

REVIEW OF CHALCIDOID PARASITOIDS (HYMENOPTERA: CHALCIDOIDEA) OF XYLOPHAGOUS BEETLES

Hosseinali Lotfalizadeh*

* Department of Plant Protection, Faculty of Agriculture, Islamic Azad University, Tabriz Branch, Tabriz, Iran. E-mail: lotfalizadeh2001@yahoo.com

[Lotfalizadeh, H. 2012. Review of chalcidoid parasitoids (Hymenoptera: Chalcidoidea) of xylophagous beetles. Munis Entomology & Zoology, 7 (1): 309-333]

ABSTRACT: Xylophagous beetles (XBs) are one of the economically important pests of woody plants especially in the forest ecosystems. Over 89 genera (4.2% of known genera) and 208 species of parasitoids (Hym.: Chalcidoidea) have been recorded from XBs worldwide. About 264 distinct parasitoid-host associations between Chalcidoidea and XBs were identify. It appears to provide effective control in many cases. XBs are mostly parasitized by species belonging to the chalcidoid families Chalcididae (6%), Encyrtidae (14%), Eulophidae (15%), Eurytomidae (10%), Eupelmidae (11%), Pteromalidae (41%), and rarely by species belonging to other families such as Leucospidae, Mymaridae, Torymidae and Trichogrammatidae. Most of the genera associated with XBs are widely distributed in the same zoogeographical region, while 14 are cosmopolitan. Fourthly genera have limited distributions to a zoogeographical region, of which 70% are found only in the Palaearctic, 17.5% in the Nearctic, and the rest in the Afrotropical, Australian, Neotropical and Oriental regions.

KEY WORDS: Xylophagous beetles, Coleoptera, parasitoids, association, Hymenoptera, Chalcidoidea.

Xylophagous insects are found in many insect orders such as Coleoptera, Lepidoptera, Hymenoptera and Diptera (Csóka & Kovács, 1999). Within these orders, insects belonging to several families of the order Coleoptera are well-known pests of woody plants including different families of trees in the orchards and forests. Severe infestations can kill trees directly or by the fungal disease (Lotfalizadeh & Khalghani, 2008). This group attack trees that are weakened or dying due to stress factors such as drought, disease, smog, mechanical injury and primary pests. Sometimes the mass outbreaks of different bark and wood boring insects can cause enormous economic losses in the forests e.g. the Hungarian coniferous forests (Lakatos & Thuroczky, 2002). Some of xylophagous beetles (XBs) are vectors of plant pathogens such as the elm bark beetles that transport Dutch elm disease. Faccoli et al. (2005) mentioned pine forests growing decrease in Europe and Northern Africa by the bark beetles feeding and pathogen transmitting.

Coleoptera with mutualistic relationships with bacteria, fungi and protists are generally considered beneficial insects in the forest ecosystems because of decomposition of dead woody plants, whether alive or dead.

XBs are large and cosmopolitan families such as Anobiidae, Bostrichidae, Cerambycidae, Buprestidae and Scolytidae (Williams & Langor, 2002; Lotfalizadeh & Khalghani, 2008). However, some xylophagous are found within the families Lucanidae, Scarabaeidae, Eucnemidae, Elateridae, Lymexylonidae, Anthribidae and Curculionidae (Williams & Langor, 2002). "Bark beetles of the world" (<http://www.barkbeetles.org/>) is a web site that concentrates on the biology of Scolytidae, with a large searchable database. Another database (<http://www.fond4beetles.com/Buprestidae/index.html>) is focused on Jewel beetles (Buprestidae).

The natural enemies of this group of pests are pathogens, predators and parasitoids. In the present work the focal point is the chalcidoid parasitoids. Several families of the superfamily Chalcidoidea are potential parasitoids of Coleoptera including xylophagous groups. Chalcidoid wasps (Hymenoptera: Chalcidoidea)- representing about 22,000 species in 19 families- are an interesting group of insects, which show exquisite life histories and diverse types of host relationships. Although chalcidoids are generally considered beneficial insects in agricultural situations, they can also be pests when their populations attack on XBs of ecological importance, e.g. beetles used for decomposition of dead woody plants. Also some of them are hyperparasitoid of XBs through their primary parasitoids such as Ichneumonidae and Braconidae. Lakatos & Thuroczky (2002) mentioned a great number of various parasitoid species found in the Hungarian coniferous forests including the families Pteromalidae, Eurytomidae, Encyrtidae, Eulophidae, Mymaridae from Chalcidoidea and further species of families Platygastriidae from Proctotrupoidea, Braconidae, Ichneumonidae from Ichneumonoidea and Bethyliidae from Chrysoidea.

Considering the importance of this group of pest, their biocontrol agents can be very important, and within these natural enemies, chalcidoid hymenopterous as parasitoid of XBs are very impotent group in controlling these pests. No works have focused especially on a broad assessment of XBs-Chalcidoidea associations world widely. The Chalcidoidea Database (<http://www.nhm.ac.uk/entomology/chalcidoids/index.html>) is a searchable electronic databases web site with useful data on biology, associations, distribution and taxonomy of Chalcidoidea.

Several general references contain synoptic information about the parasitism of chalcidoids species in different countries or regions (Austin et al., 1994; Andrianova and Makhmadziev, 1980; Bakke, 1956; Balazy, 1968; Beaver, 1967; Berisford, 1969; 1974; Bickel, 1985; Bosman and Meijeraan, 1969; Buhroo et al., 2002; Hedqvist, 1967; Kamijo, 1981; Lakatos and Thuroczky, 2002; Loerch and Cameron, 1983; Lotfalizadeh and Khalghani, 2008; Lozano and Campos, 1993; Markovic and Stojanovic, 2003; Mendel, 1985, 1986; Mendel and Halperin, 1982; Mendel and Gurevitz, 1985; Parihar and Kampantzov, 1997; Pettersen, 1976; Reid, 1957; Stojanovic and Markovic, 2007; Weslien, 1992; Williams and Langor, 2002; Yanovskii, 1986; Yang, 1987, 1996; Yunap, 1986; Zhang et al., 2005). Because of the importance of this group of parasitoids in XBs complex control, further researches should be carried out. Further study can increase our knowledge on these benefit groups of insects that in the most case all of collected species have not been identified. On the other hand, little information is available in the literature concerning the parasitoid-host associations of chalcidoids and XBs in natural or near-natural settings, the fact that influences our perception of the true diversity of such associations and diminishes our ability to draw from the full range of these associations for use in biological control efforts. Such studies could be aided by tools to help in identifying the complex fauna of benefit species. Therefore, this review was made because of necessity of more correct evaluation of importance of the superfamily in natural control, and also for evaluation of their potential importance in the control of density of XBs. The objectives of this study are (1) to provide an extensive, referenced, tabulation of XBs-parasitoids associations worldwide; and (2) to review these data for patterns of biological and/or biological control interest.

MATERIALS AND METHODS

Approximately 138 literatures were searched and the data related to parasitoids of xylophagous beetles were extracted to identify references that cited XBs-chalcidoid parasitoids association. A list of parasitic chalcidoids has been developed according to literature records. Biological information on the association of each species with XBs is summarized. For species with taxonomic and biological literature, a brief summary and key reference are given here (see Table 1).

The families Anobiidae, Bostrichidae, Cerambycidae, Buprestidae and Scolytidae that may be named as xylophagous, phloeophagous, woodborers and bark beetles in the literatures are considered as XBs in this review.

The following data on associations were recorded from the literature: (1) scientific name and family of chalcidoid parasitoid species, and (2) bibliographic citation information.

Associations were recorded only if parasitoid taxa were identified i.e., associations in which either the parasitoid taxon was identified only to family or order rank were excluded. Only in the family Mymaridae two unknown species are included because of conserve this family in the associated fauna to XBs.

After the initial compilation of parasitoid-host associations, the scientific names and family associations of all nominal taxa were checked in Noyes (2010) for accuracy, and available taxonomic and most recent nomenclatural changes were considered. The known distributions of geographically restriction of each parasitoid were presented. The abbreviations of zoogeographic regions are as follow: AFT, Afrotropical region; AUS, Australian region; NEA, Nearctic; NET, Neotropical region; ORL, Oriental region; PAL, Palaearctic region. Associated species or genera with XBs that present in three or more zoogeographical regions have been considered as a cosmopolitan species or genera.

RESULTS AND DISCUSSION

This review indicates various number of chalcidoid species living in or from XBs and identify 264 distinct parasitoid-host associations between Chalcidoidea and XBs (Table 1). These associations involve 89 genera and 208 identified parasitoid species on five families of XBs.

The number of world species of Chalcidoidea associated with XBs and their distribution are presented. In summarizing known data on parasitoids of XBs, I establish ten families of the chalcidoid wasps as the associated ones. Within the chalcidoids wasps, the families that have been known as parasitoids of XBs include Chalcididae, Encyrtidae, Eulophidae, Eurytomidae, Eupelmidae, Leucospidae, Mymaridae Pteromalidae, Torymidae and Trichogrammatidae. Lakatos and Thuroczy (2002) mentioned some other groups of parasitoids such as Braconidae, Ichneumonidae (Ichneumonoidea), Platygasteridae, Diapriidae (Proctotrupoidea) and Bethyilidae (Chrysoidea) as associated to XBs that their host relations are still not clarified.

Out of 2100 or so valid chalcidoid genera, 4.2% of them are reliably known to contain species that are parasitic on XBs. These 89 genera contain about 208 described species. It seems that the Chalcidoidea is the largest group of natural insect enemies of XBs. In Mymaridae the precise numbers of species have not been identified (Lakatos and Thuroczy 2002).

Taxa in three families predominate: Pteromalidae 47 genera (53% of Chalcidoidea genera) and 83 species (40% of chalcidoid species); Eulophidae 10

genera (11%) and 31 species (15%); and Eupelmidae 6 genera (6%) and 23 species (11%). According to this investigation, Pteromalids (41%) and Eulophids (15%) are the dominant parasitoids (Fig. 4), nevertheless, undoubtedly a large number of various parasitoid species haven't been determined yet.

Grouped by chalcidoid family, 41% of all associations involve the family Pteromalidae, 6% the Chalcididae, 14% the Encyrtidae, 15% the Eulophidae, 10% the Eurytomidae, 11% the Eupelmidae, and 1% each of the families: Mymaridae, Torymidae and Trichogrammatidae (Fig. 3).

Grouped by XB family, 40% of all associations involve the Scolytidae, 27% the Buprestidae, 18% the Cerambycidae, 10% the Anobiidae and 6% the Bostrychidae (Fig. 1). Two chalcidoid families show a clear majority of associations with a single XB family: Pteromalidae with Scolytidae (75% of pteromalid associations) and Eulophidae with Scolytidae (48% of eulophid associations). The bostrychid family has not reported as host of Torymidae.

Chalcidoid parasitoids diversity of each XBs families are summarized in Fig. 5. In addition to the number of chalcidoid species recorded for various XBs families, the number of chalcidoid species (and genera) known for those XB species within their respective family is also recorded (Fig. 6). Among XBs families, the greatest parasitoid diversity was recorded for the family Scolytidae (Fig. 6). The highest number of recorded parasitoids genera and species is found in the Palearctic region (72-148), followed by the Nearctic (33-50), Oriental (28-35), Neotropical (18-19), Afrotropical (11-13) and Australian (12-13) regions (Fig. 6). Fourthly-one genera have limited distributions to a zoogeographical region, of which 70% are found only in the Palearctic, 17.5% in the Nearctic, and the rest in the Afrotropical, Australian, Neotropical and Oriental regions.

Table 1 includes the entire chalcidoid hymenopterous parasitoid genera and species recorded on XBs families world widely.

Given this reality that some of XBs (e.g. Bark beetles) are economically important pest, hence, it is important to be able to distinguish which parasitoid species may be useful in combating those threats. This study broadly documents the current knowledge of global chalcidoid-XB parasitoid-host associations as a preliminary step for assessing the use of chalcidoid parasitoid as targeted parasitoids to control XBs.

PARASITOID ASSOCIATIONS

Chalcidid association- Chalcididae currently includes 89 genera and approximately 1500 species placed in five subfamilies in the world (Noyes, 2010). Only 13 species in four genera are reported from XBs. The number of associations between Chalcididae and XBs, at first glance, seems disproportionately highly relative to the small species diversity of the families Cerambycidae, Buprestidae, Bostrychidae and Scolytidae (Figs 3-5). Part of this may be suggested the possibility of entrance of the chalcidid parasitoids -with relatively large and stout body- into the large galleries of these families. However, there are some small species belong to the family of Scolytidae have been reported as host of this group of parasitoids, that I also suggest the possibility of a broader role for the Chalcididae in the suppression of XBs populations. It includes four genera and 13 species (6%) of the family Chalcididae which attack XBs worldwide (Fig. 4). These species are widely distributed in the tropical regions.

The strong majority of chalcidid associations with XBs in the family Buprestidae (67%) bears further study for the possible discovery of additional

parasitoids for buprestid beetles biological control efforts. This family was not recovered on Anobiidae.

Encyrtid association- Encyrtidae currently includes 483 genera and approximately 4000 species placed in two subfamilies in the world (Noyes, 2010). Thirteen genera including 28 species have been recorded on different families of XBs (see Table 1). Most of them are distributed in the Palearctic region and about 60% of them associated with Cerambycidae. It belongs 14% of total parasitoids associated to XBs (Fig. 3).

These microhymenoptera have relatively minute size that permits them to entrance all of XB's galleries. The encyrtidae is one of the most useful families in biological control mostly on Hemiptera and Coleoptera. It seems that their associations need further attention because only 2.7% of known genera are associated with XBs.

In this family *Oobius agrili* as a solitary and parthenogenic egg parasitoid, was introduced from China to use as a biocontrol agent in USA to control of *Agrilus planipennis* (Col.: Buprestidae) (Bauer et al., 2008).

Eulophid association- Eulophidae is one of the large families of chalcidoids. It currently includes 332 genera and more than 4500 species (Noyes, 2010) arranged in four subfamilies. Parasitic eulophids on XBs belong 31 species in ten genera (Fig. 4). Among these, only five genera of Tetrastichinae (*Aprostocetus* Westwood, *Baryscapus* Förster, *Tetrastichus* Haliday, *Planotetrastichus* Yang, *Phymastichus* LaSalle), two genera of Euderinae (*Boučekastichus* Andriescu, *Wichmannia* Ruschka), one genus of Eulophinae (*Prigalio* Schrank) and one genus of Entedoninae (*Entedon* Dalman) include parasitoids of XBs. It is mostly associated with Scolytidae (44%) and Buprestidae (29%) (Table 1). Eulophidae are second specious group of parasitoid community associated with XBs (Fig. 4). Such as latter family they are small wasps that may be simplify to access in the XB's galleries.

Bauer et al. (2008) mentioned *Tetrastichus planipennisi* as a classical biological control of *Agrilus planipennis* (Col.: Buprestidae) in USA (introduced from China).

Eupelmid association- This family includes 48 genera and approximately 1000 species placed in three subfamilies (Calosotinae, Eupelminae and Neanastatinae) in the world (Noyes, 2010). Some these genera that attack insects in plant stems or wood. Out of 48 so valid eupelmid genera, six (*Balcha* Walker, *Calosota* Curtis, *Eusandalum* Ratzeburg and *Pentacladia* Westwood from Calosotinae *Eupelmus* Dalman from Eupelminae and *Metapelma* Westwood from Neanastatinae) are reliably known to contain species that are parasitic on XBs. These six genera have 23 described species, mostly associated with Scolytidae (39%) and Buprestidae (39%).

This relatively large family is widely distributed through the world but most of the genera associated with XBs are not widely distributed and occur in one zoogeographical region (mostly Palearctic) of the world (Table 1), while there is not any cosmopolitan eupelmid species. It seems that this family is not studied sufficiently in the other regions. One of the reasons of this problem may be the difficulty of their collection by known methods e.g. sweeping. Because there are brachypterous and apterous forms in this family, therefore rearing on dead twigs with exit holes can be a recommended method.

Eurytomid association- Classification of Eurytomidae followed here is that of Lotfalizadeh et al. (2007). Eurytominae is the largest subfamily that contains species, which exhibit a range of biologies and includes all the XBs parasitoids species in the family. Within this subfamily, *Eurytoma* is a specious genus with remarkably varied biology, including organisms that are parasitic, inquiline, phytophagous, entomophagous and gall inducing. Many of the species of *Eurytoma* occur as parasitic in XBs.

All of XBs parasitoids species (20 species) include in this family belong to the genus *Eurytoma* (except *Endobia donacis*) (Fig. 4). These species are from two species groups, *morio*-group and *nodularis* (Lotfalizadeh et al., 2007) or *robusta*-group (Zerova and Seryogina, 2006). Lotfalizadeh et al. (2007) believe that *morio* group is not good placed in the genus *Eurytoma* because of lacking postgenal depression. But these species have hairy metacoxa, relatively inflated marginal vein and distinctive costal cell bearing numerous white hairs on its ventral surface. On the contrary the *nodularis* group has a conspicuous mesopleural ventral shelf, carinate fore coxae and the petiolate female gaster (Lotfalizadeh et al., 2007).

In summary, the adults of those eurytomid taxa parasitoids of XBs can be separated from other chalcidoid families by typical characters of the family Eurytomidae (mostly black coloration, quadrate pronotum and punctate notum). After Pteromalidae, Eulophidae and Eupelmidae, this family includes a large part (10%) of parasitoids of XBs (Fig. 3). Its association with the families Scolytidae and Buprestidae with 36% is dominant. In this family, *Endobia donacis* is a cosmopolitan species.

Pteromalid association- Pteromalidae, one of the large families of Chalcidoidea, currently includes 587 genera and approximately 3500 species placed in 30 subfamilies throughout the world (Noyes, 2010). Several groups of pteromalid are parasitoids of XBs that belong to Pteromalinae, Cerocephalinae, Cleonyminae, Louriciinae, Macromesinae and Euderinae (Fig. 2). Of which Pteromalinae is most specious group. Also most cleonymines are parasitoids or supposed parasitoids of XBs (Bouček, 1988; Gibson, 2003). Therefore, it seems that the Cleonyminae may be need more attention as XBs parasitoids. But biology of the Cleonyminae genera is mostly unknown; therefore these genera are excluded in this review. According to literatures 1) some of them have unknown biology but they are probably parasitoids of XBs such as *Lycisca* Spinola, *Westwoodiana* Girault, *Striatacanthus* Gibson (Gibson, 2003) or they are parasitoids of XBs larvae probably mainly of Buprestidae and Cerambycidae such as *Thaumasura* Westwood (Bouček, 1988); 2) some others are parasitoids of the larvae of unknown XBs in dead tree trunks and logs such as *Mesamotura* Girault, *Parepistenia* Dodd (Bouček, 1988); 3) some genera are apparently parasitoids of XBs such as *Neboissia* Bouček (Bouček, 1988).

The Pteromalidae are the well known generalists parasitoids of XBs and form a very large part of chalcidoid fauna associated with XBs (Fig. 3). Within the recovered families approximately 41% of reared species belongs to Pteromalidae. They outshine the Chalcididae, Encyrtidae, Eulophidae, Eurytomidae, Eupelmidae and Torymidae in both species richness and spectrum of XBs hosts that they attack (Fig. 5 and Table 1). About 80% of them are widely distributed in the Palearctic region (Table 1). This family show the broadest range of associations with XB families, but a distinct plurality (55%) of its associations were with the family Scolytidae. Also their association with other families were

calculated as follow: 17% with Buprestidae, 13% with Anobiidae, 8% with Cerambycidae and 7% with Bostrychidae.

The pteromalid parasitoid fauna of XBs comprise 83 of described species in 47 genera. Dzhanokmen (1991) reviewing trophic association of the family Pteromalidae, listed 14 genera for Anobiidae, eight genera for Buprestidae and 17 genera for Scolytidae within five subfamilies (Pteromalinae, Cerocephalinae, Cleonyminae, Miscogasterinae and Macromesinae) that attach XBs. She did not mention the families Cerambycidae and Bostrychidae as hosts of Pteromalidae.

The preponderance of pteromalid associations with XBs in the family Scolytidae, suggests that additional taxa in this family might be good targets for further study for control of this group of agricultural pests. Solitary parasite is predominant in this family. They can be the primary or secondary parasite of Coleoptera (Dzhanokmen, 1991).

They are potentially important natural enemies of many pest insects and there are some successful utilization in biological control programs. Bouček and Rasplus (1994) listed some of them such as *Perniphora robusta* (L.) and *Cheilopachus qucdrum* (F.) that were introduced from Europe respectively to New Zealand and North America against Scolytidae. The pteromalids associated with XBs are mostly ectoparasite that acts predominantly as larval parasite. These wasps are rarely associated with adult such as *Tomicobia seitneri* (Ruschka, 1924) on several species of *Ips* (Col.: Scolytidae) (Dzhanokmen, 1991). This family has ten species in nine genera that were widely distributed and are cosmopolitan (see Table 1).

Mymaridae association- Mymaridae currently includes 99 genera and more than 1400 species in the world (Noyes, 2010). All of the members of the family so far known are parasitic in habit and develop in the eggs of different insect orders (Lin et al., 2007). Very few reliable host records exist for more than 1400 mymarid taxa. Although members of this family are almost exclusively egg parasitoids, Lakatos and Thuroczy (2002) and Lin et al. (2007) reported two unknown species of *Anaphes* Haliday and *Prionaphes* Hincks respectively develop as parasitoids of the XBs in the Palaearctic and Australian regions.

Trichogrammatid association-They are tiny wasps that are egg parasitoid of different orders of insects. World Trichogrammatid currently includes 96 genera and approximately 900 species in the world (Noyes, 2010) of which two species have so far been reported as XB associates. They are found on XBs of the families Scolytidae and Cerambycidae and include 1% of XB's parasitoids (Fig. 3). It seems that these minute wasps (smaller than 1 mm) can enter easily in the XB's galleries but our knowledge of their controlling task of XBs is rudimentary. Two listed species in this research are widely distributed (see Table 1).

Torymid association- This family contains about 1000 species placed in 73 genera in the world (Noyes, 2010). Much useful information on the biology of Torymidae is available in summarized forms in Grissell (1995). He discussed in detail the subfamily systematics of torymids and accordingly, the family includes Megastigmminae and Toryminae. Only three species in two genera (*Ecdamua* and *Microdontomerus*) was reported on XBs families (except Bostrychidae).

This family with its characteristic morphology (long ovipositor) should have an important task in XBs control, because of their sheltered habitat. Hence, it seems its importance as the biocontrol agent of XBs needs to be reviewed in the world fauna.

ACKNOWLEDGEMENT

My thanks are due to Dr. M. Mofidi (Department of Insect Taxonomy, Iranian Research Institute of Plant Protection, Tehran) for careful reading and the editing on the manuscript.

LITERATURE CITED

- Annecke, D. P.** 1967. Three new southern African species of *Oobius* Trjapitzin, 1963 (Hymenoptera: Encyrtidae). *J. Nat. Hist.*, 1: 319-325.
- Andrianova, N. S. & Makhmadziev, A. R.** 1980. On chalcids (Hymenoptera, Chalcidoidea) - parasites of the bark beetle *Scolytus kirschi* Skal. in the semi-desert forest belts. *Entomologicheskoe Obozrenie*, 59 (1): 86-88.
- Austin, A. D., Quicke, D. L. J. & Marsh, P. M.** 1994. The hymenopterous parasitoids of eucalypt longicorn beetles *Phoracantha* spp. (Coleoptera: Cerambycidae) in Australia. *Bulleten of Entomological Research*, 84: 145-174.
- Bakke, A.** 1956. Chalcid-flies (Hym., Chalcididae) of bark beetles in Norway. I. *Norsk Entomologisk Tidsskrift*, 10: 40-42.
- Balazy, S.** 1968. Analysis of bark beetle mortality in spruce forests in Poland. *Ekologia Polska (A)*, 16 (33): 657-687.
- Barriga, T. J. E.** 1990. Parasitoids and predators of larvae of Cerambycidae and Buprestidae (Coleoptera) in Chile. *Revista Chilena de Entomología*, 18: 57-59.
- Bathon, H.** 1991. Possibilities for biological control of bark beetles. In: *Mitteilungen aus der Biologischen Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem. Heft 267.* (Eds: Wulf A, Kehr R) Borkenkäfer-Gefahren nach Sturmschäden: Möglichkeiten und Grenzen einer Integrierten Bekämpfung; Braunschweig, Germany, October 30-31, 1990: 111-117. Biologische Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem, Berlin, Germany.
- Bauer, L. S., Liu, H., Miller, D. & Gould, J.** 2008. Developing a Classical Biological Control Program for *Agrilus planipennis* (Coleoptera: Buprestidae), an Invasive Ash Pest in North America. *Newsletter of the Michigan Entomological Society*, 53 (3&4): 38-39.
- Baur, H.** 2005. Determination list of entomophagous insects nr 14. *Bulletin Section Regionale Ouest Palaearctique, Organisation Internationale de Lutte Biologique*, 28 (11) : 71 pp.
- Beaver, R. A.** 1966. Notes on the biology of the bark beetles attacking elm in Wytham Wood, Berks. *Entomologist's Monthly Magazine*, 102: 163-170.
- Beaver, R. A.** 1967. Hymenoptera associated with elm bark beetles in Wytham Wood, Berks. *Transactions of the Society for British Entomology*, 17 (6): 141-150.
- Bellamy, C. L.** 2009. The world of jewel beetles (Insecta: Coleopter: Buprestidae). Available from: <http://www.fond4beetles.com/Buprestidae/index.html>
- Berisford, C. W.** 1969. Hymenopterous parasites of *Ips* spp. bark beetles (Coleoptera: Scolytidae) in Virginia. *Dissertation Abstracts International*, 30B: 691-692.
- Berisford, C. W.** 1974. Hymenopterous parasitoids of the eastern juniper bark beetle, *Phloeosinus dentatus* (Coleoptera: Scolytidae). *Canadian Entomologist*, 106 (8): 869-872.
- Berisford, C. W.** 1991. Biological control of pine bark beetles: new approaches to an old problem. *Information Series - Virginia Polytechnic Institute and State University, College of Agriculture and Life Sciences*, 91 (2): 57-66.
- Berisford, C. W., Kulman, H. M. & Pienkowski, R. L.** 1970. Notes on the biologies of hymenopterous parasites of *Ips* spp. bark beetles in Virginia. *Canadian Entomologist*, 102 (4): 484-490.
- Bellows, T. S., Meisenbacher, C. & Reardon, R. C.** 1998. Biological control of arthropod forest pests of the Western United States: A review and recommendations, USDA, FS, FHTET-96-21.

- Bickel, D. J.** 1985. Notes on the biologies of hymenopterous parasites of *Ips* spp. bark beetles in Virginia. *Canadian Entomologist*, 102: 484-490.
- Bin, F.** 1973. Biologia ed etologia comparata di alcune *Agapanthia*: *villosoviridescens* Deg., *violacea* Fabr., *cardui* L. (Coleoptera, Cerambycidae, Lamiinae). *Bollettino di Zoologia Agraria e Bachicoltura*, Milano, 11 (2): 101-124.
- Bogdanova, D. A.** 1971. *Eurytoma blastophagi* Hedqv. (Hymenoptera, Chalcidoidea), a parasite on bark beetle larvae. *Novye maloizv. Vidy Faun.*, 5: 59-64.
- Bosman, B. T. & Meijeraan, J. W.** 1969. Some parasitic Hymenoptera of the elm bark beetles (*Scolytus scolytus* and *Scolytus mutistriatus* in the Netherlands. *System Zoölogie*, 145 (7): 325-330.
- Bouček, Z.** 1961. Notes on the chalcid fauna (Chalcidoidea) of Moldavian SSR. *Trudy Moldavskogo Nauchno-Issledovatel'skogo Instituta Sadovodstva, Vinogradarstva i Vinodeliya*. Kishinev, 7: 5-30.
- Bouček, Z.** 1967. Revision of species of *Eusandalum* Ratz. (Hym., Eupelmidae). *Acta Entomologica Bohemoslovaca*, 64: 261-293.
- Bouček, Z.** 1972. Descriptions of new eulophid parasites (Hym., Chalcidoidea) from Africa and the Canary Islands. *Bulletin of Entomological Research*, 62 (2): 199-205.
- Bouček, Z.** 1988. Australasian Chalcidoidea (Hymenoptera). A Biosystematic Revision of Genera of Fourteen Families, with a Reclassification of Species. CAB International, Wallingford, U.K. 832 pp.
- Bouček, Z.** 1993. New taxa of North American Pteromalidae and Tetracampidae (Hymenoptera), with notes. *Journal of Natural History*, 27: 1239-1313.
- Bouček, Z. & Askew, R. R.** 1968. Palaearctic Eulophidae sine Tetrastichinae. In: Delucchi V, Remaudière G (eds) *Index of Entomophagous Insects*, 3: 260 pp. Le François, Paris.
- Bouček, Z. & Rasplus, J.-Y.** 1991. Illustrated key to West-Palaearctic genera of Pteromalidae (Hymenoptera - Chalcidoidea). Paris, INRA Editions, série Techniques et Pratiques 1-140.
- Buhroo, A. A., Chishti, M. Z. & Masoodi, M. A.** 2002. Biocontrol agents of shot-hole borer, *Scolytus nitidus* Schedl. (Coleoptera: Scolytidae) infesting apple orchards. *Indian Journal of Plant Protection*, 30 (1): 71-73.
- Burks, B. D.** 1963. Ten new reared species of *Tetrastichus* (Hymenoptera, Eulophidae). *Proceedings of the Biological Society of Washington*, 76: 47-58.
- Burks, B. D.** 1979. Torymidae (Agaoninae) and all other families of Chalcidoidea (excluding Encyrtidae). In: Krombein KV, Hurd PD, Smith DR, Burks BD (eds) *Catalog of Hymenoptera in America North of Mexico*, 1: 968. Smithsonian Institution Press, Washington, D.C.
- Csóka, G. & Kovács, T.** 1999. Xilofág rovarok - Xylophagous insects. Hungarian Forest Research Institute. Erdészeti Turományos Intézet, Agroinform Kiadó, Budapest, 189 pp.
- Davatchi, A. & Chodjai, M.** 1968. Les Hyméoptères entomophages de l'IRAN- études faunistiques. Iranian Plant Protection Congress, October, Tehran, 89 pp.
- Delucchi, V.** 1962. Hyménoptères chalcidiens du Maroc. II. Pteromalidae (suite). *Al Awamia*, 4: 7-25.
- Delvare, G.** 2001. A revision of genus *Pentacladia* Westwood (Hymenoptera, Eupelmidae). *Revue Française d'Entomologie (nouvelle série)*, 23 (1): 47-62.
- De Santis, L.** 1985. Two new genera and species of oophilous encyrtids from Argentina. *Spixiana*, München, 8: 259-263.
- Dzhanokmen, K. A.** 1991. Trophic associations of parasitic Hymenoptera of the family Pteromalidae (Chalcidoidea). *Entomological Review*, 70 (5): 45-66.
- Dzhanokmen, K. A.** 1978. Hymenoptera III. Chalcidoidea 5. Pteromalidae. *Opredelitel' Nasekomikh Evropeyskoy Chasti SSSR*. 57-228.
- Ebrahimi, E.** 1993. An introduction to the new six parasitoid wasps for the fauna of Iran. *Journal of Entomological Society of Iran*, 12-13: 113.

- Faccoli, M.** 2006. Morphological separation of *Tomicus piniperda* and *T. destruens* (Coleoptera, Curculionidae, Scolytinae): New and old characters. *European Journal of Entomology*, 103 (2): 433-442.
- Faccoli, M., Pisccedda, A., Salvato, P., Simonato, M., Masutti, L. & Battisti, A.** 2005. Genetic structure and phylogeography of pine shoot beetle populations (*Tomicus destruens* and *T. piniperda*, Coleoptera Scolytidae) in Italy. *Annals of Forest Sciences*, 62: 361-368.
- Farooqi, S. I. & Subba Rao, B. R.** 1986. Family Pteromalidae. In: Subba Rao BR, Hayat M (eds) *The Chalcidoidea (Insecta: Hymenoptera) of India and the adjacent countries. Part II. Oriental Insects*, 20: 279-306.
- Fatma, A. & Shafee, S. A.** 1985. A new species of *Parasyrphophagus* Girault (Hymenoptera: Encyrtidae) from Aligarh, India. *Journal of the Bombay Natural History Society*, 81 (3): 678-679.
- Garrido Torres, A. M. & Nieves-Aldrey, J. L.** 1999. Pteromalids from the Autonomus Community of Madrid (CAM) (Spain): faunistics and catalogue (Hymenoptera: Chalcidoidea: Pteromalidae). *Graellsia*, 55: 9-147.
- Gibson, G. A. P.** 2003. Phylogenetics and classification of Cleonyminae (Hymenoptera: Chalcidoidea: Pteromalidae). *Memoirs on Entomology, International*, 28: 87-124.
- Gibson, G. A. P.** 2005. The world species of *Balcha* Walker (Hymenoptera: Chalcidoidea: Eupelmidae), parasitoids of wood-boring beetles. *Zootaxa*, 1033: 1-62.
- Gibson, G. A. P., Huber, J. T. & Woolley, J. B.** 1997. Annotated keys to the genera of Nearctic Chalcidoidea (Hymenoptera). *National Research Council Research Press, Ottawa, Canada* 794 pp.
- Girault, A. A.** 1925. An essay on when a fly is lovable. The ceremony of baptizing some and unlovely hate. private publication, Brisbane, 4 pp.
- Gordh, G.** 1979. Family Encyrtidae. In: Krombein KV, Hurd PD, Smith DR Jr, Burks BD (eds) *Catalog of Hymenoptera in America North of Mexico*. pp: 890-967. Smithsonian Institution Press, Washington, DC.
- Gordh, G. & Trjapitzin, V. A.** 1981. Taxonomic studies of the Encyrtidae with the descriptions of new species and a new genus (Hymenoptera, Chalcidoidea). *University of California Publications in Entomology*, 93: 1-64.
- Graham, M. W. R. de V.** 1969. The Pteromalidae of north-western Europe (Hymenoptera: Chalcidoidea). *Bulletin of the British Museum (Natural History) (Entomology) Supplement*, 16: 908 pp.
- Graham, M. W. R. de V.** 1991. A reclassification of the European Tetrastichinae (Hymenoptera: Eulophidae): revision of the remaining genera. *Memoirs of the American Entomological Institute*, 49: 322 pp.
- Grimble, D. G., Knight, F. B. & Nord, J. C.** 1971. Associated insects reared from galls of *Saperdainornata* Coleoptera: Cerambycidae) on trembling aspen in Michigan. *Michigan Entomologist*, 4: 53-57.
- Grissell, E. E.** 1991. A revision of Nearctic Chalcedectini (Chalcidoidea: Pteromalidae) with a New World checklist. *Proceedings of the Entomological Society of Washington*, 93 (1): 1-15.
- Grissell, E. E.** 1995. Toryminae (Hymenoptera: Chalcidoidea: Toryminae): A redefinition, generic classification and annotated world catalogue of species. *Memoirs on Entomology, International*, 2: 1-474.
- Grissell, E. E.** 2005. A review of North American species of *Microdontomerus* Crawford (Torymidae: Hymenoptera). *Journal of Hymenoptera Research*, 14 (1): 22-65.
- Guerrieri, E., Garonna, A. P. & Viggiani, G.** 1989. Description of *Oobius anomalus* sp.n. (Hymenoptera: Encyrtidae), a species with 4-segmented tarsi. *Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri', Portici*, 46: 25-29.
- Guerrieri, E. & Noyes, J. S.** 2005. *Zdenekiella deon* gen. nov. et sp. nov. (Hymenoptera: Chalcidoidea, Encyrtidae), egg parasitoid of *Phonopate frontalis* (Coleoptera: Bostrichidae) from Libya. *Acta Societatis Zoologicae Bohemoslovenicae*, 69 (1-2): 119-122.
- Gumovsky, A. V.** 1999. Review of the genus *Entedon* (Hymenoptera, Eulophidae, Entedoninae) IV. Revision of Ukrainian species of *hercyna* group. *Vestnik Zoologii Kiev*, 33 (6): 27-37.

- Haack, R. A., Benjamin, D. M. & Schuh, B. A.** 1981. Observations on the biology of *Phasgonophora sulcata* (Hymenoptera: Chalcididae), a larval parasitoid of the two-lined chestnut borer, *Agrilus bilineatus* (Coleoptera: Buprestidae), in Wisconsin. Great Lakes Entomologist, 14 (2): 113-116.
- Haeselbarth, E.** 1983. Determination list of entomophagous insects. No. 11. Bulletin Section Regionale Ouest Palaearctique, Organisation Internationale de Lutte Biologique, 12 (7): 1-62.
- Halstead, J. A. & Haines, R. D.** 1985. On the biology of *Acanthochalcis nigricans* Cameron and *Acanthochalcis unispinosa* Girault (Hymenoptera: Chalcididae). Pan-Pacific Entomologist, 61 (33): 227-228.
- Hayat, M. & Viggiani, G.** 1984. A preliminary catalogue of the Oriental Trichogrammatidae (Hym.: Chalcidoidea). Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri', Portici, 41: 23-52.
- Hedqvist, K. J.** 1967. Notes on some chalcid flies reared from Buprestidae and Bostrychidae, injurious to *Acacia roddiana* Savi in Algeria (Sahara) and North Tchad. Eos. Revista Española de Entomología Madrid, 43 (1/2): 135-146.
- Hedqvist, K. J.** 1974a. A new genus and species from Romania, representing a new family (Hymenoptera, Chalcidoidea). Polskie Pismo Entomologiczne, 44 (2): 253-256.
- Hedqvist, K. J.** 1974b. Notes on Chalcidoidea (Hym.). V. *Legolasia dinotiscoides* gen. n., sp. n. and *Trychnosoma ernobii* sp. n., two pteromalids from Sweden (Pteromalidae). Entomologisk Tidskrift, 95 (2): 117-121.
- Hérard, F. & Mercadier, G.** 1984. Biological complex of bark beetles on *Pinus sylvestris* L. in the Orleans Forest, (Loiret) France. International Congress of Entomology, 17: 601.
- Herting, B.** 1973. Coleoptera to Strepsiptera. A catalogue of parasites and predators of terrestrial arthropods. Section A. Host or Prey/Enemy. Commonwealth Agricultural Bureaux, Institute of Biological Control 3: 153 pp.
- Heydon, S. L.** 1997. A review of the world genera of the Trigonoderini, with a revision of the species of North America north of Mexico (Hymenoptera: Pteromalidae). Contributions of the American Entomological Institute, 30 (2): 1-84.
- Kalina, V.** 1984. New genera and species of Palaearctic Eupelmidae (Hymenoptera, Chalcidoidea). Silvacultura Tropica et Subtropica, Prague, 10: 1-29.
- Kamijo, K.** 1981. Pteromalid parasites (Hymenoptera) of bark beetles from Japan, with descriptions of three new species. Kontyû, 49: 86-95.
- Kapoor, K. N., Gujrati, J. P. & Gangrade, G. A.** 1972. Parasites of *Oberea brevis* (Coleoptera: Lamiidae). Annals of the Entomological Society of America, 65 (3): 755.
- Khlopunov, E. N.** 1981. A new species of the genus *Zaommoencyrtus* Girault, 1916 (Hymenoptera, Encyrtidae) from the European part of the USSR. Entomologicheskoe Obozrenie, 60: 663-665.
- Lakatos, F. & Thuróczy, C.** 2002. Parasitoids of xylophagous and phloeophagous insects of the Hungarian coniferous three species. In: Melika G, Thuróczy C (eds) Parasitic Wasps: Evolution, Systematics, Biodiversity and Biological Control.
- La Salle, J.** 1994. North American genera of Tetrastichinae (Hymenoptera: Eulophidae). Journal of Natural History, 28: 109-236.
- Liao, D. X., Li, X. L., Pang, X. F. & Chen, T. L.** 1987. Hymenoptera: Chalcidoidea (1). Economic Insect Fauna China, 34: 1-241.
- Lin, N.-Q., Huber, J. T. & La Salle, J.** 2007. The Australian genera of Mymaridae (Hymenoptera: Chalcidoidea). Zootaxa, 28: 1-111.
- Lobinger, G. & Feicht, E.** 1999. Swarming behaviour and abundance dynamics of the pteromalid wasp *Karpinskiella pityophthori* (Bouček), a parasitoid of the bark beetle *Pityogenes chalcographus* L. (Col.: Scolytidae). Anzeiger für Schädlingskunde, 72 (3): 65-71.

- Loerch, C. R. & Cameron, E. A.** 1983. Natural enemies of immature stages of the bronze birch borer, *Agrilus anxius* (Coleoptera: Buprestidae), in Pennsylvania. *Environmental Entomology*, 12 (6): 1798-1801.
- Lopez Vaamonde, C. & Moore, D.** 1998. Developing methods for testing host specificity of *Phymastichus coffea* LaSalle (Hym.: Tetrastichinae), a potential biological control agent of *Hypothenemus hampei* (Ferrari) (Col.: Scolytidae) in Colombia. *Biocontrol Science and Technology*, 8 (3): 397-411.
- Lotfalizadeh, H., Delvare, G. & Rasplus, J.-Y.** 2007. Phylogenetic analysis of Eurytominae based on morphological characters (Chalcidoidea: Eurytomidae). *Zoological Journal of the Linnean Society*, 151: 441-510.
- Lotfalizadeh, H. & Khalghani, J.** 2008. Hymenopterous parasitoids (Hym.: Chalcidoidea) of xylophagous beetles in Iran. *Entomofauna*, 29 (19): 249-264.
- Lotfalizadeh, H., Ebrahimi, E. & Delvare, G.** 2010. The first contribution to the family Chalcididae (Hym.: Chalcidoidea) in Iran. *Journal of Entomological Society of Iran* in press.
- Lozano, C. & Campos, M.** 1993. Preliminary study about entomofauna of the bark beetle *Leperesinus varius* (Coleoptera, Scolytidae). *Redia*, 74 (3, Appendix): 241-243.
- Markovic, C. & Stojanovic, A.** 2003. Significance of parasitoids in the reduction of oak bark beetle *Scolytus intricatus* Ratzeburg (Col., Scolytidae) in Serbia. *Journal of Applied Entomology*, 127 (1): 23-28.
- Masutti, L., Battisti, A. & Faccoli, M.** 2005. Entomological fauna in pine stands of the *nigra* group in Italy. Lieutier F, Ghaioule D (eds), *Proceeding of the international symposium: Entomological research in Mediterranean forest ecosystems*. Rabat (Morocco), 6-10 May 2002. INRA Editions, Paris: 79-87.
- Meduna, J.** 1986. Faunistic records from Czechoslovakia. Pteromalidae. *Acta Entomologica Bohemoslovaca*, 83: 232.
- Mendel, Z.** 1985. Hymenopterous parasitoids of bark beetles (Scolytidae) in Israel: Host relation, host plant, abundance and seasonal history. *Biocontrol*, 31 (2): 113-125.
- Mendel, Z.** 1986. Hymenopterous parasitoids of bark beetles (Scolytidae) in Israel: Host relation, host plant, abundance and seasonal history. *Entomophaga*, 31: 113-126.
- Mendel, Z. & Halperin, J.** 1982. Parasites of bark beetles (Col.: Scolytidae) on pine and cypress in Israel. *Entomophaga*, 26 (4): 375-379.
- Mendel, Z. & Gurevitz, E.** 1985. Hymenopterous parasitoids of the almond bark beetles in Israel. *Alon Ha'notea*, 39 (12): 1057-1060.
- Michalski, J. & Seniczak, S.** 1974. *Trichogramma semblidis* (Chalcidoidea, Trichogrammatidae) as a parasite of bark beetle eggs (Coleoptera: Scolytidae). *Entomophaga*, 19 (3): 237-242.
- Mitroiu, M.-D. & Andriescu, I.** 2008. Faunistic review of *Notaninus* Walker (Hymenoptera: Pteromalidae) in Romania, with a key to the European species. *North-Western Journal of Zoology*, 4 (2): 311-319.
- Myartseva, S. N.** 1979. New species of hymenopteran parasites (Hymenoptera, Encyrtidae) from Turkmenia and southern Kazakhstan. *Izvestiya Akademii Nauk Turkmenskoy SSR (Seriya Biologicheskikh Nauk)*, 6: 49-56.
- Narendran, T. C.** 1986. Family Chalcididae. In: Subba Rao BR, Hayat M (eds) *The Chalcidoidea (Insecta: Hymenoptera) of India and the adjacent countries*. *Oriental Insects*, 20: 11-41, 307-310.
- Narendran, T. C., Buhroo, A. A. & Chisti, M. Z.** 2001. Taxonomic studies on four new species of Chalcidoidea (Hymenoptera) of economic importance from Kashmir, India. *Entomon*, 26 (2): 147-159.
- Nikol'skaya, M. N.** 1960. Chalcididae and Leucospidae in central Asia (Hymenoptera, Chalcidoidea). *Trudy Zoologicheskogo Instituta. Akademiya Nauk SSSR. Leningrad*. 27: 220-246.
- Noyes, J. S.** 1990. A new genus and species of encyrtid (Hymenoptera, Chalcidoidea) parasitoid of the eggs of the varicose borer, *Agrilus sexsignatus* (Fisher) (Coleoptera, Buprestidae), a pest of bagras (*Eucalyptus deglupta* Blume) in the Philippines. *Journal of Natural History*, 24: 21-25.

Noyes, J. S. 2010. Universal Chalcidoidea Database - World Wide Web electronic publication. available from: <http://www.nhm.ac.uk/entomology/chalcidoids/index.html>.

OILB 1971. Liste d'identification des entomophages 8. OILB, Genève, pp. 18.

Parihar, D. R. & Kampantsov, A. V. 1997. Faunal diversity and associated predators and parasites of wood-boring Coleoptera of Rajasthan desert. *Annals of Arid Zone*, 36 (4): 367-372.

Peck, O. 1963. A catalogue of the Nearctic Chalcidoidea (Insecta; Hymenoptera). *Canadian Entomologist (Supplement)*, 30: 1-1092.

Perusquia Ortiz, J. 1982. Insects associated with the *Dendroctonus* spp. pine bark beetles. *Boletín Tecnico, Instituto Nacional de Investigaciones Forestales, Mexico*, 83: 33 pp.

Petersen, H. 1976. Parasites (Hym., Chalcidoidea) associated with bark beetles in Norway. *Norwegian Journal of Entomology*, 23 (1): 75-78.

Prinsloo, G. L. 1980. An illustrated guide to the families of African Chalcidoidea (Insecta: Hymenoptera). *Science Bulletin, Department of Agriculture and Fisheries, Republic of South Africa*, 395: 1-66.

Prinsloo, G. L. 1983. A parasitoid-host index of Afrotropical Encyrtidae (Hymenoptera: Chalcidoidea). *Entomology Memoirs of the Department of Agriculture, Republic of South Africa*, 60: 35 pp.

Reid, R. W. 1957. The bark beetle complex associated with lodgepole pine slash in Alberta. Part II. Notes on the biologies of several hymenopterous parasites. *Canadian Entomologist*, 89 (1): 5-8.

Schauff, M. E. 1988. The species of *Entedon* in America north of Mexico (Hymenoptera: Eulophidae). *Journal of the New York Entomological Society*, 96 (1):30-62.

Schmidt, S. & Noyes, J. S. 2003. Two new egg parasitoids (Hymenoptera: Encyrtidae) of the wood borer *Agrionome spinicollis* (Macleay) (Coleoptera: Cerambycidae), a pest of pecans in eastern Australia. *Australian Journal of Entomology*, 42: 12-17.

Springate, N. D. & Noyes, J. S. 1990. A review of British species of *Anagyris* Howard (Hymenoptera: Encyrtidae) with new records and descriptions of other Chalcidoidea. *Entomologist's Gazette*, 41: 213-230.

Steffan, J. R. 1964. Deux nouveaux genres de Torymidae et de Cleonymidae paléarctiques. *Entomophaga*, 9 (1): 101-106.

Steffan, J. R. 1968 Observations sur *Chalcedectus sinaiticus* (Ms.) et descriptions de *C. balachowskyi* sp. n. (Hym. Chalcedectidae) et d'*Oopristus safavii* gen. n., sp. n. (Hym.: Torymidae), deux parasites d'importance économique en Iran. *Entomophaga*, 13 (3): 209-216.

Stojanovic, A. & Markovic, C. 2007. The hymenopteran parasitoids of some elm bark beetles in Serbia. *Phytoparasitica*, 35 (3): 239-243.

Sureshan, P. M. & Narendran, T. C. 2003. A checklist of Pteromalidae (Hymenoptera: Chalcidoidea) from the Indian subcontinent. *Zoos' Print Journal*, 18 (5): 1099-1110.

Szczepanski, H. 1961. Chalcid flies of the genus *Platygerrhus* Thoms., parasitizing on bark beetles, with description of the species *P. millenius* sp.n. (Hym., Pteromalidae). *Polskie Pismo Entomologiczne*, 31 (1): 3-11.

Tachikawa, T. 1988. A new species of *Cerchysiella* (Hymenoptera: Encyrtidae) parasitic on a cerambycid beetle from Japan. *Transactions of the Shikoku Entomological Society*, 19: 63-66.

Thompson, W. R. 1955. *A catalogue of the parasites and predators of insect pests*. Section 2. Host parasite catalogue, Part 3. Hosts of the Hymenoptera (Calliceratid to Evaniid): Commonwealth Agricultural Bureaux, The Commonwealth Institute of Biological Control, Ottawa, Ontario, Canada, 191-332.

Thompson, W. R. 1958. *A catalogue of the parasites and predators of insect pests*. Section 2. Host parasite catalogue, Part 5. Commonwealth Agricultural Bureaux, Commonwealth Institute of Biological Control, Ottawa, Ontario, Canada, 562 pp.

- Trjapitz, V. A.** 1963. Species of the genus *Oobius* gen.n. (Hymenoptera, Encyrtidae) in the USSR. Sborník Entomologického Oddelení Národního Musea v Praze, 35: 543-547.
- Trjapitz, V. A.** 1968. A survey of the encyrtid fauna (Hym. Encyrtidae) of the Caucasus. Trudy Vsesoyuznogo Entomologicheskogo Obschestva, 52: 43-125.
- Trjapitz, V. A.** 1978. Hymenoptera II. Chalcidoidea 6. Eupelmidae. Opred. Nasek. Evrop. Chasti SSSR. 228-236.
- Trjapitz, V. A.** 1989. Parasitic Hymenoptera of the Fam. Encyrtidae of Palaearctics. Opredeliteli po Faune SSSR. Zoologicheskim Institutom Akademii Nauk SSR, Leningrad 158: 1-489.
- Trjapitz, V. A. & Zagatkevich, I. K.** 1971. On the ovumfoother of oobiusa, *Oobius zhaikevitchi* Trjap. (Hymenoptera, Encyrtidae), little known parasite of green narrow-body buprestid, *Agrilus viridis* L. (Coleoptera, Buprestidae). Vestnik Zoologii, Kiev, 1: 80-82.
- Vanlaerhoven, S. L. & Stephen, F. M.** 2002. Height distribution of adult parasitoids of the southern pine beetle complex. Environmental Entomology, 31 (6): 982-987.
- Weslien, J.** 1992. The arthropod complex associated with *Ips typographus* (L.) (Coleoptera, Scolytidae): species composition, phenology, and impact on bark beetle productivity. Entomologica Fennica, 3 (4): 205-213.
- Williams, D. J. M. & Langor, D. W.** 2002. Rearing, identification, and biology of parasitoids and predators associated with *Pissodes* weevils in Canada. Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta. Information Report NOR-X-386. 36 p.
- Xu, Z. H. & He, J. H.** 1998. Notes on a new species of encyrtid parasitized on longicorn beetles (Hymenoptera: Encyrtidae). Forest Research, 11 (1): 66-88.
- Yang, Z. Q.** 1987. A preliminary survey of parasitic wasps of *Dentroctonus armandi* Tsai et Li (Coleoptera, Scolytidae) in Qinling Mountains with descriptions of three new species and a new Chinese record (Hym., Pteromalidae). Entomotaxonomia, 9 (3): 175-184.
- Yang, Z. Q.** 1996. Parasitic wasps on bark beetles in China (Hymenoptera). Science Press, Beijing 363pp (In Chinese with English summary).
- Yang, Z. Q., Yang, Z. W. & Wei, J. R.** 1994. Two new species of Chalcididae (Hymenoptera: Chalcidoidea) from Funiushan Mountain in China. Entomotaxonomia, 19 (4): 308-312.
- Yanovskii, V. M.** 1986. Natural enemies of bark beetles. Zashchita Rasteniy, Moskva, 2: 26-29.
- Yunap, K.** 1986. Species composition of hymenopteran parasites of bark beetles on conifers in Estonia. Metsanduslikud Uurimused, Estonian SSR, 21: 79-88.
- Zach, P., Sujova, K. & Holecova, M.** 1997. Insect assemblages in Norway spruce thickets with focus on phloeo- and xylophagous beetles (Coleoptera). Entomofauna Carpathica, 9 (3): 71-75.
- Zavada, A.** 2005. Notes on *Ecdamua nambui* (Hymenoptera: Torymidae), with a key to world *Ecdamua* species. Phegea, 33 (4): 155-158.
- Zerova, M. D.** 1978. Hymenoptera II. Chalcidoidea 8. Eurytomidae. Opred. Nasek. Evrop. Chasti SSSR. 328-358 (In Russian).
- Zerova, M. D. & Seryogina, L. Y.** 2006. A review of the Palaearctic species of the genus *Eurytoma*, belonging to the *E. robusta* species-group (Hymenoptera, Eurytomidae), with description of two new species. Entomological Review, 86 (6): 695-705.
- Zerova, M. D. & Seryogina, L. Y.** 2007. *Diomorus sophiae*, a junior synonym of *Ecdamua nambui* (Hymenoptera, Torymidae). Vestnik Zoologii, Kiev, 41 (6): 564.
- Zhang, Y. Z. & Huang, D. W.** 2004. A review and an illustrated key to Chinese genera of Encyrtidae (Hymenoptera: Chalcidoidea). Science Press, Beijing, China.
- Zhang, Y. Z., Huang, D. W., Zhao, T.-H., Liu, H.-P. & Bauer, L. S.** 2005. Two new species of egg parasitoids (Hymenoptera: Encyrtidae) of wood-boring beetle pests from China. Phytoparasitica, 33 (3): 253-260.

Table 1. Chalcidoid parasitoids of xylophagous beetles worldwide with their geographical distribution, host families and literature cited.

| Parasitoids | Zoogeographical distribution* | Hosts family | Reference |
|--|-------------------------------|---------------------------|--|
| Chalcididae | | | |
| <i>Acanthochalcis nigricans</i> Cameron, 1884 | NEA, NET | Buprestidae | Halstead and Haines (1985) |
| <i>Phasgonophora sulcata</i> Westwood, 1832 | NEA | Buprestidae | Peck (1963), Haack et al. (1981) |
| <i>Tanycoryphus conglobatus</i> Steffan, 1950 | AFT | Bostrychidae | Herting (1973) |
| <i>criniger</i> Steffan, 1950 | AFT | Bostrychidae | Herting (1973) |
| <i>occultus</i> Steffan, 1957 | AFT | Buprestidae | Herting (1973) |
| <i>tibialis</i> (Nikol'skaya, 1960) | PAL | Buprestidae | Nikol'skaya (1960), Lotfalizadeh & Khalghani, (2008), Lotfalizadeh et al. (2009) |
| <i>Trigonura</i> | | | |
| <i>californica</i> Rohwer, 1917 | NEA | Buprestidae | Peck (1963) |
| <i>elegans</i> (Provancher, 1887) | NEA | Buprestidae | Peck (1963) |
| <i>chrysobathra</i> Yang, 1994 | PAL | Buprestidae | Yang et al. (1994) |
| <i>ruficaudis</i> (Cameron, 1913) | ORL, PAL | Buprestidae, Cerambycidae | Lotfalizadeh & Khalghani (2008) |
| <i>sphenoptera</i> Nikol'skaya, 1960 | PAL | Buprestidae | Nikol'skaya (1960), Lotfalizadeh & Khalghani (2008) |
| <i>tenuicaudis</i> Waterston, 1922 | ORL | Buprestidae, Cerambycidae | Narendran (1986) |
| <i>ulmi</i> Burks, 1959 | NEA | Scolytidae | Peck (1963), Herting (1973) |
| Encyrtidae | | | |
| <i>Austroencyrtus ceresii</i> (Liao & Tachikawa, 1984) | ORL | Cerambycidae | Trjapitzin (1989) |
| <i>Amauroencyrtus micans</i> De Santis, 1985 | NEO | Cerambycidae | De Santis (1985) |
| <i>Avetianella</i> | | | |
| <i>ambigua</i> Zhang & Huang, 2004 | PAL | Cerambycidae | Zhang & Huang (2004), Zhang et al. (2005) |
| <i>batocerae</i> (Ferrière, 1936) | ORL | Cerambycidae | Noyes, 2008 |
| <i>buprestidis</i> Gordh and Trjapitzin, 1981 | NEA | Buprestidae | Gordh & Trjapitzin (1981), Zhang et al. (2005) |
| <i>capnodiobia</i> Trjapitzin, 1968 | PAL | Buprestidae | Trjapitzin (1963), Trjapitzin, (1989), Zhang et al. (2005) |
| <i>coombi</i> Schmidt and Noyes, 2003 | AUS | Cerambycidae | Schmidt & Noyes (2003), Zhang et al. (2005) |
| <i>depressa</i> (Girault, 1916) | NEA | Cerambycidae | Gordh (1979), Gordh & Trjapitzin (1981), Zhang et al. (2005) |
| <i>longoi</i> Siscaro, 1992 | PAL | Cerambycidae | Austin et al. (1994) |
| <i>xystrocerae</i> Zhang & Huang, 2005 | PAL | Cerambycidae | Zhang et al. (2005) |
| <i>Baeoanusia</i> | | | |
| <i>xanthopleuron</i> Schmidt & Noyes, 2003 | AUS | Cerambycidae | Schmidt & Noyes (2003) |
| <i>Cerchysiella</i> | | | |
| <i>togashii</i> Tachikawa, 1988 | PAL | Cerambycidae | Tachikawa (1988) |
| <i>Dionencyrtus</i> | | | |
| <i>cordylomerae</i> (Risbec, 1951) | AFT | Cerambycidae | Herting (1973) |
| <i>fiorentinoi</i> De Santis, 1985 | NEO | Cerambycidae | De Santis (1985) |

| | | | |
|---|----------|--------------------------|--|
| <i>Heterococcidoxenus schlechtendali</i> (Mayr, 1876) | PAL | Scolytidae | Lotfalizadeh & Khalghani (2008) |
| <i>Oobius</i> | | | |
| <i>abditus</i> Annecke, 1967 | AFT | Buprestidae | Annecke (1967), Zhang et al. (2005) |
| <i>agrili</i> Zhang & Huang, 2005 | PAL | Buprestidae | Zhang et al. (2005) |
| <i>finestus</i> Annecke, 1967 | | Buprestidae | Annecke (1967), Zhang et al. (2005) |
| <i>rudnevi</i> (Novicky, 1928) | PAL | Cerambycidae | Trjapitzin (1963), Trjapitzin (1989) |
| <i>taybekovi</i> Myartseva & Trjapitzin, 1979 | PAL | Buprestidae | Myartseva (1979), Trjapitzin (1989), Zhang et al. (2005) |
| <i>zahaikevitschi</i> Trjapitzin, 1963 | PAL | Buprestidae | Trjapitzin (1989), Zhang et al. (2005) |
| <i>Ooencyrtus</i> | | | |
| <i>moneilemae</i> Gahan, 1925 | NEA | Cerambycidae | Peck (1963) |
| <i>ovidivorus</i> (Girault, 1925) | AUS | Cerambycidae | Girault (1925) |
| <i>Orianos</i> | | | |
| <i>brazai</i> Noyes, 1990 | ORL | Buprestidae | Noyes (1990) |
| <i>Protyndarichoides</i> | | | |
| <i>aligarhensis</i> (Fatma & Shafee, 1985) | ORL, PAL | Scolytidae | Springat & Noyes (1990), Fatma & Shafee (1985) |
| <i>Tineophoctonus</i> | | | |
| <i>armatus</i> (Ashmead, 1888) | NEA, PAL | Anobiidae | Trjapitzin (1989) |
| <i>Zaommoencyrtus</i> | | | |
| <i>brachytarsus</i> Xu & He, 1998 | ORL | Cerambycidae | Xu & He (1998) |
| <i>emetzi</i> Khlopunov, 1981 | PAL | Cerambycidae | Khlopunov (1981) |
| <i>Zdenekiella</i> | | | |
| <i>deon</i> Guerrieri & Noyes, 2005 | PAL | Bostrychidae | Guerrieri & Noyes (2005) |
| Eulophidae | | | |
| <i>Aprostocetus</i> | | | |
| <i>crypturgus</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>dendroctoni</i> Yang, 1996 | ORL | Cerambycidae | Yang (1996) |
| <i>lamiicidus</i> Kerrich, 1963 | AFT | Cerambycidae | Herting (1973) |
| <i>Baryscapus</i> | | | |
| <i>agrilorum</i> (Ratzeburg, 1844) | PAL | Buprestidae | Graham, 1991 |
| <i>holbeini</i> (Girault, 1917) | PAL | Buprestidae | Herting (1973), Peck (1963) |
| <i>nordi</i> (Burks, 1963) | NEA | Buprestidae | Burks (1963) |
| <i>Boučekastichus</i> | | | |
| <i>leileri</i> (Hedqvist, 1974) | PAL | Anobiidae | Hedqvist (1974a) |
| <i>Entedon</i> | | | |
| <i>broussonetiae</i> Yang, 1996 | PAL | | Yang (1996) |
| <i>confinis</i> Ratzeburg, 1848 | PAL | Anobiidae | Bouček & Askew (1968) |
| <i>ergias</i> Walker, 1839 | NEA, PAL | Cerambycidae, Scolytidae | Gumovsky (1999), Lotfalizadeh & Khalghani (2008) |
| <i>methion</i> Walker, 1839 | NEA, PAL | Anobiidae | Thompson (1955) |
| <i>tibialis</i> (Nees, 1834) | PAL | Anobiidae, Scolytidae | Markovic & Stojanovic (1996) |
| <i>stephanopachi</i> Heqvist, 1959 | NEA, PAL | Bostrychidae | Schauff (1988) |
| <i>zanara</i> Walker, 1839 | PAL | Buprestidae | Bouček & Askew (1968) |
| <i>Euderus</i> | | | |
| <i>agrili</i> Bouček, 1963 | PAL | Buprestidae | Bouček & Askew (1968) |
| <i>caudatus</i> Thomson, 1878 | NEA, PAL | Cerambycidae | Bouček & Askew (1968) |
| <i>regiae</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>jezoensis</i> Ishii, 1938 | PAL | Scolytidae | Herting (1973) |
| <i>Tetrastichus</i> | | | |
| <i>agrilocidus</i> Graham, 1991 | PAL | Buprestidae | Graham, 1991 |
| <i>heeringi</i> Delucchi, 1954 | PAL | Buprestidae | Herting (1973), Graham |

| | | | |
|---|------------------|---|---|
| | | | (1991) |
| <i>telon</i> (Graham, 1961) | PAL | Buprestidae | Graham (1991) |
| <i>clavicornis</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>clavatus</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>xylebororum</i> Domenichini, 1960 | ORL | Scolytidae | Herting (1973) |
| <i>taibaishanensis</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>ulmi</i> Erdős, 1954 | PAL | Buprestidae, Scolytidae, Cerambycidae | Herting (1973), Graham, (1991), Stojanovic & Markovic (2007) |
| <i>Planotetrastichus</i> <i>scolyti</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>Pnigalio</i> <i>minio</i> (Walker, 1847) | NEA | Buprestidae | Burks (1979) |
| <i>Phymastichus</i> <i>coffea</i> LaSalle, 1990 | AFT, NET | Scolytidae | Lopez Vaamonde & Moore (1998) |
| <i>Wichmannia</i> <i>pictipennis</i> Bouček, 1972 | PAL | Scolytidae | Bouček (1972) |
| <i>decorata</i> Ruschka, 1916 | PAL | Scolytidae | Bouček (1972) |
| Eurytomidae | | | |
| <i>Endobia</i> | | | |
| <i>donacis</i> Erdős, 1964 | NEA, ORL, PAL | Bostrychidae | Farooqi & Subba Rao (1986) |
| <i>Eurytoma</i> | | | |
| <i>arctica</i> Thomson, 1876 | PAL | Scolytidae | Lotfalizadeh & Khalghani (2008) |
| <i>blastophagi</i> Hedqvist, 1963 | PAL | Scolytidae | Lotfalizadeh & Khalghani (2008) |
| <i>conica</i> Provancher, 1887 | NEA | Scolytidae | Berisford et al. (1970) |
| <i>elistae</i> Zerova, 1995 | PAL | Buprestidae | Zerova & Seryogina (2006) |
| <i>flaviventris</i> Zerova, 1977 | PAL | Buprestidae | Zerova & Seryogina (2006) |
| <i>gyorfii</i> Erdős, 1957 | PAL | Anobiidae | Zerova & Seryogina (2006) |
| <i>graminicola</i> Zerova, 1981 | PAL | Buprestidae | Zerova & Seryogina (2006) |
| <i>iranicola</i> Zerova, 2007 | PAL | Cerambycidae | Zerova & Seryogina (2006), Lotfalizadeh & Khalghani (2008) |
| <i>kondarica</i> Zerova, 1994 | PAL | Buprestidae | Zerova & Seryogina (2006) |
| <i>morio</i> Boheman, 1836 | PAL | Scolytidae | Stojanovic & Markovic (2007), Lotfalizadeh & Khalghani (2008) |
| <i>nova</i> Zerova, 2001 | PAL | Anobiidae | Zerova & Seryogina (2006) |
| <i>pedicellata</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>pini</i> Bugbee, 1958 | NEA, NET | Scolytidae | Herting (1973) |
| <i>polygraphi</i> (Ashmead, 1894) | NEA, PAL | Scolytidae | Zerova, 1978 |
| <i>pyrrhidii</i> Erdős, 1969 | PAL | Buprestidae, Cerambycidae | Zerova & Seryogina (2006) |
| <i>tilicola</i> Hedqvist, 1966 | PAL | Buprestidae, Cerambycidae | Zerova & Seryogina (2006) |
| <i>tomici</i> Ashmead, 1894 | NEA | Scolytidae | Peck (1963) |
| <i>turkomanica</i> Zerova, 1995 | PAL | Buprestidae | Zerova & Seryogina (2006) |
| <i>wachtii</i> Mayr, 1878 | PAL | Cerambycidae | Zerova & Seryogina (2006); Zerova, 1978 |
| <i>zykovi</i> Zerova, 1995 | PAL | Buprestidae | Zerova & Seryogina (2006) |
| Eupelmidae | | | |
| <i>Balcha</i> | | | |
| <i>indica</i> (Mani & Kaul, 1973) | NEA, ORL | Scolytidae, Cerambycidae | Gibson (2005) |
| <i>levicollis</i> (Cameron, 1908) | ORL | Buprestidae | Gibson (2005) |
| <i>Calosota</i> | | | |
| <i>aestivalis</i> Curtis, 1836 | PAL | Scolytidae, Buprestidae, Anobiidae | Trjapitzin (1978), Mendel (1986) |

| | | | |
|--|------------------------|--|---|
| <i>agrili</i> Nikol'skaya, 1952 | PAL | Buprestidae | Trjapitzin (1978) |
| <i>yanglingensis</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>qilianshanensis</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>Eusandalum</i> | | | |
| <i>acmaeoderae</i> Rohwer, 1917 | NEA | Buprestidae | Peck (1963) |
| <i>alfieri</i> (Bolivar y Pieltain, 1925) | PAL | Buprestidae | Bouček (1967) |
| <i>coronatum</i> (Thomson, 1876) | PAL | Buprestidae | Trjapitzin (1978) |
| <i>inermis</i> (Ratzeburg, 1848) | PAL | Anobiidae, Bostrichidae, Buprestidae, Cerambycidae, Scolytidae | Lotfalizadeh & Khalghani (2008) |
| <i>flavipenne</i> Ruschka, 1921 | PAL | Buprestidae | Trjapitzin (1978) |
| <i>lindemani</i> Kalina, 1984 | PAL | Buprestidae | Kalina (1984) |
| <i>Eupelmus</i> | | | |
| <i>carinifrons</i> Yang, 1996 | ORL, PAL | Scolytidae | Yang (1996) |
| <i>kashmiricus</i> Narendran, 2001 | ORL | Scolytidae | Narendran et al. (2001) |
| <i>sculpturatus</i> Nikol'skaya, 1952 | PAL | Scolytidae | Herting (1973), Markovic & Stojanovic (2003) |
| <i>muelneri</i> Ruschka, 1921 | PAL | Buprestidae, Scolytidae | Lotfalizadeh & Khalghani (2008) |
| <i>valsus</i> Narendran, 2001 | ORL | Scolytidae | Narendran et al. (2001) |
| <i>vindex</i> Erdős, 1955 | PAL | Scolytidae | Narendran et al. (2001) |
| <i>Metapelma</i> | | | |
| <i>compressipes</i> Cameron, 1909 | ORL | Cerambycidae | Herting (1973) |
| <i>indica</i> (Girault, 1920) | ORL | Bostrichidae | Thompson (1955) |
| <i>zhangii</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>Pentacladia</i> | | | |
| <i>eques</i> (Haliday, 1862) | AFT, PAL | Buprestidae | Delvare (2001) |
| <i>mateui</i> Delvare, 2001 | PAL | Buprestidae | Delvare (2001) |
| Leucospidae | | | |
| <i>Leucospis</i> | | Bostrichidae, Cerambycidae | Herting (1973), Baur (2005) |
| <i>dorsigera</i> Fabricius, 1775 | PAL | | |
| Mymaridae | | | |
| <i>Anaphes</i> sp. | PAL | Cerambycidae | Lakatos & Thuroczy (2002) |
| <i>Prionaphes</i> sp. | AUS | Cerambycidae | Lin et al. (2007) |
| Pteromalidae | | | |
| <i>Ablaxia</i> <i>squamifera</i> (Thomson, 1878) | PAL | Cerambycidae, Scolytidae | Bouček (1961), Meduna (1986) |
| <i>Acercephala</i> <i>atroviolacea</i> (Crawford, 1913) | NEA | Scolytidae | Dzhanokmen (1991) |
| <i>Acrocormus</i> <i>semifasciatus</i> Thomson, 1878 | PAL | Scolytidae | Bouček (1961), Graham (1969), Hertig (1973), Stojanovic & Markovic (2007) |
| <i>Aggelma</i> <i>agrili</i> Bouček, 1965 | PAL | Buprestidae | Dzhanokmen (1991) |
| <i>Agrilocida</i> <i>ferrieri</i> Steffan, 1964 | PAL | Buprestidae, Scolytidae | Steffan (1964), Mendel (1986), Gibson (2003) |
| <i>Amotura</i> <i>caelata</i> Grissell, 1991 | NEA, NET | Buprestidae, Bostrichidae | Grissell (1991) |
| <i>Anisopteromalus</i> <i>calandrae</i> (Howard, 1881) | AFT, AUS, NEA, NET, | Anobiidae | Dzhanokmen (1991) |

| | ORL, PAL | | |
|--|--------------------|--|--|
| <i>Callimomoides ovivorus</i> (Ferrière, 1936) | ORL | Cerambycidae | Bouček (1988) |
| <i>Callocleonimus bimaculatae</i> Yang, 1996 | PAL | Scolytidae, Buprestidae | Dzhanokmen (1991), Yang (1996) |
| <i>pulcher</i> Masi, 1940 | AFT, PAL | Bostrychidae, Scolytidae, Buprestidae | Dzhanokmen (1991), Lotfalizadeh & Khalghani (2008) |
| <i>Cerocephala aquila</i> (Girault, 1920) | AUS, NET, ORL | Bostrychidae, Buprestidae, Scolytidae | Dzhanokmen (1991) |
| <i>eccoptogastri</i> Masi, 1921 | AFT, PAL | Scolytidae | Herting (1973), Mendel (1986), Lozano & Campos (1993), Stojanovic & Markovic (2007) |
| <i>rufa</i> (Walker, 1833) | NEA, PAL | Buprestidae, Anobiidae, Scolytidae | Dzhanokmen (1991) |
| <i>Chalcedectus balachowskyi</i> Steffan, 1968 | PAL | Bostrychidae, Buprestidae, Cerambycidae | Gibson (2003), Lotfalizadeh & Khalghani (2008) |
| <i>Cheiopachus obscuripes</i> Brues, 1910 | NEA, PAL | Scolytidae, Buprestidae | Dzhanokmen (1991) |
| <i>quadrum</i> (Fabricius, 1787) | NEA, PAL, ORL, NET | Bostrychidae, Cerambycidae, Scolytidae | Dzhanokmen (1991), Lotfalizadeh & Khalghani (2008), Stojanovic & Markovic (2007) |
| <i>Cleonymus laticornis</i> Walker, 1837 | PAL | Anobiidae, Bostrychidae, Buprestidae, Cerambycidae, Scolytidae | Dzhanokmen (1991), Gibson (2003) |
| <i>Dibrachys boarmiae</i> (Walker, 1863) | AUS, PAL, NET | Anobiidae | Dzhanokmen (1978) |
| <i>Dinotiscus aponius</i> (Walker, 1848) | PAL | Scolytidae | Dzhanokmen (1991), Stojanovic & Markovic (2007) |
| <i>colon</i> (Linnaeus, 1758) | NEA, PAL, NET | Scolytidae | Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>eupterus</i> (Walker, 1836) | NEA, PAL | Scolytidae | Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>dendroctoni</i> (Ashmead, 1894) | NEA | Scolytidae | Dzhanokmen (1991) |
| <i>tenebricus</i> Walker, 1834 | PAL | Scolytidae, Cerambycidae | Graham (1969) |
| <i>Dorcatomophaga westi</i> Kryger, 1951 | PAL | Anobiidae | Dzhanokmen (1991) |
| <i>Euderus lividus</i> (Ashmead, 1886) | ORL, NEA | Cerambycidae | Peck (1963), Grimble et al. (1971), Gibson (2003) |
| <i>Habritys brevicornis</i> (Ratzeburg, 1844) | NEA, PAL | Scolytidae | Thompson, 1958 |
| <i>Heydenia pretiosa</i> Förster, 1856 | PAL | Buprestidae, Scolytidae, Cerambycidae | Dzhanokmen (1991), Lotfalizadeh & Khalghani (2008), Lakatos & Thuroczy (2002), Gibson (2003) |
| <i>indica</i> Narendran, 2001 | ORL | Scolytidae | Buhroo et al. (2002), Sureshan & Narendran (2003) |

| | | | |
|--|------------------------------|-------------------------|--|
| <i>unica</i> Cook & Davis, 1891 | NEA | Scolytidae | Dzhanokmen (1991) |
| <i>Kaleva microps</i> Bouček, 1993 | NEA | Anobiidae | Bouček (1993) |
| <i>Tomicobia pityophthori</i> (Bouček, 1955) | PAL | Scolytidae | Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>Lariophagus puncticolis</i> (Möller, 1882) | NET, PAL | Anobiidae | Dzhanokmen (1991) |
| <i>Macromesusa amphiretus</i> Walker, 1848 | PAL | Scolytidae | Dzhanokmen (1991), Stojanovic & Markovic (2007) |
| <i>cryphali</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>huanglongnicus</i> Yang, 1996 | | Scolytidae | Yang (1996) |
| <i>harithus</i> Narendran, 2001 | ORL | Scolytidae | Narendran et al. (2001), Buhroo et al. (2002) |
| <i>Mesopolobus typographi</i> (Ruschka, 1924) | PAL | Scolytidae | Thompson (1958) Herting (1973), Stojanovic & Markovic (2007) |
| <i>Metacolus azureus</i> (Ratzeburg, 1844) | PAL | Scolytidae | Thompson (1958), Graham (1969), Herting (1973), Lakatos & Thuroczy (2002) |
| <i>sinicus</i> Yang, 1996 | PAL | Scolytidae | Dzhanokmen (1991), Yang (1996) |
| <i>unifasciatus</i> Förster, 1856 | PAL, ORL | Scolytidae | Thompson (1958), Graham (1969), Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>Nasonia vitripennis</i> (Walker, 1836) | AFT, AUS, NEA, NET, ORL, PAL | Scolytidae | Petersen (1976) |
| <i>Nikolskayana mirabilis</i> Bouček, 1965 | PAL | Scolytidae | Graham (1969), Dzhanokmen (1991) |
| <i>Norbanus scabriculus</i> (Nees, 1834) | NEA, PAL | Cerambycidae | Bin (1973) |
| <i>Notanisis oulmesiensis</i> (Delucchi, 1962) | PAL | Buprestidae, Scolytidae | Delucchi (1962), Mitroiu & Andriescu (2008) |
| <i>Oodera ahoma</i> (Mani & Kaul, 1973) | ORL | Buprestidae | Farooqi et al. (1986), Dzhanokmen (1991) |
| <i>formosa</i> (Giraud, 1863) | PAL | Buprestidae, Scolytidae | Dzhanokmen (1991), Gibson (2003) |
| <i>regiae</i> Yang, 1996 | PAL | Buprestidae | Dzhanokmen (1991), Yang (1996) |
| <i>Oxysychus convexus</i> Yang 1996 | PAL | Scolytidae | Yang (1996) |
| <i>grandis</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>pini</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>mori</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>scolyti</i> Yang, 1996 | PAL | Scolytidae | Yang (1996) |
| <i>Pandelus flavipes</i> (Förster, 1841) | PAL | Anobiidae | Dzhanokmen (1991) |
| <i>Perniphora robusta</i> Ruschka, 1923 | PAL | Scolytidae | Graham (1969), Dzhanokmen (1991) |
| <i>Platygerrhus scutellatus</i> Yang, 1996 | PAL | Scolytidae | Dzhanokmen (1991), Yang (1996) |
| <i>ductilis</i> (Walker, 1836) | PAL | Anobiidae, Scolytidae | Dzhanokmen (1991) |
| <i>Plutothrix coelius</i> (Walker, 1839) | PAL | Anobiidae | Dzhanokmen (1991) |
| <i>glareosa</i> Heydon, 1997 | | | Dzhanokmen (1991), |

| | NEA | Anobiidae | Heydon, 1997 |
|--|------------------------------------|------------------------------|---|
| <i>Rhaphitelus maculatus</i> Walker, 1834 | PAL | Bostrychidae, Scolytidae | Dzhanokmen (1991), Stojanovic & Markovic (2007), Lotfalizadeh & Khalghani (2008) |
| <i>Rhopalicus brevicornis</i> (Thomson, 1878) | PAL | Scolytidae | Graham (1969), Herting (1973), Lakatos & Thuroczy (2002) |
| <i>quadratus</i> (Ratzeburg, 1844) | PAL | Scolytidae | Kamijo (1981), Dzhanokmen (1991) |
| <i>guttatus</i> (Ratzeburg, 1844) | PAL | Buprestidae, Scolytidae | Herting (1973), Dzhanokmen (1991), Yang (1996), Lakatos & Thuroczy (2002) |
| <i>zola</i> Grissell, 1983 | NEA | Scolytidae | Dzhanokmen (1991) |
| <i>pulchripennis</i> (Crawford, 1912) | NEA | Scolytidae | Dzhanokmen (1991) |
| <i>tutela</i> (Walker, 1836) | PAL, ORL, NEA | Bostrychidae, Scolytidae | Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>pulchripennis</i> (Crawford, 1912) | NEA | Scolytidae | Dzhanokmen (1991) |
| <i>Roptrocerus brevicornis</i> (Thomson, 1878) | PAL | Scolytidae | Graham (1969), Herting (1973), Lakatos & Thuroczy (2002) |
| <i>cryphalus</i> Yang, 1996 | PAL | Scolytidae | Dzhanokmen (1991), Bouček & Rasplus (1991), Yang (1996) |
| <i>mirus</i> (Walker, 1834) | PAL | Scolytidae | Graham (1969), Herting (1973), Lakatos & Thuroczy (2002) |
| <i>xylophagorum</i> (Ratzeburg, 1844) | AUS, NEA, NET, ORL, PAL | Scolytidae | Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>Rhaphitelus maculatus</i> Walker, 1834 | AUS, NEA, NET, ORL, PAL | Scolytidae | Dzhanokmen (1991) |
| <i>Stenoselma nigrum</i> Delucchi, 1956 | PAL | Buprestidae | Garrido Torres & Nieves- Aldrey (1999) |
| <i>Solenura ania</i> (Walker, 1846) | ORL, PAL | Buprestidae, Cerambycidae | Yang (1991) |
| <i>Theocolax elegans</i> (Westwood, 1874) | AFT, AUS, NEA, NET, ORL, PAL | Bostrychidae Scolytidae | Dzhanokmen (1991), Prinsloo (1980) |
| <i>formiciformis</i> Westwood, 1832 | AUS, NEA, NET, PAL | Anobiidae | Dzhanokmen (1991) |
| <i>Tomicobia seitneri</i> (Ruschka, 1924) | PAL | Scolytidae | Dzhanokmen (1991), Lakatos & Thuroczy (2002) |
| <i>tibialis</i> Ashmead, 1904 | NEA | Scolytidae | Peck (1963), Burks (1979), Dzhanokmen (1991) |
| <i>Tricolax xylocleptis</i> Bouček, 1967 | PAL | Anobiidae | Graham (1969) |
| <i>Trychnosoma ernobii</i> Hedqvist, 1974 | PAL | Anobiidae | Hedqvist (1974b), Dzhanokmen (1991) |
| <i>Zdenekiana plana</i> (Huggert, 1976) | PAL | Buprestidae | Bouček & Rasplus (1991) |
| <i>yui</i> Yang, 1996 | PAL | Buprestidae, Scolytidae | Yang (1996) |
| <i>Zolotarewskya longicostalia</i> Yang, 1996 | PAL | Anobiidae, Scolytidae | Yang (1996), Gibson (2003) |
| <i>robusta</i> Yang, 1996 | PAL | Buprestidae, Scolytidae | Yang (1996) |

| Trichogrammatidae | | | |
|--|-------------------------|--|--|
| <i>Trichogramma minutum</i> Riley, 1871 | AUS, NEA, NET, ORL, PAL | Cerambycidae Scolytidae | Hayat & Viggiani (1984) |
| <i>semlidis</i> (Aurivillius, 1898) | NEA, ORL, PAL | Scolytidae | Michalski & Seniczak (1974) |
| Torymidae | | | |
| <i>Ecdamua nambui</i> Kamijo, 1979 | PAL | Anobiidae, Buprestidae, Scolytidae | Zavada (2005), Zerova & Seryogina (2007) |
| <i>Microdontomerus mysticus</i> Grissell, 2005 | NET | Cerambycidae | Grissell (2005) |
| <i>westcotti</i> Grissell, 2005 | NEA | Buprestidae | Grissell (2005) |

The abbreviations of zoogeographic regions are as follow: AFT, Afrotropical region; AUS, Australian region; NEA, Nearctic; NET, Neotropical region; ORL, Oriental region; PAL, Palaearctic region.

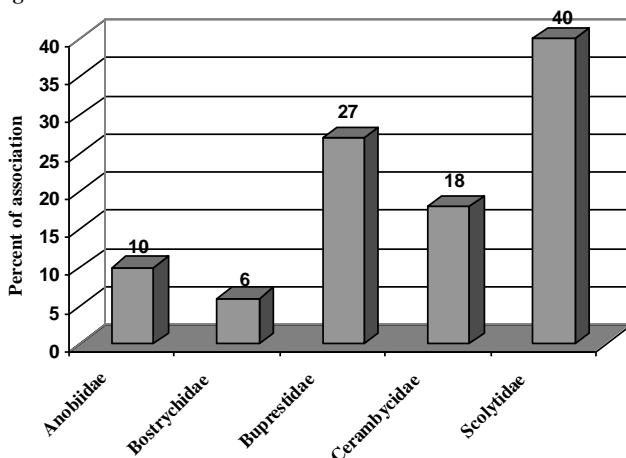


Figure 1. Percent of associations of each XB family with hymenopterous families.

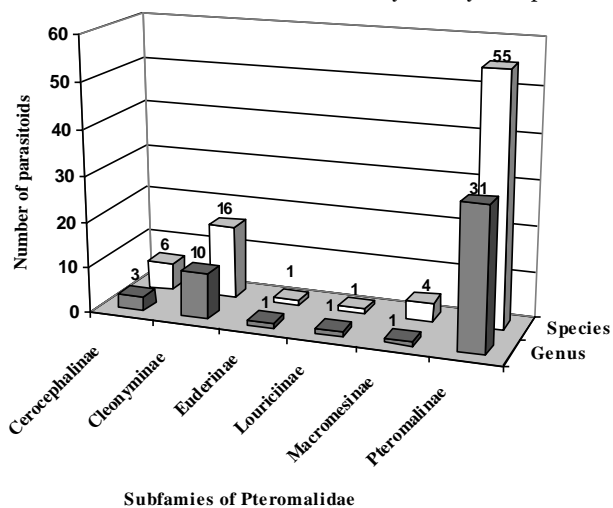


Figure 2. Numbers of the pteromalid's subfamilies taxa associated with XBs.

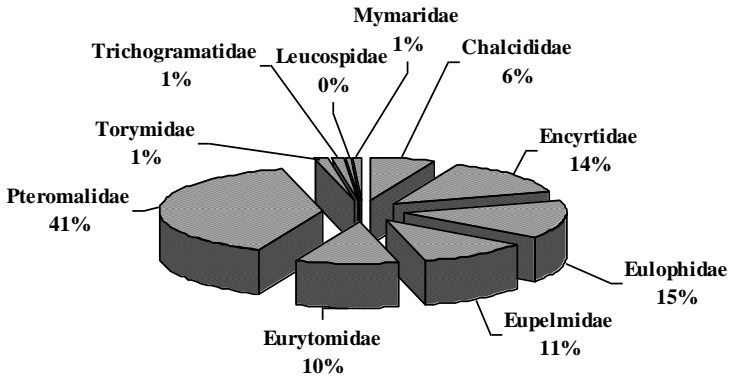


Figure 3. Percent of each chalcidoid parasitoid families reported XBs.

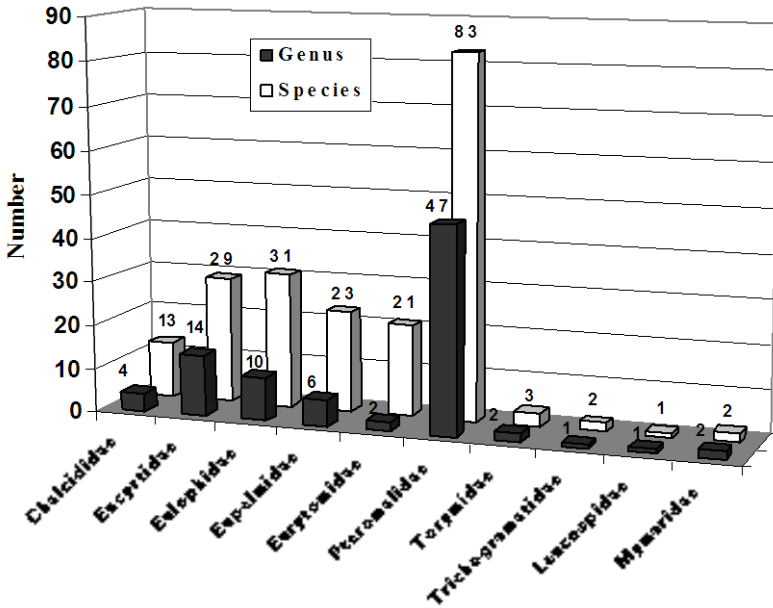


Figure 4. Numbers of chalcidoids taxa with known chalcidoid-XBs parasitoid-host associations.

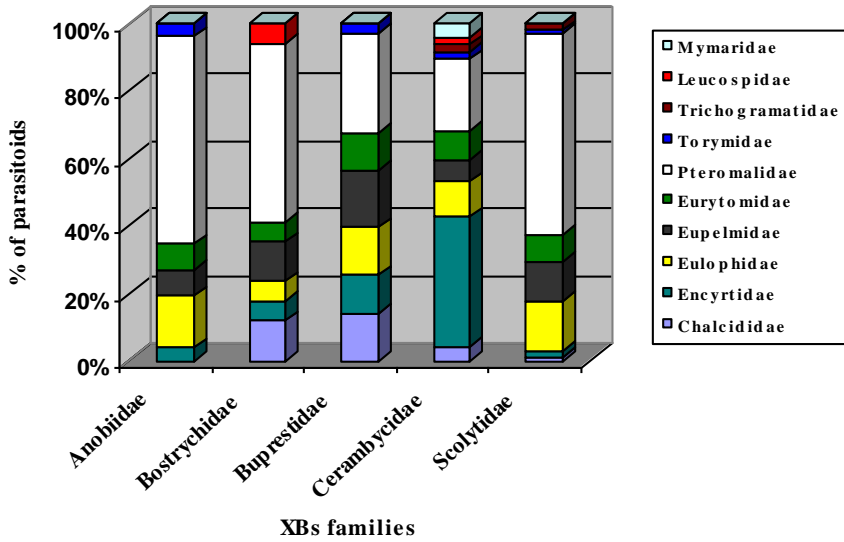


Figure 5. Percent of chalcidoids taxa on each XB families.

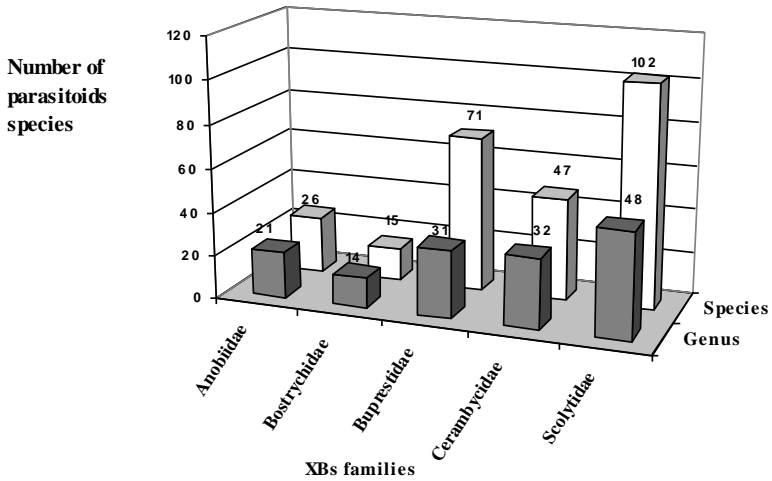


Figure 6. Numbers of chalcidoids genera and species on each XB families.

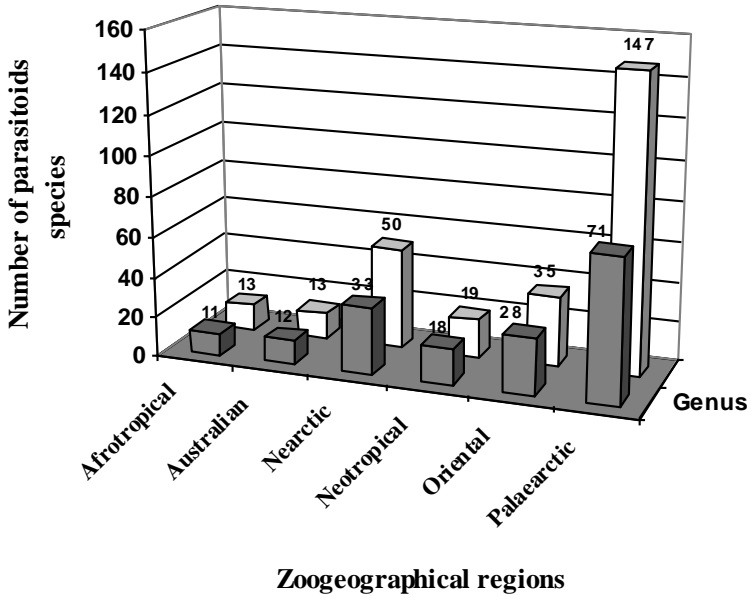


Figure 7. Numbers of chalcidoids genera and species associated with XB families in each zoogeographical regions.