

GROUND BEETLES (COLEOPTERA: CARABIDAE) OF IRANIAN COTTON FIELDS AND SURROUNDING GRASSLANDS

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ABSTRACT: The family Carabidae (Coleoptera) is among the dominant groups of terrestrial predators and includes more than 40,000 species worldwide, making it one of the largest families of beetles. The fauna of Iranian Carabidae is very diverse, but was not studied perfectly. In the present paper, this group of beneficial predators is studied on the basis of several samples through 2000-2006 in all the cotton fields and surrounding grasslands of Iran. Totally, 115 species and subspecies belonging to 16 subfamilies were collected from 18 different localities. Of these diverse fauna, 8 species are the new records for Iranian fauna.

KEY WORDS: Carabidae, Cotton fields, Grasslands, New Record, Iran.

Cotton is one of the most important crops in Iran with several pests in all regions of Iran (Khanjani, 2006). There are diverse fauna of insect predators in different cotton fields of Iran, while they were poorly studied. Ground beetles (Coleoptera: Carabidae) are one of the powerful and efficient predators in cotton fields. The family Carabidae comprises more than 40,000 species which more than 30% of species are arboreal, though in general temperate species are terrestrial, most are also flightless and predatory (Stork, 1990).

Most carabids are omnivorous (feeding on both plants and animals) and polyphagous (being able to use a wide range of foods), feeding on live prey, carrion and plant material. Some species however are specialist feeders, i.e. *Harpalus rufipes* (the Strawberry Seed Beetle) on seeds, *Loricera pilicornis* (the Springtail Beetle) on Collembola and *Abax parallelipedus* and *Cychnus caraboides* on slugs and snails. *Ophonus* species feed exclusively on the seeds of Umbellifers, which is known as spermophagy. Ground beetles also are good indicators of habitat types and environmental quality in terms of the effects of pesticides (Frank and Slosser, 1996). The larvae are always carnivorous if the adults are. Many Carabids find their food by random foraging, but specialist feeders tend to use chemical cues. *Poecilus cupreus* has a two dimensional search pattern until it finds an aphid at the base of a plant. Finding the aphid stimulates it to a three dimensional search pattern, i.e. it climbs the plant looking for more aphids. Most species of ground beetles are cannibalistic given the opportunity (Brandmayr et al., 1983).

Different ground beetle species are unofficially classified as either spring or autumn breeders. Spring breeders such as *Poecilus cupreus* over winter as adults

while autumn breeders such as *Nebria brevicollis* over winter as larvae. In general the number of eggs produced depends on nutrition, environmental factors such as moisture, temperature, and the age of the beetle. Research indicates that carabids in the wild seldom reach their reproductive capacity. As in most predators egg production is related to food supply. It has been found that the number of eggs produced is inversely related to body mass, hence large species lay less eggs than small species. It has also been found that autumn breeders tend to lay more eggs than spring breeders. Also members of a given species tend to lay more eggs in disturbed conditions than in stable ones. In the first year females will lay 5-10 eggs per female in those species with egg guarding behaviour, but up to several hundred in those that don't. Eggs are laid all in one batch, as several batches per season and in some species over several seasons. Whilst in the second year far fewer or no eggs are produced. Some species lay their eggs individually on the surface of the soil while others dig holes and lay their eggs in these before covering them over with soil. Some Pterostichini make a cocoon for the eggs and a few species dig nests with chambers and provide brood care in the form of guarding the eggs and licking them to remove fungal spores (e.g. *Harpalus* sp.). The eggs normally take about five days to hatch depending on the species and environmental conditions (den Boer et al., 1986; Lovei and Sunderland, 1996).

Larvae only use external digestion i.e. digestive juices are spat/ vomited onto the food and the resulting fluid is then sucked up. There are usually 3 life stages before pupation, however species of *Harpalus* and *Amara* have only 2 larval instars, while other species, particularly those which are ant or termite symbionts, have four larval instars. Generally development takes about a year from being an egg just laid to laying eggs, though it can take up to 4 years in harsh conditions, i.e. *Carabus problematicus* is univoltine up to 800 meters in height but semi-voltine above that. Other species such as *Carabus auronitens* are more flexible and adapt their life history strategy to the prevailing conditions. While *Laemostenus schreibersi* is a cavernicolous species (living in a cave) it can live for 5-6 years. Generally it is the larger species which live the longest. After it has finished growing the larvae constructs a pupal chamber in the soil. Most species normally take 5-10 days to emerge from the pupae (Desender et al. 1994).

Iran is a large country with various geographical regions and climates. The carabids fauna of this part of Palearctic is very diverse but unknown. With attention to the importance of these beneficial insects in biological control, the fauna of Carabidae in Iranian cotton fields is studied in this paper.

MATERIALS AND METHODS

In order to carry out faunistic surveys on Carabidae of Iranian cotton fields, firstly all the major regions which included cotton fields were detected. Totally seven provinces included Golestan, Mazandaran, Tehran, Semnan, Fars, Khorasan and Ardabil, and 18 localities included Kordkoy, Nokandeh, Salikandeh, Gorgan, Gonbad, Ali-Abad, Azadshahr, Ramian, Aghghala, Minoodasht of Golestan province, Ghaemshahr, Behshahr, Galogah of Mazandaran province, Varamin of Tehran province, Garmsar of Semnan province, Darab of Fars province, Kashmar of Khorasan province, Dasht-e-Moghan of Ardabil province and Arasbaran of East Azarbayjan province were sampled. Several plastic pitfall traps, 8.5×10 cm (diameter × depth), were installed at 10 m intervals in different cotton fields and were part-filled with ethanol 75%. The traps were emptied weekly for seven crop seasons (2000-2006) and the fallen beetles were collected and identified. In addition to the pitfall traps, sweepings were conducted

randomly in different cotton fields, and also light traps were applied for sampling. On the basis of several samplings in 18 localities contain cotton fields and also their surrounding grasslands, over than 500 carabid specimens were collected and determined.

SPECIES LIST

In a total of 115 carabid species and subspecies belonged to 16 subfamilies were collected from different cotton fields and surrounding grasslands of Iran. Of these 8 species are newly recorded from Iran. The species and subspecies belonged to subfamilies and tribes are given in alphabetical order in the following list.

Subfamily Bembidiinae Stephens, 1827

Tribus Bembidiini Stephens, 1827

Bembidion amnicola Sahlberg, 1900

Material: Golestan province: Aliabad, 1♀, 2♂; August 2001. **New record for Iranian fauna.**

Distribution: Middle and West Siberia, Russia, Transbaikalia.

Bembidion quadrimaculatum (Linnaeus, 1761)

Material: Semnan province: Garmsar, 1♀, 1♂; September 2002. East Azarbayjan province: Arasbaran, 1♂; September 2004.

Distribution: Holarctic Region, North America, Europe, Turkey, Moldova, Russia, Caucasia, Iran to Mongolia, Transbaikalia.

Bembidion (Nepha) rufimacula (Müller, 1918)

Material: Golestan province: Ramian, 2♂; October 2001.

Distribution: Balkan Peninsula, Turkey, Lebanon.

Subfamily Brachininae Bonelli, 1810

Tribus Brachinini Bonelli, 1810

Brachinus costatulus Quensel, 1806

Material: Golestan province: Aghghala, 1♀; June 2006. Khorasan province: Kashmar, 2♂; October 2004.

Distribution: Middle Asia, Russia, Ukraine, Moldova, Caucasia.

Brachinus cruciatus Quensel, 1806

Material: Ardabil province: Dasht-e-Moghan, 1♀; June 2001.

Distribution: Europe, Mountains of SE Middle Asia, Turkey, Russia, Moldova, Ukraine, Armenia, Kazakhstan, Tajikistan.

Brachinus sclopeta (Fabricius, 1792)

Material: Ardabil province: Dasht-e-Moghan, 3♀, 1♂; June 2001.

Distribution: Czech Republic, Slovakia, Moldova, Russia, Ukraine.

Pheropsophus catoirei Dejean, 1825

Material: Khorasan province: Kashmar, 2♀; April 2001. **New record for Iranian fauna.**

Distribution: Russia, Moldova, Crimea.

Pheropsophus (Stenaptinus) iranicus Reitter, 1919

Material: Golestan province: Ali-Abad, 1♀; September 2006.

Distribution: Russia, Armenia, Bulgaria.

Subfamily Broscinae Hope, 1838

Tribus Broscini Hope, 1838

Broscus (Cephalotes) laevigatus Dejean, 1828

Material: Ardabil province: Dasht-e-Moghan, 3♀, 3♂; June 2001. Tehran province: Varamin, 4♀, 1♂; September 2002. Fars province: Darab, 3♀, 2♂; July 2005. East Azarbayjan province: Arasbaran, 1♂; September 2005. Semnan province: Garmsar, 2♂; September 2006.

Distribution: Palearctic Region, Mediterranean Countries.

Subfamily Callistinae Laporte, 1834

Tribus Chlaeniini Brullé, 1834

Chlaenius canariensis persicus Redtenbacher, 1850

Material: Mazandaran province: Galogah, 2♀, 1♂; June 2005. Khorasan province: Kashmar, 1♂; October 2004.

Distribution: Palearctic Region.

Chlaenius dimidiatus Chaudoir, 1842

Material: East Azarbayjan province: Arasbaran, 2♀, 2♂; September 2004. Tehran province: Varamin, 4♂; April 2006.

Distribution: Middle, South and West Asia.

Chlaenius festivus (Panzer, 1796)

Material: Golestan province: Salikandeh, 2♂; July 2003. Khorasan province: Kashmar, 1♀; October 2002.

Distribution: Middle Asia, Central and South Europe, Turkey, Caucasia, Transcaucasia, Iran.

Chlaenius lederi Reitter, 1888

Material: Golestan province: Azadshahr, 1♂; Aug. 2001.

Distribution: Russia, Transcaucasia, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan.

Subfamily Carabinae Latreille, 1802

Tribus Carabini Latreille, 1802

Callisthenes* (s. str.) *ewersmanni persicus (Géhin, 1885)

Material: Golestan province: Gonbad, 1♀; July 2004.

Distribution: Europe, Iraq, Turkey.

Calosoma (Campalita) denticolle Gebler, 1833

Material: Golestan province: Gonbad, 2♀, 1♂; August 2003.

Distribution: Moldova, Bulgaria, Romania, Ukraine, Russia, Mongolia, Armenia, Lithuania, Crimea, Azerbaijan, Dagestan, Kazakhstan, Siberia, China.

Calosoma inquisitor cupreum Dejean, 1826

Material: Khorasan province: Kashmar, 2♂; October 2002.

Distribution: Europe, Russia, Caucasia.

Calosoma (Campalita) iranicum Mandl, 1953

Material: Golestan province: Salikandeh, 3♀, 2♂; July 2003.

Distribution: West Asia.

Calosoma olivieri Dejean, 1831

Material: Khorasan province: Kashmar, 1♀; October 2002. Mazandaran province: Behshahr, 1♀, 1♂; July 2003. Golestan province: Ramian, 1♀; July 2005.

Distribution: Russia, Tajikistan, Turkey, Turkmenistan, Uzbekistan.

Calosoma sycophanta (Linnaeus, 1758)

Material: Golestan province: Nokandeh, 2♀, 2♂; May 2006.

Distribution: North America, North Africa, West Asia, Europe, Moldova, Czech Republic, Slovakia, Jawa, Turkey, Caucasia, Siberia.

Carabus (Sphodristocarabus) armeniacus armeniacus Mannerheim, 1830

Material: Khorasan province: Kashmar, 2♀; October 2002. **New record for Iranian fauna.**

Distribution: Turkey, Russia, Caucasia.

Carabus (Procrustes) chevrolati De Cristoforis and Jan, 1837

Material: Golestan province: Gonbad, 1♂; September 2001. **New record for Iranian fauna.**

Distribution: Palearctic Region, South and West Asia.

Carabus (Linnocarabus) clathratus Linnaeus, 1761

Material: Mazandaran province: Behshahr, 2♀, 1♂; April 2003. Khorasan province: Kashmar, 1♀, 1♂; October 2004.

Distribution: Asiatic Europe, Turkey, Russia, Caucasia.

Carabus (Mimocarabus) maurus osculatii Osculati, 1844

Material: Golestan province: Gonbad, 2♀, 1♂; May 2006.

Distribution: South and West Asia, Palearctic Region.

Carabus (M.) maurus paphius Redtenbacher, 1843

Material: Mazandaran province: Ghaemshahr, 3♀; July 2006.

Distribution: Turkey, Russia, Caucasia.

Carabus (M.) roseni Reitter, 1897

Material: Tehran province: Varamin, 3♀, 4♂; August 2004.

Distribution: Palearctic Region.

***Carabus (Pachystus) tamsi* Ménétrière, 1832**

Material: Golestan province: Salikandeh, 2♀, 3♂; July 2003.

Distribution: Russia, Moldova, Ukraine, Crimea, Ciscaucasia.

***Carabus (Archicarabus) victor* Fischer von Waldheim, 1836**

Material: East Azarbaijan province: Arasbaran, 1♀, 2♂; September 2004. **New record for Iranian fauna.**

Distribution: Palearctic Region.

Subfamily Cicindelinae Latreille, 1802**Tribus Cicindelini** Latreille, 1802***Cephalota (Taenidia) zarudniana vartianorum* (Mandl, 1967)**

Material: Fars province: Darab, 1♀, 1♂; September 2001.

Distribution: Palearctic Region.

***Cephalota (T.) zarudniana zarudniana* Tschitschérine, 1903**

Material: Golestan province: Nokandeh, 1♀; July 2003.

Distribution: Palearctic Region.

***Cicindela* (s. str.) *asiatica sumbarica* Putshkov, 1993**

Material: Khorasan province: Kashmar, 1♀, 1♂; October 2002.

Distribution: Russia, Caucasia.

***Cicindela (Cephalota) deserticola* Faldermann, 1836**

Material: Semnan province: Garmsar, 2♀;

Distribution: Russia, Moldova, Ukraine, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan.

***Cicindela (Myriochile) melancholica* Fabricius, 1798**

Material: Mazandaran province: Ghaemshahr, 1♀, 1♂; April 2006.

Distribution: Caucasia, Ciscaucasia, Russia.

***Cicindela monticola* Ménétrière, 1832**

Material: Ardabil province: Dasht-e-Moghan, 1♂; September 2004. **New record for Iranian fauna.**

Distribution: Palearctic Region.

***Cicindela* (s. str.) *rhodotereana* Tschitscherine, 1903**

Material: Tehran province: Varamin, 1♀; July 2005. East Azarbaijan province: Arasbaran, 3♀; June 2006.

Distribution: Palearctic Region.

***Cylindera (Eugrapha) pygmaea pygmaea* Dejean, 1825**

Material: Mazandaran province: Galogah, 1♂; July 2005.

Distribution: Palearctic Region.

***Cylindera (E.) sublacerata balucha* Bates, 1878**

Material: Ardabil province: Dasht-e-Moghan, 2♂; September 2001.

Distribution: Palearctic Region.

***Cylindera (E.) sublacerata sublacerata* Solsky, 1874**

Material: Golestan province: Aghghala, 2♂; July 2004.

Distribution: South and West Asia, Transcaucasia.

***Lophyra (Lophyra) persicola* Horn, 1934**

Material: East Azarbaijan province: Arasbaran, 1♀, 1♂; September 2005.

Distribution: Palearctic Region.

***Myriochile (Monelica) orientalis* Dejean, 1825**

Material: Fars province: Darab, 2♂; October 2001. Khorasan: Kashmar, 2♀; October 2004.

Distribution: Palearctic Region.

Subfamily Elaphrinae Erichson, 1837**Tribus Elaphrini** Erichson, 1837***Elaphrus* (s. str.) *riparius* (Linnaeus, 1758)**

Material: Semnan province: Garmsar, 2♀, 1♂; April 2006.

Distribution: Central Asia, Europe, Turkey, Caucasia, Siberia, North Mongolia, Far East, Sakhalin, Korean Peninsula, Japan, Alaska, Canada.

Subfamily Harpalinae Bonelli, 1810**Tribus Harpalini** Bonelli, 1810***Acinopus ammophilus* Dejean, 1829**

Material: Golestan province: Gorgan, 1♀; August 2003.

Distribution: Europe, Turkey, Armenia, Daghestan, Azerbaijan, Crimea, Russia, Bulgaria, Moldova.

Acinopus laevigatus Ménétériés, 1832

Material: Golestan province: Gonbad, 5♀; August 2002. Semnan province: Garmsar, 2♂; June 2005. Tehran province: Varamin, 6♀, 4♂; July 2005. Mazandaran province: Galogah, 3♀; April 2006.

Distribution: Mediterranean Countries, Bulgaria, Moldova., Turkey, Armenia, Daghestan, Azerbaijan, Crimea, Russia, Mountains of SE Middle Asia.

Acinopus (Oedematicus) megacephalus (Rossi, 1794)

Material: Golestan province: Salikandeh, 1♀, 1♂; July 2005.

Distribution: Europe, Bulgaria, Turkey, Russia, Caucasasia.

Diachromus germanus (Linnaeus, 1758)

Material: Fars province: Darab, 1♀, 1♂; October 2003. East Azarbayjan province: Arasbaran, 1♀; September 2005.

Distribution: West Asia, Central and South Europe, Turkey, Caucasasia, Turkmenistan, Iran.

Ditomus calydonius (Rossi, 1790)

Material: Golestan province: Gorgan, 1♀; July 2005. Khorasan province: Kashmar, 1♀, 2♂; October 2004.

Distribution: Central Asia, South Europe, Caucasasia, Turkey, Syria.

Harpalus caspius Steven, 1806

Material: Golestan province: Ali-Abad, 4♀, 6♂; July 2001. Fars province: Darab, 4♂; June 2002.

Distribution: Central Europe, Balkan Peninsula, Russia, Turkey, Caucasasia, Kazakhstan.

Harpalus fuscicornis Ménétériés, 1832

Material: Tehran province: Varamin, 2♀; April 2005.

Distribution: Central Asia, North and West Africa, South Europe, Russia, Ukraine, Crimea, Turkey, Caucasasia, Iraq.

Harpalus griseus (Panzer, 1797)

Material: Mazandaran province: Ghaemshahr, 3♀, 3♂; April 2006. Khorasan province: Kashmar, 5♀; October 2004.

Distribution: North and West Africa, Europe, Russia, Moldova, Ukraine, Crimea, Azerbaijan, Daghestan, Armenia, Uzbekistan, Kazakhstan, Turkmenistan, Tajikistan.

Harpalus* (s. str.) *froelichi Sturm, 1818

Material: Golestan province: Gorgan, 1♀, 1♂; July 2001.

Distribution: Central Asia, South Siberia, Europe, Caucasasia, Kazakhstan, Mongolia, Moldova, China, Russia, North Korea.

Harpalus* (s. str.) *honestus (Duftschmid, 1812)

Material: Golestan province: Kordkoy, 4♀, 2♂; June 2003. Khorasan province: Kashmar, 1♂; October 2004.

Distribution: Central and South Europe, Turkey, Russia, Caucasasia, Siberia.

Harpalus (Harpalophonus) hospes (Sturm, 1818)

Material: East Azarbayjan province: Arasbaran, 2♀, 1♂; June 2006.

Distribution: Europe, Turkey, Crimea, Iran, Russia, Kazakhstan.

Harpalus (Artabas) kadleci (Kataev and Wrase, 1995)

Material: Golestan province: Gorgan, 2♀, 3♂; August 2004.

Distribution: Europe, Turkey.

Harpalus* (s. str.) *kazanensis Jedlicka, 1958

Material: Ardabil province: Dasht-e-Moghan, 1♀; September 2002. Khorasan province: Kashmar, 2♂; October 2002.

Distribution: Caucasasia, Turkey.

Harpalus* (s. str.) *macronotus Tschitscherine, 1893

Material: Golestan province: Nokandeh, 1♀, 2♂; July 2002. Fars province: Darab, 1♀; June 2005.

Distribution: Siberia, Kazakhstan, Russia, Transbaikalia.

Harpalus* (s. str.) *metallinus Ménétériés, 1836

Material: Golestan province: Ramian, 1♀, 2♂; September 2006.

Distribution: Europe, Balkan Peninsula, Caucasasia, Russia, Turkey, Syria, Iraq, Lebanon.

Harpalus rufipes (De Geer, 1774)

Material: Tehran province: Varamin, 3♀, 3♂; June 2003. Ardabil province: Dasht-e-Moghan, 3♀, 1♂; September 2002. Mazandaran province: Ghaemshahr, 6♀, 5♂; April 2004. Fars province: Darab, 1♀, 2♂; August 2004. Khorasan province: Kashmar, 6♀, 2♂; October 2004. Fars province: Darab, 5♀, 2♂; June 2005. Golestan province: Gorgan, 1♀; June 2006. Semnan province: Garmsar, 5♀, 3♂; June 2006.

Distribution: Palearctic Region, North America.

Harpalus smyrnensis Heyden, 1888

Material: Golestan province: Kordkoy, 2♂; July 2004.

Distribution: Europe, Caucasia, Turkey.

Ophonus (Metophonus) cordatus (Duftschmid, 1812)

Material: Mazandaran province: Behshahr, 1♀, 2♂; August 2004.

Distribution: Europe, Mediterranean Countries, Ukraine, Russia, Moldova, Crimea, Azerbaijan, Daghestan, Armenia, Kazakhstan.

Tribus Panagaecini Bonelli, 1810***Panagaeus bipustulatus*** (Fabricius, 1775)

Material: Ardabil province: Dasht-e-Moghan, 1♀; September 2003. East Azarbayjan province: Arasbaran, 1♀; September 2005.

Distribution: Central and South Europe, Turkey, Caucasia, Iran.

Subfamily Lebiinae Bonelli, 1810**Tribus Lebinini** Bonelli, 1810***Merizomena grandinella*** Semenov, 1890

Material: Golestan province: Gonbad, 1♀, 1♂; August 2001. **New record for Iranian fauna.**

Distribution: Russia, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan.

Tribus Zuphiini Bonelli, 1810***Parazuphium (Neozuphium) damascenum damascenum*** (Fairmaire, 1896)

Material: Mazandaran province: Behshahr, 2♀, 1♂; October 2004.

Distribution: South and West Asia.

Zuphium (s. str.) ***olens*** (Rossi, 1790)

Material: Golestan province: Gorgan, 2♀, 1♂; July 2004. Khorasan province: Kashmar, 1♂; October 2004.

Distribution: Europe, Mediterranean Countries, India, England, Russia, Moldova, Ukraine, Armenia, Turkmenistan, Uzbekistan, Tajikistan.

Subfamily Licininae Bonelli, 1810**Tribus Licinini** Bonelli, 1810***Licinus (Neorescius) astrabadensis*** Reitter, 1902

Material: Tehran province: Varamin, 1♀, 1♂; June 2005.

Distribution: Palearctic Region.

Subfamily Nebriinae Laporte, 1834**Tribus Nebriini** Laporte, 1834***Leistus*** (s. str.) ***lenkoranus*** Reitter, 1885

Material: Ardabil province: Dasht-e-Moghan, 1♀, 1♂; September 2001.

Distribution: Russia, Caucasia.

Leistus (Pogonophorus) spinibarbis abdominalis Reiche, 1855

Material: Golestan province: Azadshahr, 2♂; July 2001. Fars province: Darab, 3♀; June 2002.

Distribution: Europe, Caucasia.

Nebria (Alpeus) faldermanni bagrovdaghensis Shilenkov, 1983

Material: Ardabil province: Dasht-e-Moghan, 1♀; September 2005.

Distribution: Syria, Iran.

Nebria (A.) faldermanni elbursiaca Bodemeyer, 1927

Material: Tehran province: Varamin, 1♂; November 2004.

Distribution: Palearctic Region.

Nebria hemprichi Klug, 1832

Material: Golestan province: Nokandeh, 4♀, 1♂; September 2004. Mazandaran province: Behshahr, 2♀, 2♂; August 2006.

Distribution: Europe, Mediterranean Countries.

Subfamily Odacanthinae Laporte, 1834**Tribus Odacanthini** Laporte, 1834***Odacantha*** (s. str.) ***melanura*** (Linnaeus, 1767)

Material: Mazandaran province: Behshahr, 1♂; August 2004. Fars province: Darab, 1♀; September 2005.

Distribution: Europe, Caucasia, Siberia, Russia.

Subfamily Oodinae LaFerté-Sénéctere, 1851**Tribus Oodini** LaFerté-Sénéctere, 1851***Oodes gracilis*** Villa and Villa, 1833

Material: Semnan province: Garmsar, 3♀, 2♂; August 2003.

Distribution: Central and South Europe, Turkey, Caucasia, Turkmenistan.

Subfamily Pterostichinae Bonelli, 1810**Tribus Amarini** Bonelli, 1810***Amara*** (s. str.) ***aenea*** (De Geer, 1774)

Material: Golestan province: Gonbad, 3♀, 2♂; June 2005. Khorasan province: Kashmar, 2♀; October 2004.

Distribution: Palearctic Region, North America, Caucasia.

Amara (s. str.) ***anxia*** Tschitscherine, 1828

Material: Khorasan province: Kashmar, 1♀; September 2003.

Distribution: Russia, Caucasia, Transbaikalia.

Amara (Iranoleiridis) astrabadensis Lutshnik, 1935

Material: Mazandaran province: Ghaemshahr, 2♀, 2♂; September 2005.

Distribution: Palearctic Region.

Amara (s. str.) ***bamidunyae*** Bates, 1878

Material: Golestan province: Gonbad, 1♀, 2♂; October 2005.

Distribution: Russia, Ukraine, Moldova, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan, Mountains of SE Middle Asia.

Amara (s. str.) ***eurynota*** (Panzer, 1797)

Material: Mazandaran province: Behshahr, 1♀; April 2005.

Distribution: North Africa, North America, Siberia, Bulgaria, Moldova, Turkey, Czech Republic, Slovakia, Syria, China, Ukraine, Russia, Crimea, Armenia, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan.

Amara (s. str.) ***famelica*** Zimmermann, 1832

Material: Semnan province: Garmsar, 1♀, 3♂; April 2006.

Distribution: Europe, Siberia, Afghanistan, Czech Republic, Slovakia, Turkey, Russia, Caucasia.

Amara (s. str.) ***familiaris*** (Duftschmid, 1812)

Material: Golestan province: Gorgan, 2♀, 1♂; May 2006.

Distribution: West and Central Asia, Europe, North America, Moldova, Bulgaria, Russia, Caucasia, Turkey, Siberia, Korean Peninsula, China, Japan, Czech Republic, Slovakia.

Amara (Harpalodema) isfahanensis Hieke, 1993

Material: Khorasan province: Kashmar, 1♀, 2♂; October 2002.

Distribution: Palearctic Region.

Amara (s. str.) ***littorea*** Thomson, 1857

Material: Fars province: Darab, 1♀, 1♂; June 2002. Semnan province: Garmsar, 1♀; July 2005.

Distribution: Middle Asia, Europe, Siberia, Czech Republic, Slovakia, Turkey, Russia, Caucasia, Bulgaria, Moldova.

Amara (s. str.) ***lucida*** (Duftschmid, 1812)

Material: Fars province: Darab, 1♀; October 2003.

Distribution: North Africa, Europe, Moldova, Bulgaria, Slovakia, Turkey, Russia, Caucasia, Iran, Iraq.

Amara (Harpalodema) maindroni Bedel, 1907

Material: Semnan province: Garmsar, 3♀; August 2002.

Distribution: Palearctic Region.

Amara (Curtonotus) propinquus Ménétrées, 1832

Material: Semnan province: Garmsar, 3♂; October 2005.

Distribution: Central Asia, West Siberia, Bulgaria, Romania, Crimea, Ukraine, Russia, Caucasia, Iran, Mongolia, China.

Amara (C.) zagrosensis Morvan, 1973

Material: Golestan province: Gonbad, 2♀; September 2005.

Distribution: Palearctic Region.

Anthia (Termophilum) duodecimguttata Bonelli, 1813

Material: Semnan province: Garmsar, 3♀, 2♂; September 2005.

Distribution: Palearctic Region.

Asaphidion* (s. str.) *flavicorne (Solsky, 1874)

Material: Golestan province: Gonbad, 2♀, 1♂; August 2001.

Distribution: Central Asia, Balkan Peninsula, Bulgaria, Mediterranean Countries, Russia, Caucasia.

Zabrus trinii Fischer von Waldheim, 1817

Material: Khorasan province: Kashmar, 1♂; October 2002. Fars province: Darab, 1♀; August 2004. Semnan province: Garmsar, 6♀, 4♂; August 2004. Golestan province: Gorgan, 2♀, 5♂; July 2003. Mazandaran province: Ghaemshahr, 3♀, 4♂; May 2006.

Distribution: Caucasia, Russia, Iran, Turkey.

Tribus Morionini Brullé, 1835***Morion (Neomorion) olympicus*** Redtenbacher, 1843

Material: Mazandaran province: Behshahr, 2♀; July 2006.

Distribution: Russia, Caucasia.

Tribus Platynini Bonelli, 1810***Agonum chotjaili*** Morvan, 1973

Material: Semnan province: Garmsar, 1♀; October 2004.

Distribution: Palearctic Region.

Anchomenus* (s. str.) *dorsalis (Pontoppidan, 1763)

Material: Semnan province: Garmsar, 1♂; October 2001.

Distribution: Central Asia, Siberia, Europe, Turkey, Russia, Caucasia, Morocco, Near East, Czech Republic, Slovakia, Bulgaria, Moldova.

Anchomenus* (s. str.) *turkestanicus (Ballion, 1870)

Material: Mazandaran province: Galogah, 1♀, 1♂; June 2003.

Distribution: Russia, Armenia, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan.

Calathus fuscipes (Goeze, 1777)

Material: Golestan province: Nokandeh, 1♀; July 2003.

Distribution: Africa, Middle Asia, Europe, North America, Turkey, Russia, Caucasia, Iran.

Calathus libanensis pluriseriatus Putzeys, 1873

Material: Golestan province: Aghghala, 1♀, 1♂; July 2003. Fars: Darab, 1♂; June 2005.

Distribution: Europe, Mediterranean Countries, Turkey.

Calathus syriacus Chaudoir, 1863

Material: Ardabil province: Dasht-e-Moghan, 2♀, 1♂; June 2001.

Distribution: Turkey, Caucasia, Ciscausia, Mediterranean Countries.

Laemostenus (Sphodroides) cordicollis (Chodoir, 1854)

Material: Fars province: Darab, 1♀; September 2003.

Distribution: Europe, Mediterranean Countries.

Laemostenus (Pristonychus) quadrangulus Morvan, 1981

Material: Golestan province: Kordkoy; 1♀, 2♂; October 2004.

Distribution: Palearctic Region.

Olisthopus* (s. str.) *elburzensis Morvan, 1977

Material: Golestan province: Ali-Abad, 1♀, 1♂; June 2001. Khorasan province: Kashmar, 1♀; October 2004.

Distribution: Palearctic Region.

Orthotrichus (Anchomenus) cymindoides Dejean, 1831

Material: Khorasan province: Kashmar, 1♀; October 2002. Tehran province: Varamin, 2♂; June 2006.

Distribution: Palearctic Region.

Orthotrichus (Anchomenus) eberti Jedlicka, 1865

Material: Golestan province: Gonbad, 3♀, 3♂; April 2003. Ardabil province: Moghan, 2♀, 1♂; August 2004. East Azarbaijan province: Arasbaran, 6♀, 4♂; September 2006.

Distribution: Palearctic Region.

Synuchus elburzensis Morvan, 1977

Material: Golestan province: Kordkoy, 1♀, 3♂; June 2004.

Distribution: Caucasia, Iran.

Tribus Pterostichini Bonelli, 1810***Poecilus cupreus*** (Linnaeus, 1758)

Material: Mazandaran province: Behshahr, 5♀, 3♂; August 2002. Fars province: Darab, 4♀, 1♂; July 2005. Ardabil province: Dasht-e-Moghan, 1♀, 2♂; September 2002. Tehran province: Varamin, 3♂; July 2005. Semnan province: Garmsar, 2♀; September 2001. Golestan province: Azadshahr, 3♀, 5♂; August 2003.

Distribution: Central Asia, Europe, Turkey, Caucasia, Syria, Siberia.

Polistichus (s. str.) ***connexus*** (Geoffroy, 1785)

Material: Fars province: Darab, 2♂; June 2003. Golestan province: Ali-Abad, 3♀, 1♂; September 2005.

Distribution: Russia, Caucasia.

Pterostichus (Platysma) niger (Schaller, 1783)

Material: Golestan province: Kordkoy, 4♀; August 2004. Khorasan province: Kashmar, 2♀, 3♂; July 2004. Tehran province: Varamin, 3♀, 4♂; August 2004. Fars province: Darab, 6♀, 4♂; September 2005. Mazandaran province: Behshahr, 3♂; August 2004.

Distribution: Central Asia, Europe, Turkey, Caucasia, Iran, Siberia.

Tribus Sphodrini Laporte, 1834***Sphodrus leucophthalmus*** (Linnaeus, 1758)

Material: Golestan province: Nokandeh, 2♀, 2♂; August 2003.

Distribution: North Africa, South and West Asia, Europe, Turkey, Caucasia, India, Canary Island.

Taphoxenus (s. str.) ***goliath*** (Faldermann, 1836)

Material: Golestan province: Ali-Abad, 3♀, 2♂; July 2005. Khorasan province: Kashmar, 1♀; October 2004.

Distribution: Russia, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan.

Taphoxenus (Lychnifugus) persicus persicus Jedlicka, 1952

Material: Mazandaran province: Ghaemshahr, 2♀; April 2005. Tehran province: Varamin, 1♂; June 2006.

Distribution: Europe, Iran.

Taphoxenus (L.) persicus sahendensis Morvan, 1981

Material: Golestan province: Azadshahr, 1♀, 1♂; September 2003.

Distribution: Palearctic Region.

Subfamily Scaritinae Bonelli, 1810**Tribus Dyschiriini** Kolbe, 1880***Dyschirius*** (s. str.) ***nitidus chivensis*** (Fedorenko, 1992)

Material: Ardabil province: Dasht-e-Moghan, 2♂; September 2003.

Distribution: Caucasia, Transcaucasia.

Dyschirius (s. str.) ***nitidus nitidus*** Dejean, 1825

Material: Golestan province: Aghghala, 3♂; September 2004.

Distribution: Middle Asia, Caucasia, Siberia.

Tribus Scaritini Bonelli, 1810***Clivina*** (s. str.) ***attenuate*** Herbst, 1806

Material: Golestan province: Nokandeh, 2♀; July 2005.

Distribution: Palearctic Region.

Clivina (s. str.) ***collaris*** (Herbst, 1784)

Material: Khorasan province: Kashmar, 3♀, 1♂; July 2005.

Distribution: Middle Asia, Europe, Turkey, Czech Republic, Slovakia, Caucasia, Russia.

Coryza (Clivina) carinifrons Reitter, 1900

Material: East Azarbaijan province: Arasbaran, 1♀, 2♂; June 2004. **New record for Iranian fauna.**

Distribution: Middle Asia.

Distichus planus Bonelli, 1813

Material: Tehran province: Varamin, 1♀; August 2005. Khorasan province: Kashmar, 2♂; October 2004.

Distribution: South, West and Middle Asia, Africa, Caucasia, Mediterranean Countries.

Scarites procerus eurytus Fischer, 1828

Material: Mazandaran province: Galogah, 1♀, 3♂; November 2002.

Distribution: Syria, Israel, Russia, Armenia, Kazakhstan, Turkmenistan, Uzbekistan, Mountains of Middle Asia.

Scarites (Parallelomorphus) terricola pacificus Bates, 1873

Material: Golestan province: Ramian, 2♂; June 2005.

Distribution: Russia, Caucasia.

Subfamily Siagoninae Bonelli, 1810**Tribus Siagonini** Bonelli, 1810***Siagona europaea*** Dejean, 1826

Material: Mazandaran province: Behshahr, 2♀; September 2006.

Distribution: Africa, Central Asia, Europe, Iraq, Iran, India, Turkey, Mediterranean Countries.

DISCUSSION

The result of this research indicated that there is a diverse fauna of Carabidae in the cotton fields and surrounding grasslands of Iran. Among the 115 identified species, 7 species including, *Harpalus rufipes*, *Acinopus laevigatus*, *Brosicus laevigatus*, *Calosoma olivieri*, *Poecilus cupreus*, *Pterostichus niger*, and *Zabrus trinii* are more abundant than the others.

Carabid beetles are increasingly used as taxonomic study group in biodiversity and as bio-indicators in monitoring or site assessment studies for nature conservation purposes (e.g. Luff et al. 1989, 1992; Luff, 1990; Desender et al. 1991, 1992; Erwin, 1991; Loreau, 1994; Heijerman & Turin, 1995). The very high number of species, estimated some ten years ago at about 40000 described species (Noonan, 1985), as well as the well studied pronounced habitat or even microhabitat preference of many of these (Thiele, 1977) are important reasons for the increasing interest they get. Furthermore, the majority of carabid beetles (at least in temperate or subarctic climates) are relatively easily collected in a more or less standardized way by means of pitfall trapping. Nevertheless, much discussion remains on the necessary methodologies in sampling (details of techniques, intensity and duration of trapping) as well as in data analyses (multi-variate analysis techniques for community and indi-Eyrecator analyses, see e.g. Konjev and Desender, 1996) or in diversity assessment (Southwood, 1978).

One problem related to the study of carabid diversity is to assess which part of the species caught at a certain site actually belongs to the local fauna and has reproducing populations. Related to this problem is the question of observed turnover in species richness from year to year on a given site. A short review of the literature shows that most authors either deny the problem (i.e. assume that all species caught on a site belong to the local fauna and/or that species caught in low numbers have a small local population) or use a more or less arbitrary limit between so-called local species and accidentally caught species. Surprisingly, there have been few attempts to discriminate between the two by means of long term population studies or by investigating additional aspects of the biology (dispersal power and reproductive characteristics) and ecology (occurrence in surrounding or nearby other habitats). A comparable problem is also encountered on a larger geographical scale, where one recently has started to distinguish between core and satellite species (e.g. Niemels & Spence 1994; Konjev and Desender, 1996).

A second problem is the lack of knowledge of year-to-year variation in numbers of many carabid species, in other words data on the magnitude of population dynamics in more or less natural situations. Such studies of course

require a continuous long term sampling effort, which is probably the most obvious reason for their scarcity. If one does not take succession studies into account (which address different questions (e.g. Meijer 1980; Verschoor & Krebs 1995a, b) but not always are able to discriminate natural dynamics from those linked to directional changes), there are indeed only a few studies where sampling has continued for over 5 years. As a result, until now relatively few authors have tried to document and explain these dynamics in carabids, and if and how these might be regulated (Weber & Klenner 1987; Den Boer 1990, 1991; Luff 1990; Van Dijk & den Boer 1992; Den Boer et al. 1993; Van Dijk 1994). Also, a recent paper by Den Boer & van Dijk (1994) shows that many of their long term series on carabid dynamics seem to have been influenced to a high degree by recent directional changes in environmental conditions (e.g. air pollution, changed drainage and vegetation cover) which could mean they have to be classified more as success studies.

Although producers are beginning to adopt reduced tillage practices, the effects of these new tillage systems on pest populations in cotton have received little attention in Texas. For example, a recent economic analysis by Johnson and Polk (2004) of different farming operation indicated that cost savings for labor, fuel, machinery, equipment, repairs and maintenance were offset by higher chemical costs due to a reliance on herbicides to manage weeds. Studies of this type indicate that producers need to look at all aspects of production when assessing the change of production practices.

In a review of conservation tillage studies, Stewart (2003) indicated that most data indicate that in-season pest populations are minimally affected by tillage operations. Lower thrips populations were associated with conservation tillage plots (All et al. 1992, Leonard, 1995). Cotton aphid densities were higher in conservation tillage plots than in conventional tillage plots (Leonard, 1995). Similar studies in Texas have been confounding. De Spain et al. (1992) reported that early season aphid numbers were elevated in reduced tillage plots compared to conventional tillage plots in three out of the four years of the study. These studies were conducted in the Lower Gulf Coast region of Texas where humidity levels are generally higher and the cropping system is composed of corn and grain sorghum. Leser (1995) reported fewer thrips and aphids in reduced tillage systems compared to conventional systems in the High Plains of Texas. Both Leser (1995) and Leonard (1995) reported higher survival of bollworm/tobacco budworm pupae in reduced tillage systems but both also noted that migration is probably a bigger factor in determining if this insect will be an economic pest in any particular season. The High Plains system is dominated by continuous cotton planted into terminated wheat.

Clearly, conservation tillage practices have both potentially positive and negative effects on both pest and beneficial populations in cotton. As these effects are unknown for cotton production, results of this project may help plan IPM programs needed to fully realize the benefits of reduced tillage systems in cotton. Also, growers may be reluctant to adopt conservation tillage because of perceived risks due to increased insect problems. Results of this study identify some of the risks and benefits relative to insect pests and thus speed adoption of conservation tillage.

The researches of Sansone and Minzenmayer (2005) indicated that the reduced tillage systems did show higher numbers of ground predators and spiders early in the season. These predators may play a role in reducing the first generation populations. The impact of these ground predators is difficult to

measure because most of them are active at night. As the season progressed, natural enemy populations became similar in both tillage systems.

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