7 (2.18)	4.7 (2.17)	5.6 (2.36)	5.7 (2.38)	4.3 (2.08)	4.5 (2.12)	4.5 (2.12)	4.8 (2.20)
22nd Aug	4.5 (2.12)	4.9 (2.21)	5.9 (2.44)	5.7 (2.38)	4.3 (2.08)	4.5 (2.12)	4.0 (2.02)	4.8 (2.20)
12th Sept	4.5 (2.14)	4.8 (2.19)	6.1 (2.48)	6.0 (2.45)	4.3 (2.07)	4.7 (2.18)	4.1 (2.04)	4.9 (2.22)
MEAN	5.1 (2.26)	5.2 (2.29)	5.8* (2.41)	5.8* (2.41)	4.9 (2.21)	5.1 (2.26)	5.0 (2.24)	
$CD_{0.05}$	T (Treatment) I (Brood cycle) T X I (Treatment X Brood cycle)				0.02 0.03 0.07			

*Values in parentheses square root transformed value

Figure I. Feeding of pollen patties on top bars of bee hive.

Table III. Effect of feeding diet formulations on bee strength.

Treatment Period	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Control	MEAN
18th April	9252.7 (3.96)*	9151.3 (3.96)	9487.3 (3.97)	9149.3 (3.96)	9056.3 (3.95)	9375.3 (3.97)	9347.0 (3.97)	9259.8 (3.96)
9th May	9163.7 (3.96)	9159.3 (3.96)	9083.7 (3.95)	9049.3 (3.95)	8762.3 (3.94)	9134.3 (3.96)	9103.3 (3.95)	9065.1 (3.95)
30th May	8642.3 (3.93)	8592.7 (3.93)	9219.3 (3.96)	9063.3 (3.95)	8140.3 (3.91)	8645.7 (3.93)	8657.3 (3.93)	8708.6 (3.93)
20th June	8148.3 (3.91)	7931.3 (3.89)	8926.3 (3.95)	8366.3 (3.92)	7673.3 (3.88)	7937.7 (3.89)	8234.7 (3.91)	8173.9 (3.91)
11th July	7526.3 (3.87)	7427.3 (3.87)	8650.3 (3.93)	8328.7 (3.92)	7123.7 (3.85)	7557.3 (3.87)	7939.0 (3.89)	7793.2 (3.89)
1st Aug	7468.3 (3.87)	7209.3 (3.85)	8729.7 (3.94)	8614.7 (3.93)	6929.0 (3.84)	7533.3 (3.87)	7257.0 (3.86)	7677.3 (3.88)
22nd Aug	7326.3 (3.86)	7574.3 (3.87)	9207.7 (3.96)	6091.7 (3.60)	7244.3 (3.86)	7548.0 (3.87)	6903.7 (3.83)	7413.7 (3.84)
12th Sept	7454.0 (3.87)	7574.0 (3.87)	9802.0 (3.99)	9353.0 (3.97)	7874.7 (3.89)	7815.3 (3.89)	6560.3 (3.81)	8035.2 (3.90)
MEAN	8122.7 (3.90)	8077.3 (3.90)	9138.6* (3.96)	8501.6 (3.90)	7850.0 (3.89)	8193.3 (3.91)	8000.3 (3.89)	
CD$_{0.05}$	T (Treatment) 0.04 I (Brood cycle) 0.04 T X I (Treatment X Brood cycle) 0.12							

*Values in parentheses are log transformed value

Figure II. Frame sized wire grid used to measure brood area.

DIVERSITY OF THE PRESENT OSTRACOFAUNA IN LAGOONS OF THE CENTRAL REGION OF THE REPUBLIC ARGENTINA

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ABSTRACT: In this work, the present ostracofauna in the "Laguna Don Tomás" (36 º 18 ' 18.31 " S and 64 º 18 ' 49.02" W), located in the city of Santa Rosa, La Pampa, Argentina, is studied. Seasonal studies were carried out, 1447 valves and shells were recovered. Four species were identified and specimens of *Heterocypris símilis* with *Oichnuns simplex* were found. In all the samples, *H. similis* was the dominant species which would indicate a high degree of eutrophication in the area of study and it would allow to take this species how bioindicator of pollution.

KEY WORDS: ostracods, Lagoon, Santa Rosa, eutrophic.

Wetlands are systems characterized by having a high productivity plant that feeds a food web composed of zooplankton, arthropods, other macroinvertebrates and microinvertebrates, reptiles, birds and mammals directly or indirectly associated to water bodies. However, productivity is so high that much of the biomass is not consumed directly and dies (Marquez, 2003), generating an excess of organic matter. This, along with humidity, promotes the growth of fungi, bacteria, detritivorous invertebrates, and terrestrial arthropods.

This research was carried out along the periphery of the "Laguna Don Tomas" located in the province of La Pampa, Argentina. This is a hypereutrophic water-body, as it is highly affected by the surrounding city (Echaniz et al., 2008). The goal is to survey the ostracofauna of this lagoon by analyzing the diversity and abundance of species present, as well as the ontogenetic composition of ostracod populations. It is important to assess the biodiversity in this lake as it is a municipal water reservoir. Monitoring the ostracod species present might indicate changes in the level of eutrophication in this body of water through time. Ostracods are small crustaceans characterized by a bivalved calcified carapace. They are all essentially aquatic, mainly benthic, showing a wide ecological range inhabiting both marine and non-marine environments. They are very sensitive to environmental changes that reflect not only in variations in communiy structure, but also in structural and morphological changes of the shell at the individual level (Horne et al., 2002).

This work represents the first contribution to the knowledge of the ostracofauna in water-bodies of the province of La Pampa, so that the information provided in this study is a tool for site characterization as well as for biodiversity assessment.

Study area

The "Laguna Don Tomas" (36 º 18 '18.31'' S and 64 º 18' 49.02'' W) is a highly modified shallow hypereutrophic water-body located west of the city of Santa Rosa (Figures 1 and 2). It is surrounded by three basins that were built to prevent flooding of the surrounding city. It has an average depth of 2.3 m, which varies according to the rainy season, and covers an area of 135.2 ha. Maximum length and width are 1565 and 1181 m, respectively (Echaniz et al., 2008).

In the vicinity of the lagoon there are sites that have been anthropogenically modified and where the vegetation composition is variable, i.e., halophiles in flood areas, and psammophile in the grasslands. It lies within the eastern subhumid-dry climate physiographic region, where the average annual rainfall is 600 mm (Pall et al., 2011).

MATERIALS AND METHODS

Sediment samples were taken using a 10 cm diameter and 2 cm high metal ring. The northern shore basin was sampled, because it is the site subject to less human action and lacks a wire mesh on the shore that prevents the deposition of sediment, as occurs with the other two basins. Sampling was conducted in July and October 2011 and January 2012.

The northern basin (Fig. 2) is a low saline endorrheic basin with a water input consisting of the contribution of rainfall, storm runoff from the city and the loading and unloading of the water table (Alvarez et al., 2009); it is characterized by halophytic vegetation present.

The samples were washed using a 63 µm mesh sieve and dried in an oven at 50°C. They were washed with Rose Bengal for the determination of live. We extracted the total number of individuals using the technique of picking. Identification of the species was done following the classification proposed by Moore (1961). Specimens were photographed using a Nikon microscope camera Si 80 drawing.

RESULTS

A total of 1447 specimens was recovered. These were assigned to 4 species (Fig. 3): *Limnocythere* sp. (Fig. 3A-D), *Cypridopsis vidua* (O. F. Müller, 1776) (Fig. 3E, F), *Heterocypris similis* (Wierzejski in Ramirez, 1967) (Fig. 3G, H) and *Kapcypridopsis* sp.. The dominant species in all samples was *H. Similis*, of which populations were found with complete live specimens. *Limnocythere* sp. was also generous with adults and juveniles, males and females. October sampling was conducted after rain, so that the basin had a higher water-level and lower water turbidity than in the July sampling. In January there was a high algal concentration, due to the high temperatures and low rainfall reached during this period, the water content was lower, with the highest turbidity of all samples taken.

The seasonal succession and species composition of ostracods were similar in the different sampling stations during the study. In all samples the dominant species is *H. similis*, with a type A (Whatley, 1988) ontogenetic structure of the population. Adult shells of *Heterocypris similis* were collected which showed the presence of *Oichnus simplex* Bromley 1981. The Shannon-Weaver index ranged from maximum values of 1.5 to minimum values of 0.5, the highest values recorded in the October sampling.

DISCUSSION

The similarity in the seasonal succession and species composition of ostracods may be cause by the relatively stable chemical water conditions throughout the year. The great dominance of *Heterocypris similis* indicates environmental oligohaline, eutrophic to hypertrophic conditions, agreeing with Laprida (2006), who studied permanent and seasonal water-bodies in the province of Buenos Aires. An increased turbidity was observed during the January sampling.

The presence of *Oichnus simplex* Bromley (1981) only on shells of *H. similis* may be related to the larger size of these shells compared to the size of the other species present and the dominance of *H. similis* in all samples analyzed agrees with that reported by Ruiz et al., 2010, 2011 for modern and fossil specimens from different parts of Spain and Kihn et al., 2011 for the Quaternary of southern Buenos Aires province.

The highest values of the Shannon-Weaver index reported during the month of October would be associated with an increased supply of water and nutrients to the basin, providing optimal conditions for the development of ostracod populations.

CONCLUSIONS

The dominance of *H. similis* at all sampling points indicates eutrophic to hypertrophic conditions of the basin under study, whereby *H. similis* could be used as a species-level bioindicator of eutrophication of the water body. The presence of *Oichnus similis* points to low energy and high nutrient level of the water-body. The highest degree of turbidity in the basin was manifested during the summer months of algal blooms that hamper the normal development of the ostracofauna, being *H. similis* the only species of which live specimens were found. This is the first contribution to the knowledge of ostracofauna from the Laguna Don Tomás It is important to track seasonal changes in the ostracofauna to determine the different degrees of contamination that eventually may affect the basin because of its proximity to the city. Additionally, further sampling of the ostracofauna from the various non-polluted lagoons in the province of La Pampa would be extremely interesting in order to assess more ccurately the real impact of human activity on these lagoons and the potential usefulness of ostacods in measuring this impact.

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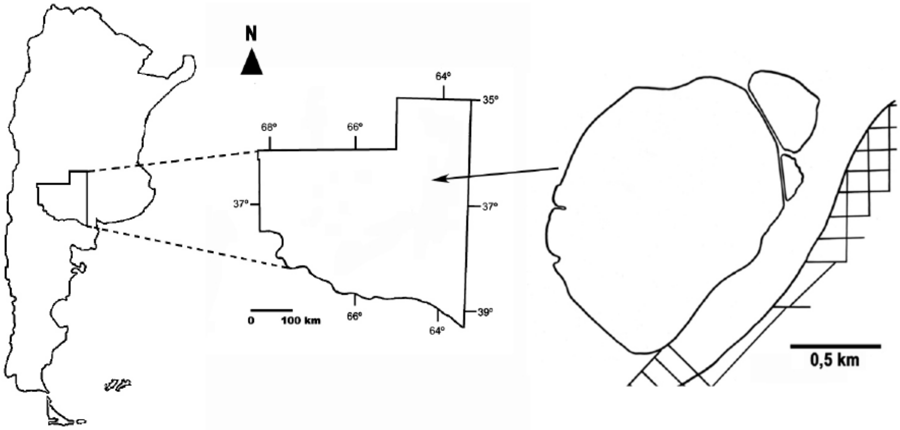

Figure 1. Geographical location of Lake Don Thomas in the province of La Pampa, central Argentina.

Figure 2. Location of the North basin and sampling sites (red) in Laguna Don Tomas (near the city of Santa Rosa) in the province of La Pampa, Argentina.

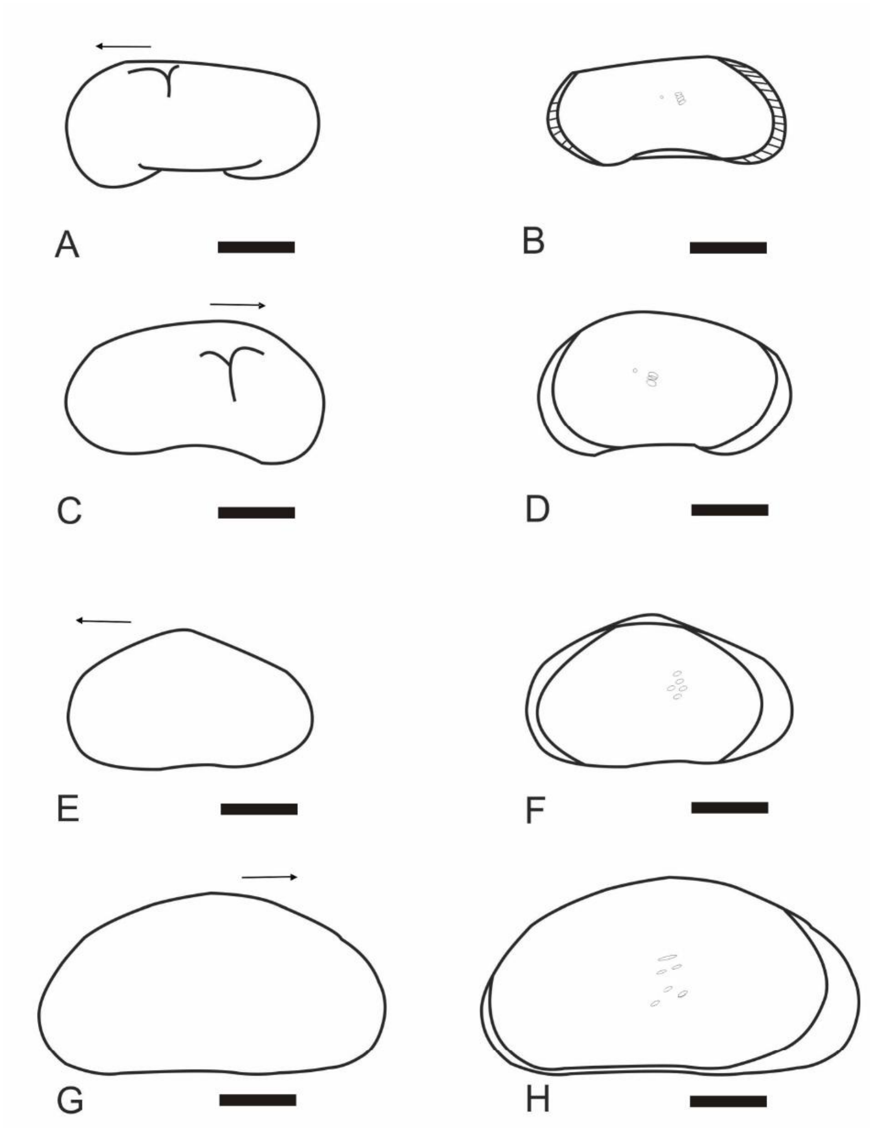

Figure 3. Ostracod species present in the Laguna Don Tomas: A-D: *Limnocythere* sp., E-F: *Cypridopsis vidua*, G-H: *Heterocypris similis*. (Scale 30μm).

REVIEW ON THE BIOLOGY OF TURKISH CERAMBYCOIDEA (COLEOPTERA) PART I – VESPERIDAE AND CERAMBYCIDAE (PRIONINAE)

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ABSTRACT: The present paper gives an integrative information on the biology of Turkish Vesperidae and Cerambycidae (for only the subfamily Prioninae). The main aim of this work is to clarify current status of the members of the superfamily in Turkey in terms of biologycal data. This work is the first attempt for this purpose.

KEY WORDS: Vesperidae, Cerambycidae, Prioninae, Coleoptera, Turkey.

Works on Turkish longicorn beetles began in late 19th century. Especially since the last century, they were increased as chiefly faunistic and taxonomic works. Recently, they continue with an increased speed. Knowledge about Turkish longicorn beetles, however, is far from satisfaction. Besides, the information on the biology of Turkish taxa have been given by some authors in piecemeal fashion. For example, as the most important work, Öymen (1987) studied the forest Cerambycidae of Turkey. He mentioned only the information on host plants for biology of species in Turkey in his work. Unfortunately, his work is so far from to reveal the real status in terms of faunistic, taxonomic and biological data. The other data were given by various authors in piecemeal fashion. A planned work on this subject is also absent. In any work, the recorded information has not also been reviwed yet. This scattered information can be obtained from cited references.

As known, Turkey that has continental properties, is origin of many taxons and is a refigium (an area where conditions have enabled a species or a community of species to survive after extinction in surrounding areas) for effected living creatures from geological and climatical changes has more biological importance than any land in the World.

As seen the whole World, an incredible variations have also been seen among the insects which are the most influenced living creatures from these changes occurred in the past in Turkey. Turkey appears a continental property changeable in very short distances in terms of climatical features and field structures. Therefore, biology of the species has a distinct importance. Hence, a serie work is planned that is aim to expose to the biology of Turkish Cerambycidae as possible as detailed by beginning from Vesperidae and Cerambycidae (Prioninae). The present study is attempted as the first step of this aim.

SUPERFAMILY CERAMBYCOIDEA Latreille, 1802

FAMILY VESPERIDAE Mulsant, 1839: 214

SUBFAMILY VESPERINAE Mulsant, 1839

TRIBE VESPERINI Mulsant, 1839

GENUS *VESPERUS* Dejean, 1821: 111

SPECIES *V. ocularis* Mulsant & Rey, 1863: 172

The species is not a forester. It is a harmful of cultivated or wild shrubs and herbaceous plants.

The species was described on the base of a male specimen from İzmir ("Smyrne") in W Turkey. It has been known only from the type locality until now. Because, it has not been collected by anybody since 1863. Therefore, some authors regard it as a doubtful species.

In this respect, Vives (2004) gave a photo of the species. However, Vives (2004) mentioned that accuracy of the type locality of the species can be under discussion. He stated "*We could not locate the type of this species which had to be in the collection of Mulsant & Rey, in Lyons. Besides, there is no Vesperus there (pers. com. J. Clary). There is not more specimen in the collection of Pellet, in MHN of Perpignan (pers. com. R. Bourgat), where from the type comes. Finally in the material of old collection of Mulsant, in MNHN of Paris, Vesperus (Paulian 1944) exists, but we found no labelled specimen there as came from Smyrne*". And "*We studied a male specimen which corresponds to the present description, having labelled "Syria" in the collection of J. Negro (ex. coll. E. Baer). This ancient locality seems to be very suspicious for us since no Vesperus was collected from Syria. Besides, it is very curious that we can see a female labelled as Syria, (Vesperus in the collection of J. Thomson), in MNHN in Paris. This second specimen seems to be for us as an atypical female of V. luridus, with the more protruding prothorax and the very short elytra. Because of this, the Syrian locality could correspond to the species of Mulsant & Rey, which comes from Izmir. It is amazing in effect that no new capture from the type locality since in Turkey*". Anyway, figure out the problem is based on to collect new specimens from the type locality, İzmir.

According to Vives (2004), biology of the species is unknown. However, Mulsant et Rey (1863) stated that the species is close to the species *V. xatarti* and *V. luridus*. So, **host plants** for the species can be most probably the grapevine (*Vitis vinifera*) and also potato (*Solanum tuberosum*), the tomato (*Solanum lycopersicum*), the garlic (*Allium sativum*) and other vegetables, especially grasses. **Adults and larvae** of the species can obtain most probably from the host plants in lowlands and foothills. **Life cycle** of the species probably is a few year. **Larvae** are most likely terricolous and can feed on roots of various plants (incl. *Vitis*). **Pupation** is most probably in the soil. **Adults** probably are crepuscular and nocturnal, attracted by light. **Adults fly** most likely in summer (between June-August) (Svacha & Danilevsky, 1987; Vives, 2000, 2001, 2004).

FAMILY CERAMBYCIDAE Latreille, 1802: 211

SUBFAMILY PRIONINAE Latreille, 1802: 212

TRIBE ERGATINI Fairmaire, 1864: 117

GENUS *CALLERGATES* Lameere, 1904: 47

SPECIES *C. gaillardoti* (Chevrolat, 1854: 481)

The species is a forester.

The **host plant** of the species is conifers (*Pinus* spp.). The **specimens** that were collected **from Turkey** were found on or in *Pinus brutia* and *Pinus pinea* as adults or larvae. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 150-1467 m). **Life cycle** of the species is at least 3 years. **Overwintering stage** is larva. **Larvae live** in dead decaying trunk and in dead stumps of the host plant. **Pupation** seems to be in spring and summer in the wood (in pupal cell). **Adults** probably are crepuscular and nocturnal, attracted by light. **Adults fly** in summer (between May-August) (Demelt, 1963; Svacha & Danilevsky, 1987; Adlbauer, 1988; Jenis, 2001; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012; Sama, Rapuzzi & Özdikmen, 2012).

GENUS *ERGATES* Audinet-Serville, 1832: 143

SPECIES *E. faber* (Linnaeus, 1760: 187)

The species is a forester.

The **host plants** of the species are conifers (*Pinus*, *Picea*, *Abies, Cedrus* and *Larix*) and exceptionally deciduous trees (*Alnus, Populus*). *Pinus* spp., however, are preferred host plants. The **specimens** that were collected **from Turkey** were found on or in *Pinus brutia, Pinus nigra, Pinus pinaster, Picea orientalis, Abies bornmuelleriana* as adults or larvae. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 40-1670 m). **Life cycle** of the species is at least 3 years. **Overwintering stage** is larva. **Larvae live** in dead, rotten, dried wood and also in roots (in standing or fallen trunks and stumps) of the host plants. **Pupation** seems to be in spring and summer in the wood (in pupal cell). **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in summer-early autumn (between June-September) (Çanakçıoğlu, 1956, 1983; Acatay, 1968; Villiers, 1978; Svacha & Danilevsky, 1987; Bense, 1995; Yüksel, 1996; Alkan, 2000; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

TRIBE MACROTOMINI Thomson, 1861: 312
SUBTRIBE MACROTOMINA Thomson, 1861: 312
GENUS *PRINOBIUS* Mulsant, 1842: 207
SPECIES *P. myardi* Mulsant, 1842: 207

The species is a forester.

The **host plants** of the species are many deciduous trees (*Quercus, Fraxinus, Pyrus, Acer, Alnus, Morus, Olea, Citrus, Populus, Platanus, Salix, Prunus, Robinia, Pistacia, Salix*) and occasionally conifers (*Pinus, Cedrus, Picea*). *Quercus* spp., however, are mostly recorded host plants. The **specimens** that were collected **from Turkey** were found on or in deciduous trees (*Quercus cerris, Quercus ilex*, *Quercus suber*, *Fraxinus dimorpha*, *Prunus armeniaca, Morus alba*) and conifers (*Picea orientalis, Cedrus libani*, *Pinus brutia*) as adults or larvae. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 220-1120 m). **Life cycle** of the species is a few year. **Overwintering stage** is larva. **Larvae live** in living or dead deciduous trees, in rotting wood of dead stems and also in roots (both standing or fallen) of the host plants. **Pupation** is in the wood in spring and summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in summer-early autumn (between June-September) (Bodenheimer, 1958; Demelt & Alkan, 1962; Demelt, 1963; Ekici, 1971; Tosun, 1975; Gül-Zümreoğlu, 1975; Villiers, 1978; Öymen, 1987; Svacha & Danilevsky, 1987; Adlbauer, 1992; Bense, 1995; Yüksel, 1996; Alkan, 2000; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

TRIBE REMPHANINI Lacordaire, 1868: 103
SUBTRIBE REMPHANINA Lacordaire, 1868: 103
GENUS *RHAESUS* Motschulsky, 1875: 153 [RN]
SPECIES *R. serricollis* (Motschulsky, 1838: 187)

The species is a forester.

The **host plants** of the species are many deciduous trees (*Fagus, Celtis, Platanus, Quercus, Castanea, Tilia, Juglans, Salix, Morus, Liquidambar*) and exceptionally conifers (*Pinus*). The **specimens** that were collected **from Turkey** were found on or in deciduous trees (*Juglans regia, Liquidambar orientalis, Platanus orientalis, Morus alba*) and conifers (*Pinus brutia, Pinus nigra*) as adults or larvae. **Adults and larvae** of the species can obtain only from the host plants in lowlands (between 5-1000 m). **Life cycle** of the species is at least 3 years. **Overwintering stage** probably is larva. **Larvae live** in rotten wood of large trunks (both standing or fallen) of the host plants. **Pupation** is in the wood in spring and summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in early spring-summer (between May-August) (Demelt, 1963; Acatay, 1971; Gül-Zümreoğlu, 1975; Erdem, 1977; Çanakçıoğlu, 1983; Öymen, 1987; Svacha & Danilevsky, 1987; Adlbauer, 1988; Bense, 1995; Bahadıroğlu, Agras & Salman, 2009; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

TRIBE AEGOSOMATINI Thomson, 1861: 308
GENUS *AEGOSOMA* Audinet-Serville, 1832: 162
SPECIES *A. scabricorne* (Scopoli, 1763: 54)

The species is a forester.

The **host plants** of the species are many deciduous trees (*Salix, Populus, Acer, Quercus, Alnus, Fagus, Ulmus, Morus, Aesculus, Carpinus, Castanea, Malus, Juglans,* *Prunus, Celtis, Hedera, Fraxinus, Platanus, Tilia*). *Populus* and *Salix* spp., however, are preferred host plants. The **specimens** that were collected **from Turkey** were found on or in deciduous trees (*Populus nigra, Salix nigra, Fagus orientalis*) as adults or larvae. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 126-1680 m). **Life cycle** of the species is at least 3 years. **Overwintering stage** is larva. **Larvae live** in living or dead deciduous trees, in dead stumps, in moist decaying wood (both standing or fallen), often in dead parts of living trees of the host plants. **Pupation** is in the wood in spring and summer. **Adults** are nocturnal, attracted by light. **Adults fly** in late spring-early autumn (between May-September) (Sekendiz, 1974; Villiers, 1978; Öymen, 1987; Svacha & Danilevsky, 1987; Adlbauer, 1992; Bense, 1995; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Özdikmen & Şahin, 2006; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012; Sama, Rapuzzi & Özdikmen, 2012).

TRIBE PRIONINI Latreille, 1802: 212

GENUS *MESOPRIONUS* Jakovlev, 1887: 323

SPECIES *M. angustatus* (Jakovlev, 1887: 327)

The species probably is not a typical forester because of lives on/in brushes. It has not been recorded from Turkey with exact locality. It was reported only by Löbl & Smetana (2010) from Asian Turkey (=Anatolia). So, biology in Turkey is unknown.

The **host plants** of the species are *Haloxylon, Calligonum*. **Adults and larvae** of the species can obtain from separate trees in dry, almost semidesert open areas. **Larvae live** in roots of the host plants. **Pupation** is in the soil (in larval tunnels of mature larvae). **Adults** probably are nocturnal, attracted by light. **Adults fly** in summer (at least June) (Svacha & Danilevsky, 1987).

SPECIES *M. asiaticus* (Faldermann, 1837: 263)

The species probably is not a typical forester because of lives also on/in brushes. It has not been recorded from Turkey with exact locality. It was reported only by Löbl & Smetana (2010) from Asian Turkey (=Anatolia). So, biology in Turkey is unknown.

The **host plants** of the species are deciduous tree (*Ficus carica, Salix*) and brushe (*Tamarix*). **Adults and larvae** of the species can obtain from separate trees in dry, almost semidesert open areas. **Life cycle** of the species is at least 3 years. **Larvae live** in dead underground parts of trees or in roots of a brush. **Pupation** probably is in the soil. **Adults** probably are nocturnal, attracted by light. **Adults fly** in summer (between June-August) (Danilevsky & Miroshnikov, 1985; Svacha & Danilevsky, 1987).

SPECIES *M. besikanus* (Fairmaire, 1855: 318)

The species is a forester.

The biology of the species is not known well. The **host plants** of the species are deciduous trees (*Platanus, Ficus, Olea*). The **specimens** that were collected **from Turkey** were found on or in deciduous trees (*Ficus carica, Olea europaea*). **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 110-1680 m). **Life cycle** of the species is 2-3 years. **Larvae live** in roots of the host plants. **Pupation** probably is in the soil. **Adults** probably are nocturnal, attracted by light. **Adults fly** in summer (between June-August) (İyriboz, 1940; Bodenheimer, 1948; Demelt, 1963; İren & Ahmed, 1973; Gül-Zümreoğlu, 1975; Öymen, 1987; Svacha & Danilevsky, 1987; Bense, 1995; Database of Özdikmen, 2012).

SPECIES *M. lefebvrei* (Marseul, 1856: 47)

The biology of the species is unknown, but probably similar to *M. besikanus*. The **host plants** of the species are unknown. **Life cycle** of the species is 2-3 years. **Adults** probably are nocturnal, attracted by light. **Adults fly** in summer (between June-August) (Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SPECIES *M. persicus* (Redtenbacher, 1850: 49)

The species is a forester. It has not been recorded from Turkey with exact locality. It was reported only by Löbl & Smetana (2010) from Asian Turkey (=Anatolia). So, biology in Turkey is unknown.

The **host plants** of the species are deciduous trees (*Quercus*). **Life cycle** of the species is unknown. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-July) (Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

GENUS *PRIONUS* Geoffroy, 1762: 198

SPECIES *P. coriarius* (Linnaeus, 1758: 389)

The species is a forester.

The **host plants** of the species are conifers (*Pinus, Picea, Abies, Cedrus*) and deciduous trees (*Quercus, Fagus, Alnus, Castanea, Malus, Salix, Fraxinus, Betula, Ulmus, Corylus, Carpinus, Acacia, Cerasus*). The **specimens** that were collected **from Turkey** were found on or in conifers (*Pinus brutia, Picea orientalis, Cedrus libani*) and deciduous trees (*Corylus avellana, Malus sylvestris, Cerasus avium, Cerasus vulgaris*) as adults or larvae. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 03-1700 m). **Life cycle** of the species is at least 3 years. **Overwintering stage** is larva. **Larvae feed** almost exclusively underground, rarely above ground level. **Larvae live** in dead, rotten wood especially at the base of dead stems, in stumps and roots of the host plants. **Pupation** is in the soil (in a cocoon) in late spring and early summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in summer-early autumn (between June-September) (Schimitschek, 1944; Ekici, 1971; Tosun, 1975; Erdem, 1977; Villiers, 1978; Öymen, 1987; Cherepanov, 1990; Bense, 1995; Yüksel, 1996; Lodos, 1998; Kanat, 1998; Vives, 2000, 2001; Jenis, 2001; Sama, 2002; Bahadıroğlu, Agras & Salman, 2009; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SPECIES *P. komiyai* Lorenc, 1999: 13

The species probably is a forester. It has not been recorded from Turkey with exact locality. It was reported only by Löbl & Smetana (2010) from Asian Turkey (=Anatolia). The biology of the species is unknown. **Adults fly** in summer (at least July).

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HOST PLANT AFFECTS THE PREDATION AND OVIPOSITION RATE OF THE PREDACEOUS THRIPS OF SPIDER MITES, *SCOLOTHRIPS LONGICORNIS*

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ABSTRACT: On the basis of controlling spider mites as a serious pest in four greenhouse vegetables, some experiments were conducted to measure the interaction between the biological control agent, *Scolothrips longicornis* Priesner, and host plant species. The predation and oviposition rates of the predator were monitored as two indices of the predator fitness on the host plants. It was hypothesized that plant chlorophyll content and leaf surface quality can affect this biocontrol agent. The results showed that plant leaf tissue affected the oviposition rate of the predator. As the highest oviposition rate was seen on eggplant (9.70±1.03 larvae) and the lowest belonged to sweet pepper (3.70±0.85 larvae). Predation mean was affected by host plant, also; the result was somehow different, as the highest predation mean was recorded for tomato (6.10±0.88 unfed mite/plant) and sweet pepper was not favorable for prey searching, either. In addition, the chlorophyll content of the host plant could indirectly affect the predator via prey feeding; however, the results indicated the final decisions of predator are related to more than one factor in host plant and prey.

KEY WORDS: Preference, oviposition, predation, *Scolothrips longicornis,* host plant.

When ecologists study interactions between trophic levels, they often limit their attention to two levels as a means of simplifying the analysis and this simplification may mislead many of the tritrophic interactions. In addition, a goal of integrated pest management is to combine optimally all available tactics to maintain pest population below economic injury level. Two strategies of host plant selection (somehow resistant cultivars) and biological control can be greatly effective when used simultaneously in time and related to biological control agent fitness. Because predators often encounter herbivores on plants, the topography of plant surfaces may influence herbivore and natural enemies' interactions (Dicke, 1996; Heinz & Zalom, 1996; Roda et al., 2001) and also host plant quality is expected to enhance the predators via nourishing of pests (Nachman & Zemek, 2002).

Due to the increasing resistance of pests such as *Tetranychus urticae* Koch (Acari: Tetranychidae) to pesticides and exactly the numerous side-effects of chemical control, it is needed to enhance biological control. Cucumber, eggplant, tomato and sweet pepper are among the most cultivated and susceptible host plants cultivated in Iran which are under biological control programs, also. Spider mites suck the chlorophyll out of plant tissue leaving dried out leaves with yellow or red spots and blotches sometimes with tiny white dots (Zhang, 2003). Among the predators used mainly in controlling spider mites is the specialist predatory thrips *Scolothrips longicornis* Priesner (Thysanoptera: Thripidae), which consumes on all the life stages of spider mites mainly adults. As the predator tend to oviposit into the host plant leaf tissue, deep knowledge of plant-predator interaction is needed for planning an integrated management combining biological and cultural control (Priesner, 1950). Predator should be able to oviposit in the host plant tissue and on the other hand, host plant leaf tissue should be able to keep the eggs until hatched.

To quantify the biological control agent compatibility with the host plant, there is a requirement of knowledge of host plant effect on predator performance and fitness. It means how the plant feature can affect the natural enemies to suppress the pest population. The efficiency with which predators pursue prey can be affected by the texture and structure of the surface that they search (Grevstad et al., 1992), which can be monitored by their consumption and oviposition rate.

Previous investigations of the interplay between plant morphology and predators related to many different plant-herbivore-predator species. Among morphological feature, plant trichomes can have positive or negative influence on natural enemies. These structures can provide shelters for tiny predators against unfavorable abiotic and biotic factors (Dicke & Sabelis, 1988). Predatory bugs, *Anthocoris confuses* Reuter are greatly affected in predation rate by host plant trichomes (Evans, 1976). Considering the observations of Heinz & Zalom (1996), they showed the effect of trichomes of tomato on effective biological control of whiteflies by predator *Delphastus pusillus* LeConte. In other studies, the leaf hairs had direct effect on whiteflies movement and indirect effect on prey consumption of the predator (Bottrell et al., 1998). In a study, trichomes on the lower surface of gerbera cultivars were shown to affect the predation rate of *Phytoseiulus persimilis* Athias-Henriot (Krips et al., 1999). The oviposition rate of this predatory mite differs according to apple leaves topography (Roda et al., 2001); also, density and length of trichomes on three different plant species have positive and negative effect on functional response of *P. persimilis* to control spider mites (Skirvin & Fenlon, 2001).

A crucial aspect of predator oviposition behaviour is host plant choice and host plant characteristics were among the factors affecting *Episyrphus balteatus* De Geer oviposition rate (vanHaelen et al., 2001). Adult *Hippodamia convergens* Guerrin-Menneville, *Orius insidiosus* Say and *Chrysoperla carnea* Stephens are reported to reduce populations of *Plutella xylostella* L. larvae on cabbage with glossy surface (Eigenbrode et al., 1996). The implication of soybean cultivars on the reproductive capacity and biological control by *O. insidiosus* has great effect on aphids (Lundgren & Fergen, 2006). Female *O. insidiosus* oviposit into plant species with the thinnest layers of epidermal and collenchyma cells, a decision that is significantly correlated with the survival of their offspring. Once a plant species is chosen, the female mainly bases her oviposition decisions on epidermal thickness and the surface density of hair-like appendages on the plants (Lundgren et al., 2008). Also it was shown that choice of oviposition site in anthocorids determines the later distribution of nymphs (Sigsgaard, 2005). Plant architecture is likely to be an important component of the predation risk of *Diurapphis noxia* Mordvilko by the fourteen spotted ladybird, *Propyloea quaturodecimpunctat* L. (Clark & Messina, 1998). Mahdian et al. (2007) showed the effect of plant surface on the functional response of the predatory bug *Picromerus bidens* L.

We used four greenhouse crops that differ largely in their undersurface of the leaves and determined whether searching efficiency of *S. longicornis* differs on these crops by monitoring their predation rate related to plant leaf structure and chlorophyll content. In parallel, because of the predator's dependence for oviposition into the host plant leave texture, we considered the oviposition rate of predators as a factor of combining biological agents with host plants.

MATERIALS AND METHODS

Spider mites were provided from a colony at Biological Control Department of IRIPP kept on cow-pea plants for at least six months. To determine the predation and oviposition rate of the predator, a spider mite colony was used that originated from mites collected in the last year from a research lima bean field. The mites belonged to the sixth generation were used in the experiments.

Predatory thrips were obtained from a colony reared on spider mites *T. urticae* on cow-pea leaves. Predatory thrips were kept in a container covered by a thin layer of water saturated cotton and a squash leaf disk upside and small leaves of cow pea full of spider mites. Every two weeks, predatory thrips were transferred to a new leaf disk. Containers were kept in a climate room at 25±0.5°C, 60±65% RH and a photoperiod of 16L: 8D. All experiments were carried out with mated adult females at the age of 3-4 days.

Commercial hybrid of four main greenhouse vegetables, representing different types in trichomes and leaf indices were selected as test plants to determine how plant leaf structure can influence the predation and oviposition rate of *S. longicornis,* feeding on two-spotted spider mite. The most cultivated greenhouse plants such as cucumber cv. Sultan, tomato cv. Cantander, eggplant cv. Valencia and sweet pepper cv. Local were obtained from three commercial companies, Petoseed, Royal and Enza Zaden and subsequently grown in a shared pot that had some barriers under the soil to prevent root connection (Fathipour et al. 2006). The pots were kept in a greenhouse at Biological Control Department of Iran Research Institute of Plant Protection (IRIPP; 25±0.5°C, 60-65% RH and a photoperiod of 16L:8D).

The distance among the plants and their height was as there was no touch between them but they were so close that the thrips could travel among the plant by a small jump. The experimental plants were chosen in the 4-5 leaves stage for the tests. A transparent cylinder was put on each pot to prevent thrips dispersal. Each plant was infected by 100 adult female spider mites. The predator individuals were starved for 12 hours. Seven female thrips at the age of 3-4 days and 10 male thrips were isolated from the colony on a plants pot combination without prey. For each set, five adult females and two males for insured mating from the isolated colony were transferred to each pot and let them 24 hours consume spider mites (Grevstad & Klepetka, 1992; Krips et al., 1999) and oviposit in the leaf tissue (Coll, 1996; Heinz & Zalom, 1996; Margolies et al., 1997; Venzon et al., 2002; Lundgren & Fergen, 2006). The test was done in 10 replications. After 24 hours, the thrips were removed from the pots and the number of alive spider mites was counted on each plant in each combination. As there is no cannibalism in the first instar larvae of the genus (Covile & Allen, 1977), then after one week, the number of first instar larvae, which hatched successfully, was recorded as the oviposition ability of the predators in correlation with host plant. Data were analyzed using ANOVA and mean comparison method of LSD in SPSS 14.0 software.

Since not all the elements of plant condition can be included in an analysis, some components were used in this experiment as the indicators of host plant effective parameters, namely the amount of chlorophyll per 6 mm^2 leaf area, leaf area and thickness. The amount of chlorophyll in leaf tissue was measured by a simple chlorophyll-meter (Minolta SPAD-502) after removing the predator. Ten plants of each species that were used in the oviposition-predation test were used in the experiments. Leaf thickness was measured by a simple micrometer and area was monitored by a leaf area meter (CI-202) instruments. Data were analyzed by ANOVA and mean difference significacy was monitored by LSD comparison test in the software of SPSS 14.0. To obtain the correlation between leaf thickness and oviposition rate and also, leaf area and feeding rate, the data were analyzed through linear regression model to find out any linear correlation.

RESULTS

The predation mean of *S. longicornis* on the four greenhouse crop species is shown in table. 1. The one way ANOVA for these data showed the significant effect of host plant on predation mean of the predator (df=3, *F*=8.121 and *sig.*<0.001). The highest and lowest consumption mean was recorded on tomato and sweet pepper plant with the mean of 6.10±0.88 and 18.2±1.65 left alive mites per plant, respectively. The amount of alive left mites showed no significant difference between cucumber (11.5± 1.66 mite/plant) and eggplant (12.5±2.40 mite/plant).

The oviposition mean of *S. longicornis* in the leaf tissue of the four greenhouse crops is shown in table. 1. The one way ANOVA for these data showed the significant effect of host plant tissue on oviposition capacity of the predator (df=3, *F*=6.614 and *sig.*=0.001). The highest reproductive ability was recorded on eggplant with the mean of 9.70±1.03 first instar larvae per plant and the lowest was observed on sweet pepper (3.70±0.85 1st. instar larvae/plant). The difference between cucumber and tomato was not significant.

Among the different leaf area indices, two studied parameters in this paper showed significant difference. The largest and smallest leaf area was recorded for cucumber leaves (A= 13.84±0.57 cm^2, *F*= 41.801, *sig.* <0.000) and tomato (A= 4.71±0.36 cm^2), respectively. On the other hand, the thickest leaf was belonged to eggplant with 0.45±0.01 mm thickness and the thinnest leaf was for sweet pepper (0.29±0.01 mm) with significant difference (F= 18.64, sig.<0.000). Regression model between oviposition rate and leaf thickness showed linear increasing correlation (F= 6.713, Sig. = 0.14; r=0.48, figure 1) that showed increasing the leaf thickness, the predator preferred to lay more eggs. Mostly, egg laying were observed around leaf thickness of 0.35-0.50 mm which is so close to eggplant leaf thickness (figure 1). In addition, regression between feeding rate of the predator (log unfed mites) and leaf area showed similar results, as by increasing the leaf area from tomato to cucumber, more mites were left unfed with significant difference (F= 5.779, Sig.=0.021; r= 0.404).

Chlorophyll content of four experimental plants showed significant difference, too (df=3, *F*=7.374 and *sig.*=0.001). The highest amount of chlorophyll was recorded in cucumber leaves (37.37±1.56 mg/g), followed by tomato and sweet pepper with no significant difference and at last, eggplant (26.94±1.79 mg/g) had the lowest chlorophyll content (Table 1) which would be another indirect effect of host plant o the predation rate of *S. longicornis*.

DISCUSSION

Our study showed that plant morphology can substantially alter the foraging success and predation of *S. longicornis* searching for prey on the plant surface. We found that the mean of prey consumption by the predacious thrips varied among different Solanaceous and Cucurbitaceous species with diverse architecture. These discrepancies in feeding and oviposition rate of the predator can be explained by the difference in chlorophyll content, leaf area and thickness, which would enhance or suppress the nutritional aspect of the prey and plant surface structure. The lowest consumption rate on sweet pepper suggested that *S. longicornis* searches less effectively on sweet pepper than other threes. Effects can also indirectly mediate predator search through the host and prey (Sabelis et al., 1999; Kennedy, 2003). Highest predation rate of the predator on tomato leaf surface can be due to smallest leaf area which would limit the foraging arena for the predator or refuging surface for the prey. On the other hand, lower predation mean on sweet pepper could be related to the physical and chemical properties of this host plant. Although the leaf area of sweet pepper showed no difference with eggplant and the chlorophyll content, the slippery surface of sweet pepper may play an important role on foraging efficiency of predators. These results of Yasuda (1998) indicated that chlorophyll in the prey diet serves as an important cue in the prey-locating behavior of *Eocanthecona furcellata* Wolff in lettuce, bean and spinach. It means that the amount of (E)-phytol as a component of chlorophyll in spinach led the higher feeding rate in this predator. In previous study it was found that spider mites has lower developmental time and fecundity value on sweet pepper than other greenhouse vegetables (Kheradpir et al., 2008); that is, sweet pepper can be an unfavorable host plant for this prey. Although the chlorophyll content of sweet pepper was as much as tomato, because of higher potassium level could not be a good host plant for prey and subsequently not a good prey for a predator (Malekahmadi et al., 2005). The use of non-destructive methods of chlorophyll measurement provides reliable and effective means of plant analysis in a ide range of biological context (Samsone et al., 2007). Somehow plant structure and nutrition can change the searching efficacy of a predator (Mahdian et al., 2007; De Clercq et al., 2000). In another study, plant species had a significant effect on the functional response of *P. persimilis* to eggs of *T. urticae*. But as there was no effect of the host plant species on the number of prey eaten by *P. persimilis,* this removed the possibility that the effect in functional response is due to plant chemistry (Skirvin & Fenlon, 2001). According to the data collected from our experiment, we can conclude that the difference in number of eaten preys among different host plants is related to plant chemistry and at the first level the chlorophyll content of the leaves would be the most effective factor. By the way, all data in our study does not exactly support this hypothesis. It means that as we explained above, although sweet pepper had relatively high chlorophyll content, the slippery surface of the leaves and secondary metabolites in plant chemistry mediated by prey consumption prevent the predator to show its maximal predation capacity and switch to the other host plants. On the other hand, highest chlorophyll content in cucumber leaves over passed by heavy density of trichomes on the leaf surface that made a good shelter for prey to hide against the predator. The predator individuals apparently compensate relatively lower chlorophyll content in tomato (at the same level with sweet pepper) by eating more preys. The lower consumption rate on eggplant than tomato is difficult to explain; it is possible that the trichomes structure makes it more difficult for *S. longicornis* to find its prey. According to Kheradpir et al. (2010), diference in trichome density on the four experimental plants would lead to affecting *S. longicornis* movement ability which can explain the data obtained in this experiment. However, to discount fully the effect of the secondary plant compounds on the predation rate of this predator, more detailed research of the plant biochemistry is necessary.

The oviposition mean in *S. longicornis* on our experimental plants showed the direct effect of both structural and chemical effect of host plants. *O. insidiosus* showed an obvious preference for laying eggs on certain plant structures among the host plants of pole bean, soybean, redroot pigweed and velvetleaf (Lundgren et al. 2008; Lundgren & Fergen, 2006). Coll (1996) also found that *O. insidiosus* does not prefer to lay eggs on the vegetative structure of sweet peppers and tomatoes. Our observations support this conclusion that many dinocot plants are unacceptable oviposition sites for *S. longicornis,* specially in case of sweet pepper and tomato. This being said, our result showed that *S. longicornis* can distinguish between egg-laying sites, but the mechanisms behind the oviposition decision and its implications for biological control remain to be investigated. Thickness of the external covering may also render some species unsuitable as oviposition sites (Castane & Zalom, 1994); dense trichomes also as what we have seen in cucumber could render predators to find suitable place to penetrate their ovipositor (Armer et al., 1999; Roda et al., 2001). Among the spider mites predators, *P. persimilis* and *Typhlodromus pyri* Scheuten has been shown to distinguish plant structure to lay egg on and mostly they prefer dense trichomes surfaces rich of hidden preys, however the trichomes density and the leaf surface topography diversify their response. We can conclude that the predacious thrips follows the same strategies to find more prey, but as it has bigger size, so it should prefer lower densities of trichomes (Krips et al., 1999). On the other hand, the leaf tissue has great effect on the oviposition rate of a predator which lay egg inside the leaf tissue. In comparison with other thripids, female thrips of *Scirtothrips perseae* Nakahara laid eggs into the small avocado fruit rather than any other vegetative parts of the plant (Hoddle, 2002). Oviposition behavior of the western flower thrips, *Frankliniella occidentalis* Pergande on greenhouse cucumber showed most eggs were laid in the leaves, along veins and under leaf hairs, with only a few on plant stems and flowers (Kiers et al., 2000). According to Kishimoto & Adachi (2008), the predacious thrips in the genus of *Scolothrips* preferred leaves with trichomes, but there should be long and shelter type not as dense as it can not walk through; the result of our study regarding to higher oviposition rate in eggplant is supported by this hypothesis.

Our data showed that plant characteristics influence the ability of *S. longicornis* to respond to changes in prey density and suggest that the predator may perform better as a biological control agent of mite pests on eggplant and sweet pepper than on tomato. However, host plant is only one source of variation in the way that predators respond to varying prey densities. Predation behavior of an arthropod predator may be affected by a complex of biotic and abiotic factors. Totally, the experimental results appeared that *S. longicornis* is less efficient as a biological control agent on sweet pepper. The prey consumption ability of a predator within a plant is just one aspect that needs to be considered in developing biological control strategies. The predator also needs to be able to locate its prey, and hence the movement of predators within the plant canopy is also important. If the morphological feature of a plant affect the movement of a predator to such a degree that it is unable to move rapidly between patches of its prey then, irrespective of its predation capacity, its use as a biological control agent is limited.

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Table 1. Host plant parameters and predator predation and oviposition mean on the four experimental plants.

Host plant	Area (cm^2)	Thickness (mm)	Chlorophyll content (mg/g)	Oviposition mean	Predation mean (unfed mites)
Tomato	04.71±0.36^{c}	0.39±0.02^{b}	32.18±1.34^{b}	7.50±0.68^{b}	6.10±0.88^{c}
Cucumber	13.83±0.57^{a}	0.37±0.01^{b}	37.37±1.56^{a}	6.20±1.02^{b}	11.5±1.66^{b}
Eggplant	10.80±0.73^{b}	0.45±0.01^{a}	26.94±1.79^{b}	9.70±1.03^{a}	12.5±2.40^{b}
Sweet Pepper	11.21±0.64^{b}	0.29±0.01^{c}	33.64±1.54^{c}	3.70±0.85^{c}	18.2±1.65^{a}

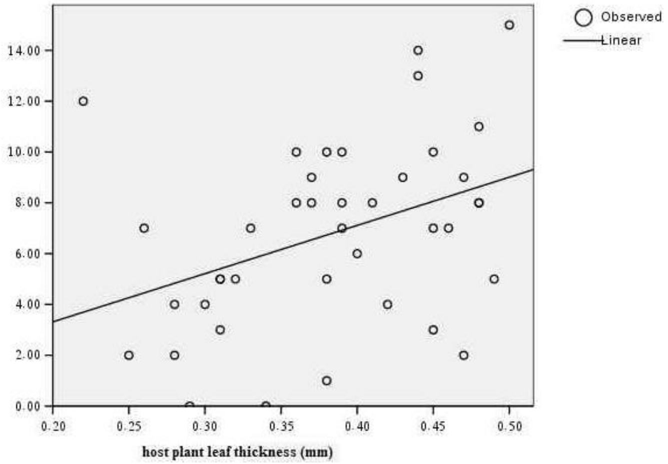

Figure 1. Regression curve between host plant leaf thickness and the predator oviposition preference (y axis: mean number of alive larvae).

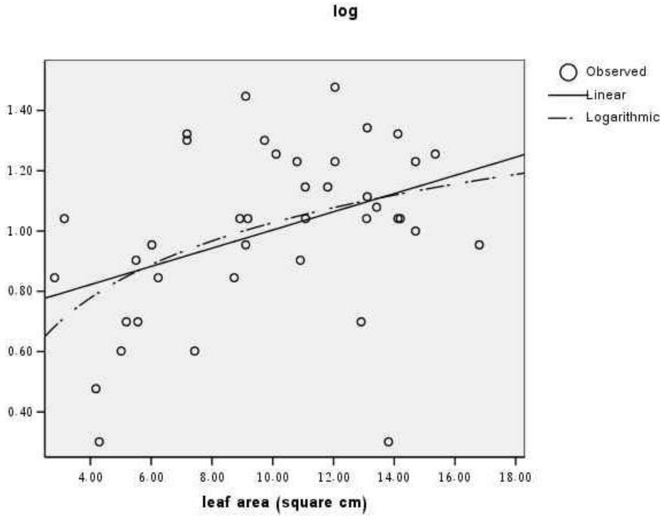

Figure 2. Regression curve between host plant leaf area and predation rate as the log number of unfed mites. Increase leaf area, more unfed mites left (y axis: mean number of alive mites).

BIONOMIC AND LIFE TABLE PARAMETERS OF OLIVE PSYLLID, *EUPHYLLURA STRAMINEA* ON OLIVE SEEDLINGS UNDER THREE CONSTANT TEMPERATURES

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ABSTRACT: Bionomic and life table parameters of *Euphyllura straminea* Loginova were carried out at three constant temperatures (20°C, 25°C and 30°C) on olive seedlings throughout one complete generation. Durations and percentage of mortalities for different developmental stages were estimated. Results revealed that egg incubation period, durations of nymphal stage and the five nymphal instars were decreased as temperature increased from 20°C to 30°C. Moreover, the highest percentage of mortality was occurred throughout 1st nymphal instar at 30°C, while the lowest percentage was occurred throughout 4th nymphal instar. The values of zero of development for different developmental instars were 11.96, 13.30, 13.40, 13.10, 15.40 and 14.50 for egg 1st, 2nd, 3rd, 4th and 5th nymphal instars and nymphal stages, respectively. Results showed that the highest percentage of adults' emergence and sex ratio were occurred at 25°C being 92.6 % and 1: 1.8, respectively. Also, results revealed that temperature had highly significant effects on durations of pre-oviposition, oviposition and post-oviposition periods as well as adult longevity for both sexes. These durations were decreased as temperature increased from 20°C to 30°C. Female fecundity and egg hatchability were affected by prevailing temperature. The highest numbers of deposited eggs was 277.2 eggs/ female and egg hatchability was 87.66 % occurred at 25°C. Results of life table parameters showed that the highest percentage of egg hatchability and the lowest percentages of apparent and real mortality as well as the highest numbers of adult's survival were occurred at 25°C. The highest net reproductive rate (R) was occurred at 25°C being 88.91 eggs / female. The shortest generation time (GT) was 46.66 day occurred at 30°C. Both intrinsic rate of increase (r_m) and finite rate (λ) were occurred for those reared at 25°C and 30°C. Both values were 0.03 and 1.03 occurred at the two tested temperatures. The shortest population doubling time (Dt) was occurred at 25°C being 27.95 days. All these parameters revealed that 25°C seemed to be optimal temperature for rearing *E. straminea.*

KEY WORDS: *Euphyllura straminea,* bionomic, life table parameters.

Olive groves are widely distributed allover the world specially Mediterranean Basin and Western Asia. In Egypt the olive groves are distributed in North West coastal region, Sinai, West delta, Fayoum, Sewa and New valley. Olive groves are attacked by many pests which cause considerable reduction in quantity and quality of olive fruit yield. These pests are scale insects, olive fruit fly, stem borers, lepidopterous worms, olive thirips, mites and root-knot nematode. During the last decade of the twentieth century olive Psyllid, *Euphyllura straminea* Loginova was recorded as new pest on olive trees in El-Arish (Nada, 1994). Afterwards, this species was widely distributed allover the country and began to be a key pest in some localities.

Biological information about this new pest are relatively scarce i.e. Ali & Ahmed (1984) in Iraq and Hamza (2007) in Egypt.

The present work aimed at studying bionomic and life table parameters for *E. straminea* under three constant temperatures on olive seedlings to investigate the optimum temperature for this insect.

MATERIALS AND METHODS

A stock culture of *Euphyllura straminea* Loginova on olive seedlings was maintained under insectary conditions. Also stocks of olive seedlings “Tophahy” cultivar about 40–45 cm. height were cultivated in plastic pots 15 cm. diameter and kept free of infestation under insectary conditions. After adults emerged one pairs (male + female) were taken from the stock culture and placed on olive seedlings (10 seedlings). Each seedling was put inside plastic chimney which fixed firmly at the lower end at the soil pot, while the upper end was covered with muslin which fixed by rubber band. These pots were examined daily until female deposited eggs. All biological experiments were carried out under laboratory conditions inside incubators at three constant temperatures, 20°C, 25°C and 30°C and relative humidity 55 ± 5 % and illuminated with florescent lamp for 12 hrs. daily.

To determine incubation period, percentages of eggs hatchability and zero of development, seven hundred and fifty eggs which deposited in the same days were collected from the ten pairs found on olive seedlings. These eggs were divided into 3 groups each 250 eggs. Each group was divided into five replicates (each 50 eggs) and placed on a black cloth inside Petri dishes. These dishes were put at the three tested temperatures. These eggs was examined twice daily by using stereoscopic microscope. Incubation periods and percentages of hatchability were recorded. Their means and standard error were calculated.

Three groups of olive seedlings free of infestation, each five seedlings were used to estimate duration and mortality percentages of different nymphal instars as well as nymphal stages at the three tested constant temperatures. Newly hatching nymphs from eggs which used to estimate incubation period were transferred gently by aid of fine camel hair brush to the corresponding temperatures to the five olive seedlings. After settling nymphs on the seedling, a sketch of each one was made and numerated. Each seedling was examined daily by using USB microscope. Duration and mortality were recorded for the five nymphal instars as well as means and slandered error were calculated.

After adults emergence, they were collected and sexed from each group, sex ratio was calculated. Ten pairs for each tested temperatures were used to estimate duration of both sexes and fecundity for females. Each pair was transferred to a clean olive seedling covered with plastic chimney and kept at the corresponding temperatures. Each seedling was provided with few drops of honey solution for adult feeding. Adult males were observed until death and longevity was calculated.

The adult females were observed daily until death. Also, pre-oviposition, oviposition and post-oviposition periods as well as fecundity were estimated. The means and standard error of the above mentioned durations and fecundity were calculated. Results obtained were subjected to statistical analysis of variance using SAS program and mean mortality percentages were transformed to arc-Sine before analysis (Anonymous, 1990).

Zero of development of different stages was calculated according the equation proposed by Stinner et al. (1974).

$$\text{Rate of development} = 1/\ t \times 100$$

Where: t = duration in days.

Thermal units required for different development stages were determined according Price (1984) using the following equation:

$$K = di \times (ti - a)$$

Where: a: zero of development; ti: Temperature of incubation; di: Mean number of days in incubation and K: Thermal unit.

Life tale parameters were constructed according Anderwartha & Birch (1984) for the three constant temperatures. Results of life table parameters were subjected to computer program proposed by Abou Setta et al. (1984).

RESULTS AND DISCUSSION

Results obtained about bionomic parameters at three constant temperatures (20°C, 25°C and 30°C) of *Euphyllura straminea* are given in Tables (1 to 7). It found more convince to discuss results for each stage separately.

1. Egg stage:

Results of incubation period, percentage of egg hatchability, zero of development, rate development and thermal constant are given in Table (1).

These results revealed that temperature had highly significant effect on egg incubation period of *E. straminea*. Egg incubation period was decreased gradually as the temperature increased from 20°C, 25°C and 30°C. Mean incubation periods of egg stage were 11.02, 8.90 and 5.20 days at 20°C and 30°C, respectively. Also, results showed that temperature had highly significant effect on percentage of eggs hatchability. The highest egg hatchability percentage (87.66 %) was occurred at 25°C, followed by those at 30°C being 83.50 %, while the lowest percentage (74.00 %) was occurred at 20°C.

Moreover, results showed that zero of development for egg stage was 11.96. Results showed that of development was increased gradually as the temperature increased from 20°C to 30°C. These rates were 9.07, 11.23 and 19.23 at 20°C, 25°C and 30°C, respectively. Also, results revealed that thermal constant units required for development of egg stage were greatly affected by prevailing temperature. The highest thermal units needed was occurred at 25°C 116.06 DD's, while the lowest thermal units needed was occurred at 20°C being 89.60 DD's.

From these results it could be stated that 25°C seemed to be the optimum temperature for egg stage of *E. straminea*. At this degree the highest hatchability percentage as well as the highest thermal constant was needed. These results are in harmony with those obtained by Ksantini et al. (2002). They stated that optimal temperature for egg of this species was 25°C.

2. Nymphal stage:

Nymphal stage of *E. straminea* is passed throughout five nymphal instars. Results obtained about the effects of the three constant temperatures and durations of the five nymphal instars as well as nymphal stage and their percentage of mortality are given in Table (2).

These results showed that the three tested temperatures had highly significant effects on mean durations of the five nymphal instars as well as duration of nymphal stage. Means duration of the five nymphal instars and mean duration of nymphal stage were decreased gradually as the temperature increased from 20°C to 30°C.

The shortest means duration were occurred at 30°C being 3.09, 5.50, 3.73, 4.31, 3.92 and 20.55 days for 1st, 2nd, 3rd, 4th, 5th and nymphal stage, respectively. While, the longest mean for both instar and nymphal stage were occurred at 20°C being 8.07, 9.40, 8.11, 9.90, 8.50 and 43.98 days for the five instars and stage, respectively. Moreover, results revealed that temperature had highly significant effects on the percentage of mortalities of the five nymphal instars as well as nymphal stage. The highest percentage of mortalities was occurred at 30°C for the 1st nymphal instar being 17.32, 11.76, and 24.04 at 20°C, 25°C and 30°C, respectively. The general average of mortality percentage for this instar was 17.70% at the three tested temperatures. While, the lowest percentage of mortality were occurred at the 4th nymphal instar being 1.50, 4.00 and 10.26 % at 20°C, 25°C and 30°C, respectively. The general average of percentage of mortality was 5.25 % at the three tested temperatures. Also, the highest mortality percentage for nymphal stage was occurred at 30°C being 14.34 % followed by those at 20°C being 8.90 %, while, the lowest percentage of mortality was occurred at 25°C being 6.80 %.

From these results it could be stated that the highest percentage of mortality was occurred throughout the 1st nymphal instar. While, the lowest percentage was occurred throughout the 4th nymphal instar. Moreover, it could be stated that 25°C seemed to be the most favorable when the lowest percentages of mortality were occurred throughout the five nymphal instar as well as nymphal stage.

These results are closely related by these obtained by Hamza (2007) he stated that duration of nymphal stage of *E. straminea* ranging 23 - 25 days at 25°C. Also, he added that the highest percentage of mortality was occurred in the first nymphal instar being 2.5–6.8 %, while, the lowest percentage was occurred in the fourth nymphal instar.

Results of zero of development for the five nymphal instars as well as nymphal stage and effects of temperature rate of development and thermal constant units are given in Table (3).

These results revealed that zero of development for the five nymphal instars and nymphal stage were 13.3, 13.4, 13.1, 13.9, 15.4 and 14.5°C for the 1st, 2nd, 3rd, 4th, 5th and nymphal stage, respectively. Moreover, results revealed that both rate of development and thermal units for nymphal instars as well as nymphal stage were obviously affected by prevailing temperatures. Rate of development was increased gradually as the temperature increased from 20°C to 30°C. The lowest rate was occurred at 20°C (2.27) followed by 25°C (2.86); while, the highest rate was occurred at 30°C (4.87). Also, results revealed that thermal constant required for development of nymphal stage of *E. straminea* were greatly affected by changes of prevailing temperature. The highest value of needed thermal units was occurred at 25°C being 326.43 DD's, while the lowest thermal value of needed temperature was occurred at 20°C being 189.11 DD's. From these results it could be stated that 25°C seemed to be the most favorable temperature for rearing nymphal stage.

3. Adult stage:

Adults emergence was occurred usually at afternoon. After emergence the males began to move around the female, then they stand side by side in V-shape position, then copulation was take place. After copulation process the fertile females passed throughout three periods, pre-oviposition, oviposition and post-oviposition periods.

Results in Table (4) summarized the effects of three constant temperatures on percentage of adult emergence, sex ratio and mean durations of different periods of adult female as well as female fecundity and percentage of egg hatchability.

Percentage of adult emergence and sex ratio:

Results revealed that the three constant temperatures were highly significant affected on both percentage of adults emergence as well as sex ratio. The highest percentage of adult emergence was occurred at 25°C being 92.6 % and sex ratio male : female was 1: 1.8, followed by those at 30°C being 92.4 % and 1: 1.7, while, the lowest percentage of adult emergence and sex ratio were occurred at 20°C being 87.8 % and 1: 1.6, respectively.

From these results it could be stated that 25°C seemed to be the most favorable temperature of adults emergence as well as sex ratio. These results are similar to those obtained by Ali & Ahmed (1984) they stated that sex ratio of *E. straminea* under laboratory conditions was 1: 1.4 with slight predominance to females. Also, Hamza (2007) recorded sex ratio was 1: 1.7 for the same species.

Pre–oviposition period:

Results of statistical analysis showed that the three constant temperatures had highly significant effects on mean duration of pre- oviposition period. These results revealed that means of pre- oviposition periods were decreased when temperature increased from 20 to 30°C. The longest period was occurred at 20°C being 16.5 days followed by those at 25°C being 9.5 days. While, the shortest period was occurred at 30°C being 4.5 days.

Oviposition Period:

Results showed that oviposition period found to be the longest period followed by pre - oviposition period, while, post- oviposition period was the shortest period. Results of statistical analysis revealed that the three tested temperatures had highly significant effects on mean duration of oviposition period. Mean durations of this period were decreased when temperature increased. The longest mean was occurred at 20°C being 33.10 days, followed by those reared at 25°C being 29.4 days. While, the shortest mean was 22.5 days occurred for females reared at 30°C.

Post-oviposition Period:

Results of statistical analysis showed that temperature had highly significantly effects on mean durations of post oviposition period. Mean durations of this period were decreased as temperature increased from 20°C to 30°C. The longest mean duration was occurred at 20°C being 10.50 days, followed by those reared at 25°C being 6.10 days. While, the shortest mean was occurred at 30°C being 3.30 days.

Female Fecundity:

The reproductive potentiality is expressed as total numbers of deposited eggs per female during its longevity.

Data obtained about female fecundity of *E. straminea* which reared at the three constant temperatures are given in Table (4). Results of statistical analysis revealed that temperature had highly significant effects on female fecundity. The highest mean fecundity was occurred at 25°C being 277.2 eggs / female, followed by those at 30°C being 214.8 eggs / female. While, the lowest mean was occurred for those reared at 20°C being 101.1 eggs / female.

From those results it could be stated that 25°C seemed to be the most favorable temperature for rearing *E. straminea* under laboratory conditions.

These results are in harmony with these obtained by Ksantini et al. (2002) they stated the optimum temperature for female fecundity of *E. olivine* was 25°C. While, female fecundity was decreased with increasing when temperature exceeded to 32°C inhibition of ovary activity was occurred.

Egg Fertility:

Egg fertility is represented by percentage of egg hatchability of deposited eggs. Data in Table (4) showed percentages of egg hatchability of *E. straminea* when reared under the three tested temperatures. Results of statistical analysis showed that temperature had highly significant effects on percentage of egg hatchability. The highest mean of egg hatchability 87.66 % was occurred at 25°C followed by those reared on 30°C being 83.50 %.While, the lowest mean was occurred at 20°C being 74.00 %.

These results confirmed that 25°C seemed to be optimal temperature for rearing *E. straminea* under laboratory conditions.

Adults Longevity:

Longevity of both male and female are represented by time elapsed between adults emergence from fifth nymphal instar until death. Data obtained about the effects of the three tested temperatures on longevity for both sexes and mean durations of generation are given in Table (5). Results of statistical analysis showed that the three tested constant temperatures had highly significant effects on means longevity of both sexes.

The female longevity was longer than male longevity at the three tested temperatures. These results revealed that means longevity for both sexes were decreased as temperature increased. Means male longevity were 42.40, 39.70 and 28.50 days at 20°C, 25°C and 30°C, respectively. Also, means female longevity were 60.10, 45.00 and 30.30 days for the same temperatures, respectively.

Duration of Generation:

Duration of generation is the time elapsed from egg deposition till the first deposited egg (from egg to egg). This duration was calculated by summing egg incubation period, duration of nymphal stage and duration of pre oviposition period.

Data obtained are given in Table (5). Results revealed that mean duration of generation was decreased as temperature increased from 20°C to 30°C. Mean durations were 71.50, 53.50 and 30.25 days at 20°C, 25°C and 30°C, respectively.

4. Life Table Parameters:

Life table analysis of *E. straminea* was carried out at three constant temperatures (20°C, 25°C and 30°C) on olive seedlings. Each tested temperature was started with 250 eggs. Data obtained were used to investigate survival for each nymphal instar, adult female, fecundity, generation time and other life table parameters at the three tested temperatures.

4.1. Immature stages:

Results obtained for percentage of apparent and real mortalities for the five nymphal instars are given in Table (6). These results revealed that both apparent and real mortalities were differed from stage to another as well as from instar to another according to the prevailing temperature. Regarding the percentages of egg mortalities (apparent and real) at the three tested temperatures, the highest percentage of mortality was occurred at 20°C being 26.00 % followed by those incubated at 30°C being 16.80 %. While, the lowest percentage was occurred for those incubated at 25°C being 11.60 %.

Results of percentage of apparent mortalities of the five nymphal instars revealed that the highest percentage was occurred at those reared at 30°C being 24.0% followed by those at 20°C being 17.3%, while, the lowest percentage was occurred at 25°C being 11.8%. Also, percentage of real mortalities of the first nymphal instar nearly followed the same trend; these percentages were 20.0, 12.80 and 10.40% at 30°C, 20°C and 25°C, respectively. The percentages of apparent mortalities for the second nymphal instar were 5.2, 5.6 and 13.9% for those reared at 20°C, 25°C and 30°C, respectively. Also, the percentages of real mortalities were 3.20, 4.40 and 8.80% at the three tested temperatures, respectively. The percentages of both apparent and real mortalities of the third nymphal instar were followed the same trend. The highest percentages were occurred for those reared at 30°C being 13.9 and 7.60%, followed by those reared at 25°C being 8.30 and 4.80%, while, the lowest percentages were occurred for those reared at 25°C being 4.90 and 3.60% for apparent and real mortalities, respectively. Moreover, percentages of apparent and real mortality percentages of fourth nymphal instar followed the same trend. The highest percentages were occurred for those reared at 30°C being 10.30 and 4.80% followed by these reared at 25°C being 4.0 and 2.80 %, while the lowest percentages were occurred for those reared at 20°C being 1.50 and 0.80%, for the fourth nymphal instar, the apparent and real mortalities, respectively.

Moreover fifth nymphal instar the both percentages showed that the highest percentages were occurred for those reared at 20°C being 12.20 and 6.40% followed by those reared at 30°C being 9.50 and 4.00%, while the lowest percentages were occurred for those reared at 25°C being 7.70 and 5.20% for appeared and real mortalities, respectively.

The survival for nymphal stage to adult revealed that the highest numbers of adult were obtained from those reared at 25°C being 155 adults, followed by those reared at 20°C being 115 adults, while, the lowest number was obtained for those reared at 30°C being 95 adults only.

From these results it could be stated that 25°C seemed to be the optimum temperature for rearing *E. straminea* on olive seedlings. The highest percentage of eggs hatchability and the lowest percentages of apparent and real mortality most nymphal instars as well the highest number of adults survival were occurred at this degree.

4.2. Survival and Fecundity of Adults:

Table (7) summarized life table parameters of *E. straminea* reared at three constant temperatures (20°C, 25°C and 30°C) on olive seedlings.

4.2.1. Net reproduction rate (R):

Results indicated that net reproductive rate of *E. straminea* female gave the highest birth average at 25°C being 88.91 eggs / female followed by those reared at 30°C being 26.40 eggs / female, while the lowest rate was occurred by those reared at 20°C being 4.92 eggs / female.

4.2.2. Generation time (Gt):

Results revealed that generation time was varied at the three tested temperatures. The shorted generation time was occurred at 30°C being 46.66 days, followed by those reared at 25°C being 61.71 days. While, the longest generation time was occurred by these reared on 20°C being 68.75 days.

4.2.3. Intrinsic rate of increasing (r_m):

The intrinsic rate of increase (**r_m**) refers to the rate of daily population growth and is also considered an important index of potential population performance. The calculated values of (r_m) showed that these rates were affected by the prevailing temperatures. The highest intrinsic rates individual / days were obtained for those reared at 25°C and 30°C being 0.03 and 0.03 individual / day, while lowest rate was occurred for those reared at 20°C being 0.01 individual / day.

4.2.4. Finite rate of increase (λ):

The finite rate of increase or (exp r_m) is considered as the discrete version of (r_m). The calculated values of finite rate of increase of *E. straminea* followed the same trend which occurred for the intrinsic rate of increase. The highest values were 1.03 and 1.03 female / days for those reared at 25°C and 30°C, while the lowest value was 1.01 female / day for those reared at 20°C.

4.2.5. Population double time (Dt):

Results revealed that population of *E. straminea* reared at 20°C recorded the longest double generation value being 86.32 days followed by those at 30°C being 28.47 days. While, the shortest double generation value was occurred for those reared at 25°C being 27.93 days.

From the above mentioned results it could be concluded that 25°C seemed to be the optimum degree of temperature for rearing *E. straminea* on olive seedlings. At this degree female fecundity, net reproduction rate, intrinsic rate of increase and finite rate of increase recorded their maximum values. Also, population doubling time was recorded its minimum value. These results are in harmony with those obtained by Arambourg (1985) who stated that favorable temperature for *E. olivine* was ranged between 20°C - 25°C. He added that extreme temperatures above 27°C decreased oviposition and low temperature caused a significant drop in egg laying.

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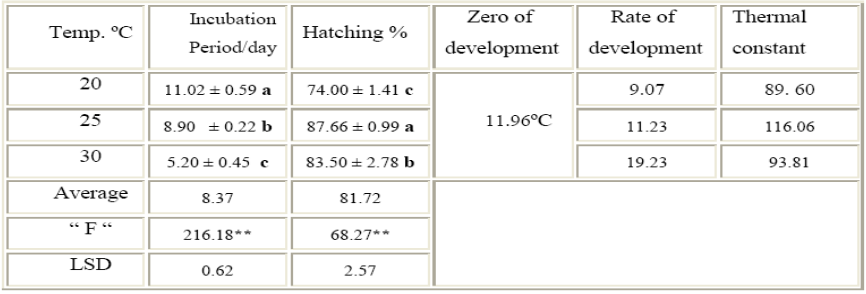
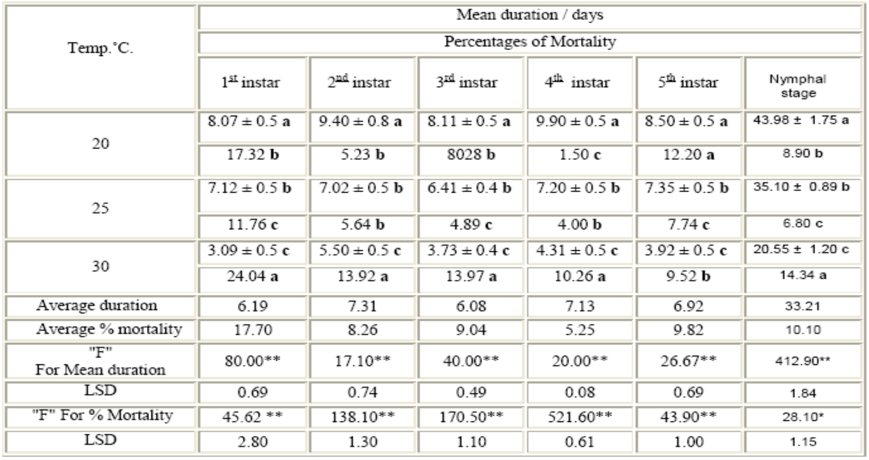
Table 1. Effects of three constant temperatures on egg incubation period, percentage of hatchability of olive Psyllid, zero of development, rate of development and thermal constant units of egg stage of *E. straminea*.



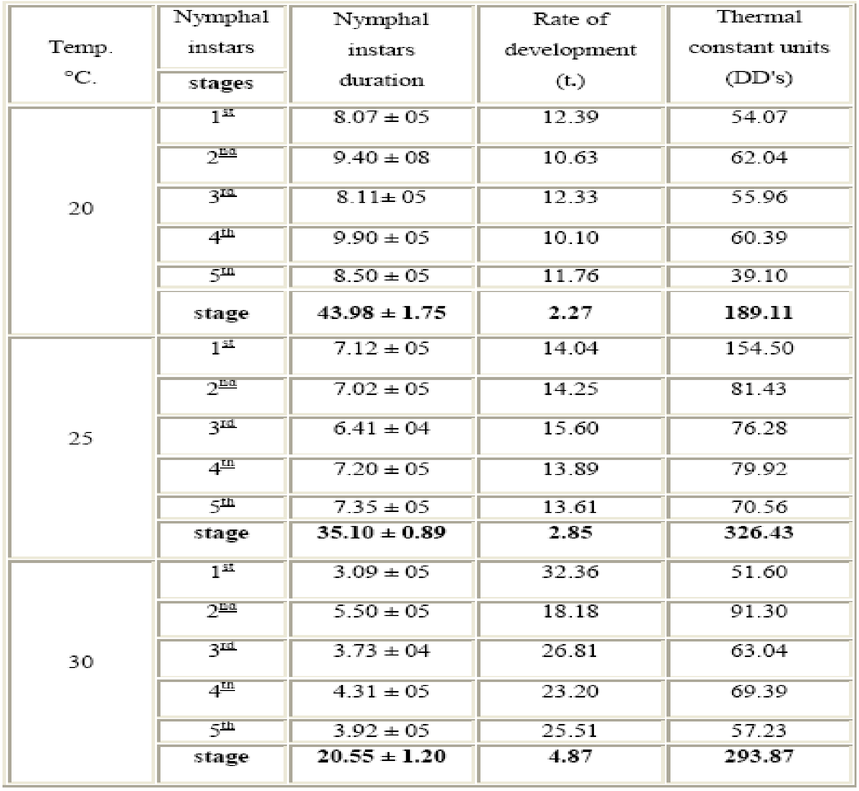
Temp. °C	Incubation Period/day	Hatching %	Zero of development	Rate of development	Thermal constant
20	11.02 ± 0.59 **a**	74.00 ± 1.41 **c**	11.96°C	9.07	89. 60
25	8.90 ± 0.22 **b**	87.66 ± 0.99 **a**		11.23	116.06
30	5.20 ± 0.45 **c**	83.50 ± 2.78 **b**		19.23	93.81
Average	8.37	81.72			
" F "	216.18**	68.27**			
LSD	0.62	2.57			

Table 2. Effects of three constant temperatures on means duration and mortality percentages of the five nymphal instars and nymphal stage of olive Psyllid, *E. straminea*.



Temp. °C.	Mean duration / days					
	Percentages of Mortality					
	1st instar	2nd instar	3rd instar	4th instar	5th instar	Nymphal stage
20	8.07 ± 0.5 **a**	9.40 ± 0.8 **a**	8.11 ± 0.5 **a**	9.90 ± 0.5 **a**	8.50 ± 0.5 **a**	43.98 ± 1.75 **a**
	17.32 **b**	5.23 **b**	8028 **b**	1.50 **c**	12.20 **a**	8.90 **b**
25	7.12 ± 0.5 **b**	7.02 ± 0.5 **b**	6.41 ± 0.4 **b**	7.20 ± 0.5 **b**	7.35 ± 0.5 **b**	35.10 ± 0.89 **b**
	11.76 **c**	5.64 **b**	4.89 **c**	4.00 **b**	7.74 **c**	6.80 **c**
30	3.09 ± 0.5 **c**	5.50 ± 0.5 **c**	3.73 ± 0.4 **c**	4.31 ± 0.5 **c**	3.92 ± 0.5 **c**	20.55 ± 1.20 **c**
	24.04 **a**	13.92 **a**	13.97 **a**	10.26 **a**	9.52 **b**	14.34 **a**
Average duration	6.19	7.31	6.08	7.13	6.92	33.21
Average % mortality	17.70	8.26	9.04	5.25	9.82	10.10
"F" For Mean duration	80.00**	17.10**	40.00**	20.00**	26.67**	412.90**
LSD	0.69	0.74	0.49	0.08	0.69	1.84
"F" For % Mortality	45.62 **	138.10**	170.50**	521.60**	43.90**	28.10*
LSD	2.80	1.30	1.10	0.61	1.00	1.15

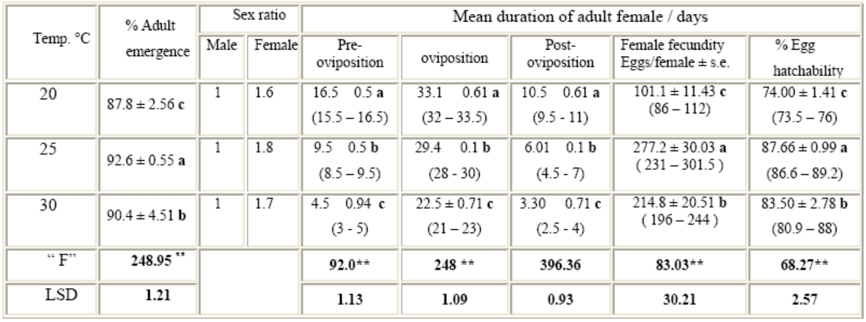
Table 3. Effects of three constant temperatures on rate of development and thermal constant units of the five nymphal instars duration of *E. straminea*.



Temp. °C.	Nymphal instars stages	Nymphal instars duration	Rate of development (t.)	Thermal constant units (DD's)
20	1st	8.07 ± 05	12.39	54.07
	2nd	9.40 ± 08	10.63	62.04
	3rd	8.11± 05	12.33	55.96
	4th	9.90 ± 05	10.10	60.39
	5th	8.50 ± 05	11.76	39.10
	stage	**43.98 ± 1.75**	**2.27**	**189.11**
25	1st	7.12 ± 05	14.04	154.50
	2nd	7.02 ± 05	14.25	81.43
	3rd	6.41 ± 04	15.60	76.28
	4th	7.20 ± 05	13.89	79.92
	5th	7.35 ± 05	13.61	70.56
	stage	**35.10 ± 0.89**	**2.85**	**326.43**
30	1st	3.09 ± 05	32.36	51.60
	2nd	5.50 ± 05	18.18	91.30
	3rd	3.73 ± 04	26.81	63.04
	4th	4.31 ± 05	23.20	69.39
	5th	3.92 ± 05	25.51	57.23
	stage	**20.55 ± 1.20**	**4.87**	**293.87**

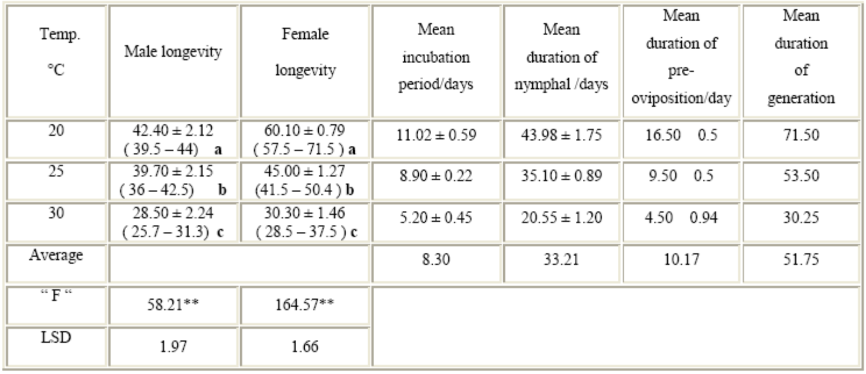
Zero of development for the five nymphal instars and nymphal stage: 1st = 13.3 °C / 2nd = 13.4 °C / 3rd = 13.1 °C / 4th = 13.9 °C / 5th = 15.4 °C / Nymphal stage = 14.5°C

Table 4. Effects of three constant temperatures on adults emergence, sex ratio and mean durations of pre-oviposition, oviposition, post-oviposition periods, female fecundity and percentage of egg hatchability of *E. straminea*.



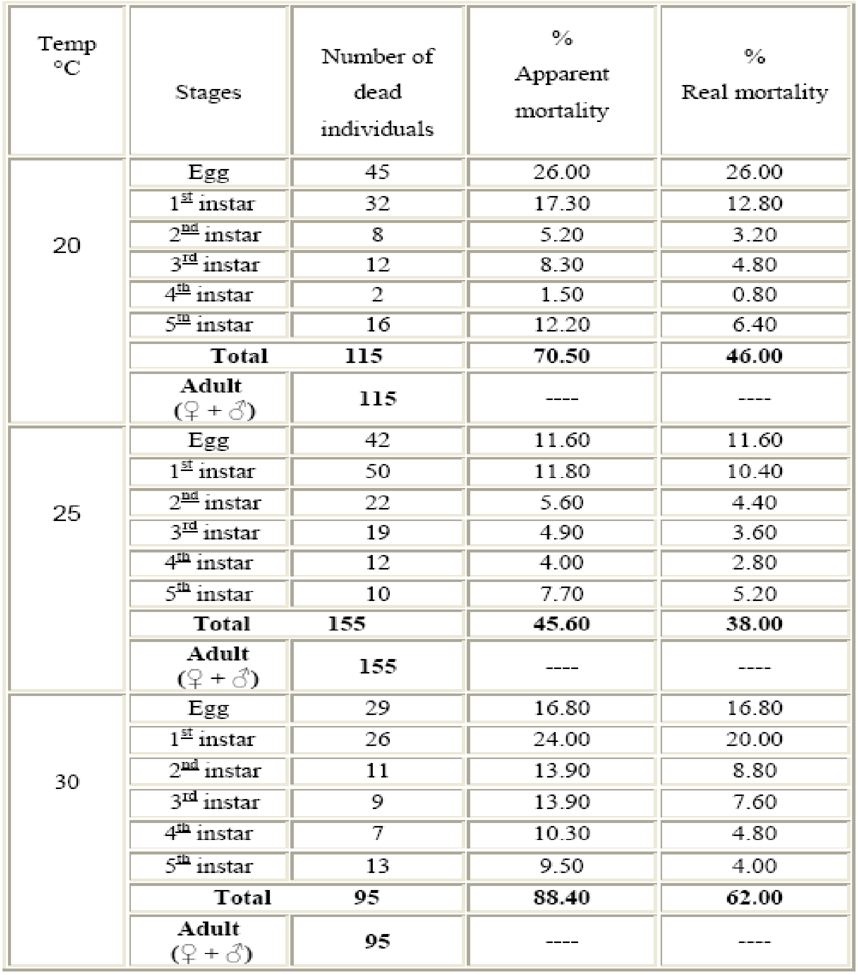
Temp. °C	% Adult emergence	Sex ratio		Mean duration of adult female / days				
		Male	Female	Pre-oviposition	oviposition	Post-oviposition	Female fecundity Eggs/female ± s.e.	% Egg hatchability
20	87.8 ± 2.56 **c**	1	1.6	16.5 0.5 **a** (15.5 – 16.5)	33.1 0.61 **a** (32 – 33.5)	10.5 0.61 **a** (9.5 - 11)	101.1 ± 11.43 **c** (86 – 112)	74.00 ± 1.41 **c** (73.5 – 76)
25	92.6 ± 0.55 **a**	1	1.8	9.5 0.5 **b** (8.5 – 9.5)	29.4 0.1 **b** (28 - 30)	6.01 0.1 **b** (4.5 - 7)	277.2 ± 30.03 **a** (231 – 301.5)	87.66 ± 0.99 **a** (86.6 – 89.2)
30	90.4 ± 4.51 **b**	1	1.7	4.5 0.94 **c** (3 - 5)	22.5 ± 0.71 **c** (21 – 23)	3.30 0.71 **c** (2.5 - 4)	214.8 ± 20.51 **b** (196 – 244)	83.50 ± 2.78 **b** (80.9 – 88)
" F"	**248.95 ****			**92.0****	**248 ****	**396.36**	**83.03****	**68.27****
LSD	**1.21**			**1.13**	**1.09**	**0.93**	**30.21**	**2.57**

Table 5. The effects of three constant temperatures on means longevity and durations of generation of *E. straminea*.



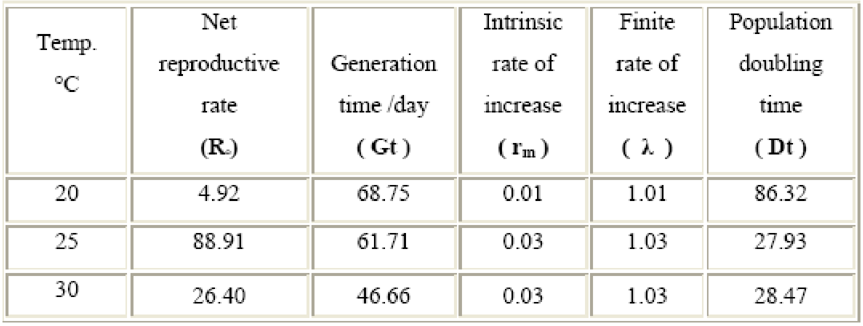
Temp. °C	Male longevity	Female longevity	Mean incubation period/days	Mean duration of nymphal /days	Mean duration of pre-oviposition/day	Mean duration of generation
20	42.40 ± 2.12 (39.5 – 44) **a**	60.10 ± 0.79 (57.5 – 71.5) **a**	11.02 ± 0.59	43.98 ± 1.75	16.50 0.5	71.50
25	39.70 ± 2.15 (36 – 42.5) **b**	45.00 ± 1.27 (41.5 – 50.4) **b**	8.90 ± 0.22	35.10 ± 0.89	9.50 0.5	53.50
30	28.50 ± 2.24 (25.7 – 31.3) **c**	30.30 ± 1.46 (28.5 – 37.5) **c**	5.20 ± 0.45	20.55 ± 1.20	4.50 0.94	30.25
Average			8.30	33.21	10.17	51.75
" F "	58.21**	164.57**				
LSD	1.97	1.66				

Table 6. Some life table parameters of *E. straminea* from egg stage to adults reared on three constant temperatures.



Temp °C	Stages	Number of dead individuals	% Apparent mortality	% Real mortality
20	Egg	45	26.00	26.00
	1st instar	32	17.30	12.80
	2nd instar	8	5.20	3.20
	3rd instar	12	8.30	4.80
	4th instar	2	1.50	0.80
	5th instar	16	12.20	6.40
	Total	**115**	**70.50**	**46.00**
	Adult (♀ + ♂)	**115**	----	----
25	Egg	42	11.60	11.60
	1st instar	50	11.80	10.40
	2nd instar	22	5.60	4.40
	3rd instar	19	4.90	3.60
	4th instar	12	4.00	2.80
	5th instar	10	7.70	5.20
	Total	**155**	**45.60**	**38.00**
	Adult (♀ + ♂)	**155**	----	----
30	Egg	29	16.80	16.80
	1st instar	26	24.00	20.00
	2nd instar	11	13.90	8.80
	3rd instar	9	13.90	7.60
	4th instar	7	10.30	4.80
	5th instar	13	9.50	4.00
	Total	**95**	**88.40**	**62.00**
	Adult (♀ + ♂)	**95**	----	----

Table 7. Summary of life table parameters for *E. straminea* reared at three constant temperatures.



Temp. °C	Net reproductive rate (R_o)	Generation time /day (Gt)	Intrinsic rate of increase (r_m)	Finite rate of increase (λ)	Population doubling time (Dt)
20	4.92	68.75	0.01	1.01	86.32
25	88.91	61.71	0.03	1.03	27.93
30	26.40	46.66	0.03	1.03	28.47

TWO NEW LIOCRANID SPECIES RECORDS FROM TURKEY (ARANEAE: LIOCRANIDAE)

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ABSTRACT: Two liocranid spiders, which are species new to Turkey, *Agroeca parva* Bosmans, 2011 and *Mesiotelus scopensis* Drensky, 1935, are recorded. The illustrations for all of the species are also provided.

KEY WORDS: *Agroeca*, fauna, *Mesiothelus*, spiny-legged sac spiders.

Liocranidae are small to medium-sized araneomorph spiders, generally known as ground dwellers occupying tree litter on the forest floor. Symbiosis with ants and termites has also been recorded in this family. They are entelegyne and ecribellate, with two tarsal claws and eight eyes (Jocqué & Dippenaar-Schoeman, 2006). The global fauna consists of 186 known species in 30 genera; the family is represented in Turkey by 9 species and 7 genera (Bayram et al., 2012).

The purpose of this brief article is to present the liocranid spiders *Agroeca parva* and *Mesiotelus scopensis* as two new records for the Turkish araneofauna.

MATERIAL AND METHODS

Samples examined were collected from olive groves in the Aegean region of Turkey using hand aspirators and pitfall trap surveys. All specimens were directly placed into 70% ethanol; while trap samples were previously exposed to 80% ethylene glycol used as a preservative liquid in the pitfall traps. Species identifications were made using a Leica S8AP0 stereomicroscope and based on genitalia drawings of Bosmans (2011) for *A. parva* and Bosmans et al. (2009) for *M. scopensis*.

RESULTS

Agroeca parva Bosmans, 2011
(Figs. 1-5)

A. p.; Bosmans, 2011: 19, f. 11-14 (original description of male & female).

Material examined Specimen collected at night in active searching of the ground in olive gardens; 1 female Muğla Province, Milas District, Kıyıkışlacık Village (37°16'38.80"N; 27°33'47.97"E), 10.04.2011, leg. M. Elverici | Specimen acquired from pitfall trap survey between 01.10.2010 - 20.11.2010 in olive gardens; 1 male same locality, leg. M. Elverici.

General distribution: Greece (Platnick, 2012)

Comments: The leg spination pattern of paired ventral spines on the anterior legs (three on the metatarsus, two on the tibia) is diagnostic for the genus

Agroeca, which is already represented by two species in Turkey: *A. inopina* O. P.-Cambridge, 1886 and *A. proxima* (O. P.-Cambridge, 1871). These two species can be readily identified by the morphology of male tibial apophysis. *A. parva* has a relatively longer tibial apophysis compared to the aforementioned species, with a truncate tip. It also has a smaller body size. As the type locality of *A. parva* is Lesbos Island (Greece), and considering the broad distribution of the genus in the region, it is not particularly surprising to find this species on the Aegean coastline of Turkey.

Mesiotelus scopensis Drensky, 1935
(Figs. 6-11)

M. cyprius s.; Drensky, 1935: 106, f. 5 (original description of female).
M. cyprius s.; Hadjissarantos, 1940: 96, f. 32a-b (original description of male).
M. skopensis; Bosmans et al., 2009: 34, f. 29-33 (male & female; elevated to species level, **lapsus**).

Material examined Specimens collected at night in active searching of the ground or collected under rocks in olive gardens; 2 females Muğla Province, Milas District, Kıyıkışlacık Village (37°16'38.80"N; 27°33'47.97"E), 20.11.2010, leg. M. Elverici 1 male 5 females same locality, 4.03.2011, leg. M. Elverici 2 females same locality, 10.04.2011, leg. M. Elverici | Specimens acquired from pitfall trap surveys in olive gardens; 3 females Muğla Province, Marmaris District, Kıyıkışlacık Village (37°16'38.80"N; 27°33'47.97"E), 29.5.2010 - 29. 6. 2010, leg. M. Elverici 2 females same locality, 01.10.2010 - 20.11.2010, leg. M. Elverici 2 males 1 female same locality, 20.11.2010 - 4.3.2011, leg. M. Elverici 3 males 2 females same locality, 4.3.2011 - 9.4.2011, leg. M. Elverici.

General distribution: Greece, Bulgaria and Macedonia (Platnick, 2012)

Comments: *Mesiotelus* is represented by 15 described species, mostly known from the Mediterranean region and its peripheries; although there are representatives distributed from the Canaries to China along the southern part of the Palearctic region. The taxonomic validity of the only known species from Kenya, *Mesiotelus pococki* Caporiacco, 1949 is uncertain. This problem was first raised by Marusik & Guseinov (2003). After examining the female genitalia of *M. pococki* from illustrations and description provided by Caporiacco (1949), it is evident that the epigyne structure is simple and pentangular, well sclerotized at the margins and compressed in the middle; and thus inconsistent with the epigyne structure typical of the genus *Mesiotelus*. Moreover, Bosmans et al. (2009) have stressed the necessity of a generic revision. Other species of the genus already known from Turkey are *M. annulipes* (Kulczyński, 1897) and *M. tenuissimus* (L.Koch, 1866).

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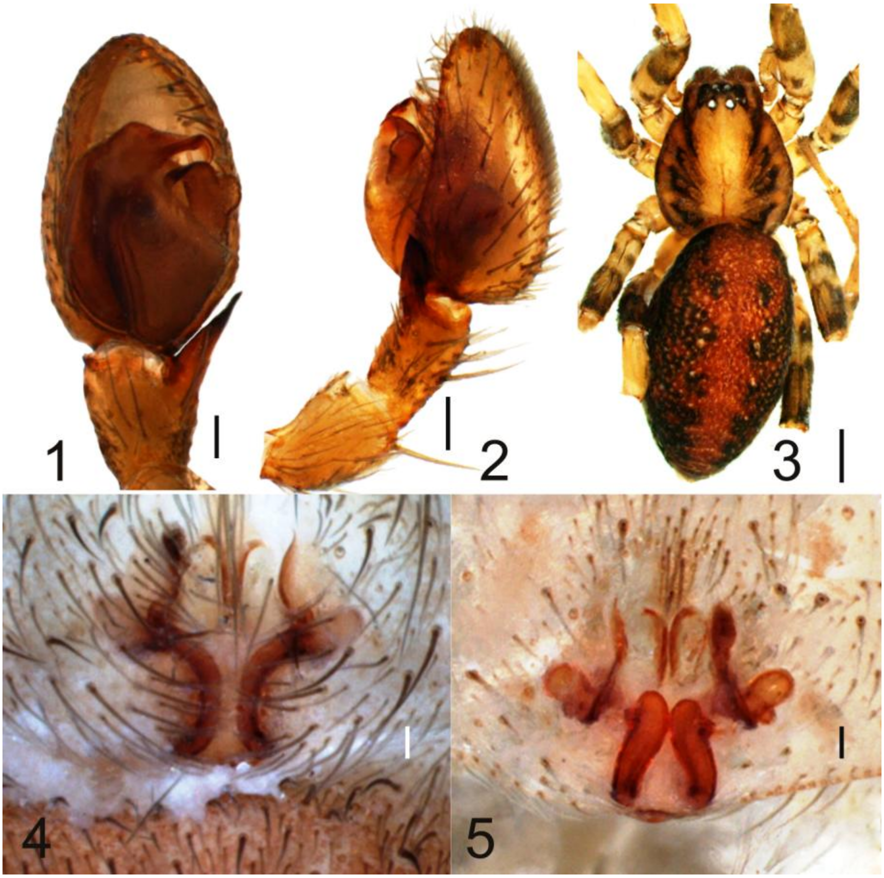
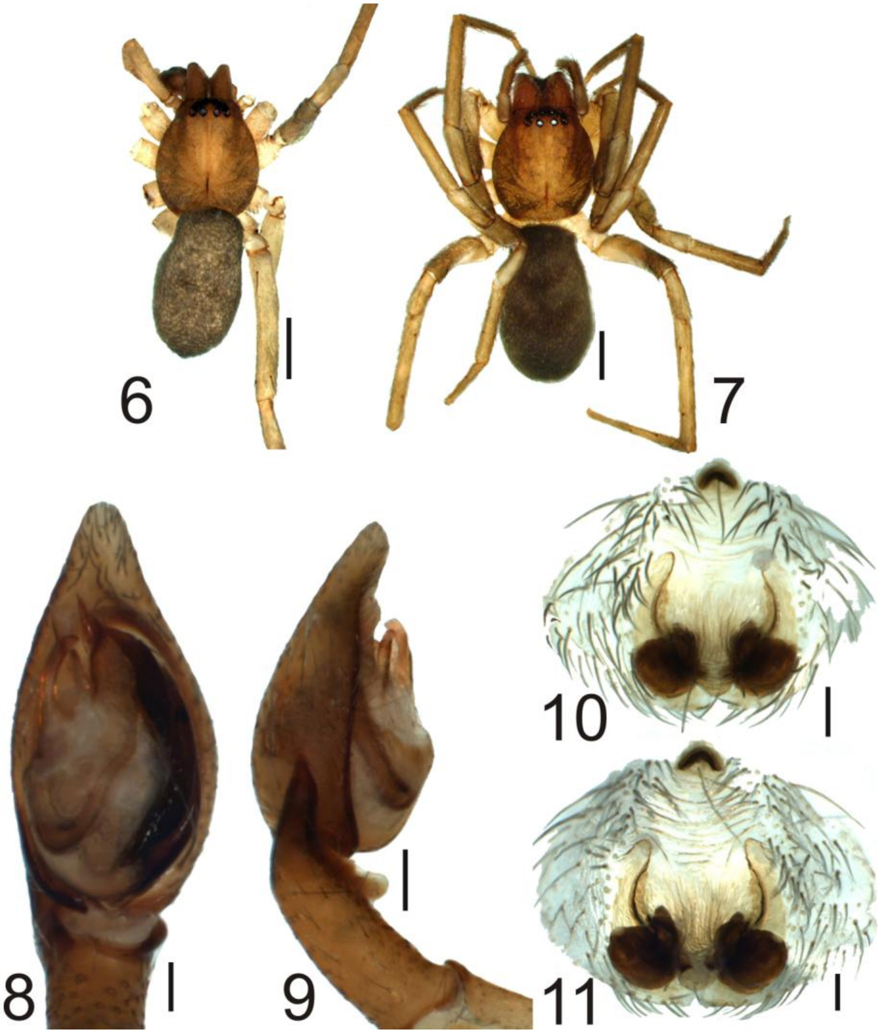


Figures 1-5. *Agroeca parva* Bosmans, 2011: 1 Male palp, ventral view 2 Ditto, retrolateral view 3 Female, habitus 4 Epigyne, ventral view 5 Ditto, dorsal view Scale lines: 1, 2, 4, 5 0.1 mm 3 0.5 mm.



Figures 6-11. *Mesiotelus scopensis* Drensky, 1935: 6 Male, habitus 7 Female, habitus 8 Male palp, ventral view 9 Ditto, retrolateral view 10 Epigyne, ventral view 11 Ditto, dorsal view Scale lines: 6,7 0.25 mm 8-11 0.1 mm.

STUDIES ON THE EMERGENCE BEHAVIOUR OF THE OAK TASAR SILKMOTH, *ANTHERAEA PROYLEI* JOLLY

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ABSTRACT: The Indian oak tasar silkworm, *Antheraea proylei* Jolly behaves uni- and weak bivoltinism depending upon the prevailing environmental conditions. The silkworm undergoes pupal diapause for about eight months (June to January) after spring crop. During prolonged preservation, large quantity of seed cocoons are lost due to erratic emergence, pupal mortality, decrease in vigour, etc. The main reason behind erratic emergence could be attributed to weak voltinism of the silkworm. However, the maintenance of suitable environmental conditions during the preservation of cocoon plays a key role for emergence of moths. The summer or autumn crop can be taken up by breaking the pupal diapause subjecting to photoperiodic treatment of the seed cocoons. Considering the problems in relation to emergence of moths encountered by the silkmoth, observations were made exclusively on different aspects of emergence pattern of *A. proylei* during normal grainage period in spring crop and long preservation (pupal diapausing) period in the present study.

KEY WORDS: Emergence behaviour, oak tasar silkmoth, *Antheraea proylei*, pupal diapause.

In India, the oak tasar culture has been widely practiced in the sub-Himalayan belt extending from Manipur in the east to Jammu and Kashmir in the west where oak flora is grown abundantly in nature. The Indian oak tasar silkworm, *Antheraea proylei* Jolly is wild in nature but becomes semi-domesticated after exploitation. The silkworm behaves uni- and weak bivoltinism depending on the prevailing environmental conditions. The insect exhibits facultative diapause in pupal stage under short-day (8 hr and below) and long-day (10-14 hr) photophase condition and tends towards univoltinism under the short day regime of sub-Himalayan belt under the low temperature (below 20^{o}C). In the north eastern region the spring crop is the main seed / commercial crop which start during the first week of March coinciding with the natural sprouting of oak plant, *Quercus acutissima*, the main food plant of the silkworm. However, summer or autumn crop can also be taken up by breaking the pupal diapause subjecting to photoperiodic treatment to the seed cocoons.

The emergence of adult moths in general is governed by a circadian rhythm and this behaviour is very common among the lepidopterans (Matthews & Matthews, 1988; Horodyski, 1996). Photoperiod may be one of the key factors controlling the onset of adult behaviours. The *A. proylei* undergoes pupal diapause after spring crop extending through about eight months period from June to January. During this long preservation period seed cocoons were lost due to erratic emergence. The main reason behind erratic emergence may be due to weak voltinism of the silkworm. However, the maintenance of suitable environmental conditions during the preservation of cocoons played key role for emergence of moths. Due to long period of diapause and exposure to varied climatic conditions, substantial percent of seed cocoon loss was reported in *Antheraea mylitta* D. (Kapila et al., 1992). In tropical insects, environmental regulators, such as day length, temperature and rainfall regulate their diapause (Denlinger, 1986) and even higher temperature blocks initiation of development (Hackett & Gatehouse, 1982). Onset of rains is directly linked to diapause termination and synchronised adult insects availability (Wolda & Denlinger, 1984; Denlinger, 1986). Impact of temperature on growth, development and reproduction of insect has been studied by many workers in different insects (Malik, 2001; Ahmad et al., 2008). The moth emergence behaviour of tropical tasar silkworm, *A. mylitta* D. was studied in different preserved conditions and worked out its suitability for synchronizing seed production (Dinesh Kumar et al., 2012). However no study has been made on the emergence behaviour of the oak tasar silkmoth, *A. proylei*, both in the grainage period and long preservation period for synchronised seed production and its correlation with the climatic factors. Considering the problems in relation to emergence of moths encountered by the oak tasar silkmoth during normal grainage period in spring crop and long preservation (pupal diapausing) period, a series of observation were made exclusively on different aspects of emergence pattern of *A. proylei* in order to make grainage performance successful, such as less span of emergence, synchronised moth emergence, higher coupling percentage, less pupal mortality, high seed recovery, etc.

MATERIALS AND METHODS

The univoltine lot of oak tasar silkworm, *A. proylei* Jolly was reared during spring crop in the outdoor condition as normal practice providing bush plantations of oak plant, *Quercus acutissima*. The cocoons were harvested during the last week of April to middle of May. After sorting, the diapaused seed cocoons were preserved under semi-dark condition in the grainage building of Regional Tasar Research Station, Imphal for prolonged preservation up to eight months, *i.e.*, June to January till the grainage for seed preparation of next spring crop. In another set of experiment, the seed cocoons selected from the prolonged preservation lot were kept in another grainage building for seed preparation of spring crop rearing. For conducting the spring crop grainage, the grainage house is maintained at 24-26°C temperature and 70-80% R. H. The emergence behaviour of the silkmoth was recorded from both the conditions of prolonged preservation and spring crop grainage. Data were recorded for daily emergence percentage of male, female and total from both the lot. The temperature (minimum & maximum) and relative humidity were recorded from both the preserved conditions.

The data on pattern of erratic emergence for five years in both the preserved lots (prolonged and spring crop grainage) were also analyzed to see the behaviour of the moth emergence. Besides, such studies may also provide valuable information on the behaviour of the adults because of nocturnal habit of the moths. The response of the silkworm reared under different photophase to erratic emergence was also investigated. The correlation studies between erratic emergence and abiotic factors (temperature and relative humidity) were also worked out and analysed statistically. In another experiment, every two hourly emergence of male and female moths were also recorded to study the rhythm of emergence through hours of the day. The investigations were conducted at Regional Tasar Research Station, Central Silk Board, Imphal.

RESULTS AND DISCUSSION

Pattern of erratic emergence from the diapausing cocoons: Figure 1 showed the five years data on the weekly trend of erratic emergence of oak tasar silk moths from the diapausing cocoons. It was found that about 7-15% of moths were emerged erratically during the period of about eight months (June-January). During the period, the fluctuating emergence was observed with slight fluctuating temperature but variable relative humidity. However, it was found that higher the temperature, higher the emergence and vice-versa. The emergence started in the first week of June to a negligible extent but it suddenly increased reaching 0.89% in the fourth week of June. The second highest peak was observed in the second week of July with 0.90% emergence. The emergence of male moths (0.51%) was comparatively more than the females (0.39%) up to the second week of July. Further the decreasing and increasing trend of emergence was observed with peaks in alternate weeks and finally a higher peak of emergence (0.87%) in the second week of October. During the peak period the weather factors like minimum and maximum temperature and relative humidity ranged from 20.86-25.59°C, 26.01-29.44°C and 70.01-81.80% respectively. The emergence declined gradually from the third week of October onwards and continued sporadically (0.5%) up to the third week of January where minimum and maximum temperature and relative humidity ranged from 10.05-20.14°C, 17.40-24.67°C and 67.48-75.09% (Fig. 1). Thereafter, the diapause in the prolonged preserved seed cocoons is observed to be terminated with the increase of temperature and photoperiod.

Pattern of emergence during spring crop grainage operation: In oak tasar culture, spring crop is the only successful crop where the prevailing climatic condition is suitable for the silkworm rearing. Besides, brushing of worm is coincided with the natural sprouting of the oak plants. Five year's data on weekly pattern of moth emergence during spring crop grainage revealed that moth emergence started from the last week of January with a total emergence of 1.38% (0.55% male and 0.84% female) and continued up to the last week of March with 2.82% (0.82% male 2.00% female). The peak emergence was obtained during the third week of February with 26.54% emergence and declined gradually (Figure 2). The span of emergence during grainage ranged from 59 to 75 days and the average total emergence was recorded as 87.73%. The sex ratio of the emerged moths was 1 : 0.78 (male: female).

Correlation studies between erratic emergence of moths and abiotic factors: The correlation studies between moth emergence and abiotic factors revealed that the temperature and relative humidity exhibited positive correlation with the emergence of moth from the diapausing cocoon (Table 1). Minimum temperature exhibited significant positive correlation with both male (r=0.478) and female (r=0.509) emergence but highly significant with total emergence (r=0.566, P<0.001). Significant correlation was also obtained between maximum temperature and emergence (Table 1). However, the correlation was non-significant between relative humidity and both male and female emergence separately. But it was significant with the total emergence (r=0.412, P<0.05). From the above studies, it can be inferred that temperature played significant role in influencing the erratic emergence of moths. Moreover, minimum temperature is responsible to minimise the emergence. Our finding corroborates the finding of Malik (2001); Ahmad et al. (2008) which indicated that temperature has an impact on growth and development of insect. During the period of about four months, *i.e.*, October to January, there was a decreasing trend of emergence with minimum temperature ranging from 10.05-20.14°C (Fig. 1). It was reported that the environmental regulators, like day length, temperature and rainfall played main role for regulating their diapause in tropical insects and even higher temperature blocks initiation of development (Denlinger, 1986; Hackett & Gatehouse, 1982).

In another set of experiment, a batch of seed cocoons was preserved in four different photophases, *i.e.*, L : D 16 : 8, 12 : 12, 8 : 16 and 0 : 24 and another batch was preserved in L : D 16 : 8 photophase only to see the emergence response of the worms reared under different photophases. Grainages of both the batches were conducted separately in both the conditions. The rearing also conducted in the respective photophases separately as mentioned above. The cocoons were harvested in the middle of April and kept in different photophases to observe the emergence response. The moth emergence started in the second week of May in all the photo-treatments and continued up to the second week of July. The worms reared at L : D, 16 : 8 responded nicely with 99.8% emergence within 45 days. Maximum emergence was recorded during the second and third week of May (93.5%) but other treatments showed irregular emergence in variable span (Table 2).

Rhythm of emergence, *i.e.*, the pattern of emergence over the hours of the day was also studied for three consecutive days. It was recorded that most of the moths emerged between 17.00 h and 23.00 h with 78.2% emergence and highest peak was observed at 19.00 h (31.90%). However, sporadic emergence continued throughout the hours of the day in negligible amount (Fig. 3).

Sufficient seeds can be prepared at different intervals out of the erratically emerged moths from the prolonged preservation of cocoons. The maximum of them are unutilized due to non-availability of good foliage. The rearing of these dfls during second crop (summer/ autumn) as trial was almost a failure in general at lower altitude whereas successful at middle and high altitude during June to October months. Some of the workers also have studied the problems of erratic emergence during prolonged preservation of oak tasar silkmoth and opined to preserve the seed cocoons at higher altitudes (above 2000 m MSL) from November to February so that the problems can be resolved considerably. However, heavy loss of seed cocoons was encountered due to pupal mortality up to 15-20% during transportation of seed cocoons from lower to higher altitudes. Among the abiotic factors, temperature and photoperiod are considered as the two main factors controlling diapause. If these factors are manipulated without breaking diapause, the cocoons can be preserved for a considerable period of time without any emergence.

Till recently, attempts have been made to preserve the seed cocoons at the place of harvest after rearing in respective places preferably in middle and high altitudes to minimise the stray emergence pattern during long term preservation after spring crop rearing. Therefore, it is encouraging that in oak tasar culture the silkworm rearing as well as seed cocoon preservation can be done at the same agro-ecological zones by manipulating the suitable environmental factors. After repeated rearing, the silkmoths will be acclimatized in the respective locality and suitable technique of seed cocoon preservation should be worked out according to the locality so as to check the erratic emergence of moths.

Therefore, in order to check erratic emergence of moths during prolong preservation period, a suitable preservation technique is to be worked out with different methods at different places considering the role of abiotic factors mainly temperature and photoperiod. Prolonged preservation of seed cocoons leads to low fecundity and low hatchability (Singh *et al.* 2003). Regarding the emergence of moths during spring crop grainage, efforts are to be made to shorten the grainage span as much as possible so as to coincide the brushing with the availability of good foliage of oak sprouts and also to avoid preservation of eggs in cold storage which often leads to loss of seed and low hatchability. During spring crop grainage, seed cocoons should be consigned and treated as and when required only. From the present study, it is deduced that photophase and temperature play vital role in regulating the pupal diapause of the oak tasar silkmoths. During prolonged preservation of cocoon, high temperature to the tune of 26.01 to 29.44°C induces higher sporadic emergence and lower temperature ranged from 10.05 to 20.14°C is found to be suitable to maintain the pupal diapause.

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Table 1. Correlation studies between erratic emergence of moths with abiotic factors in *Antheraea proylei* J.

Sl. No.	Combination (variables)	a	b	'r'
1.	Min. Temp. vs. Male emergence	-0.012	0.013	0.478**
2.	Min. Temp. vs. Female emergence	0.054	9.167	0.509**
3.	Min. Temp. vs. Total emergence	0.066	0.021	0.566***
4.	Max. Temp. vs. Male emergence	-0.142	0.015	0.432*
5.	Max. Temp. vs. Female emergence	-0.068	0.012	0.521**
6.	Max. Temp. vs. Total emergence	0.148	0.014	0.500**
7.	Relative humidity vs. Male emergence	-0.737	0.013	0.334 NS
8.	Relative humidity vs. Female emergence	-0.419	8.878	0.342 NS
9.	Relative humidity vs. Total emergence	-1.137	0.022	0.412*

* P<0.05; ** P<0.01; *** P<0.001; NS: Non-significant

Table 2. Emergence response of *Antheraea proylei* J. moths after rearing and preservation of cocoons under different photophases.

Photophase during silkworm rearing (L : D)	Photophase during cocoon preservation (L : D)	Weekly Emergence (%)									Total Emergence (%)	Span of emergence (days)
		MAY			JUNE				JULY			
		II	III	IV	I	II	III	IV	I	II		
16 : 08	16 : 08	58.0	35.5	0	2.1	2.1	0	2.1	0	0	99.8	45
12 : 12	12 : 12	2.2	0	0	0	0	0	2.2	0	0	4.4	45
08 : 16	08 : 16	2.1	0	0	0	0	0	0	2.1	0	4.2	52
00 : 24	00 : 24	31.0	0	0	0	0	0	0	0	0	31.0	08
16 : 08	16 : 08	58.0	35.5	0	2.1	2.1	0	2.1	0	0	99.8	45
12 : 12	16 : 08	0	0	0	0	3.2	16.6	53.0	14.0	3.2	90.0	32
08 : 16	16 : 08	4.4	0	0	0	0	8.8	75.5	2.2	2.2	93.1	60
00 : 24	16 : 08	14.6	16.6	0	2.1	6.3	25.0	10.4	2.1	8.3	85.4	60

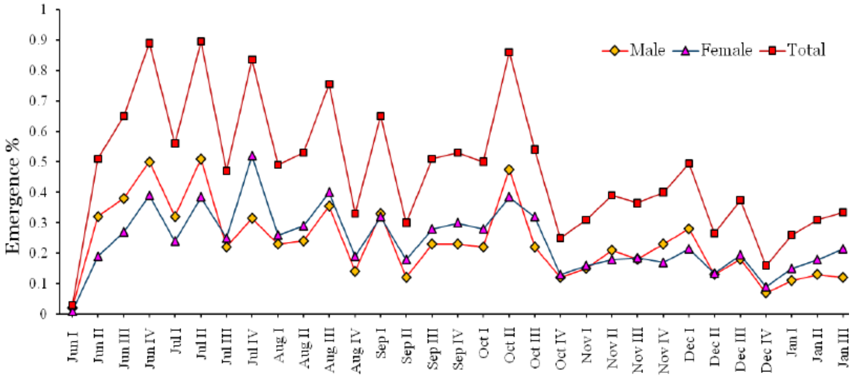

Figure 1. Weekly pattern of erratic emergence from the diapausing cocoons of *Antheraea proylei* J.

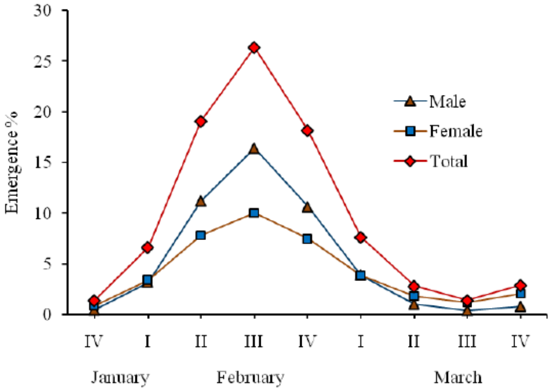

Figure 2. Weekly emergence pattern of *Antheraea proylei* J. During spring crop grainage operation.

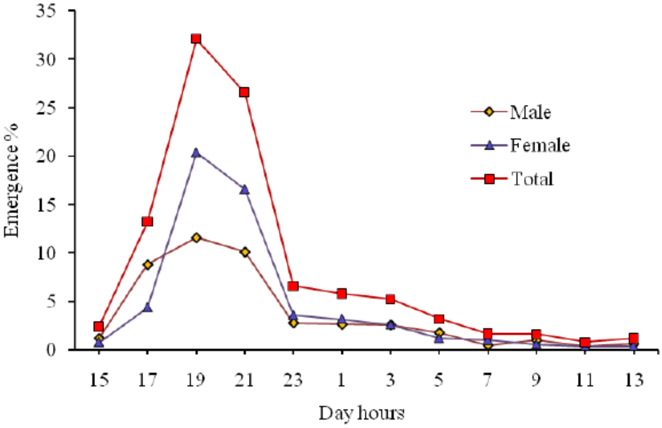

Figure 3. Rhythm of emergence in univoltine stock of *Antheraea proylei* J.

(a) (b)

Figures 4. a) Oak tasar silk moths in the cocoon garland, b) Moth (close up view).

(a) (b)

Figures 5. a) Female moth, b) Male moth.

(a)

Figures 6. a) Oak tasar cocoon garlands inside the cage in the grainage.

ESTIMATE BIODIVERSITY ARANEIDS (ARTHROPODA: QUELICERIFORMES) AND FORMICIDAE (INSECTA: HYMENOPTERA) IN CULTURES OF SOYBEAN AND PEANUTS FROM A SITE OF THE ECOREGION PAMPEANA

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ABSTRACT: The arthropods are a dominant group due to his morphologic characteristics. La Pampa not only possesses a scanty knowledge of the arthropodological fauna, but also presents an expansion of the agricultural area on the natural ecosystems. As controllers of these plagues, we find the spiders and the ant. The aim of this work is to evaluate the biodiversity of spiders (araneids) and the ants (formicids), in two crops peanut and soybean located in Maisonave, North-East of La Pampa, (64° S and 35° O). Samples were carried about all over a hectare of surface from December, 2008 to March, 2009. In every plot three transects were settled separated one another by 25 meters. In each transect each pitfall was placed to a distance of 25 meters. The obtained material was preserved in alcohol to 80% and settled in the subject Biology of the Invertebrate II, Faculty of Exact and Natural Sciences, of the U.N.L.Pam. The analyses were performed with Estimates. The obtained results show a dominance of the species *Solenopsis saevissima* in the ants (formicids); while in the spiders (araneids) the families Lycosidae and Thomisidae are the ones which present major abundance.

KEY WORDS: Biodiversity, soy bean, peanut, crop, Araneidae, Formicidae, Argentina.

Knowledge of biodiversity is a global challenge, due to the environmental impact of human activities on natural systems (Lagos, 2004), with the protection of biodiversity in a relevant global conservation.

In Argentina there is a simplification of the landscape for expansion and intensification of agriculture, causing a rapid fragmentation of the landscape (Zaccagnini et al., 2008) resulting in biodiversity losses.

There is concern about the possible decline of biodiversity and hence the sustainability of the current production system (Houston, 1994). In agricultural systems, biodiversity provides ecosystem services such as nutrient recycling, control of the local microclimate, regulation of local hydrological processes, the abundance of undesirable organisms and detoxification of harmful chemical residues (Altieri & Letorneau, 1982; Andow, 1991).

Conserving biodiversity is important to the proper functioning of the agro ecosystem (Zaccagnini & Calamari, 2001). Arthropods make up a high percentage of this diversity. Greater heterogeneity in culture stablish more diverse and / or abundant arthropods than in a monoculture. In the latter, removal of plant diversity reduces food sources and shelter for phytophagous organisms and their natural enemies causing increased damage from insect pests (Weaver, 1995). It is at this point that becomes important the need to know the crop arthropods for a possible IPM.

Furthermore, studies have shown that margins adjacent to agricultural areas also support arthropod populations by providing alternative sources of food, protection from pesticides and shelters during the cold season (Weyland & Zaccagnini, 2008).

The cultures began to increase, producing a fragmentation, leaving few remaining natural areas, thereby impairing diversity.

In recent years, in our province, there was a marked increase in crops such as soybeans and peanuts: in the north dominates the peanut crop, while in the central area soybean predominates.

Peanuts (*Arachis hypogaea* L.) is an annual legume 50 cm tall, presenting branched stem with oval leaves (Gispert, 1984), and has a taproot (Gillier & Wild, 1970). Argentina is concentrated mainly in the production and marketing of peanuts and edible fruit confectionery type, which are mainly exported to the European Union (Boito et al., 2006), although it is worth noting its importance as oilseed.

The soybean *Glycine max* (L.) Merrill, has a taproot, pubescent pods containing seeds rounded (EEA INTA Marcos Juárez, 2007). It is remarkable for its high protein content and nutritional quality. It occupies an intermediate position between legumes and oilseeds (Kantolic et al., 2006). The soybean and its derivatives (pellets, oil, etc.) are the main export of Argentina, one of the leading producing countries worldwide. This increase in the area planted with soybeans gave agricultural frontier expansion, due to a rapid clearing system and the replacement of natural or for crops, which means a direct loss of native biodiversity (Donald, 2004; Grau et al., 2005).

In most of them, particularly in soybean and peanut, general insecticides are applied to achieve high productivity. This results in the disappearance of natural enemies (biological control) on harmful species, which is one of the pillars of integrated pest management (IPM). Spiders and ants are important predators of other arthropods and often spatially and temporally share the same habitat.

In the last decade there has been an increasing interest in generalist predators, especially spiders (Rinaldi, 1998; Avalos et al., 2005), which are numerically important and are a diverse and successful group in all ecosystems because of its ease to disperse and colonize new habitats (Halaj et al., 1998). Their abundance and diversity in general, are positively correlated with environmental diversity at different spatial scales (Samu & Lovei, 1995), which is reflected in the variety of behaviors that they own and the habitats they occupy, and also the potential to capture a larger number of prey (Nyffeler et al., 1987, 1992; Provencher & Riechert, 1994; Riechert & Lawrence, 1997; Riechert & Maupin, 1998; Riechert 1999). The diet of spiders can be restricted when a prey type is offered in high densities, as often happens with certain pests in monoculture (Cheli, 2004). Among the arthropods, arachnids stabilizers act as agents of insect populations (Pérez-de la Cruz & de la Cruz-Perez, 2005). The study of spider predation on arthropods associated with crops, is important because of the wide diversity of insects in the agroecosystem, which include phytophagous species, predators, parasitoids, pollinators and medically important hematophagous, among others (Entwistle, 1972, 1982), involving the spiders as organisms that prey mainly insects and are part of the natural enemy complex of the same in almost all terrestrial ecosystems (Turnbull, 1973; Foelix, 1996).

Another important predator group is the ant crops. For its high diversity and biomass develop significant roles in various ecosystems (Corrêa et al., 2006; Tizón et al., 2009; Quirán & Pilati, 1997), an activity that is associated with social behaviors that develop as division of labor within the colony and cooperative work (Schultz, 2000; Wilson & Hölldobler, 2005) held in their nests, those favoring an acceleration of nutrient cycling caused by the addition of organic matter (Farji

Brener, 1992; Quirán & Casadío, 1994). They operate on several trophic levels as diverse invertebrate predation, removal and seed consumption (Hölldobler & Wilson, 1990; Pilati et al., 1997; García & Quirán, 2002), highlighting the importance here of granivorous ants (Rios Casanova et al., 2004; Pilati & Quirán, 1996; Claver, 2000). However, the importance of ants belonging to other associations as mycophagous food, fodder and generalist predator has not yet been determined, although they are also diverse and abundant in these agricultural areas (Mac Kay, 1991; Rojas & Fragoso, 2000; Casadío & Quirán, 1990).

It is necessary to know the regional biodiversity of arthropods for good practice for the protection and conservation, based on local wealth of an area at a given time, allowing estimates to larger spatial and temporal scales. Estimation of arthropods is difficult, being a hyper diverse group and most successful evolving on earth. Its anatomical and physiological characteristics have allowed them to occupy a variety of niches and micro habitats (Lagos, 2004).

In some cases they act as pollinators and dispersal of seeds in reducing plant fragments and nutrient cycling (Lagos, 2004). This study is conducted to determine the biodiversity and araneids and formicids taxocenosis of each of the cultures to determine the diversity of arthropods according to the physiognomy (structure and architecture) of the plants and of the functional groups along the phenology. It is hoped that the diversity of arthropods and functional groups vary along crop phenology, which in turn is influenced by the structure and architecture of the plant and that the abundance and richness of arthropods decrease in the centre of the cultivation.

MATERIALS AND METHODS

Study area:

The study was realized in two plots of peanuts and soy, in Maisonave (35° 2' S and 62° W), Department of Realicó (La Pampa, Argentina), (146 m asl), which are located biogeographically in the Province of Espinal, the Dominio chaqueño (Cabrera 1994) and geographically in the center-north of the province La Pampa, limiting to the north with Cordoba. This area which presents climatic differences, was subdivided in three agroecological subzones: Subzone II A (plain of hills and ridges); Subzone II B (plain with central stone) and Subzone II C (plain of the plateaus with stone) (Lorda et al., 2008).

Subarea II B comprises a small strip east Rancul Department, eastern half Department Conhelo and the Departments of Realicó, Trenel and Capital, with a total area of 1,043,741 ha.

The rainfall is about 670 mm per year, with an important month and annual variation. The climate is template with average temperature in winter of 7.7 °C and in summer of 22.8 °C, the soils are sandy, with presence of clays in the lower areas (Cano et al., 1980). The 180 km of orientation N-S of this Subzone determine climatic differences. This situation determines a displacement in the sowing date of the summer crops between 10-15 days.

The limitations are: little effective depth, excessive natural drainage, seasonal drought and potential wind erosion in view of improper practices of soil management.

Production systems are adapted to the climate conditions and the variability in the depth of the stone, which may emerge in certain areas, or be found between 60 and 120 cm. deep. The most fertile soils are in a fringe that extends from the Provincial Route No. 2 to the north in the Department Realicó and from 40 to 50 km with direction E-W, taking as axis the National Route N° 35. They make it possible the excellent development of the forage crops and thick harvesting as sunflower or soybean, that in this area yields reach over 1800 kg/ha and 2,000 kg/ha, respectively.

Experimental Design:

The study was conducted in two plots, one for each crop, one of soy and another of peanut, using pitfall traps ("pit-fall"). Sampling was carried out from December 2008 to March 2009, once a month, covering great part of the crop phenological cycle.

The two crops cover a total area of 200 hectares. In both of them, two plots were randomly selected of one hectare each.

The field with peanut is limited by different crops, while that of soya is also surrounded by small patches of natural vegetation. In each plot three transects were drawn, each one_separated by 25 meters from the other, in which pitfall traps were placed at a distance of 25 meters from each other, resulting 5 traps per transect, and 15 traps per plot. The traps consisted in plastic containers of 1 litre of capacity and a diameter of approximately 15 cm. heaping up two thirds of its capacity with a mixture of water, sodium chloride and detergent and were allowed to operate for five days. The samples were transported to the laboratory for cleaning and fixing with 80% alcohol. After the labeling for each sample was performed the material was identified with a binocular loupe of 72 X. The taxonomic identification was performed in araneids to family level using keys (Benamú, 2007) and to the formicidae to species level (Bolton, 2007). The specimens were deposited in the chair of Invertebrate Biology II, Faculty of Natural Sciences, UNLPam. For data analysis, software PAST ver. 1.94b (2009) and StimateS 8.0 (Colwell, 2006) were used.

Curves of rarefaction were obtained. They allow comparisons of numbers of species between communities when the sample size is not equal. These software calculate the expected number of species in each sample.

The curves of Rarefaction were obtained by samples.

Rates of dominance, Simpson index and Pielou Equity (Magurran, 2004) were achieved.

RESULTS

6.854 arthropods were collected, of which 4.874 belonged to peanuts crop and 1.980 individuals of the soy. The Formicidae collected were 3.386, corresponding to 16 species. The araneids addep up 288 copies, distributed in 16 families. It can be seen that the species *Solenopsis saevissima* was dominant in the crop peanuts, and presented a greater abundance in the center of the study plot, compared with the edge (Fig.1).

In soybeans, *Pheidole bergi* was the dominant species, being more abundant in the center of the plot (Fig. 2).

As for araneids, there was a greater abundance of the families: Lycosidae, Dysderidae, and Thomisidae. In soybeans, the family Lycosidae appears mostly in the edge (Fig. 3). In peanuts, the family more abundant is Dysderidae on the edge, while the family Lycosidae is more abundant in the center (Fig. 4).

The structure of the plants of peanut and soybean change throughout their phenology. In turn, each plant is different with respect to height and diameter. The plant of peanut increases more in diameter but less in height, compared with soy, which is the other way round (Figs. 5 and 6).

Comparing both crops, a significant difference is shown (P = 0.01628). Evenness, abundance and diversity increase in soybean (Fig. 7).

According to rarefaction curves for peanuts, it is observed that the greatest diversities occur in January and March, falling in February and reaching minimum values in December (Fig. 8), with a similar behavior in soybean (Fig. 9).

The estimator Mao Tau, tends to asymptote for both peanut (Fig. 10) as for soybean (Fig. 11), demonstrating that the sample was adequate, and giving a 92% of the species sampled in peanuts, and 88% for soybeans.

In the peanut crop it is observed that predators begin to increase in December and continue like this as the culture progresses into January, where they make the peak, then decline sharply and begins a recovery for the month of March. For herbivores and others sampling is started with few individuals in December, but increase in January and February, to decrease when reaching March (Fig. 12).

In soybean, there was a greater richness of predators in December, begins in January to decrease and continues, reaching a steep slope in February and starts recovery in March. The richness of herbivores is high in December and January; decreases in February and is recovered in March (Fig. 13).

The evenness, diversity and abundance in the soybean, have a significant difference in all the phenological cycle in Table 1 (Fig. 14).

The evenness, diversity and abundance in the peanut crop, show a significant difference in the months of February and March in Table 2 (Fig. 15).

In peanuts, a greater abundance of araneids were seen on the edge, unlike the Formicidae that were more abundant in the center. (Figs. 1 and 2).

Soy showed a greater abundance of Formicidae such as araneids of the edge (Figs. 1 and 2).

DISCUSSION

The families of Araneids best represented were Lycosidae and Thomisidae, both in peanut and soybean. These results are consistent with the data of Liljesthröm et al., 2002 and Rubio et al., 2004 for a soybean crop in the provinces of Buenos Aires and Corrientes, respectively.

The lowest values registered in the graphic of rarefaction of peanut are explained in December, because of/by the beginning of the phenological crop cycle, and in February, because of/by fumigation that are very frequent in January end and February principle. In the case of soybeans, the curves of accumulation show no marked differences, probably due to less frequent fumigation.

There were differences in the abundance and richness of species in both crops, which can be explained in part by the structure of the plant. The soybean develops one high plant, which occupies a large area and, consequently, can accommodate large numbers of arthropods.

The results obtained with StimateS show that the sampling effort was correct. For the case studied, MMMeans was the best estimator because it was closer to the stability.

For analysis of functional groups, we observed that in both crops, there is a greater richness of species of predators, with respect to the presence of phytophagous. This could be understood as a result of the fumigation that are very frequent in those times of the crops, and recoveries observed in these populations, could be explained because predators usually take refuge in the surrounding natural small patches and recolonize quickly after an application. This situation does not match Andow (1991) and Tonhasca (1993), who argue that "herbivorous insects achieve higher levels of abundance and natural enemies lower abundance in simple farming systems than in diverse ones" and the results obtained in the Chaco ecoregion-Espinal, where the percentage is 65% herbivores and the predators is 23% (Weyland & Zaccagnini, 2008).

In the phenological crop cycle, of evenness remains constant, showing slight variations increase as growth progresses. Comparing the results of the edge and center of peanut, it can be seen that at the beginning of the development of the crop, the abundance is higher at the edge, but as it grows, it increases in the center, and decreases because of the fumigation. In soybean, with more separate applications over time, the center and edge difference is not so noticeable, the edge being higher in most sampling months. To this must be added the presence of small patches of natural contributors settlers, coinciding with Coombes & Sotherton (1986), Dennis et al. (2000) and Weyland et al. (2008), who argues that "empirical studies have shown that arthropod populations sustain margins by offering alternative sources of food, protection from pesticides and over-wintering shelters", this author also affirms the possibility of greater species richness found in margins with respect to crops by greater plant diversity on the site.

The species richness of formicids found is high for the study area, including in the ecoregion, which is similar to those found in other agroecosystems (Perez-de la Cruz et al., 2007; Pardave et al., 2008).

CONCLUSIONS

The araneids were dominated by the Thomisidae, Lycosidae and Dysderidae families.

The families of Araneids underrepresented were Oxyopidae, Philodromidae, Zodariidae.

The formicids presented as dominant species *Solenopsis saevissima* in peanuts and *Pheidole bergi* in soy.

The functional group of predators presents more abundance and richness for both crops, in peanuts and in soy as compared with other herbivores.

The soybeans showed more abundance and diversity, that the peanuts in relation to its structure, as it is of greater height, and can thus be shelter of more arthropods.

The differences in the results observed in the accumulation curves species of peanut and soy are due to the different frequencies of fumigation.

With regard to the comparison of the edge and center of the soybean, the abundance was greater at the edge, because the site of study is being surrounded by natural patches. Unlike peanut that suffered variations in the edge and in the center, because of insecticide applications.

The sampling effort was adequate, and demonstrated a wide diversity of arthropods in both crops.

It is necessary to further deepen such studies to apply a suitable control method.

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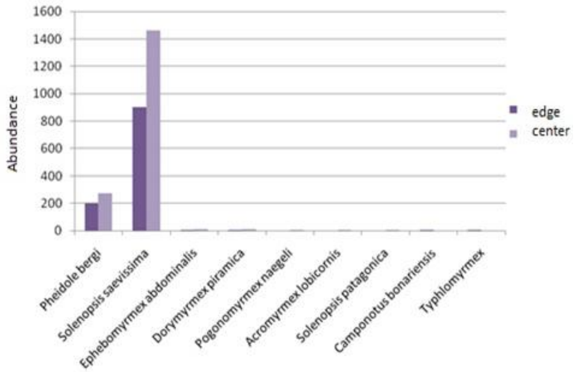

Figure 1. Abundance of ants per species collected in peanut Maisonave, La Pampa (Argentina) during 2008-9.

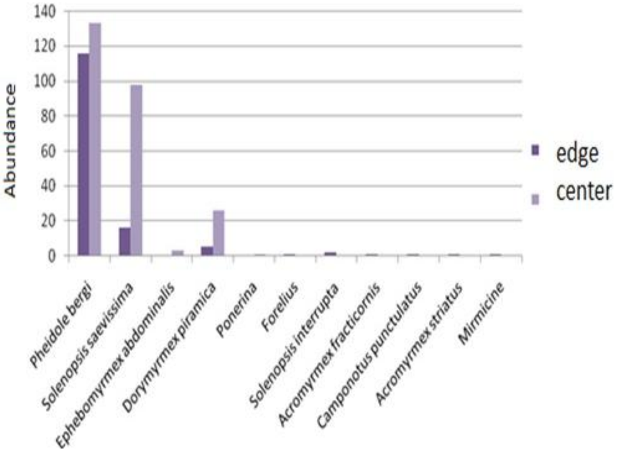

Figure 2. Abundance of ants per species collected in soybean (Maisonave, La Pampa, Argentina) during 2008-9.

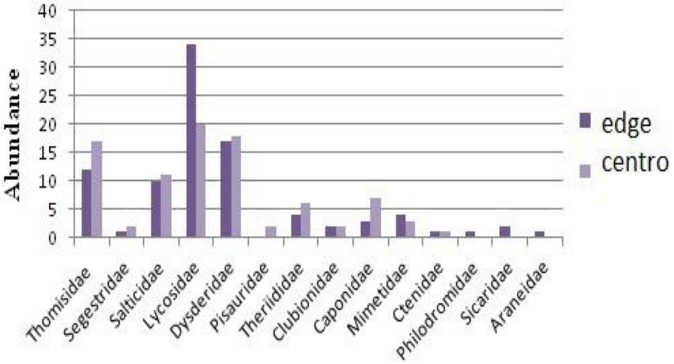

Figure 3. Abundance of araneidos per family in soybean (Maisonave, La Pampa, Argentina, 2008-9), at the edge and center of the plot.

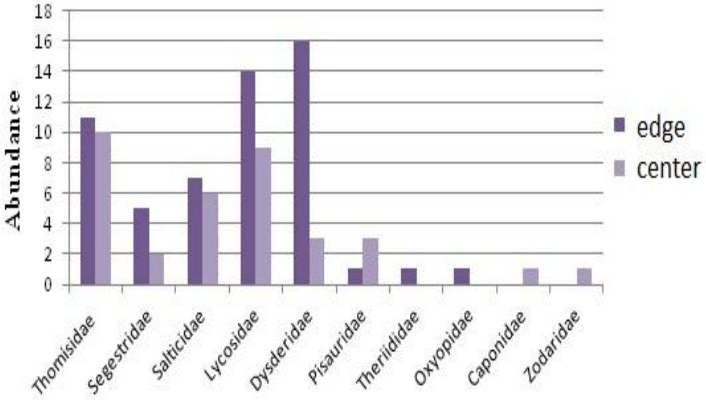

Figure 4. Abundance of family araneidos per peanut (Maisonave, La Pampa, Argentina, 2008-9) in edge and center of the plot.

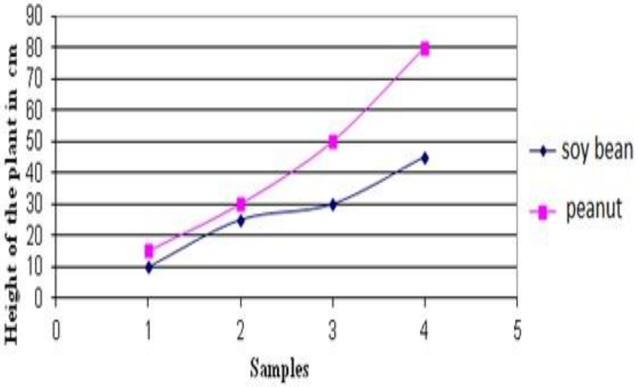

Figure 5. Comparative curves of height growth of peanut and soybean (Maisonave, La Pampa).

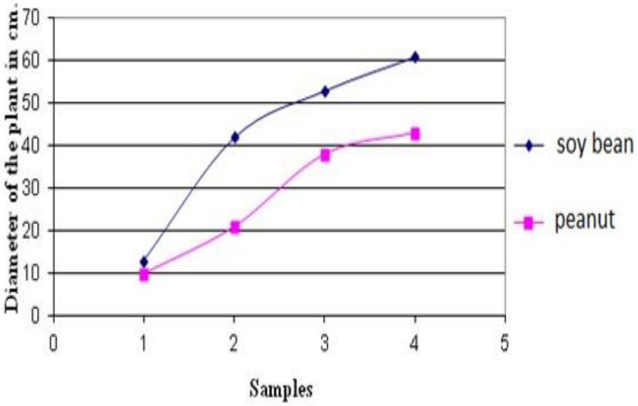

Figure 6. Diameter curves compare peanuts and soy (Maisonave, La Pampa).

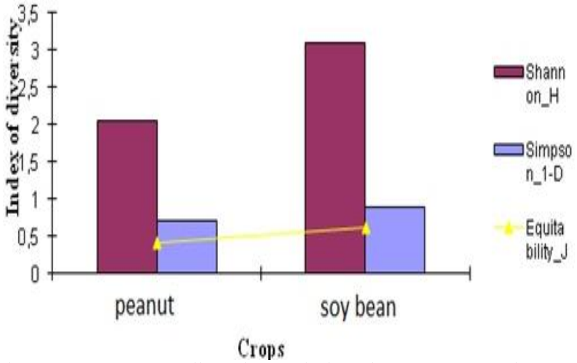

Figure 7. Evenness, diversity and abundance compared to peanut and soybean (Maisonave, La Pampa, Argentina, 2008-9).

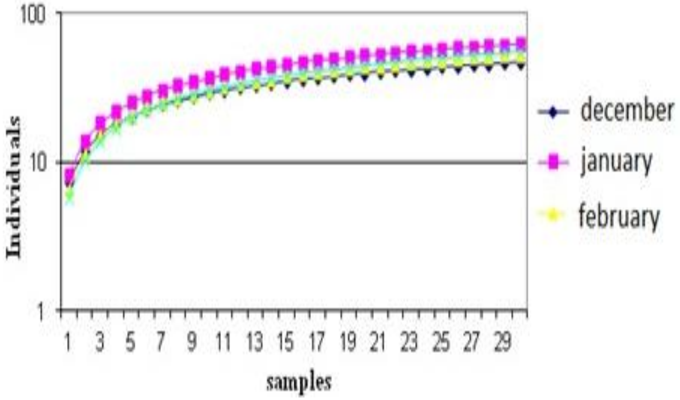

Figure 8. Arthropod rarefaction curves for mani (Maisonave, La Pampa, Argentina, 2008-9).

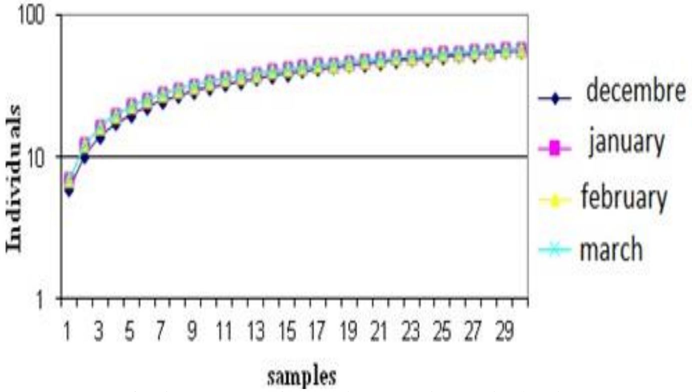

Figure 9. Rarefaction curves for soybean arthropods (Maisonave, La Pampa, Argentina 2008-9).

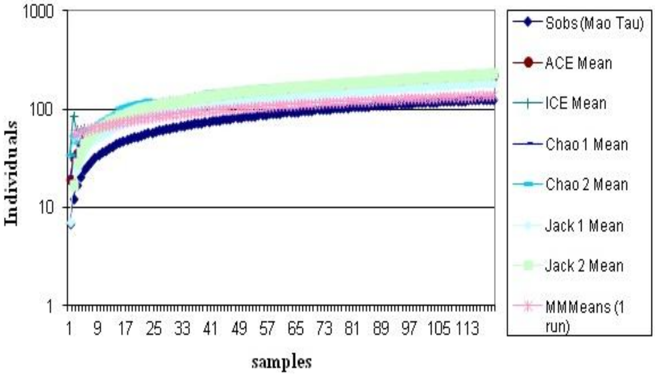

Figure 10. Estimates of arthropod richness and cumulative curves for peanuts (Maisonave, La Pampa, Argentina, 2008-9).

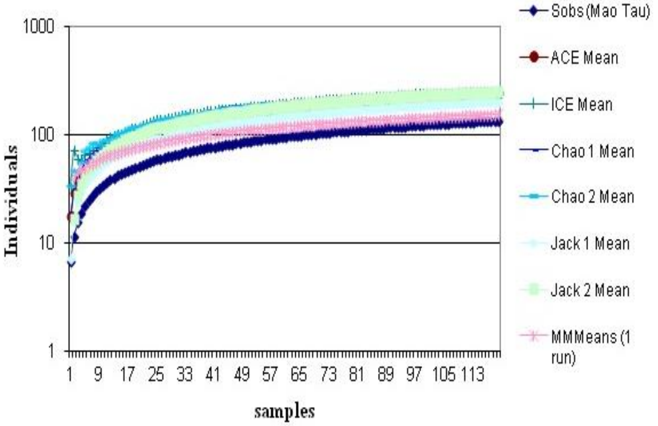

Figure 11. Estimates of arthropod richness and cumulative curves for soybean (Maisonave, La Pampa, Argentina, 2008-9).

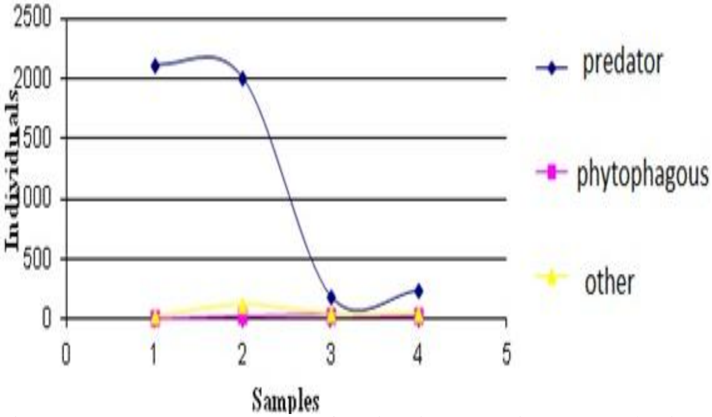

Figure 12. Curves comparative functional groups in peanut (Maisonave, La Pampa, Argentina, 2008-9).

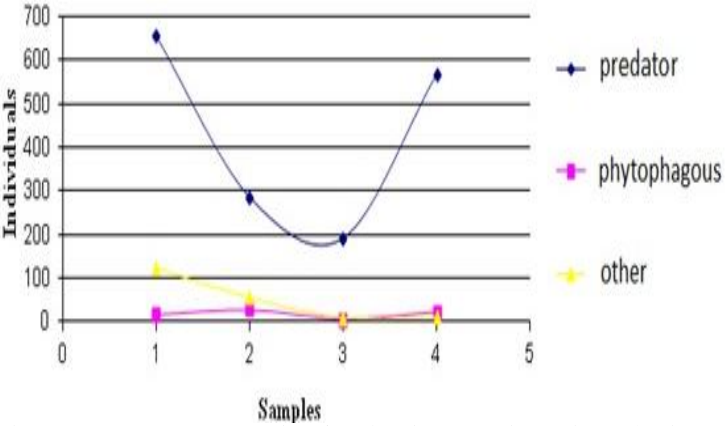

Figure 13. Curves comparative functional groups in soybean (Maisonave, La Pampa, Argentina, 2008-9).

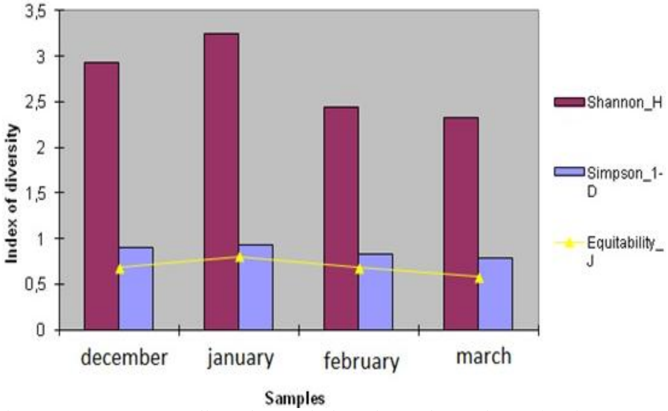

Figure 14. Evenness, diversity and abundance in soybean (Maisonave, La Pampa, Argentina, 2008-9).

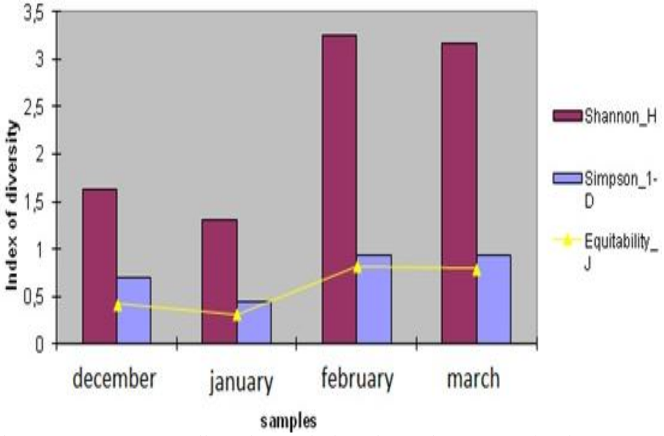

Figure 15. Evenness, diversity and abundance in peanut (Maisonave, La Pampa, Argentina, 2008-9).

TAXONOMIC STUDIES ON DUNG BEETLES (COLEOPTERA: SCARABAEIDAE, GEOTRUPIDAE, HYBOSORIDAE) OF CHHATTISGARH, INDIA

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ABSTRACT: The study presents taxonomic account of 52 species of dung beetles belonging to 22 genera, 12 tribes, 04 subtribes, 05 subfamilies and 03 families viz. Scarabaeidae, Geotrupidae and Hybosoridae from Chhattisgarh. Interactive identification keys to the subfamilies, tribes, genera and species were prepared by studying thoroughly the morphological characters of all the dung beetles specimens collected from the state. The subfamilies; Aphodiinae and Orphninae and the genera namely; *Aphodius*, *Bolboceras*, *Caccobius*, *Copris*, *Drepanocerus*, *Phaeochrous*, *Phalops*, *Rhyssemus*, *Sisyphus*, *Tiniocellus*, *Oniticellus*, *Onitis* and *Orphnus* are first time studied, illustrated and keyed from the state. Out of 52 species, 36 species are reported as addition to the dung beetle fauna of Chhattisgarh. Based on the collection data, the highest number of species were recorded from Barnawapara Wildlife Sanctuary (41spp.) followed by Achanakmar-Amarkantak Biosphere Reserve (27 spp.) and Kanger Valley National Park (15 spp.).

KEY WORDS: Taxonomy, Chhattisgarh, dung beetles, identification keys, new records and distribution.

Dung beetles are a globally distributed insect group, with their high diversity in tropical forests and savannas (Hanski & Cambefort, 1991) and are member of family Scarabaeidae of insect's largest order Coleoptera. The beetles mostly feed on the micro-organism rich liquid component of mammalian dung and use the more fibrous material to brood their larvae (Halffter & Edmonds, 1982; Halffter & Matthews, 1966). Based on their nesting strategies dung beetles are broadly classified into three functional groups viz. rollers (telocoprid), tunnelers (paracoprid) and dwellers (endocoprid). Rollers form balls from a dung pat, which are rolled away and buried in the ground for feeding and breeding while tunnelers make underground vertical chambers in close proximity to the dung pat and construct their nest using the dung from pat whereas dwellers breed in dung pats itself (Halffter & Edmonds, 1982). Geotrupidae and most of the tribes of subfamily Scarabaeinae (Dichotomiini, Coprini, Onitini, Phanaeini, Onthophagini and Oniticellini) are tunnelers and the tribes Canthonini, Scarabaeini, Eucraniini, Sisyphini, Gymnopleurini and Eurysternini are considered to be rollers. Some Oniticellini along with members of subfamily Aphodiinae are dwellers and various Onthophagini and Dichotomiini are kleptoparasites. Through their dung consumption and relocation activities, dung beetles are involved in the ecological functions of parasite suppression, secondary seed dispersal, nutrient cycling and bioturbation (Andresen 2002, 2003; Nichols et al., 2008; Stokstad, 2004; Waterhouse, 1974).

Review of literature on the taxonomic studies of dung beetle fauna of Central India including Madhya Pradesh and Chhattisgarh revealed a series of publications namely; Arrow (1931), Balthasar (1963a,b, 1964), Kuitjen (1978, 1983), Krikken (1977, 1980), Newton & Malcolm (1985), Chandra (1999, 2000, 2002, 2008, 2009); Chandra & Ahirwar (2005a,b, 2007); Chandra & Singh (2004), Chandra & Singh (2010), Chandra & Gupta (2011a,b,c, 2012a,b) and Chandra et al. (2011, 2012).

Arrow (1931) in the 'Fauna of British India' devoted to Coprinae (Scarabaeinae) studied 352 species of dung beetles from different parts of India and adjacent countries. Later monographic works on the subfamilies Aphodiinae and Scarabaeinae of the Palaearctic and Oriental region were made by Balthasar (1963a,b, 1964) but the information on diversity of these beetles in Chhattisgarh was lacking. Chandra (2000) published an inventory of 96 species of scarab beetles of Madhya Pradesh and discussed distribution of these beetles in different protected areas of the state. Chandra & Ahirwar (2007) further published a comprehensive account of the scarab beetles of Madhya Pradesh and Chhattisgarh and recorded 124 species/subspecies belonging to 45 genera under 11 subfamilies, including 81 species of dung beetles. Recently, Chandra and Singh (2010) reported 22 species of the scarab beetles belonging to 11 genera and 6 subfamilies from Achanakamar Wildlife Sanctuary, Chhattisgarh.

A perusal of literature on the diversity of dung beetles of Central India (Madhya Pradesh and Chhattisgarh) revealed that there are very few reports on the taxonomic studies and distribution of dung beetles of the state, Chhattisgarh. Keeping in view, the present work is aimed to prepare the identification keys and reports on the distribution and diversity of these beetles from the state. Altogether, 432 specimens collected from Chhattisgarh, resulted in the identification of 52 dung beetle species belonging to 22 genera distributed in 12 tribes, 4 sub tribes, 5 subfamilies, and 03 families. The diagnostic characters and photographs of all the species and the identification keys to the subfamilies, tribes, genera and species were also provided.

MATERIALS AND METHODS

Study area: Chhattisgarh is the tenth largest state of India, constituted on 1st November, 2000 and occupying a total area of 135,000 sq. km. with its capital at Raipur. It lies between latitudes 17° to 23.7° N and Longitudes 83.38° to 84.0° E. The total forest area of the state is 59,772 sq. km. (44 %). The climate of Chhattisgarh is mainly tropical, humid and sub-humid. Chhattisgarh can be divided into three distinct regions viz. Northern region, Central plains region and Southern region. There are 3 national parks, 11 wildlife sanctuaries and one biosphere reserve covering about an area of 6615 sq. km. Being 3rd largest forest cover in India, the state covers about 13% forests with its area of about 59772 sq. km.

Collection of beetles: Specimens for the present study were collected by different scientific teams of Zoological Survey of India (ZSI), Jabalpur during the year's *viz.* 2004, 2005, 2008 and 2011. A total of 432 specimens were collected from three main protected areas of the state; Achanakmar-Amarkantak Biosphere Reserve (AABR), Achanakmar Wildlife Sanctuary (AMWLS), Kanger Valley National Park (KVNP) and Barnawapara Wildlife Sanctuary (BWLS) (Figure 1). Two major collection tools *viz.* light trapping and handpicking methods were used for adult beetle sampling. After collection, beetles were killed in Benzene vapors and preserved dry pinned. Voucher specimens were deposited in National Zoological Collection of Zoological Survey of India, Jabalpur Madhya Pradesh (India).

Examination of external male genitalia: Wherever required external male genitalia were studied for assigning the species identity. For that purpose male specimen was dissected out and abdomen was separated from the body and aedeagus was extracted from the abdomen. The genitalia was then cleaned and softened in a dish of hot water and further cleaned in a hot water solution of 10% KOH. If not damaged, the abdomen was again glued to the specimen. The aedeagus was washed in 95% ethanol and stored in a glass vial containing 70% alcohol.

Identification of beetle species: The morphological studies were undertaken using a binocular microscope (Leica M205 A) and the photographs of adult beetles were taken with the help of a digital camera attached to it. Dung beetles were identified with the help of available literature (Arrow, 1931; Balthasar, 1963a, 1963b, 1964; Krikken, 1980; Kuitjen, 1978, 1983). A total of 432 specimens were studied which resulted in the identification of 52 species belonging to 22 genera distributed in 12 tribes, 4 sub tribes, 5 subfamilies and three families. The classification adopted in the article is after Smith (2006).

Key to subfamilies, tribes and genera of dung beetles of Chhattisgarh based on studied specimens

1. Antennae 11-segmanted and club rounded; abdomen exceptionally short…………………………………………………………………………Bolboceratinae Mulsant…………2
- Antennae with 10 or fewer segments and club generally elongate, rarely cupuliform……………………………………………………………………………………………3

2. **BOLBOCERATINAE:** Anterior margin of eye canthus smooth; frontal protrusion situated centrally or anterior in position nearby or on frontal clypeal suture; head with a pair of transversely conical tubercles; metasternum with anterior lobe narrowly separating middle coxae, anteriorly always with a small spiniform protrusion……………………………………………***Bolbohamatum*** Krikken
- Anterior margin of eye canthus with medial tubercle; frontal ridge posterior in position and transversely crossing over half of distance and between eyes; metasternum with anterior lobe narrowly separating middle coxae, anteriorly without a small spiniform protrusion…………………………………***Bolboceras*** Kirby

3. Antennae usually 10-segmented sometimes 9-segmented; labrum and mandibles generally projected and visible from above or not concealed by clypeus……………………………………………………………………………………………4
- Antennae usually 9-segmented, sometimes 8-segmented; labrum and mandibles concealed by clypeus…………………………………………………………………………6

4. Antennae 10-segmented and club cupuliform……….Hybosorinae Erichson……..5
- Antennae 10-segmented and club simple……Orphninae Erichson……***Orphnus*** Macleay

5. **HYBOSORINAE**: Clypeus with antero-lateral angles sub rectangular somewhat protruding forward; pronotum with lateral sides deplanate; external claws of fore tarsi in male cleft…………………………………***Phaeochrous*** Castelnau
- Clypeus with antero-lateral angles obtuse often rounded not protruding forward; pronotum with lateral sides not deplanate; external claws of fore tarsi simple……………………………………………………………………………………***Hybosorus*** Macleay

6. Elytra completely covering abdomen; hind tibiae with two terminal spurs; middle coxae almost contiguous; scutellum visible............Aphodiinae Leach.......7
- Elytra leaving pygidium exposed; hind tibia with single spur; middle coxae rather widely separated; scutellum often invisible........Scarabaeinae Latreille.......8

7. **APHODIINAE**: Posterior tibiae with two oblique transverse carinae. Hind femora normal or slightly thickened, never very long. Pronotum simple, without transverse folds or furrows.............................Aphodiini Leach....***Aphodius*** Illiger
- Posterior tibiae with out transverse carinae. Pronotum with transverse folds separated by furrows...................Psammodiini Mulsant.......***Rhyssemus*** Mulsant

8. **SCARABAEINAE**: Middle coxae not far apart, converging strongly behind; middle tibiae with one terminal spur..9
- Middle coxae far apart and almost parallel; middle tibiae with two terminal spur..12

9. Elytra not excised behind shoulders; front tarsi absent.......................................
....Scarabaeini Latreille.......***Scarabaeus*** Linnaeus
- Elytra excised behind shoulders; front tarsi present..
....Gymnopleurini Lacordaire....10

10. **GYMNOPLEURINI**: Sides of abdomen not carinate at base...........................
....***Gymnopleurus*** Illiger
- Sides of abdomen carinate at base. 11

11. Clypeus in front distinctly bi-dentate...................***Paragymnopleurus*** Shipp
- Clypeus in front distinctly tetra-dentate...................................***Garreta*** Janssens

12. Posterior legs extremely long and tarsi filiform..
....Sisyphini Mulsant......***Sisyphus*** Latreille
- Posterior legs not extremely long and tarsi more or less flat and tapering 13

13. Second segment of labial pulp smaller than first, third always distinct..............
....Coprini Leach....14
- Second segment of labial pulp longer than first, third very small sometimes scarcely visible or absent..16

14. **COPRINI**: Elytra with one lateral carina................................***Copris*** Geoffroy
- Elytra with two lateral carina.. 15

15. First segment of antennal club shining not pubescent.........***Heliocopris*** Hope
- First segment of Antennal club entirely pubescent..................***Catharsius*** Hope

16. Pronotum with two median basal depressions...
....Onitini Laporte..***Onitis*** Fabricius
- Pronotum without two median basal depressions...17

17. Scutellum invisible; antennae 9-segmented.......Onthophagini Burmeister.....18
- Scutellum visible; antennae 8-segmented........................Oniticellini Kolbe.......20

18. **ONTHOPHAGINI**: Four posterior tarsi broadly dilated....***Phalops*** Erichson
-Four posterior tarsi not broadly dilated..19

19. Terminal margin of fore tibiae at right angle to inner margin; anterior angles of pronotum hollowed beneath..***Caccobius*** Thomson
- Terminal margin of fore tibiae generally oblique; anterior angles of pronotum not hollowed beneath..***Onthophagus*** Latreille

20. **ONITICELLINI**: Pygidium margined or transversely carinate at base; upper surface setose.................Drepanocerina van Lansberge.......***Drepanocerus*** Kirby
- Pygidium neither margined nor carinate at base; upper surface shining and without setae...Oniticellina Kolbe....21

21. Pronotum densely and sub-rugosely punctate; elytral intervals minutely granulate..***Tiniocellus*** Peringuey
- Pronotum smooth; elytral intervals convex and finely and closely punctuate........ ....***Oniticellus*** Serville

TAXONOMIC ACCOUNT

Order: Coleoptera Linnaeus, 1758
Suborder: Polyphaga Emery, 1886

Family Geotrupidae Latreille, 1802

Subfamily Bolboceratinae Mulsant, 1842
Tribe Eubolbitini Nikolajev, 1970

Key to the species of genus *Bolbohamatum*

Lateral tubercles of pronotum marginally situated..........*Bolbohamatum marginale* Krikken
Lateral tubercles of pronotum not marginally situated..*Bolbohamatum calanus* (Westwood)

1. *Bolbohamatum marginale* Krikken, 1980 (Plate 1B)

Diagnostic characters: Dorsal outline of left mandible lobate. Clypeus with a pair of dentiform tubercles each placed against lateral margin. Pronotum with strongly approximated paramedian tubercles and a pair of lateral tubercles situated marginally. Median longitudinal zone and lateral declivities of pronotum densely and coarsely punctate while impression between paramedian and lateral tubercles virtually devoid of punctures.
Collection data: Bilaspur, AABR, 18.vi.2004 (1♂), light trap.
Geographic distribution: India: Chhattisgarh, Madhya Pradesh, Tamil Nadu, Karnataka and Uttarakhand. *Elsewhere*: West Pakistan.

2. *Bolbohamatum calanus* (Westwood, 1848) (Plate 1A)

Diagnostic characters: Cephalic tubercles dentiform, isolated and placed on clypeal disc. Dorsal outline of left mandible sinuate lobate. Pronotum with a pair of feebly developed, slightly transverse median tubercles with lateral callosities. Pronotum abundantly punctate and paramedian tubercles separated by less than inter-ocular distance.
Collection data: Raipur, BWLS, 01.vii.2011 (1♂), light trap.
Geographical distribution: India: Assam, Bihar, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bengal and Uttarakhand. *Elsewhere*: Bangladesh and Java.

Tribe Bolboceratini Mulsant, 1842

3. *Bolboceras quadridens* (Fabricius, 1781) (Plate 1C)

Diagnostic characters: Short, globular, dark brown, shining and lower surface with long brown setae. Pronotum strongly punctate in anterior and lateral sides, smooth in middle except on median longitudinal furrow with four tubercles in anterior half with middle ones a little closer. Elytra finely punctate striate with intervals smooth. Scutellum finely and sparsely punctate.
Collection data: Bilaspur, AABR, 19.vii.2004 (1♂); Raipur, BWLS, 01.vii.2011 (4♂), light trap.

Geographical distribution: India: Chhattisgarh, Haryana, Madhya Pradesh and Uttarakhand. *Elsewhere*: Asia, Europe, North America and South America.
Remarks: New state record.

Family Hybosoridae Erichson, 1847

Subfamily Hybosorinae Erichson, 1847

4. ***Hybosorus orientalis*** **Westwood, 1845** (Plate 1D)

Diagnostic characters: Black and shining with elongate and oval body. Anterior margin of labrum with 9 denticles. Head very closely and rugosely punctate anteriorly. Pronotum transversely strongly and sparsely punctate. Elytra with 9 complete striae between suture and shoulder and 7-8 complete striae between shoulders and elytral margins.
Collection data: Bastar, KVNP, 12.iv.2005 (1 ex.); Raipur, BWLS, 01.vii.2011 (1 ex.), light trap.
Geographical distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal. *Elsewhere*: Afghanistan, Sri Lanka, Myanmar, Nepal and Pakistan.

5. ***Phaeochrous emarginatus emarginatus*** **(Castelnau, 1833)** (Plate 1E)

Diagnostic characters: Brown, oblong and rather flat. Head irregularly punctate anteriorly. Pronotum glabrous with lateral sides de-planate and with strong intermixed punctures. Elytra strongly punctate striate with intervals almost flat and smooth. Fore tibia tridentate, with first two apical teeth strongly developed and basal one less developed, serrated in between and above teeth. Fore tarsal claws cleft in male.
Collection data: Raipur, BWLS, 01.vii.2011 (2♂3♀), 02.vii.2011 (4♂7♀), 03.vii.2011 (5♂11♀) light trap.
Male female ratio: 32 specimens: 11 male: 21 female (0.52)
Geographical distribution: India: Chhattisgarh, Haryana, South India and Uttar Pradesh. *Elsewhere*: Sri Lanka, Bhutan, Vietnam, Laos, China, Japan, Thailand, Malaysia, Indonesia, Papua, Philippines and Australia,
Remarks: New state record.

Family Scarabaeidae Latreille, 1802

Subfamily Orphninae Erichson, 1847
Tribe Orphnini Erichson, 1847

6. ***Orphnus impressus*** **Westwood, 1846** (Plate1F)

Diagnostic characters: Brown-black, smooth and shining. Clypeus with antero-lateral angles feebly produced. In male, head with a triangular horn and pronotum with three-fourth anterior part excavated while in female, head with a small tubercle in middle and pronotum with a weak depression in middle of the anterior part. Pronotum with lateral margins rounded and anterior angles acute. Elytra strongly, sparsely and irregularly punctate in longitudinal rows with striae indistinct.
Collection data: Raipur, BWLS, 01.vii.2011 (2♂3♀), light trap.
Geographical distribution: India: Chhattisgarh, Haryana and Uttar Pradesh.
Remarks: New state record.

7. ***Orphnus parvus*** **Wiedemann, 1823** (Plate1G)

Diagnostic characters: Brown-black, smooth and shining. In male, head with a triangular long horn and pronotum with three-fourth anterior part excavated while in female, head with a small tubercle in middle and pronotum with a weak depression in middle of the anterior part. Pronotum with lateral margins rounded and anterior angles acute. Scutellum broad and smooth. Elytra strongly, sparsely and irregularly punctate in longitudinal rows with striae distinct.
Collection data: Raipur, BWLS, 01.vii.2011 (2♂), light trap.
Geographical distribution: India: Chhattisgarh, Madhya Pradesh, Orissa and West Bengal.
Remarks: New state record.

Subfamily Aphodiinae Leach, 1815
Tribe Aphodiini Leach, 1815
Subtribe Aphodiina Leach, 1815

Key to the species of genus *Aphodius*

Head not tuberculate in middle; not uniformly coloured; pronotum black with lateral sides yellow; elytra yellow with black strips................. *Aphodius* (*Calaphodius*) *moestus* Fabricius
Head tuberculate in middle; uniformly blackish-brown in colour..
....*Aphodius* (*Pharaphodius*) *crenatus* Harold

8. *Aphodius* (*Calaphodius*) *moestus* Fabricius, 1801 (Plate1H)

Diagnostic characters: Pale-yellow in colour. Head, disc of pronotum, scutellum, and elytra with fourth interval in last half and sixth in anterior two third black, smooth and moderately shining. Pronotum very finely and sparsely punctate. Elytra superficially punctate-striate. Scutellum elongate and pointed towards apex with surface coriaceous having few minute punctures at base.

Collection data: Bastar, KVNP, 12.vii.2005 (1♀), 13.iv.2005 (1♀); Raipur, BWLS, 01.vii.2011 (2 ♂), light trap and dung.

Male female ratio: 4 specimens: 2 male: 2 female (1.0)

Geographical distribution: India: Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh, Rajasthan and Uttar Pradesh.

Remarks: New state record.

9. *Aphodius* (*Pharaphodius*) *crenatus* Harold, 1862 (Plate1I)

Diagnostic characters: Black or brown in colour. Scutellum with median longitudinal depressed line. Punctures of elytral striae cutting into sides of intervals. Elongate, very convex and broadly excised in middle, frontal clypeal suture with a short slender horn in middle. Para-ocular lobes angulate on sides. Pronotum moderately strongly, very sparsely and unevenly punctate. Scutellum broad and almost smooth. Elytra very strongly deeply punctate-striate.

Collection data: Bastar, KVNP, 03.iv.2005 (1ex.), dung

Geographical distribution: India: Andaman and Nicobar Island, Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh and Uttar Pradesh.

Remarks: New state record.

Tribe Psammodiini Mulsant, 1842
Subtribe Psammodiina Mulsant, 1842

10. *Rhyssemus germanus* (Linnaeus, 1767) (Plate 1J)

Diagnostic characters: Head transversely granulate. Vertex with two oblique ridges on either side. Clypeus strongly excised in middle with two obtuse well marked angles and lateral sides angulated. Pronotum with five transverse folds and four grooves, anterior fold a little raised and granulate, next two more prominent, smooth and shining, fourth one interrupted in middle with both inner ends bent towards base, with a groove in between crossing posterior fold, furrow transversely, coarsely punctate, with lateral margins angulated in middle and nearly straight anteriorly and posterior. Elytra strongly punctate striate.

Collection data: Raipur, BWLS, 02.vii.2011 (5ex.), light trap.

Geographical distribution: India: Andaman and Nicobar Island, Chhattisgarh, Haryana, Madhya Pradesh and Uttarakhand.

Remarks: New state record.

Subfamily Scarabaeinae Latreille, 1802
Tribe Scarabaeini Latreille, 1802

The members of this tribe are characterized by the presence of; anterior margin of head, which is six dentate, comprising quadric-dentate anterior margin of clypeus and two lateral teeth formed by the anterior angles of genae, long legs for ball-rolling and fast running and absence of fore tarsi. It comprises about 150 species and species distributions are centered in the Afro tropical (130 species), Palaearctic (22 species) and Oriental regions (3 species in India and Sri Lanka), as well as in southwest Madagascar (3 species). Another two species are shared between the Palaearctic and Oriental regions (India) and a further two between the Afro-tropical and Palaearctic.

11. *Scarabaeus* (*Kheper*) *sanctus* (Fabricius, 1798) (Plate 2K)

Diagnostic characters: Broadly oval, shining, strongly punctate above. Dark green above, with lower surface and legs nearly black. Head coarsely, densely and rugosely punctate. Clypeus quadri-dentate. Pronotum moderately convex and densely punctate. Elytra finely striate, with the intervals coarsely punctate.
Collection data: Bilaspur, AMWLS, 21.vi.2004 (2♀), 27.vi.2004 (1♂); Bastar, KVNP, 13.vii.2005 (1 ♀); Raipur, BWLS, 03.vii.2011 (2♂ 1♀), dung.
Male female ratio: 7 specimens: 3 male: 4 female (0.75).
Nesting strategy: Roller (Telocoprid).
Geographical distribution: India: Bihar, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra and Orissa.

Tribe Sisyphini Mulsant, 1842

The members of this tribe are characterized by the presence of eight antennal segments, relatively short bodies that are laterally compressed and flattened, especially at sides of the pronotum, elytra that are broad proximally but attenuate posteriorly and the exceptionally long middle and hind legs. The tribe comprises 60 species in only three genera which are entirely ball-rolling species showing diurnal flight activity. Pairs co-operate in ball rolling with the male pushing using the back legs, and the female pulling using the front legs.

Key to the species of genus *Sisyphus*

Hind femur gradually dilated.......................................*Sisyphus* (*Sisyphus*) *longipes* (Olivier)
Hind femur abruptly dilated...*Sisyphus* (*Sisyphus*) *neglectus* Gory

12. *Sisyphus* (*Sisyphus*) *longipes* (Olivier, 1789) (Plate 2L)

Diagnostic characters: Broadly oval, highly convex, black and shining body with very minute clothing of erect setae fairly close upon pronotum and very scanty upon head and elytra. Lower surface and posterior legs extremely long. Middle and hind femora very slender at basal part.
Collection data: Bastar, KVNP, 03.iv.2005 (3♂4♀); Raipur, BWLS, 03.vii.2011 (2♀), dung.
Male female ratio: 9 specimens: 3 male: 6 female (0.5).
Nesting strategy: Roller (Telocoprid).
Geographical distribution: India: Chhattisgarh, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and West Bengal. *Elsewhere*: Sri Lanka and Myanmar.
Remarks: New state record.

13. *Sisyphus* (*Sisyphus*) *neglectus* Gory, 1833 (Plate 2M)

Diagnostic characters: Oval, highly convex, with very long and slender posterior legs. Black and opaque and fairly closely clothed above with minute brown, erect, hooked setae. Front margin of clypeus bears two fairly widely separated teeth, divided by a curvilinear excision, and outer teeth blunt and feeble. Head and pronotum moderately closely punctate.
Collection data: Bilaspur, AABR, 07.v.2005 (1♂1♀) dung.
Male female ratio: 2 specimens: 1 male: 1 female (1.0).
Nesting strategy: Roller (Telocoprid).
Geographical distribution: India: Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Uttar Pradesh. *Elsewhere*: Pakistan.
Remarks: New state record.

Tribe Gymnopleurini Lacordaire, 1856

The members of this ball-rolling tribe are characterized especially by an emargination of lateral edge of each elytron that exposes the underlying pleural sclerites. The tribe comprises about 110 ball-rolling species in four relatively species-rich genera. A ball intended for brood construction is rolled away from the dung, possibly by a single beetle or by male/female pairs.

Key to the species of tribe Gymnopleurini

1. Sides of abdomen not carinate at base……………………………………………………………2
- Sides of abdomen sharply carinate at base. ……………………………………………………4

2. Clypeus bi-dentate. Pronotum with fifteen shining spot……………………………………… ……………………………………………*Gymnopleurus* (*Metagymnopleurus*) *gemmatus* Harold
- Clypeus quadri-dentate……………………………………………………………………………3

3. Upper surface without hairy clothing……………………………………………………………… ……………………………………………*Gymnopleurus* (*Gymnopleurus*) *cyaneus* (Fabricius)
- Upper surface clothed with fine hairs………………………………………………………………… ……………………………………………*Gymnopleurus* (*Metagymnopleurus*) *miliaris* (Fabricius)

4. Clypeus bi-dentate……………………………………………*Paragymnopleurus sinuatus* (Olivier)
- Clypeus quadri-dentate……………………………………………………………………………5

5. Pronotum finely and distinctly punctate………………………… *Garreta mundus* Wiedemann
- Pronotum without punctures but distinctly granular throughout……………………………… ……………………………………………………………………………*Garreta dejeani* Castelnau

14. *Gymnopleurus* (*Metagymnopleurus*) *gemmatus* Harold, 1871 (Plate 2N)

Diagnostic characters**:** Oval, rather flat and densely setose above. Head densely granulate. Clypeus with anterior margin bi-dentate. Pronotum granulate with fifteen shining spots. Elytra with intervals irregularly rugose. Pygidium closely and rather strongly punctate.

Collection data: Raipur, BWLS, 03.vii.2011 (1♂) fresh cow dung.

Nesting strategy: Roller (Telocoprid).

Geographical distribution: India: Andhra Pradesh, Chhattisgarh, Maharashtra, West Bengal, Madhya Pradesh, Chhattisgarh, West Bengal, Karnataka and Tamil Nadu. *Elsewhere*: Sri Lanka.

15. *Gymnopleurus* (*Gymnopleurus*) *cyaneus* (Fabricius, 1798) (Plate 2O)

Diagnostic characters: Bright metallic green with oval and convex body and devoid of hairs above. Clypeus with anterior margin quadric-dentate. Pronotum very strongly, unevenly and sparsely punctate. Elytra deeply punctate-striate with intervals strongly and transversely punctate.

Collection data: Bilaspur, AABR, day collection, 07.vi.2004 (3♂3♀), 08.vi.2004 (4♂4♀), 17.vi.2004 (2♂), 18.vi.2004 (3♂2♀), 19.vi.2004 (2♂2♀), 27.vi.2004 (2♂, 1♀), 22.vii.2004 (1♀), 07.v.2005 (1♂ 2♀), 11.v.2005 (1♂), 15.v.2005 (1♂), 05.vi.2008 (1♂), 10.vi.2008 (1♂) 12.vi.2008 (2♂1♀), AMWLS, 18.vii.2005 (1♂1♀); Raipur, BWLS, 03.vii.2011 (2♂, 1♀), dung.

Male female ratio: 44 specimens: 26 male: 18 female (1.44).

Nesting strategy: Roller (Telocoprid).

Geographical distribution: India: Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Sri Lanka.

16. *Gymnopleurus* (*Metagymnopleurus*) *miliaris* (Fabricius, 1755) (Plate 2P)

Diagnostic characters: Broad, not very convex, closely clothed with grey setae. Head densely granulate. Clypeus with anterior margin quadri-dentate. Pronotum densely granulate, with black shining spots; a central one surrounded by a ring of five spots, and an outer one on either lateral side.

Collection data: Raipur, BWLS, 01.vii.2011 (1♂, 1♀) Fresh cow dung.

Male female ratio: 2 Specimens: 1 male: 1 female (1.0).

Nesting strategy: Roller (Telocoprid).

Geographical distribution: India: Chhattisgarh, Maharashtra, Madhya Pradesh, Jammu & Kashmir, Karnataka, Orissa, Uttar Pradesh and Uttarakhand.

Remarks: New state record.

17. *Paragymnopleurus sinuatus* (Olivier, 1789) (Plate 2Q)

Diagnostic characters: Opaque, dark red-coppery with antennal clubs bright yellow. Broad, oval not very convex. Clypeus with anterior margin bi-lobed. Pronotum finely rather closely punctate. Elytra with intervals flat and coriaceous.

Collection data: Bilaspur, AABR, 18.vi.2001 (1♂), 07.vi.2004 (1♂1♀), 17.vi.2004 (1♂1♀,), 21.vi.2008 (4♀); AMWLS, light trap, 03.vi.2004 (1♂), 14.vi.2004 (1♂), 18.vii.2005 (1♀): Raipur, BWLS, day collection, 04.vii.2011 (1♂1♀) Nilgai (*Boselaphus tragocamelus*) and cow dung.
Male female ratio: 14 Specimens: 6 male: 8 female (0.75).
Nesting strategy: Roller (Telocoprid).
Geographical distribution: India: Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal.

18. *Garreta mundus* Wiedemann, 1819 (Plate 2R)

Diagnostic characters**:** Broadly oval and not very convex. Dull, opaque, olive-green, entirely devoid of hairs. Head finely granular, with clypeus produced into four lobes and ocular lobes slightly prominent. Pronotum finely punctate with the interstices minutely coriaceous. Elytra finely striate and intervals finely coriaceous and without punctures.
Collection data: Raipur, BWLS, 03.vii.2011 (1♀, 1♂); Nilgai (*Boselaphus tragocamelus*) and cow dung.
Male female ratio: 2 Specimens: 1 male: 1 female (1.0).
Nesting strategy: Roller (Telocoprid).
Geographical distribution**:** Bihar, Chhattisgarh and Madhya Pradesh. *Elsewhere*: South West China.
Remarks: New state record.

19. *Garreta dejeani* Castelnau, 1840 (Plate 2S)

Diagnostic characters**:** Dark coppery greenish and entirely dull above. Very broad and flat body. Head and pronotum closely and finely granulate. Clypeus rugose in front and produced into four lobes at front margin. Elytra rather faintly striate and intervals rather more finely and less closely granular.
Collection data: Raipur, BWLS, 04.vii.2011 (3♂); Nilgai (*Boselaphus tragocamelus*) and cow dung.
Nesting strategy: Roller (Telocoprid).
Geographical distribution**:** India: Chhattisgarh, Kerala, Maharashtra, Madhya Pradesh and Uttarakhand.
Remarks: New state record.

Tribe Coprini Leach, 1815

The tribe Coprini comprises shiny black, medium to large bodied species averaging 9.5 mm to 30.0 mm long in length. This tunneling tribe comprises a total of about 400 species in 10 valid genera distributed in all geographical regions of the world. The genera are classed as fast-burying tunnellers as dung is first rapidly removed into a tunnel, which is re-located into one or more deeper tunnels for nest construction. The members of the tribe show predominantly nocturnal flight activity.

20. *Heliocopris bucephalus* (Fabricius, 1775) (Plate 3T)

Diagnostic characters: Broad and nearly quadrate. Head rather small with a moderately slender, pointed, slightly curved, nearly erect horn at centre in male and with a cephalic carina in female. Pronotum unevenly rugose, vertical in front with a sharp straight carina, feebly toothed at each end and anterior angles very smooth and rather sharply produced in male while in female, anterior carina sharp and gently curved with its front angles blunt.
Collection data: Bilaspur, AABR, 17.vi.2004 (2♀), 18.vi.2004 (2♀), 20.vii.2004 (1♀), 27.vii.2004 (1♀), 22.vi.2004 (2♀), 19.vii.2004 (2♀), 26.vi.2004 (1♀), 12.vi.2008 (1♀); Raipur, BWLS, 01.vii.2011 (2 ♀) light trap and dung.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal. *Elsewhere*: Myanmar, Malay Peninsula and Java.

Key to the species of genus *Catharsius*

1. Elytra not entirely opaque; male with a horn and two tubercles on pronotum…………………
……………………………………………………………*Catharsius* (*Catharsius*) *pithecius* (Fabricius)
- Elytra entirely opaque; male without tubercles. ……………………………………………………………2

2. Head with a small smooth area adjoining each eye and bears a conical median horn which is broad at base, sharp-pointed at tip and inclined a little forward.. ....*Catharsius* (*Catharsius*) *molossus* (Linnaeus)
- Head without a small smooth area adjoining each eye and bears a cephalic horn which is less erect and situated farther forward upon head... ....*Catharsius* (*Catharsius*) *sagax* (Quenstedt)

21. *Catharsius* (*Catharsius*) *pithecius* (Fabricius, 1775) (Plate 3U)

Diagnostic characters: Black, shining, shortly oval and very convex. Head nearly semicircular, clypeus feebly excised in middle bearing nearly straight slender horn just in front of eyes in male while female bears slightly acuminate transverse elevation. Pronotum bears sharp and conical protuberance on each side of median groove in male. Elytra finely but distinctly striate with scarcely perceptible punctures.

Collection data: Bilaspur, AABR, 21.vi.2004 (1♂), 30.vi.2004 (1♀), 25.vii.2004 (1♀), 23.vii.2005 (1♀), 09.vii.2004 (1♀), 15.vii.2005 (1♀); Raipur, BWLS, 01.vii.2011 (3♂6♀), 02.vii.2011 (2♂ 3♀), 03.vii.2011 (1♀) light trap and cow dung.

Male female ratio: 21 Specimens: 6 male: 15 female (0.40).

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Andhra Pradesh, Bihar, Chhattisgarh, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. *Elsewhere*: Sri Lanka.

Remarks: New state record.

22. *Catharsius* (*Catharsius*) *molossus* (Linnaeus, 1758) (Plate 3V)

Diagnostic characters: Black, broadly oval, very convex and opaque. Head broad with ocular lobes densely and coarsely granular with a small smooth shining area adjoining inner margin of each eye. Pronotum densely granulate with a sharp declivity in front and upper surface of which forms a sharp ridge feebly convex in middle and curved with its extremities. Male having a conical median horn with broad and flattened base and short pointed tip while female bears a short pointed process.

Collection data: Bilaspur, AABR, 04.xi.2007 (1♂1♀), AMWLS, 17.vi.2004 (1♂1♀), 24.vii.2005 (1♂), 13.vi.2004 (1♀); Bastar, KVNP, 14.vii.2005 (1♂); Raipur, BWLS, 01.vii.2011 (1♂), 02.vii.2011 (1♂1♀) light trap and dung.

Male female ratio: 10 Specimens: 6 male: 4 female (1.5).

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Andaman and Nicobar Island, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Kerala Madhya Pradesh, Meghalaya, Orissa, Sikkim, Uttar Pradesh, Uttarakhand and West Bengal.

23. *Catharsius* (*Catharsius*) *sagax* (Quenstedt, 1806) (Plate 3W)

Diagnostic characters: Black, opaque, broad, oval and very convex. Head broad and clypeus closely transversely rugose with ocular lobes densely and coarsely granular and head lacking smooth shining area adjoining eyes. Pronotum granulate and elytra finely and lightly striate. Male rather narrower in shape with the cephalic horn rather less erect and situated farther forward upon the head. Upper margin of thoracic declivity straight.

Collection data: Bilaspur, AABR, 09.vii.2004 (1♀), 01.vii.2004 (1♂1♀), 25.vii.2004 (1♀), 17.vi.2004 (2♀), 22.vi.2004 (1♂2♀), 23.vii.2004 (1♀), 11.viii.2005 (1♂), 27.vi.2005 (1♀), 18.vi.2004 (1♀), AMWS, 14.vi.2004 (2♀), 18.vii.2005 (1♀); Bastar, KVNP, 12.vii.2005 (1♂1♀), 14.vii.2005 (1♂1♀); Raipur, BWLS, 01.vii.2011 (1♂ 2♀), 02.vii.2011 (3♀), 03.vii.2011 (3♀) light trap and dung.

Male female ratio: 29 Specimens: 6 male: 23 female (0.26).

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Andhra Pradesh, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Bhutan.

Key to the species of genus *Copris*

1. Pronotum with sharply defined anterior declivity..2
- Pronotum without sharply defined anterior declivity...3

2. Pygidium strongly punctuate; clypeus narrowly notched in middle and feebly bi-lobed…… ………………………………………………………………………………… *Copris* (*Copris*) *carinicus* Gillet
- Pygidium not strongly punctuate; clypeus deeply notched in middle and strongly bi-lobed.. …………………………………………………………………………………*Copris* (*Copris*) *repertus* Walker

3. Pronotum with a median groove; elytral intervals convex and finely punctate; clypeal margin with one process…………………………………………*Copris* (*Paracopris*) *imitans* Felsche
- Pronotum without a median groove; elytral intervals very closely punctate; clypeal margin with two margin processes………………………………………… *Copris* (*Paracopris*) *surdus* Arrow

24. ***Copris* (*Copris*) *carinicus* Gillet, 1910** (Plate 3X)

Diagnostic characters: Broadly oval, highly convex, black and shining. Pronotum closely punctate except in front and middle and with a deep median longitudinal groove posteriorly. Elytra deeply striate and intervals slightly convex and minutely and sparsely punctate. Pygidium fairly strongly and closely punctate. In male, head bears a laterally compressed horn in middle and upper edge of the declivity of pronotum bears two minute tubercles while in female a short transverse carina is present on head and pronotum bears a straight transverse carina.
Collection data: Bilaspur, AABR, 14.vi.2004 (1♂ 5♀) light trap.
Male female ratio: 6 Specimens: 1 male: 5 female (0.2).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Assam, Chhattisgarh, Madhya Pradesh, Manipur and Meghalaya. *Elsewhere*: Myanmar.
Remarks: New state record.

25. ***Copris* (*Copris*) *repertus* Walker, 1858** (Plate 3Y)

Diagnostic characters: Broadly oval, highly convex, black and shining. In female head bears a short, transverse, elevated carina and clypeus deeply notched in middle with a slight lobe on each side of the notch. Pronotum very shining with a strong longitudinal groove in middle. Elytra lightly striate except at base and apex and intervals flat and very minutely and inconspicuously punctate.
Collection data: Bastar, KVNP, 02.iv.2005 (1♀), 04.iv.2005 (1♀), 09.iv.2005 (1♀), 12.iv.2005 (1♀) light trap.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Karnataka, Uttar Pradesh and Tamil Nadu. *Elsewhere*: Sri Lanka and Myanmar.
Remarks: New state record.

26. ***Copris* (*Paracopris*) *imitans* Felsche, 1910** (Plate 3Z)

Diagnostic characters: Broadly oval, convex, black and shining. Clypeal margin produced upward as a short erect process in front of middle. In male, anterior clypeal process flat and pronotum without a distinct longitudinal groove, while in female anterior clypeal process carinate behind, triangular in section at base and pronotum with a longitudinal median groove in its posterior half. Elytra deeply striate and intervals convex with minute rather scattered punctures. Pygidium strongly punctate.
Collection data: Bilaspur, AMWLS, 09.vi.2004 (1♂), 14.vi.2004 (1♀), 22.vii.2005 (1♀), 13.vii.2005 (1♀),light trap and dung.
Male female ratio: 4 Specimens: 1 male: 3 female (0.33).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Madhya Pradesh, Goa, Karnataka and Maharashtra.
Remarks: New state record.

27. ***Copris* (*Paracopris*) *surdus* Arrow, 1931** (Plate 3AA)

Diagnostic characters: Black and opaque with elongate-oval body. Clypeus bi-dentate in front, smooth in middle, lightly punctate at sides and with ocular lobes strongly punctate. Head, with a deep transverse depression at back and a short conical horn. Pronotum finely and closely punctate. Elytra finely striate, intervals flat and densely punctate. Metasternal shield smooth with few scattered punctures in front and sides strongly punctate.
Collection data: Bilaspur, AABR, 23.vii.2004 (1♀); Raipur, BWLS, 03.vii.2011 (1♂2♀), light trap and dung.

Male female ratio: 4 Specimens: 1 male: 3 female (0.33).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh and Uttarakhand. *Elsewhere*: Sri Lanka.
Remarks: New state record.

Tribe Onthophagini Burmeister, 1846

The members of tribe Onthophagini are characterized by the presence of; antennae with nine antennal segments, fore tibiae usually with four teeth and scutellum invisible. Species separation is based especially on, horns, ridges and clypeal indentation on head, sculpturing of pronotal disc, and on punctuation and/or granulation of head, thorax and abdomen. The tribe includes over 2200 species distributed in 40 genera of which 345 species are so for reported from the Oriental region.

28. *Caccobius* (*Caccophilus*) *unicornis* (Fabricius, 1798) (Plate 3AB)

Diagnostic characters: Broad oval, compact and moderately convex. Black or pitchy with clypeus, elytra and legs dark red. In male, head bears a short erect horn while in female clypeus, separated by a rounded carina from forehead. Pronotum evenly and moderately strongly punctate. Elytra finely striate and 7th striae strongly curved.
Collection data: Raipur, BWLS, 02.vii.2011 (3♂ 2♀) light trap.
Male female ratio: 5 Specimens: 3 male: 2 female (1.5).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Haryana, Madhya Pradesh, Orissa, Uttar Pradesh, Uttarakhand and West Bengal. *Elsewhere*: Borneo, China, Java, Malay Peninsula, Philippines and Sri Lanka.
Remarks: New state record.

29. *Phalops divisus* (Wiedemann, 1823) (Plate-4AC)

Diagnostic characters: Bright metallic green. Elytra decorated with yellow triangular patch at outer edge just behind middle. Upper surface shining and clothed with fine erect yellow setae. Pronotum closely and evenly covered with fine granules. In male, clypeus smoother in front than behind and reflexed into a tongue-like lobe, a blunt sub angular process in front of eyes, and posterior part of head produced backwards into a broad lamina, terminating in two slightly separate but not divergent points while in females clypeus slightly bi-lobed.
Collection data: Bilaspur, AABR, 15.vii.2005 (1♂), 10.vi.2008 (1♀); Raipur, BWLS 01.vii.2011 (1♀) light trap and dung.
Male female ratio: 3 Specimens: 1 male: 2 female (0.5).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Uttar Pradesh and Tamil Nadu. *Elsewhere*: Sri Lanka.
Remarks: New state record.

Key to the species of genus *Onthophagus*

1. Pronotum completely or partly granulate or rugose 2
- Pronotum punctate without granules..10

2. Pronotum entirely granulate or rugose without distinct punctures....................................3
- Pronotum partly granulate or rugose with some punctures or smooth areas.......................5

3. Granules of pronotum not closely packed; metallic in colour; male with a long horn protruding up to base of pronotum............*Onthophagus* (*Onthophagus*) *spinifex* (Fabricius)
- Granules of pronotum closely packed...4

4. Head gently rounded at sides; pronotum opaque..*Onthophagus* (*Onthophagus*) *griseosetosus* Arrow
- Head very strongly angular at sides; pronotum brilliant coppery red...*Onthophagus* (*Onthophagus*) *igneus* Vigors

5. Base of pronotum strongly produced in middle..*Onthophagus* (*Proagoderus*) *pactolus* (Fabricius)
- Base of pronotum not strongly produced in middle 6

6. Front angles of pronotum not produced very blunt..*Onthophagus* (*Onthophagus*) *ramosellus* Bates
- Front angles of pronotum more or less produced..7

7. Elytra pale..8
- Elytra dark 9

8. Anterior angles of pronotum very sharp; male with two horns and with a tubercle in between them; armatures identical in both sexes..*Onthophagus* (*Digitonthophagus*) *bonasus* (Fabricius)
- Anterior angles of pronotum not very sharp; male with two horns and without a tubercle in between horns; armatures differ between sexes..*Onthophagus* (*Digitonthophagus*) *gazella* (Fabricius)

9. Not metallic; male with two long laterally compressed and curved horns..*Onthophagus* (*Onthophagus*) *ramosus* (Wiedemann)
- Slightly metallic; male with a short backwardly directed horn on posterior margin of head..*Onthophagus* (*Onthophagus*) *abreui* Arrow

10. Upper surface without hair, smooth or with only very minute, scanty and inconspicuous setae..11
- Upper surface distinctly hairy or setose...16

11. Upper surface not entirely dark; elytra mottled; male bears a pair of erect horns upon line of clypeo-frontal suture....................*Onthophagus* (*Serrophorus*) *sagittarius* (Fabricius)
- Upper surface entirely dark; male single horned or with two horns on posterior margin of head..12

12. Pronotum finely rather sparsely punctuate...13
- Pronotum well rather closely punctuate...14

13. Metallic green; vertex of male with a pair of horns arising close to eyes inclined slightly backward, curving outward and approaching one another at tips..*Onthophagus* (*Onthophagus*) *dama* (Fabricius)
- Black; in male, hind margin of head produced backward, forming a pair of short horns curving upward and outward and slightly approximating at tips; at base of each horn a short upwardly directed spine like tooth present..*Onthophagus* (*Onthophagus*) *quadridentatus* (Fabricius)

14. Elytral suture with a minute elevation near base; middle of posterior margin of head produced backward as a short pointed horn..*Onthophagus* (*Colobonthophagus*) *hindu* Arrow
- Elytral suture without a minute elevation near the base; head two horned........................15

15. Pronotum closely and uniformly punctate; in male, posterior margin of head produced backward as broad smooth lamina, gently curving upward and its outer angles forming a pair of short horns which curves strongly each other..*Onthophagus* (*Onthophagus*) *armatus* Blanchard
- Pronotum unequally and unevenly punctate; posterior margin of head bears a pair of short straight horns and a tubercle on clypeo-frontal carina..*Onthophagus* (*Onthophagus*) *agnus* Gillet

16. Pronotum evenly and uniformly punctate..*Onthophagus* (*Onthophagus*) *unifasciatus* (Schall.)
- Pronotum unequally and unevenly punctate...20

20. Pygidium and lower surface more or less pale..*Onthophagus* (*Onthophagus*) *cervus* (Fabricius)
- Pygidium and lower surface entirely dark...*Onthophagus* (*Onthophagus*) *ludio* Boucomont

30. *Onthophagus* (*Onthophagus*) *spinifex* (Fabricius, 1781) (Plate 4AD)
Diagnostic characters: Dark metallic blue, broadly oval, convex and clothed with fine yellow hairs. Males with a long slender horn on head. Clypeus coarsely and transversely rugose with anterior margin semicircular. Pronotum moderately strongly and closely granulate. Elytra with intervals finely and irregularly granulate.
Collection data: Raipur, BWLS, 03.vii.2011 (1♂), light trap.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: West Bengal, Maharashtra, Bihar, Chhattisgarh, South India, Haryana and Madhya Pradesh. *Elsewhere*: Sri Lanka.
Remarks: New state record.

31. *Onthophagus* (*Onthophagus*) *griseosetosus* Arrow, 1931 (Plate 4AE)
Diagnostic characters: Oval, convex, dull black and upper surface clothed with small grey setae. Clypeus produced anterroiorly with anterior margin rounded and strongly reflexed. Pronotum densely covered with strong granules. Elytra very lightly punctate-striate, with intervals bearing numerous aspirate punctures.
Collection data: Raipur, BWLS, 04.vii.2011 (1ex.) dung.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Himachal Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu and Uttarakhand.
Remarks: New state record.

32. *Onthophagus* (*Onthophagus*) *igneus* Vigors, 1825 (Plate 4AF)
Diagnostic characters: Broad oval and very convex. Black with head (except anterior part of clypeus) and pronotum fiery crimson. Head flat, rather coarsely rugose and strongly angulate on each side. Pronotum very convex, closely and evenly covered with not very minute oval granules. Elytra finely striate with intervals flat and very minutely granular.
Collection data: AABR, Bilaspur, 23.vii.2004 (1♂).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Karnataka and Tamil Nadu.
Remarks: New state record.

33. *Onthophagus* (*Proagoderus*) *pactolus* (Fabricius, 1787) (Plate 4AG)
Diagnostic characters: Deep metallic green, with sides of pronotum golden yellow. Oval and convex. Pronotum with base strongly proceed into a flat lobe in middle having a slight apical depression. Elytra finely and closely punctate. Male with a long slender slightly curved horn on head.
Collection data: Bilapsur, AABR, 21.vi.2004 (1♀); Raipur, BWLS, 01.vii.2011 (1♂), cow dung.
Male female ratio: 2 Specimens: 1 male: 1 female (1.0).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Karnataka, Uttar Pradesh and Uttarakhand.

34. *Onthophagus* (*Onthophagus*) *ramosellus* Bates, 1891 (Plate 4AH)
Diagnostic characters: Black, opaque above and shining beneath. Broadly oval, compact and convex and devoid of hairs above and beneath. In male, head bears a pair of horns which diverge a little from base to apex, nearly straight, and scarcely curved, but feebly bi-sinuate. The sides of pronotum, a little depressed anterroiorly. In females, horns very short and pronotum not depressed at sides. Elytra strongly punctate-striate, with intervals very minutely and sparsely punctate.
Collection data: Bilaspur, AABR, Day 23.vii.2004 (1♂), night, 13.vi.2008 (1♂3♀), 12.vi.2008 (1♂2♀); Bastar, KVNP, 01.iv.2005 (1♂); Raipur, BWLS, Day 03.vii.2011 (1♂) light trap and cow dung.
Male female ratio: 10 Specimens: 5 male: 5 female (1.0).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand and West Bengal. *Elsewhere*: Pakistan.

Remarks: New state record.

35. *Onthophagus* (*Digitonthophagus*) *bonasus* (Fabricius, 1775) (Plate 4AI)

Diagnostic characters: Broadly oval and convex. Testaceous yellow with head and pronotum more dark greenish. Head with a pair of strongly diverging and backwardly directed horns with a tubercle in between them. Pronotum smooth in middle with few scattered granules and with a median groove having a slight tubercle on either side in anterior part. Elytra with intervals minutely and scarcely punctate.

Collection data: Bastar, KVNP, 27.ii.2004 (1♂), 13.iv.2005 (1♂); 10.iv.2005 (1♂); Bilaspur, AABR, 03.vi.2004 (1♂), 20.ii.2003 (1♂) light trap.

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Bihar, Chhattisgarh, Himachal Pradesh, Karnataka, Orissa, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu Uttar Pradesh, Uttarakhand and West Bengal. *Elsewhere*: Myanmar, Pakistan, Thailand and Vietnam.

36. *Onthophagus* (*Digitonthophagus*) *gazella* (Fabricius, 1787) (Plate 4AJ)

Diagnostic characters: Testaceous yellow with broad, oval, convex, smooth and shining body. Pronotum bears few granules in middle and fine scattered punctures behind. Elytra finely striate with intervals flat and impunctate. Vertex of male bears a pair of slender horns and pronotum with two minute prominences separated by a slight groove.

Collection data: Bilaspur, AABR, 03.vi.2004 (2♂1♀), 26.vi.2004 (1♀); Bastar, KVNP, 25.v.2005 (1♂), 24.v.2005 (1♀); Raipur, BWLS, 01.vii.2011 (19♂14♀), 02.vii.2011 (1♀), 03.vii.2011 (1♂) dung, 04.vii.2011 (3♀) light trap and cow dung.

Male female ratio: 44 Specimens: 23 male: 21 female (1.09).

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Tamil Nadu. *Elsewhere*: Africa, Arabia, Madagascar, Pakistan and Sri Lanka.

37. *Onthophagus* (*Onthophagus*) *ramosus* (Wiedemann, 1823) (Plate 4AK)

Diagnostic characters: Opaque, black or indigo black, with broad, oval, compact, and moderately convex body. Head semicircular, entirely rugose and separated from clypeal region by a rounded carina, and vertex bearing a pair of backwardly inclined horns united by straight carina and a sharp tubercle in middle. Pronotum closely punctate and elytra finely striate and intervals flat and finely punctate.

Collection data: Bastar, KVNP, 12.vii.2005 (1♀), 13.vii.2005 (3♀), 14.vii.2005 (1♂1♀); Bilaspur, AABR, 24.vii.2004 (1♂); Raipur, BWLS, 01.vii.2011 (8♂5♀), 02.vii.2011 (1♂2♀), 03.vii.2011 (2♂ 4♀),light trap.

Male female ratio: 29 Specimens: 13 male: 16 female (0.81).

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Kashmir, Madhya Pradesh, Maharashtra, Orissa, Punjab, Uttarakhand, Uttar Pradesh and Tamil Nadu. *Elsewhere*: Thailand.

Remarks: New state record.

38. *Onthophagus* (*Onthophagus*) *abreui* Arrow, 1931 (Plate 5AM)

Diagnostic characters: Narrowly oval and moderately convex. Deep chocolate-brown with a light coppery or greenish luster above and beneath. Upper surface clothed with yellowish setae. Head possess a short process in middle. Pronotum rather finely and closely punctate. Elytra finely striate and intervals flat and bear minute irregular granules.

Collection data: Raipur, BWLS, 04.vii.2011 (3♀), cow dung.

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Chhattisgarh, Haryana, Kerala, Madhya Pradesh and Uttarakhand.

Remarks: New state record.

39. *Onthophagus* (*Serrophorus*) *sagittarius* (Fabricius, 1775) (Plate 5AN)

Diagnostic characters: Testaceous yellow, oval, moderately compact, fairly convex, not very shining. Devoid of hairs above and very scantily hairy beneath. In male clypeus bears a pair of short erect horns upon line of the clypeo-frontal suture while in female an erect horn present on vertex. Pronotum smooth in front and well punctate behind. Elytra strongly striate with intervals flat and sparsely punctate, except at sides.

Collection data: Jagdalpur, KVNP, 11.iii.2007 (1♀), 17.iii.2007 (1♀); Raipur, BWLS, 01.vii.2011 (3♂1♀) light trap.

Male female ratio: 6 specimens: 3 male: 3 female (1.0).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal. *Elsewhere*: Java, Myanmar, Malay Peninsula and South China.
Remarks: New state record.

40. *Onthophagus* (*Onthophagus*) *dama* (Fabricius, 1798) (Plate 5AO)

Diagnostic characters: Dark greenish, oval, compact, shining and without hairs above. Clypeus semicircular with margin more strongly raised. Pronotum finely and sparsely punctate. Elytral striae distinctly punctate with intervals flat. Vertex of male with a pair of horns and each having an external tooth beyond middle, while in female an erect, flattened and truncate tubercle present upon vertex.
Collection data: Bastar, KVNP, 12.iv.2005 (1♂), 14.vii.2005 (1♀); Bilaspur, AABR, 07.i.2007 (1♀), 04.vi.2004 (1♀), 12.vi.2008 (1♀), 13.vi.2008 (1♀); Raipur, BWLS, 01.vii.2011 (8♀) light trap and cow dung.
Male female ratio: 14 specimens: 1 male: 13 female (0.076).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and Uttarakhand. *Elsewhere*: Bhutan and Sri Lanka.

41. *Onthophagus* (*Onthophagus*) *quadridentatus* (Fabricius, 1798) (Plate 5AP)

Diagnostic characters: Black, smooth and shining, broad, oval and convex body. Head, smooth and shining with clypeal margin, rounded and strongly reflexed and separated from fore head by a slight rounded carina and hind margin having a pair of short horns. At base of each horn a short spine like tooth present in male. Pronotum finely and sparsely punctate and striae of elytra closely punctate.
Collection data: Bilaspur, AABR, 03.vi.2004 (2♂); Bastar, KVNP, 13.vii.2005 (1♂), 14.vii.2005 (1♂); Raipur, BWLS, 03.vii.2011 (1 ♂) light trap and cow dung.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Arunachal Pradesh, Bihar, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Sri Lanka.
Remarks: New state record.

42. *Onthophagus* (*Colobonthophagus*) *hindu* Arrow, 1931 (Plate 5AQ)

Diagnostic characters: Black, oval and not very convex. In male posterior margin of head produced backward as a sinuous sharp-pointed horn. Pronotum smooth and shining in front and slightly hollowed and almost vertical in middle. In male terminal spurs of front tibia very short and quadrate. Elytra shallowly but distinctly striate.
Collection data: Raipur, BWLS, 01.vii.2011 (1♂) light trap.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Madhya Pradesh, Maharashtra and South India. *Elsewhere*: Sri Lanka.
Remarks: New state record.

43. *Onthophagus* (*Onthophagus*) *armatus* Blanchard, 1853 (Plate 5AR)

Diagnostic characters: Black without hair above. Broadly oval, compact and moderately convex. Clypeus finely punctate with its front margin strongly reflexed and bluntly bi-angulated in middle, Posterior margin of head produced backward as a broad smooth lamina, gently curving upward, its outer angles forming a pair of short horns, curving strongly towards each other. Pronotum finely and not closely punctate. Elytra deeply striate.
Collection data: Bilaspur, AABR, 12.vi.2008 (2♂), light trap.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Assam and Chhattisgarh. *Elsewhere*: Java Myanmar, Philippines, Sunda-Island, Taiwan, Marina islands, Guam and Vietnam.

44. *Onthophagus* (*Onthophagus*) *agnus* Gillet, 1925 (Plate 5AS)

Diagnostic characters: Oval and not very convex. Black and shining with elytra and pygidium sub opaque. Clypeus short, evenly but not very closely punctate, separated by a curved carina from forehead and bears a slight tubercle just behind carina. In males, posterior margin of head bears a pair of short straight horns. Pronotum strongly and not closely punctate, sloping in middle of front margin.

Collection data: Bilaspur, AABR, 03.vi.2004 (3♂), 22.vii.2004 (1♂), 29.vii.2004 (1♂), 12.vi.2008 (2♂), 13.vi.2008 (2♂); Raipur, BWLS, 04.vii.2011 (3♂), 03.vii.2011 (2♂), light trap and cow dung.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra and West Bengal.
Remarks: New state record.

45. *Onthophagus* (*Onthophagus*) *unifasciatus* (Schall., 1783) (Plate 5AT)
Diagnostic characters: Oval, very convex, bluish green or coppery, elytra orange-yellow, with a transverse median band on 5th elytral interval at base. Pronotum longitudinally depressed in middle, both sides of depression strongly elevated, with three prominences in a transverse row in anterior half. Pronotum rather strongly and closely punctate. Both sexes without any horn.
Collection data: Raipur, BWLS, 01.vii.2011 (2♂, 6♀), dog dung.
Male female ratio: 8 specimens: 2 male: 6 female (0.33).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Bihar, Chhattisgarh, Jharkhand, Maharashtra, Tamil Nadu, Karnataka and Uttar Pradesh.
Remarks: New state record.

46. *Onthophagus* (*Onthophagus*) *cervus* (Fabricius, 1798) (Plate 6AU)
Diagnostic characters: Oval and moderately convex. Shining black with head, pronotum and lower surface, coppery or greenish-black. Elytra decorated with orange band forming a broad external margin, extending almost to suture posteriorly. Upper surface thinly clothed with minute yellow setae. Pronotum fairly strongly not very closely but unevenly punctate. Male with a pair of horns arising behind eyes.
Collection data: Raipur, BWLS, 01.vii.2011 (4♀).
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Chhattisgarh, Madhya Pradesh, Maharashtra, Tamil Nadu and West Bengal. *Elsewhere*: Sri Lanka.
Remarks: New state record.

47. *Onthophagus* (*Onthophagus*) *ludio* Boucomont, 1914 (Plate 5AU)
Diagnostic characters: Black and shining with pronotum and posterior part of head blue. Elytra bright yellow with black markings, consisting of a sutural line, a transverse patch crossing suture at base and an irregular transverse bar crossing it well beyond. Posterior margin of head produced backward as a triangular lamina and apex of which drawn into a short pointed horn curving upward. Pronotum a little hollowed between two tubercles.
Collection data: Bilaspur, AABR, 10.vi.2008 (1♂) light trap.
Nesting strategy: Tunnelers (paracoprid).
Geographical distribution: India: Maharashtra, Chhattisgarh and Tamil Nadu. *Elsewhere*: Sri Lanka.
Remarks: New state record.

Tribe Onitini Laporte, 1840

The members the tribe Onitini are characterized by nine segmented antennae, fore tibiae with four teeth and presence of a visible scutellum. The tribe includes about 210 tunneling species under 18 genera, distributed from Africa to the Palaearctic and Oriental zoogeographic regions. Onitini are mostly slow tunnellers and most, though not all, *Onitis* species are night-flyers.

Key to the species of genus *Onitis*

Green or coppery in colour; metasternum longitudinally grooved in front; front tibia armed with four feeble teeth..*Onitis philemon* Fabricius
Black or pitchy black in colour; metasternum flat not grooved in front; front tibia armed with three short teeth and a blunt terminal process...........................*Onitis subopacus* Arrow

48. *Onitis philemon* Fabricius, 1801 (Plate 6AV)
Diagnostic characters**:** Green, coppery and oval. Head rugulose with ocular lobes rather smooth and clypeus parabolic and separated from forehead by an interrupted curved carina

and with a short transverse carina just before it and a conical tubercle just behind it. Pronotum strongly punctate without well marked median line. Elytra strongly striate and intervals very finely and sparsely punctate.

Collection data: Bilaspur, AABR, 04.xi.2007 (1♀), 06.xi.2007 (1♀); Bastar, KVNP, 14.vii.2005 (1♂), 09.iv.2005 (3♀), Raipur, BWLS, 01.vii.2011 (5♂10♀), light trap and cow dung.

Male and female ratio: 21 specimens: 6 male: 15 female (0.4)

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttaranchal and West Bengal. *Elsewhere*: Myanmar, Pakistan, Sri Lanka, Thailand and Vietnam.

Remarks: New state record.

49. *Onitis subopacus* Arrow, 1931 (Plate 6AW)

Diagnostic characters: Black or pitchy black with oval, rather narrow, smooth and moderately convex body. Head and pronotum shining and elytra rather dull. Pronotum closely punctate with incomplete smooth median line. Pygidium opaque and smooth. In male front tibia long, slender and strongly curved with a single or double tooth near base and armed with three short teeth and a blunt process, while in female front tibia short with four stout external teeth.

Collection data: Bilaspur, AABR, 12.vi.2008 (1♂), 26.vi.2004 (1♂); Raipur, BWLS, 01.vii.2011 (1♂) light trap and dung.

Nesting strategy: Tunnelers (paracoprid).

Geographical distribution: India: Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal.

Remarks: New state record.

Tribe Oniticellini Kolbe, 1905

The members of tribe Oniticellini are characterized by the presence of eight segmented antennae and a small visible scutellum. Body shape elongate, usually quasi-rectangular but occasionally tapering posteriorly, with a slightly flattened, square appearance from an end-on view. The tribe includes about 180 described species comprising 15 genera assigned to three different subtribes viz. Helictopleurina, Drepanocerina and Oniticellina.

Subtribe Oniticellina Kolbe, 1905

50. *Oniticellus* (*Oniticellus*) *cinctus* (Fabricius, 1775) (Plate 6AX)

Diagnostic characters: Oblong-oval, not very convex. Smooth and shining black. Head shining and smooth and without any carina. Pronotum very smooth with a rather deeply impressed median longitudinal line upon its posterior half. Elytra deeply striate and each elytron with a pale yellow external border extending from behind shoulder to sutural angle.

Collection data: Raipur, BWLS, 01.vii.2011 (5♂3♀).

Male and female ratio: 8 specimens: 5 male: 3 female (1.66)

Nesting strategy: Dwellers (endocoprid).

Geographical distribution: India: Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Remarks: New state record.

51. *Tiniocellus spinipes* (Roth, 1851) (Plate 6AY)

Diagnostic characters: Opaque and dark brown with elongate-oval and flat body. Head lacking carina, slightly shining in front and rugose behind. Pronotum densely and sub-rugosely punctate. Intervals of elytra flat and minutely granulate. Meta-sternum opaque and sparsely granulate at sides.

Collection data: Raipur, BWLS, 04.vii.2011 (4♀).

Nesting strategy: Dwellers (endocoprid).

Geographical distribution: India: Chhattisgarh, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu and Uttarakhand. *Elsewhere*: Africa and Uganda.

Remarks: New state record.

Subtribe Drepanocerina van Lansberge, 1875

52. *Drepanocerus setosus* (Wiedemann, 1823) (Plate 6AZ)

Diagnostic characters: Elongate-oval, dark-brown, opaque clothed with grey scale-like setae arranged mostly in longitudinal rows. Clypeus with anterior margin strongly bi-lobed. In male, pronotum with a large depression posteriorly, basal part with a slender obliquely forwarded horn, a little bifid at apex. Pronotum almost flat with shallow pits. Elytral intervals having more or less complete setose ridge.
Collection data: Raipur, BWLS, 01.vii.2011 (2♀1♂).
Nesting strategy: Dwellers (endocoprid).
Geographical distribution: India: Chhattisgarh, Himachal Pradesh, Haryana, Madhya Pradesh,
Maharashtra, Tamil Nadu, Uttarakhand and Uttar Pradesh. *Elsewhere*: Sri Lanka.
Remarks: New state record.

RESULTS AND DISCUSSION

Species diversity: The dung beetle fauna of Chhattisgarh is represented by three families of Laparostict scarabs' viz. Hybosoridae, Geotrupidae and Scarabaeidae. Altogether, 52 species of dung beetles belonging to 22 genera distributed in 12 tribes, 04 subtribes, 05 subfamilies and 03 families were studied from Chhattisgarh. The highest number of species were studied from family Scarabaeidae (47 species) followed by Geotrupidae (03 species) and Hybosoridae (02 species). Within Scarabaeidae, the subfamily Scarabaeinae constitutes 42 species, Aphodiinae 03 species and Orphninae 02 sspecies respectively (Figure 2). *Onthophagus* includes 18 species under 05 sub genera was found to be the most species rich genus followed by *Copris* (04 species), *Catharsius* (03 species), *Aphodius*, *Bolbohamatum, Garreta*, *Gymnopleurus*, *Sisyphus*, *Orphnus* and *Onitis*, (each with 02 species). Other genera such as; *Bolboceras*, *Caccobius*, *Drepanocerus*, *Heliocopris*, *Hybosorus*, *Phaeochrous*, *Phalops*, *Paragymnoleurus*, *Rhyssemus*, *Scarabaeus*, *Tiniocellus* and *Oniticellus*, were each represented by only single species.

New records and distribution in studied protected areas: The study adds 36 new records to the faunal diversity of dung beetles of Chhattisgarh. The subfamily Aphodiinae and Orphninae were recorded for the first time from the state. The genera namely; *Aphodius*, *Bolboceras*, *Caccobius*, *Copris*, *Drepanocerus*, *Phaeochrous*, *Phalops*, *Rhyssemus*, *Sisyphus*, *Tiniocellus*, *Oniticellus*, *Onitis*, and *Orphnus*, are first time recorded from the state. Based on the beetle collections, the study reveals that the diversity of these beetles is quite variable in studied protected areas of the state. The highest number of species were reported from Barnawapara Wildlife Sanctuary (41 species) followed by Achanakmar-Amarkantak Biosphere Reserve (27 species) and Kanger Valley National Park (15 species).

Identification keys: Identification keys to the subfamilies, tribes, genera and species were prepared by studying thoroughly the morphological characters of the dung beetle specimens collected from the state. The morphology of head, pronotum, elytra, legs, and metasternum are the main diagnostic characters on which the identification of these beetles is based on.

Field observations: Survey of the state and data available from previous collections of dung beetles yielded many interesting facts about dung beetles from Chhattisgarh. In the present study, according to the mode of food manipulation, dung beetles belonging to all the three nesting strategies; rollers, tunnellers and dwellers were recorded. The first category, which consists of ball rollers (telocoprid), was represented the genera; *Scarabaeus*, *Gymnopleurus*, *Paragymnoleurus*, *Garreta* and *Sisyphus*. The second group of dung-burying beetles, called as tunnelers (paracoprid), take the dung to the underground chamber at the end of the burrow and make it into a ball, include the genera; *Hybosorus*, *Phalops*, *Onthophagus*, *Heliocopris*, *Copris*, *Catharsius* and *Onitis*. The third group, called as dwellers or dung feeders (endocoprid) are represented by *Oniticellus*, *Tiniocellus*, *Drepanocerus* and *Aphodius*. Some of the genera, such as *Bolboceras*, *Bolbohamatum*, *Orphnus*, *Rhyssemus* and *Phaeochrous* undoubtedly feed on dung, but were collected from light sources. Most of the species were collected using light trap method, while there were some species which did not attract towards light and were exclusively captured from dung pats itself. *Drepanocerus setosus*, *Tiniocellus spinipes*, *Oniticellus* (*Oniticellus*) *cinctus*, *Onthophagus* (*O.*) *griseosetosus*, *Onthophagus* (*O.*) *unifasciatus*, *Onthophagus* (*Proagoderus*) *pactolus*, *Garreta dejeani*, *Garreta mundus*, *Gymnopleurus* (*Metagymnopleurus*) *gemmatus*, *Gymnopleurus* (*M.*) *miliaris*, *Gymnopleurus* (*Gymnopleurus*) *cyaneus*, *Paragymnopleurus sinuatus*, *Scarabaeus* (*Kheper*) *sanctus*, *Sisyphus* (*Sisyphus*) *longipes*, *Sisyphus* (*S.*) *neglectus* were among such species that were only collected from dung not from light source. On the other hand, the species belonging to *Bolboceras*, *Bolbohamatum*, *Orphnus* and some species of *Onthophagus* and *Rhyssemus* were collected mostly from light sources. While species under the genera; *Heliocopris, Copris, Catharsius*, *Onthophagus, Onitis*, *Hybosorus* and *Aphodius* were collected from both dung pats and light sources.

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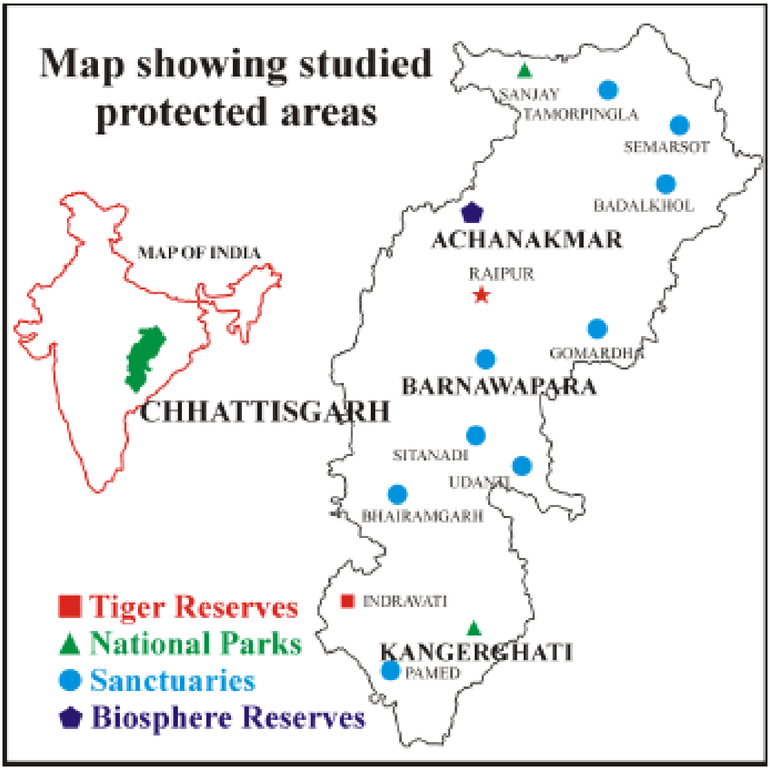

Figure 1. Map showing studied protected areas in Chhattisgarh (India).

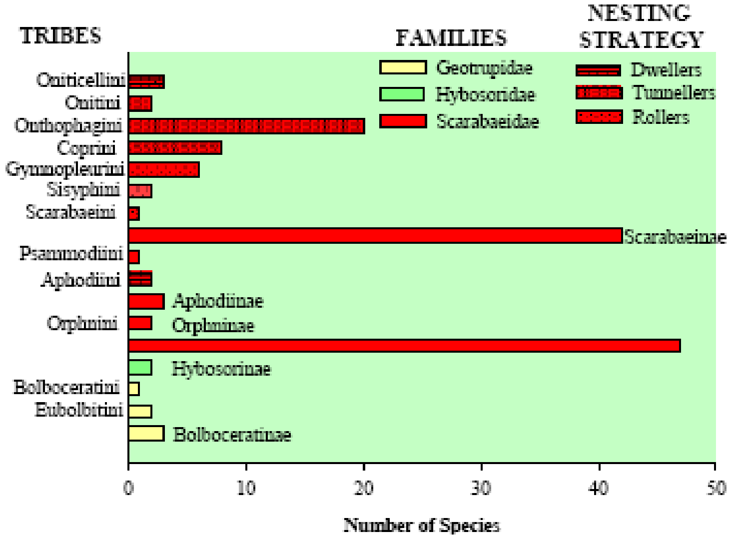

Figure 2. Graphical presentation of species diversity among subfamilies, tribes and families.

Plate 1. (A) *Bolbohamatum calanus* (Westwood), (B) *Bolbohamatum marginale* Krikken (C) *Bolboceras quadridens* (Fabricius), (D) *Hybosorus orientalis* Westwood, (E) *Phaeochrous emarginatus emarginatus* (Castelnau), (F) *Orphnus impressus* Westwood, (G) *Orphnus parvus* Wiedemann, (H) *Aphodius* (*Calaphodius*) *moestus* Fabricius (I) *Aphodius* (*Pharaphodius*) *crenatus* Harold, (J) *Rhyssemus germanus* (Linnaeus).

Plate 2. (K) *Scarabaeus* (*Kheper*) *sanctus* (Fabricius), (L) *Sisyphus* (*Sisyphus*) *longipes* (Olivier), (M) *Sisyphus* (*Sisyphus*) *neglectus* Gory, (N) *Gymnopleurus* (*Metagymnopleurus*) *gemmatus* Harold, (O) *Gymnopleurus* (*Gymnopleurus*) *cyaneus* (Fabricius), (P) *Gymnopleurus* (*Metagymnopleurus*) *miliaris* (Fabricius), (Q) *Paragymnopleurus sinuatus* (Olivier), (R) *Garreta mundus* Wiedemann, (S) *Garreta dejeani* Castelnau.

Plate 3. (T) *Heliocopris bucephalus* (Fabricius), (U) *Catharsius* (*Catharsius*) *pithecius* (Fabricius), (V) *Catharsius* (*Catharsius*) *molossus* (Linnaeus), (W) *Catharsius* (*Catharsius*) *sagax* (Quenstedt), (X) *Copris* (*Copris*) *carinicus* Gillet, (Y) *Copris* (*Copris*) *repertus* Walker, (Z) *Copris* (*Paracopris*) *imitans* Felsche, (AA) *Copris* (*Paracopris*) *surdus* Arrow, (AB) *Caccobius* (*Caccophilus*) *unicornis* (Fabricius).

Plate 4. (AC) *Phalops divisus* (Wiedemann), (AD) *Onthophagus* (*Onthophagus*) *spinifex* (Fabricius), (AE) *Onthophagus* (*Onthophagus*) *griseosetosus* Arrow, (AF) *Onthophagus* (*Onthophagus*) *igneus* Vigors, (AG) *Onthophagus* (*Proagoderus*) *pactolus* (Fabricius), (AH) *Onthophagus* (*Onthophagus*) *ramosellus* Bates, (AI) *Onthophagus* (*Digitonthophagus*) *bonasus* (Fabricius), (AJ) *Onthophagus* (*Digitonthophagus*) *gazella* (Fabricius) (AK) *Onthophagus* (*Onthophagus*) *ramosus* (Wiedemann).

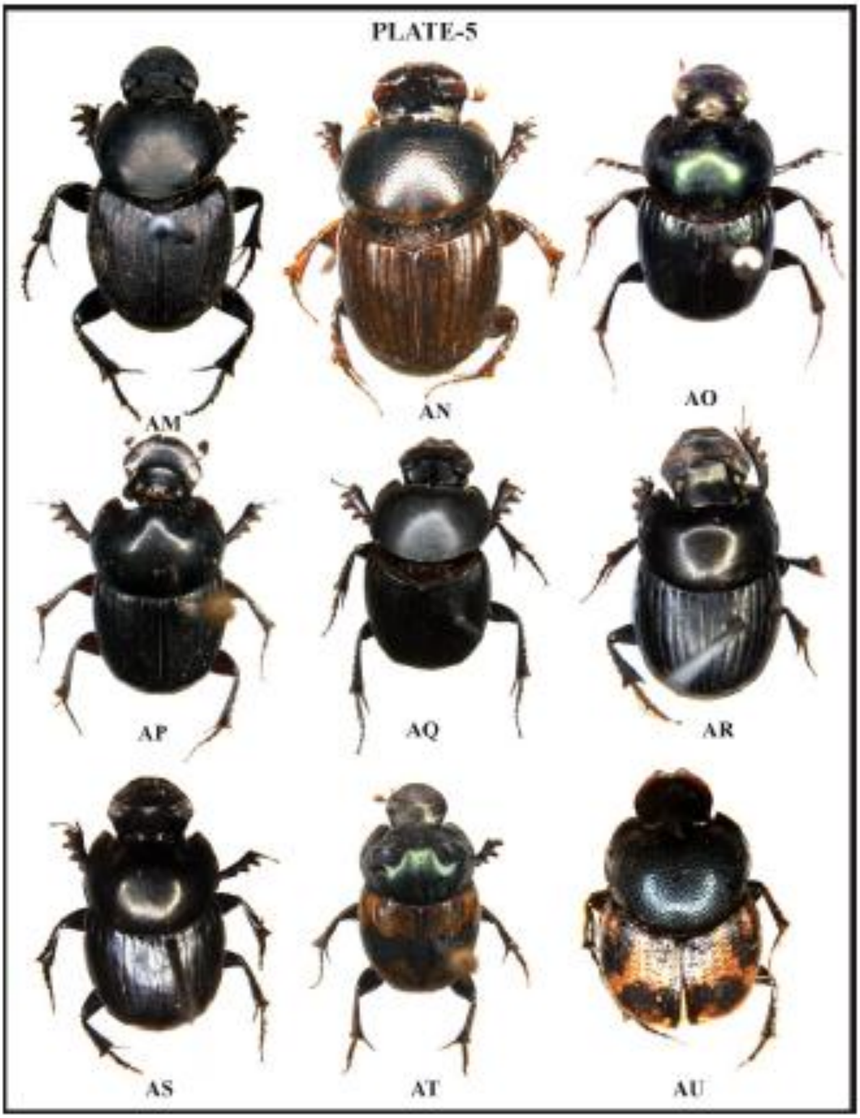

Plate 5. (AM) *Onthophagus* (*Onthophagus*) *abreui* Arrow, (AN) *Onthophagus* (*Serrophorus*) *sagittarius* (Fabricius), (AO) *Onthophagus* (*Onthophagus*) *dama* (Fabricius), (AP) *Onthophagus* (*Onthophagus*) *quadridentatus* (Fabricius), (AQ) *Onthophagus* (*Colobonthophagus*) *hindu* Arrow, (AR) *Onthophagus* (*Onthophagus*) *armatus* Blanchard, (AS) *Onthophagus* (*Onthophagus*) *agnus* Gillet, (AT) *Onthophagus* (*Onthophagus*) *unifasciatus* (Schall.), (AU) *Onthophagus* (*Onthophagus*) *ludio* Boucomont.

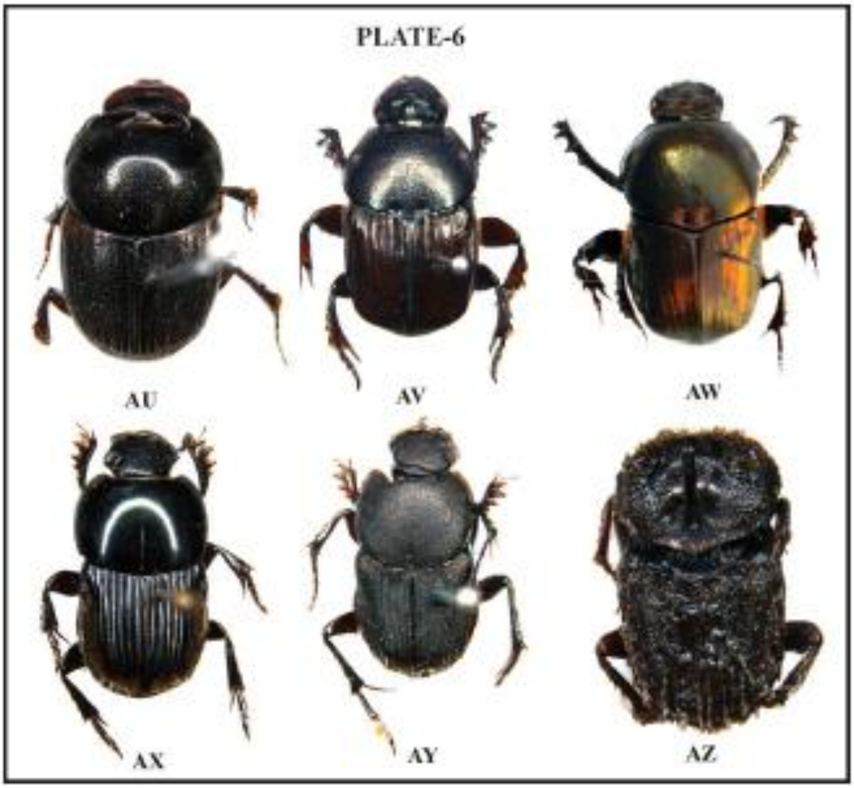

Plate 6. (AU) *Onthophagus* (*Onthophagus*) *cervus* (Fabricius), (AV) *Onitis philemon* Fabricius, (AW) *Onitis subopacus* Arrow, (AX) *Oniticellus* (*Oniticellus*) *cinctus* (Fabricius), (AY) *Tiniocellus spinipes* (Roth), (AZ) *Drepanocerus setosus* (Wiedemann).

IMPACT OF JUTE YELLOW MITE, *POLYPHAGOTARSONEMUS LATUS* (BANKS) DENSITY ON HOSTS (*CORCHORUS OLITORIUS* L.) PHENOLOGY AND ASSESSMENT OF YIELD LOSS UNDER FIELD CONDITION

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ABSTRACT: Jute yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) is one of the destructive pests of jute, which has been expanded in recent years in Bangladesh. Jute plants of tossa (*Corchorus olitorius* L.) varieties were considered as treatments viz., O-9897, O-72, OM-1 and O-795. The paired plot treatments (miticide treated and miticide untreated cintrol) were laid out under field condition. The yellow mite impact was studied on three stages of jute plants: 60 DAS (day after sowing), 90 DAS and 120 DAS. The higher number of mite stages observed upto 90 DAS then declined afterward upto 120 DAS in var. OM-1 among four C. olitorius varieties. A damage index scale (0-5) was to assess yellow mite injury to jute plants. The percent infestation and damage index was also used to relate yellow mite injury to different yield contributing characters of plants infested at three different phenological stages. The yield contributing characters of untreated plots showed significant damage at 60, 90 and 120 DAS in C. olitorius varieties compared to treatment plots. The highest fibre yield losses due to mite infestation was found in the variety OM-1 (77.93%) followed by O-795 (75.40%), O-72 (69.59%) and the lowest was in O-9897 (69.35%); the highest stick yield losses was in the variety OM-1(75.56%) followed by O-795 (71.44%) and O-72 (65.87%), the lowest was in O-9897 (65.75%) and the highest seed yield losses was in the variety O-795 (49.08%) followed by OM-1 (47.46%) and O-72 (39.10%), the lowest was in O-9897 (29.94%) under field condition. High yellow mite population in the untreated check decreased plant growth and showed significant yield loss in the variety OM-1.

KEY WORDS: *Polyphagotarsonemus latus*, *Corchorus olitorius*, incidence, yield loss.

Yellow mite is becoming an increasingly important pest of economic crops in the Bangladesh. The genus Corchorus is the most important family Tiliaceae, highlighting the jute as the culture of higher expression economy. Yellow mite (*Polyphagotarsonemus latus*), is one of the most common and destructive pests of jute (*Corchorus olitorius* L.). Both yield and quality of fibre are reduced due to the attack of this pest. Due to the attack of this pest, the vertical growth of the internodes is suppressed thereby side branches are enhanced (Kabir, 1975). Small-sized herbivorous mites are difficult to detect, but their damage often produces dramatic effects on plant morphology and physiology. The yellow mite, *Polyphagotarsonemous latus* (Banks) (Acari: Tarsonemidae), is extremely polyphagous, and is found on more than 60 plant families (Gerson, 1992). The softer portions of the plants such as cotton (Cividanes et al., 1987), eggplant (Queiroz & Oliveira, 1992), jute (Hath, 2000) and grape (Haji et al., 2001) was attacked by this pest. Since yellow mites are very small (body length between 100 and 200 microns) they are unnoticeable until serious damage occurs rapidly to appeal leaves. Growers who are not familiar with the plant symptoms associated with the presence of yellow mites can first confuse symptoms with a virus, phytotoxicity from a sprayed product, or a nutrient related disorder (Gerson, 1992). The mites are usually found on the upper part of the plant, feeding on the apical shoots and the abaxial side of young leaves. Yellow mites are believed to be cell feeders, having styliform simple chelicerae that are only slightly reversible (Jeppson et al., 1975), with an approximate extended length of 43 microns (Gui et al., 2001). Yellow mite feeding causes a variety of symptoms in different hosts and plant organs. In general, plant growth is inhibited (Peña & Bullock, 1994; Cho et al., 1996a,b). Usually, the young apical leaves are heavily damaged, seem distorted, more rigid, and their edges curl downwards. The fruits, if any appear, may be cracked and sometimes reticulated (Bassett, 1981; Cross & Bassett, 1982; Gerson, 1992; Cho et al., 1996b). The study was designed to (1) determine the response of mite populations to host phenology in jute under field condition and (2) to measure the impact of mite density on yield, fruit number, number of leaves and flowers of different developmental stages of jute plants.

MATERIALS AND METHODS

The experiment was conducted in the field of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) of Gazipur during the period from March to August, 2009. Jute plants of tossa *(Corchorus olitorius* L.) varieties sown in 15 March, 2009 were considered as treatments viz., O-9897, O-72, OM-1 and O-795. The paired plot treatments were laid out under field condition in randomized complete block design (strip trial) with three replications and consider 30 plants/plot in both treated and untreated situation; the unit plot size was 2×2.1m, row to row distance 30 cm and block to block distance 1 m. After natural population (infestations) build up in the field, when plant age at 28th days the treatment plots were treated with miticide (Mycosul 80 WDG @ 3 gm per litre of water) and repeat treatment after 7 days interval until harvest to kill the nymphs which may hatch out after these treatments (Kabir, 1975) and control plots were left untreated. Young 3rd leaves from the tip described by Alagarmalai et al. (2009) were collected at 60, 90 and 120 days after sowing (DAS), because yellow mites are commonly found on the lower surfaces of young apical leaves and flowers, where they deposit their eggs. The number of mite stages (egg, larva, pupa, female and male) per cm^2 leaf (20 leaves/plot) was counted under a stereomicroscope.

Damage index at different plant ages

The experiment consisted of 10 yellow mite infested plants and 10 uninfested plants of each variety at different ages (60, 90 and 120 DAS), where the percentage of infestation, rating score of yellow mite infested plants were recorded at three stages of plants pre and post harvestation. To establish a damage index per plant, plants were separated into 5 categories of damage followed by Pradhan (1988) method. The rating scores of the categories were: 0= Fresh and healthy leaves, without any changes in colour, 1= Slight changes in colour of leaves, 2= Curling of leaves, 3= 1 to 3 infested leaves dropped from the top, 4= All infested leaves fall prematurely but top shoot alive and 5= Top shoots dead. Different phenology viz., leaf area, fresh leaf weight, dry leaf weight, number of leaves, plant height, base diameter, fibre weight, stick weight, number of flowers per plant, number of pod per plant, pod weight, number of seed per pod, seed weight per plant and 1000' seed weight from both treated and untreated plots was also assessed at 3 stages (60, 90 & 120 DAS) of plants during the course of study. Leaf area was determined with a leaf area meter (LI-COR, Lambda Instruments Corporation, Lincoln, NE) and water content was determined by subtracting dry leaf weight from fresh leaf weight.

Assessing yield loss

The difference between the weight of yield in treated and untreated plots were considered as loss. The percent loss in yield was calculated using the following formula (Khosla 1977):

X1-X2 Per cent loss in yield = x 100

X1 Where, X1 is the mean yield in treated plots. X2 is the mean yield in untreated plots.

Data Analysis

The experimental data were analyzed statistically after appropriate transformation. Densityof mite population data were transformed into square root transformation and Tukey's test (P= 0.05) was done using the program MSTAT and analysis of variance (ANOVA) was usedto determine differences among varieties.Differences in categories for treated and untreated plants were analyzed by t-test (P= 0.05) using the program MSTAT and analysis of variance (ANOVA) was used to determinedifferences among plant ages. Yield data for both treated and untreated condition were transformed in to square root/logarithm transformation where necessary, percent data were transformed into arcsin (y= sin-1 x) or square root (y= x + 0.5) and means were separated by Tukey's test Test (Steeland Torrie 1960).

RESULTS AND DISCUSSION

Mite dynamics related to plant age

The number of mite stages varied for different plant stages. The mean number of eggs, larvae, pupae, females and males per cm^2 leaf on different *Corchorus olitorius* varieties (O-9897, O-72, OM-1 and O-795) at different plant stages in field condition is presented in Table 1. Number of eggs, larvae, pupae, females and males increase over time upto 90 DAS and then declined. There were significant differences in the population of eggs, larvae, pupae, females and males among different varieties of jute. The maximum eggs, larvae, pupae, females and males population was found at 90 DAS with *Corchorus olitorius* variety OM-1. The ascending orders of infestation in case of egg population among the varieties were O-9897 (39.22) < O-72 (46.22) < O-795 (53.67) < OM-1 (54.89); larval population among the varieties were O-9897 (37.56) < O-72 (40.55) < O-795 (42.78) < OM-1 (43.11); for pupal population among the varieties were O-9897 (3.22) < O-795 (3.44) < O-72 (3.55) < OM-1 (5.45); in female population among the varieties were O-9897 (4.67) < O-72 (5.00) < O-795 (6.11) < OM-1 (6.78) and male population among the varieties were O-72 (3.67) < O-9897 (3.78) < O-795 (4.22) < OM-1 (5.11), respectively. Similar trend of results were reported by De Coss-Romero and Peña (1998) in pepper plant. Apparently, tarsonemid mouthpart appendages are unsuitable for effective penetration ofrenitent tissues (Jeppson et al., 1975). Thus *P. latus* may not be able to puncture the lignified tissues found in after 90 days old plants as opposed to those tissues in 60-90 days old plants.These data is more potential value in programs for evaluating resistance of jute to *P. latus*. Assessments of plant resistance to *P. latus* carry out at early growth stages of jute would beparticularly effective for identifying highly resistant plants.

Incidence of *P. latus* on host (*Corchorus olitorius*) phenology and yield

Yellow mites significantly reduced the leaf sizes of untreated plants compared to that of treated plants in all varieties (O-9897, O-72, OM-1 and O-795) at three plant growth stages (Table 2). Fresh leaf weight was reduced at all the three plant stages, but significantly reductions in dry weight was observed for 90 DAS in var. O-795 and 120 DAS in var. OM-1 & var. O-795. The level of significance associated with the soluble solids was also reduced at all the three plant growth stages (Table 3). The numbers of leaves per plant, plant heights, base diameter, fibre weight, stick weight, number of flowers per plant, number of pods per plant, pod weight, number of seed per pod, seed weight and 1000 seed weight per plant were also affected by mite injury at three plant growth stages in all the varieties and was significantly reduced compared to those of uninfested plants (Table 4 and 5). The results suggested that yellow mites reduce height of the infested plants, and it induced lateral shoot growth. Fibre yield, stick yield and seed yield both in treated and untreated situation in different varieties (O-9897, O-72, OM-1 and O-795) and the yield loss due to yellow mite infestation are presented in Table 6. The differences in the fibre yield, stick yield and seed yield in different varieties, which could be avoided by the insecticidal treatment. The yield and yield losses have been found to vary in different varieties. Both in treated and untreated situation the highest fibre yield was obtained in the variety O-9897 (4.08 ton/ha.) followed by O-72 (3.92 ton/ha.), OM-1 (3.83 ton/ha.) and the lowest fibre yield was obtained in O-795 (3.75 ton/ha.). Yield loss was varied because of mite population fluctuations in order to host phenology and environmental condition. The highest fibre yield losses due to mite infestation was found in the variety OM-1 (77.93%) followed by O-795 (75.40%), O-72 (69.59%) and the lowest fibre yield losses was obtained in O-9897 (69.35%). The highest stick yield was obtained in the variety O-9897 (8.75 ton/ha.) followed by O-795 (8.74 ton/ha.), O-72 (8.33 ton/ha.) and the lowest stick yield was obtained in OM-1 (7.92 ton/ha.). The highest stick yield losses was showed in the variety OM-1 (75.56%) followed by O-795 (71.44%), O-72 (65.87%) and the lowest seed yield was found in O-9897 (65.75%). The highest seed yield was obtained in the variety O-9897 (1550.00 kg/ha.) followed by O-72 (1422.50 kg/ha.), O-795 (1397.50 kg/ha.) and lowest was in OM-1 (1385.00 kg/ha.). The highest seed yield losses was found in the variety O-795 (49.08%) followed by OM-1 (47.46%), O-72 (39.10%) and the lowest was found in O-9897 (29.94%). High levels of stress induced by *P. latus* feeding resulted in reduction in vegetative growth, flower development and reduction in quantity & quality of seed might be in response to some anatomical, physiological or biochemical differences between vegetative and reproductive stage of plants. These reductions are chronic feeding on plants younger leaf tissue, which appear to be more susceptible than plants with greater numbers of mature leaves. This effect has been shown to vary with the phenological development of hedera, reported by Nemestothy et al. (1982). Plants with younger hirsute leaves suffered the strongest damage compared to older plants with leaves with less hairs and where cell differentiation has already occurred. These results are similar with the reported by Smith (1935) who stated that the yellow mite cannot survive longer on the tough, mature leaves of most plants. Its result mentioned that about 15.50% (O-9897) and 10.00% (CVL-1) of fibre yield were decreased by the attack of yellow mite in potted plants and 12.30% (O-9897) of fibre yield was decreased under field condition (Faruquzzaman, 1987). De Coss-Romero (1998) reported about 80% of yield reduced by *P. latus* in green house pepper plant. The above discussion concluded that the variety OM-1of *C. olitorius* showed most susceptible against *P. latus* under field condition. The knowledge that the damage arises from mite responses to the phenological stage of the crop can enhance the efficiency and value of yellow mite monitoring programs and control strategies by focusing attention on the critical periods in jute crop. We observed in economic crop jute, *Corchorus olitorius* L.,that rapidly increases of yellow mite numbers coincided with different stages of the plant. However, under field conditions it is difficult to determine whether enlarged yellow mite populations on vegetative or reproductive host plant stages resulted from an enhanced mite growth rate compounded over time, or from immigration from outside sources.

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Table 1. Comparison of mean number of population at different stages of yellow mite per cm2 of the leaf at three DAS of *C. olitorius* under field condition.

Variety	Egg			Larva			Pupa			Female			Male		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
O-9897	37.56c (6.13)	39.22c (6.26)	35.22a (5.93)	30.56b (5.52)	37.56a (6.12)	27.67b (5.26)	2.22c (1.48)	3.22b (1.78)	1.89c (1.36)	3.67b (1.91)	4.67b (2.15)	2.89b (1.70)	3.55a (1.88)	3.78b (1.94)	3.33a (1.82)
O-72	42.89bc (6.55)	46.22b (6.80)	35.56a (5.96)	37.89a (6.15)	40.55a (6.36)	31.00ab (5.57)	3.11bc (1.76)	3.55b (1.88)	2.89b (1.69)	4.56ab (2.13)	5.00b (2.23)	4.00ab (2.00)	3.56a (1.87)	3.67b (1.90)	3.00a (1.73)
OM-1	54.11a (7.35)	54.89a (7.41)	38.89a (6.23)	39.11a (6.25)	43.11a (6.57)	35.22a (5.93)	4.78a (2.18)	5.45a (2.33)	4.55a (2.13)	5.33a (2.31)	6.78a (2.60)	4.55a (2.13)	3.89a (1.97)	5.11a (2.26)	3.56a (1.89)
O-795	48.56ab (6.97)	53.67a (7.33)	38.22a (6.18)	38.00a (6.16)	42.78a (6.54)	32.00a (5.66)	4.33ab (2.08)	5.44a (2.33)	3.78ab (1.95)	5.22a (2.29)	6.11ab (2.47)	4.54a (2.13)	3.78a (1.94)	4.22ab (2.04)	3.44a (1.85)

Means followed by same letter in column do not differ by Tukey's test (P = 0.05).
Figures in the parentheses are the square root transformed mean values.

Table 2. Comparison of mean percent infestation, damage rating, leaf area of jute plants infested with yellow at three plant stages under field condition.

Variety	% infestation						Damage rating						Leaf area (cm^2)					
	60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	0.00 b	77.33 a	0.00 b	77.33 a	0.00 b	63.81 a	0.00 b	1.73 a	0.00 b	1.44 a	0.00 b	1.67 a	14.07 a	7.22 b	18.80 a	9.80 b	17.13 a	13.77 b
O-72	0.00 b	70.67 a	0.00 b	80.00 a	0.00 b	64.76 a	0.00 b	2.13 a	0.00 b	1.78 a	0.00 b	1.33 a	13.20 a	6.69 b	17.63 a	11.87 b	19.60 a	14.87 b
OM-1	0.00 b	78.67 a	0.00 b	86.67 a	0.00 b	70.47 a	0.00 b	2.33 a	0.00 b	1.81 a	0.00 b	1.67 a	13.17 a	7.53 b	17.10 a	12.50 b	19.80 a	12.61 b
O-795	0.00 b	77.67 a	0.00 b	84.00 a	0.00 b	71.43 a	0.00 b	2.30 a	0.00 b	1.69 a	0.00 b	1.33 a	12.86 a	7.94 b	19.53 a	11.27 b	19.47 a	11.80 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 3. Comparison of mean fresh leaf weight, dry leaf weight and soluble solids at three jute plant stages infested with yellow mite under field condition.

Variety	Fresh leaf weight (g)						Dry leaf weight (g)						Soluble solids (g)					
	60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	0.32 a	0.13 b	0.22 a	0.13 b	0.23 a	0.16 b	0.09 a	0.06 a	0.05 a	0.03 a	0.07 a	0.08 a	0.23 a	0.07 b	0.17 a	0.09 b	0.16 a	0.08 b
O-72	0.29 a	0.13 b	0.21 a	0.17 b	0.33 a	0.23 b	0.08 a	0.05 a	0.05 a	0.04 a	0.07 a	0.08 a	0.21 a	0.08 b	0.16 a	0.12 b	0.25 a	0.15 b
OM-1	0.31 a	0.15 b	0.22 a	0.12 b	0.30 a	0.25 b	0.09 a	0.05 a	0.05 a	0.05 a	0.07 a	0.11 b	0.22 a	0.10 b	0.16 a	0.07 b	0.23 a	0.14 b
O-795	0.30 a	0.13 b	0.25 a	0.16 b	0.37 a	0.24 b	0.08 a	0.06 a	0.07 a	0.04 b	0.12 a	0.05 b	0.22 a	0.08 b	0.18 a	0.12 b	0.25 a	0.19 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 4. Comparison of mean number of leaves, plant height and base diameter at three jute plant stages infested with yellow mite under field condition.

Variety	No. leaves/plant						Plant height (m)						Base diameter (mm)					
	60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	23.47 a	18.53 b	124.72 a	83.89 b	66.17 a	48.17 b	1.71 a	1.57 b	3.39 a	3.06 b	3.47 a	3.25 b	13.27 a	11.53 b	19.89 a	15.00 b	19.07 a	15.87 b
O-72	26.67 a	24.00 b	102.11 a	84.67 b	65.17 a	48.83 b	1.88 a	1.66 b	3.21 a	2.94 b	3.47 a	3.23 b	11.43 a	10.33 b	18.89 a	14.45 b	18.63 a	15.57 b
OM-1	28.60 a	25.40 b	88.11 a	52.89 b	51.33 a	33.00 b	1.76 a	1.55 b	3.34 a	2.98 b	3.44 a	3.09 b	13.80 a	12.75 b	23.20 a	17.78 b	22.80 a	19.33 b
O-795	29.00 a	24.47 b	129.22 a	80.45 b	64.17 a	49.83 b	1.89 a	1.78 b	3.34 a	3.01 b	3.51 a	3.35 b	13.27 a	11.53 b	20.44 a	15.67 b	20.14 a	16.40 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 5. Comparison of mean fibre weight, stick weight, number of flowers, number of pods per plant, pod weight per plant, number of seed per pod, seed weight per plant and 1000 seed weight recorded at three jute plant stages infested with yellow mite under field condition.

Variety	Fibre weight (g)		Stick weight (g)		No. flowers		Pod/plant		Pod weight/plant (g)		Seed/pod		Seed weight/plant (g)		1000 seed weight (g)	
	120DAS		120DAS		120DAS		120DAS		120DAS		120DAS		120DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	16.33 a	5.00 b	35.00 a	12.00 b	38.33 a	27.70 b	27.67 a	14.33 b	10.01 a	7.48 b	134.59 a	116.07 b	6.20 a	4.34 b	1.83 a	1.67 b
O-72	15.67 a	4.67 b	33.33 a	11.33 b	38.22 a	19.14 b	21.80 a	12.40 b	9.81 a	5.77 b	112.13 a	100.41 b	5.69 a	3.43 b	1.73 a	1.57 b
OM-1	15.33 a	3.33 b	31.67 a	7.67 b	35.10 a	23.06 b	27.40 a	13.67 b	10.63 a	6.63 b	123.48 a	107.75 b	5.54 a	2.91 b	1.93 a	1.77 b
O-795	15.00 a	3.67 b	35.00 a	10.00 b	38.95 a	25.78 b	27.27 a	18.00 b	10.14 a	7.45 b	135.36 a	130.47 b	5.59 a	2.82 b	1.60 a	1.43 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 6. Yield loss of *C. olitorius* varieties due to *P. latus* infestation under field condition.

Variety	Fibre yield (ton/ha)			Stick yield (ton/ha)			Seed yield (kg/ha)		
	Treated	Unteated control	Loss(%)	Treated	Unteated control	Loss(%)	Treated	Unteated control	Loss(%)
O-9897	4.08 a (2.02)	1.25 a (1.11)	69.35 a (56.42)	8.75 a (2.96)	3.00 a (1.73)	65.75 b (54.20)	1550.00 a (3.19)	1085.00 a (3.03)	29.94 b (33.31)
O-72	3.92 a (1.98)	1.17 ab (1.08)	69.59 a (56.60)	8.33 a (2.89)	2.83 a (1.68)	65.87 b (54.24)	1422.50 a (3.15)	858.33 b (2.93)	39.10 ab (38.61)
OM-1	3.83 a (1.96)	0.83 b (0.91)	77.93 a (62.07)	7.92 a (2.81)	1.92 b (1.38)	75.56 a (60.42)	1385.00 a (3.14)	726.67 c (2.87)	47.46 a (43.53)
O-795	3.75 a (1.94)	0.92 ab (0.95)	75.40 a (60.34)	8.74 a (2.96)	2.50 ab (1.58)	71.44 ab (57.69)	1397.50 a (3.14)	705.83 c (2.85)	49.08 a (44.45)

In a column, treatment means having the same letter(s) are not significantly different by Tukey's test (P=0.05).

Figures in the parentheses are the transformed mean values.

ADDITIONS TO THE RARE SPECIES OF BRACONIDAE FAUNA (HYMENOPTERA: BRACONIDAE) FROM TURKEY

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ABSTRACT: 7 subfamilies of the Braconidae family were identified, and 5 of these, Adeliinae, Charmontinae, Exothecinae, Ichneutinae and Rhyssalinae are new records for the Turkish fauna. In addition, 7 genera: *Adelius* Haliday, 1833; *Charmon* Haliday, 1833; *Ichneutes* Nees, 1816; *Proterops* Wesmael, 1835; *Pseudichneutes* Belokobylskij, 1996; *Dolopsidea* Hincks, 1944; *Colastes* Haliday, 1833 and 12 species: *Adelius* (*Adelius*) *erythronotus* (Förster, 1851); *A.* (*A.*) *subfasciatus* Haliday, 1833; *Charmon extensor* (Linnaeus, 1758); *Homolobus* (*Chartolobus*) *infumator* (Lyle, 1914); *H.* (*Phylacter*) *annulicornis* (Nees, 1834); *Hormius moniliatus* (Nees, 1811); *Ichneutes reunitor* Nees, 1816; *Proterops nigripennis* Wesmael, 1835; *Pseudichneutes levis* (Wesmael, 1835); *Dolopsidea tatianae* (Telenga, 1941); *D. indagator* (Haliday, 1836) and *Colastes* (*Xenarcha*) *lustrator* (Haliday, 1836) are recorded for the first time from Turkey. Comments are presented on some insufficiently known taxa, and zoogeographic interest is the record of the each species for considered to be Turkey's fauna.

KEY WORDS: Braconidae, Hymenoptera, new records, zoogeographic, Turkey.

Braconidae is a family of parasitoid wasps and one of the richest families of insects. Between 17,963 species exist worldwide. The species are grouped into about 47 subfamilies, 97 tribe and 1,032 genera. This work reports on the rare braconids fauna, and in particular new records for Turkey. Although there has been a significant increase in our knowledge of rare braconid taxonomy, in this paper only Homolobinae and Hormiinae subfamilies had been previously recorded from Turkey (Yu et al., 2006).

Members in this family have long and thin body, long antenna and some with very long ovipositor. They have narrow waist like most other wasps. They are from small to medium in size. The two families Braconidae and Ichneumonidae are very close related and some species look similar. They can be distinguished by the forewing venation. In the Ichneumons there is an extra vein creating a cell which can not be found on Braconids (Matthews, 1974).

Braconidae wasps are attack of wide range of host species (Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Neuroptera, Orthoptera, Psocoptera) (Yu et al., 2006). Some species attack spiders, while some are hyperparasitic. There are both solitary and gregarious species in the family (Shaw, 1995; Wharton, 1993). Braconids represent two biological groups substantially differing in mode of life and morphology of larvae. All ectoparasites have been combined in the subfamilies Braconinae, Doryctinae and Microgastrinae, and the endoparasites in the remaining subfamilies. Since Braconidae with few exceptions are all primary parasites, this family in particular has attracted increasing interest as emphasis in pest control has shifted toward biotic agents (Sharkey, 1993; Tobias, 1986).

Although many studies were carried out about different habitats, altitude, and season on braconid wasps in different regions of Turkey, in Turkey such studies are the first time. Here, we add a few more species and discuss the distribution of others.

MATERIAL AND METHODS

Sample collection

Adult braconid wasps from Turkey were collected from various habitats and altitudes between years 1986-2009. Sweeping nets and light traps were used to obtain samples on grass-type plants. The specimens were then pinned and labeled according to taxonomic rules and regulations.

Species identification

Morphological terminology and characters used in this description follow: Achterberg, 1993; Belokobylskij, 1988, 1998; Chen et al., 2004 and Tobias, 1986. The specimens were deposited in the collection of the Zoological Museum at Trakya University.

Study area

Turkey, at the centre of Asia, Europe and Africa continents, is located between 26° and 45° east meridians according to Greenwich, between 36° and 42° North paralel according to Ecvator. Some parts of the country belongs to Asia continent (Anatolian Peninsula), and the other belongs to Europe continent (Thrace includes the westernmost part of Turkey). Also the country is related to Africa continent. According to these features, Turkey has three different bio-geographical regions, namely Europe-Siberian, Mediterranean and Iran-Turan. So, the country is a small continent according to its biodiversity (Lodos, 1995).

For each species, a listing of the materials examined, species distribution (Yu et al., 2006) and proposed chorotypes (items of classification based on distribution patterns as inferred from the comparative analysis of the geographical ranges of species, Vigna Taglianti et al., 1999). Vigna Taglianti et al. (1999) classification results from the comparision of over 3,000 geographical ranges of terrestrial and freshwater animal species. Chorotypes are useful for interspecific faunistic and biogeographic comparisions. The present zoogeographical characterization is based on the chorotype classification of Anatolian fauna, recently proposed by Vigna Taglianti et al. (1999).

RESULTS

13 species belonging to 7 subfamilies within family Braconidae were identified, and 5 subfamilies, 7 genera and 12 species new records for fauna of Turkey. The taxa are presented alphabetically.

Subfamily Adeliinae

Adelius Haliday, 1833

Adelius (*Adelius*) *erythronotus* (Förster, 1851)

Material examined: **Kastamonu**-Ilgaz Mountain-Çatören, mixed forest, 1280 m, 30.08.2002, 1♀, 2♂♂.

Distribution: Palearctic (Azerbaijan, Bosnia Hercegovina, former Czechoslovakia, France, Georgia, Germany, Hungary, Ireland, Korea, Moldova, Poland, Russia, Switzerland, Turkmenistan, Ukraine, United Kingdom, former Yugoslavia).

Chorotype: Asiatic-European.

New record for Turkey.

Adelius (*Adelius*) *subfasciatus* Haliday, 1833

Material examined: Bolu-Gerede-Güney, pasture, 1200 m, 13.06.2002, 1♂; **Karabük**-Safranbolu-İnceçay-Sarıçiçekdağı, *Pinus* sp., oak and pasture, 1567 m, 29.06.2001, 1♀; **Trabzon**-Maçka-Şolma Yaylası, fir forest, 1677 m, 05.08.2005, 3♀♀; -Maçka-Sümela, pasture, 1073 m, 03.07.2004, 1♀; **Sivas**-Hafik-Durulmuş, clover field and pasture, 1275 m, 31.5.2007, 1♀.

Distribution: Palearctic: Belgium, Bulgaria, Croatia, Czech Republic, former Czechoslovakia, Finland, France, Georgia, Germany, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Netherlands, Poland, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, former Yugoslavia.

Chorotype: Asiatic-European.

New record for Turkey.

Subfamily Charmontinae

Charmon Haliday, 1833

Charmon extensor (Linnaeus, 1758)

Material examined: Samsun-Salıpazarı-Astepe mevkii, chestnut and pasture, 600 m, 03.07.2003, 1♀.

Distribution: Ethiopian, Nearctic, Neotropical, Oriental, Paleearctic: Austria, Azerbaijan, Belgium, Bulgaria, China, former Czechoslovakia, Czech Republic, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Mongolia, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, United Kingdom.

Chorotype: Holarctic.

New record for Turkey.

Subfamily Homolobinae

Homolobus Förster, 1862

Homolobus (*Apatia*) *truncator* (Say, 1829)

Material examined: Adana-Kadirli, pasture, 89 m, 18.12.1997, 1♀; **Afyon**-Emirdağ-Kırkpınar, poplar woodland and pasture, 911 m, 07.07.2006, 1♂; **Amasya**-Suluova, poplar woodland and pasture, 470 m, 03.09.2003 1♂; **Ankara**-Temelli-Elagöz, poplar woodland and pasture, 803 m, 10.07.2007, 1♂, 3♀♀; -Tuz Gölü 22.04.2001, pasture, 920 m, 1♀; **Aydın**-Kocarlı, orchard and pasture, 51 m, 18.09.1996, 1♂; **Batman**-Ünlüce, pasture, 1506 m, 15.08.1991, 1♂; **Bayburt**, vegetable garden, 1562 m, 07.08.2005, 1♂; -Konursu, clover field, 1522 m, 30.08.2004, 1♀, 2♂♂; **Bursa**-Süleymaniye, orchard, 380 m, 19.09.1992, 1♀; **Çanakkale**-Yenice-Sameteli, pasture, 120 m, 12.09.2002, 1♂; **Elazığ**-Cip Barajı, poplar woodland and pasture, 1006 m, 04.06.2007, 2♂♂; **Çorum**-Alacahöyük, pasture, 867 m, 07.06.2003, 1♀; -İskilip-Karlık, orchard and pasture, 546 m, 26.08.2004, 1♂; Denizli-Tavas-Tekkeköy, vegetable garden, 419 m, 30.07.1997, 1♂; **Edirne**-Lalapaşa-Sinanköy, clover field, 350 m, 02.08.2000, 1♀; **Erzurum**, pasture, 1939 m, 10.06.1999, 3♂♂; **Giresun**-Alucra, oak and clover field, 1300 m, 02.07.2004, 1♂; **Gümüşhane**-Kelkit, pasture, 1259 m, 29.07.1991, 1♀; -Şiran-Karaşeyh, poplar woodland and pasture, 1435 m, 29.08.2004, 1♂; **Isparta**-Güneykent, pasture, 1032m, 12.05.2004, 1♂; **Kastamonu**-Alamaşişli, orchard and clover field, 620 m, 06.09.2001, 1♂; -Daday-İnceğiz-Çiftlik, pine forest, 860 m, 29.08.2002, 1♀; **Kayseri**-Bağpınar, clover field, 1097 m 14.09.2006, 2♂♂; -Erciyes, pasture, 2056 m, 25.6.2009, 1♀; **Kırklareli**-İnece-Paşayeri, clover field, 150 m, 02.08.2000, 1♀; -Lüleburgaz-Türkgeldi, orchard and pasture, 60 m, 13.08.1992, 1♂; **Kırıkkale**-Karakeçili, poplar woodland and clover field, 839 m, 11.07.2007, 5♀♀, 4♂♂; **Kırşehir**-Kaman, crop field and pasture, 1020 m, 10.07.2007, 1♀, 1♂; -Kaman-Darıözü, beetroot field, 902 m, 16.09.2006, 1♂; -Özbağ, clover field and poplar woodland, 1036 m, 16.09.2006, 1♀, 1♂; **Konya**-Beyşehir, clover field, 1256 m, 22.04.2001, 1♀; -Seydişehir, vegetable garden, 1130 m, 09.09.2006, 1♂; **Mardin**-Ömerli, pasture, 1088 m, 19.6.2009, 1♀; **Muğla**-Milas-Çamiçi 24.06.1999, clover field, 100 m, 1♀; **Nevşehir**-Avanos-Saruhan, poplar woodland and pasture, 958 m, 06.06.2007, 1♀; -Gülşehir-Gümüşkent, crop field and pasture, 1286 m, 07.06.2007, 1♀; **Niğde**-Ava, pasture, 1467 m, 02.06.2005, 1♀; -Bor-Çukurkuyu, vegetable garden and clover field, 1078 m, 19.07.2007, 5♀♀, 2♂♂; **Siirt**, pasture, 986 m, 30.7.2009, 3♀♀; **Sivas**-Taşlıdere, pasture, 956 m, 23.05.2001, 1♂; **Tekirdağ**-Işıklar, pasture, 400 m, 09.09.1999, 2♀♀; (light trap), 09.09.1999, 3♀♀; -Saray-Küçüksinekli, orchard, 170 m, 25.08.1992, 1♂; **Tokat**-Almus-Çilhane, clover field and pasture, 830 m, 02.09.2003, 1♀; **Uşak**-Banaz, orchard and crop field, 820 m, 22.07.1997, 1♀; **Yozgat**-Sorgun-Mahmatlı, crop field and pasture, 1083 m, 21.08.2008, 1♀.

Distribution: Ethiopian, Nearctic, Neotropical, Palearctic (Afghanistan, Austria, Belgium, Bosnia Hercegovina, Bulgaria, China, Cyprus, Czech Republic, former Czechoslovakia, Denmark, Finland, Egypt, France, Georgia, Germany, Greece, Hungary, Israel, Italy, Japan, Kazakhstan, Lithuania, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Tunisia, Turkmenistan, Turkey, United Kingdom, former Yugoslavia).

Chorotype: Holarctic.

Homolobus (*Chartolobus*) *infumator* (Lyle, 1914)

Material examined: **Aydın**-Germencik-Kızılcapınar, clover field, 70 m, 17.09.1996, 1♀; Edirne-Trakya Üniversitesi, Biyoloji Bölümü, Balkan Yerleşkesi, (light trap), crop field and pasture, 09.07.2001 1♀; **Sinop**-Ünlüce, pasture, 150 m, 17.07.1993, 1♀.

Distribution: Nearctic, Neotropical, Oriental, Palearctic (Armenia, Austria, Azerbaijan, Belgium, Bulgaria, China, Czech Republic, former Czechoslovakia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom).

Chorotype: Holarctic.

New record for Turkey.

Homolobus (*Phylacter*) *annulicornis* (Nees, 1834)

Material examined: **Gümüşhane**-Kelkit-Köycük, pasture, 1223 m 08.08.2005 2♀♀; 2♂♂; -Şiran-Arıtaş, poplar woodland, oak and pasture, 1300 m, 08.08.2005, 1♀; **Ordu**-Akkuş-Yukarıdüğencili, pasture, 1340 m, 05.07.2003, 1♀.

Distribution: Oriental, Palearctic (Austria, Azerbaijan, Belgium, China, Czech Republic, former Czechoslovakia, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Moldova, Netherlands, Poland, Romania, Russia, Sweden, Switzerland, United Kingdom, former Yugoslavia).

Chorotype: Asiatic-European.

New record for Turkey.

Subfamily Hormiinae

Hormius Nees, 1819

Hormius moniliatus (Nees, 1811)

Material examined: **Ankara**-Kızılcahamam-Pazar, poplar woodland, oak and pasture, 959 m, 17.9.2006, 1♀; -Kızılcahamam-Özbekler, orchard, poplar woodlandand pasture, 970 m, 17.9.2006, 2♀♀; **Eskişehir**-Bilecik yolu 26. km, pasture, 789 m, 01.09.2006, 1♂; -Alpu-Sündiken mountain, pine forest,1573 m, 05.09.2006, 1♂.

Distribution: Nearctic, Oceanic, Oriental, Palaearctic (Afganistan, Armenia, Azerbaijan, Belarus, Belgium, Bulagaria, Canary islands, China, Czech Republic, former Czechlovakia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Moldova, Mongolia, Morocco, Netherlands, Norway, Poland, Russia, Slowakia, Spain, Sweden, Switzerland, Tajikistan, Turkmenistan, Ukraine, United Kingdom, Uzbekistan).

Chorotype: Holarctic.

New record for Turkey.

Subfamily Ichneutinae

Ichneutes Nees, 1816

Ichneutes reunitor Nees, 1816

Material examined: **Sivas**-Yıldızeli, crop field, 1152 m, 30.05.2007, 1♂.

Distribution: Nearctic, Palearctic (Azerbaijan, Belgium, Finland, France, former Czechoslovakia, Georgia, Germany, Hungary, Ireland, Italy, Japan, Kazakhstan, Lithuania,

Mongolia, Netherlands, Norway, Poland, Romania, Russia, Sweden, Switzerland, Ukraine, United Kingdom, former Yugoslavia).
Chorotype: Holarctic.
New record for Turkey.

Proterops Wesmael, 1835
Proterops nigripennis Wesmael, 1835

Material examined: Trabzon-Maçka-Sümela, pasture, 1073 m, 03.07.2004, 1♂.
Distribution: Palearctic (Austria, Azerbaijan, Belgium, China, Czech Republic, former Czechoslovakia, Denmark, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Japan, Kazakhstan, Korea, Mongolia, Netherlands, Norway, Poland, Russia, Sweden, Switzerland, United Kingdom).
Chorotype: Asiatic-European.
New record for Turkey.

Pseudichneutes Belokobylskij, 1996
Pseudichneutes levis (Wesmael, 1835)

Material examined: Sivas-Cumhuriyet Üniversitesi, pasture, 1278 m, 13.06.2001, 1♀; **Tekirdağ**-Ganos mountain, pine forest, 554 m, 17.05.1986, 1♂.
Distribution: Palearctic (Belgium, Finland, France, Germany, Hungary, Italy, Kazakhstan, Netherlands, Poland, Russia, Sweden, United Kingdom, Ukraine).
Chorotype: Asiatic-European.
New record for Turkey.

Subfamily Rhyssalinae
Dolopsidea Hincks, 1944
Dolopsidea indagator (Haliday, 1836)

Material examined: Amasya-Çakallar, orchard, 780 m, 28.05.2002, 1♀.
Distribution: Palaearctic (Armenia, Austria, Azarbaijan, Belgium, Bulgaria, former Czechoslovakia, Finland, France, Germany, Hungary, Ireland, Italy, Korea, Lithuania, Russia, Sweden, Switzerland, Ukraine, United Kingdom).
Chorotype: Asiatic-European.
New record for Turkey.

Dolopsidea tatianae (Telenga, 1941)

Material examined: Zonguldak-Ilıksu, mixed forest, 25 m, 08.06.2002, 1♀.
Distribution: Palaearctic (Lithuania, Moldova, Russia).
Chorotype: Sibero-European.
New record for Turkey.

Subfamily Exothecinae
Colastes Haliday, 1833
Colastes (*Xenarcha*) *lustrator* (Haliday, 1836)

Material examined: Kastamonu-Hanönü, pasture, 450 m, 06.09.2001, 1♂; -Ilgaz Dağı, pasture, 2100 m, 30.08.2002, 1♀; **Ordu**-Korgan-Belalan, vegetable garden, 1040 m, 31.08.2003, 2♀♀.
Distribution: Palaearctic (Austria, Belarus, Belgium, Bulgaria, former Czechoslovakia, Denmark, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Lithuania, Moldova, Netherlands, Poland, Russia, Spain, Sweden, Switzerland, United Kingdom).
Chorotype: Asiatic-European.
New record for Turkey.

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LIFE CYCLE AND MORPHOMETRIC STUDIES OF VARIEGATED GRASSHOPPER, *ZONOCERUS VARIEGATUS* (LINNAEUS, 1758)

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ABSTRACT: Morphometric analysis of the external parts and the alimentary canal as well as the stadia time of each post embryonic developmental stage of variegated grasshopper, *Zonocerus variegatus* was carried out. Data collected included body weight, length of pronotum, prothoracic leg, mesothoracic leg, metathoracic leg, antenna, whole body and gut. The result of the study showed that the size of the measured parts and the body weight of the insects increased progressively during the post embryonic development. There was a strong positive relationship between the body length and body weight (0.858) on one hand and between the body weight and antenna length (0.952) on the other hand. The body weight and body length slope between 1st – 5th instar was less than the slope between the 6th instar and adult stage. There were six nymphal stages and adult stage for the insect. The number of days spent in lower instars was less than those spent in higher instars. The nymphal periods were 7.0, 7.6, 10.0, 19.1, 20.5 and 46.9 days respectively for 1st - 6th instars. The total days spent in adult stage ranged between 101.9-127.9 days. The relevance of this information in the understanding of *Z. variegatus* behavior and possible control was discussed.

KEY WORDS: *Zonocerus variegatus,* stadial time, morphometrics, pest control.

The variegated grasshopper *Z. variegatus* is a polyphagous pest found in the forest and Savanna zones of central and West Africa (Chiffaud & Nestre, 1990). The increasing impact of *Z. variegatus* as observed today in fields is a result of deforestation and increase in surface of herbaceous fallow. The damage caused by this pest is higher in fields adjacent to *Chromolaena odorata* and herbaceous fallow than in those adjacent to forest as shrubby fallows (Kekeunou et al., 2006).

There usually six nymphal stages (Youdeowei, 1974), but Jerath (1965) recorded as many as eight or nine nymphal stages. Chapman et al. (1977) however, recorded a total of five nympal stages. Nymphal development is completed in 3-4 month and reversal of the wings occur in the fifth instar. After the final moult, the newly emerged adult rests for 2-3 hours to permit the wing and cuticle to harder before it begins to feed. Adult begin to copulate when they are 2-3 weeks old and female begin to lay eggs when they have mated 2 or 3 times.

The life cycle of *Z. variegatus* occupies a full year with two populations: a dry season population (Nov.-March) and a wet-season population (April–October). The early instars of development of *Z. variegatus*, that is the 1st - 3rd instars have different characteristics from the other later instars, that is the 5th - 6th and the adult. While the 1st - 3rd instars are closely – packed (aggregation), the later instar are more dispersed (Modder, 1986). Similarly while 1st – 3rd instars survive on weeds as *C. odorata* and *Aspilia africana* (Toye, 1982), the later instars prefer *Manilot esculenta* (Chapman et al., 1986).

It is obvious from literature that it would be more convenient and economical to direct control operations to the usually conspicuous aggregated nymphs, 1st – 3rd instars. However in other to do this effectively, the stadial time of each instar stage should be known which is not available in the literature. Also, our control strategies will be handicapped without a comprehensive knowledge of the biology of the insect which morphometrics are part of. The aim of this work is to carry out morphometric analysis and determine stadial period of each instar stage of *Z. variegatus* body parts during post embryonic development of the insect.

MATERIALS AND METHODS

A known oviposition site for adult of *Z. variegatus* at uncultivated farm on Campus of University of Agriculture, Abeokuta (UNAAB) was marked and monitored until first instars nymphs were hatched. The insects were caught with insect sweep net and later transferred to the Insectaria in Department of Biological Sciences, UNAAB. The insect were reared in wire cages (30 x 30 x 45 cm) and fed daily fresh leaves of *Chrolaena odorata* and *Manilot esculenta*. Twenty first instar nymphs were collected from the stock of insects and were used for this experiment. Readings were taken on the developmental periods for every instar. After the emergence of the adult, one male and female were placed in another cage that has five 1.25 m plastic jar filled with soil to one-fifth of its capacity to serve as oviposition site. Five such pairs were set up and fed *ad libitum* with *M. esculenta*. They were maintained until they all died.

In the morphometrics studies, as each developmental stage emerged, 30 insects each of all the nymphal stages (1st – 6th instars) and male adults (female insects were excluded from this study because of variations in their structures in the 6th and adult stages of development due to reproduction processes) were immobilized in a dessicator containing chloroform soaked cotton wool. Measurements on the following parts were taken under a dissecting microscope: Pronotum, Mesothoracic leg, Prothoracic leg, metathoracic leg, antennae, whole body length and gut length. The body weight was taken by a sensitive weighing balance (Mettler-PM11-K). For the measurement of the gut the insects were dissected as described by Youdeowei (1974) and the whole gut was removed carefully with the aid of forceps.

A comparison of mean of all the data was subjected to ANOVA and Duncan multiple range as illustrated by steel and Torries (1990) Regression analysis was also used to determine the relationships between the measured part.

RESULTS

The measurements of the body parts examined are shown in Table 1 below. There was a progressive increase in the sizes of the pronotum, prothoracic leg, mesothoracic leg and metathoracic leg.Regression analysis showed a strong positive relationship between the body weight and the length of the antenna (0.952) as well as between the body weight and the whole body length (0.858). There was a significant difference ($P<0.05$) in the sizes of the antennae, body length, prothoracic legs, mesothoracic legs, and metathoracic legs during post embryonic development. Similarly, the size of the gut was steadily increasing from the 1st instar to the adult.

The body weight and body length showed a two phase relationship (Figure 1), the slope of 1st – 5th instar was less than those of later instar 6th and adult.

Examination of the instars showed that there were six instar stages and adult stage. Figure 2 shows in percentage the stadial time of each nymphal stage during the life cycle. Statistical analysis showed that there was a significant difference in the developmental periods (stadial time) across the post embryonic development.

It can also be seen from figure 2 that relatively fewer days were spent on lower instar stages than the higher instars. Furthermore, correlation analysis revealed a strong positive relationship between the stages of development and stadial time (0.6015).

The total number of days spent for nymphal development was 111.1 ± 0.02 while the total days on adult stage for male and female were 101.2 ± 0.32 and 127.9 ± 0.22 respectively, hence the total life cycle of *Z. variegatus* was between 210.8 and 237.5 days (Table 2). The breakdown of days spent by the adult stage showed that after emergence, 68.9 days were spent before copulation began and mating duration was for 10.9 days. 16.8 days were used for oviposition and the insect further lived 31.3 days before death (Table 2).

DISCUSSION

There was a progressive increase in the size of all the parts measured as the insect ages during the post embryonic development. A similar finding was recorded by Chapman et al. (1977) that the sizes of appendages of *Z. variegatus* (L.) increased during development. Clarke & Richards (1976) likewise reported that the growth in locust is rapid and as the insect undergoes molting, there is an increase in body parts. The positive strong relationship between body weight and body length and between body weight and antenna length means that one is a good indication of the other. Idowu (1995) likewise found that a good/strong relationship existed between the body size and the size of the repellent gland.

The slope of body weight and body size from 1st – 5th instars was less than that from 6th to adult. This is not unexpected as the adult stage is the main stage where sexual maturity is reached and this involves development of additional structures and for these to be accommodated, there must be a commensurate increase in the size of the adult stage. Anya (1973) opined that in variegated grasshopper there is much more pronounced development of reproductive structures in adults than other instars. Chapman (1980) established that in the development of hemimetabolus insects, the degree of change from last instar to adult varies considerably and may be marked.

The gradual increase in the gut length corroborates Ademolu & Idowu (2011) observation that there was increase in the microbial load of *Z. variegatus* gut as it molts from 1st instar to the adult stage. The increase in the length is necessary probably in order to accommodate the increase in food consumption during the post embryonic development.

The length of antenna was progressively increasing from 1st instar to adult stage. This observation may likely explain the gregarious behaviour of the lower instars (1st – 3rd) and the dispersing character of the 5th instar to adult as reported by Toye (1982). The difference between prothoracic leg and mesothroacic leg means was not statistically different (P>0.05), however, there was a significant difference between mesothoracic and metathoracic legs. This might likely be explained in terms of their functions. While prothoracic leg and mesothoracic leg are both sets of walking legs, metathoracic legs are for hopping in prygomorphs (Chapman, 1980).

It can be observed from this study that body parts and gut length of *Z. variegatus* was increasing as the insect advanced in age, which became more pronounced in 6th to adult stage, thus increasing in complexity. Interestingly, the concentration of tissue metabolites increased as the insect moult from the first instar to the adult stage of development (Ademolu et al., 2007). It is thus advisable to launch control attacks on the early instars that are physiologically less complicated.

The number of instars recorded for *Z. variegatus* in this study was six and this is in agreement with the findings of Chapman et al. (1986) and Toye (1981). The stadial time of lower instars (1st -3rd) was much lower than those of the higher instars (4th-6th) and adults. The time required for the development of structures especially in the adult stage might necessitate the longer stadial time. During the development of lower instars, the only changes involved are increases in the body length and weight (Borror et al., 1989). However, the stage between 6th and adult stage is for preparation for reproduction activities which are the major concern of the adult stage.

Correlation analysis revealed a strong relationship between the stages and the stadial time. Oke (2004) recorded similar observation for *Neochetina eichhorcae*, that is, as the ages of the insect increases, the stadial time also increases. After the emergence of the adult, sixty-eight days lapsed before mating activity started. This is likely due to the non-maturation and non readiness of the reproductive organs and structures. Richards & Davies (1984) reported that after emergence, the adult hemimetabolus insect spent some days before reproductive activities commence during which the gonads and accessory organs attain their full size and become functional.

Female adult *Z. variegatus* lived for another 31.3 days after the oviposition exercise, while the male spent 32.3 after mating. This observation is in deference or contrary to what happen in *Cerasus auratus* where the female is known to eat the male after mating and female also passes away after oviposition process. Post mating time or life is used by the males to assist the females in finding and selecting the oviposition site for the laying of the eggs for the next generation (Chapman, 1980).

The total stadium for the adult male and female were 101.2 and 127.9 days respectively. This agrees with Muse (2004) observation that laboratory reared adult *Z. variegatus* spent 3-4 months. The total life cycle of the insect covered 210.8-237.5 days and this is not contrary to observation of Toye (1981) and Messi (2006). This relative long life span compared to other insects afford the *Z. variegatus* to have two have two populations in a year. The adult of one population will still be on the field when the first instar of the second population will emerge. This phenomenon makes the insect to be available on the field all the year round as reported by Youdeowei (1974) and Modder (1986).

This information will be of particular interest to crop protection agents and farmers. The knowledge of the stadial time of each developmental stage of *Z. variegatus* will help to determine the exact time to administer control strategies. It is noteworthy that the lower instars (1st – 3rd) that are easier to control because of their simplicity (Ademolu & Idowu, 2006) and gregarious habit (Toye, 1981) spend very few days on this stage.

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Table 1. Mean Length (±s.e) of nymphs and adults of *Zonocerus variegatus* during post embryonic development (cm) (n= 30).

STAGES	ANT	PNT	PTL	MSL	MTH	GTH
1^{ST}	0.19±0.12^{c}	0.10±0.01^{c}	0.36±0.02^{b}	0.46±0.01^{c}	1.13±0.01^{c}	0.86±0.01^{b}
2^{ND}	0.27±0.01^{c}	0.11±0.01^{c}	0.50±0.01^{b}	0.54±0.01^{c}	1.16±0.01^{c}	0.89±0.02^{b}
3^{RD}	0.29±0.01^{c}	0.17±0.01^{c}	0.58±0.02^{b}	0.64±0.01^{c}	1.54±0..01^{c}	0.90±0.01^{b}
4^{TH}	0.45±0.01^{c}	0.26±0.01^{b}	0.75±0.01^{b}	0.78±0.01^{b}	1.70±0.03^{c}	0.98±0.03^{b}
5^{TH}	0.54±0.01^{c}	0.34±0.01^{b}	0.80±0.02^{a}	0.88±0.01^{b}	2.28±0.02^{b}	1.05±0.01^{b}
6^{TH}	0.85±0.03^{b}	0.44±0.04^{b}	1.04±0.04^{a}	1.12±0.03^{b}	2.78±0.06^{b}	1.95±0.04^{a}
ADULT	1.73±0.06^{a}	0.95±0.04^{a}	1.88±0.04^{a}	1.93±0.03^{a}	4.37±0.09^{a}	2.64±0.02^{a}

Mean values in same column having different superscript are significantly different ($p<0.05$)

ANT-ANTENNA, PNT-PRONOTUM, PTL-PROTHORACIC LEG, MSL-MESOTHORACIC LEG, MTH- METATHORACIC LEG., GTH-WHOLE GUT LENGTH.

Table 2. Breakdown of days spent on adult stage.

PRE MATING DAYS	MATING DAYS	OVIPOSITION DAYS	LONGEVITY	TOTAL
68.9±0.01	10.9±0.14	16.8±0.07	31.3±0.51 (32.3±0.02)	127.9±0.02 (101.2±0.32)

Values in ( ) are for male adult

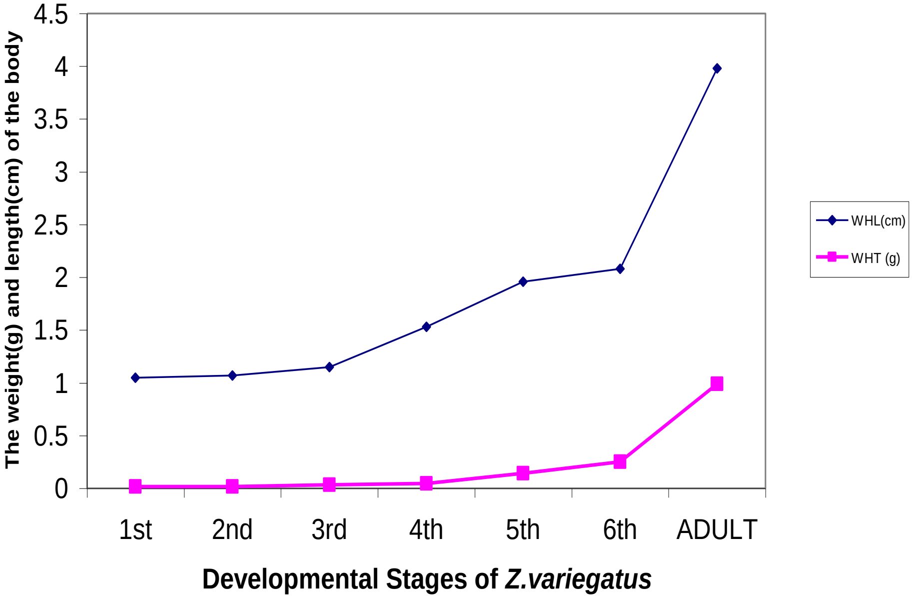

Figure 1. Growth relationship of *Z. variegatus* as indicated by body length and weight.

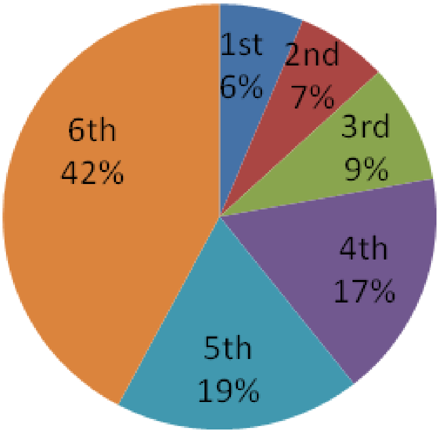

Figure 2. Stadial time for nymphal developmental stages of *Z. variegates.*

NEW RECORDS OF SPECIES OF THE FAMILY RHOPALIDAE (HETEROPTERA) IN THE PROVINCE OF LA PAMPA (ARGENTINA)

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[Pall, J. L., Quirán, E. M. & Coscarón, M. Del C. 2013. New records of species of the family Rhopalidae (Heteroptera) in the province of La Pampa (Argentina). Munis Entomology & Zoology, 8 (1): 382-386**]**

ABSTRACT: At the global level are 18 genera that constitute Rhopalidae family in our country are only 5 genera, of which 3 are provided in this contribution to the province of La Pampa. The material comes from the entomological collection of the Museum of La Plata (Argentina) and campaigns conducted by the authors in the province of La Pampa.

KEY WORDS: Rhopalidae. Geographical distribution. La Pampa.

The Rhopalidae is a family of the order Heteroptera (Insecta), are called "scent-less plant bugs" because of their eating habits. They are part of a group of small insects 4-15 mm, varying in shape and color (Schuh & Slater, 1995).

Rhopalidae family comprising 18 genera and 209 species worldwide, and is divided into two subfamilies according (Henry, 2009), Serinethinae and Rhopalinae. In Argentina there are 5 genera and 35 species (Pall & Coscarón, 2012).

Most Rhopalidae are of little economic importance, according to Schaefer & Panizzi (2000) do not refer agricultural importance in our country. All individuals in this family are phytophagous species, members of the subfamily Rhopalinae feed on various plants, while members of the subfamily Serinethinae, this eat mostly plant family Sapindaceae (Schaefer & Chopra, 1982; Schaefer & Mitchell, 1983).

The knowledge of the fauna in this part of the world is poor, especially economically important taxa, not yet published keys that help complete identification of the species living in this region.

Argentina covers an area of 2,791,810 km2 and is bordered by Bolivia, Brazil, Chile and Uruguay. Approximately 75% of its territory comprises arid and semiarid regions, are also wetter areas as regions of the highly endangered and the Yungas, a lesser percentage. The province of La Pampa (Fig. 3), studied in this work, is located in the region of the neotropical fauna, comprising an area of 143,440 km2, bordering the provinces of Buenos Aires, to the east, San Luis and Cordoba, north; Mendoza, west and Black River to the south. It is crossed by three phytogeographic regions: Monte, Espinal and Pampa, consecutively (Brown et al., 2005; Morrone, 2001).

The aim of this paper is to present new records of species of the genera *Niesthrea*, *Harmostes* and *Xenogenus* (Rhopalidae): *N. pictipes* (Stål), *H. prolixus* Stål and *X. gracilis* Berg and expand its geographic distribution in the province of La Pampa, Argentina.

MATERIALS AND METHODS

He was examined material belonging to the collections of the Museum of Natural Sciences of La Plata (MLP) (Fig. 1A), Buenos Aires, Argentina http://www.fcnym.unlp.edu.ar/abamuse.html and material from campaigns during the months of March and April 2010 in the province of La Pampa (Fig. 1B-D), conducted by the authors, with networks entomological, square canvas and G-Vac for catching insects.

For the geographical distribution program was used DIVA-GIS 7.1.7 (http://www.diva-gis.org/). The genera were photographed with a Kodak EasyShare M530 camera (12 megapixels) and used a magnifying glass M-Stereomicroscope Wild. The figures were created through Adobe Photoshop CS3 and numbering was performed using the program CorelDraw X3.

The genera were identified through the work of Pall & Coscarón (2012) (http://dx.doi.org/10.1080/00222933.2012.673643) and species through the diagnosis of Chopra (1967) (http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2311.1967.tb00503.x/pdf).

The resulting material in the campaigns was deposited in the Museum of Natural Sciences of La Plata (MLP).

RESULTS

We obtained a total of 77 individuals belonging to the family Rhopalidae, of which 26 belonged to the species *N. pictipes*, 30 to the species *H. prolixus* and 21 to the species *X. gracilis* (Figure 2A-C).

Harmostes prolixus Stål, 1860: 37

Distribution: **Buenos Aires:** Lujan, Chacabuco, Baradero; **Catamarca**; **Córdoba**: Río San José; Carlos Paz; **Corrientes**; **Entre Ríos:** Gualeguay; **Jujuy**; **La Pampa:** Catriló; **La Rioja**; **Mendoza**; **Misiones:** El dorado, Montecarlo, Belgrano; **Neuquén**; **Río Negro:** Río Colorado; **San Luis**; **San Juan**; **Santa Fe**; **Santiago del Estero**; **Tucumán**.

Studied material. (Fig. 1C) **ARGENTINA. LA PAMPA**: Metileo (35° 47' 40.27" S; 64° 05' 57.54" W); 15-IV-2010; J.L. Pall Col.; 3 ♂, 5 ♀ (MLP). Lihue Calel (38° 00' 19.85" S; 65° 35' 35.29" W); 03-III-2010; J.L. Pall, E. Quirán & M.C. Coscarón Col.; 5 ♂ (MLP). Parque Luro (36° 53' 49.30" S; 64° 16' 00.71"W); 15-IV-2010; J.L. Pall & E. Quirán Col.; 9 ♀ (MLP). ZTP 216 (50 Km southern of Metileo) (36° 18' 18.80" S; 65° 09' 14.52" W); 15-IV-2010; J.L. Pall Col.; 4 ♂, 4 ♀ (MLP). Gral Pico (35°39'57,86" S; 63°44'57,11" W); 1938; n/n Col.; 3 ♀ (MLP). Catriló (36°25'00,10" S; 63°24'01,13" W); 1938; Biraben-Scott Col.; 2 ♂ (MLP).

New record: **La Pampa**: Gral. Pico, Metileo, Lihue Calel, Parque Luro.

Niesthrea (*Corizus*) *pictipes* (Stål, 1859: 239)

Distribution: **Buenos Aires:** La matanza, La Plata; **Corrientes:** Loreto, Pellegrini; **Córdoba:** Villa dolores; **Chaco**; **Entre Río:** La Paz; **Mendoza**; **Misiones**; **La Pampa:** Gral. Pico; **Santa Fe:** Arrufo; **Salta:** J.V. Gonzales.

Studied material. (Fig. 1B) **ARGENTINA. LA PAMPA**: Río Salado (Sta. Isabel) (36° 17' 12.53" S; 66° 50' 23.85" W); 15-IV-2010; J.L. Pall Col.; 7 ♂ (MLP). Lihue Calel (38° 00' 19.85" S; 65° 35' 35.29" W); 03-III-2010; J.L. Pall & E. Quirán Col.; 4 ♀ (MLP). Casa de Piedra (38° 09' 23.41" S; 67° 04' 56.79" W); 03-III-2010; J.L.

Pall & M.C. Coscarón Col.; 4 ♂, 3 ♀ (MLP). ZTLC-75 (50 Km northeast of Lihue Calel) (37° 27' 53.35'' S; 65° 05' 54.25'' W); 03-III-2010; J.L. Pall Col.; 8 ♂ (MLP). Gral Pico (35°39'57,86'' S; 63°44'57,11'' W); 1938; n/n Col.; 2 ♀ (MLP).
New record: **La Pampa:** Casa de piedra, Lihue Calel, Santa Isabel.

Xenogenus gracilis Reed, 1899: 44

Distribution: **Buenos Aires:** La Plata, Felipe Saja, José C. Paz; **Catamarca:** Miraflores, Belén; **Córdoba:** Villa allende, La Puerta, Cabaña; **Corrientes:** San Roque; San Juan: Villa aberostein; **Jujuy:** Pampa blanca; **La Pampa:** Gral. Pico; **La Rioja:** Nonogasta; **Neuquén:** Lago Currhue; **Salta:** Guemes, Coronel moldes; **Santiago del Estero:** Quimilí; **Tucumán:** La cocha, Trancos.
Studied material. (Fig. 1D) **LA PAMPA**: Lihue Calel (38° 00' 19.85'' S; 65° 35' 35.29'' W); 03-III-2010; J.L. Pall & M.C. Coscarón Col.; 6 ♂ (MLP). ZTP 216 (50 Km southern of Metileo) (36° 18' 18.80'' S; 65° 09' 14.52'' W); 15-IV-2010; J.L. Pall Col.; 8 ♀ (MLP). ZTLC-75 (50 Km northeast of Lihue Calel) (37° 27' 53.35'' S; 65° 05' 54.25'' W); 03-III-2010; J.L. Pall & M.C. Coscarón Col.; 4 ♂, 3 ♀ (MLP). Gral Pico (35°39'57,86'' S; 63°44'57,11'' W); 1938; n/n Col.; 2 ♂ (MLP).
New record: **La Pampa:** Lihue Calel.

COMMENTS

In addition to providing new records of the genera of the family and its species Rhopalidae, vastly expanded the geographic distribution of the same and related family in this province.

While we agree with Schaefer & Panizzi (2000), we must clarify that the presence of these insects involves the study and monitoring them, because with current environmental changes and planting methodology that takes place in the province and in the country, coupled with the expansion of agriculture in different regions and the threats to their power sources, could lead the attack of these insects to crops.

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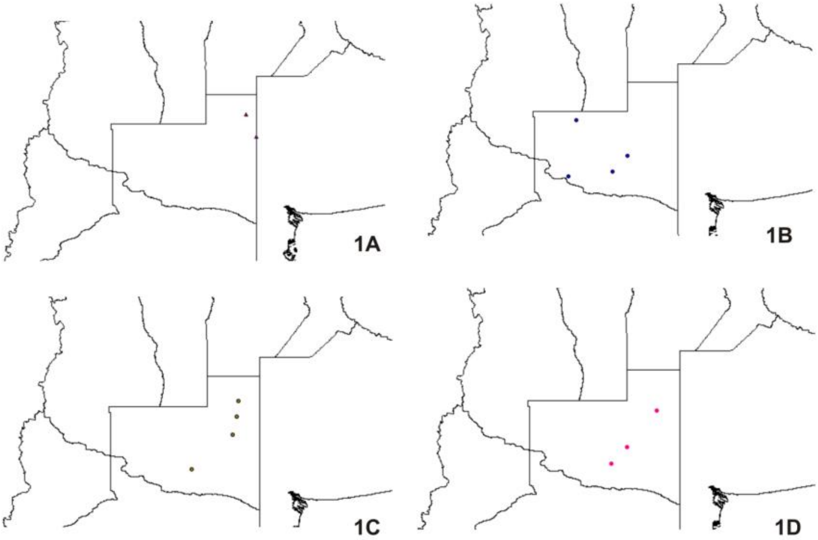
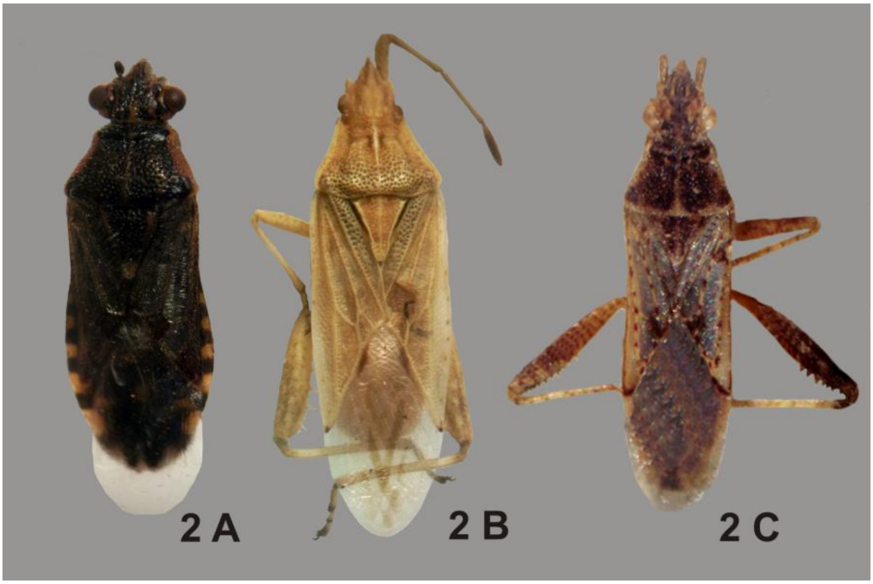


Figures 1A-C: 1A: Geographical distribution of the genera *Niesthrea*, *Xenogeus* and *Harmosts* in the province of La Pampa material obtained from MLP. 1B: New contribution of geographic distribution for the species *N. pictipes* 1C: New contribution of geographic distribution for the species *H. prolixus* 1D: New contribution of geographic distribution for the species *X. gracilis*, in prov. La Pampa, Argentina.



Figures 2A-C: 2A. *Niesthrea pictipes*, 2B. *Harmosts prolixus* and 2C. *Xenogenus gracilis*.

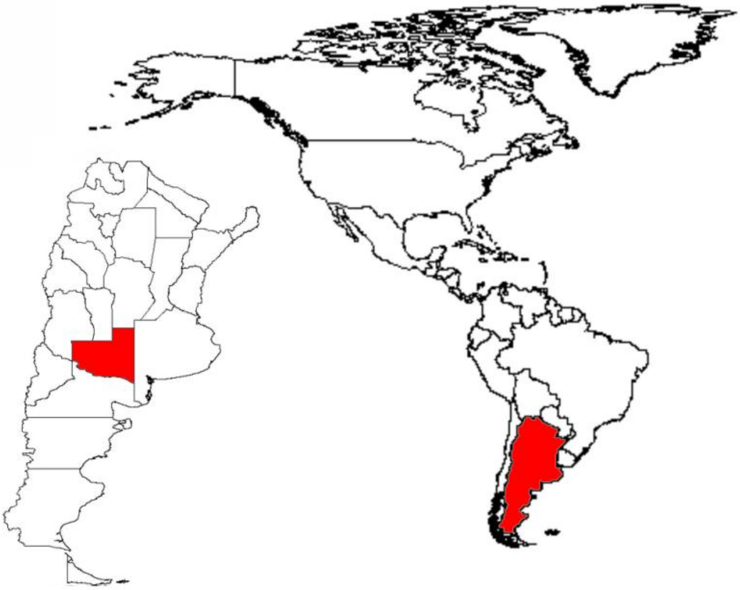


Figure 3. Geographical location of Argentina and the Province of La Pampa.

GENETIC FINGERPRINTS AND PHYLOGENETIC RELATIONSHIPS OF EIGHTEEN APHID SPECIES FROM EGYPT (HEMIPTERA: STERNORRHYNCHA: APHIDIDAE)

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[Amin, A. H., Draz, K. A., Soliman, Kh. A. & Tabikha, R. M. 2013. Genetic fingerprints and phylogenetic relationships of eighteen aphid species from Egypt (Hemiptera: Sternorrhyncha: Aphididae). Munis Entomology & Zoology, 8 (1): 387-406**]**

ABSTRACT: The current study aimed to identify eighteen aphid species belonging to Tribes Macrosiphini and Aphidini (Subtribe: Rhapalosiphina) by using Biochemical and Molecular genetic markers (isozymes, SDS-Page total protein and RAPD-PCR markers) as well as surveying of biochemical and RAPD–PCR species – specific bands for some of those tested species. Each of isozyme and RAPD electrophoresis analysis revealed the highest level of polymorphism, comparing with total protein electrophoresis analysis. The electrophoresis study for those different molecular systems revealed that 160 different bands pattern, seven of them were considered as common bands in all tested species, while thirty four bands were observed in some species as species - specific bands. The electrophoresis studies in those different molecular systems reflected 95.21% polymorphism among the tested species. Phylogenetic relationship based on combined effect of isozyme, Total protein and RAPD-PCR analysis reflected that the highest similarity was recorded between *Rhopalosipum maidis* and *R. padi*, dendrogram analysis can separate the Greaminaceae host plant aphid from the other species. Moreover it showed clearly the gab between Tribe: Macrosiphini and Tribe: Aphidini (Subtribe: Rhapalosiphina). A molecular branching key was constructed to identify thirteen species out of the eighteen tested species. This key is depended on species-specific markers.

KEY WORDS: Genetic fingerprints, Phylogentic relationships, Aphids, Molecular branching key.

Family Aphididae comprises more than 4400 aphid species placed in 493 genera, which from one of the most prolific groups of insects. Because they are capable of not only rapid increase of population though parthenogenesis but also transmission of plant viral diseases and secreting honey dew which become suitable media for sooty moulds. So they are regarding as one of the most important groups of agricultural pests. In addition aphid attack many economic important host plants such as horticultural, forest trees and field crops (Minks & Harrewijn, 1989). This family includes eight Sub-families; Aphidinae is considered as the largest sub families contains most widespread aphid in Egypt; many species have host alternation between woody and herbaceous angiosperms; few species live on Conferee and ferns, the majority on higher angiosperms (Blackman & Eastop, 1984).

Aphids are considered as polymorphic species. Species identification mostly depends on the morphological features of the alate adults. Morphological characters alone have proven inadequate in differentiation between closely related species, which is known to be greatly influenced by either environmental factors such as climatic conditions or the physiological status of their host plants. Moreover, various morphs of the same species can occur during the same time interval, making aphid identification in some cases a very difficult and conflicted task. In addition, closely related taxa, which often cannot be distinguished morphologically, colonize different host plants (Guldemond, 1991). In the past, variation of biological properties between clones of the same species had also been described. The host plants were used for species or subspecies differentiation (Blackman, 1987). Chromosome measurements were also used to separate closely and related species and biotypes of aphid species (Mayo et al., 1988), which was incapable to solve some taxonomic problems.

On the other hand, although biochemical techniques such as allozymes electrophoresis have been developed and showed better diagnosis for some aphid species, it haven't been useful tool to indicate variability which has often been detected in the biological attributes of various aphid species (May & Holbrook, 1978). Also, molecular markers may be helpful in solving this problem (Yeh-Hsin et al., 2005). A diverse range of novel molecular (DNA) markers are now available for entomological investigations. Both DNA and protein markers have revolutionized the biological sciences and have enhanced many fields of studies. Relative to DNA markers, alloenzymes are cheap, often much quicker to isolate and develop, even from minute insects *i.e.* aphid (Aphidoidea), thrips (Thysanoptera), parasitic wasps (Hymenoptera), etc., and subsequently easy to use (Loxdale & Lushai, 1998).

These modern techniques are now available for systematic studies of aphid. Mitochondrial DNA analysis was used to differentiate between closely related aphid species (Footit & Bonen, 1990), biotypes (Powers et al., 1989) and clones (Martinez et al., 1992). Also using of random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR) has proven useful for detection and differentiation of the wide range of organisms. Moreover it can be useful mean in studying closely related species, (Black et al., 1992 and Puterka et al., 1993).

So the current study continues to complete aphid biochemical and molecular genetic fingerprints with other aphid species. The study concentrated on common eighteen aphid species belonging to Tribe Macrosiphini and Tribe Aphidini (Sub-tribe Rhapalosiphina), to detect species – specific molecular marker, which can be used to construct a molecular key used in identification procedure with some tested aphid species, moreover to study phylogenetic relationship depending on these parameters.

MATERIAL AND METHODS

Samples Collection

Some aphid species belonging to Tribe: Macrosiphini and Sub-tribe: Rhapalosiphina were surveyed and collected from main host plants in some localities of Egypt, through out two successive years extended from December, 2005 to June, 2007. Surveyed species are listed alphabetically with scientific names in Table (1). Alate forms of each species were preserved in 70% ethyl alcohol and stored till specimen mounting.

Specimen (alate and apterus forms) of each species were collected from their host plants and put in glass jar covered with muslin cloth and transferred to the laboratory. Data about host plant, date of collection, locality and color of each specimen were recorded. In laboratory, five clones of each species with apart of host plant were preserved in glass jar covered with muslin under dark condition till alate forms appear. Mounted specimens were identified by using professional taxonomic keys of aphids such as Habib & El-Kady (1961) and Blackman & Eastop (1984, 2000) to identify species.

One adult apterus female from each identified species was reared on its fresh and healthy host plants and caged separately by leaf cages under laboratory conditions, its offsprings of the second generation for each stem mother were collected and preserved in Eppendorf tubes at –20 °C until subjected to biochemical genetic analyses (Isozyme and SDS-PAGE) and DNA fingerprint analysis (RAPD- PCR).

Biochemical Genetic Characterizations

Isozyme Electrophoresis.

Aphid species were subjected to Native – polyacrylamide gel electrophoresis (Native- PAGE) to identify isozyme variation among them. So in this study, four enzymatic systems (α- Esterase, β- Esterase, Acid phosphatase and Alkaline phosphatase) were extracted from adult apterus females gel according to Stegmann et al. (1985) and separated in 9% Polyacrylamide. Then gel stained according to Scadalios (1964) and Wendel & Weeden (1989).

SDS Protein Electrophoresis.

The eighteen aphid tested species were subjected to Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE) to study the total protein profiles of these species for appreciation in species discrimination. Mini – Gel Electrophoresis apparatus (Bio-Rad), supplemented with vertical slab (8.5 cm x 9cm) were used for this purpose.

Protein extraction buffer was prepared according to Hames & Rickwood (1981). Hundred µl of extraction buffer were added to the Eppendorf's contains ten adult apterus female homogenized together. Extraction was left overnight in -20 °C then vortexed for 15 second, centrifuged at 12.000 rpm at 4 °C for 15 minutes, transferred to new Eppendorf tubes and kept under -20 °C till using in protein electrophoresis.

Molecular Genetic Characterizations

The Eighteen tested aphid species were subjected to Random Amplified Polymorphic DNA – Polymerase Chain Reaction (RAPD- PCR) with ten arbitrary ten-mer primers, which synthesized by Operon Biotechnology. Inc. Germany. The primer sequences are as follow:-

Primer Code	**Nucleotide Sequence** **5\ -------------------- 3**
B_{10}	CTGCTGGGAC
C_{15}	GACGGATCAG
D_2	GGACCCAACC
D_5	TGA GCGGACA
I_{17}	GGTGGTGATG
L_{12}	GGGGGGTACT
L_{13}	ACCGCCTGCT
L_{20}	TGGTGGACCA
Z_1	TCTGTGCCAC
UBC_{75}	GAGGTCCCAA

Primer Code	**Nucleotide Sequence** **5\ --------------------- 3**
B_{10}	CTGCTGGGAC
C_{15}	GACGGATCAG
D_2	GGACCCAACC
D_5	TGA GCGGACA
I_{17}	GGTGGTGATG
L_{12}	GGGGGGTACT
L_{13}	ACCGCCTGCT
L_{20}	TGGTGGACCA
Z_1	TCTGTGCCAC
UBC $_{75}$	GAGGTCCCAA

DNA Extraction:

Five individuals of apterus aphid were grinded in 1.5 Eppendorf tube with 200 µl of cooled extraction buffer (1.5 gm NaCl, 2.42 gm Tris – HCl, 0. 5 gm SDS, 0.73 gm Na_2- EDTA, 100 ml distillated water, adjusted to pH 8) in liquid nitrogen, then 100 µl of Sodium acetate (3M) were added and vortexed gently. The tubes were placed under–20 °C for 15 minutes then centrifuged at 10.000 rpm at 4 °C for 5 minutes. The supernatants were transferred to a new Eppendorf tube with equal volume of cold Isopropanol, then vortexed gently and placed under – 20 °C for 1 hour. The precipitated DNA was pelleted by centrifuged at 13.000 rpm at 4 °C for 20 minutes. The supernatant was poured off gently and 100 µl of Ethanol 70% were added and centrifuged at 10.000 rpm at 4 °C for 5 minutes, then Ethanol poured off gently and the tubes were inverted on filter paper for 30 minutes, which DNA pellets appear on the bottom and was left to dry. Finally, the pellets were dissolved in 100 µl of Tris -EDTA buffer (TE) (0.151 gm Tris – base, 0.029 gm Na_2- EDTA, 100 ml distillated water adjusted to pH 8.) and added 2.5 µl of RNAse.

Polymerase chain reaction (PCR) preparations and conditions:

Amplification reaction was performed with 20 µl final volume of reaction mixture [10 µl Prime Taq™ Premix (2X), 2 µl Primer, 7 µl Injection water, 1 µl Genomic DNA (25 ng)].

Amplification was performed in a thermal cycler (Perkin Elmer Gene Amp. PCR System 2400) with Initial Denaturation (Initial strands separation) on 94 °C for 4 min., then 35 cycles each cycle contained Denaturation on 94 °C for 45 Sec., Annealing on 37 °C for 45 Sec. and extension on 72 °C for 1.5 min. finally, the program was ended with final extension 72 °C for 10 min.

The PCR products were electropherized in 1.2% Agarose gel at 110 volts by using Bio – Rad DNA electrophoresis system. Then gel analysis was carried out by using Bio-Rad Quantity one computer system version 4.0.3.

Phylogenetic Relationships:

Each of bands variations in Isozyme, SDS-PAGE and RAPD-PCR were subjected individually to statistical analysis. Then those parameters were also pooled together to it, to study the Phylogenetic relationship among the eighteen aphid species on each level and to generate dendrogram by using SPSS computer program version 13 and applying Dice equation.

RESULTS AND DISSCUSION

Biochemical Genetic Characterizations

Isozyme Electrophoresis.

Electrophoretic profile of α-Esterase isozyme for the eighteen tested aphid species are presented in Figure (1a). These results revealed that α-Esterase gave high levels of variations that give seven polymorphic α-Esterase isozyme bands. Both *Myzus persicae* and *Metopolophium dirhodum* gave the highest number of banding pattern (7 bands); in contrast, *Acyrthosiphon pisum* gave the lowest banding pattern (1 band). The α-Esterase 4 (α-est4) was with frequency in most tested aphid species.

Results of β-Esterase isozyme pattern are illustrated Figure (1b), which reflected that the eighteen aphid species gave eight β-Esterase isozyme with polymorphism variation 87.50 %. β-Esterase 1 (β-est1) was common band in all tested aphid species, while β-est5, β-est7 and β-est8 were unique bands for *Rhopalosiphum maidis, Macrosiphum rosae* and *Brevicoryne brassicae*, respectively.

Results of electrophoresis pattern of acid phosphatase for the eighteen tested aphid species are illustrated in Figure (1c). This enzyme gave eight isozymes in tested species with polymorphism 100%. Acph1 was the most frequent isozyme band in tested species except in *Myzus persicae*. Each of Acph3, Acph7 and Acph8 were unique bands for *Brachycaudus schwartzi*, *Capitophorus elaeagina* and *Nasonovia (Hyperomyzus) lactucae*, respectively.

Electrophoretic profile of alkaline phosphatase isozymes is illustrated in Figure (1d). These results revealed that four isozymes of alkaline phosphatase were found in the tested aphid species, with polymorphism 100%. Aph1 was the most frequent isozyme in the tested species except *Brachcaudus helichrysi*, *Chomaphis inculata*, *Myzus persicae* and *Hyalopterus pruni*. Aph4 was unique band for *Hyalopterus pruni*. Alkaline phosphatase isozymes were totally absent in each of *Brachcaudus helichrysi, Chomaphis inculata* and *Myzus persicae*.

Esterases enzymes gave a diagnostic and specific banding patterns, can separate *Sitobion avenae, Rhopalosiphum padi* and *R. maidis*. (Singh & Cunningham, 1981). Also, Esterase banding pattern most useful tool to separate the different genera as well as individual species of *Sitobion avenae*, *S. fragariae*, *Metopolophium dirhodum*, *M. festucae*, *Rhopalosiphum padi* and *R. maidis* (Loxdale et al., 1983). *Schizaphis graminum* gave nine Esterase bands, the 5th and 6th bands were stained darker (Sivakumaran & Mayo, 1991). *Myzus antirrhinii* was distinguished electrophoretically from both *M. persicae* and *M. nicotianae* by its distinctive patterns of Esterases (Blackman & Spence, 1992). Esterase isoenzyme analysis can be used to differentiate between *Myzus persicae* and *Rhopalosiphum padi* (Vranac et al., 1994). Nine bands were found for Esterase in *Sitobion avenae, Rhopalosiphum padi* and *Schizaphis graminum* (Celis et al., 1996). In addition, electrophoratic banding pattern of α- Esterase and β- Esterase for ten aphis species, collected from Egypt, gave seven and eight bands, respectively. α-est5 was species specific band for *Aphis nerii,* and α-est2 was common band; while β-est1 and β-est7 were expressed in *A. compositae* and *A. medicaginis*, respectively, and β-est2 was common band (Amin et al., 2008).

Acid and Alkaline phosphatase electrophoresis could be used to discriminate each of *Sitobion avenae*, *Rhopalosiphum padi* and *R. maidis* (Singh & Cunningham, 1981). Also among *Sitobion avenae*, *S. fragariae*, *Metopolophium dirhodum*, *M. festucae*, *Rhopalosiphum padi* and *R. maidis* (Loxdale et al., 1983) among *Sitobion fragariae, Macrosiphum funestum* and *Amphorophora rubi* (Loxdale & Brookes, 1989). Electrophoratic banding pattern of Acid phosphatase and Alkaline phosphatase for ten aphis species, collected from Egypt, gave four bands. Acph1 appeared as specific for *Aphis compositae*; while Aph1 and Aph2 were expressed as unique bands in each of *A. citricola* and *A. compositae*, respectively. Aph bands pattern were absent in each of *A. medicacaginis, A. rumicis, A. zizyphi, A. gossypii* and *A. faba*. It was suggested that Ach isozyme could discriminate among the tested *Aphis* species (Amin et al., 2008).

SDS- Protein Electrophoresis.

Total protein electrophoresis pattern among the eighteen aphid species is illustrated in Figures (2). Thirty two protein bands were recorded along SDS-Polyacrlamide gel. Molecular weights of recorded bands ranged from 14.366 to 245.578 KDa. Two monomorphic bands were observed in electrophorasis with molecular weights of 100.654 and 25.929 KDa, respectively. On the other hand, one of protein band with molecular weight of 23.789 KDa was recorded as unique band in *Capitophorus elaeagina*. The most frequent polymorphic band was 126.379 KDa, which observed in most species except in each of *Macrosiphum (Sitobion) avenae* and *Metopolophium dirhodum*. These results showed that total protein electrophoresis harbored 93.75% polymorphism among the eighteen tested aphid species, which gave adequate level to discriminate among them, because of they are belong to different species, genera and moreover different tribes.

Protein assay was not able to distinguishing *Myzus persicae* clones collected from different locatities (Baker, 1979). *Aphis pomi* gave two protein loci (Singh & Rhomberg, 1984). *Uroleucon gobonis, Aphis craccivora* and *Greenidea formosana heeri* exhibited 11, 13 and 26 protein bands, respectively (Khuda-Buksh & Khuda-Buksh, 1991). Moreover, protein electrophoresis didn't differentiate among *A. gossypii* population in Japan (Owsus et al., 1996). Total protein electrophoresis for ten *Aphis* species collected from Egypt, gave twenty three bands with molecular weights ranged from 13.49 to 118.23 KDa. Protein band with molecular weight 13.49 KDa was recorded as unique band for *Aphis punicae*. (Amin et al., 2008).

The present work showed that 25.929 KDa is common band in the eighteen tested aphid species may be the same common band (25.63 KDa), recorded by Amin et al. (2008) with the ten *Aphis* species.

Molecular Genetic Characterizations:

RAPD-PCR analysis.

The RAPD analysis as shown in Figure (3) with the ten primers gave 101 different DNA fragment bands with wide molecular sizes. Four monomorphic distinct fragment bands were recorded; most of them were occurred with primers B10 and L13. So, the lowest value of polymorphism (80%) was generated by them.

On the other hand, the highest polymorphic bands were produced by primers C15, D2, I17, L12, L20, UBC75 and Z1 to achieve polymorphism levels reaching 100%. The highest number of DNA fragment bands (fifteen bands) was observed in primer D5, while the lowest number was five bands, generated by primer L13. Twenty six DNA fragment bands were expressed as species – specific bands. Five of them occurred in primer I17, while primer L12 gave one species- specific band. The complied data for the ten primers recorded 95% polymorphism among the eighteen tested species.

Primer B10 produced ten DNA fragment with the eighteen tested aphid species with molecular size ranged from 246 bp to 2402 bp. Each of *Capitophorus elaeagina* and *Pentalonia nigronervosa* gave one unique band with molecular weight 900 and 830 bp, respectively.

The generated RAPD profile of DNA fragment bands with the primer C15 gave the highest number of bands (7 bands) in each of *Doctynotus sonchi* and *Hyalopterus pruni*. Each of *Brevicoryne brassicae* and *Doctynotus sonchi* gave unique band with molecular sizes 1282 and 1497 bp, respectively.

Two unique bands with molecular size 1132 and 171 bp were noticed and recorded as specific band for *Brevicoryne brassicae* and *Schizaphis graminum* species, respectively with primer D2. *Schizaphis graminum* harbored seven DNA fragment bands to record the highest number of bands with this primer. In contrary, *Brachcaudus helichrysi* didn't give any banding pattern with this primer.

Primer D5 produced fifteen DNA fragment bands with wide molecular size extended from 129 to 1967 bp. One monomorphic DNA band was recorded in all tested species in molecular size 181 bp to reveal polymorphism degree reaching to 93.33%. On the other hand, each of *Capitophorus elaeagina*, *Doctynotus sonchi* and *Hyalopterus pruni* had species- specific bands with molecular sizes 129, 1198 and 1401 bp, respectively.

DNA fragment bands profile with arbitrary primer I17 gave fourteen DNA bands, which were polymorphic and unique bands that could adequate to help in discrimination procedure of the eighteen aphid tested species. Five bands are recorded as species – specific bands that observed with *Brevicoryne brassicae*, *Macrosiphum (Sitobion) avenae*, *Hyalopterus pruni*, *Schizaphis graminum* and *Nasonovia (Hyperomyzus) lactucae* in molecular sizes 1171, 1555, 759, 565 and 326 bp, respectively.

It was obvious from bands analysis that the PCR products generated by L12 primer were eight bands with molecular sizes ranged from 191 to 2843 bp with 100% polymorphism among the eighteen tested species. One unique band with molecular size 237 bp was detected as species – specific band for *Rhopalosiphum maidis*.

Primer L13 gave limited number of DNA fragment bands (five bands) with molecular sizes ranged from 227 to 1146 bp, and reflected 80% polymorphism among tested species. One common band was detected in all species in molecular size 1146 bp. On the other hand, three unique bands were noticed; two of them with molecular sizes 227 and 420 bp can be species - specific bands for *Doctynotus sonchi*, in addition to another one with molecular sizes 303 bp was observed in *Brachcaudus helichrysi*.

The bands of DNA fragment electrophoresis with primer L20 are graphically illustrated eight bands with molecular sizes ranged from 163 to 2084 bp. One species – specific band was found in *Hyalopterus pruni* with molecular size 2084 bp. the lowest number of DNA bands pattern were found in *Doctynotus sonchi* (one band).

Primer UBC75 generated eight different DNA fragment bands with molecular sizes ranged from 201 to 1983 bp. *Chomaphis inculata* harbored the highest number of DNA bands with this primer (five bands), while the lowest number of band (one band) was found in *Macrosiphum (Sitobion) avenae*. Four unique DNA fragment bands were observed, two of them were species- specific bands in *Chomaphis inculata*, which their molecular sizes 1983 and 1366 bp. While the others were species – specific bands in each of *Pleotrichophorus chrysanthemi* and *Nasonovia (Hyperomyzus) lactucae* with molecular sizes 639 and 201 bp, respectively.

Primer Z1 produced thirteen DNA fragment bands with wide molecular sizes ranged from 143 to 3894 bp. Three different species – specific bands were detected with primer Z1 in each of *Capitophorus elaeagina*, *Rhopalosiphum padi* and *Brachcaudus helichrysi*, which their molecular sizes were 2250, 225 and 143 bp, respectively.

The RAPD-PCR analysis gave difference not only among different genera but also for differentiation between different species of the same genus, when used with *Rhopalosiphum padi, Aphis gossypii, A. fabae A. craccivora, Myzus persicae,* and *Acyrthosiphan pisum* (Cenis et al., 1993). It was suitable method to determine genetic distances among different taxa (families, subfamilies, genera, species and populations within species) of aphids, moreover for differentiation and identification of aphids especially for closely related species at DNA level (Zhang et al., 2000). RAPD –PCR analysis gave detectable genetic polymorphism between *Myzus persica* complex and *M. cerasi, M. hemerocallis* and *M. varians* species; in addition to, *Myzus persica* and *M. nicotianae* could be considered as synonyms (Clements et al., 2000). Each of geographical and seasonal distribution of *Sitobion avenae* populations had low effect on genetic variability (Figueroa et al., 2005). Each of primers B10, D2, I17, L12, L13 and Z1 generated species specific markers in six *Aphis* species (*A. craccivora, A. faba, A. nerii, A. punicae, A. rumicis* and *A. zizyphi*); primer D2 was the most efficient primer, because of it could distinguish four *Aphis* species (*A. faba, A. nerii, A. punicae* and *A. rumicis*) (Amin et al., 2008).

Survey of Biochemical and RAPD–PCR Species – Specific Marker for the eighteen Tested Aphid Species:-

Thirty four diagnostic markers for the eighteen aphid species were surveyed and presented in Table (2), which based on biochemical genetic analysis (α-Esterase, β-Esterase, Acid phosphatase, Alkaline phosphatase isozymes and total protein) and RAPD – PCR analysis with the ten arbitrary primers.

Isozyme analysis gave seven species - specific markers except α- Esterase didn't gave any species- specific markers. Most of obtained isozyme markers were observed in each of β- Esterase and Acid phosphatase isozyme analysis. The isozyme analysis could distinguish only the following species (*Brevicoryne brassicae*, *Brachycaudus schwartzi*, *Capitophorus elaeagina*, *Nasonovia (Hyperomyzus) lactucae, Macrosiphum rosae*, *Rhopalosiphum padi* and *Hyalopterus pruni*). On the other hand, total protein analysis could distinguish only *Capitophorus elaeagina* by protein band with molecular weight 23.789 Kda.

Obtained results revealed that abundant numbers of DNA fragment species – specific marker were generated by the ten arbitrary primers comparing to isozyme and total protein electrophoresis analysis, which reveal the importance and effectiveness of RAPD – PCR analysis. It can distinguish thirteen aphid species out of the eighteen aphid species. Each of *Acyrthosiphon pisum*, *Brachycaudus schwartzi*, *Myzus persicae*, *Macrosiphum rosae* and *Metopolophium dirhodum* didn't generate any species- specific markers with the ten used primers, so those five species should be tested with other random primers to detect their species – specific bands in further studies. In contract, *Doctynotus sonchi* harbored the highest number of DNA species – specific bands with the ten used primers. Primer I17 was the most effective primer which generated the highest number of species - specific marker. So it can distinguish five aphid species [*Brevicoryne brassicae*, *Nasonovia (Hyperomyzus) lactucae*, *Macrosiphum (Sitobion) avenae*, *Hyalopterus pruni* and *Schizaphis graminum*]. While each of primers L12 and L20 gave one species – specific marker, which can distinguish *Rhopalosiphum maidis* and *Hyalopterus pruni*, respectively.

From aforementioned results, it could be concluded that fifteen species out of eighteen could be differentiated well by applying electrophoresis analysis program based on only β- Esterase and Acid phosphatase isozyme analyses in addition to application of RAPD-PCR analysis with primers B10, I17, L12, L13, UBC75 and Z1 which can save time, material and efforts with the fifteen aphid differentiated species. So it scored all species – specific makers, which can differentiate among them.

Proposal Molecular Branching Key for Identification of Thirteen Aphid Species:

During the present work of molecular genetic characterizations by using ten random primers with the eighteen tested aphid species, 26 DNA species – specific bands were detected. Eighteen DNA species – specific bands out of the twenty six DNA species – specific bands, generated by main six primers (B10, I17, L12, L13, UBC75 and Z1) out of the ten random primers, were used successfully to construct a molecular branching key to identify thirteen aphid species out of the eighteen tested aphid species (Figure 4). While the other species - specific bands (8 bands), generated by the other primers (C15, D2, D5 and L20) were used only in this key as confirming bands for the thirteen species which can be used after identify those aphid species with the main six primers.

Phylogenetic Relationships:

Results of proximity matrix analysis for the eighteen aphid species based on isozyme polymorphism reflected that the highest similarity value 88.9% was recorded between *Chomaphis inculata* and *Doctynotus sonchi*, while the lowest similarity in isozyme polymorphism (25%) was recorded between *Brachcaudus helichrysi* and *Schizaphis graminum*. Moreover, dendrogram analysis based on isozyme polymorphism is graphically illustrated in Figure (5), which reflects that the eighteen tested aphid species can be classify into two main groups depending on isozyme polymorphism analysis. The first main group divided to two sub groups, the first includes *Chomaphis inculata*, *Doctynotus sonchi*, *Brachcaudus helichrysi*, *Capitophorus elaeagina*, *Pleotrichophorus chrysanthemi*, *Myzus persicae* and *Metopolophium dirhodum* while the second includes *Brachcaudus schwartzi* and *Hyalopterus pruni*. The second main group contains also two sub groups; the first one includes *Brevicoryne brassicae*, *Nasonovia (Hyperomyzus) lactucae*, *Acyrthosiphon pisum*, *Rhopalosiphum padi*, *Schizaphis graminum*, *Macrosiphum (Sitobion) avenae* and *Rhopalosiphum maidis*; while the second sub group includes *Pentalonia nigronervosa* and *Macrosiphum rosae*.

Results of the eighteen aphid species based on RAPD-PCR polymorphism analysis agree with proximity matrix analysis of total protein, which reflected that the highest similarity value was recorded between *Rhopalosiphum maidis* and *Rho. padi*, and each of them can also separate the Greaminaceae host plant aphid from others. Moreover it showed the gab between Tribe Macrosiphini and Tribe Aphidini (Sub-tribe: Rhapalosiphina).

Total protein dendrogram analysis, graphically illustrated in Figure (6) showed that the eighteen tested aphid species can be classified into two main groups depending on total protein polymorphism analysis. The first main group divided into two sub groups, the first includes the Greaminaceae host plant aphid *i.e. Rhopalosiphum maidis*, *Rho. padi*, *Hyalopterus pruni*, *Schizaphis graminum*, *Macrosiphum (Sitobion) avenae* and *Metopolophium dirhodum* while the second includes *Acyrthosiphon pisum*, *Brevicoryne brassicae*, *Capitophorus elaeagina*, *Doctynotus sonchi*, *Brachycaudus schwartzi* and *Bra. helichrysi*. The second main group contains also two sub groups; the first one includes *Chomaphis inculata* and *Myzus persicae*; while the second sub group includes *Pleotrichophorus chrysanthemi*, *Macrosiphum rosa, Pentalonia nigronervosa* and *Nasonovia (Hyperomyzus) lactucae*.

Polymorphism dendrogram analysis of DNA is graphically illustrated in Figure (7). Results showed that the eighteen tested aphid species can be classify into two main groups depending on DNA polymorphism analysis. The first main group divided into three sub groups, the first includes the Greaminaceae host plant aphid [*Rhopalosiphum maidis*, *Rho. padi*, *Hyalopterus pruni*, *Schizaphis graminum*, *Metopolophium dirhodum* and *Macrosiphum (Sitobion) avenae*], in addition to *Pleotrichophorus chrysanthemi* and *Macrosiphum rosae*; The second sub group includes *Chomaphis inculata*, *Nasonovia (Hyperomyzus) lactucae*, *Myzus persicae*, *Acyrthosiphon pisum*, *Pentalonia nigronervosa*, *Brevicoryne brassicae* and *Capitophorus elaeagina*. The third sub group contains *Doctynotus sonchi* only. On the other hand, the second main group includes two closely related species *Brachycaudus helichrysi* and *Bra. schwartzi*.

Results of proximity matrix analysis for the eighteen aphid species based on combined effect of isozyme, Total protein and RAPD-PCR analysis reflected that the highest similarity value (89.9%) was recorded between *Rhopalosiphum maidis* and *Rho. padi*, Dendrogram analysis based on them is graphically illustrated in Figure (8), which can separate the Greaminaceae host plants aphid from other species. Moreover it showed clearly the gab between Tribe Macrosiphini and Tribe Aphidini (Sub-tribe: Rhapalosiphina). These studies declared that the eighteen tested aphid species can be classified into two main groups depending on combined effect of isozyme, Total protein and RAPD analysis. The first main group divided into three sub groups, the first sub group includes the Greaminaceae host plants aphid *i.e. Rhopalosiphum maidis*, *Rho. padi*, *Schizaphis graminum*, *Hyalopterus pruni*, *Macrosiphum (Sitobion) avenae* and *Metopolophium dirhodum*. While the second sub group includes *Acyrthosiphon pisum, Brevicoryne brassicae, Capitophorus elaeagina* and *Doctynotus sonchi*. The third sub group contains *Pleotrichophorus chrysanthemi*, *Macrosiphum rosae, Chomaphis inculata* and *Myzus persicae, Nasonovia (Hyperomyzus) lactucae* and *Pentalonia nigronervosa*. On the other hand, the second main group includes two closely related species *Brachycaudus helichrysi* and *Bra. schwartzi*.

Both of *Aphis gossypii* and *Myzus persicae* showed a higher genetic differentiation than *Rhopalosiphum padi* (Martinez et al., 1997). The genetic similarities coefficient ranged from 0.414 to 0.808 in two morphological types of *Myzus persicae* collected from tobacco plants. Moreover, no correlation between morphological types and RAPD polymorphism was detected (Chae-Soon et al., 1998). *Myzus persicae* on rape plants was more closely related to those from tobacco than those on peach (Yang-Xiao et al., 1999). There was a close relationship between the green spruce aphid, *Elatobium abietinum* in two localities (Sigurdsson et al., 1999). Each of *Aphis citricolla* and *A. compositae* were the most closely related species depending on RAPD-PCR analysis or on combined effect of isozyme, Total protein and RAPD analysis, with similarities values 88.6% and 84.45%, respectively (Amin et al., 2008).

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Table 1. List of eighteen aphid species under consideration with their host plants and localities.

	No. of Aphid	Aphid species	Host plant	Locality
Tribe: Macrosiphini	1	*Acyrthosiphon pisum*	*Pisum sativum,* *Vicia Faba*	El- Behera, Qalyubiya, Giza
	2	*Brevicoryne brassicae*	*Brassica oleracea* *Brassica rapa*	Kafer El-Shakh, El- Behera, Qalyubiya
	3	*Brachcaudus helichrysi*	*Ageratum houstonianum,* *Myosotis sp.,* *Prunus armeniaca, P. persica*	Cairo El- Behera
	4	*Brachycaudus schwartzi*	*Prunus armeniaca,* *Prunus persica*	El- Behera
	5	*Capitophorus elaeagina*	*Cynara scolymus*	El- Behera
	6	*Chomaphis inculata*	*Foeniculum vulgar*	Kafer El-Shakh, El- Behera
	7	*Doctynotus sonchi*	*Sonchus oleraceus*	Qalyubiya, Giza
	8	*Myzus persicae*	*Solanum tuberosum, Lactuca sativa, Petunia hybrida* *Linaria bipartite*	Qalyubiya Cairo
	9	*Nasonovia (Hyperomyzus) lactucae*	*Sonchus oleraceus*	El- Behera Qalyubiya
	10	*Pentalonia nigronervosa*	*Musa sapientum*	El- Behera Qalyubiya
	11	*Pleotrichophorus chrysanthemi*	*Silybium marianum,* *Calendula officinalis*	Qalyubiya
	12	*Macrosiphum rosae*	*Rosa hybrida*	El- Behera Giza
	13	*Macrosiphum (Sitobion) avenae*	*Triticum aestivum, ,* *Hordeum vulgare,* *Setaria glauca*	Kafer El-Shakh El- Behera Giza
	14	*Metopolophium dirhodum*	*Triticum aestivum,* *Hordeum vulgare ,* *Avena fatua*	El- Behera Giza
Tribe:Aphidini	15	*Rhopalosipum maidis*	*Hordeum vulgare,* *Triticum aestivum*	El- Behera
	16	*Rhopalosipum padi*	*Triticum aestivum,* *Setaria glauca*	Kafer El-Shakh, El-Behera
	17	*Hyalopterus pruni*	*Aronda donax ,* *Prunus armeniaca*	El-Behera
	18	*Schizaphis graminum*	*Sorghum spacchartum*	Beni-Suef El-Behera

Table 2. Summary of surveyed biochemical and RAPD-PCR species – specific marker for the eighteen tested aphid species.

	Aphid species Biochemical and Molecular Marker	*Acy. pisum*	*Bre. brassicae*	*Bra. helichrysi*	*Bra. schwartzi*	*Cap. elaeagina*	*Com. inculata*	*Doc. sonchi*	*Myz. persicae*	*Nas. (Hyp.) lactucae*	*Pen. nigronervosa*	*Ple. chrysanthemi*	*Mac. rosae*	*Mac. (Sit.) avenae*	*Met. dirhodum*	*Rho. maidis*	*Rho. padi*	*Hyl. pruni*	*Sch. graminum*
Enzyme (isoenzyme)	α - Esterase																		
	* β- Esterase		Est8										Est7				Est5		
	* Acid phosphatase				Acph3	Acph8				Acph7									
	Alkaline phosphatase																	Aph4	
Protein weight (KDa)	Total protein					23.789													
Code of Arbitrary primer (Molecular Size) (bp)	* B10					900					830								
	C15		1282					1497											
	D2		1132																171
	D5					129		1198										1401	
	* I17		1771							326				1555				759	565
	* L12															237			
	* L13			303				420 227											
	L20																	2084	
	* UBC75						1983 1366			201		693							
	* Z1			143		2250											225		

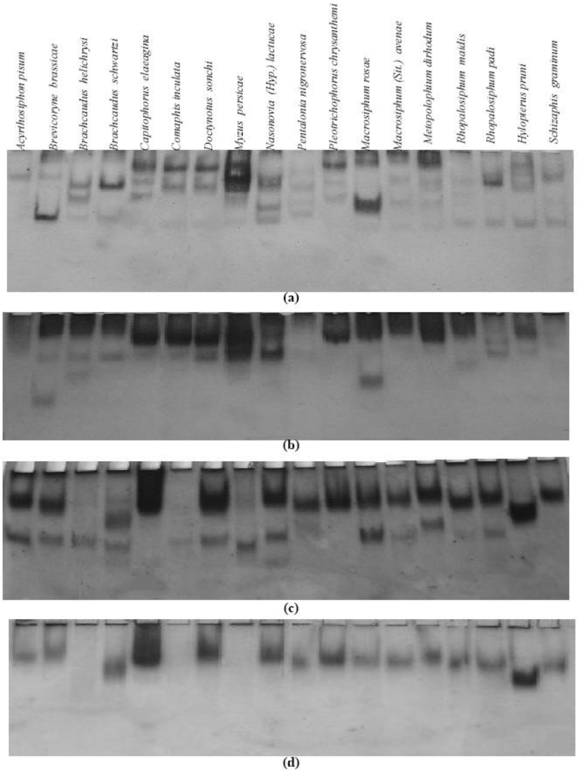


Figure 1. Zymogram of α- Esterase (a), β- Esterase (b), acid phosphatase (c) and alkaline phosphatase (d) banding pattern of the eighteen tested aphid species in Egypt.

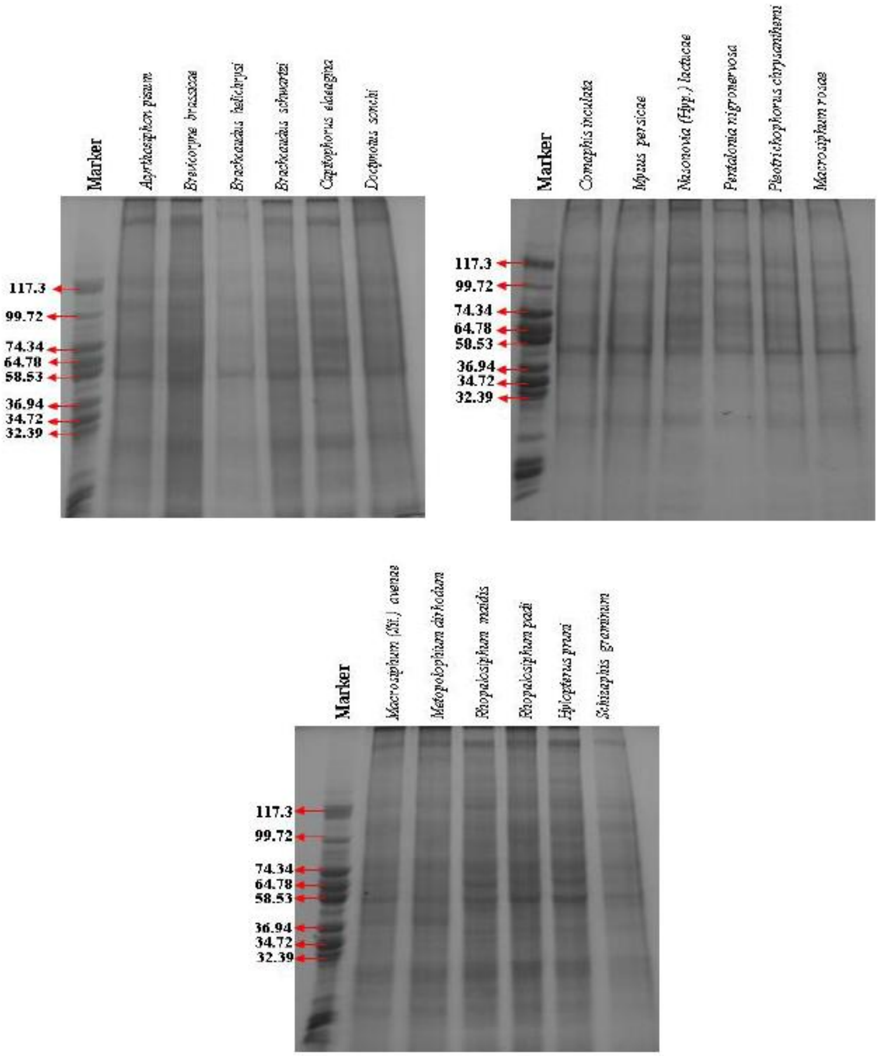
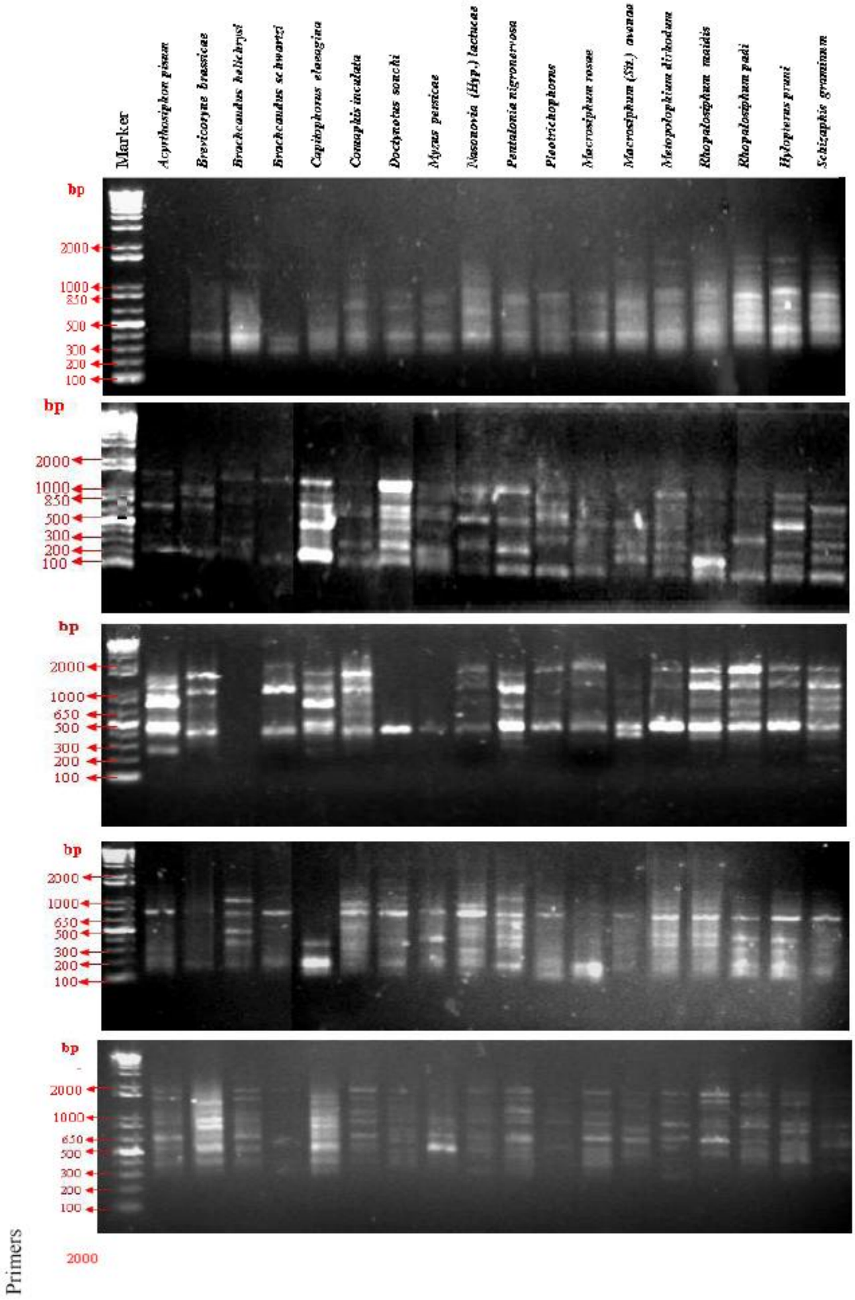


Figure 2. Zymogram of SDS- protein banding pattern for the eighteen tested aphid species.


Marker
Acyrthosiphon pisum
Brevicoryne brassicae
Brachcaudus helichrysi
Brachcaudus schwartzi
Capitophorus elaeagina
Coloaphis inculata
Doctynotus sonchi
Myzus persicae
Nasonovia (Hyp.) lactucae
Pentalonia nigronervosa
Pleotrichophorus
Macrosiphum rosae
Macrosiphum (Sit.) avenae
Metopolophium dirhodum
Rhopalosiphum maidis
Rhopalosiphum padi
Hyalopterus pruni
Schizaphis graminum
bp
2000
1000
850
500
300
200
100
bp
2000
1000
850
500
300
200
100
bp
2000
1000
650
500
300
200
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2000
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200
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bp
2000
1000
650
500
300
200
100
Primers
2000

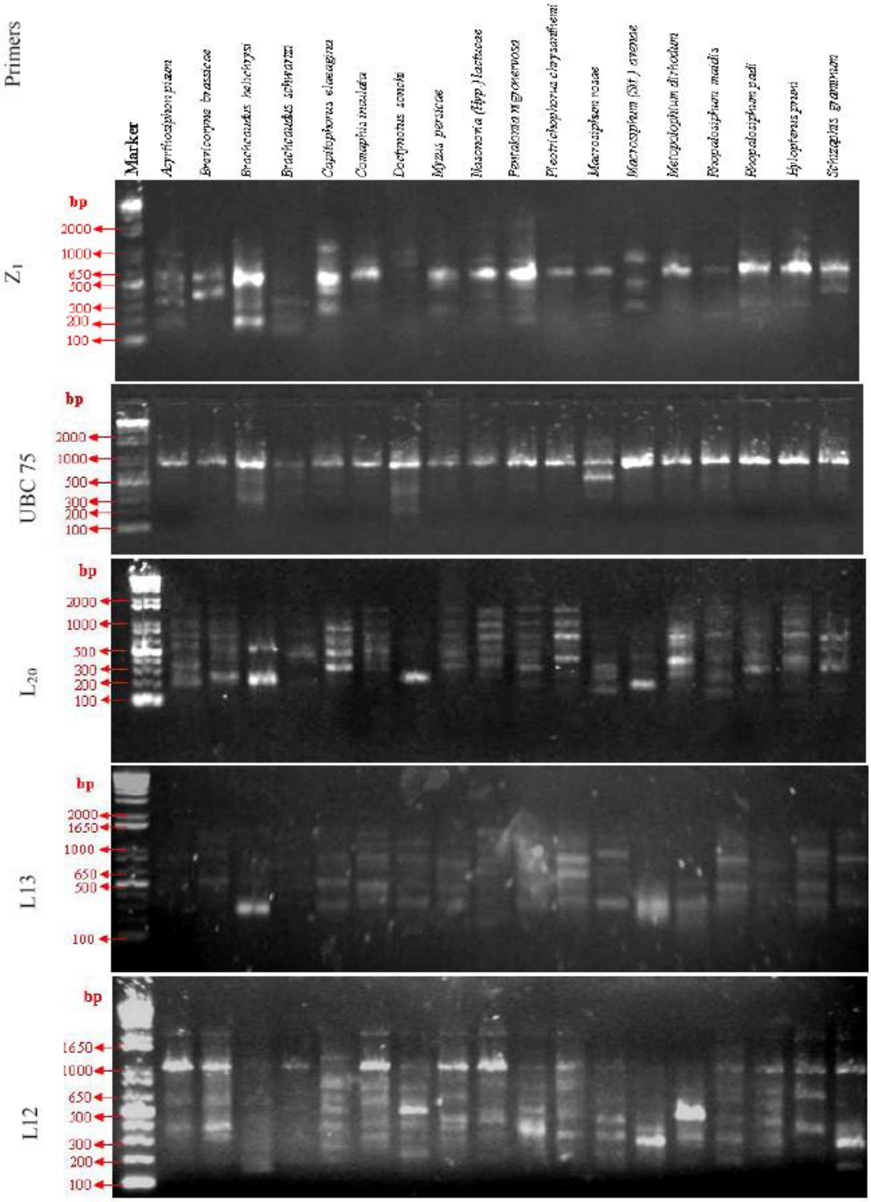

Figure 3. DNA fragment bands generated by ten arbitrary primers in the eighteen aphid species.

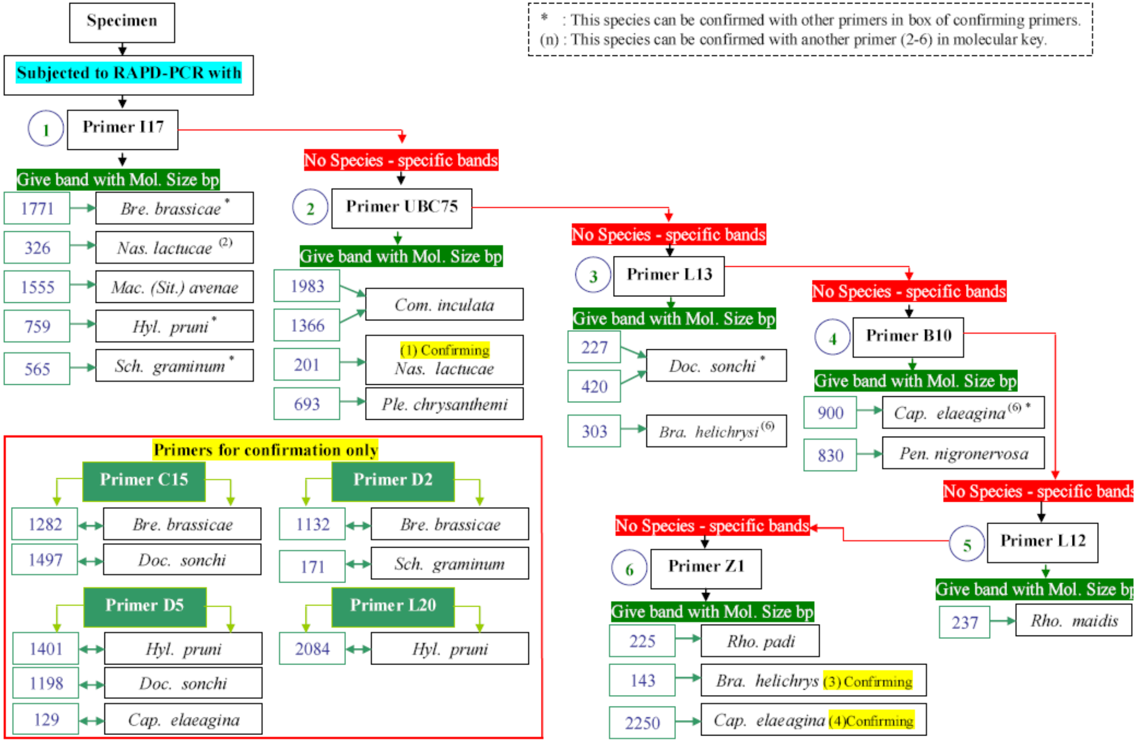

Figure (4): Branching molecular Key for identifying thirteen aphid species by using species –specific markers.

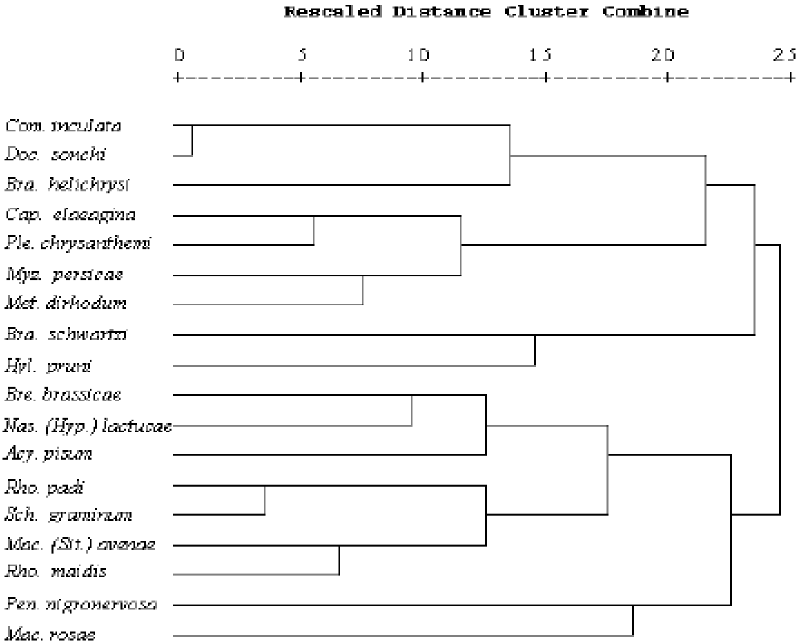

Figure 5. Dendrogram show phylogenetic relationship among the eighteen aphid species based on isozyme banding pattern analysis.

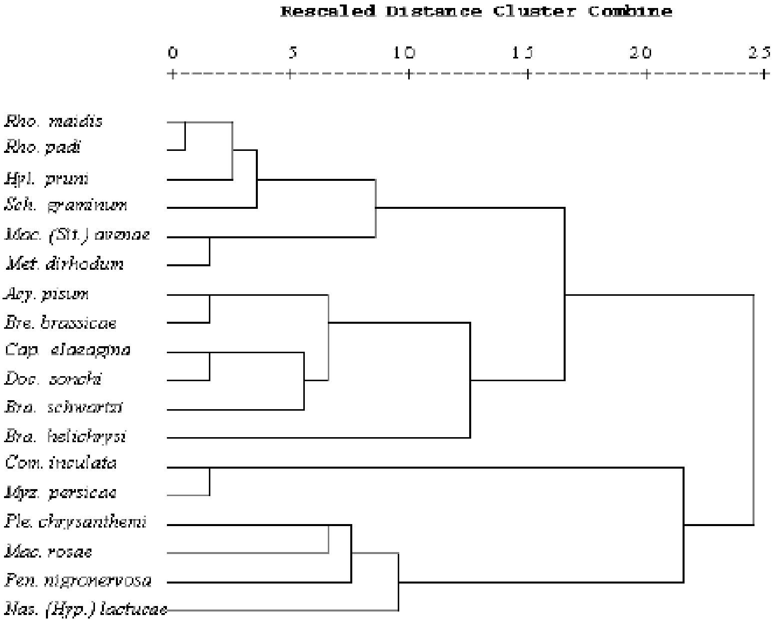

Figure 6. Dendrogram show phylogenetic relationship among the eighteen aphid species based on total protein banding pattern analysis.

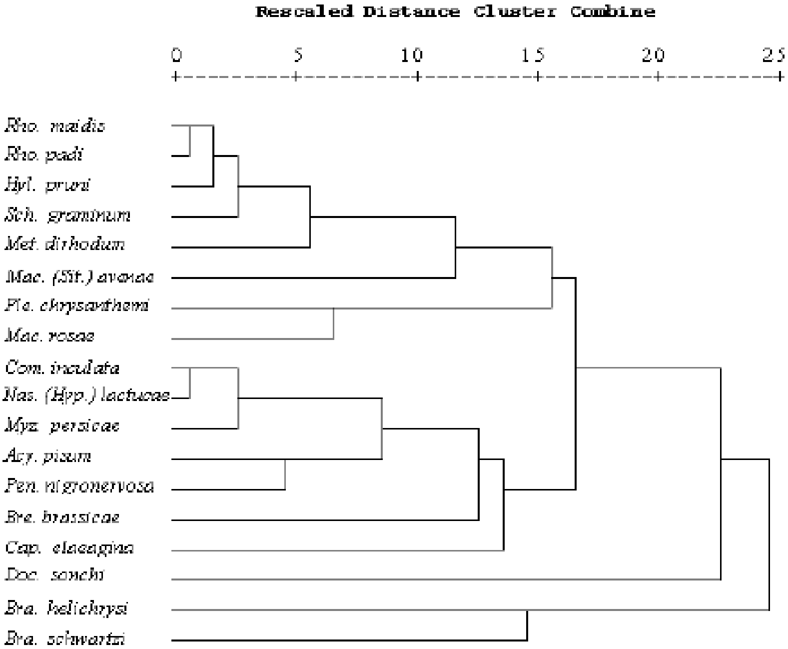

Figure 7. Dendrogram show phylogenetic relationship among the eighteen aphid species based on RAPD banding pattern analysis.

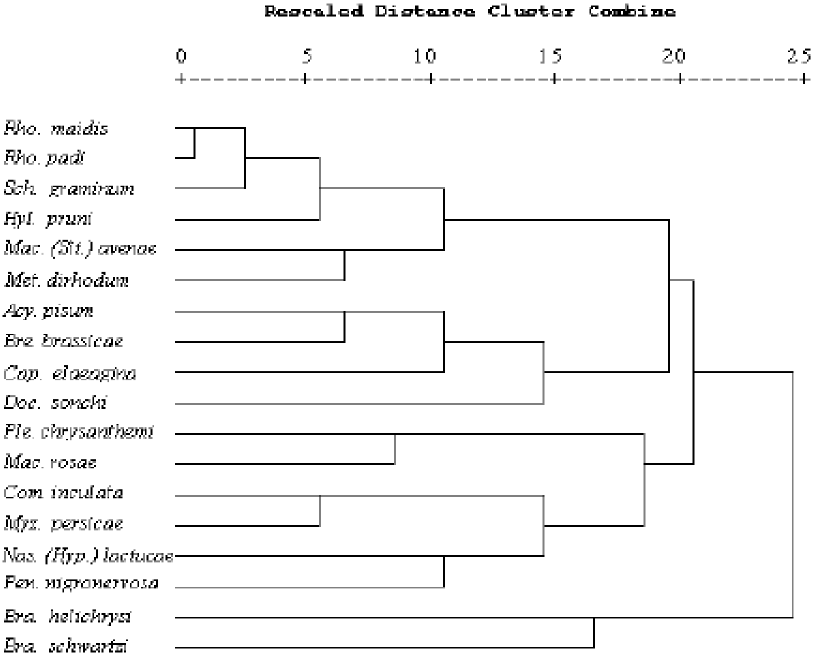

Figure 8. Dendrogram show phylogenetic relationship among the eighteen aphid species based on combined effect of isozyme, Total protein and RAPD analysis.

ASSESSMENT OF *DATURA METEL*, LOCAL SOAP AND GARLIC (*ALLIUM SATIVUM*) IN THE MANAGEMENT OF TERMITE (TERMITIDAE: ISOPTERA)

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ABSTRACT: The study investigated the efficacy of extracts from *Datura metel*, local soap and garlic in the management of *Macrotermes bellicosus*. The synthetic insecticide (chlorpyrifos 0.1%) and water were included in the study as controls. In the laboratory, contact toxicity was conducted using the standard method described by Mc Donald et al. (1970). The treatments (10 ml each) were applied to the thorax of worker termite and insect mortality was noted. The repellent action of the treatment was based on an area preference test described by McDonald et al. (1970) and Landani et al. (1955). The "test area" was Whatman filter paper cut into equal halves and placed in a plastic Petri dish. One half was treated with the treatment and the other half with water (control). Four termites were released into the centre of the Petri dishes and the number of insect present on the control (NC) and treatment (NT) halves were recorded after 1hour exposure and percentage repellence (PR) values were computed. The efficacy of the treatments at managing termite populations in the field was tested on five average-sized termitaria. They were demolished and dug 40 – 50 cm below ground level. Five litres each of the treatments was applied to a termitaria with knapsack sprayer and resurgence/rebuilding of termitaria was observed as from the 2nd day till the 90th day. The results showed that all the treatments had repellence value of between 75% - 100 % and caused 100 % mean insect mortality in the laboratory. On the field only *D. metel* and chlorpyrifos were effective at preventing the upsurge and rebuilding of termitaria for 90 days. *Datura metel* could be used as an eco-friendly botanical for the management of termites in the field.

KEY WORDS: *Datura metel*, garlic, mortality, repellence, synthetic insecticide, termitaria.

Termites are an important component of tropical and sub-tropical ecosystems. They are group of social insects that belong to the order Isoptera and family "Termitidae" (Mitchell, 2002). The insect are truly social animals classified along with the ants, some bees and wasps in the order hymenoptera (Myles, 2003). The most important termite pest genera in Africa include: *Odontotermes*, *Macrotermes*, *Pseudacanthotermes*, *Microtermes*, *Ancistrotermes*, *Allodontermes*, *Amitermes*, *Trinervitermes* and *Hodotermes* (Mailu et al., 1995; Mitchell, 2002).

Termites mostly feed on dead plant materials generally in the form of wood, leaf litter, soil or animal dung and about 10 % of the estimated 4000 species of the insect are economically significant as pests that can cause serious structural damage to buildings, crop or plantation forest. Termites are major detrivores particularly in the sub-tropical region, and their recycling of wood and other plant matter is of considerable ecological importance. As an eusocial insect, termites live in mounds that may consist of several hundred to several million individuals (Davis & Williams, 1979). They are prime example of insects that display decentralized, self organized system, swarm intelligence and co-operation among colony members to exploit food sources and environment that could not be available to any single insect acting alone.

A typical colony contains nymphs (semi matured young), workers, soldiers and reproductive individuals, sometimes containing several egg laying queens. A worker termite undertake the labour of foraging, food storage, brood, nest maintains and some of the defense effort in certain species (Watson et al., 1985). They are the main caste in the colony for digestion of cellulose in food and are the most likely to be found in infested wood (Krishnak & Weesner, 1969, 1970). Termites thrive in every type of terrestrial environment where enough food is present. They are soil miners, soil engineers and soil architects and in Africa, Asian, Australian and South America build various impressive nests and mounds that provide protection from predators and help in thermoregulation within the nest (Gay & Calaby, 1970; Davis & Williams, 1979; Howell et al., 1986). They are highly voracious and destructive and cause substantial damage to homes and other wooden structures in our environment; in severe infestation, structural integrity of a building and the safety of the occupiers could be threatened.

Although termites play beneficial roles in ecology; they are also destructive and are a major threat to crops and household properties (Edwards & Mill, 1986; Wood & Pearce, 1991). Crops such as yam and cassava (Atu, 1993), sugar cane (Sands, 1977), groundnuts (Johnson et al., 1981), sorghum (Logan et al., 1990) and maize (Wood et al., 1980) are prone to infestation and damage by termites. Termites also attack grain stores and are commonly responsible for mortality of tree seedlings in forestry and cause considerable damage to buildings and other wooden structures like fence posts and utility poles. *Macrotermes* spp. are members of the fungus-growing sub-family Macrotermitinae. They are mostly mound building and are the largest termite species. The queen could attain a length of nearly 6 inches (15 cm) in *Macrotermes natalensis*. There are about 330 species in the *Macrotermes* genus, spread over tropical Africa and Asia. *Macrotermes* spp build large epigeal nests (mounds) from where they forage outwards to distances up to 50m in galleries/runways. They attack plants at the base of the stem, ring-barking or cutting them completely. The huge mounds of *Macrotermes* termites are complex structures with ventilation, air ducts, heating, cooling systems, and chambers containing fungus gardens which the termites cultivate. In Africa, *Macrotermes* has been a serious pest of some agricultural crops and tree plantations. They are responsible for the majority of crop damage and 90% of tree mortality in forestry. Seedlings in the nurseries and newly planted trees are particularly susceptible to attack during the first 6-9 months after planting. Mortalities vary between 19 - 78%, occasionally approaching 100% in some areas. Bigger (1966) and Munthali et al. (1992) reported *Macrotermes* as the major pest in cassava. Damage by termite to stored products also provides entry for secondary infection by pathogens especially *Aspergillus*, which cause indirect yield loss and contamination of products with aflatoxins (Lynch & Dicko, 1991).

Many plants have developed effective defences against termites, and in most ecosystems, there is an observable balance between the growth of plants and the feeding of termites (Xie et al., 1995). Defence is typically achieved by secreting anti-feedant chemicals (such as oils, resins, and lignins) into the woody cell walls. This reduces the ability of termites to efficiently digest the cellulose. Many of the strongly termite-resistant tree species have heartwood timber that is extremely dense (such as *Eucalyptus camaldulensis*) due to accretion of these resins. Over the years there has been considerable research into these natural defensive chemicals with scientists seeking to add them to timbers from susceptible trees. A commercial product, "Blockaid", has been developed in Australia and uses a range of plant extracts to create a paint-on non-toxic termite barrier for buildings. Termites are strongly repelled by some toxic materials to the extent that they become disoriented and eventually die from starvation rather than consume cross treated samples (Xie et al., 1995; Peterson & Wilson, 2003). The control of termite with synthetic insecticides is prone to pollution of environment and underground water, killing of beneficial pest, pest resistance and resurgence etc. Hence, there is the need for continuous research into testing of extract from natural occurring plants that are cheap, readily available, eco-friendly and effective at managing the population of termite on the field. This study evaluates the effectiveness of *Datura metel,* garlic and local soap at managing the population of termites.

MATERIALS AND METHODS

Collection of termites, plant materials and preparation of extract

The leaves of *Datura metel* were collected from farms in Ogun State, Nigeria. 100 g fresh leaves were crushed in a mortar to soften the leaves: thereafter, 5 litres of water was poured into the crushed leaves and left for 3 days when the liquid was sieved. Dried bulb of garlic – *A. sativum* was ground into powder with an electric grinding machine and left for 48 h to dry. Dried garlic powder (100 g) was thereafter diluted in 5 litres of water. The local soap was sourced from Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Nigeria. The soap (100 g) was soaked overnight in 5 litres of water and sieved through cheese cloth. The solution was made up to 10 litres with water. Worker termites used for the laboratory studies were sourced from termite mounds in FUNAAB. They were collected about 1 hour prior to use in 250cm^3 Kilner jars and placed in the deep freeze for one minute to reduce their activeness for ease of handling.

Laboratory studies

Contact toxicity by topical application

Test of contact toxicity of the extracts to termite was conducted by topical application of the treatments to the insect using standard method described by McDonald et al. (1970). Four termites of unknown age and sex were placed in a Petri dish lined with moist Whatman filter paper. 10 ml each of the extracts and the synthetic insecticide (0.1% chlorpyrifos) was applied to the dorsal surface of thorax of each insect individually with a micro applicator (Obeng-Ofori and Reichmuth, 1997; Ebenezer, 2000). The treatments were arranged on worktable in the laboratory using complete randomized design (CRD). Percentage insect mortality was calculated according to Baba-Tierto Niber (1994) using the formulae:

$$\% \text{ mortality} = \frac{\text{No of dead insect}}{\text{Total number of insect}}$$

Repellency study by treated paper method

The study was based on an area of preference test described by Landani et al. (1955) and Mc Donald et al. (1970). Test area was number 1 Whatman filter paper (11cm diameter) cut into equal halves that have no contact with each other to prevent exchange of content. One half was dipped into each of the treatment with forceps and allowed to drain before being placed into the plastic Petri dish. The other half was placed into distilled water (control), allowed to drain and was placed sideway with the first halve. Four termites were released separately into the centre of each filter paper in the Petri dish. Each treatment was replicated four times and arranged on the work table in the laboratory using complete randomized design (CRD). The number of insects present on control (NC) and treatments (NT) half was recorded after 1 hour exposure. Percent repellence (PR) values was computed using the method of Hossanah *et al.* (1990) as follows:

$$PR = \frac{(NC - NT)}{(NC - NT)}$$

FIELD STUDY

The field trial of the extracts and local soap was conducted on two field locations in UNAAB. Five average-sized termitaria of between 0.5 and 1m heights were used for the study. The termitaria were demolished and dug to depth of 40 - 50 cm below the ground level to expose the termite to application of the treatments. The king and queen were not injured nor killed during the digging. Five litres of the extracts were evenly applied to the dug termitaria with the aid of Cooper Peegler (CP15) Knapsack sprayer. One of the demolished termitaria was sprayed with 5 litres of 0.1% chlorpyrifos (synthetic insecticide) and another 5 litres of distilled water and these served as controls. The termitaria were observed for re-built and termite resurgence as from the second day after application of extract.

STATISTICAL ANALYSIS

Statistical analysis of data was based on SAS's general linear model procedure (SAS Institute, 1988). The data was subjected to Analysis of Variance (ANOVA) and mean separation was done using Least Significant Difference (LSD).

RESULTS

Repellence of termite by the treatments

The repellence effects of the treatments on termite are shown on Table 1. Garlic repelled the entire termite population (100%), followed by *Datura metel* (83.3%). Their repellence values were however, not significantly ($P > 0.05$) difference from each other. Local soap induced 75% repellence and it was significantly ($P < 0.50$) lower than percentage repellence induced by garlic and *D. metel.* The synthetic insecticide, chlorpyrifos induced 100% repellence. It was however, not significantly ($P > 0.05$) difference from repellence induced by garlic (100%) and *D. metel* (83.3%).

Mortality of termites topically treated with the treatments

Table 2 shows the mortality of the termites after the treatments were topically applied on them. All the treatments induced 100% mortality and they were not significantly ($P > 0.05$) difference from each other.

Field trial of treatments

The effectiveness of the treatments in the management of the termite on the field was based on the rating according to Osipitan (2008) as shown in Table 3. As shown in Table 4, the synthetic insecticide was highly effective, while the extract of *Datura metel* was effective. Local soap solution and garlic solution were not effective at managing the termite population as the termite resurged and rebuilt the demolished termitaria.

DISCUSSION

The study indicated the ability of garlic, *Datura metel* and local soap to repel and cause high mortality of termite in the laboratory. This is in consonance with the report of Zhu et al. (2001) who reported that naturally occurring anti-termite compounds extracted from locally available plants or trees have potential for managing termite population. Khan & Gumbs (2003) reported that repellent offer protection and drive away insect pest from treated materials. In this study, although garlic and local soap were effective in the laboratory, they were not effective at managing the population of termite on the field. This result is in consonance with the results from the use of other control options such as biological control (Logan et al., 1990; Grace, 1997), use of entomopathogenic nematodes and bacteria (Mauldin & Beal, 1989; Milner & Staples, 1995), use of entomopathogenic fungi (Milner & Staples, 1996; Rath, 2000) that indicated successful control of termites in the laboratory, but failure on the field. The ineffectiveness of garlic and local soap at controlling termite on the field in this study may result from the likely instability of their active ingredients on the when exposed to high atmospheric condition especially temperature or due to the field composite castes (queen, king, soldier, worker) to which the extract were applied on the field as against single caste (workers) trial in the laboratory study.

On the field, the extract of *Datura metel* and the synthetic insecticide were effective at managing the population of termites. The termitaria disinfested with the two treatments were not rebuilt three months after application of the treatments and the termite population did not resurge. This implies that the extract of *D. metel* could effectively manage the population of termites on the field. This result is similar to the findings of Osipitan and Oseyemi (2012) that indicated the bio-activity of aqueous extract from citrus (*Citrus cinensis*), cocoa (*Theobroma cacao*), cashew (*Anarcardium occidentals*) and sunflower (*Tithonia diversifolia*) at managing the population of *macrotermes bellicosus* on the field.

Termites are usually controlled with persistent organochlorines such as aldrin, lindane, chlordane and dieldrin applied as seed treatments, on seedlings, mature These chemicals plants and for tree protection (Sands, 1977). The banning of these organochlorines, has shifted use to products like organophosphates, carbamates, and synthetic pyrethroids. are however expensive and prone to side effects such as pest resistance and resurgence, biomagnifications, death of beneficial insects etc. Similarly, cultural practices such as crop rotation, demolishing of mounds, intercropping etc are labour-intensive and have not achieved much success (Gethi et al., 1995). Most of the African farmers are subsistence farmers with small farm holdings and could not afford high cost of synthetic termiticides. It beholds therefore that steady efforts should be geared at exploring the potentials of extracts from plants that abound in Africa and easily accessible. The comparable effectiveness of the extract of *D. metel* with the synthetic insecticide in this study is a good development for the management of termite as the plant thrive in forest and the technology of its extraction could be easily adapted.

In this study, the extracts of *D. metel* was effective in the management of the population of termite in the laboratory and on the field and could therefore be explored in the management of termite.

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Table 1. Repellency of termites by the treatments.

Treatments	% repellency± SE
Datura metel	83.33±16.67a
Garlic	100±0.00a
Local soap	75.00±14.43b
chlorpyrifos	100±0.00a

Means followed by the same letter are not significantly different from each other at P < 0.05 using least significant difference (LSD)

Table 2. Mean % mortality of termites with treatments topically applied.

Treatments	% Mortality± SE
Datura metel	100±0.00a
Garlic	100±0.00a
Local soap	100±0.00a
chlorpyrifos	100±0.00a

Means followed by the same letter are not significantly different from each other at $P < 0.05$ using least significant difference (LSD)

Table 3. Scale of measuring effectiveness of treatments in the management of termites.

Upsurge/rebuilding of termitaria	
Days after application of the treatments	Rating
1 – 20	Not effective
21 – 40	Slightly effective
41 – 60	Effective
61 days and longer	Highly effective

Table 4. Effectiveness of extracts in the management of termites on the field.

Upsurge/rebuilding of termitaria	
Treatments	Rating
Datura metel	Effective
Garlic	Not effective
Local soap	Not Effective
Water	Not effective
chlorpyrifos	Highly effective

FAUNISTIC STUDIES ON STAPHYLININAE (COLEOPTERA: STAPHYLINIDAE) IN KAZDAĞLARI (BALIKESİR PROVINCE) IN TURKEY

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ABSTRACT: In this study, determination of Staphylininae fauna of Kazdağları (Balıkesir province) in Turkey has been aimed. Materials have been collected from 61 localities by two weeks' intervals during the months of February to November in 2008-2010. As a result of the study, 36 species of 24 genera and subgenera have been determined. Among them, 2 species, *Quedius unicolor* Kiesenwetter, 1847 and *Q. henroti* Coiffait, 1970 have been reported as new records for Turkish fauna. All evaluated species in the study have been reported as the first records for Kazdağları (Balıkesir province) fauna.

KEY WORDS: Staphylininae, Staphylinidae, Kazdağları, Balıkesir, Turkey, new record.

The family Staphylinidae also known as "rove beetles" belong to the suborder Polyphaga of the order Coleoptera. Total number of 45.707 species and subspecies are registered for 3845 genera in 32 subfamilies belonging to Staphylinidae family worldwide. 1600 species and subspecies of 246 genera connected to 22 subfamilies are registered in Turkey. Staphylininae is one of the largest subfamilies of Staphylinidae with more than 6.500 described species in approximately 282 genera worldwide (Herman, 2001). In Turkey, 346 species and subspecies belonging to 39 genera and subgenera of Staphylininae were recorded until now (Anlaş, 2009).

Species of subfamily Stapylininae is common in almost all types of ecosystems throughout the world even though they are generally adapted to live on the ground or in the soil of cool and humid biotopes. Mature insects can live in habitats that are humid and humus rich, like as in loose soils, on and under fallen foliage, in caves, around creek biotopes, under the stones, in tidal zones, under the barks of fallen trees, dead logs and many more. Some species of this subfamily live as saprophagous around decomposing organic matter including animal carcass or droppings. Phytophagous feeder species are rarely observed. These feed on fresh leaves, pollens or flowers of plants. However none of these species cause loss on economic level. Also some species do live as mycetophagous inside decomposing or live mushrooms. Rove beetles are classified generally according to their behavior type as a predator or a parasite. Termitophilic and myrmecophilic species living with ants or termites in the same nest parasitically or neutrally are known as well (Lodos, 1989).

Early detailed morphologic data regarding Staphylinidae species are provided by Blackwelder (1936), Smetana (1958), Lohse (1964), Coiffait (1972), Tikhomirova (1973), Naomi (1987,1987a) and Newton (1990). Staphylinidae larvae were studied morphologically by Paulian (1941), Pototskaya (1967), Topp (1978) and Bohàč (1982). First catalog of family Staphylinidae was prepared by Bernhauer & Schubert (1910, 1911, 1912, 1914, 1916) in five volumes. This was followed by catalogs that were prepared by Bernhauer & Scheerpeltz (1926), Scheerpeltz (1933, 1934) and Lohse (1964). Moreover, Coiffait (1972, 1974, 1978) in his study about subfamily Staphylininae which is widespread in Palaearctic region also provided systematical and faunistical information about a great number of species living in Turkey along with many identification keys. Works of German scientist Assing has become well known in the last ten years concerning Staphylinidae fauna in the world. He made contributions to Turkish fauna during his journeys to Turkey. Furthermore, studies of Sahlberg (1912-1913), Herman (2001), Löbl & Smetana (2004), Bordoni (2003), Coiffait (1972, 1974, 1978) are among the significant publications in the world. The first investigations about Staphylinidae fauna in Turkey conducted by Ganglbauer (1905), Bordoni (1971, 1973, 1973a, 1973b), Smetana (1967, 1967a, 1968, 1968a, 1977), Sahlberg (1912-1913), Bernhauer (1927, 1935, 1936). Some of the publications regarding Staphylinidae fauna in the world today belongs to Staniec (1999, 1999a, 2002, 2004), Staniec & Pietrykowska-Tudruj (2008, 2009), Solodovnikov (2004, 2005), Schillhammer (2007, 2008, 2009), Khachikov (2005, 2006, 2007). Major studies of Staphylinidae fauna in Turkey were carried out by Bordoni (1999, 2000), Tezcan & Amiryan (2003), Anlaş (2007, 2009), Schillhammer et al. (2007) and Assing (2009, 2009a, 2009b, 2009c, 2010, 2010a, 2010b, 2010c).

Kazdağları Mountain range (38.50-40.50° N / 25.00-28.50° E) which occupies 258.000 hectares is located in Northwest Anatolia and forms a boundary between Marmara and Aegean Regions. This mountain range consisting of Dede Mountain in the west, main Kazdağı in the center, Eybek Mountain in the east, Gürgen, Kocakatran and Susuz (Sakar) Mountains in the northeast makes the highest formation of Biga Peninsula. South side of the Kazdağları starting from Zeytinli Rivulet covering all the region to the west of Altınoluk settlement (Damla Hill) and 21.450 hectares of heights that exist above these locations are declared as a National Park in 1993 with a legislation via Ministry Cabinet. Because Kazdağları is sheltering 800 plant species in which 70 of them are endemic, aside from Kazdağları fir [*Abies nordmanniana* ssp. *equi-trojani* (Asch. & Sint.) Coode & Cullen (Pinales: Pinaceae)] only specific to this area, it is selected as a pilot region of the World Bank supported "Protection of Plant Gene Resources in Place" project and conservation of this plant and animal diversity was initiated. This study aims to determine existing members of Staphylininae subfamily, their biological diversity and their occurrence, contribute data to the regional zoogeographic distribution of species belonging to Staphylininae in Kazdağları which has significant characteristics.

This article has been prepared in order to give some additional information after the completion of a doctoral research dissertation project of the first author on the fauna of Kazdağları.

MATERIAL AND METHODS

The research was carried out in 61 localities located in Kazdağları during the months of February-November in 2008-2010. Detailed information regarding these localities are shown in Table 1. Study area was investigated by dividing into sections because of its large size. In 2008, National Park section; in 2009, National Park, South, Southeast and West; in 2010, North, Northeast, East of the Kazdağları were studied to determine the best locations for Staphylininae with two weeks' sampling intervals. Map regarding research localities is displayed in Figure 1.

According to Boháč (2007), methods used for collection of Staphylinidae species vary in efficiency. In respective order sifting and knock down has 32.63% - 19.27% efficiency, also collected by hand, pitfall trap and bait trap with hibernation trap-band has corresponding efficiency of 15.66%, 6.02% and 4.42%, respectively. Sampling was carried out via suitable method for each habitat type and vegetation cover with these differences in consideration. Therefore, specimens located in and around soil, pebble, detritus and fallen foliage were obtained by sifting, samples on bushes, and leaves, flowers of short nonwoody plants were collected with sweeping net, especially collected by hand from in stream biotopes whether found under a stone or underneath dead tree barks, through pitfall and bait traps in fir, *Quercus* sp., *Pinus brutia*, *Pinus nigra* and *Abies nordmanniana* ssp. *equi-trojani* biotopes. Labels of gathered specimens include respectively material collection locality, date, subject biotop or collection method, number of specimens collected and total specimen number. All of the specimens were collected and determined by first author of this article. Materials have been deposited in the Balıkesir University Zoological Museum, Balıkesir, Turkey.

Classification and nomenclature of the subfamily Staphylininae suggested by Löbl & Smetana (2004) have been followed in this study. Worldwide and in Turkey distributions of identified species are given in an alphabetical order, the information about material examined are indicated according to locality numbers.

Countries have been coded as follows after Löbl & Smetana (2004):

E - Europe: AB Azerbaijan, AL Albania, AN Andorra, AR Armenia, AU Austria, AZ Azores, BE Belgium, BH Bosnia Hercegovina, BU Bulgaria, BY Byelorussia, CR Croatia, CZ Czech Republic, DE Denmark, EN Estonia, FA Faeroe Islands, FI Finland, FR France, GB Great Britain, GE Germany, GG Georgia, GR Greece, HU Hungary, IC Iceland, IR Ireland, IT Italy, KZ Kazakhstan, LA Latvia, LS Liechtenstein, LT Lithuania, LU Luxembourg, MA Malta, MC Macedonia, MD Moldavia, NL The Netherlands, NR Norway, PL Poland, PO Portugal, RO Romania, RU Russia (CT Central European Territory, NT North European Territory, ST South European Territory), SK Slovakia, SL Slovenia, SP Spain, SR Svalbard, SV Sweden, SZ Switzerland, TR Turkey, UK Ukraine, YU Yugoslavia.

N - North Africa: AG Algeria, CI Canary Islands, EG Egypt (except Sinai), LB Libya, MO Morocco, MR Madeira Archipelago, TU Tunisia.

A - Asia: AE Arab Emirates, AF Afghanistan, AP Arunachal Pradesh, BA Bahrain, BT Bhutan, CH China [CE Central Territory (ANH Anhui, HUB Hubei, HUN Hunan, JIA Jiangsu, JIX Jiangxi, SHG Shanghai, ZHE Zhejiang), NE Northeastern Territory (HEI Heilongjiang, JIL Jilin, LIA Liaoning), NO Northern Territory (BEI Beijing, GAN Gansu, HEB Hebei, HEN Henan, NIN Ningxia, NMO Nei Mongol, SHA Shaanxi, SHN Shandong, SHX Shanxi, TIA Tianjin), NW Northwestern Territory (GAN Gansu, NMO Nei Mongol, XIN Xinjiang), SE Southeastern Territory (FUJ Fujian, GUA Guangdong, GUX Guangxi, HAI Hainan, HKG Hong Kong, MAC Macao, TAI Taiwan), SW Southwestern Territory (GUI Guizhou, SCH Sichuan, YUN Yunnan), WP Western Plateau (QIN Qinghai, XIZ Xizang)], CY Cyprus, HP Himachal Pradesh, IN Iran, IQ Iraq, IS Israel, JA Japan, JO Jordan, KA Kashmir, KI Kyrgyzstan, KU Kuwait, KZ Kazakhstan, LE Lebanon, MG Mongolia, NP Nepal, NC North Korea, OM Oman, PA Pakistan, QA Quatar, RU Russia (ES East Siberia, FE Far East, WS West Siberia), SA Saudi Arabia, SC South Korea, SD Sikkim, Darjeeling, SI Sinai (Egyptian part), SY Syria, TD Tadzhikistan, TM Turkmenistan, TR Turkey, UP Uttar Pradesh, UZ Uzbekistan, YE Yemen.

AFR Afrotropical region, **AUR** Australian region, **NAR** Nearctic region, **NTR** Neotropical region, **ORR** Oriental region.

RESULTS

Family Staphylinidae Latreille, 1802
Subfamily Staphylininae Latreille, 1802
Tribe Othiini Thomson, 1859
Genus *Othius* Stephens, 1829

Othius laeviusculus Stephens, 1833

Material examined: Kavakardı, 23.X.2010, *Pinus nigra, Suillus* sp., aspirator, (2♂♂). Totally 2 specimens. **Distribution in the world: E:** AB AU BH BU CR CZ FR GB GE GR HU IR IT MC NL PL PT SK SL SP ST SZ **N:** AG MO TU **A:** CY IN SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Adıyaman, Ankara, Antalya, Ardahan, Aydın, Bursa, İstanbul, İzmir, Manisa, Mersin (Çamlıyayla), Muğla, Rize, Samsun, Tunceli (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Tribe Staphylinini Latreille, 1802
Subtribe Philonthina Kirby, 1837
Genus *Gabrius* Stephens, 1829

Gabrius anatolicus Smetana, 1953

Material examined: Sarıkız Hill, 10.V.2009, *Pinus nigra*, pitfall trap, (1♀); Çam Çeşme Stream, 06.IX.2009, stream bed, under stone, (3♂♂ 3♀♀); Çeşme Stream, 27.VI.2010, stream bed, under stone, (5♂♂ 2♀♀); Şahmelik Stream, 06.IX.2009, stream bed, under stone (3♀♀); Eğrisu Stream, 24.V.2009, stream bed, under stone, (1♂); Boz Stream, 27.VI.2010, stream bed, under stone, (7♂♂ 3♀♀); Domuz Çukuru Road 2, 21.VI.2009, stream bed, under stone, (1♂ 1♀); Domuz Çukuru Road 3, 21.VI.2009, stream bed, under stone, (2♂♂); Küçük Stream 1, 01.VIII.2010, stream bed, under stone, (1♂ 2♀♀); Gelin Rivulet, 16.X.2010, stream bed, under stone, (1♂ 1♀). Totally 37 specimens. **Distribution in the world: A:** TR (Löbl & Smetana, 2004). **Distribution in Turkey:** İzmir (Bozdağlar), Mersin (Yeniköy-Toros) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Gabrius astutus (Erichson, 1840)

Material examined: Çam Çeşme Stream, 21.VI.2010, stream bed, under stone, (1♂); Ayı Stream 1, 26.IV.2008, *Quercus* sp., bait trap, (1♂); Şahmelik Area, 21.VI.2009, stream bed, under stone, (1♂); Küçük Stream 2, 17.VII.2010, stream bed, sifting, (1♀). Totally 4 specimens. **Distribution in the world: E:** AR AU BE BH BU CR CZ FR GE GR HU IT NL PL RO SK SP ST SZ UK **A:** ES FE LE TM TR UZ WS (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana (Bürücek-Toros), Konya (Karapınar) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Philonthus* Stephens, 1829
Subgenus *Philonthus* Stephens, 1829

Philonthus* (*Philonthus*) *cognatus Stephens, 1832

Material examined: Nanekırı Hill, 04.VI.2009, (1♂), 02.VIII.2009, (6♂♂ 4♀♀), *Sideritis trojana*, pitfall trap; Beypınarı 1, 05.VII.2008, (1♂), 04.VII.2009, (4♂♂ 1♀), 19.VII.2009, (4♂♂ 2♀♀), *Pinus nigra, Vicia villosa*, pitfall trap; Beypınarı 2, 21.VI.2009, (1♂), 04.VII.2009, (1♂ 1♀), 19.VII.2009, (4♂♂ 2♀♀), *Phaseolus vulgaris, Lycopersicon esculentum*, *Capsicum annuum*, pitfall trap; Koçere Stream 1, 19.VII.2009, stream bed, pitfall trap, (2♂♂); Altıparmak, 02.VI.2009, (3♂♂ 1♀), 21.VI.2009, (1♂ 1♀), 04.VII.2009, (2♂♂ 1♀), *Pinus nigra*, *Anthriscus nemorosa, Mentha pulegium*, aspirator, pitfall trap; Yedikardeşler, 05.VII.2008, (19♂♂ 14♀♀), 14.VI.2008, (1♂), 31.VI.2008, (1♂), *Abies equi-trojani, Pinus nigra*, aspirator, pitfall trap. Totally 78 specimens. **Distribution in the world: E:** AL AU BE BH BU BY CR CT CZ DE EN FI FR GB GE HU IR IT LA LT LU MO NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **N:** AG TU **A:** ES IN JIL KA KI KZ NP PA TD TR WS **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** Mersin (Yeniköy), Trabzon (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***concinnus*** (Gravenhorst, 1802)
Material examined: Nanekırı Hill, 04.VII.2009, rocky field, *Sideritis trojana*, sweeping net, (1♀), 02.VIII.2009, rocky field, *Sideritis trojana*, pitfall trap, (2♂♂ 1♀); Sarıkız Road, 31.V.2008, stream bed, under stone, (3♂♂), 10.V.2009, *Pinus nigra*, pitfall trap, (2♂♂); Levent Boğazı, 06. IX. 2009, *Quercus* sp., stream bed, under stone, (1♂ 1♀); Beypınarı 1, 14.VI.2008, (3♂♂ 4♀♀), 05.VII.2008, (2♂♂ 1♀), 04.VII.2009, (3♀♀), 19.VII.2009, (1♂ 2♀♀), *Pinus nigra, Vicia villosa*, pitfall trap, 04.VII.2009, *Pinus nigra, Vicia villosa*, under stone, (2♂♂ 1♀); Beypınarı 2, 04.VII.2009, (1♀), 19.VII.2009, (2♂♂), 18.X.2009, (1♂), *Phaseolus vulgaris, Lycopersicon esculentum, Capsicum annuum*, pitfall trap; Koçere Stream, 21.VI.2009, (4♂♂ 5♀♀), 19.VII.2009, (1♀), stream bed, pitfall, 21.VI.2009, (5♂♂ 2♀♀), 27.VI.2009, (1♀), 19.VII.2009, (2♂♂ 2♀♀), 06.IX.2009, (1♀), stream bed, under stone; Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (9♂♂ 16♀♀); Koçere Stream 2, 06.IX.2009, *Abies equi-trojani*, *Fagus orientalis*, under stone, (3♂♂ 5♀♀); Altıparmak, 02.VI.2009, (2♂♂ 6♀♀), 06.VI.2009, (11♀♀), 06.VI.2009, (8♂♂ 2♀♀), 21.VI.2009, (7♂♂ 6♀♀), 04.VII.2009, (1♂), 02.VIII.2009, (1♂), *Pinus nigra*, *Anthriscus nemorosa, Mentha pulegium*, under stone, 21.VI.2009, (1♂ 4♀♀), 19.VII.2009, (1♂ 1♀), 04.VII.2009, (2♂♂ 3♀♀), 02.VIII.2009, (1♀), 18.X.2009, (1♀), *Pinus nigra*, *Anthriscus nemorosa, Mentha pulegium*, pitfall trap; Kırlangıç Stream 1, 04.VII.2009, stream bed, *Quercus* sp., under stone, (2♂♂ 7♀♀); Çamçeşme, 21.VI.2009, *Pinus brutia*, *Fagus orientalis*, *Castanea sativa*, under stone, (1♂ 5♀♀); Şahmelik, 21.VI.2009, (8♂♂ 20♀♀), 06.IX.2009, (1♂ 2♀♀), stream bed, under stone; Eğrisu Stream, 24.V.2009, (5♂♂ 11♀♀), 19.VII.2009, (3♂♂), stream bed, under stone, Gıldırdak Stream, 27.VI.2010, stream bed, under stone, (1♂ 5♀♀); Bozdere, 19.VII.2009, *Centaurea* sp., aspirator, (1♀); Çamçeşme Stream, 21.VI.2009, (12♂♂ 11♀♀), 06.IX.2009, (1♂ 1♀), 27.VI.2010, (1♀), stream bed, under stone; Şahmelik Area, 21.VI.2009, stream bed, under stone, (5♂♂); Domuz Çukuru Road 1, 21.VI.2009, stream bed, under stone, (1♂); Yedikardeşler, 05.VII.2008, *Abies equi-trojani*, *Pinus nigra*, pitfall trap (3♂♂ 2♀♀); Kırlangıç Stream 1, 17.VII.2010, stream bed, sifting, (2♀♀); Kapanca Stream, 21.VI.2009, stream bed, under stone, (2♂♂ 2♀♀); Hanlar Üstü, 16.X.2010, meadow, cow dung, aspirator, (4♀♀). Totally 267 specimens. **Distribution in the world: E:** AL AR AU AZ BE BH BU CR CT CZ DE EN FI FR GB GE GG GR HU IR IT LA LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **N:** AG CI LB MO MR TU **A:** AF CY ES FE IN IS KZ LE MG TD TR UZ WS **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana, Ankara, Bolu (Kaynaşlı), Kayseri (Erciyes Mountain), Konya, Manisa, Mersin (Yeniköy), Mersin-Karaman, Tunceli (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***coprophilus*** Jarrige, 1949
Material examined: Hanlar Üstü, 16.X.2010, meadow, cow dung, aspirator, (1♂ 1♀). Totally 2 specimens. **Distribution in the world: E:** AU BE BU CZ FR GB GE HU IT LA LT LU SK ST **N:** "Nordafrika" **A:** WS (Löbl & Smetana, 2004). **Distribution in Turkey:** Erzurum (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***corruscus*** (Gravenhorst, 1802)
Material examined: Nanekırı Hill, 02.VIII.2009, rocky field, *Sideritis trojana*, pitfall trap, (1♂ 1♀); Sarıkız Road, 05.VII.2008, *Pinus nigra*, pitfall trap, (1♀), 04.VII.2009, *Pinus nigra*, under stone, (3♂♂ 8♀♀); Beypınarı 1, 14.VI.2008, (1♀), 19.VII.2009, (1♂), *Pinus nigra, Vicia villosa,* pitfall trap; Beypınarı 2, 21.VI.2009, (1♂), *Phaseolus vulgaris, Lycopersicon esculentum, Capsicum annuum*, pitfall trap; Koçere Stream, 21.VI.2009, stream bed, under stone, (1♂); Koçere Stream, 06.IX.2009, stream bed, pitfall trap, (2♂♂ 4♀♀); Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (1♂); Altıparmak, 06.VI.2009, *Pinus nigra, Anthriscus nemorosa, Mentha pulegium*, under stone, Ayı Stream 2, 14.VI.2008, *Pinus brutia*, *Moenchia mantica* subsp. *mantica*, pitfall trap, (1♀); Ayı Stream 2, 14.VI.2008, *Pinus brutia*, *Moenchia mantica* subsp. *mantica*, pitfall trap, (1♂); Söbüyurt, 04.VII.2009, nonwoody plants, under stone, (1♂); Şahmelik Area, 24.V.2009, stream bed, under stone, 1♂); Eybek Observation Tower 1, 16.X.2010, *Hydnum repandum*, aspirator, (1♀). Totally 30 specimens. **Distribution in the world: E:** AR AU BE BU CZ DE EN FR GB GE GG GR HU IR IT LT LU NL PL RO SK SP ST SV SZ UK **N:** AG **A:** AF IS LE TM TR UZ WS (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana (Bürücek,

Suluhan-Toros), Ankara (Çamlıdere-Işık Mountain), İzmir, Mersin [Tarsus (=Tarsous), Caramania] (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***cruentatus*** (Gmelin, 1790)

Material examined: Nanekırı Hill, 06.VI.2009, rocky field, *Sideritis trojana*, sweeping net, (1♀); Altıparmak, 02.VI.2009, (1♂), 06.VI.2009, (1♀), *Pinus nigra, Anthriscus nemorosa, Mentha pulegium,* under stone; Hanlar Üstü, 16.X.2010, meadow, cow dung, aspirator, (1♀). Totally 4 specimens. **Distribution in the world: E:** AL AR AU BE BH BU BY CR CT CZ DE EN FI FR GB GE GG GR GU IR IT LA LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **N:** AG CI MO **A:** AF ES FE IN KI KZ LE MG TD TR UP UZ WS **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** Denizli (Babadağı), İstanbul (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***debilis*** (Gravenhorst, 1802)

Material examined: Nanekırı Hill, 06.VI.2009, rocky field, *Sideritis trojana*, sweeping net, (3♂♂ 6♀♀), 04.VII.2009, rocky field, *Sideritis trojana*, under stone, (1♂); Beypınarı 1, 14.VI.2008, (1♂), 06.VI.2009, (2♂♂), *Pinus nigra*, *Vicia villosa*, pitfall trap; Koçere Stream 1, 21.VI.2009, (2♂♂), 06.IX.2009, (1♂), stream bed, pitfall trap; Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (14♂♂ 13♀♀); Altıparmak, 02.VI.2009, stream bed, under stone, (1♂); Şahmelik, 24.V.2009, (11♂♂ 20♀♀), 06.IX.2009, (1♂), stream bed, under stone; Eğrisu Stream, 24.V.2009, stream bed, sifting, (3♂♂); Kırlangıç Stream 2, 04.VII.2009, stream bed, sifting, (1♂). Totally 80 specimens. **Distribution in the world: E:** AB AL AR AU BE BH BU CR CT CZ DE EN FI FR GB GE GG GR HU IR IT LA LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **N:** AG CI EG MO MR TU **A:** AF ES FE IN IS JA JIL LE KZ MG TM TR UZ WS ZHE **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana (Suluhan-Toros), Ankara (Çankaya), Denizli, Sarayköy, Meandros, Mersin [Tarsus (=Tarsous), Caramania] (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***intermedius*** (Lacordaire, 1835)

Material examined: Beypınarı 1, 06.VI.2009, (1♀), 04.VII.2009, (1♀), *Pinus nigra, Vicia villosa*, pitfall trap; Beypınarı 2, 09.XI.2008, (1♀), 04.VII.2009, (1♂), *Phaseolus vulgaris, Lycopersicon esculentum, Capsicum annuum*, pitfall trap; Koçere Stream 1, 21.VI.2009, (1♂ 1♀), 19.VII.2009, (1♀), stream bed, pitfall trap; Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (1♀); Altıparmak, 02.VI.2009, (8♂♂ 3♀♀), 06.VI. 2009, (2♂♂ 1♀), stream bed, under stone; Altıparmak, 21.VI.2009, *Pinus nigra*, *Anthriscus nemorosa, Mentha pulegium*, pitfall trap, (2♂♂ 2♀♀); Şahmelik, 21.VI.2009, stream bed, under stone, (1♂); Hanlar Üstü, 16.X.2010, (1♂), 07.XI.2010, (4♂♂ 2♀♀), meadow, cow dung, aspirator. Totally 34 specimens. **Distribution in the world: E:** AB AL AR AU BH BU CR CZ DE EN FR GB GE GG GR HU IR IT LA LT LU NL PL PT RO SK ST SV SZ UK YU **N:** AG MO TU **A:** CY IN IQ LE TM TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Ankara, Denizli (Babadağı), İzmir, Kahramanmaraş, Mersin (Tarsus) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus (***Philonthus***) ***nitidicollis*** (Lacordaire, 1835)

Material examined: Nanekırı Hill, 06.VI.2009, rocky field, *Sideritis trojana*, sweeping net, (5♂♂); Nanekırı Hill, 02.VIII.2009, (3♂♂ 5♀♀), 04.VII.2009, (3♂♂ 5♀♀), rocky field, *Sideritis trojana*, pitfall trap; Beypınarı 1, 14.VI.2008, (1♀), 05.VII.2008, (1♂ 4♀♀), 06.VI.2009, (2♀♀), 21.VI.2009, (2♀♀), 04.VII.2009, (4♂♂ 2♀♀), 18.X.2009, (1♀), *Pinus nigra, Vicia villosa*, pitfall trap; Beypınarı 2, 06.VI.2009, (1♂), 21.VI.2009, (3♂♂ 7♀♀), 04.VII.2009, (1♀), 19.VII.2009, (1♂), *Phaseolus vulgaris, Lycopersicon esculentum, Capsicum annuum*, pitfall trap; Koçere Stream 1, 06.IX.2009, stream bed, sifting, (1♀); Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (2♂♂ 3♀♀); Koçere Stream 2, 19.VII.2009, *Abies equi-trojani, Fagus orientalis,* pitfall trap, (2♂♂); Altıparmak, 02.VI.2009, (5♂♂ 9♀♀), 06.VI.2009, (5♂♂ 7♀♀), 04.VII.2009, (1♂ 1♀), 19.VII.2009, (1♀), *Pinus nigra, Anthriscus nemorosa, Mentha pulegium,* sifting; Şahmelik, 21.VI.2009, (1♀), 24.V.2009, (1♀), stream bed, sifting; Küçük Stream 2, 01.VIII.2010, stream bed, sifting, (1♂); Hacımevlüt Çeşmesi Road, 27.VI.2010, stream bed, sifting, (1♂ 1♀); Yedikardeşler, 05.VII.2008, *Abies equi-trojani*, *Pinus nigra*, pitfall trap, (2♂♂ 1♀); Kırlangıç Stream, 17.VII.2010, stream bed, sifting, (1♂); Karayaprak Stream, 16.X.2010, stream bed, sifting, (1♂); Hanlar Üstü, 07.XI.2010, meadow, cow dung, aspirator, (1♀). Totally 99 specimens. **Distribution in the world: E:** AR AU BE BH BU CR CT CZ DE EN FR GB GE GG GR HU IR IT NL PL PT RO SK SL SP ST SV SZ UK YU **N:** AG LB MO TU **A:** AF CY IN IQ IS KZ LE TD TM TR UZ WS (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana (Bürücek, Suluhan-Toros), Ankara (Çamlıdere-Işık Mountain), Gaziantep, İzmir, Konya (Karapınar) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Philonthus* (*Philonthus*) *rufimanus Heer, 1839

Material examined: Altıparmak, 02.VIII.2009, *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, under stone, (2♂♂). Totally 2 specimens. **Distribution in the world: E:** AB AL AU BH BU CZ CR FR GE GG GR HU IT MC RO SK SL SP ST SZ UK YU **A:** AF CY IS LE SY TR UZ (Löbl & Smetana, 2004). **Distribution in Turkey:** Aydın, Bayburt, İzmir, Kilis, Manisa, Mersin [Tarsus (=Tarsous), Caramania] (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Subtribe Quediina Kraatz, 1857
Genus *Quedius* Stephens, 1829
Subgenus *Microsaurus* Dejean, 1833

Quedius* (*Microsaurus*) *brevis Erichson, 1840

Material examined: Eybek Observation Tower 1, 16.X.2010, *Hydnum repandum,* aspirator, (1♂). Totally 1 specimen. **Distribution in the world: E:** AU BE CR CZ DE FI FR GB GE HU IR IT LA LT NL NR NT PL RO SK SL ST SP SV SZ UK **N:** MO (Löbl & Smetana, 2004) **A:** TR (Anlaş, 2009) **Distribution in Turkey:** Kastamonu (Ilgaz Mountains) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Quedius* (*Microsaurus*) *cruentus (Olivier, 1795)

Material examined: Sarıkız Road, 06.IV.2008, (1♂), 26.IV.2008, (2♀♀), *Pinus nigra*, bait trap, 31.V.2008, (1♀), 19.VII.2008, (1♀), *Abies equi-trojani*, bait trap. Totally 5 specimens. **Distribution in the world: E:** AL AU BE BH BU CR CT CZ DE FI FR GB GE GR HU IR IT LA LT LU NL NR NT PL PT RO SK SP ST SZ SV UK YU **N:** AG MO TU **A:** TR **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** Manisa (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Quedius* (*Microsaurus*) *fissus Gridelli, 1938

Material examined: Eybek Observation Tower 1, 16.X.2010, *Hydnum repandum*, aspirator, (1♂); Musa Hill, 07.XI.2010, *Suillus* sp., aspirator, (1♂ 3♀♀). Totally 5 specimens. **Distribution in the world: E:** GR (Lésvos; Ródhos) **A:** TR (Löbl & Smetana, 2004). **Distribution in Turkey:** İzmir (Monti Salbak, Karish Taurus) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Quedius* (*Microsaurus*) *lateralis (Gravenhorst, 1802)

Material examined: Beypınarı 1, 23.X.2010, *Pinus nigra*, *Vicia villosa*, under stone, (1♀); Şahmelik Area, 21.VI.2009, stream bed, under stone, (1♂). Totally 2 specimens. **Distribution in the world: E:** AL AU BE BH BU CR CZ DE FR GB GE GR HU IT MC NL PL PT RO SK SL SP SV SZ UK YU **A:** TR (Löbl & Smetana, 2004). **Distribution in Turkey:** İzmir [Yamanlar Mountain (=Jamanlar Dagh)] (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Subgenus *Quedius* Stephens, 1829

Quedius* (*Quedius*) *levicollis (Brullé, 1832)

Material examined: Nanekırı Hill, 04.VII.2009, (3♂♂ 1♀), 02.VIII.2009, (3♂♂ 1♀), 06.IX.2009, (1♂), rocky field, *Sideritis trojana*, pitfall trap; Sarıkız Road, 10.V.2009, *Pinus nigra*, pitfall trap, (1♂ 1♀); Beypınarı 1, 04.VII.2009, (1♀), 18.X.2009, (4♂♂), *Pinus nigra*, *Vicia villosa*, pitfall trap; Beypınarı 2, 21.VI.2009, (1♀), 04.VII.2009, (1♂), 06.IX.2009, (1♂), *Phaseolus vulgaris*, *Lycopersicon esculentum*, *Capsicum annuum*, pitfall trap, 23.X.2010, *Phaseolus vulgaris*, *Lycopersicon esculentum*, *Capsicum annuum*, under stone, (5♂♂ 7♀♀); Koçere Stream 1, 19.VII.2009, (2♂♂), 21.VI.2009, (2♂♂ 2♀♀), stream bed, pitfall trap, 21.VI.2009, stream bed, under stone, (2♂♂); Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (2♀♀); *Abies equi-trojani* Natural Reserve, 18.X.2009, *Abies equi-trojani*, *Digitaria sanguinalis*, pitfall trap, (1♂); Koçere Stream 2, 06.IX.2009, *Abies equi-trojani*, *Fagus orientalis*, sifting, (5♂♂ 1♀), 06.IX.2009, *Abies equi-trojani*, *Fagus orientalis*, under stone, (1♂), 06.IX.2009, *Abies equi-trojani*, *Fagus orientalis*, pitfall trap, (1♀), 19.VII.2009, stream bed, under stone, (2♀♀); Altıparmak, 06.VI.2009, *Pinus nigra*, *Anthriscus nemorosa, Mentha pulegium*, under stone, (1♂), 21.VI.2009, (2♂♂), 04.VII.2009, (5♂♂ 1♀), 02.VIII.2009, (1♂), 18.X.2009, (2♂♂), *Pinus nigra*, *Anthriscus nemorosa, Mentha pulegium*, pitfall trap; Kırlangıç Stream 1, 17.VI.2010, stream bed, *Quercus* sp., pitfall trap, (1♀); Şahmelik, 21.VI.2009, stream bed, under stone, (4♂♂ 2♀♀); Eğrisu Stream, 24.V.2009, stream bed, under stone, (1♂); Söbüyurt 1, 04.VII.2009, (1♂), 02.VIII.2009, (1♀), nonwoody plants, pitfall trap; Darıdere, 01.VIII.2010, *Quercus* sp., under bark, aspirator, (1♀); Darıdere Road 2, 18.X.2009, stream bed, under stone, (1♂); Köprü Stream, 11.VII.2010, stream bed, under stone, (1♀); Kırlangıç Stream 2, 11.VII.2010, stream bed, sifting, (5♂♂ 12♀♀); Kırlangıç Stream 1, 17.VII.2010, stream bed, sifting, (1♂ 2♀♀); Ayı Stream Road, 24.V.2009, *Matricaria* sp., aspirator, (1♀); Ayı Stream 3, 31.V.2008, *Pleurotus* sp., aspirator, (1♂); Gelin Rivulet, 16.X.2010, stream bed, under stone, (1♂); Eybek Observation Tower 2, 16.X.2010, *Hydnum repandum*, aspirator, (1♂); Tahta Köprü Stream, 07.XI.2010, stream bed, under stone, (1♀); Şefin Çeşmesi, 07.XI.2010, on the ground, (1♂). Totally 103 specimens. **Distribution in the world: E:** AL AU BE BH BU CR CZ DE FR GB GE GG GR HU IR IT LA LT LU MC NL NR PL PT RO SK SL SP ST SV SZ UK **N:** AG MR TU **A:** CY IN IS LE SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana (Börücek-Toros), Ankara, Manisa (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Quedius* (*Quedius*) *unicolor Kiesenwetter, 1847

Material examined: Koçere Stream 1, 21.VI.2009, stream bed, pitfall trap, **(**1♂). Totally 1 specimen. **Distribution in the world: E:** AU CZ FR GE IT PL SK SZ UK (Löbl & Smetana, 2004). **Distribution in Turkey:** This species was not known from Turkey. **Remarks:** The species is here reported from Turkey for the first time.

Subgenus *Raphirus* Stephens, 1829

Quedius* (*Raphirus*) *acuminatus Hochhuth, 1849

Material examined: Bozdere (Kirse Area 3), 27.VI.2010, stream bed, sifting, (1♀); Darıdere, 01.VIII.2010, wood chips, sifting, (1♂ 1♀); Darıdere Road 2, 17.VII.2010, stream bed, under stone, (1♂). Totally 4 specimens. **Distribution in the world: E:** AR AU BH CR FR GE HU ST **A:** IN LE TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Ağrı Mountain (=Mont Ararat), Giresun (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Quedius* (*Raphirus*) *gemellus Eppelsheim, 1889

Material examined: Söbüyurt 1, 02.VIII.2009, stream bed, sifting, (5♂♂); Köprü Stream, 11.VII.2010, stream bed, sifting, (1♀); Söbüyurt 2, 19.VII.2009, *Macrolepiota* sp., aspiratör, (1♀). Totally 7 specimens. **Distribution in the world: E:** GG ST (Kavkaz) **A:** TR (Löbl & Smetana, 2004). **Distribution in Turkey:** The exact locality of this species has not been cited by previous studies (Coiffait, 1978). **Remarks:** This new and exact locality is registered for the first time from Turkey with this study.

Quedius* (*Raphirus*) *henroti Coiffait, 1970

Material examined: Altıparmak, 06.IX.2009, *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, pitfall trap, (1♂); Karaçam Observation Tower, 07.XI.2010, *Pinus nigra*, *Verbascum* sp., under stone, (1♀). Totally 2 specimens. **Distribution in the world: E:** GR (Lésvos) (Löbl & Smetana, 2004). **Distribution in Turkey:** This species was not known from Turkey. **Remarks:** The species is here reported from Turkey for the first time.

Quedius* (*Raphirus*) *nemoralis nemoralis Baudi di Selve, 1848

Material examined: Altıparmak, 18.X.2009, *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, pitfall trap, (1♂); Eybek Observation Tower 2, 16.X.2010, *Hydnum repandum*, aspirator, (1♂). Totally 2 specimens. **Distribution in the world: E:** AU BE BH BU BY CR CZ DE EN FI FR GB GG GR HU IT LT MC NL NT PL PT RO SK SP ST SV SZ UK YU **A:** CY IN TR (Löbl & Smetana, 2004). **Distribution in Turkey:** The exact locality of this species has not been cited by previous studies (Anlaş, 2009). **Remarks:** This new and exact locality is registered for the first time from Turkey with this study.

Quedius* (*Raphirus*) *semiobscurus (Marsham, 1802)

Material examined: Sarıkız Hill, 10.V.2009, rocky field, under stone, (1♂); Beypınarı 1, 14.VI.2008, *Pinus nigra*, *Vicia villosa*, pitfall trap, (1♀); Koçere Stream 2, 21VI.2009, *Abies equi-trojani*, *Fagus orientalis*, pitfall trap, (1♂), 21VI.2009, *Abies equi-trojani*, *Fagus orientalis*, under stone (1♀). Totally 4 specimens. **Distribution in the world: E:** AB AU BE BH CR DE FR GB GE GG GR HU IR IT LU NL PL PT SL SP ST SV SZ **N:** AG CI (La Palma) MO TU **A:** CY IN SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Bursa (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Velleius* Leach, 1819

Velleius dilatatus Fabricius, 1787

Material examined: Ayı Stream, 14.VI.2008, (1♀), 05.VII.2008, (2♀♀), *Quercus* sp., bait trap; Ayı Stream 2, 05.VII.2008, *Pinus brutia*, bait trap (1♀). Totally 4 specimens. **Distribution in the world: E:** AU BE CR CT CZ DE EN FI FR GB GE HU IT LA LU NL NT PL PT RO SK ST SV SZ UK **A:** JA LIA SC TR WS (Löbl & Smetana, 2004). **Distribution in Turkey:** Samsun, Tunceli (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Subtribe Staphylinina Latreille, 1802

Genus *Creophilus* Leach, 1819

Creophilus maxillosus (Linnaeus, 1758)

Material examined: Dalak Suyu Area, 12.V.2010, *Fagus orientalis*, animal carcass, (1♂ 2♀♀). Totally 3 specimens. **Distribution in the world: E:** AL AR AU AZ BE BH BU BY CR CT CZ DE EN FA FI FR GB GE GG GR HU IC IR IT LA LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **N:** AG CI EG LB MO MR TU **A:** AF BEI BT CY ES FE HEI HKG HP IN JA JIL KA KI KZ LE LIA NC MG NP PA SC SCH SD SHA SY TD TM TR UP WS YUN **NAR ORR (**Löbl & Smetana, 2004). **Distribution in Turkey:** Adana (Börücek-Toros), Gaziantep, Hatay, İzmir, Kayseri [Erciyes Mountain (=Erdschias-Gebiet)], Manisa, Mersin [Tarsus (=Tarsous), Caramania] (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Ocypus* Leach, 1819

Subgenus *Matidus* Motschulsky, 1860

Ocypus* (*Matidus*) *nitens (Schrank, 1781)

Material examined: *Abies equi-trojani* Natural Reserve, 18.X.2009, *Abies equi-trojani*, *Digitaria sanguinalis*, pitfall trap, (1♀); Ayı Stream 2, 19.VII.2008, *Pinus brutia*, *Moenchia mantica* subsp. *mantica*, pitfall trap, (1♂). Totally 2 specimens. **Distribution in the world: E:** AL AR AU BE BH BU CR CT DE EN FI FR GB GE GG GR HU IR IT LA LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **A:** IN TR **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** The exact locality of this species has not been cited by previous studies (Anlaş, 2009). **Remarks:** This new and exact locality is registered for the first time from Turkey with this study.

Subgenus *Ocypus* Leach, 1819

Ocypus* (*Ocypus*) *curtipennis Motschulsky, 1849

Material examined: Beypınarı 1, 14.VI.2008, (1♂), 02.VIII.2008, (3♂♂), 31.VIII.2008, (3♂♂ 2♀♀), 13.IX.2008, (2♂♂ 2♀♀), 19.IX.2008, (1♂ 2♀♀), 09.XI.2008, (2♂♂ 1♀), 19.VII.2009, (3♂♂ 1♀), 18.X.2009, (5♂♂ 7♀♀), 27.VI.2010, (1♂), *Pinus nigra*, *Vicia villosa*, pitfall trap; Beypınarı 2, 13.IX.2008, (3♂♂ 6♀♀), 06.IX.2009 (2♂♂ 3♀♀), *Phaseolus vulgaris*, *Lycopersicon esculentum*, *Capsicum annuum*, pitfall trap; Altıparmak, 04.VII.2009, (1♂), 02.VIII.2009, (3♂♂), 06.IX.2009, (7♂♂ 5♀♀), 18.X.2009, (8♂♂ 5♀♀), *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, pitfall trap, 02.VIII.2009, *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, under stone, (1♀); Padişah Pınarı, 11.VII.2010, *Mentha pulegium*, stream bed, under stone, (3♂♂); Gelin Çayı, 16.X.2010, *Pinus nigra*, stream bed, under stone, (2♀♀); Hanlar Üstü, 16.X.2010, meadow, cow dung, aspirator, (1♂); Yaşyer 1, 16.X.2010, stream bed, under stone, (1♂); Yaşyer 2, 16.X.2010, stream bed, under stone, (3♂♂); Yaşyer 3, 16.X.2010, *Pinus nigra*, *Agaricus* sp., aspirator, (1♀); Yaşyer Stream 4, 07.XI.2010, stream bed, *Agaricus* sp., aspirator, (1♀); Musa Hill, 07.XI.2010, *Lycoperdon perlatum*, aspirator, (1♂); Havran, Kalabak Village, 01.VII.2010, on the ground, aspirator, (1♂). Totally 94 specimens. **Distribution in the world: E:** AB BU GG GR MC ST TR UK **A:** CY IN IQ LE SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Bursa, İstanbul, İzmir (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Subgenus *Pseudocypus* Mulsant & Rey, 1876

Ocypus **(*Pseudocypus*)** ***mus*** (Brullé, 1832)

Material examined: Dereçatı 1, 17.VII.2010, *Platanus orientalis*, *Quercus* sp., stream bed, under stone, (1♂); Dereçatı 2, 17.VII.2010, *Platanus orientalis*, *Quercus* sp., stream bed, under stone, (1♀); Gelin Rivulet, 16.X.2010, stream bed, under stone, (1♂); Eybek Observation Tower 2, 16.X.2010, *Hydnum repandum*, aspirator, (1♂). Totally 4 specimens. **Distribution in the world: E:** AB AU BH BU CR CZ GR HU IT MC RO SK TR UK YU **A:** CY IN IQ IS LE SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Ankara, İzmir, Manisa, Mersin [Bolkar Mountains (=Bulghar Dagh)], Muğla, Şanlıurfa, Trabzon (=Trapezunt) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Ocypus **(*Pseudocypus*)** ***orientis*** Smetana & Davies, 2000

Material examined: Beypınarı 1, 09.XI.2008, (1♂), 21.VI.2009, (1♂), *Pinus nigra*, *Vicia villosa*, pitfall trap; Koçere Stream 1, 19.VII.2009, stream bed, pitfall trap, (1♂); *Abies equi-trojani* Natural Reserve, 18.X.2009, *Abies equi-trojani*, *Digitaria sanguinalis*, pitfall trap, (3♂♂); Koçere Stream 2, 06.IX.2009, (2♂♂), 27.VI.2010, (1♂), *Abies equi-trojani*, *Fagus orientalis*, under stone; Altıparmak, 21.VI.2009, *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, pitfall trap, (1♂); Yedikardeşler, 05.VII.2008, *Abies equi-trojani*, *Pinus nigra*, pitfall trap, (1♂). Totally 11 specimens. **Distribution in the world: E:** GR **A:** CY IS LE SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Manisa (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Ocypus **(*Pseudocypus*)** ***sericeicollis*** (Ménétriés, 1832)

Material examined: Nanekırı Hill, 06.VI.2009, rocky field, *Sideritis trojana*, aspirator, (1♀), 04.VII.2009, (11♂♂ 13♀♀), 06.IX.2009, (1♂), rocky field, *Sideritis trojana*, pitfall trap; Sarıkız Road, 14.VI.2008, (2♂♂), 05.VII.2008, (1♀), 06.VI.2009, (3♂♂), *Pinus nigra*, pitfall trap, 06.VI.2009, (1♀), 04.VII.2009, (3♂♂ 3♀♀), *Pinus nigra*, under stone; Çeyiz Stream, 31.V.2008, (1♂), 14.VI.2008, (1♂ 1♀), *Abies equi-trojani*, pitfall trap, 31.V.2008, *Abies equi-trojani*, sweeping net, (1♀), 05.VII.2008, *Abies equi-trojani*, bait trap, (1♂); Beypınarı 1, 14.VI.2008, (1♂ 3♀♀), 05.VII.2008, (1♂), 31.VIII.2008, (1♀), 06.VI.2009, (2♂♂ 3♀♀), 21.VI.2009, (9♂♂ 3♀♀), 04.VII.2009, (1♂), 06.IX.2009, (1♀), 18.X.2009, (1♂ 1♀), 23.X.2010, (3♂♂ 3♀♀), *Pinus nigra*, *Vicia villosa*, aspirator; Beypınarı 2, 06.VI.2009, (4♂♂ 1♀), 21.VI.2009, (8♂♂ 3♀♀), *Phaseolus vulgaris*, *Lycopersicon esculentum*, *Capsicum annuum*, pitfall trap; Koçere Stream 1, 21.VI.2009, (2♀♀), 19.VII.2009, (2♂♂ 2♀♀), 06.IX.2009, (4♂♂ 1♀), 18.X.2009, (1♂), 27.VI.2010, (1♀), stream bed, under stone, 27.VI.2010, stream bed, pitfall trap, (3♂♂ 1♀); Büyük Rahat Stream, 21.VI.2009, stream bed, under stone, (1♀); Altıparmak, 02.VI.2009, (3♂♂ 2♀♀), 06.VI.2009, (2♀♀), 21.VI.2009, (3♂♂), *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, under stone, 21.VI.2009, (1♂ 1♀), 04.VII.2009, (1♂), *Pinus nigra*, *Anthriscus nemorosa*, *Mentha pulegium*, pitfall trap; Kırlangıç Stream 1, 04.VII.2009, *Quercus* sp., stream bed, sifting, (1♂); Eşek Stream, 18.X.2009, stream bed, under stone, (1♂); Ayı Stream Bridge, 06.IX.2009, *Heracleum platytaenium*, *Urtica urens*, aspirator, (1♂ 1♀); Ayı Stream 2, 09.XI.2008, *Pinus brutia*, *Moenchia mantica* subsp. *mantica*, pitfall trap, (1♀); Yedikardeşler, 31.V.2008, (3♂♂), 31.VIII.2008, (2♀♀), *Abies equi-trojani*, *Pinus nigra*, aspirator, 05.VII.2008, *Abies equi-trojani*, pitfall trap, (5♂♂ 3♀♀); Köprü Stream, 11.VII.2010, stream bed, under stone, (1♀); Kırlangıç Stream 2, 11.VII.2010, stream bed, sifting, (1♂); Havran, Kalabak Village, 10.V.2010, on the ground, aspirator, (1♀). Totally 145 specimens. **Distribution in the world: E:** AB AL AR BE BU FR GB GG GR IT TR **A:** CY IN SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Ankara, İzmir, Manisa, Şanlıurfa (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Platydracus* Thomson, 1858
Subgenus *Platydracus* Thomson, 1858

Platydracus* (*Platydracus*) *stercorarius (Olivier, 1795)

Material examined: Beypınarı 1, 13.VIII.2008, (1♀), 06.IX.2009, (3♂♂), *Pinus nigra*, *Vicia villosa*, pitfall trap. Totally 4 specimens. **Distribution in the world: E:** AB AR AU BE BH BU CR CT CZ DE EN FI FR GB GE GG HU IT LA LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ UK YU **A:** ES IN KI TM TR WS (Löbl & Smetana, 2004). **Distribution in Turkey:** Rize (İkizdere), Trabzon (Of) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Tasgius* Stephens, 1829
Subgenus *Rayacheila* Motschulsky, 1845

Tasgius* (*Rayacheila*) *morsitans (Rossi, 1790)

Material examined: *Abies equi-trojani* Natural Reserve, 18.X.2009, *Abies equi-trojani*, *Digitaria sanguinalis*, pitfall trap, (1♂); Çam Çeşme, 06.IX.2009, *Pinus brutia*, *Fagus orientalis*, *Castanea sativa*, pitfall trap, (2♂♂). Totally 3 specimens. **Distribution in the world: E:** AU BE BH BU CR CZ DE FR GB GE GR HU IR IT NL NR PL RO SK SP SV SZ UK YU **A:** SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Sakarya [Sapanca Lake (=Sabandja)] (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Tribe Xantholinini Erichson, 1839
Genus *Gauropterus* Thomson, 1860

Gauropterus sanguinipennis (Kolenati, 1846)

Material examined: Koçere Stream 1, 19.VII.2009, stream bed, under stone, (1♂). Totally 1 specimen. **Distribution in the world: E:** AB AR GG GR ST **A:** IN TM TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana, Amasya, Ankara, Antalya, Batman, Bayburt, Bilecik, Bingöl, Bitlis, Bursa, Erzurum, Eskişehir, Gaziantep, Hakkari, Hatay, Isparta, İzmir, Kars, Kastamonu, Konya, Malatya, Manisa, Mersin (Bolkar Mountains, Namrun=Çamlıyayla), Muğla, Niğde, Sakarya (Gök Hill), Siirt, Şırnak, Tunceli, Van, Zonguldak (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Gyrohypnus* Leach, 1819
Subgenus *Gyrohypnus* Leach, 1819

Gyrohypnus* (*Gyrohypnus*) *angustatus Stephens, 1833

Material examined: Ayı Stream 3, 23.X.2010, *Pleurotus* sp., aspirator, (1♂). Totally 1 specimen. **Distribution in the world: E:** AR AU BE BH BU CR CT CZ DE EN FI FR GB GE GG GR HU IC IR IT LA LT MA NL NR PL PT RO SK SL SP ST SV SZ UK YU **N:** MO MR **A:** ES TD TR WS **NAR** (Löbl & Smetana, 2004). **Distribution in Turkey:** Amasya, Ankara, Artvin, Aydın, Bayburt, Bitlis, Bolu, Bursa, Erzurum, Giresun, Isparta, İstanbul, İzmir, Kastamonu, Konya, Kütahya, Manisa, Mersin, Ordu, Osmaniye, Rize, Sinop, Zonguldak (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Megalinus* Mulsant & Rey, 1877

Megalinus scutellaris (Fauvel, 1900)

Material examined: Havran, Kalabak Village, 05.XI.2009, on the ground, aspirator, (4♂♂ 3♀♀), Eybek Observation Tower 1, 16.X.2010, *Hydnum repandum*, aspirator, (1♂). Totally 8 specimens. **Distribution in the world: A:** TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Adana, Ankara, Antalya, Çanakkale, Denizli, İzmir, Manisa, Mersin (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

Genus *Xantholinus* Dejean, 1821
Subgenus *Calolinus* Coiffait, 1956

Xantholinus* (*Calolinus*) *rufipennis Erichson, 1839

Material examined: Havran, Kalabak Village, 05.XI.2009, (5♂♂), 10.V.2010, (1♂), on the ground, aspirator. Totally 6 specimens. **Distribution in the world: E:** AL BH CR GR IT RO **A:** CY IS LE SY TR (Löbl & Smetana, 2004). **Distribution in Turkey:** Antalya, Bilecik, Bursa, Çanakkale, Diyarbakır, Gaziantep, Hatay, İstanbul, İzmir, Kahramanmaraş, Kilis, Mardin, Manisa, Mersin, Muğla, Zonguldak (Ereğli, Amaçlar Cave) (Anlaş, 2009). **Remarks:** This species is the first record for Balıkesir fauna.

RESULTS

Among the specimens of subfamily Staphylininae, 36 species were identified as belonging to 24 genera and subgenera of 3 tribes. One of them is in tribe Othiini, 31 of them are in tribe Staphylinini, 4 of them are in Xantholinini tribe. Also among the members of tribe Staphylinini, 11 species are in Philonthina, 12 are in Quediina, and 8 are in Staphylinina subtribe. Comperative quantitative distribution of identified species according to tribe and subtribe of Staphylininae subfamily present in Turkey is shown in Table 2. as a result of this study.

Among those, *Q. unicolor* and *Q. henroti* are new records for Turkish fauna. The exact localities of *Q. gemellus*, *Q. nemoralis nemoralis* and *Ocypus nitens* are given for the first time from Turkey with this study. All of the identified species are also reported for the first time concerning Balıkesir and Kazdağları regional fauna.

The most common and abundant species of the research area are determined as *Ph. concinnus* (267 individuals), *O. sericeicollis* (145 individuals), *Q. levicollis* (103 individuals), *Ph. nitidicollis* (99 individuals), *O. curtipennis* (94 individuals), *Ph. debilis* (80 individuals) and *Ph. cognatus* (78 individuals). Only one specimen was collected from the species *Q. brevis, Q. unicolor* and *G. sanguinipennis*.

During the study respectively 42.03 % (446 individual) of the samples were collected by hand under the stones; 41.94 % (445 individual) by pitfall trap; 7.63 % (81 individual) by sifting; 1.60 % (17 individual) by sweeping net and 1.03 % (11 individuals) by bait traps. Additionally 5.77 % (61 individuals) of the specimens were collected from under barks, vegetation surfaces, carcasses, cow dung and decomposing mushrooms. Hibernation traps were found to be unsuccessful in collecting samples.

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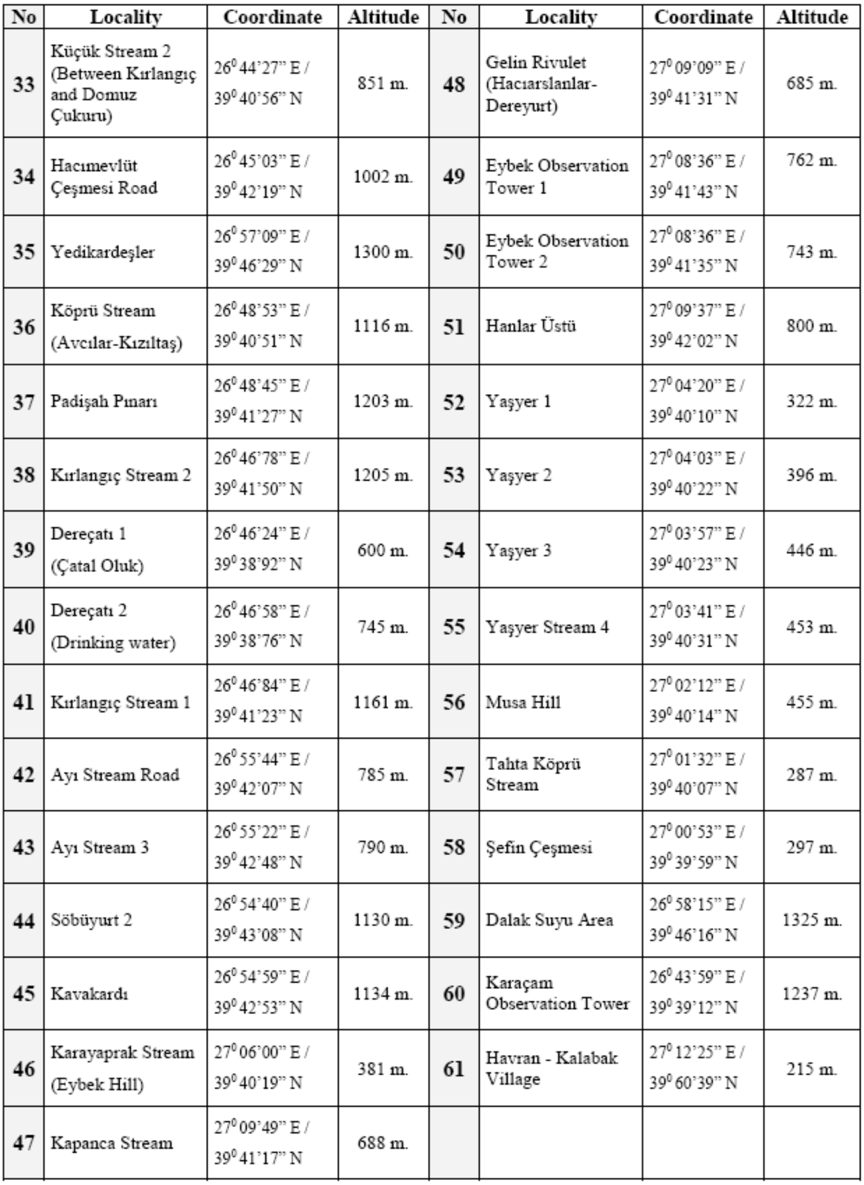
Table 1. Detailed information of sampling localities.

No	Locality	Coordinate	Altitude	No	Locality	Coordinate	Altitude
1	Sarıkız Hill	26^{0} 52’28” E / 39^{0} 41’30” N	1720 m.	**17**	Eşek Stream	26^{0} 57’09” E / 39^{0} 40’39” N	520 m.
2	Nanekırı Hill	26^{0} 52’52” E / 39^{0} 42’03” N	1649 m.	**18**	Ayı Stream Bridge	26^{0} 56’15” E / 39^{0} 41’17” N	580 m.
3	Sarıkız Road (Çeyiz Stream)	26^{0} 53’07” E / 39^{0} 42’12” N	1576 m.	**19**	Ayı Stream 2	26^{0} 56’29” E / 39^{0} 41’32” N	588 m.
4	Levent Boğazı	26^{0} 52’09” E / 39^{0} 43’28” N	1367 m.	**20**	Eğrisu Stream	26^{0} 58’20” E / 39^{0} 40’25” N	231 m.
5	Beypınarı 1	26^{0} 54’37” E / 39^{0} 44’29” N	1300 m.	**21**	Gıldırdak Stream (Kirse Area 1)	26^{0} 59’03” E / 39^{0} 41’26” N	525 m.
6	Beypınarı 2	26^{0} 54’36” E / 39^{0} 44’27” N	1294 m.	**22**	Bozdere (Kirse Area 2)	26^{0} 59’28” E / 39^{0} 41’55” N	479 m.
7	Koçere Stream 1	26^{0} 56’42” E / 39^{0} 45’55” N	1252 m.	**23**	Bozdere (Kirse Area 3)	26^{0} 59’37” E / 39^{0} 42’02” N	497 m.
8	Büyük Rahat Stream (Kocarahat Stream)	26^{0} 55’29” E / 39^{0} 44’06” N	1243 m.	**24**	Çamçeşme Stream	26^{0} 59’ 42” E / 39^{0} 42’11” N	500 m.
9	*Abies equi-trojani* Natural Reserve	26^{0} 57’12” E / 39^{0} 45’47” N	1376 m.	**25**	Söbüyurt 1	26^{0} 54’12” E / 39^{0} 42’48” N	1220 m.
10	Koçere Stream 2	26^{0} 56’36” E / 39^{0} 45’16” N	1218 m.	**26**	Şahmelik Area	26^{0} 59’06” E / 39^{0} 43’35” N	1140 m.
11	Altıparmak (Pazareğrek)	26^{0} 53’59” E / 39^{0} 44’06” N	1146 m.	**27**	Darıdere	26^{0} 41’35” E / 39^{0} 38’30” N	633 m.
12	Kırlangıç Stream 1	26^{0} 45’42” E / 39^{0} 39’50” N	1120 m.	**28**	Darıdere Road 2. Stream	26^{0} 41’17” E / 39^{0} 38’17” N	621 m.
13	Çamçeşme	26^{0} 57’37” E / 39^{0} 43’56” N	996 m.	**29**	Domuz Çukuru Road 1	26^{0} 42’21” E / 39^{0} 40’07” N	652 m.
14	Çamçeşme Stream	26^{0} 57’29” E / 39^{0} 43’51” N	949 m.	**30**	Domuz Çukuru Road 2 (Karababa Stream)	26^{0} 43’35” E / 39^{0} 41’02” N	822 m.
15	Şahmelik	26^{0} 58’10” E / 39^{0} 43’42” N	941 m.	**31**	Domuz Çukuru Road 3	26^{0} 44’01” E / 39^{0} 41’35” N	883 m.
16	Ayı Stream 1	26^{0} 56’29” E / 39^{0} 41’28” N	582 m.	**32**	Küçük Stream 1 (Between Kırlangıç and Domuz Çukuru)	26^{0} 44’19” E / 39^{0} 40’17” N	851 m.

Table 1. Continued.



No	Locality	Coordinate	Altitude	No	Locality	Coordinate	Altitude
33	Küçük Stream 2 (Between Kırlangıç and Domuz Çukuru)	26^{0} 44’27” E / 39^{0} 40’56” N	851 m.	**48**	Gelin Rivulet (Hacıarslanlar-Dereyurt)	27^{0} 09’09” E / 39^{0} 41’31” N	685 m.
34	Hacımevlüt Çeşmesi Road	26^{0} 45’03” E / 39^{0} 42’19” N	1002 m.	**49**	Eybek Observation Tower 1	27^{0} 08’36” E / 39^{0} 41’43” N	762 m.
35	Yedikardeşler	26^{0} 57’09” E / 39^{0} 46’29” N	1300 m.	**50**	Eybek Observation Tower 2	27^{0} 08’36” E / 39^{0} 41’35” N	743 m.
36	Köprü Stream (Avcılar-Kızıltaş)	26^{0} 48’53” E / 39^{0} 40’51” N	1116 m.	**51**	Hanlar Üstü	27^{0} 09’37” E / 39^{0} 42’02” N	800 m.
37	Padişah Pınarı	26^{0} 48’45” E / 39^{0} 41’27” N	1203 m.	**52**	Yaşyer 1	27^{0} 04’20” E / 39^{0} 40’10” N	322 m.
38	Kırlangıç Stream 2	26^{0} 46’78” E / 39^{0} 41’50” N	1205 m.	**53**	Yaşyer 2	27^{0} 04’03” E / 39^{0} 40’22” N	396 m.
39	Dereçatı 1 (Çatal Oluk)	26^{0} 46’24” E / 39^{0} 38’92” N	600 m.	**54**	Yaşyer 3	27^{0} 03’57” E / 39^{0} 40’23” N	446 m.
40	Dereçatı 2 (Drinking water)	26^{0} 46’58” E / 39^{0} 38’76” N	745 m.	**55**	Yaşyer Stream 4	27^{0} 03’41” E / 39^{0} 40’31” N	453 m.
41	Kırlangıç Stream 1	26^{0} 46’84” E / 39^{0} 41’23” N	1161 m.	**56**	Musa Hill	27^{0} 02’12” E / 39^{0} 40’14” N	455 m.
42	Ayı Stream Road	26^{0} 55’44” E / 39^{0} 42’07” N	785 m.	**57**	Tahta Köprü Stream	27^{0} 01’32” E / 39^{0} 40’07” N	287 m.
43	Ayı Stream 3	26^{0} 55’22” E / 39^{0} 42’48” N	790 m.	**58**	Şefin Çeşmesi	27^{0} 00’53” E / 39^{0} 39’59” N	297 m.
44	Söbüyurt 2	26^{0} 54’40” E / 39^{0} 43’08” N	1130 m.	**59**	Dalak Suyu Area	26^{0} 58’15” E / 39^{0} 46’16” N	1325 m.
45	Kavakardı	26^{0} 54’59” E / 39^{0} 42’53” N	1134 m.	**60**	Karaçam Observation Tower	26^{0} 43’59” E / 39^{0} 39’12” N	1237 m.
46	Karayaprak Stream (Eybek Hill)	27^{0} 06’00” E / 39^{0} 40’19” N	381 m.	**61**	Havran - Kalabak Village	27^{0} 12’25” E / 39^{0} 60’39” N	215 m.
47	Kapanca Stream	27^{0} 09’49” E / 39^{0} 41’17” N	688 m.				

Table 2. Comperative quantitative distribution of identified species according to tribe and subtribe of Staphylininae present in Turkey with the completion of this study (Anlaş, 2009).

Tribe / Subtribe	Number of species in Turkey	Number of species collected in this study
Diochini Casey, 1906	2	-
Othiini Thomson, 1859	10	1
Platyprosopini Lynch Arrıbálzaga, 1884	1	-
Staphylinini Latreille, 1802	(272)	(31)
Philonthina Kirby, 1837	115	11
Quediina Kraatz, 1857	90	12
Staphylinina Latreille, 1802	67	8
Xantholinini Erichson, 1839	61	4
Total	**346**	**36**

Table 3. The status of collecting material for the years 2008-2010.

Tribe / Subtribe	Species	2008	2009	2010
Xantholinini	*Xantholinus rufipennis*	-	+	+
	Gyrohypnus angustatus	-	-	+
	Megalinus scutellaris	-	+	+
	Gauropterus sanguinipennis	-	+	-
Othiini	*Othius laeviusculus*	-	-	+
Staphylinini / Philonthina	*Gabrius anatolicus*	-	+	+
	Gabrius astutus	+	+	+
	Philonthus cognatus	+	+	-
	Philonthus concinnus	+	+	+
	Philonthus coprophilus	-	-	+
	Philonthus corruscus	+	+	+
	Philonthus cruentatus	-	+	+
	Philonthus debilis	+	+	-
	Philonthus intermedius	+	+	+
	Philonthus nitidicollis	+	+	+
	Philonthus rufimanus	-	+	-
Staphylinini / Quediina	*Quedius levicollis*	+	+	+
	Quedius unicolor	-	+	-
	Quedius brevis	-	-	+
	Quedius cruentus	+	-	-
	Quedius fissus	-	-	+
	Quedius lateralis	-	+	+
	Quedius acuminatus	-	-	+
	Quedius gemellus	-	+	+
	Quedius henroti	-	+	+
	Quedius nemoralis nemoralis	-	+	+
	Quedius semiobscurus	+	+	-
	Velleius dilatatus	+	-	-
Staphylinini / Staphylinina	*Creophilus maxillosus*	-	-	+
	Platydracus stercorarius	+	+	-
	Tasgius morsitans	-	+	-
	Ocypus nitens	+	+	-
	Ocypus mus	-	-	+
	Ocypus orientis	+	+	+
	Ocypus sericeicollis	+	+	+
	Ocypus curtipennis	+	+	+
	Total number of species	**16**	**26**	**25**

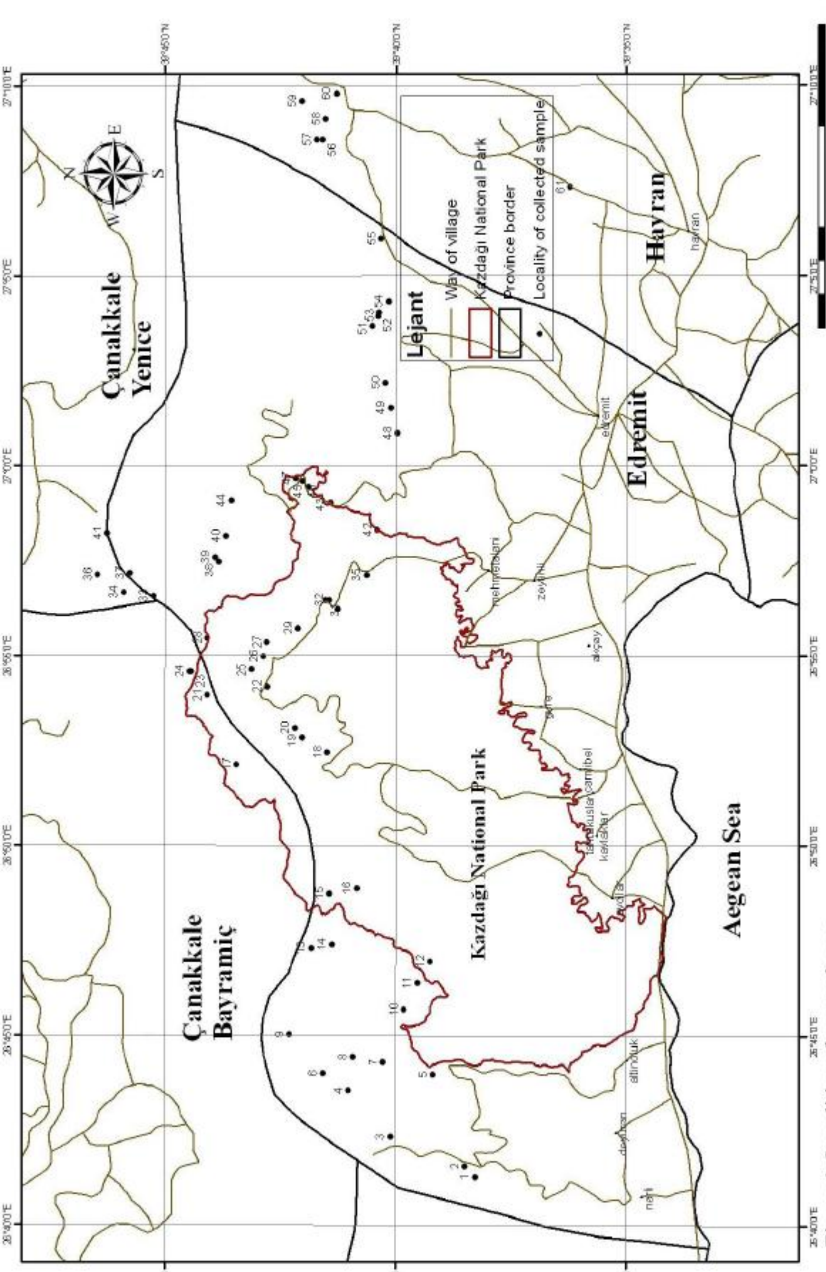


Figure 1. Localities of research area.

A STUDY ON ASSESSMENT OF DURATION OF DEARTH PERIOD FOR HONEY BEES IN HARYANA, INDIA

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ABSTRACT: Good beekeeping management requires complete knowledge of available bee flora (floral calendar) round the year in a particular area (apiary). In the present study, honey bee colonies were checked for their performance during summer dearth periods. It was observed that the values for all the selected colony parameters: Egg laying, unsealed and sealed brood, honey and pollen stores, were maximum during April when sufficient food stores were available in bee hive. These values started decreasing drastically in the subsequent months i.e. May and June when there was scarcity of nectar and pollen. No any sealed brood, pollen stores and honey stores were observed in June month when dearth period was on its peak. An increase was observed in various colony parameters form July onwards, and it was noticed that by the mid of September, bee colonies started recovering from the losses occurred during pollen dearth periods.

KEY WORDS: *Apis mellifera*, dearth period, brood, pollen.

Due to shortage of bee flora, particularly during summer & monsoon seasons (April to September), the task of beekeeping becomes difficult and troublesome. The reserve stores of honey and pollen are rapidly consumed by bees during this period and overall activities of honey bees including foraging, egg laying, brood rearing are reduced. Further, bee coverage area & bee population are also reduced. The colonies become prone to face drastic effects of sun stroke, heat waves, shortage of water and attacks of enemies like black ants, wasps and wild bees etc. Heavy bee mortality may occur in some of the colonies resulting in absconding, quick dwindling and even perishing of bee colonies. In order to save the colonies, colony migration to a safer place having optimum bee flora, is performed that requires lot of time, labour and money, even then success is not guaranteed. Provision of supplementary feeding can also be made. This also requires a lot of knowledge and understanding on the part of beekeeper that what and how much to be fed. In addition to migration (based on bee floral calendar of the respective area), information data based on the study of colony parameters during dearth period may help in variety of ways in successful beekeeping management. This study may help in calculating the severity of dearth period and amount of pollen substitute to be provided to bee colonies during different time intervals of the dearth period. Mishra (1995) reported the dearth of bee flora from May to September and emphasized the necessity of feeding artificial diets to bee colonies during this period to strengthen their stores. The present study was conducted to assess the severity of dearth period during summer season so that arrangements can be done for proper management of bee colonies.

MATERIAL AND METHODS

The experiment was conducted in the Apiary maintained at Panchkula, Haryana (India) during summer 2008-09 following randomized block design. The colonies of *Apis mellifera* of almost similar strength were selected and checked for the presence of any disease or infection. Egg laying area, unsealed and sealed brood area, pollen and honey stores in the colonies was measured after every 21 days interval with the help of wire grid measuring frame consisting of squares of the size of one inch^2 (Seeley & Mikheyev, 2003; Amir & Peveling, 2004) (Figure 1). This value denotes the area in inch^2 which was then converted into cm^2 by multiplying with a factor of 6.45.

RESULTS AND DISCUSSION

Egg laying area was observed to be 823 cm^2 per colony in April month which decreased significantly to 166.7 cm^2 per colony in May followed by 43.0 cm^2 per colony in late May. No any egg laying was observed in the June month. Fresh egg laying was observed in July and after that it started increasing. Non-significant differences were observed in the egg laying area during July (26.0 cm^2 per colony) and first half of August (128.0 cm^2 per colony). Egg laying area was increased to the level of 198.7 cm^2 per colony in September (Figure II). The unsealed brood area was recorded to be maximum (552.3 cm^2 per colony) in April month followed by 155.0, 36.7 cm^2 per colony in First and last half of May. No any unsealed brood was observed in the colonies in June and July months. After that, an increase was noticed in the unsealed brood area as 176.7 and 190.3 cm^2 per colony in August and September months. Sealed brood area was observed maximum 1421.7 cm^2 per colony in April month which decreased to 0.0 as no any sealed brood was observed in July month. After that sealed brood area started increasing and reached to a level of 165.0 cm^2 per colony in September (Figure II).

Sufficient pollen stores were observed in the colonies during April month when enough natural bee flora was available. The pollen stores were observed to be 417.0 cm^2 per colony in April followed by 380.7, 112.0 cm^2 per colony in May month. No pollen stores were observed in June and July month. After that with the fresh showers of monsoon, flora reappeared and fresh pollen was observed in the colonies September month (123.0 cm^2 per colony) (Figure III). Observations recorded in case of honey storage area revealed that no honey stores were found in the colonies in June & July months. Fresh honey (46.0 cm^2 per colony) was observed in August which increased to 97.7 cm^2 per colony in September month (Figure III).

The inferences drawn from this study are comparable to the observations of Standifer et al. (1973b), Doull (1980a), and Mishra (1995) who reported the dearth of bee flora from May to September and emphasized the necessity of feeding artificial diets to bee colonies during this period to strengthen their stores. It was also observed that the colony parameters (egg laying, unsealed and sealed brood) started improving with the first showers of monsoon (July onwards). The observations were in accordance with that of Singh (1943b); Thakar & Shende (1962); Shah & Shah (1976) who reported an increase in the rate of egg laying by queen bee and brood rearing with the first income of pollen after dearth period.

At the end of study, it can be concluded that intensive care and heavy feeding of bee colonies is required only during May, June and July months as when the dearth period was on its peak.

The study on control colonies was of prime significance in calculating the severity of dearth period for honey bees so that proper management of bee colonies can be done to have maximum profit in next honey flow season. Also, the study was helpful in determining the amount of pollen substitute to be provided to bee colonies during different time intervals of the dearth period. Right decision at right time by the beekeeper can lead to successful beekeeping and prevent colony losses during lean periods.

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Figure I. Frame sized wire grid used to measure various colony parameters.

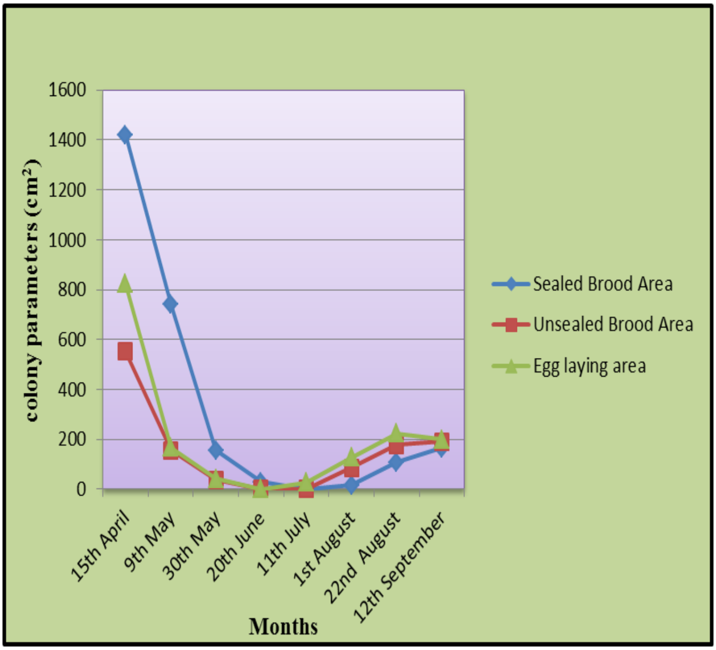

Figure II. Showing variation trend in various colony (egg laying, unsealed & sealed brood area) parameters during summer dearth period.

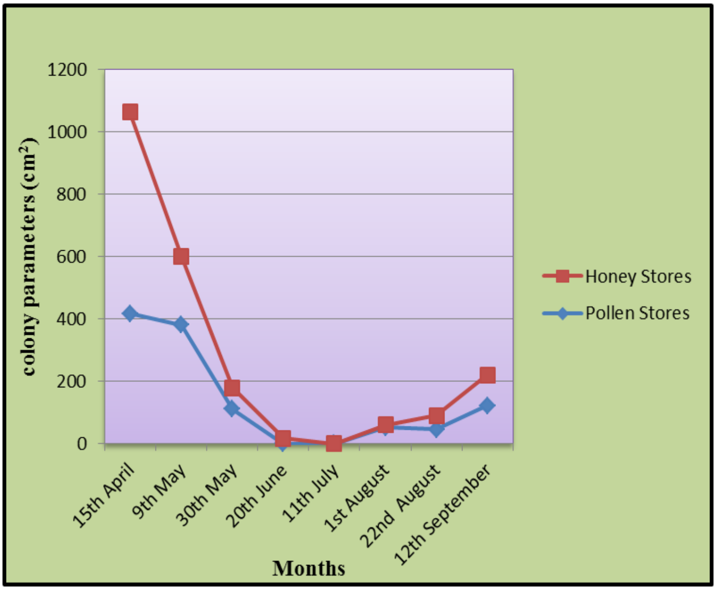

Figure III. Showing variation trend in various colony parameters (honey & pollen storage area) during summer dearth period.

REVIEW ON THE BIOLOGY OF TURKISH CERAMBYCOIDEA (COLEOPTERA) PART II – CERAMBYCIDAE (ASEMINAE-DORCASOMINAE)

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[**Özdikmen, H.** 2013. Review on the biology of Turkish Cerambycoidea (Coleoptera) Part II – Cerambycidae (Aseminae-Dorcasominae). Munis Entomology & Zoology, 8 (1): 438-443]

ABSTRACT: The present paper gives an integrative information on the biology of Turkish Cerambycidae (from the subfamily Aseminae to the subfamily Dorcasominae). The main aim of this work is to clarify current status of the members of the superfamily in Turkey in terms of biologycal data. This work is the second attempt for this purpose.

KEY WORDS: Cerambycidae, Aseminae, Saphaninae, Spondylidinae, Dorcasominae, Coleoptera, Turkey.

A serie work is planned that is aim to expose to the biology of Turkish Cerambycidae as possible as detailed by beginning from Vesperidae and Cerambycidae (Prioninae) (Özdikmen, 2013). The present study is the second part of the planned work.

SUBFAMILY ASEMINAE Thomson, 1861: 139

TRIBE ASEMINI Thomson, 1861

GENUS *ARHOPALUS* Audinet-Serville, 1834: 77

SPECIES *A. ferus* (Mulsant, 1839: 64)

The species is a forester.

The **host plants** of the species are conifers (*Pinus*, *Picea*). Besides, adults have been reported by Gül-Zümreoğlu (1975) and Lodos (1998) on deciduous trees (*Prunus cerasus, Cerasus avium, Cerasus vulgaris*) from Turkey. These records, however, seem to be wrong. Because host plants of the species are known as only conifers. The **specimens** that were collected **from Turkey** were found on or in *Pinus halepensis, Pinus sylvestris, Pinus brutia*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 300-1700 m). They occur also in mountainous areas according to Jenis (2001). **Life cycle** of the species is 2-4 years. **Overwintering stage** is larva. **Larvae live** in dead trees especially basal parts, in stems, stumps and also often penetrating into surface of roots (fallen or standing) of the host plants. Young larvae are under the bark, soon penetrate into the wood. **Pupation** is in the wood or in thick bark in spring and summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-early autumn (between June-September) (Gül-Zümreoğlu, 1975; Öymen, 1987; Lodos, 1998; Villiers, 1978; Svacha & Danilevsky, 1987; Cherepanov, 1990; Bense, 1995; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SPECIES *A. rusticus* (Linnaeus, 1758: 395)

The species is a forester.

The **host plants** of the species are conifers (*Pinus*, *Picea, Abies, Larix*). Besides, adults have been reported by Gül-Zümreoğlu (1975) on *Prunus cerasus* from Turkey. The record, however, seems to be wrong. Because host plants of the species are known as only conifers. The **specimens** that were collected **from Turkey** were found on or in *Pinus brutia, Pinus sylvestris, Pinus pinea, Pinus nigra, Picea orientalis*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 05-1700 m). They occur also in mountainous areas according to Jenis (2001). **Life cycle** of the species is 2-3 years. **Overwintering stage** is larva. **Larvae live** in dead trees especially basal parts, in stems, stumps and also often penetrating into surface of roots (fallen or standing) of the host plants. Young larvae are under the bark, soon penetrate into the wood. **Pupation** is in the wood in spring and summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-early autumn (between May-September) (Schimitschek, 1944; Gül-Zümreoğlu, 1975; Tosun, 1975; Öymen, 1987; Villiers, 1978; Svacha & Danilevsky, 1987; Cherepanov, 1990; Bense, 1995; Yüksel, 1996; Alkan, 2000; Tozlu, 2001; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SPECIES *A. syriacus* (Reitter, 1895: 86)

The species is a forester.

Biology of the species is similar to that of the other *Arhopalus* species. The **host plants** of the species are conifers (*Pinus*). The **specimens** that were collected **from Turkey** were found on or in *Pinus brutia, Pinus sylvestris, Pinus halepensis*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 100-1100 m). **Life cycle** of the species is 2-3 years. **Overwintering stage** is larva. **Larvae live** in dead trees especially basal parts, in stems, stumps and also often penetrating into surface of roots (fallen or standing) of the host plants. Young larvae under the bark, soon penetrate into the wood. **Pupation** is in the wood in spring and summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-August) (Demelt & Alkan, 1962; Demelt, 1963; Tosun, 1975; Sekendiz, 1981; Villiers, 1978; Svacha & Danilevsky, 1987; Bense, 1995; Jenis, 2001; Vives, 2000, 2001; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

GENUS ASEMUM Eschscholtz, 1830: 66

SPECIES *A. striatum* (Linnaeus, 1758: 396)

The species is a forester.

The **host plants** of the species are conifers [*Pinus* (preferred), *Picea, Abies, Larix*). The **specimens** that were collected **from Turkey** were found on or in *Pinus sylvestris*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 800-1415 m). **Life cycle** of the species is 2-3 years. **Overwintering stage** is larva. Habits generally similar to *Arhopalus* species, but **larvae live** in dead trees especially in parts near to the ground, in stems, stumps and also in roots of the host plants. Young larvae are under the bark, soon penetrate into the wood. **Pupation** is in the wood in spring and summer. **Adults** are diurnal, predominantly crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-August) (Villiers, 1978; Svacha & Danilevsky, 1987; Cherepanov, 1990; Bense, 1995; Tozlu, 2001; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SPECIES *A. tenuicorne* Kraatz, 1879: 97

The species is a forester.

Biology of the species probably is similar to that of *A. striatum*. The **host plants** of the species are conifers (*Pinus*). **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (~ up to 1400 m). **Life cycle** of the species is 2-3 years. **Overwintering stage** is larva. **Larvae** attack freshly dead trees. **Adults** are diurnal, predominantly crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-August) (Svacha & Danilevsky, 1987; Bense, 1995; Jenis, 2001; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

GENUS *TETROPIUM* Kirby, 1837: 174

SPECIES *T. castaneum* (Linnaeus, 1758: 396)

The species is a forester.

The **host plants** of the species are conifers [*Picea* (preferred), *Abies, Pinus, Larix*]. The **specimens** that were collected **from Turkey** were found on or in *Picea orientalis, Abies* *bornmuelleriana*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (~ up to 1250 m). **Life cycle** of the species is 1-2 years. **Overwintering stage** is larva. **Larvae live** often under bark of relatively freshly dead trees (standing or fallen), mostly in stems, occasionally in roots of the host plants. **Pupation** is in the wood or more rarely under the bark in spring and summer. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in spring-summer (between April-August) (Defne, 1954; Öymen, 1987; Villiers, 1978; Svacha & Danilevsky, 1987; Bense, 1995; Yüksel, 1996; Alkan, 2000; Vives, 2000, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SPECIES *T. fuscum* (Fabricius, 1787: 154)

The species is a forester.

The **host plants** of the species are conifers [*Picea* (preferred), *Pinus*]. The **specimens** that were collected **from Turkey** were found on or in *Picea orientalis*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills ((~ up to 1510 m). They occur also in mountainous areas according to Jenis (2001). **Life cycle** of the species is 1 year. **Overwintering stage** is larva. **Larvae live** under the bark of sick, dying or freshly dead trees (standing or fallen), mostly in trunks, only occasionally in roots of the host plants. **Pupation** is in the wood or rarely under the bark in spring. **Adults** are diurnal, crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-July) (Villiers, 1978; Svacha & Danilevsky, 1987; Bense, 1995; Yüksel, 1996; Alkan, 2000; Jenis, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

TRIBE NOTHORHININI Zagajkevich, 1991: 110
GENUS *NOTHORHINA* Redtenbacher, 1845: 109
SPECIES *N. muricata* (Dalman, 1817: 193)

The species has been reported as *N. punctata* by Lobanov et al., 1981 and Svacha & Danilevsky, 1986; Löbl & Smetana (2010) from Turkey without any exact locality. So, any information on biology of the species in Turkey is unknown.

The species is a forester.

The **host plants** of the species are conifers (*Pinus*). **Adults and larvae** of the species can obtain only from the host plants in lowlands, foothills and mountainous areas. **Life cycle** of the species is 1-2 years. **Overwintering stage** is larva. Habits are rather unusual. **Larvae live** in the bark of large, living, mostly sun-exposed trees of the host plants. **Pupation** is in outer bark in spring and summer. **Adults** are diurnal and crepuscular, sometimes attracted by light. **Adults fly** in summer (between June-August) (Villiers, 1978; Svacha & Danilevsky, 1987; Cherepanov, 1990; Bense, 1995; Jenis, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SUBFAMILY SAPHANINAE Gistel, 1848: [1]
TRIBE ANISARTHRINI Mamaev & Danilevsky, 1973: 1260
GENUS *ALOCERUS* Mulsant, 1862: 127
SPECIES *A. moesiacus* (Frivadszky, 1837: 177)

The species is a forester.

The **host plants** of the species are deciduous trees (*Populus, Ficus, Ulmus, Platanus, Acacia, Quercus*). **Adults and larvae** of the species can obtain only from the host plants in lowlands. **Life cycle** of the species is at least 2 years. **Overwintering stage** is larva. **Larvae live** in moist, rotten wood of dead trunks, barkless parts of living trunks and in dead branches of the host plants. **Pupation** is in the wood or rarely under the bark in spring. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in summer-early autumn (between June-September) (Svacha & Danilevsky, 1987; Bense, 1995; Jenis, 2001; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

TRIBE SAPHANINI Gistel, 1848: [1]
GENUS *DRYMOCHARES* Mulsant, 1847: 518
SPECIES *D. starcki* Ganglbauer, 1888: 398

The species is a forester.

The **host plants** of the species are deciduous trees (*Fagus, Betula, Buxus, Quercus, Carpinus, Salix, Prunus*). **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills ((~ up to 1500 m). **Life cycle** of the species is at least 3 years. **Larvae live** in dead standing trees or in stumps, always at the ground level or usually underground, in wet rotting wood of the host plants. **Pupation** is at the top of a longer vertical gallery in the wood in spring and summer, pupal cell usually just above the ground. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-July) (Svacha & Danilevsky, 1987; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

GENUS *SAPHANUS* Audinet-Serville, 1834: 81
SPECIES *S. piceus* (Laicharting, 1784: 56)

There is no published record from Turkey. However, Danilevsky (2012) stated that this species collected from Turkey is preserved in collection of Stanislav Kadlec (Czechia). Besides, the species has been reported by Löbl & Smetana (2010) only from European Turkey as *S. piceus ganglbaueri* without any exact locality. So, any information on biology of the species in Turkey is unknown.

The species is a forester.

The **host plants** of the species are deciduous trees (*Corylus, Alnus, Fagus, Quercus, Carpinus, Salix, Betula, Prunus, Crataegus*) and occasionally conifers (*Picea, Abies*). **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills. **Life cycle** of the species is at least 3 years. **Overwintering stage** is larva. **Larvae live** in dead standing trees or in stumps, always at the ground level or usually underground, in wet rotting wood of the host plants. **Pupation** is at the top of a longer vertical gallery in the wood in spring and summer, pupal cell is usually just above the ground. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-summer (between May-August) (Villiers, 1978; Svacha & Danilevsky, 1987; Bense, 1995; Jenis, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

GENUS *OXYPLEURUS* Mulsant, 1839: 57
SPECIES *O. nodieri* Mulsant, 1839: 57

The species is a forester.

The **host plants** of the species are conifers (*Pinus*). The **specimens** that were collected **from Turkey** were found on or in *Pinus halepensis*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills. **Life cycle** of the species is 2 or more years. **Overwintering stage** is larva and adult (in pupal cells). **Larvae live** in dry dead wood, barkless parts of living trees, also in freshly dead branches, trunks and stumps of the host plants. **Pupation** is in the wood, shallow pupal cells in sapwood in spring. **Adults** are crepuscular and nocturnal, attracted by light. **Adults fly** in spring-winter (between April-December) (Demelt, 1963; Villiers, 1978; Svacha & Danilevsky, 1987; Bense, 1995; Vives, 2000, 2001; Jenis, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SUBFAMILY SPONDYLIDINAE Audinet-Serville, 1832: 123
TRIBE SPONDYLIDINI Audinet-Serville, 1832: 123
GENUS *SPONDYLIS* Fabricius, 1775: 159
SPECIES *S. buprestoides* (Linnaeus, 1758: 388)

The species is a forester.

The **host plants** of the species are conifers [*Pinus* (preferred), *Picea, Abies, Larix*]. The **specimens** that were collected **from Turkey** were found on or in *Pinus sylvestris, Pinus nigra, Picea orientalis*. **Adults and larvae** of the species can obtain only from the host plants in lowlands and foothills (between 500-1500 m). **Life cycle** of the species is 2-3 years. **Overwintering stage** is larva. **Larvae live** in roots in dead trees or stumps of the host plants, almost always underground or at least at the ground level. Young larvae are under the bark. Older larvae are in the wood. **Pupation** is in the wood near ground level in late spring and early summer. **Adults** are diurnal, crepuscular and nocturnal, attracted by light. **Adults fly** in late spring-early autumn (between May-September) (Erdem, 1947; Çanakçıoğlu, 1956; Villiers, 1978; Öymen, 1987; Svacha & Danilevsky, 1987; Bense, 1995; Yüksel, 1996; Alkan, 2000; Vives, 2000, 2001; Tozlu, 2001; Jenis, 2001; Sama, 2002; Database of Özdikmen, 2012; Hoskovec & Rejzek, 2012).

SUBFAMILY DORCASOMINAE Lacordaire, 1868: 456

TRIBE DORCASOMINI Lacordaire, 1868: 456

GENUS *APATOPHYSIS* Chevrolat, 1860: 95

SUBGENUS *APATOPHYSIS* Chevrolat, 1860: 95

Biology of this group is not well known. According to Danilevsky (2008), most of species are connected with desert and semi-desert landscapes. Only 1 species, *A. pavlovskii,* is known as inhabitant of broadleaf forests. So, Turkish species are not forester. All known larvae feed in roots of shrubs and trees. Known host plants of the species are shrubs (*Haloxylon, Kalidium, Salsola, Calligonum, Armeniaca, Ephedra*) and deciduous trees (*Ulmus, Crataegus, Juglans*) for *A. pavlovskii.*

SPECIES *A. anatolica* Heyrovsky, 1938: 93

The **host plants** of the species are unknown. **Adults and larvae** of the species can obtain from dry foothills and sandy deserts (~ 1000-1100 m). **Larvae** probably **live** in roots of the host plants. **Pupation** probably is in the soil. **Adults** are nocturnal, attracted by light. **Adults fly** in summer (between July-August) (Danilevsky, 2008; Database of Özdikmen, 2012).

SPECIES *A. kadleci* Danilevsky, 2008: 29

The **host plants** of the species are unknown. **Adults and larvae** of the species can obtain from dry mountain landscapes. **Larvae** probably **live** in roots of the host plants. **Pupation** probably is in the soil. **Adults** probably are nocturnal, attracted by light. **Adults fly** in late spring (May) (Danilevsky, 2008; Database of Özdikmen, 2012).

SPECIES *A. karsica* Danilevsky, 2008: 28

The **host plants** of the species are unknown. **Adults and larvae** of the species can obtain from dry mountain landscapes (up to 2400 m). **Larvae** probably **live** in roots of the host plants. **Pupation** probably is in the soil. **Adults** probably are nocturnal, attracted by light. **Adults fly** in summer (between July-August) (Danilevsky, 2008; Database of Özdikmen, 2012).

SPECIES *A. vedica* Danilevsky, 2008: 26

The **host plant** of the species is *Salsola*. **Adults and larvae** of the species can obtain from fixed sandy landscapes, clay deserts and also dry bush mountain landscapes (up to 2400 m). **Larvae live** in roots of the host plant. **Pupation** probably is in the soil. **Adults** are nocturnal, attracted by light. **Adults fly** in summer-early autumn (between June-September) (Danilevsky, 2008; Database of Özdikmen, 2012).

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NOMENCLATURAL CHANGES AND CORRECTIONS FOR MILLIPEDE SPECIES DESCRIBED BY MANUEL A. GONZÁLEZ-SPONGA FROM VENEZUELA (MYRIAPODA: DIPLOPODA)

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ABSTRACT: Nomenclatural discrepancies involving Diplopoda species described by González-Sponga from Venezuela are discussed and corrected. An emendation and subsequent spelling for the species *Stemmiulus deantier* González-Sponga, 2001 (Stemmiulida: Stemmiulidae) is proponed. Nine new combinations for the genus *Mestosoma* Silvestri, 1897 (Polydesmida: Paradoxosomatidae) are herein proposed: *Mestosoma acariguensis* (González-Sponga, 2004) comb. nov., *Mestosoma brionensis* (González-Sponga, 2004) comb. nov., *Mestosoma casimiranus* (González-Sponga, 2004) comb. nov., *Mestosoma minaensis* (González-Sponga, 2004) comb. nov., *Mestosoma mirandensis* (González-Sponga, 2004) comb. nov., *Mestosoma monaguensis* (González-Sponga, 2004) comb. nov., *Mestosoma punctiaguda* (González-Sponga, 2004) comb. nov., *Mestosoma ramosa* (González-Sponga, 2004) comb. nov., *Mestosoma ramosa* (González-Sponga, 2004) comb. nov..

KEY WORDS: Nomenclatural changes, Diplopoda, Stemmiulidae, Paradoxosomatidae, *Stemmiulus*, *Mestosoma*, Venezuela.

During the compilation of a checklist and bibliography of the millipedes from Venezuela, we have found some important nomenclatural discrepancies that should be discussed and corrected before the publication of the checklist. The present article addresses a number of nomenclatural problems that have been discovered with some millipede species described by González-Sponga (2001, 2004) from Venezuela. The problems dealt with in this article are strictly of a nomenclatural nature and we do not intent to validate the taxonomy involved with the current problems.

Order STEMMIULIDA
Family STEMMIULIDAE

The species *Stemmiulus dentier* was described by González-Sponga (2001) from Venezuela. The specific epithet "*dentier*" was used by González-Sponga (2001) in the heading of the description of this new species, but in the text of the description (page 55), captions of illustrations (page 56) and distribution map (page 62), the specific epithet is consistently spelled as "*deantier*" with the letter '*a*' included and forming the '*ea*' hiatus. In the etymology section, González-Sponga (2001) clearly states that the specific epithet assigned to this new species comes from the joining of the two last words in the phrase "Venezuela de antier". Therefore, it is evident that the misspelled specific epithet "*dentier*" is a typographical error in the original description. This case is well established in

Article 32.5.1 (ICZN, 1999) which states that only clear evidence of an inadvertent error, contained in the original publication itself, allows to emend an original spelling. Therefore, we propose amend the specific epithet to "*deantier*", thus preserving the original author's etymological intention and avoid the continuation of this misspelt in future publications. This species has not been cited by other authors since its original description, so that Article 33.3.1 (ICZN, 1999) on prevailing usage does not apply in this case.

Finally, it is important to note that in the same article, González-Sponga (2001) referred the family Stemmiulidae into the order Chordeumida (sic!) as was originally established by Gervais & Goudot (1844). However, Cook (1895) proposed to separate the family Stemmiulidae from the order Chordeumida (currently Chordeumatida) in a new and different order, Stemmiulida. Since then this taxonomic arrangement has not changed and has been widely accepted by the specialists (Silvestri, 1916; Chamberlin, 1920; Loomis, 1964, 1968; Hoffman, 1999; Shelley, 2003; Shear, 2011).

Order POLYDESMIDA
Family PARADOXOSOMATIDAE

The genus *Mestosoma* was created by Silvestri (1897) in the family Strongylosomatidae with the type species *Strongylosoma salvadorii* Silvestri, 1895 from Bolivia. Silvestri (1897) included, along with the type species, another ten South American species. Three of them described by himself as new species (*M. laetum* Silvestri, 1897; *M. luctuosum* Silvestri, 1897 and *M. lugubre* Silvestri, 1897) and other seven transferred from the genus *Strongylosoma* Brandt, 1833 (*S. balzanii* Silvestri, 1895; *S. borelli* Silvestri, 1895; *S. camerani* Silvestri, 1895; *S. derelictum* Silvestri, 1895; *S. montanum* Silvestri, 1895; *S. pseudomorphum* Silvestri, 1895 and *S. semirugosum* Pocock, 1888). Currently, it is a valid genus name in Polydesmida and includes 76 nominal species from the Neotropical region (Jeekel, 1963; Hoffman, 1977, 1999; Golovatch et al., 2003).

Subsequently, Chamberlin (1952) proposed the genus *Nearctoma* in the family Strongylosomatidae for two new South American species, *N. cuzconum* Chamberlin, 1952 from Peru as type species and *N. araguanum* Chamberlin, 1952 from Venezuela.

Later, Jeekel (1963) established the synonymy of the family Strongylosomatidae (also cited as Strongylosomidae) with the family Paradoxosomatidae, and only with some exceptions, referred to the family Paradoxosomatidae all genera included in the family Strongylosomatidae. Jeekel (1963) also established the synonymy of the genus *Nearctoma* Chamberlin, 1952 with the genus *Mestosoma* Silvestri, 1897, since in the original sense both genera were based on the same characters.

Recently, González-Sponga (2004) inadvertently overlooked all taxonomic changes proposed by Jeekel (1963), and he described nine new species from Venezuela in the family Strongylosomidae (sic!), under the generic name *Neactoma*, a misspelt of the genus name *Nearctoma* Chamberlin, 1952. As was stated previously, the generic name *Nearctoma* Chamberlin, 1952 is no longer in use since it was synonymized by Jeekel (1963) with the genus *Mestosoma* Silvestri, 1897, therefore it is an invalid genus name. Consequently, all species described by González-Sponga (2004) in the genus *Nearctoma* Chamberlin 1952 (misspelled as *Neactoma*) should be transferred to the Genus *Mestosoma* Silvestri, 1897.

Summary of nomenclatural changes:

Mestosoma acariguensis (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *acariguensis* González-Sponga, 2004.

Mestosoma brionensis (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *brionensis* González-Sponga, 2004.

Mestosoma casimiranus (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *casimiranus* González-Sponga, 2004.

Mestosoma minaensis (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *minaensis* González-Sponga, 2004.

Mestosoma mirandensis (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *mirandensis* González-Sponga, 2004.

Mestosoma monaguensis (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *monaguensis* González-Sponga, 2004.

Mestosoma punctiaguda (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *punctiaguda* González-Sponga, 2004.

Mestosoma ramosa (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *ramosa* González-Sponga, 2004.

Mestosoma ramosa (González-Sponga, 2004) **comb. nov.**
= *Neactoma* (*sic!*) *zeaensis* González-Sponga, 2004.

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LABORATORY TOXICITY AND FIELD EFFICACY OF LUFENURON, DINOTEFURAN AND THIAMETHOXAM AGAINST *HYPERA POSTICA* (GYLLENHAL, 1813) (COLEOPTERA:CURCULIONIDAE)

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ABSTRACT: Toxicity of the insect growth regulator lufenuron and two neonicotinoids, dinotefuran and thiamethoxam, for the alfalfa weevil, *Hypera postica* (Gyllenhal, 1813), was determined through exposure of the second instar larvae and adults to dipped alfalfa leaves under laboratory conditions at 25±1 °C, 60±5% RH ,16:8 L:D. Based on mode of action, the mortality of the treated larvae and adults was recorded after 72 hours for lufenuron, and after 24 hours for dinotefuran and thiamethoxam. LC_{50} values for second instar larvae were 34.32, 24.91.32.9, 15.82 AI L-1 and for adults were 175.67, 289.76, 164.02 AI L-1 for dinotefuran, thiamethoxam and lufenuran, respectively. Results showed that lufenuron was the most toxic to both larvae and adults of *H. postica* among insecticides tested. Once the height of alfalfa field reached to about 20 cm, a single treatment was made on May 11th. All insecticides reduced the mean number of alfalfa weevil. According to results of laboratory and field experiments, lufenuron might be a more valuable chemical to adequately control *H. postica* with little adverse effects on environment. lufenuron may be considered as alternative chemicals to other compounds with a high potential for controlling certain pests and with less adverse effects on natural enemies.

KEY WORDS: Alfalfa weevil, Dinotefuran, LC_{50}, Lufenuron, Thiamethoxam.

Alfalfa, *Medicago sativa* L., is one of the important forage crops cultivated in most regions of the world. Lucerne is another name sometimes used for alfalfa, which was first cultivated in Iran. Because of its importance among forage crops, alfalfa is referred to as the 'Queen of Forages' (Caddel et al., 2003). Alfalfa is an extremely adaptable plant and can be grown under a wide range of soil and climatic conditions. It is annually attacked by a diversity of arthropod pests. Among arthropods attacking alfalfa, *Hypera postica* (Gyllenhal) is the most damaging phytophagous pest and the major limiting factor in alfalfa production in the most regions of the world (Blodgett et al., 2000; Danielson et al., 2006).

The alfalfa weevil is a snout beetle that is usually univoltine (Radcliffe & Flanders, 1998; Caddel et al., 2003). Both larvae and adults of alfalfa weevil are voracious feeders damaging terminals, foliage and new crown shoots. The larvae cause indirect damage by feeding on and removing the highly digestible solute portion of the cell, which is intended for livestock (Summers, 1998). Direct alfalfa weevil damage is caused by adults and larvae feeding on the growing tips, leaves and buds of alfalfa, which removes crop biomass and reduces harvested yield (Fick & Liu, 1976).

Multiple measures have been examined to manage alfalfa weevil populations. Tolerant cultivars are currently available, often do not provide sufficient protection from alfalfa weevil larval damage (Blodegett et al., 2000). Although biological agents have reduced weevil populations below economic injury thresholds in most regions of world (Richardson et al., 1971), limited commercial utility of biological, cultural and biotechnological control options Iran means that growers remain heavily reliant on insecticides. Application of insecticides has been an essential component of the control programs, and it has prevented economic damage to the alfalfa crop in Iran (Karimpour, 1994). In order to prevent resistance, effective chemical control of the pest requires new insecticides with novel modes of action. Organophosphates, carbamates, pyrthroids (Armbrust & Grysco, 1965; Pass, 1966; Stenhauer & Blickenstaff, 1967; Windbiel et al., 2005) and different compounds such as dieldrin, diazinon, aldrin, trichlorfon and lindane have been used against the pest recently (Vodjdani & Daftari, 1963). In the late 60s, the weevil developed resistance to heptachlor and dieldrin, and these agents no longer provided satisfactory control (Alder & Blickenstaff, 1964; Dorsey, 1966). The effects of some other insecticides on the pest have been studied by several researchers in Iran (Esmaili, 1970; Habibi, 1976; Karimpour & Pourmirza, 2000).

Lufenuron, a chitin synthesis inhibitor, can control immature stages of many pests with relatively low harm to beneficial arthropods and environment (Catangui et al., 1996; Consoli et al., 2001; Wakgari & Gilimore, 2003). An assessment of the potential impact of lufenuron on *Shistocerca gregaria* showed satisfactory impact on it (Hamadah et al., 2012). Dal pogoetto et al. (2012) and Abd El-Mageed et al. (2011) studied susceptibility of some insecticides on *Spodoptera littoralis* and reported lufenuron as the most effective toxicant. Neonicotinoids are a unique chemical class for several insect pest controls owing to their broad spectrum of activity (Elbert et al., 2008). Dinotefuran and thiamethoxam belong to the neonicotinoids and are neurotoxins (Arthur et al., 2004; Tomizawa & Casida, 2005). These chemical compounds, with their specific mode of action, are relatively new in Iran. In the current study, new groups of chemical compounds were tested against *H. postica*.

MATERIALS & METHODS

Insecticides

Three relatively new chemical insecticides in Iran, i.e. lufenuron (Match® 5EC, 200ml/ha, Syngenta Crop Protection, Greensboro, NC), dinotefuran (Dinotefuran MTI-446® 20SG, 120g/ha, Syngenta Crop Protection, Greensboro, NC) and thiamethoxam (Actara® 25WG, 60g/ha, Syngenta Crop Protection, Greensboro, NC) were obtained from Iranian Research Institute of Plant Protection, Tehran and were used in the present studies.

Laboratory Bioassays

Laboratory experiments were conducted at 25±1 °C, 60±5 RH and photoperiod of 16:8 L:D conditions at the Entomology Laboratory of Mohaghegh Ardabili University. A laboratory colony of *H. postica* was established in May 2011 from 1st instars collected from experimental field of Mohaghegh Ardabili University in the suburb of Ardabil, Iran. To assess the insecticidal activity of the chemicals, different concentrations were prepared based on preliminary experiments. The freshly moulted 2nd instars larvae were used in the experiments. The leaf dipping technique was used (Morse et al., 1986; Munger, 1942; Immaraju et al., 1989). Alfalfa leaves were dipped in different concentrations of tested insecticides for 30s, were left to dry at room temperature before being subject to *H. postica* larvae and adults. The control was only dipped in water. Each experiment consisted of five concentrations and control by four replications (15 larvae per dose). Each replication was done on a different day and the solutions used for the treatments were freshly prepared each time. Lufenuron, dinotefuran and thiamethoxam concentrations ranged from 30-3000, 25- 2500, 5-2100 AI L-1 for larvae and 800-500, 150-3000, 200-3500 AI L-1 for adults respectively. Based on insecticides mode of action, mortality was recorded after 72h for lufenuron and after 24h for dinotefuran and thiamethoxam. The mortality percentage of larvae and adults was corrected by using Abbott formula (Abbott, 1925). Probit analysis was performed using a software to calculate LC_{50} and LC_{90} and slope values of the tested chemicals (Finney 1971).Statistical analysis was conducted by SPSS (2004). Confidence intervals for toxicity ratios of LC_{50} values were determined by the method of Robertson and Preisler (1992). If the 95% confidence interval was 1, then the difference between LC_{50}s was considered insignificant (Robertson & Preisler, 1992).

Field Experiments

Field trials were conducted during the spring and summer of 2011 at the experimental field of Mohaghegh Ardabili University, located in a suburb of Ardabil, Iran (38 and 19´ N, 048 and 50´ E and 1340 m altitude). The 20 plots were 5×5 m^2, arranged in a randomized complete block design with five replications, three treatments and one control for each replication. The treatments randomly allocated to the plots were as follows: 1. Recommended dose of lufenuron (200 ml/ha), 2. Recommended dose of thiamehoxam (120g/ha), 3. Recommended dose of dinotefuran (60 g/ha), 4. Control that was treated only with equal amount of distilled water that was used in insecticide applications.

Once the alfalfa reached about 20 cm in height in each plot, a single treatment was made on 11 May, 2011, with a compressed air-powered hand-sprayer with 2 nozzles on a 2.4m boom at a pressure of 10psi. Assessments were done one day before and 3, 7, 14, 21 and 28 days after treatment. Plots were sampled for larval density by counting all living and dead larvae collected from 20 stems randomly selected from each plot. The stems were shaken against a white surface to dislodge the larvae from the plants, and the number of larvae per stems was recorded exactly. Data were subjected to analysis of variance for significance, and SNK test was applied to separate pair comparison. All analyses were performed using the SPSS Version 16.0 (2004) software package.

RESULTS

Laboratory Bioassays

LC_{50} values for 2nd instar larvae and adults of *H. postica* are shown in Tables 1 and 2 respectively. According to the LC_{50} values, the 2nd larvae instar were more susceptible to the insecticides than the adults. The LC_{50} values of the insecticides for adults were about 5-10 times higher than those for 2nd instars. Figs. 1-2 present the relationship between the probit of percentage mortalities and the logarithm of the concentrations of insecticides tested. Lufenuron and thiamethoxam were more toxic than dinotefuran for 2nd larval instars, especially lufenuron was the most toxic compared with two other insecticides with a different mode of action. Lufenuron was also the most toxic compound for alfalfa weevil adults followed by dinotefuran and thiamethoxam, respectively (Table 2).

The slopes of the dose-response lines of the compounds tested were quite steep (Fig. 2).

Results showed that among the insecticides tested, lufenuron was the most effective at low concentrations against larvae and adults of *H. postica*. Neonicotinoids compounds, dinotefuran (with LC_{50} values of 34.320 AI L-1) for larvae of *H. postica* and thiamethoxam (with LC_{50} values of 289.768) for adults, had the least lethal effect on alfalfa weevil.

Field Experiments

Population density of alfalfa weevil during the sampling period was significantly different among treatments ($P<0.01$) (Fig. 3). Mean number of live and dead alfalfa weevils in different treatments and control in different sampling dates is shown in Table 3. These results indicated that all insecticide treatments significantly reduced the densities compared with control ($P<0.05$). During the 2011 season, significant differences in *H. postica* catches were observed among treatments and dates, but there were no significant differences between mean number of alfalfa weevils in different plots before insecticide spraying (F= 1.61; df=19; P=0.225). The number of *H. postica* in lufenuron treatment was significantly different just three days after treatment (Table 3), and not on any other day ($P\leq 0.05$). The date had no observed effect on the impact of lufenuron and two other insecticides on alfalfa weevil after May 10. Although mortality of *H.postica* in insecticide-treated plots resulted in significantly fewer number of weevils compared with the control in all days of sampling ($P\leq 0.05$), there was no difference among three tested insecticides.

Larvae densities of pest in control increased from May 10 to May 25 (Fig. 3). In lufenuron, thiamethoxam and dinotefuran treatments, density of weevil decreased respectively from 16, 81, 11.96 weevils per plant before treatment to 0.03, 0.05, 0.02, respectively (Fig. 3). Therefore, these chemicals can be used as an alternative to the traditional chemical insecticides to control this pest. So, the application of recommended dose of lufenuron (F=28.64; df= 29; P=0.000), thiamethoxam (F=8.00; df=29; P=0.000) or dinotefuran (F=11.69; df= 29; P= 0.000) reduced significantly the alfalfa weevil population. Also in all insecticides treated plots number of injured stems reduced significantly. Lufenuron had the least injury in stem at 3 days after treatment (F=115.07; df= 29; P=0.000). But in thiamethoxam (F=61.53; df= 29; P=0.000) an dinotefuran (F=22.66; df= 29; P=0.000) there was significant difference among pre-treatment, 3 days after treatment and other date of sampling. Plots were not sampled after 28 days from treatment because many of weevils were beginning to move to diapause phase, and further sampling would not have been meaningful.

In control treatment, rates of density increased gradually until May 25th but after that time, they gradually decreased due to aging till June 8th. After treatment, all plots continued to have significantly fewer weevils than the untreated control (Fig. 3).

All insecticides reduced the mean number of alfalfa weevils and had a significant effect on its mortality.

DISCUSSION

The LC_{50} values were invariably lower for lufenuron than for thiamethoxam and dinotefuron, indicating that the former is more toxic to weevil larvae and adults.

Results showed that with a fairly small increase in insecticides concentration, the mortality would increase considerably. This requires more careful use of these chemicals in the field to prevent exerting a high selection pressure that could eliminate the susceptible insects and lead to selection of resistant ones (Alyokhin et al., 2007).

Recently developed neonicotinyl insecticides such as dinotefuran, thiamethoxam and Clothianidin have been shown to be effective against different pests (Delgrade & Rouland-Lefevre 2002; Corbel et al., 2004; Nault et al., 2004; Wilde et al., 2004). However, there are no reported data on susceptibility of *H. postica* to these chemicals; several insecticides representing various classes of chemistry have been evaluated to estimate LC_{50} of these insecticides against other coleopteran pests. For example, the efficiency of dinotefuran and thiamethoxam were evaluated on adults of a cerambycid beetle, *Anoplophora glabripennis,* and the LC_{50} values were 2.2 ppm for dinotefurran and 1.0 ppm for thiamethoxam. Wang et al. (2005) and Mcleod et al. (2002) also found toxicity of thiamethoxam against the eggplant flea beetle, *Epirtrix fuscula* crotch on eggplant foliage. There are also many other studies conducted evaluating the effect of these insecticides on coleopteran pests (Alyokhin et al., 2007; Acda, 2008; Hoffmann et al., 2008). Since these compounds do not belong to the groups of chemical compounds conventionally applied for *H. postica* control in Iran, so they can be used in rotation with other insecticides. This would confirm that for an effective *H. postica* management program, the same class of insecticides should not be applied more than once within a growing season.

Insect growth regulators (IGRs) are known to be highly effective against many agricultural pests with a relatively low toxicity to mammals and natural enemies (Ishaaya, 1990). Lufenuron is an IGR assessed against several insect pests, such as summer fruit tick, *Adoxophyes orana* (Charmmillot et al., 1991; Ioriatti et al., 1993), cat flea and *Ctenocephalides felis* (Hink et al., 1991). However, there are different results about the effects of these acylurea compounds on the pests. Present experiments indicated that lufenuron, a chitin synthesis inhibitor with demonstrated selectivity in favor of beneficial insects, can provide very good protection of alfalfa from the pest and gives the best control. Control of larvae is especially important since this stage is usually responsible for over 90% of the defoliation caused by *H. postica* (Fick, 1976; Blodgett & Lenssen, 2004). Several studies have been done about field efficacy of several chemicals against alfalfa weevil (Koehler et al,. 1959; Armbrust et al., 1965; Abu Yaman & Naser, 1970; Depew, 1987), but there were not any reports about our tested chemicals on this pest. However, these chemicals have been tested on other coleopteran pest such as efficacy of lufenuron on snout beetles (Echeverri-Molina & Santolamazza-Carbone, 2010).

Thiamethoxam has been applied successfully to other coleopteran pests such as cerambyciidae and chrysomelidae (Alyokhin et al., 2007; Acda, 2008; Hoffmann et al., 2008). Over the last 3 years, sales of the total group have nearly doubled, and future expansion will be driven by growth of the established neonicotinoids, which also will open new opportunities in low-price markets (Elbert et al., 2008). Combined with active life-cycle management such as optimized formulations and new combinations, neonicotinoids could be important chemical for insect control.

Overall, all three insecticides tested in present study significantly reduced density of alfalfa weevil. According to LC_{50} values, Lufenuron with the least value can be suggested as the most potent insecticide. Lufenuron is recommended with satisfactory control due to low values of toxin needed for more mortality percentage, relatively wider margin of safety, reducing cost and risk of insecticide for *H. postica* in Iran. Although additional research with these insecticides is needed, the results presented in this study should aid producers in making alfalfa weevil management decisions.

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Table 1. LC_{50} and LC_{90} values of insecticides on 2nd instars of *Hypera postica* after using the leaf dip method.

Insecticide	$LC_{50}{}^{1}$	95% C.L.[1,2]		Slope±SE	$LC_{90}{}^{1}$	X^{3}	*df*[4]
		upper	lower				
Lufenuron	15.82^{a5}	554.50	187.53	0.69±0.11	1108.37	1.56	3
Dinotefuran	34.32^{a}	262.52	104.80	0.82±0.11	1256.41	0.88	3
Thiamethoxam	24.91^{a}	174.86	56.60	0.64±0.08	2354.78	2.54	3

[1] mg AI L-1, [2] Confidence Limits, [3] Chi square values, [4] Degrees of freedom, [5] Data in the same letter are not statistically different ($P \geq 0.05$)

Table 2. LC_{50} and LC_{90} values of insecticides on adults of *Hypera postica* after using the leaf dip method.

Insecticide	LC_{50}^{1}	95% C.L.[1,2]		Slope±SE	LC_{90}^{1}	X^{3}	*df*[4]
		upper	lower				
Lufenuron	164.02^{a5}	4190.88	2740.92	2.09±0.29	670.31	3.28	3
Dinotefuran	175.67^{a}	44471.54	250.20	1.00±0.15	3338.23	4.84	3
Thiamethoxam	289.76^{a}	4886.75	502.78	1.39±0.20	2387.79	2.54	3

[1] mg AI L-1, [2] Confidence Limits., [3] Chi square values, [4] Degrees of freedom, [5] Data in the same letter are not statistically different ($P \geq 0.05$)

Table 3. Efficacy of selected insecticides for control of alfalfa weevil, *H. postica* on alfalfa in 2011.

Treatments	Mean number (±SE) alfalfa weevil plant						
	Rate/ha	10 May (1 DBT[1])	14 May (3 DAT[2])	18 May (7 DAT)	25 May (14 DAT)	1 June (21 DAT)	8 June (28 DAT)
Control	-	20.83 ±0.98^{aA}	20.49 ±0.09^{aA}	28.48 ±1.23^{aA}	24.29 ±1.42^{aA}	7.45 ±0.08^{aA}	2.03 ±0.02^{aA}
Lufenuron	200ml	11.96 ±1.65^{bA}	11.4 ±0.19^{bB}	0.13 ±0.04^{bC}	0.22 ±0.03^{bC}	0.06 ±0.01^{bC}	0.03 ±0.00^{bC}
Thiamethoxam	120gr	12.81 ±1.98^{bA}	12.71 ±0.17^{bB}	0.05 ±0.01^{bB}	0.38 ±0.06^{bB}	0.09 ±0.01^{bB}	0.05 ±0.1^{bB}
Dinotefuran	60gr	16.85 ±1.21^{bA}	16.23 ±0.09^{bB}	0.92 ±0.13^{bB}	0.56 ±0.06^{bB}	0.44 ±0.05^{bB}	0.02 ±0.01^{bB}

[1] Day before treatment , [2] Day after treatment, Means with lower letters within the column are significantly different at P<0.05 in comparison with control, Means with capital letters within the row are significantly different at P<0.05 in different date, probability level were estimated using SNK tests

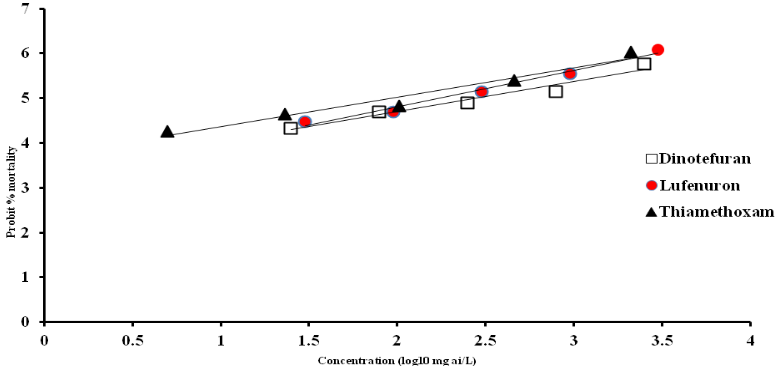

Figure 1. Concentration-response relationship between three insecticides and the 2nd instars of *Hypera postica,* after treatment.

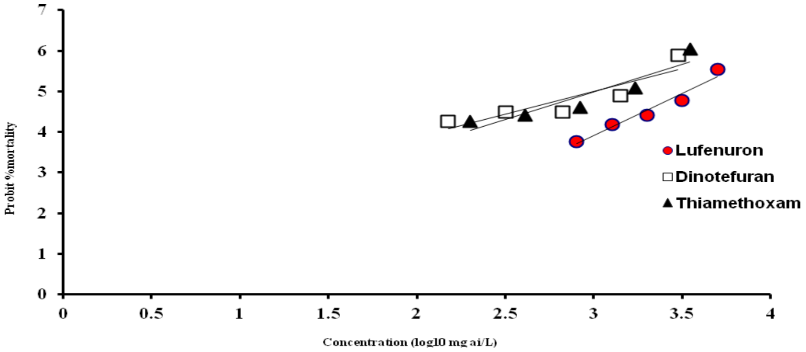

Figure 2. Concentration-response relationship between three insecticides and the adult of *Hypera postica,* after treatment.

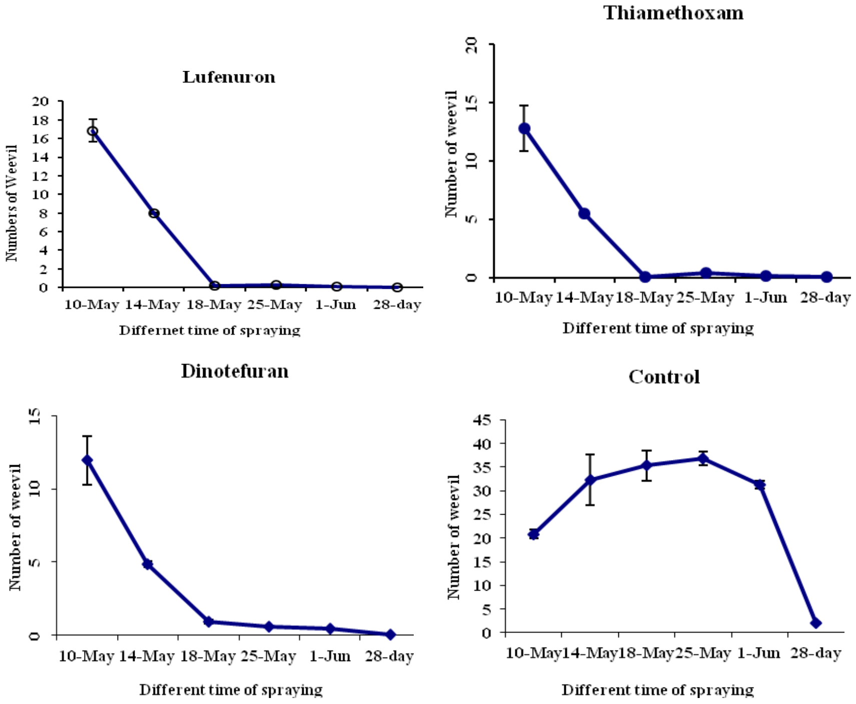

Figure 3. Comparison of fluctuation of densities of the alfalfa weevil at different treatments during 2011.

CHOROLOGICAL DATA ON SOME GEOTRUPIDAE, APHODIIDAE AND SCARABAEIDAE (COLEOPTERA: SCARABAEOIDEA) SPECIES COLLECTED DURING SOME FIELD-TRIPS IN TURKEY

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ABSTRACT: Some faunist records of Scarabaeoidea species from Turkey are presented. The species treated are 19, 3 belonging to the family of Geotrupidae, 9 to Aphodiidae and 7 to Scarabaeidae. Of considerable interest is the record of *Onthophagus* (*Palaeonthophagus*) *furciceps* Marseuil, 1869, known only for the holotype and for another specimens from Adıyaman.

KEY WORDS: Scarabaeoidea, faunistic notes, Turkey.

After the researches and the publications of Rudolf Petrovitz along all the fifty, sixty and seventy years, it could be reasonable to suppose that the knowledge of the Coleoptera Scarabaeoidea of Turkey is near to be sufficiently thorough. Notwithstanding, the only downright summary on the Turkish fauna can be considered the paper by Carpaneto (1977), that mainly referenced to unpublished data of the same Petrovitz, and, to some extent, the checklist with no localities by Carpaneto et al. (2000).

Anyway, in these last 35 years the opportunity to visit and collect material in areas once hard to reach, has brought to new species and new and sometime noteworthy records.

The aim of this work is to provide new chorological data regarding some interesting species belonging to three Scarabaeoidea families and collected in the Anatolian Peninsula by the first author, in summer of 1992 and spring of 2004 and 2006, and by the second author in late spring and summer of 1997, 1998 and 2011. Hereafter 19 species are listed. For most of them new provincial records for Turkey are given. In some cases records already published by the literature are confirmed.

The scarabs were found mainly in dung, in burrow of small mammals, sometimes in ground beetle traps or, more rarely, under stones, in some sites of the following provinces, arranged here in alphabetic order:

- Adana
- Adıyaman
- Ağrı
- Antalya
- Artvin
- Erzincan
- Erzurum
- Gümüşhane
- Kars
- Kayseri
- Kırklareli

- Kirşehir
- Konya
- Kahramanmaraş
- Malatya
- Mardin
- Muş
- Niğde
- Siirt
- Sivas
- Tunceli
- Van

The systematic of species-group taxa is from Löbl & Smetana, 2006, if not explained in the "Remarks" section. The arrangement of genus group names and family-group names reflects the systematic thought of the first author.

Under the section "Turkish records", literature data are provided, with the name of the provinces where the species is been recorded.

All the material examined is preserved in the collections of the authors.

LIST OF SPECIES

GEOTRUPIDAE

1. *Geotrupes* (*Glyptogeotrupes*) *molestus* Faldermann, 1835

Material examined. Kars, Cam geç., 2250/2600 m, 9.vi.1998, G. Sama leg. 1 specimen; Erzurum, Ovitagi geç., 2600 m, 11.vi.1998, G. Sama leg. 2 specimens.
Distribution. Turkey (Löbl et al., 2006c).
Turkish records. Gümüşhane, Rize, Trabzon (Carpaneto, 1977). Ordu (Tauzin, 2003).

2. *Thorectes brullei* ssp. *anatolicus* (Jekel, 1865)

Material examined. Konya, 10 km N Yarpuz, 1800 m., 20.v.1997, G. Sama leg. 1 specimen; Antalya, Irmasan geç., 1300 m, 22.vi.1997, G. Sama leg. 1 specimen.
Distribution. Greece (Rhódos); Turkey (Löbl et al., 2006c).
Turkish records. İzmir, Konya, İsparta (Baraud, 1966). Antalya, Hatay (Tauzin, 2003). Çanakkale (I. Rozner & G. Rozner, 2009).

3. *Trypocopris fulgidus* (Motschulsky, 1845)

Material examined. Kırklareli, Demirkoy, 26.vi.1997, G. Sama leg. 2 specimens.
Distribution. Bulgaria; Turkey (Löbl et al., 2006c).
Turkish records. İstanbul (Küster, 1852). Bolu, Düzce, Kocaeli (Balthasar, 1952). İstanbul (Bytinski-Salz, 1956). Ankara, Sakarya, Ordu (Carpaneto, 1977). Kütahya, Erzurum, Kars, Amasya (Krell, 1996). Samsun, Rize, Tokat, Giresun, Sinop, Antalya, Kastamonu (Tauzin, 2003).

APHODIIDAE

4. *Esymus suturinigra* (A. Schmidt, 1916)

Material examined. Adıyaman, Nemrut dağ. 1000/1800 m, 13.v.1997, G. Sama leg. 3 specimens; ditto, 13.iv.2004, S. Ziani leg. 1 specimen; Mardin, 30 km SE Midyat, 16.iv.2006, S. Ziani leg. 1 specimen.
Distribution. Romania, Armenia; Turkey, Cyprus, Israel, Lebanon, Syria, Iraq, Iran (M. Dellacasa & G. Dellacasa, 2006).
Turkish records. Ağrı, Gaziantep, Kahramanmaraş (Carpaneto, 1977).

5. *Liothorax isikdagensis* (Balthasar, 1952)

Material examined. Erzincan, 8 km Assale, 1.v.1998, G. Sama leg. 1 specimen. Muş, Buglan geç., 1400 m, 17.v.2011, G. Sama leg. 1 specimen.

Distribution. Greece; Turkey, Cyprus, Israel (M. Dellacasa et al., 2007).

Turkish records. Ankara (Balthasar, 1952). Hatay [type locality of *Aphodius (Ataeniomorphus) ressli* Petrovitz, 1962, junior synonym of *L. isikdagensis* according to G. Dellacasa et al., 2001] (Petrovitz, 1962).

6. *Liothorax niger* (Illiger, 1798) *s. l.*

Material examined. Artvin, Cam geç., 2000 m, spruce, 10.vi.1998, G. Sama leg. 1 specimen.

Distribution. Europe; Asia Minor, Central Asia, China (Tibet) (M. Dellacasa et al., 2007).

Turkish records. Eskişehir, Kahramanmaraş, Kırıkkale, Konya (Lodos et al., 1999). Istanbul (Maté & Angus, 2005, as *Aphodius* (*Liothorax*) *wilsonae* Maté & Angus, 2005).

7. *Neagolius ovitensis* ssp. *laticeps* (Pittino & Ballerio, 1996)

Material examined. Gümüşhane, Zigana dagl., 2300 m, 12.vi.1998, G. Sama leg. 1 specimen.

Distribution. North East Turkey (M. Dellacasa & G. Dellacasa, 2006).

Turkish records. Gümüşhane (Pittino & Ballerio, 1996).

8. *Parammoecius asphaltinus* (Kolenati, 1846)

Material examined. Artvin, Cam geç. 2000 m, 10.vi.1998, G. Sama leg. 1 specimen.

Distribution. Armenia, Georgia, South Russia. Turkey (M. Dellacasa & G. Dellacasa, 2006).

Turkish records. Ordu, Giresun, Trabzon, Rize, Artvin (Carpaneto, 1976). Gümüşhane (Carpaneto, 1977).

9. *Phaeaphodius tauricola* (Hrubant, 1961)

Material examined. Sivas, 8 km W from crossroads to Zara, 1400 m, 18.vi.1998, G. Sama leg. 1 specimen.

Distribution. Turkey (M. Dellacasa & G. Dellacasa, 2006). Armenia (Ahrens, 1997). Iran (Ziani & Moradi Gharakhloo, 2011).

Turkish records. Karaman (Hrubant, 1961). Çankırı (Petrovitz, 1968). Kastamonu, Bolu (Carpaneto, 1977). Antalya, Konya (Ahrens, 1997).

10. *Phalacronothus fumigatulus* (Reitter, 1892)

Material examined. Adıyaman, Nemrut dağ., 1000/1800 m., 13.v.1997, G. Sama leg. 2 specimens; Mardin, Ömerli, 15.iv.2006, S. Ziani leg. 1 specimen.

Distribution. Greece, Bulgaria, Georgia, Armenia; Turkey, Israel, Lebanon, Syria, Turkmenistan (M. Dellacasa & G. Dellacasa, 2006).

Systematic note. G. Dellacasa et al. (2001) have proposed the synonymy *Phalacronothus sculpturatus* (Reitter, 1892) versus *P. fumigatulus* (Reitter, 1892).

Turkish records. Ankara, Eskişehir, Konya, Kahramanmaraş, Niğde, Van (Carpaneto, 1977). Hakkari, İsparta, İzmir, Kirşehir (Carpaneto, 1977, as *P. sculpturatus*). Konya (G. Dellacasa et al., 2001). Çanakkale (I. Rozner & G. Rozner, 2009).

11. *Osmanius balthasari* (Petrovitz, 1963)

Material examined. Niğde, Kolsuz geç., 1490 m, 9.iv.2004, S. Ziani leg. 3 specimens; ditto, 15.iv.2004, S. Ziani leg. 8 specimens; Aksaray, Selime, 1300 m, 10.iv.2004, S. Ziani leg. 8 specimens.

Distribution. Greece; Turkey, Iran (Moradi Gharakhloo & Ziani, 2010).

Turkish records. Hatay (Petrovitz, 1963). Niğde, Aksaray, Konya, Kirşehir, Yozgat (Pittino, 1996).

12. *Ataenius horticola* Harold, 1869

Material examined. Hatay, Nur dağl., Topaktas, E of Dörtyol, 1150 m, 20/24.v.2011, G. Sama leg. 1 specimen.

Distribution. Germany, Caucasus, Balkan, Ukraine; Turkey, Cyprus, Jordan, Israel, Lebanon, Syria, Iraq, Iran, Afghanistan, Tajikistan; Egypt (M. Dellacasa & G. Dellacasa, 2006).
Turkish records. İstanbul (Harold, 1869). Mersin, İzmir (Sahlberg, 1913). Hatay (Petrovitz, 1963). Adana, Antalya, Muğla, Tokat, Zonguldak (Carpaneto, 1977). Çanakkale (I. Rozner & G. Rozner, 2009).

SCARABAEIDAE

13. *Copris* (*Copris*) *armeniacus* Faldermann, 1835

Material examined. Muş, Buglan geç., 1650 m, 2.vi.1998, G. Sama leg. 2 specimens.
Distribution. Armenia; Turkey, Iran (Löbl et al., 2006a). Azerbaijan (Kabakov, 2006).
Systematic note. According to Iablokov-Khnzorian (1967) *Copris felschei* Reitter, 1892 is a junior synonym of *Copris armeniacus* Faldermann, 1835.
Turkish records. Adana (Petrovitz, 1968, as *C. felschei*). Gaziantep, Hakkari (Carpaneto, 1977, as *C. felschei*). Konya, Gümüşhane, Van, Çankırı, Muş, Erzurum (Tauzin, 2001). Kars, Erzincan (I. Rozner & G. Rozner, 2009).

14. *Onthophagus* (*Palaeonthophagus*) *angorensis* Petrovitz, 1963

Material examined. Kahramanmaraş, env. Goksun, 1500 m., 11.v.1997, G. Sama leg. 1 specimen; Siirt, 10 km N Sirnak, 1500 m, 16.iv.2006, S. Ziani leg. 1 specimen; Niğde, Kolsuz Geçidi, 1490 m, 15.iv.2004, S. Ziani leg. 3 specimens; Niğde, Caykavak Geçidi, 1600 m, 9.iv.2004, S. Ziani leg. 2 specimens; Malatya, Resadiye Geçidi, 1510 m, 13.iv.2004, S. Ziani leg. 13 specimens; Adıyaman, Nemrut Dağ., 1600 m, 13.iv.2004, S. Ziani leg. 1 specimen.
Distribution. Yugoslavia, Macedonia, Greece, Bulgaria, Romania; Turkey, Israel, Lebanon Syria, Iran (Löbl et al., 2006b). Southern Russia, Armenia, Azerbaijan; Turkmenistan (Kabakov, 2006).
Turkish records. Ankara (Petrovitz, 1963). Konya (Carpaneto, 1977). Gaziantep, Mersin, Tokat (Martin-Piera & Zunino, 1985). Hatay, İsparta (Keith, 1998). Tunceli (Tauzin, 2000). Adana, Afyonkarahisar, Amasya, Aksaray, Burdur, Çanakkale, Diyarbakır, İzmir, Kahramanmaraş, Kirşehir, Mardin, Yozgat (Pittino, 2004). Antalya (Bellmann, 2007).

15. *Onthophagus* (*Palaeonthophagus*) *carpanetoi* Pittino, 1982

Material examined. Van, Kuskun Kiran geç., 2200 m, 4.vi.1998, G. Sama leg. 1 specimen; Muş, Buglan geç., 1400 m, 17.v.2011, G. Sama leg. 4 specimens. Erzurum, Kop dağ., Kandilli, 2500 m., 3.vii.1992, S. Ziani leg. 34 specimen; Ağrı, Tahir 2100 m, 4.vii.1992, S. Ziani leg. 6 specimens; Ağrı, Tutak, 1600 m, 4.vii.1992, S. Ziani leg. 1 specimen; Gümüşhane, Bayburt 2000 m, 3.vii.1992, S. Ziani leg. 27 specimens; Adıyaman, Nemrut dağ., 1600 m, 13.iv.2004, S. Ziani leg. 12 specimens; Malatya, 10 km S Tepehan, 1200 m, 12.iv.2004, S. Ziani leg. 4 specimens; Adana, Belemedik, 1300 m, 9.iv.2004, S. Ziani leg. 9 specimens; Kayseri, Bunyan, 1300 m, 11.iv.2004, S. Ziani leg. 2 specimens; Niğde, Kolsuz geç., 1490 m, 9.iv.2004, S. Ziani leg. 16 specimens; Niğde, Caykavak geç., 1600 m, 9.iv.2004, S. Ziani leg. 19 specimens; Malatya, Resadiye geç., 1510 m, 13.iv.2004, S. Ziani leg. 88 specimens.
Distribution. Turkey, Jordan, Iran (Löbl et al., 2006b). Armenia; Syria, Iraq (Kabakov, 2006).
Turkish records. Bolu, Gümüşhane, Kars, Antalya, İsparta, Konya, Tokat, Kahramanmaraş, Mersin, Kayseri, Afyonkarahisar (Pittino, 1982). Hatay (Keith, 1998). Ankara, Burdur, Çankırı, Denizli, Erzurum, Hakkari, Kastamonu, Kütahya, Nevşehir, Niğde, Rize, Tunceli, Van (Pittino, 2004).

16. *Onthophagus* (*Palaeonthophagus*) *dorsosignatus* d'Orbigny, 1898

Material examined. Van, Kuskum Kiran geç., 2200 m, 4.vi.1998, G. Sama leg. 2 specimens; Ağrı, Tutak, 1600 m, 4.vii.1992, S. Ziani leg. 1 specimen; Ağrı, Tahir, 4.vii.1992, S. Ziani leg. 1 specimen; Van, Kocapinar, 1900 m, 4.vii.1992, S. Ziani leg. 3 specimens; Erzurum, env., 4.vii.1992, S. Ziani leg. 1 specimen; Erzurum, Kop dağ., Kandilli, 2500 m, 3.vii.1992, S. Ziani leg. 2 specimens; Van, Gurpinar, 2100 m, 5.vii.1992, S. Ziani leg. 25 specimens; Adıyaman, Nemrut dağ., 1600 m, 13.iv.2004, S. Ziani leg. 5 specimens; Malatya, Kubbe Geç., 1966 m, 12.iv.2004, S. Ziani leg. 9 specimens; Malatya, Resadiye Geç., 1510 m,

13.iv.2004, S. Ziani leg. 6 specimens; Malatya, 10 km S Tepehan, 1200 m, 12.iv.2004, S. Ziani leg. 1 specimen.
Distribution. Azerbaijan, Armenia; Turkey, Iraq, Iran, Afghanistan (Löbl et al., 2006b). Syria (Kabakov, 2006).
Turkish records. Van (D'Orbigny, 1898). Bitlis (Carpaneto, 1977). Adana, Mersin, Kahramanmaraş (Pehlivan, 1989).

17. *Onthophagus* (*Palaeonthophagus*) *fissinasus* Fairmaire, 1895
Material examined. Adıyaman, Nemrut dağ., 1000/1800 m, 13.v.1997, G. Sama leg. 1 specimen; Malatya, 10 km S Tepehan, 1200 m, 12.iv.2004, S. Ziani leg. 1 specimen; Malatya, Kubbe geç., 1966 m, 12.iv.2004, S. Ziani leg. 1 specimen; Malatya, Resadiye geç., 1510 m, 13.iv.2004, S. Ziani leg. 133 specimens; Niğde, Kolsuz geç., 1490 m, 15.iv.2004, S. Ziani leg. 3 specimens; Siirt, 10 km N Sirnak, 1500 m, 16.iv.2006, S. Ziani leg. 2 specimens.
Distribution. Turkey, Israel, Lebanon, Syria, Iraq, Iran (Löbl et al., 2006b).
Turkish records. İzmir, Hatay (Fairmaire, 1895). Niğde (Durand, 1970). Eskişehir (Zunino, 1976). Ankara (Carpaneto, 1977). Diyarbakır, Kahramanmaraş (Pehlivan, 1989). Gaziantep (Lodos et al., 1999). Afyonkarahisar (I. Rozner & G. Rozner, 2009).

18. *Onthophagus* (*Palaeonthophagus*) *furciceps* Marseul, 1869 [Fig. 1]
Material examined. Tunceli, Pass N Pülümür, 1800 m, 10.v.2011, G. Sama leg. 1 specimen ♂.
Distribution. Turkey, Lebanon (Ziani & Gudenzi, 2006).
Turkish records. Adıyaman (Ziani & Gudenzi, 2006). All other Turkish records quoted by the literature are to be reviewed after Pittino (2004) and Ziani & Gudenzi (2006).
Remarks. *O. furciceps* is known only for the holotype, a male from Lebanon, and for another male examined by Ziani & Gudenzi (2006). The record of Tunceli is the third for the species. The female still remains unknown.

19. *Onthophagus* (*Palaeonthophagus*) *rakovici* Pittino, 2004
Material examined. Muş, Buglan geç., 1400 m, 17.v.2011, G. Sama leg. 1 specimen.
Distribution. Armenia; Turkey, Iran (Ziani, 2009).
Turkish records. Ankara, Çankırı, Bolu, Kastamonu, Ağrı, Kars, Erzurum (Pittino, 2004).

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Figure 1. *Onthophagus* (*Palaeonthophagus*) *furciceps* Marseul, 1869 [Turkey: Tunceli, Pass N Pülümür]. Photo by A. Degiovanni.

PACHYTA GORODINSKII N. SP. FROM WESTERN CHINA (QINGHAI) (COLEOPTERA: CERAMBYCIDAE)

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[Rapuzzi, P. 2013. *Pachyta gorodinskii* n. sp. from Western China (Qinghai) (Coleoptera: Cerambycidae). Munis Entomology & Zoology, 8 (1): 466-467**]**

ABSTRACT: In this paper is described a new species of *Pachyta* Dejean, 1821 from China, Qinghai province. The new species is close to *Pachyta lamed* (Linnaeus, 1758).

KEY WORDS: Cerambycidae, *Pachyta*, new species, China.

Thanks to my friend Andrè Gorodinski from Moskow (Russia) I had the opportunity to study several Cerambycidae collected in China. Among them I found a specimen belongs to the Genus *Pachyta* Dejean, 1821 but of an unknown species. The new species is close to *Pachyta lamed* (Linnaeus, 1758) but easy to be distinguish for the black color of the body, the deeper punctures on elytra and pronotum and the prominent antennal tubercles.

***Pavchyta gorodinskii* n. sp.**

(Fig. 1)

Material examined: Holotypus ♀: **China**: Qinghai prov., Lajishan ridge, near Guide, 3300 m., 20.VII.2010, A. Gorodinski lgt.
Holotypus in collection P. Rapuzzi.

Description of the Holotype: Length 20 mm, width 7 mm. Body entirely black. Head long, with dense, deep and rugulose punctures, denser on the vertex. Antennal tubercles prominent and acute. Front between eyes with a deep groove. All the head surface covered by long, thin, silvery erect hairs. Pronotum as long as wide, deep punctured. Sides with an obtuse tooth just up to the middle. Disk of pronotum with two large and flat callosities, the middle with a groove, more visible in the first half. Base of pronotum with a large transverse groove. Pronotum with dense, long, thin erect silvery hairs. Elytra long, convex, restricted towards apex. Shoulders obtuse, with a small groove between side and scutellum. Apex evidently convex truncate with a small acute tooth at the sutural side. Elytra shiny, with dense punctures, denser on the first third where is more or less rugulose; towards the apex it is more sparse but it still remains dense and deep. Elytra nearly glabrous except for very short and sparse erect silvery hairs. Scutellum triangular, long and matt due to a very dense and fine punctures. Legs very long and slender. Tibiae slightly curved, more pronounced on hind tibiae. Tarsi very long with the last joint very slender and long. Inner side of femora with a fringe of dense erect silvery hairs. Antennae slender, short, reaching the middle of elytra. Fourth joint shorter then third. Fifth joint longer than each other joint. Antennae glabrous, except for the first two joints that show very short brown setae.

Discussion: Genus *Pachyta* Dejean, 1821 was represented by 6 species in China (Löble & Smetana, 2010): *P. bicuneata* Motshulsky, 1860; *P. degener* Semenov & Plavilstshikov, 1936; *P. felix* Holzschuh, 2007; *P. lamed* (Linnaeus, 1758); *P.*

mediofasciata Pic, 1936 and *P. quadrimaculata* (Linnaeus, 1758). The new species is closer with *P. lamed* and secondly with *P. degener* but it is easy to be distinguish from the first according the deeper punctures on the disk of pronotum, the stronger, denser and deeper punctures on the elytral surface. In *P. gorodinskii* n. sp. the antennal tubercles are acute and prominent, obtuse and short in *P. lamed*. The last tarsal joint is very slender and longer than in *P. lamed*. The erect hairs on pronotum and elytra are shorter, denser and light gold colored in *P. lamed* than in the new species. From *P. degener* it is distinguish because lacking the deep excavation at the side of the disk of pronotum and the elytral pattern.

Etymology: I dedicate the new species to my friend Andrè Gorodinski from Moskow (Russia) as thanksgiving for the opportunity that he gives me to study such interesting Cerambycidae.

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Figure 1. *Pachyta gorodinskii* n. sp. Holotypus.

A FAUNISTIC STUDY OF TRUE BUGS (HETEROPTERA) FROM HORAND GRASSLANDS, NW IRAN

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[Khaghaninia, S., Farshbaf Pour Abad, R., Askari, O. & Havaskary, M. 2013. A faunistic study of true bugs (Heteroptera) from Horand grasslands, NW Iran. Munis Entomology & Zoology, 8 (1): 468-474**]**

ABSTRACT: In order to study of Heteroptera fauna of Horand region in East Azerbayjan province, a survey was conducted during 2008-2009. Out of 650 collected specimens, 29 species belonging to 12 families including Anthocoridae, Miridae, Tingidae, Nabidae, Lygaeidae, Pyrrhocoridae, Coreidae, Stenocephalidae, Rhopalidae, Cydnidae, Scutelleridae, Pentatomidae were identified. In addition to the faunistic survey, distributions of the all species are reviewed.

KEY WORDS: Heteroptera, Fauna, Horand, East Azerbayjan province, Iran.

In the recent classification, the true bugs (Heteroptera) has been regulated as a suborder rank in order of Hemiptera and some differences are happened between traditional and modern classification base on phylogenetic investigations. Heteroptera can be as serious crop pests, harmful to humans or valuable as biological control agents (Carver et al., 1991; Havaskary, 2010; Schaefer & Panizzi, 2000; Triplehorn & Johnson, 2005). Although some researchers have been performed to determine the Heteropteran fauna of East Azarbaijan province (Modarres Awal, 1997a,b; Farshbaf Pour Abad, 2000; Khaghaninia et al., 2010a,b, 2011; Khalilzadeh et al., 2007, 2008; Hassanzadeh et al., 2009a,b; Havaskary, 2012; Nikdel, 2011; Sadeghi, 2004, 2009; Sadeghian et al., 2002, 2004) but the true bugs' fauna of this region has not been studied so it subjected for the present study. The studied grasslands is situated at northwest of Arasbaran forests in the East Azarbaijan province of Iran with UTM (Universal Transfer Mercator) coordinate system; X 690447.57 to 709176.87 E; Y 4304419.14 to 4317039.59 N.

MATERIAL AND METHODS

The specimens were collected during 2008-2009 from 22 different localities of Horand grasslands by sweeping net, malaise trap and some of them captured by hand (Fig. 1). Their recognition was based on morphological structure and male genital inspections especially pygophores and parameres. For determining the materials, the following papers by Anufriev et al. (1988), Baker (1931), Kment & Jindra (2008), Borror (1989), Carapezza & Jindra (2008), Lodos (1959), Thomas (1994), Ribes et al. (2007, 2008), Rider (1989), Siddiqui (2000), were used. The system, nomenclature and unmentioned references in distribution ranges followed from Aukema & Rieger (2001, 2006).

RESULTS

In this research 29 species dependent to 12 families were identified which all of them are being newly reported for the studied area. The list of the verified species, their examined material, GPS position and their distribution are given in below.

Family Anthocoridae Amyot and Serville, 1843

Anthocoris nemorum (Linnaeus, 1761)

Material Examined: 25 specimens, (10 ♂♂, 15 ♀♀); 26 May 2008, N38 57.937, E47 17.277. Distribution in Iran: Generally distributed in north and central provinces. Fars (Modaress Awal, 1997; Ostovan & Niakan, 2000), Yazd (Modaress Awal, 1997) from S Iran. Range: Palaearctic (Pericart, 1996).

Anthocoris nemoralis (Fabricius, 1794)

Material Examined: 16 specimens, (8♂♂, 8♀♀); 26 June 2009, N38 58.467, E47 18.198. Distribution in Iran: Generally distributed in north and central provinces, also two provinces including Fars and Yazd from S Iran (Ostovan & Niakan, 2000). Range: Holarctic (Pericart, 1996).

Family Miridae Hahn, 1833

Adelphocoris lineolatus (Goeze, 1778)

Material examined: 25 specimens, (11♂♂, 14♀♀); 5 June 2009, N38 57.082 E 47 17.058. Distribution in Iran: Widespread (Modaress Awal, 1997). Range: Holarctic.

Lygus rugulipennis (Poppius, 1911)

Material examined: 28 specimens, (5♂♂, 23♀♀); 8 July 2009, N38 57.111 E47 17.006. Distribution in Iran: EastAzarbaijan, Hamedan (Modarres Awal, 1997), Ardabil, Golestan, Tehran, Zanjan, Khorasan (Havaskary et al., 2010). Range: Holarcic.

Deraeocoris punctulatus (Fallen, 1801)

Material examined: 23 specimens, (8♂♂, 15♀♀); 2 Augest 2009, N38 57.097 E47 17.021. Distribution in Iran: Ardabil, Fars, Isfahan (Modaress Awal, 1997), Gilan, Tehran, Zanjan, Khorasan (Havaskary, 2010). Range: Euro-Siberian (Linnavouri, 2007a).

Notostira elongata (Geoffroy, 1785)

Material examined: 82 specimens, (43♂♂, 39♀♀); 12 July 2008, N38 56.138 E47 27.665, (31♂♂, 18♀♀); 5 June 2009, N38 57.111 E47 17.006, (12♂♂, 21♀♀).
Distribution in Iran: East Azarbaijan (Modaress Awal, 1997; Hassanzadeh et al., 2009).

Family Tingidae Laporte de Castelnau, 1833

Stephanitis (*Stephanitis*) *oschanini* Vasiliev, 1935

Material examined: 37 specimens, (15♂♂, 22♀♀); 26 May 2009, N38 56.723 E47 27.145. Distribution in Iran: Widespread. Range: Armenia, Azerbaijan, Afghanistan, Georgia, Iraq, Iran, Turkey and Central Asia (Golub, 2002; Kment & Jindra, 2005).

Family Nabidae A. Costa, 1853

Nabis Pseudoferrus (Remane, 1949)

Material examined: 19 specimens, (8♂♂, 11♀♀); 12 July 2008, N38 57.060 E47 17.286. Distribution in Iran: Northern and central provinces, mainly introduced from Khorasan in different papers (Havaskary, 2010; Heiss, 2002; Kerzhner, 1987; Linnavuori & Modaress Awal, 1998; Modaress Awal, 2008). Range: Iran and Turkmenistan (Kerzhner, 1996).

Family Lygaeidae Schilling, 1829

Emblethis ciliatus (Horváth, 1875)

Material Examined: 24 specimens, (15♂♂, 9♀♀); 5 June 2009, N38 53.838 E47 16.988.

Distribution in Iran: This species introduced from North (East Azarbaijan, Guilan, Tehran Khorasan Razavi), West (Kurdestan), and S Iran (Fars, Kerman). Range: Russia to Middle East.

Scolopostethus affinis (Sch., 1823)

Material examined: 13 specimens, (12♂♂, 1♀); 26 May 2008, N38 56.723 E47 27.145.
Distribution in Iran: West Azarbaijan (Sakenin et al., 2010), Hamedan (Samin et al., 2011). Range: Asia.

Family Pyrrhocoridae Dohrn, 1859

Pyrrhocoris apterus (Linnaeus, 1768)

Material examined: 27 specimens, (16♂♂, 11♀♀); 12 July 2008, N38 53.169 E47 15.784.
Distribution in Iran: Widespread. Range: Holarctic.

Pyrrhocoris marginatus (Kolenati, 1845)

Material examined: 20 specimens, (8♂♂, 12♀♀); 26 June 2009, N38 49.558 E47 23.683.
Distribution: North of Iran. Range: Palaearctic.

Family Coreidae Leach, 1815

Coreus marginatus (Linnaeus, 1758)

Material examined: 13 specimens, (8♂♂, 5♀♀); 26 May 2008, N38 53.169 E47 15.784.
Distribution in Iran: Widespread. Range: Holarctic.

Coriomeris affinis (Herrich-Schäffer, 1839)

Material examined: 15 specimens, (9♂♂, 6♀♀); 26 May 2008, N38 54.926 E47 16.935.
Distribution in Iran: Widespread in N Iran. Range: Holomediterranean, extending to Central Europe and the Middle East.

Family Stenocephalidae Dallas, 1852

Dicranocephalus setulosus (Ferrari, 1874)

Material examined: 27 specimens, (15♂♂, 12♀♀); 5 Augest 2008, N38 56.723 E47 27.145.
Distribution of Iran: Northern and Western provinces of Iran. Range: Holomediterranean, extending to Israel, Iraq, and Turkey (Aukema & Rieger, 2006; Linnavouri, 2007b).

Family Rhopalidae Amyot & Serville, 1843

Corizus hyoscyami (Linnaeus, 1758)

Material examined: 11 specimens, (4♂♂, 7♀♀); 16 April 2009, N38 57.111 E47 17.006.
Distribution in Iran: Widespread. Range: Holarctic.

Maccevethus caucasicus (Kolenati, 1845)

Material examined: 12 specimens, (9♂♂, 3♀♀); 26 June 2009, N38 56.723 E47 27.145.
Distribution in Iran: Widespread. Range: Palaearctic.

Family Cydnidae Billberg, 1820

Cydnus aterrimus (Foster, 1771)

Material examined: 19 specimens, (11♂♂, 8♀♀); 26 May 2008, N38 57.111 E47 17.006.
Distribution in Iran: Northern and Southern provinces. Range: European, widely distributed in the Middle East, Middle Asia, and the Oriental region.

Family Scutelleridae Leach, 1815

Eurygaster maura (Linnaeus, 1758)

Material examined: 20 specimens, (13♂♂, 7♀♀); 2 Augest 2009, N38 56.723 E47 27.145.
Distribution in Iran: East and West Azarbaijan, Gorgan, Mazandaran (Modaress Awal, 1997), Khorasan (Linnavuori, 2008), Zanjan (Akari et al., 2009). Range: Euro-Siberian.

Family Pentatomidae Leach, 1815

Aelia rostrata (Bohemann, 1852)

Material examined: 16 specimens, (11♂♂, 5♀♀); 26 June 2009, N38 49.558 E47 23.683.
Distribution in Iran: Northern and central provinces. Range: Holarctic.

Aelia virgata (Herrich-Schaeffer, 1841)

Material examined: 14 specimens, (13♂♂, 11♀♀); 16 April 2009, N38 55.985 E47 18.034.
Distribution in Iran: Kermanshah, Fars, Lorestan, Markazi, Hamedan, Zanjan, Khorasan and other provinces in N Iran (Havaskary et al., 2012). Range: EUROPE; Bulgaria, Turkey, Greec, Macedonia, Uzbekistan. ASIA; Azerbaijan, Armenia, Turkey (Asian part), Israel, Lebanon, Syria.

Antheminia lunulata (Goeze, 1778)

Material examined: 10 specimens, (6♂♂, 4♀♀); 12 July 2008, N38 56.723 E47 27.145.
Distribution in Iran: Ardabil, Fars, Ghazvin, Gilan, Golestan, Kerman, Khorasan Razavi, Khorasan Shomali, Mazandaran, Semnan, Yazd and Zanjan provinces (Hoberlandt, 1995; Linnavuori, 2008). Range: Euro-Siberian (Linnavuori, 2008).

Ancyrosoma leucogrammes (Gmelin, 1790)

Material examined: 8 specimens, (3♂♂, 5♀♀); 26 May 2009, N38 50.764 E47 22.661.
Distribution in Iran: Gilan, Khorasan (Linnavuori, 2008), Zanjan, East Azarbaijan, West Azarbaijan, Ardabil. Range: Holomediterranean, extending to Central Europe, the Middle East and Central Asia (Linnavuori, 2008).

Apodiphus amygdali (Germar, 1817)

Material examined: 16 specimens, (7♂♂, 9♀♀); 8 July 2009, N38 55.985 E47 18.034.
Distribution in Iran: East Azarbaijan Fars, Tehran, Markazi, Kerman, Hormozgan, Semnan, Balouchestan, Esfahan, Khorasan (Havaskary et al., 2012). Range: EUROPE; Albania, Bosnia Herzegovina, Bulgaria, Croatia, Turkey, Greece, Italy, Macedonia, Yugoslavia. ASIA; Azerbaijan, Armenia, Turkey (Asian Part) Georgia, Iraq, Israel, Lebanon, Syria, Turkmenistan.

Carpocoris coreanus (Distant, 1899)

Material examined: 10 specimens, (3♂♂, 7♀♀); 26 May 2009, N38 53.169 E47 15.784.
Distribution in Iran: Ardabil, East Azarbaijan, Gilan, Semnan, Tehran, Zanjan (Havaskary et al., 2012). Range: Eastern Palaearctic Asia, extending to southern Russia, the Middle East and Pakistan.

Dolycoris baccarum (Linnaeus, 1758)

Material examined: 21 specimens, (14♂♂, 7♀♀); 5 Augest 2008, N38 56.723 E47 27.145.
Distribution in Iran: Ardabil, East Azarbaijan, Fars, Isfahan, Gilan, Golestan, Tehran, West Azarbaijan, Zanjan (Havaskary et al., 2012). Range: Holarctic, also in India and Pakistan.

Eurydema ornata (Linnaeus, 1758)

Material examined: 26 specimens, (11♂♂, 15♀♀); 5 Augest 2008, N38 53.399 E47 12.110.
Distribution in Iran: Ardabil, Azarbaijan, Sistan and Balouchestan, Esfahan, Gilan, Golestan, Kerman, Kermanshah, Khorasan Razavi, Northern Khorasan, Khuzestan, Lorestan, Mazandaran, Tehran and Zanjan provinces(Havaskary et al., 2012). Range: Holarctic.

Graphosoma lineatum (Linnaeuse, 1758)

Material examined: 8 specimens, (3♂♂, 5♀♀); 5 June 2008, N38 53.169 E47 15.784.
Distribution in Iran: Northern and central provinces. Range: Holomediterranean, extending to Central Europe, the Middle East and Central Asia (Linnavuori, 2008).

Neottiglossa leporina Herrich-Schäffer, 1830

Material examined: 9 specimens, (4♂♂, 5♀♀); 26 May 2008, N38 57.111 E47 17.006.

Distribution in Iran: Tehran, Golestan, Khorasan, Razavi, West Azarbaijan, East Azarbaijan (Havaskary et al., 2012). Range: Europe and Asia.

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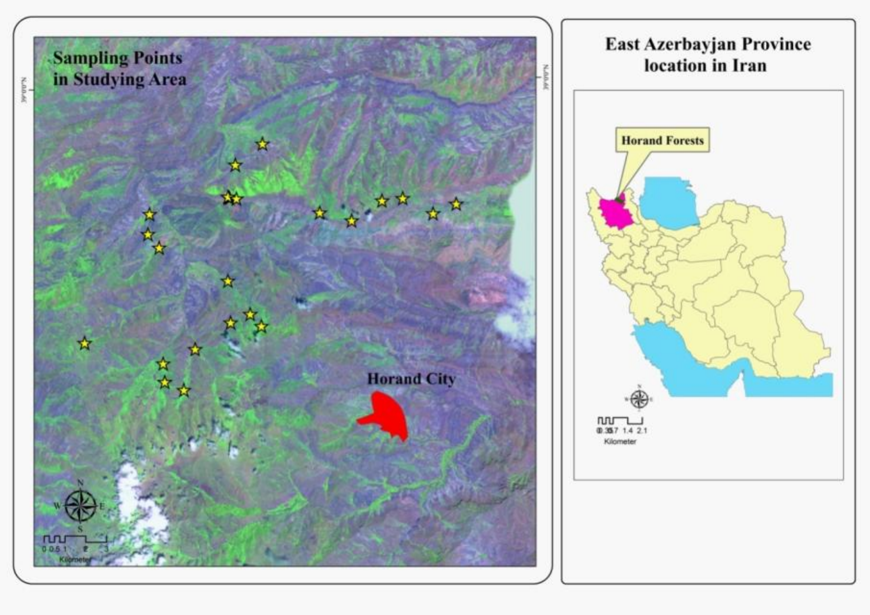

Figure 1. Map of the sampling areas in Horand grasslands, East Azarbaijan Province, northern west of Iran based on satellite images (SPOT).

SUBSTITUTE NAMES FOR TWO PREOCCUPIED GENUS GROUP NAMES IN TREMATODA (PLATYHELMINTHES)

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[Özdikmen, H. 2013. Substitute names for two preoccupied genus group names in Trematoda (Platyhelminthes). Munis Entomology & Zoology, 8 (1): 475-476**]**

ABSTRACT: Two proposed genus names in Trematoda are nomenclaturally invalid, as the genus group names have already been used by different authors in Hemiptera and Lepidoptera respectively. In accordance with Article 60 of the International Code of Zoological Nomenclature, I propose substitute names for these genus group names.

KEY WORDS: Replacement names, *Prionosoma, Loxura,* Monogenea, Digenea, Trematoda.

Family ECHINOSTOMATIDAE
Genus *EDIETZIANA* nom. nov.

Prionosoma Dietz, 1909. Zool. Anz., 34: 190. (Platyhelminthes: Trematoda: Digenea: Echinostomida: Echinostomatidae). Preoccupied by *Prionosoma* Uhler, 1863. Proc. ent. Soc. Philadelphia, 2: 363. (Insecta: Hemiptera: Pentatomoidea: Pentatomidae).

Remarks on nomenclatural change: The genus *Prionosoma* was described by Dietz (1909) with the type species *Prionosoma serratum* (Diesing, 1850) from Brazil and Cuba. It is still used as a valid genus name in the family Echinostomatidae (Trematoda: Digenea).

Nevertheless the name *Prionosoma* is already occupied. Since the name *Prionosoma* was erected by Uhler (1863) with the type species *Prionosoma podopioides* Uhler, 1863 from America. Also, it is still used as a valid genus name in Pentatomidae (Insecta: Hemiptera).

Thus the genus *Prionosoma* Dietz, 1909 is a junior homonym of the valid genus name *Prionosoma* Uhler, 1863. So I suggest here that *Prionosoma* Dietz, 1909 should be replaced with the new name *Edietziana*, as a replacement name.

Etymology: The genus is named after the current author of *Prionosoma,* E. Dietz.

Summary of nomenclatural changes:

Edietziana **nom. nov.**
pro *Prionosoma* Dietz, 1909 (non Uhler, 1863)

Edietziana malacophilum (Perez Vigueras, 1944) **comb. nov.**
from *Prionosoma malacophilum* Perez Vigueras, 1944

Edietziana pricei (Perez Vigueras, 1944) **comb. nov.**
from *Prionosoma pricei* Perez Vigueras, 1944

Edietziana serrata (Diesing, 1850) **comb. nov.**
from *Prionosoma serratum* (Diesing, 1850)

Edietziana zachwatkini (Sergienko, 1970) **comb. nov.**
from *Prionosoma zachwatkini* Sergienko, 1970

Family AXINIDAE
Genus *NEOLOXURA* nom. nov.

Loxura Unnithan, 1957. Bull. cent. res. Inst. Univ. Kerala (C) 5: 45. (Platyhelminthes: Trematoda: Monogenea: Polyopisthocotylea: Axinidae). Preoccupied by *Loxura* Horsfield, 1829. Cat. Lepidopt. Ins. Mus. East India Co., (2) 119. (Insecta: Lepidoptera: Papilionoidea: Lycaenidae: Theclinae: Loxurini).

Remarks on nomenclatural change: Firstly, the genus group name *Loxura* was proposed by Horsfield (1829) with the type species *Papilio atymnus* Stoll, 1780 by original designation from India in Lepidoptera. It is still used as a valid genus name.

Subsequently, the genus *Loxura* was described by Unnithan (1957) with the type species *Loxura ananaphallus* Unnithan, 1957 by original designation from India. The name is currently used as a valid generic name in Trematoda.

Thus the genus *Loxura* Unnithan, 1957 is a junior homonym of the valid genus name *Loxura* Horsfield, 1829. Under the International Code of Zoological Nomenclature (ICZN 1999) it must be rejected and replaced. So, I suggest here that *Loxura* Unnithan, 1957 should be replaced with replacement name *Neoloxura* nom. nov..

Etymology: The name is named after the current genus name, *Loxura,* + the Latin prefix “neo” (meaning in English “new”).

Summary of nomenclatural changes:

Neoloxura **nom. nov.**
pro *Loxura* Unnithan, 1957 (non Horsfield, 1829)

Neoloxura ananaphallus (Unnithan, 1957) **comb. nov.**
from *Loxura ananaphallus* Unnithan, 1957

Neoloxura peruensis (Oliva & Luque, 1995) **comb. nov.**
from *Loxura peruensis* Oliva & Luque, 1995

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EFFECTS OF DIFFERENT IRRIGATION INTERVALS ON *MONOSTERIA UNICOSTATA* (HETEROPTERA: TINGIDAE) DENSITIES IN NINE POPLAR SPECIES AND CLONES IN KARAJ, IRAN

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[Tahriri Adabi, S., Sadeghi, S. E. & Bagheri, R. 2013. Effects of different irrigation intervals on *Monosteria unicostata* (Heteroptera: Tingidae) densities in nine poplar species and clones in Karaj, Iran. Munis Entomology & Zoology, 8 (1): 477-485**]**

ABSTRACT: Like many countries, water is one of the most important limiting factors for poplar plantation in Iran. So there is essential to study water amount needed for every poplar species and clones. During the years 2009-2010 effects of irrigation intervals on poplar lace bug, *Monosteria unicostata* (Mulsant and Rey) damage rate were studied on the nine poplar clones in Alborz Research Station of Karaj. This study was carried out under a split plot design. Three irrigation intervals with 4, 8 or 12 days interval of irrigations were considered as main experimental plots and nine poplar clones were secondary treatments. This experiment had three repetitions. Two ways analyze of variance were performed. Analyze variance table showed significant differences between irrigation intervals and poplar species and clones ($\alpha < 0.01$). Poplar lace bug density was significantly higher under 4 days irrigation interval than two others treatments. The density of the pest was significantly highest in *P. trichocarpa*. A significant interaction was found between irrigation intervals and the poplar clones. It means that more irrigation could provide suitable conditions for growth and development of *M. unicostata* on every poplar clones.

KEY WORDS: Poplar, clones, *M. unicostata,* irrigation intervals.

Forestry by short-term and compact culture of woody crop species was regarded from 30 years ago, as a rapid manner to produce wood and cellulose sources (Tuskan, 1998). Poplar (*Populous* spp.) from Salicaceae family is one of the fastest growing trees in temperate regions of the world. It has potential for producing a large volume of wood and lumber and used as an ornamental plantings, pulp, plywood, windbreaks, landscapes, soil stabilizers and phyto-remediation (Asare & Madison, 2000). Over 400,000 hectares of Iran are suitable for poplar plantation. Forests and rangelands organization of Iran intend to use this suitable surface for growing fast growth trees such as poplar species. Since 1963, native and exotic species and clones of poplars have been studied under different climates of Iran consistently. These researches comprise evaluation of some agro-technical factors like effects of poplar plantation intervals on yield (Asadi et al., 2005) and different pest densities (Sadeghi, 2008). Effects of tree's shadow on yield of poplars and its pests densities were studied (Sadeghi et al., 2008). They include effects of poplar clones and irrigation intervals on weeds species and clones in nursery (Fanaei, 2011). Khabir & Sadeghi (2012) studied effects of agroforestry system on damage of *Melanophila picta* Pall. In addition, several studies have been carried out on resistance and susceptibility of poplar species and clones against poplar pests and diseases (Modir-Rahmati et al., 1997; Augustin et al., 2000; Han & Fang, 2000; McNabb et al., 2000; Meilan et al., 2000; Singh, 2000; Villar et al., 2000; Yan et al., 2000; Singh & Pandey, 2002; Sadeghi, 2004; Nordman et al., 2005; Sadeghi et al., 2006; Sadeghi, 2007; Hannon et al., 2008; Nikdel & Dordaei, 2008; Ahadiyat et al., 2010; Babmorad et al., 2010; Pahlevan-Yali et al., 2010; Pearson et al., 2010). Poplar lace bug, *M. unicostata*, is one of the most economically important sucking pests of poplar in Iran (Sadeghi, 2004; Sadeghi, 2007). This insect produces pale spots on upper side and small black points on underside leaves of poplar and willow host species. It makes leaves start falling down and trees become weakness and susceptive to some pest attack including xylophagous (Neal & Schaefer, 2000). This insect pest is presented nearly whole part of the country (Sadeghi et al., 2002; Haghighian & Sadeghi, 2006). Babmorad & Sadeghi (2004) reported this pest on 18 species and 50 clones of poplar in Karaj. Babmorad et al. (2010) and Ahadiyat et al. (2010) studied susceptibility and resistance of poplar species and clones against the pest. Because of being one of the poorest countries in water resources, poplar culture is limited in Iran. Annual average raining in Iran is about 250 millimeters which is lower than Asia. Iran is located on 25-40 degrees of latitude and 44-64 degrees of longitude and 76 percentages of regions of Iran go on drought (Hayati & Lari, 2010). Therefore, there is essential to study on effect of water supply on yield and pests densities of poplar. Guo et al. (2010) have studied effects of flooding water on physiology, morphology and growth response of 13 clones of poplar. Pearson et al. (2010) searched effects of short term and intensive culture on yield of poplar. LeBoldus et al. (2007) studied effect of irrigation stresses on poplar clones. White (1974) showed drought stresses can change herbivorous pest densities of poplar trees. Daane & Williams (2003) have studied effects of irrigation intervals on density of herbivorous insects of vines. Trueta (1993) investigated leafhopper densities on vines under different amounts of irrigation regimes. Irrigation amounts could be manipulated in the relationship between irrigation amounts and some insect pest density (Trichilo et al., 1990). The aim of this study is an evaluation interval of irrigation on *M. unicostata* densities on poplar species and clones in Karaj, Iran.

MATERIALS AND METHODS

The experiments were carried out in Alborz Research Station of the Research Institute of Forests and Rangelands (RIFR) in Karaj. Base of previous studies that had done on adaptabilities of different poplar species and clones in Karaj condition by research Institute of Forests and Rangelands of the country, nine poplar clones with highest yield were selected and used for this study. Theses clones are include *Populus trichocarpa*, *P. euramericana triplo*, *P. euramericana* 561.41, *P. euramericana vernirubensis*, *P. nigra betulifolia*, *P. nigra* 42.78, *P. nigra* 62.154, *P. deltoides* 69.55, *P. alba* 44.9. The experiments design applied for this study was split plot with 3 repetitions. Each repetition was divided to 3 plots known main treatment (irrigation intervals; 12, 8 and 4 days). Each main plot was divided to 9 accessorial treatments. Each accessorial plot included 9 trees of one poplar clone with 2.5*2.5 meters intervals plantation. During 2009-2010 from each tree, 8 leaves were randomly selected in four main geographical directions of trees. Then the numbers of *M. unicostata* (nymphs and adults) were counted and registered. Finally, the leaves were transferred to the RIFR laboratory and their surfaces were measured by a leaf area meters device (Gate house, scientific instrument LTD) in order to calculate number of this pest in surface unit. The recorded data were analyzed by SAS software, (LSD).

RESULTS

Two ways analysis of variance shows significant difference between main treatments (irrigation intervals) for *M. unicostata* density (Table 1). Meanwhile this table shows that poplar clones had significant effect on poplar lace bug densities. According to the table, interaction of irrigation interval treatments and poplar species and clones were significant. The highest density of *M. unicostata* registered under 4 day irrigation interval (Table 2), but there is no significant difference between 8 and 12 day irrigation intervals. Dancun's means comparisons showed the highest density of *M. unicostata* on *P. trichocarpa*. *P. alba* 44.9, *P. nigra betulifolia* and *P. nigra* 62.154 set in the next levels considering *M. unicostata* density. The least density of *M. unicostata* obtained on *P. euramericana triplo* and *P. deltoides* 69.55 (Table 3). Table 4 shows the highest density of *M. unicostata* observed on *P. trichocarpa* treated 4 and 12 days irrigation intervals. *P. alba* 44.9 had high density of the pest under 3 levels of irrigation but there was no significant difference between them. *P. nigra* 62.154 and *P. nigra betulifolia* had higher density of *M. unicostata* treated by 4 days than 8 and 12 days, significantly. Densities of *M. unicostata* on *P. nigra* 42.78 and *P. euramericana vernirubensis* were different in 3 intervals irrigation, significantly. *P. euramericana triplo*, *P. euramericana* 561.41 *and P. deltoids* 69.55 did not show any significant difference treated by the irrigation intervals.

DISCUSSION

The highest density of *M. unicostata* was registered under four days interval of irrigation, having significant different from 8 and 12 days irrigation intervals. As adult and fifths nymph instars of the pest are feeding from poplar sap, so high provided amount of water in 4 days interval in comparison to 8 and 12 days, make poplar species and clones more susceptible against this sucking pest. These results are confirmed by some studies that show plant stresses change plant quality as a proper food for sucking insects (Mattson & Haack, 1987). Stresses change insect's life history indirectly and host plant physiology directly as well (Schultz, 1988; Waring & Price, 1990; Waring & Cobb, 1992; Schowalter et al., 1999; Breshears et al., 2005; Ditmarová et al., 2010; Ryan & Way, 2011). Rouault et al. (2006) showed water stress effects on population of forest insect pests. Perfect et al. (1986) have confirmed applied water influence on pest management programs. Climate and nature changes affect insect life-factors (Netherer & Schopf, 2010). Huberty & Denno (2004) showed that water stresses of host plant affect herbivorous population dynamics, especially sap-feeders and gall-makers. Survey of Daane & William (2003) showed that leafhopper density had a positive linear function with applied water amounts. Trueta (1993) showed higher leafhopper densities found on vines receiving greater amounts of irrigation water. Patel et al. (2010) showed increasing of irrigation intervals enhance population of thrips, *Scirtothrips dorsalis* Hood in Chili. Perfect (1988) indicated irrigation is an affective factor for the management of agricultural pests. According to Kannan & Mohamed (2001) densities of *Thrips tabaci* Lindeman on onion, increased over short irrigation regimes and reduced over longer irrigation regimes. Simpson et al. (2012) demonstrated that drought reduce the population of *Myzus persicae* Sulzer on cabbage. Tariq et al. (2012) reported that drought affects fecundity and intrinsic rates of increase of *Brassica oleracea* L. and *M. persicae* on *Brassica oleracea*. Research of Paine & Hanlon (2010) verified populations of red gum lerp psyllid, *Glycaspis brimblecombei* Moore increased by lower amount of irrigation and higher fertilization than higher irrigation level and no fertilization. Mody et al. (2009) and Staley et al. (2006) recorded water stresses enhance and reduce susceptibility of plants against insect pests. King et al. (2006) showed water deficiency affect on *Lipaphis erysimi* (Kaltenbach) and *Brevicoryne brassicae* (L.), on canola (*Brassica napus* L.). Daane et al. (1995) reported that density, size, number and reproductive potential of variegated grape leafhopper, *Erythroneura variabilis* Beamer are higher under increase amount of applied water. Under water stresses adult survival and total aphid number of *Macrosiphum euphorbiae* (Thomas) reduces significantly on popato *Solanum tuberosum* L., fields (Nguyen et al., 2007). Johnson et al. (2011) showed drought decreased abundance of *Rhopalosiphum* sp. Density of *M. unicostata* on *P. trichocarpa* is statistically higher than the other tested clones. The clones *P. alba* 44.9, *P. nigra betulifolia* and *P. nigra* 62.154 placed in the second and third levels of infection. Without accounting on irrigation treatments, *P. euramericana triplo* and *P. deltoids* 69.55 clones had significantly lowest infection to *M. unicostata*. These results confirmed by some researches such as studies of Ahadiyat et al. (2010), Sadeghi (2004), Babmorad et al. (2010) and Sadeghi et al. (2006). Ahadiyat et al. (2010) observed highest density of *M. unicostata* on *P. nigra* and *P. alba* and the lowest on *P.euramericana* and *P. deltoids*. Sadeghi (2004) studied on poplar species and clones including, *P. nigra* 63.135, *P. euramericana triplo*, *P. alba*, *P. trichocarpa*, *P. deltoids* 77.51 and *P. e. verniruben*. They showed *P. trichocarpa* and *P. euramericana triplo* being the highest and the least preferred host against *M. unicostata* respectively. According to the researches *P. trichocarpa* had the highest susceptibility against *M. unicostata* under different irrigation intervals. Besides, some researchers (Sadeghi et al., 2006; Babmorad et al., 2010) recorded the maximum eggs of *M. unicostata* on this clone as well. This clone is not recommended to culture for wood production in Karaj because of short growth regime and fast falling down (Bagheri, 2010). *P. alba* 44.9 showed high infection to poplar lace bug under 3 intervals of irrigation. Babmorad et al. (2010) recorded susceptibility of clones against this pest. Also Babmorad et al. (2010) recorded the highest egg amounts of *M. unicostata* on *P. alba* 58.57 and on *P. alba* 44.9 and the lowest was seen on *P. deltoides* 77.51, *P. deltoides* 73.51, *P. deltoides* 69.55 and *P. x euramericana* 561.41. Sadeghi et al. (2004) recorded that leaves of *P. alba* was more infected to *M. unicostata* eggs than leaves of *P. deltoids*. The highest and the least infection had reported in theses to poplar clones respectively. Bagheri (2010) showed clones of this species are susceptive against drought stresses. Considering its slow growing, it just recommended for landscapes programs. According to this study, all of the *P. nigra* clones showed high infection to the pest. *P. nigra* 62.154 has a long growth, suitable volume and density of top, closed top, furrow plantation and resistant against drought stress compared to the other varieties (Bagheri, 2010). Therefore, it is suitable for wood production in regions where *M. unicostata* is not key pest of poplar. Considering high wood production of *P. euramericana vernirubensis* and *P. euramericana* 561.41 (Bagheri, 2010) and resistance to poplar lace bug (Sadeghi, 2004; Sadeghi et al., 2006; Ahadiyat et al., 2010; Babmorad et al., 2010), can being as a candidate for poplar plantation. New researches demonstrated *P. euramericana triplo* and *P. deltoides* 77.51 having lower infection against this pest (Sadeghi, 2004; Sadeghi et al., 2006; Ahadiyat et al., 2010; Babmorad et al., 2010) and resistance to drought stresses (Bagheri, 2010). In conclusion, 8 days irrigation interval is the most reasonable irrigation regimes in Karaj region, because yield of poplar compared with 12 days, is higher, density of *M. unicostata* in comparing with 4 days interval is lower and can economize save at least about 7500 m3 water compared to 4 days interval (Bagheri, 2010).

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Table 1. Two ways analysis of variance table of *M. unicostata* densities on 9 poplar clones on three irrigation regimes.

Variation sources	density of *M. unicostata*			
	df	Mean Square	*F*-value	*P*-value
I	2	0.708	25.49	<.0001**
C	8	1.896	68.25	<.0001**
I*C	16	0.278	10	<.0001**

I: Irrigation interval, C: Clone, **: significant difference at α = 1%

Table 2. Means number of *M. unicostata* in each cm² on irrigation intervals.

Irrigation regimes	Mean
Every 4 days	0.064a
Every 8 days	0.034b
Every 12 days	0.037b

Means followed by the same letter are not significantly different (*P* = 0.05; SAS Institute 2002).

Table 3. Means number of *M. unicostata* in each cm² of leaves of poplar clones.

Clones	mean
P. n. betulifolia	0.054c
P. n. 42.78	0.027d
P. n. 62.154	0.058c
P. a. 44.9	0.076b
P. e. triplo	0.005e
P. e. vernirubensis	0.018de
P. e. 561.41	0.016de
P. d. 69.55	0.003e
P. trichocarpa	0.15a

Means followed by the same letter are not significantly different (*P* = 0.05; SAS Institute 2002).

Tabe 4. Means number of *M. unicostata* on 9 poplar clones under three different irrigation intervals.

Clones	Irrigation intervals		
	12 days	8days	4days
P. n. betulifolia	0.0028 ± 0.0008i	0.0491 ± 0.0132fgh	0.1268 ± 0.0342b
P. n. 42.78	0.0017 ± 0.0006i	0.0497 ± 0.0128fgh	0.0279 ± 0.0016ghi
P. n. 62.154	0.0534 ± 0.0031efg	0.0052 ± 0.0019i	0.1162 ± 0.0144bc
P. a. 44.9	0.083 ± 0.0108de	0.0851 ± 0.0136cde	0.0621 ± 0.0076ef
P. e. triplo	0.0037 ± 0.0008i	0.0033 ± 0.0016i	0.0069 ± 0.0017i
P. e. vernirubensis	0.0015 ± 0.0004i	0.0013 ± 0.0006i	0.0524 ± 0.0075efg
P. e. 561.41	0.0014 ± 0.0004i	0.0173 ± 0.0054hi	0.0303 ± 0.0045fghi
P. d. 69.55	0.0010 ± 0.0004i	0.0026 ± 0.0008i	0.0057 ± 0.0016i
P. trichocarpa	0.1898 ± 0.0191a	0.0961 ± 0.0116bcd	0.1653 ± 0.0097a

Means followed by the same letter are not significantly different
(*P* = 0.05; SAS Institute 2002).

THE CAPTURE EFFECTS OF YELLOW STICK TRAPS IN THE DIFFERENT WAVELENGTHS TO THE ADULTS OF *AGONESCENA PISTACIAE* BURC. & LAUT. (HEMIPTERA: PSYLLIDAE) FROM TURKEY

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[Özgen, İ., Ayaz, T., Mutlu, Ç. & Bolu, H. 2013. The capture effects of yellow stick traps in the different wavelengths to the adults of *Agonescena pistaciae* Burc. & Laut. (Hemiptera: Psyllidae) from Turkey. Munis Entomology & Zoology, 8 (1): 486-492**]**

ABSTRACT: This study was carried out between 2008 to 2009 years in pistachio orchards in Siirt province of Turkey. For this study, various shades of yellow plates on the market on the metal plate cut 15-20 cm in length scales in different RAL (1021, 1003, 1018, 1046, 0.279, 1012, 1023, 1028) in the form of a small yellow plates glued to the edge of the trees were hung on pegs . As a control, a colorless stretch film on the metal plate suspended from the trap by passing averages were calculated for 5 applying any color tone. For this purpose, damaging pest populations are monitored on a weekly basis after the launch EZE per sheet of 20/30 nymphs / leaf, or a compound which is half of 10/15 nymphs / leaf density of the composite hanging traps and counts 1, 4 and 7 were the days. The capture effects of *A. pistaciae* was determined in the 1,4 and 7 days. The results of the study, statistical evaluation of the trap code 1016 is higher than the gravitational forces and other code groups into different tests except the control group in the trap in three groups of different tests were entered. Second experiment, the trap 1016 coded in different shades (1016A, 1016B, 1016C, 1016D, 1016, 1016F, 1016G, 1016H) activities are investigated and statistically evaluated results of studies into different groups according to 1016 B-coded into the trap, and most other groups of adult individuals were captured.

KEY WORDS: *Agonescena pistaciae*, yellow stick traps, wavelengths, capture effect.

Turkey is one of the origin of the pistachio. Pistachio was cultured for the first time in Southeastern Anatolia in Eti's period. Turkey is in the third place in pistachio production following Iran and USA 90% of the pistachio production is Southeastern Anatolia (Anonymous, 2002). There are a lot of pests effect pistachio production Bolu (2002) has determined 8 important hazardous species in the investigation made on the insect and mite fauna in the pistachio fields within Southeastern Anatolian Region. These species are: *Anapulvinaria pistaciae* Bod., *Eulecanium rugulosum* Arch., *Kermania pistaciella Amsel., Chatoptelis* (*Hylesinus*) *vestitus* Mulsant et Rey*, Suturaspis pistaciae* Lindinger.*, Megastigmus pistaciae* Walker*, Idiocerinus stali* Fieb. and *Agonoscena pistaciae* Burck. and Laut.. *Agonoscena pistaciae* is very important pistachio pest in Turkey pistachio crops. It have aproximately six or seven generation every year. Pest appear following of middle of May in study area, and pesticides are sprayed 2 or 3 times per pear. Every year is used some insecticides on this pest in pistachio orchards in Turkey. In this reason, there are some need to alternative struggle methods except the chemical methods. Hirota & Kato (2001) indicated that the color of yellow causes reflection on the yellow objects which attract the insects at a level higher than the normal values in order words the all the phytophage insects are attracted by the color of yellow. Hadian & Seyedoleslami (2001) used yellow glued traps in order to determine the adult population density and sexual ratio of the pistachio psyllid *Agonescena pistaciae* Burkhard & Lauterer (Hem.: Psyllidae) and found out that the yellow sticky traps are important for the seasonal population studies.

MATERIAL AND METHODS

In this study, the *A. pistaciae* adult catching effects of the yellow trap whose mixture has been adopted according to the RALE code having 8 different wave lengths has been analyzed (Table 1 & Fig. 1).

The small plates having 8 different codes located on the same trap have been hung on the traps of 1 meter and *A. pistaciae* adult catching effects in the 1st, 4th and 7th day have been determined. This study has been started on 22.09.2008 in the Center pistachio garden in the city of Siirt in 10/15 nymph/composite leaf density that is in 15 (average) nymph density that is the half of the economical injury level 20/30 nymph/composite leaf.

RESULTS

During the population follow up of the pests, the follow up of the adult, nymph and egg periods of the pests in 100 leaves in total gathered from 10 leaves in each gardens after the trees have come into leaf have been made. We are determined of *Agonescena pistaciae* population fluctutations in Siirt province (two different locations: Central and Aydınlar). It is demonstrated of Figs. 2, 3, 4, 5.

When the population shift of *A. pistaciae* in both traps has been analyzed, it has been found out that the population density in the center of the district is higher than that of in Aydınlar district. When the population density of each year has been analyzed, it has been found out that the population of *A. pistaciae* is higher in 2008 compared to 2009. We are used of different yellow tones to *A. pistaciae* these population levels (critical levels: 2008:2009 years) (Figs. 6, 7, 8, 9, 10, 11).

When the results of the study have been analyzed statistically, it has been observed that the attraction power of the trap code 1016 is higher than the other ones and that it is included in a different statistical group and the other three trap groups are included in a different statistical group (Table 2).

The result of the study: since the trap code 1016 has statistically been found to be more effective than the other traps, trials have been established by means of making certain color whitening and applications on the trap code 1016 (1016 A,B,C,D,E,F,G,H) (Figs. 12, 13, 14). When the results of the study have been analyzed statistically, it has been observed that the trap code 1016 B is included in a different group and that it is the trap that catches the most adults (Table 3).

When the number of the adults caught by the traps has been evaluated in terms of the days they have been caught, the 1st, 4th and 7th days have been included in a different group in terms of catching the adults and the traps that caught the most have been those hung in the 7th day (Table 4).

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Table 1. Rale codes of yellow sticky traps.

Number	**Code**	**Name of Code**
1	1021	Kadmiumgelb
2	1003	Signalgelb
3	1018	Zinkgelb
4	1046	Schwefelgelb
5	0,279	Scaniagelb
6	1012	Zitronengelb
7	1023	Werkehesgelb
8	1028	Melonengelb

Table 2. Statistical groups of different ral codes.

Level						**Least Sq Mean**
kod 1016	A					41,100000
kod 1012		B				28,366667
kod 1018		B	C			27,383333
kod 1023		B	C	D		25,933333
kod 1021			C	D		22,616667
kod 279			C	D		22,466667
kod 1003			C	D		22,233333
kod 1028				D		21,566667
Kontrol					E	10,000000

Table 3. Statistical groups of different 1016 ral code.

Level					**Least Sq Mean**
1016 B	A				31,000000
		B			25,666667
1016 H		B	C		24,666667
		B	C		24,333333
1016 E		B	C		24,333333
		B	C		24,333333
		B	C		24,000000
1016 D			C		21,333333
Kontrol				D	9,333333

Table 4. Statistical analyses of capture effects in different days.

Level				**Least Sq Mean**
7	A			29,888889
4		B		25,333333
1			C	14,444444

Figure 1. Yellow sticky trap (different plates).

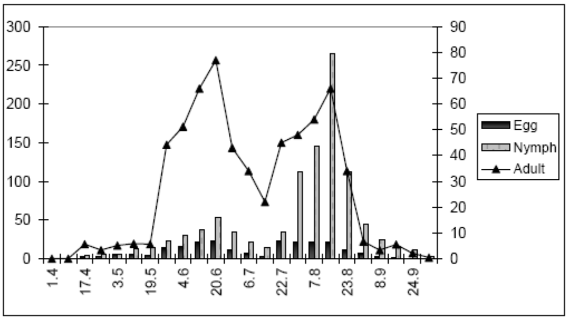

Figure 2. The population fluctutations of *Agonescena pistaciae* in Siirt (Central) in 2008.

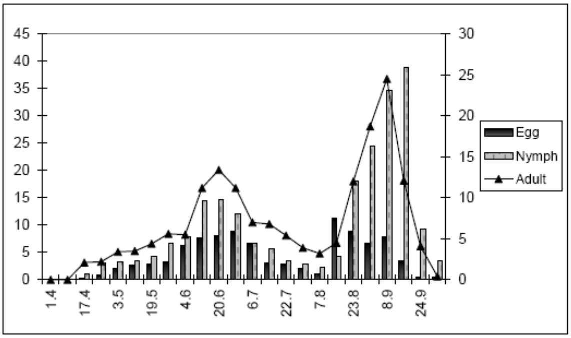

Figure 3.The population fluctutations of *Agonescena pistaciae* in Siirt (Aydınlar) in 2008.

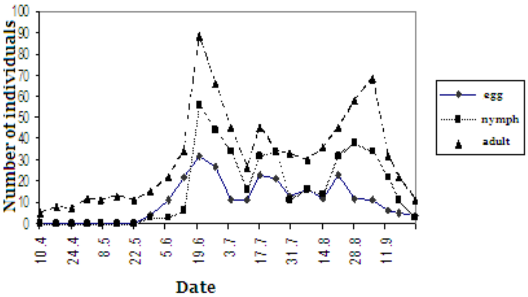

Figure 4 .The population fluctutations of *Agonescena pistaciae* in Siirt (Central) in 2009.

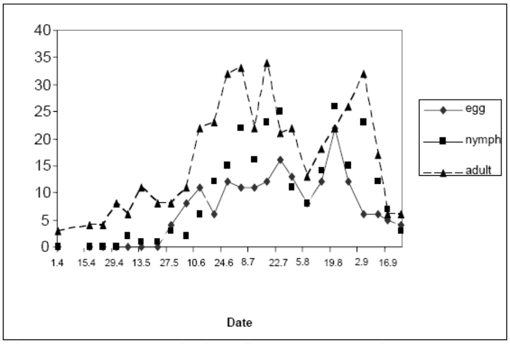

Figure 5 .The population fluctutations of *Agonescena pistaciae* in Siirt (Aydınlar) in 2009.

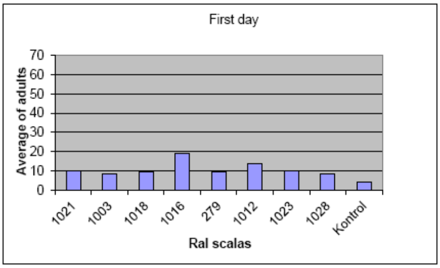

Figure 6 .The capture effects on first day of *Agonescena pistaciae* in the different ral codes (2008).

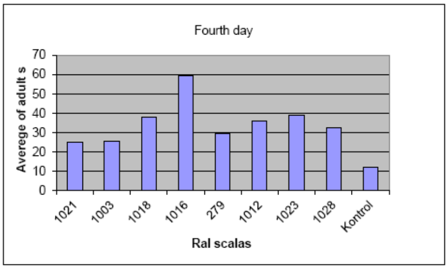

Figure 7. The capture effects on fourth day of *Agonescena pistaciae* in the different ral codes (2008).

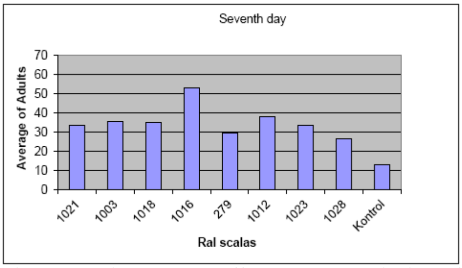

Figure 8. The capture effects on seventh day of *Agonescena pistaciae* in the different ral codes (2008).

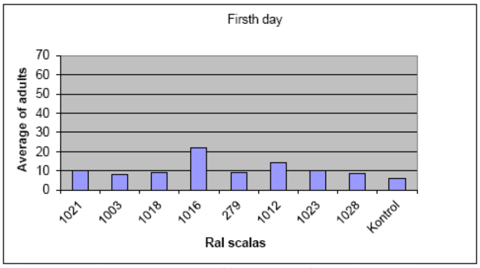

Figure 9.The capture effects on first day of *Agonescena pistaciae* in the different ral codes (2009).

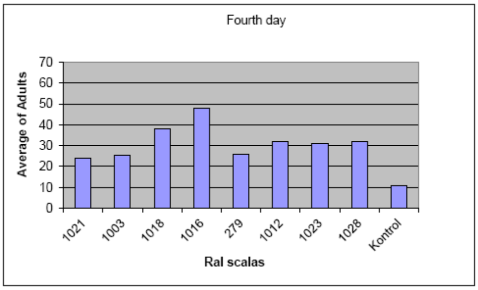

Figure 10. The capture effects on fourth day of *Agonescena pistaciae* in the different ral codes (2009).

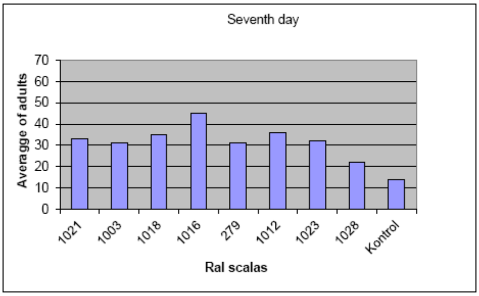

Figure 11. The capture effects on seventh day of *Agonescena pistaciae* in the different ral codes (2009).

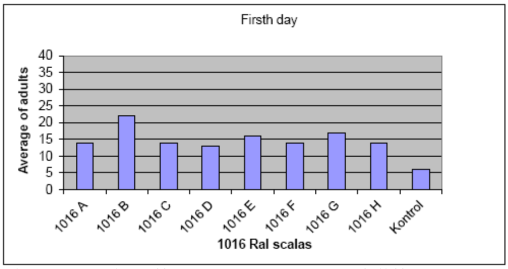

Figure 12. The effects on *A.pistaciae* of different tones of 1016 trap (1st Day).

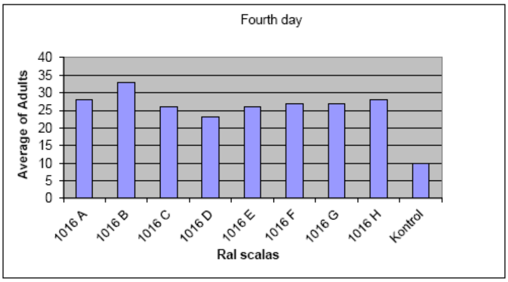

Figure 13. The effects on *A.pistaciae* of Different tones of 1016 trap (4th Day).

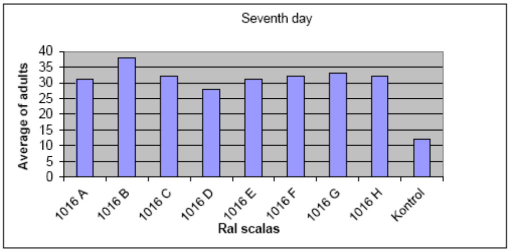

Figure 14. The effects on *A.pistaciae* of Different tones of 1016 trap (7th Day).

DORCADION (*MEGALODORCADION*) PESARINI & SABBADINI, 1998 WITH A NEW SPECIES FROM TURKEY (COLEOPTERA: CERAMBYCIDAE)

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ABSTRACT: The Turkish endemic subgenus *Dorcadion* (*Megalodorcadion*) Pesarini & Sabbadini, 1998 is evaluated. And also the following new taxon is described: *Dorcadion* (*Megalodorcadion*) *dombilicoides* sp. n. from Turkey, close to *D. glabrofasciatum* Daniel, 1900. A short key to the identification of the species of *Dorcadion* (*Megalodorcadion*) is proposed.

KEY WORDS: Cerambycidae, Dorcadioninae, *Dorcadion, Megalodorcadion*, new species, Turkey.

The subgenus *Megalodorcadion* was proposed by Pesarini & Sabbadini (1998) with the type species *Dorcadion ledereri* Thomson, 1865 by original designation. They stated that the subgenus includes 6 species as *D. angorense, D. escherichi, D. glabrofasciatum, D. ledereri, D. parallelum, D. walteri*. All species are endemic to Turkey.

Also, Özdikmen (2010) stated 6 species (including *D. angorense*) on the base of Pesarini & Sabbadini (1998). However, Löbl & Smetana (2010) gave *D. angorense* as a synonym of *D. escherichi*. So they mentioned only 5 species for the subgenus *Megalodorcadion* in their catalogue. Both taxa, *D. angorense* and *D. escherichi,* were described by Ganglbauer (1897) from Ankara province in Turkey. And also *D. angorense* was described only on the base of a male specimen. Now, I agree with Löbl & Smetana (2010) that the mentioned characters in the original description fall into the variability of *D. escherichi* (see below). Anyway, *D. angorense* was also given by Breuning (1962) as a morpha of *D. escherichi.*

Original description of *Dorcadion angorense* Ganglbauer, 1897:

> ***Dorcadion angorense* Ganglb. n. sp.**
>
> ♂. Praecedentum maribus simile, differt prothoracis tuberculis lateralibus obtusis, anticis et prothoracis vittis nigro velutinis multo lateribus, linea media albo tomentosa angusta, elytrorum sutura angustus albo-tomentosa, vitta dorsali postice abbreviata, cum humerali band conjuncta, palporum articulis medio infuscatis, tarsis omnibus basi excepta nigro piceis. Long. 19 mm. Lat. elytr. 6,5 mm.
>
> ♀ ignota.

The number of species of the subgenus *Megalodorcadion* is 6 with a new species that described in the present work. First group includes 3 species as *D. escherichi, D. ledereri* and *D. walteri*. Second group includes only 1 species as *D. parallelum*. Third group includes 2 species as *D. glabrofasciatum* and the new species*, D. dombilicoides* sp. n..

Used faunal areas and faunal subareas for Turkey in the text were proposed by Özdikmen (2010).

All taxa of the subgenus *Megalodorcadion* are presented alphabetically as follows:

Genus *DORCADION* Dalman, 1817

Subgenus *MEGALODORCADION* Pesarini & Sabbadini, 1998

Dorcadion dombilicoides sp. n.

(Fig. 1, 2)

Type serie. Holotype ♂: Turkey, Çorum prov.: Gölünyazı district, VI.2012. Paratypes 2 ♀♀: from the same locality with holotype. The specimens are conserved in Gazi University (Ankara province, Turkey).

Description:

Body length: 21.88 mm.

Body black, underside partly reddish brown, covered with rather dense, recumbent, short yellowish-white pubescence.

Head black except reddish palpi. Labrum with fringed margins of reddish-yellow distinct hairs. Head on vertex almost glabrous with very sparsely scattered finely punctuated. Antennae black except dark reddish colored on the outside of first segment.

Pronotum transversal and almost completely glabrous except a tuft of dense white hairs in the median line. Pronotum with very sparsely and finely punctuated, but coarser and denser on the sides except the disc. Lateral hump of pronotum pointed. Scutellum small and triangular with white pubescence. Elytra with blackish ground pubescence, each elytron with complete 1 lateral band, 1 humeral band, 1 dorsal band, almost entirely mottled with blackish hairs 1 presutural band (white hairs visible only at the base), and distinct 1 sutural band of white pubescence. The bands narrowed from lateral band to sutural band gradually. So the row of bands from the widest to the narrowest is lateral band, humeral band, dorsal band and sutural band. Presutural band with black spots almost entirely, white pubescence recognizable only at the base. Dorsal band joined humeral band at the apical part of elytron (four fifth of elytral length). Pygidium can see above clearly. Legs almost reddish completely, only the femora with blackish patterns on inside and outside apically.

Differential diagnosis. The new species is in the subgenus *Dorcadion* (*Megalodorcadion*) definitely. This group includes 6 species as *D. dombilicoides* sp. n., *D. escherichi, D. glabrofasciatum, D. ledereri, D. parallelum* and *D. walteri*. All species are endemic to Turkey.

Male: *D. glabrofasciatum* Daniel, 1900 is closely related species to the new species. It is easily distinguished from *D. glabrofasciatum* by longer elongated body (about 14 mm in *D. glabrofasciatum*, 21.88 mm in the new species), elytral bands clear (bands expunged in *D. glabrofasciatum*), and very weaker pubescence of head and pronotum (Fig. 1, 3). It is more different from the remaining species (Fig. 3).

Female: It is very close to the female of *D. glabrofasciatum* in respect to the elytral design. It is easily distinguished from *D. glabrofasciatum* by larger and longer body (about 14 mm in *D. glabrofasciatum*, 22.50-23.75 mm in the new species), more glabrous head and pronotum (*D. glabrofasciatum* with dense pubescence on head and pronotum) (Fig. 2) reddish colored first antennal segment only on the outside (antenna is completely black in *D. glabrofasciatum*) (Fig. 3), reddish colored legs (legs are more darker than the new species in *D. glabrofasciatum*) (Figs. 2, 3).

Etymology. From a word of Turkish jargon "dombili" (meaning in English, "pretty, fat and large").

The new species is endemic to the NC-Anatolian (Pontic) faunal subarea of N-Anatolian faunal area for Turkey now. Namely, it distributes only in Central part of Northern Anatolia for Turkey.

Dorcadion escherichi **Ganglbauer, 1897: 54**

(Figs. 3A,B)

Type loc.: Ankara prov. (Turkey)

Other names: *angorense* Ganglbauer, 1897: 57; *egregium* Ganglbauer, 1897: 56; *obliquesignatum* Pic, 1900: 12; *posticedisjunctum* Pic, 1909: 99; *cappadocicum* Breuning, 1946: 132.

Records in Turkey: Ankara prov. as the type loc. (Ganglbauer, 1897; Aurivillius, 1921); **Ankara** prov. as *D. egregium* and *D. angorense* (Ganglbauer, 1897; Aurivillius, 1921); **Bilecik** prov. (Bodemeyer, 1900); **Ankara** prov. as *D. egregium* and **Konya** prov. as *D. escherichi* ab. *obliquesignatum* (Aurivillius, 1921); **Turkey** as *D. egregium* (Winkler, 1924-1932; Lodos, 1998); **Ankara** prov., **Konya** prov., **Cappadocia** (Breuning, 1962); **Ankara** prov.: Gölbaşı (Braun, 1978); **Ankara** prov.: Central, Hüseyin Gazi Mt., **Konya** prov., **Amasya** prov., **Tokat** prov.: Turhal, Niksar (Önalp, 1990); **Anatolia** (Pesarini & Sabbadini, 1998; Danilevsky in Löbl & Smetana, 2010).

Distribution: Turkey.

Chorotype: Anatolian.

This species is endemic to CN-Anatolian (Galatio-Paphlagonian), CS-Anatolian (Lycaonian), CSE-Anatolian (Cappadocian) faunal subareas of C-Anatolian faunal area and NW-Anatolian (Bithynio-Mysidian), NC-Anatolian (Pontic) faunal subareas of N-Anatolian faunal area for Turkey. Namely, it distributes in Central Anatolian Region, Central and Western parts of Northern Anatolia for Turkey.

Dorcadion glabrofasciatum **Daniel, 1900: 140**

(Figs. 3C,D)

Type loc.: Bithynia (Turkey)

Other names: *imparivittatum* Daniel, 1900: 140; *parivittatum* Breuning, 1946: 98; *glabroseparatum* Breuning, 1962: 310.

Records in Turkey: (AF-BI-ES-IZ-TUR-US)
Anatolia as the type loc. (Daniel, 1900); **Anatolia** as the type loc. of *D. glabrofasciatum* var. *imparivittatum* (Daniel, 1900); **Anatolia: Bythinia** (Aurivillius, 1921); **Anatolia** (Winkler, 1924-1932); **Turkey: Bithynia** as the type loc. (Breuning, 1962); **Bilecik** prov., **Eskişehir** prov., **İzmir** prov.: Bozdağ (Breuning, 1962); **Uşak** prov. (Demelt, 1963); **Afyon** prov.: Bayramgazi (Braun, 1978); **Bilecik** prov., **İzmir** prov.: Ödemiş (Bozdağ), **Eskişehir** prov. (Önalp,

1990); **Turkey** (Lodos, 1998); **Anatolia** (Pesarini & Sabbadini, 1998; Danilevsky in Löbl & Smetana, 2010).

Distribution: Turkey.

Chorotype: Anatolian.

This species is endemic to NCW-Anatolian (Galatio-Paphlagonian) faunal subarea of C-Anatolian faunal area, NW-Anatolian (Bithynio-Mysidian) faunal subarea of N-Anatolian faunal area, and W-Anatolian faunal area for Turkey. Namely, it distributes in North-Western part of Central Anatolia, Western part of Northern Anatolia, and Western Anatolia for Turkey.

Dorcadion ledereri **Thomson, 1865: 548**

(Fig. 3E)

Type loc.: Turkey ("Russia or." definitely mistaken information)

Other names: *discoseparatum* Breuning, 1946: 132; *preconjunctum* Breuning, 1946: 132.

Records in Turkey: (AM-SM-TUR)
Turkey as the type loc. (Thomson, 1865); **Amasya** prov. (Ganglbauer, 1884); **Amasya** prov. as *D. parallelum* v. *ledereri* (Aurivillius, 1921); **Samsun** prov., **Amasya** prov. (Breuning, 1962): **Anatolia** as *D. parallelum* v. *ledereri* (Winkler, 1924-1932); **Anatolia** (Pesarini & Sabbadini, 1998; Danilevsky in Löbl & Smetana, 2010).

Distribution: Turkey.

Chorotype: Anatolian.

This species is endemic to the NC-Anatolian (Pontic) faunal subarea of N-Anatolian faunal area for Turkey. Namely, it distributes only in Central parts of Northern Anatolia for Turkey.

Dorcadion parallelum **Küster, 1847: 79**

(Figs. 3F,G)

Type loc.: Turkey

Other names: *rufimembre* Breuning, 1946: 132.

Records in Turkey: (AM-AN-CO-TO-YO-TUR)
Turkey as the type loc. (Küster, 1847); Turkey (Ganglbauer, 1884; Aurivillius, 1921); Tokat prov. (Ganglbauer, 1884); Anatolia (Winkler, 1924-1932); Çorum prov.: Alaca (Braun, 1978); Amasya prov., Ankara prov.: Central / Hüseyin Gazi Mountain / Lalabel (Önalp, 1990); Çorum prov.: Alaca (Adlbauer, 1992); Turkey (Lodos, 1998); Yozgat prov.: Yozgat National Park (Özdikmen & Hasbenli, 2004); Anatolia (Pesarini & Sabbadini, 1998; Danilevsky in Löbl & Smetana, 2010).

Distribution: Turkey.

Chorotype: Anatolian.

This species is endemic to CN-Anatolian (Galatio-Paphlagonian) faunal subarea of C-Anatolian faunal area, NC-Anatolian (Pontic) faunal subarea of N-Anatolian faunal area for Turkey. Namely, it distributes in Northern part of Central Anatolia, and Central parts of Northern Anatolia for Turkey.

Dorcadion walteri **Holzschuh, 1991**

(Figs. 3H,I)

Type loc.: Bolu prov. (Turkey)

Records in Turkey: Bolu prov.: Alpu Bey village as the type loc. (Holzschuh, 1991); **Anatolia** (Pesarini & Sabbadini, 1998; Danilevsky in Löbl & Smetana, 2010).

Distribution: Turkey.

Chorotype: Anatolian.

This species is endemic to NCW-Anatolian (Paphlagonian) faunal subare of N-Anatolian faunal area for Turkey. Namely, it distributes only in North-Western part of Northern Anatolia for Turkey.

A short key for the species of *Dorcadion* (*Megalodorcadion*)

1. Pronotum with 1 median band and 2 lateral bands of hairy areas.......................**2**
- Pronotum never without a complete median band, only males with a small hairy area at the base..**5**

2. Humeral and dorsal bands on elytra separated at least in the most part............**3**
- Humeral and dorsal bands on elytra fused entirely.. ....***D. parallelum*** Küster, 1847

3. Body length relatively large, up to 24 mm; Dorsal band on elytra joined with humeral band posteriorly, if not joined dorsal band ended rather closely humeral band..**4**
- Body length relatively small, up to 16 mm; Dorsal band on elytra clearly not joined with humeral band posteriorly..........................***D. walteri*** Holzschuh, 1991

4. Presutural band on elytra without black spots........***D. ledereri*** Thomson, 1865
- Presutural band on elytra with black spots........***D. escherichi*** Ganglbauer, 1897

5. In male, elytral bands clear, body clearly elongated, pygidium distinctly visible; In female, head on vertex without triangular patterns due to head and pronotum without dense pubescence..***D. dombilicoides* sp. n.**
- In male, elytral bands expunged, body not clearly elongated, pygidium not visible clearly; In female, head on vertex with triangular patterns distinctly due to head and pronotum with dense pubescence....***D. glabrofasciatum*** Daniel, 1900

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Figure 1. *D. dombilicoides* sp. n. (holotype ♂).

Figure 2. *D. dombilicoides* sp. n. (paratype ♀).

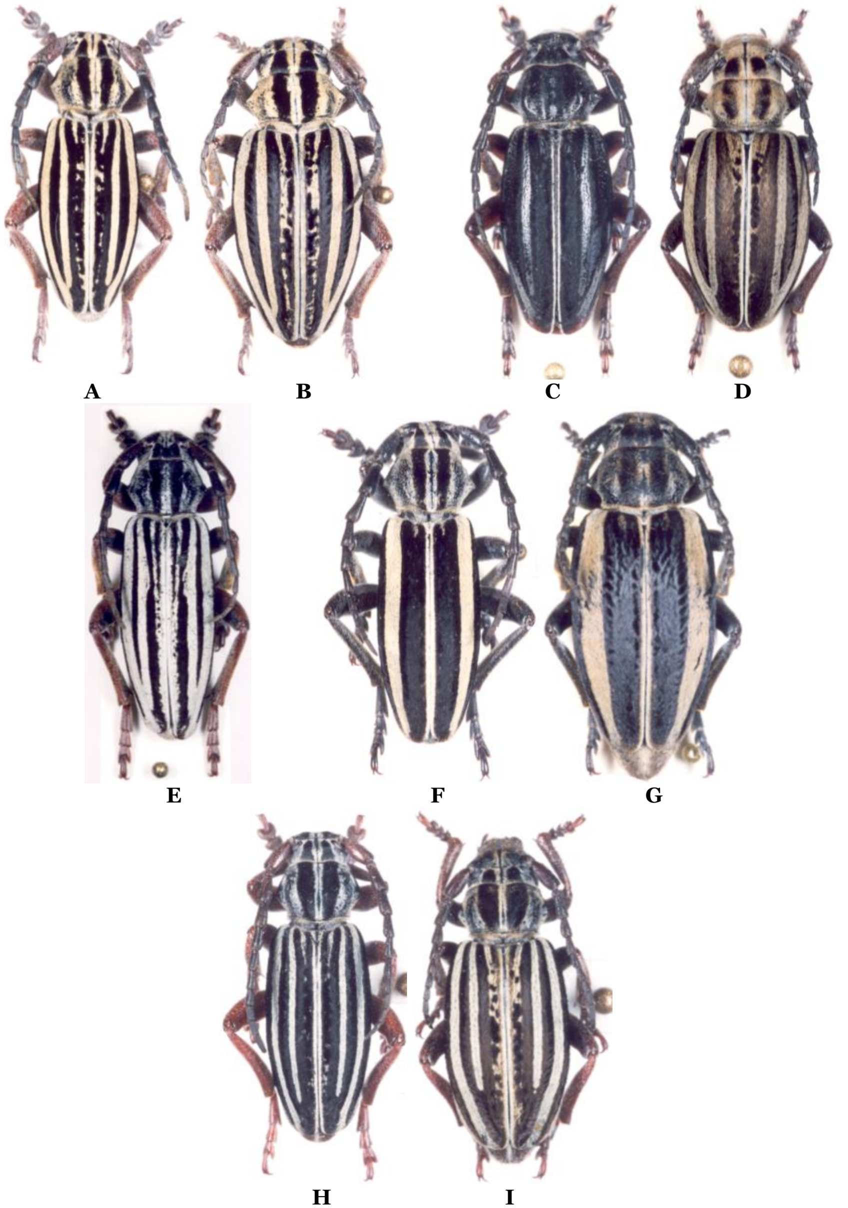

Figure 3. A. *D. escherichi* Ganglbauer, 1897 (male), B. *D. escherichi* Ganglbauer, 1897 (female), C. *D. glabrofasciatum* Daniel, 1900 (male), D. *D. glabrofasciatum* Daniel, 1900 (female), E. *D. ledereri* Thomson, 1865 (male), F. *D. parallelum* Küster, 1847 (male), G. *D. parallelum* Küster, 1847 (female), H. *D. walteri* Holzschuh, 1991 (male), I. *D. walteri* Holzschuh, 1991 (female) [all photos by M. L. Danilevsky from http://www.zin.ru/Animalia/Coleoptera/eng/megalodn.htm].

SCIENTIFIC NOTES

FIRST RECORD OF *CENTROMERUS ALBIDUS* SIMON, 1929 FROM TURKEY (ARANEAE: LINYPHIIDAE)

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[Özkütük, R. S., Kunt, K. B. & Elverici, M. 2013. First record of *Centromerus albidus* Simon, 1929 from Turkey (Araneae: Linyphiidae). Munis Entomology & Zoology, 8 (1): 502-504**]**

Centromerus Dahl, 1886 is just one of the 589 extant genera of Linyphiidae Blackwall, 1859, and is represented by 84 species and 2 sub-species mainly distributed through the western Palaearctic region (Platnick, 2012). In general, they are small-sized ground dwellers with a maximum body length of 4 mm.

A pale abdomen lacking any colour pattern, the absence of cheliceral stridulation ridges and the legs with few spines are characteristics of the genus (for detailed description see Helsdingen, 1973).

The genus is represented by the following four species in Turkey (Bayram et al., 2012): *C. minor* Tanasevitch, 1990; *C. sylvaticus* (Blackwall, 1841); *C. turcicus* Wunderlich, 1995 and *C. unicolor* Roewer, 1959. Of these, the type localities of *C. turcicus* and *C. unicolor* are in Turkey and they have not yet been recorded from any other country (Platnick, 2012).

The purpose of this brief article is to document *Centromerus albidus* Simon, 1929 as a new record for the Turkish spider fauna, based on adult female specimens collected from the western Black Sea region of Turkey. Photographs of the habitus and species specific female genitalia are provided to support our identification.

Specimens were collected by sieving of tree litter and were placed directly into 70% ethanol and transferred to the laboratory. The specimens were examined using a Leica S8AP0 stereomicroscope. The identifications are based on the genitalia drawings of Roberts (1987). The specimens were deposited in the Zoology Museum of Anadolu University. All measurements provided in the text are in mm.

Taxonomy

Centromerus Dahl, 1886

C. Dahl, in Dahl, 1886: 73-74, type *C. brevivulvatus* Dahl, 1912

Centromerus albidus Simon, 1929

(Figs. 1-3)

Material examined: 4 ♀♀, Zonguldak Province, Zonguldak-Bartın Hwy (41°26'16.06"N; 31°50'11.18"E), 28.06.2012, in leaf litter, K. B. Kunt leg.

Measurements (n=4): Carapace; 0.53 long, 0.40 wide (maximum) — **Abdomen**; 0.77 long, 0.54 wide (maximum) — **Epigyne** 0.22 long, 0.25 wide — **Leg I** 1.36 **II** 1.40 **III** 1.11 **IV** 1.52.

Description: Carapace, chelicera, sternum, gnathocoxae, labium and legs brownish yellow. Legs covered by thin, dark brown setae. Anterior median eyes circular and relatively small compared to the others. Anterior and posterior lateral eyes contiguous. Posterior median eyes separated by less than their diameter (Fig. 2). Abdomen greyish brown. Epigyne reddish, strongly sclerotized and broad. Almost equal in width and length. Scapus distinct; widened at sides, getting thinner and blunt towards the tip. Tip of the scapus loosely sclerotized and almost transparent (Fig. 3).

Note: Due to no males being found in our field surveys we could not present photographs of the male genitalia. Nevertheless, owing to the wrinkled scapus morphology of the female genitalia we were able to identify our specimens to the *sylvaticus* species group and were able to easily distinguish them from the previously known species in Turkey, *C. sylvaticus*, based on differences in the morphology of the female genitalia. In *C. sylvaticus* the epigyne is wider than long and the shape of the scapus is wide at the base, narrow in the middle, widening towards the end and semi-circular posteriorly (Fig. 4).

The number of known species of the family Linyphiidae in Turkey is now 105. However, we expect that more species will be recorded in the future, given the high species richness of this family (589 genera, 4419 species) and their biodiversity in adjacent countries such as Bulgaria (96 genera, 231species), which has been more comprehensively studied (Blagoev et al., 2002; Platnick, 2012).

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Figures 1-3. *Centromerus albidus,* 1. Female, habitus, 2. Eyes, 3. Epigyne, ventral view (arrow indicates the transparent tip of the scapus), 4. *C. sylvaticus* (Çankırı Province, Ilgaz Mountain National Park, 16.09.2010, R. S. Özkütük leg.). Scale lines: 1 0.2 3 0.2

SCIENTIFIC NOTES

AVAILABILITY AND TYPE DEPOSITORY OF FOUR SPECIES OF *MEGASTIGMUS* (HYMENOPTERA: TORYMIDAE)

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[**Doğanlar, M. & Hassan, E.** 2013. Availability and type depository of four species of *Megastigmus* (Hymenoptera: Torymidae). Munis Entomology & Zoology, 8 (1): 505-506**]**

For four nominal species of *Megastigmus* described from several parts of the world by Doğanlar & Hassan (2010), no information is given on the type depositories of the holotypes, making these names unavailable according to Article 16.4.2 of the International Commission on Zoological nomenclature (ICZN 1999). We describe them here as new species and make their names available with the original authorship from the date of publication of this correspondence. For each new species, a reference is given to the published description, satisfying the conditions of Article 13.1.2 (ICZN, 1999).

The depositories for the four holotypes are either the ANIC (Australian National Insect Collection) or ICMKU (Insect Collection of Mustafa Kemal University) are indicated. Matrix code labels are now attached to all the holotypes, which uniquely identify each specimen, and are referred to as ‘unique specimen identifiers’ (USIs). Please visit the reference given belove for additional information on these specimens and their descriptions.

We thank Dr. J. S. Noyes (Natural History Museum, London) for his generous suggestions concerning these nomenclatural actions.

Megastigmus leptocybus **Doganlar & Hassan, sp. nov.**

Megastigmus leptocybus Doganlar & Hassan, 2010: 5089-90. Holotype female, Nir David, Bed Shaen, Israel, May, 2007, Z. Mendel, reared from galls of *Leptocybe invasa* on *Eucalytus camaldulensis*, deposited in the ICMKU; Paratypes: 8 females, 14 males, same data as holotype; Turkey: 5 females, 7 males, Samandağ, Hatay, May, 2006, 12 females, 18 males, Adana, June, 2007, 9 females, 11 males, Kadirli, Adana, June 2007, reared from same host, M. Doğanlar; 1 female, 2 males, Palermo, Italy, 2006, G. Viggiani. All of them were deposited in the same museum.

Megastigmus rieki **Doganlar & Hassan, sp. nov.**

Megastigmus rieki Doganlar & Hassan , 2010: 5103-5104. Holotype female, S. E. Ayr Q, 6 Sebtember, 1950. E. F. Riek, deposited in the ANIC; Paratype: 1 male, same data as the Holotype.

Megastigmus thailandiensis **Doganlar & Hassan, sp. nov.**

Megastigmus thailandiensis Doganlar & Hassan, 2010: 5108-5110. Holotype female, Thailand, reared from galls on *Eucalyptus* sp. by Dr. Vitoon Luangviriyasaeng, deposited in the ICMKU. Paratypes: 8 females, same data as holotype.

Megastigmus thitipornae **Doganlar & Hassan, sp. nov.**

Megastigmus thitipornae Doganlar & Hassan, 2010: 5109-5111. Holotype female, Thailand, ?. vi. 2001, Miss. Saimanee Thitiporn, reared from galls of *Eucalyptus* deposited in the ICMKU; Paratypes: 2 males, same data as the Holotype, except reared on 22.x. 2001.

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SCIENTIFIC NOTES

COLLECTION OF *ORIUS* SPECIES (HEMIPTERA: ANTHOCORIDAE) IN SOME COUNTIES OF YAZD PROVINCE, IRAN

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[Hassanzadeh, H., Shishehbor, P., Esfandiari, M. & Rajabpour, A. 2013. Collection of *Orius* species (Hemiptera: Anthocoridae) in some counties of Yazd province, Iran. Munis Entomology & Zoology, 8 (1): 507-508**]**

Recently, the use of predatory bugs of the genus *Orius* Wolff has greatly increased in many greenhouses and horticultural crops. These are generalist predators able to control pest outbreaks on different crops. To evaluate a natural enemy for biological control, is first necessary to search in the area of origin to determine if an efficient predator, parasitoid or pathogen is present (Luck et al., 1988). Therefore, it is necessary to explore the local fauna for indigenous *Orius* species which are adapted to the local climatic conditions of a region.

Until now, 14 *Orius* species has recorded from various parts of Iran (Ghahari et al., 2009), but not a single species from Yazd province, located in the centre of the country with an area of 131.575 km². In order to determine distribution and abundance of *Orius* species in this area, we investigated greenhouses, fruit gardens, crop fields and ornamental plants in counties of Yazd, Saduq, Taft, Mehriz and Abarkuh in Yazd province, during growing season in 2010-2011 (April-September). Samplings were done mainly by beating flowers or terminal buds onto a white plastic plate and specimens were taken back to the laboratory. Using genital preparations, specimens were identified based on available resources and keys (see e.g. Pericart, 1995; Ostovan, 1998; Linnavuori & Hosseini, 2000).

Totally, 5 species belonging to the tribe Oriini and the genus *Orius* were collected and identified. All of them are first report from Yazd province.

Relative abundance for each species among total collected specimens was also calculated.

Orius (Dimorphella) albidipennis (Reuter)

Material examined: 230♂♂, 340♀♀, from all of the sampling areas throughout the sampling period.
Host plants: sunflower, alfalfa, sorghum, almond, green onion and ornamental flowers.
Relative abundance: %85.

Orius (Orius) niger (Wolff)

Material examined: 4♂♂, 5♀♀, Yazd, August 2010, sunflower; 1♂, 2♀♀, Mehriz, August 2010, sunflower; 6♂♂, 10♀♀, Yazd, July 2010 & 2011, alfalfa; 5♂♂, 7♀♀, Mehriz, August 2010, alfalfa; 2♂♂, 3♀♀, Yazd, June 2011, millet; 3♂♂, 4♀♀, Saduq, June 2011, alfalfa.
Relative abundance: %7.8.

Orius (O.) pallidicornis (Reuter)

Material examined: 2♂♂, 3♀♀, Yazd, July 2010, zinnia flowers; 5♂♂, 7♀♀, Yazd, August 2010 & 2011, sunflower; 2♂♂, 2♀♀, Yazd, June 2010, alfalfa; 2♂♂, 4♀♀, Saduq, June 2011, sunflower.
Relative abundance: %3.8.

Orius (O.) laevigatus (Fiber)

Material examined: 2♂♂, 3♀♀, Abarkuh, July 2010, sunflower; 2♂♂, 3♀♀, Mehriz, August 2010, alfalfa; 1♂, 1♀, Yazd, August 2010, sorghum.
Relative abundance: %1.7.

Orius (Heterorius) vicinus (Ribaut)

Material examined: 3♂♂, 5♀♀, Taft, September 2010, almond; 2♂♂, 2♀♀, Taft, June 2011, green onion.
Relative abundance: % 1.7.

The survey indicates that *O. albidipennis* is well adapted to the investigated area which may make it good candidate for biological control programs.

ACKNOWLEDGEMENTS

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