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## **Hymenopterous parasitoids (Hym.: Chalcidoidea) of xylophagous beetles in Iran**

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### **Abstract**

A survey was conducted in Iran, on xylophagous beetles, to collect and determine their associated chalcidoid parasitoids (Hym.: Chalcidoidea). Nineteen species of parasitoids are recorded. These species are from 6 families: Chalcididae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae and Pteromalidae belong 4, 1, 1, 2, 4 and 7 species, respectively. Five species were discovered as new record for the fauna of Iran: *Callocleonimus pulcher* MASI (Pteromalidae), *Eurytoma blastophagi* HEDQVIST (Eurytomidae), *Eusandalum inerme* (RATZEBURG) (Eupelmidae) and 2 Chalcididae, *Trigonura ruficaudis* (CAMERON) and *Trigonura sphenoptera* NIKOL'SKAYA. A brief discussion of the biological information and distribution of each entry is given. *Heydenia pretiosa* FÖRSTER, *Eurytoma blastophagi* are recorded for the first time parasitizing *Xylopertha reflexicauda* LESNE (Col.: Bostrychidae) and *Trigonura sphenoptera* on an unknown buprestid beetle.

Key words: xylophagous beetles, parasitoid, Chalcidoidea, Iran, fauna.

## Introduction

Some insect feeds on almost every part of a dead or living plant as plant pests. Xylophagous insects play a multifunctional and very important role in forest ecosystems (CSÓKA & KOVÁCS 1999). They play a special role in this resource partitioning because feed in the heartwood and on the intercortex tissues of woody plants such as trunks, stumps and branches of trees and shrubs, whether alive or dead. Some xylophagous insects that develop in dead trees and shrubs play an important and irreplaceable role in the decomposition of dead woody plants. Mutualistic relationships with bacteria, fungi and protists are a common solution to the problem of digesting the cellulose and lignin in wood. They are found in many insect orders such as Coleoptera, Lepidoptera, Hymenoptera and Diptera (CSÓKA & KOVÁCS 1999). Within xylophagous insects, xylophagous beetles (Coleoptera) are important pest of woody plants. Hence, this research was focused on coleopterous xylophagous families. Chief among these groups are the large and cosmopolitan families Bostrichid beetles (Bostrichidae), Longhorned beetles (Cerambycidae), Jewel beetles (Buprestidae) and Bark beetle (Scolytidae), but some xylophagous are also found in the other families such as Stag beetles (Lucanidae), Dung beetles (Scarabaeidae), Eucnemid beetles (Eucnemidae), Click beetles (Elateridae), Furniture beetles (Anobiidae), Timber beetles (Lymexylonidae), Anthribid beetles (Anthribidae) and Weevils (Curculionidae) (WILLIAMS & LANGOR 2002). For example three families Buprestidae, Scolytidae and Cerambycidae attack black pines in Italy (MASUTTI et al. 2002). Severe infestations of this group can kill trees directly or by the fungal disease. Many xylophagous beetles are known to be vectors of serious pathogens of woody plants (such as Dutch elm disease transported by the elm bark beetles) which sometimes it is more serious than the insect's feeding itself.

Bark beetles attack trees that are weakened or dying due to stress factors such as drought, disease, smog, mechanical injury. Most species attack weakened or dying trees, and they may be associated with primary pests and root diseases (WILLIAMS & LANGOR 2002). The bark beetles have a major role in the decline of many pine forests growing in both Europe and Mediterranean countries, including Northern Africa (FACCOLI et al. 2005).

Within the parasitoids the nature of the association of many of parasitic species is not well understood, although the biology of some species has been studied and their status as parasitoids was confirmed. Within these parasitoids the superfamily Chalcidoidea are very impotent group in controlling these pests. Catalogs for parasitic Hymenoptera, Chalcidoidea in different regions are available in book (GIBSON et al. 1997) and electronic form (NOYES 2007). The wasps belonging to several families of the suborder Chalcidoidea (Hymenoptera) are well-known parasitoids of Coleoptera including xylophagous groups. They attack larvae developing deep in the heartwood. This group of control agent was widely studied in different zoogeographical regions (BELLOWS et al. 1998, BICKEL 1985, KAMIJO 1981, MASUTTI et al. 2002, MENDEL 1985, PETERSEN 1976, SHARIFI & JAVADI 1971, VANLAERHOVEN & STEPHEN 2002, WILLIAMS & LANGOR 2002, YANG 1987, 1996).

The larvae of these small parasitoids often enter via the tunnels made by the xylophagous insect itself. In many cases the parasitoids find these fine holes by detecting the presence of the symbiotic fungus of the xylophages (CSÓKA & KOVÁCS 1999).

Considering importance of these group of parasitoids in control of xylophagous beetles; on the other hand, no works have focused specifically on assessment of chalcidoids - xylophagous beetles parasite associations and their distribution in Iran the propose of this paper is to document the possibility of occurrence of new species or new records in this area and their known geographical distribution. Such studies could be aided by tools to help in identifying the complex fauna of parasitoid species.

## Materials and Methods

The present study is based on examination of collected specimens by first author and other Iranian entomologists from different regions of Iran. Previously reported species are considered as well. Available complementary biological, geographical, ecological and morphological information originated from Iranian studies were accompanied. Identifications of specimens was mainly accomplished using, following alphabetically arranged keys and references: BOUČEK (1972, 1988), BOUČEK & RASPLUS (1994), DZHANOKMEN (1978), GRAHAM (1969) and NIKOL'SKAYA (1952, 1960). Species are ordered alphabetically.

Known zoogeographical distribution for each species is presented in parentheses. The abbreviations of zoogeographic regions are as follow: AFT, Afrotropical region; AUS, Australian region; NEA, Nearctic region; NET, Neotropical region; ORL, Oriental region; PAL, Palaearctic region. Finally their geographical distribution in Iran was mapped. Studied materials were deposited in Hayk Mirzayans Insects Museum (HMIM), Tehran.

## Results

We found 6 families Chalcididae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae and Pteromalidae. The family Torymidae is also known as a parasitoid of this group of the pests. An unknown species of the family has been reported on *Osphranteria coeruleascens* REDTENBACHER (Col.: Cerambycidae) in Esfahan Province (RADJABI 1991) without complementary information and this materials are not available for us to identify.

Nineteen chalcidoids species (Hymenoptera: Chalcidoidea) are listed as parasitoids of xylophagous beetles in Iran. Of which 2 pteromalids, *Rhaphitelus maculatus* WALKER, *Cheiropachus quadrum* (FABRICIUS) are widely distributed in the most of zoogeographical regions. While chalcidid species, *Trigonura ruficaudis* (CAMERON) – which was distributed in the Oriental region – found for first time in the Palaearctic region. Alphabetically arranged list of species is as follow:

### Fam. Chalcididae

A few chalcidids parasitize xylophagous beetles. It belongs to 4 genera and 11 species attacking xylophagous beetles in the world (NOYES 2007). In this study, we found only 4 species within the 3 genera as follow:

***Cratocentrus tomentosus* (NIKOL'SKAYA, 1952) - [PAL, ORL]**

Species of the genus *Cratocentrus* Cameron are generally parasitic on different families of beetles Buprestidae, Curculionidae and Cerambycidae. NIKOL'SKAYA (1952) originally described this species as *Lepidochalcis tomentosa* from northern part of Iran without precise its exact locality in Iran. Lately it was transferred to *Cratocentrus* (STEFFAN 1957). It is known from India, as well. *C. tomentosus* is relatively large species (female 9.5mm and male 7 mm), rusty-brown body, white hairs on some parts of body.

***Trigonura ruficaudis* (CAMERON, 1913) - [ORL]**

Specimens examined: Yazd Province, Ardakan- Zarch and Taft, ex *Chrysobothris* sp. (Col.: Buprestidae), summer 1991, (AHMADIAN), 7 ♀♀, 4 ♂♂. Hayk Mirzayans Insect Museum (HMIM) (no label), 1 ♀, 1 ♂.

This species is known only from Oriental region (India) as a parasitoid of the beetles *Chrysobothris*, *Derolus discicollis*, *Diorthrus simplex* and *Glenea* (NOYES 2007). The studied specimens were bred on larvae of an unknown buprestid beetle, *Chrysobothris* that attacks pomegranate. Also in Hayk Mirzayans Insect Museum, Tehran we found a pair specimens of this species collected in Iran without label. It is new record for Palearctic region.

***Trigonura sphenoptera* NIKOL'SKAYA, 1960 - [PAL]**

It was described based on material from Kazakhstan and has been reported from Iran (HAESELBARTH 1983). ABAI collected this species from Tehran (Fig. 1) on Buprestidae (Coleoptera). Little is known about the biology of this rare species.

***Varzobia tibialis* NIKOL'SKAYA, 1960 - [PAL]**

Specimens examined: Tehran Province, Evin, 22.vi.2005, ex Buprestidae (Coleoptera), on pine, (M. ABAI), 4 ♀♀.

Our studied specimens have been reared on xylophagous beetle, *Chrysobothris solieri* GORY & LAPORTE (Col.: Buprestidae) on pine *Pinus eldarica*. This species was originally described from Central Asia (Tajikistan, Turkmenistan and Uzbekistan) as a parasitoid of *Chrysobothris affinis* and *Sphenoptera kaznakovi*. This monospecific genus has been known from Palearctic region as parasitoid of xylphagous beetles.

**Fam. Encyrtidae**

Most of the species belonging in this family are parasitoid of scale insects and mealy bugs (Homoptera) and some Lepidoptera. A few species of this family live parasitically on beetles especially xylophagous groups. Many species have been used very successfully in biological control programs against serious agricultural pests, particularly in warmer regions.

***Heterococcidoxenus ?schlechtendali* (MAYR, 1876) - [PAL]**

Specimens examined: Ilam, Shirvan-Chardavol, Malaise tarp, vii.2003, (B. GHARALI), 1 ♀.

Two species were known in the genus *Heterococcidoxenus* ISHII that BOUČEK (1977) mentioned *H. schlechtendali* as a parasitoid of Scolytidae in Germany and UK. It has not been reported from Iran. Two species of the genus *Scolytus* are host of this species (NOYES 2007).

**Fam. Eulophidae**

Based on NOYES (2007) eulophids with 32 species within 10 genera have been known as parasitoids of xylophagous beetles in the world. In this group only one species has been recorded in Iran (DAVATCHI & CHODJAI 1968).

***Entedon ergias* (RATZBURG, 1844) - [PAL, NEA]**

This common species is widely distributed from Caucasian area in the Palearctic region to USA in the Nearctic region. It was reported on *Rogulascolytus mediterraneus* EGGERS (Col.: Scolytidae) in Iran: Markazi, Tehran (Karaj, Shahriar, Shemiran), and Zanjan Provinces (DAVATCHI & CHODJAI 1968, RADJABI 1991). *E. ergias* was mentioned as a parasitoid of different scolytid species in the world (NOYES 2007). Within the genus *Entedon* 7 species has been listed live parasitically on 4 families of xylophagous beetles: Anobiidae, Bostrychidae, Buprestidae and Scolytidae.

**Fam. Eurytomidae**

Based on the LOTFALIZADEH et al. (2007) within the family Eurytomidae the most known parasitoids of xylophagous beetles belong to the group *morio* of *Eurytoma*. Also, the genus *Endobia* ERDÖS – which revalidated recently (LOTFALIZADEH et al. 2007) – known as a parasitoid of xylophagous beetles. The genus *Ipideurytoma* BOUČEK & NOVICKY was supposed to attack this group. Three species have been known within the genus *Eurytoma* associated with xylophagous beetles in Iran. Here we add *Eurytoma blastophagi* as a new record for the fauna of Iran.

***Eurytoma morio* BOHEMAN, 1836 - [PAL]**

Specimens examined: Azarbaijan-e-Sharghi Province, Marand, 2.ix.2003, ex dead woods, (H. LOTFALIZADEH), 1 ♀, 33 ♂♂.

It belongs to *morio* group of the genus *Eurytoma* (LOTFALIZADEH et al. 2007), that parasites a wide range of the host such as some beetles (Cerambycidae, Curculionidae, Scolytidae) and Lepidoptera (Gelechiidae and Pieridae). *E. morio* has been reported by DAVATCHI & CHODJAI (1968) as a patristic species on *Rogulascolytus mediterraneus* EGGERS and *Scolytochelus multistratatus* MARSHAM (Col.: Scolytidae) on *Biota orientalis* from Tehran Province (Karaj and Shahriar). Also its occurrence in Esfahan and Zanjan Provinces as a parasitoid of *R. mediterraneus* was mentioned (RADJABI 1991)

(Fig. 2). *E. morio* is widely distributed from India to Western Europe and in the Middle East it has been found in Lebanon, Yemen and Morocco (NOYES 2007).

***Eurytoma arctica* THOMSON, 1876 - [PAL]**

It belongs to *E. morio* group of the genus *Eurytoma* such as the former species (LOTFALIZADEH et al. 2007). In Iran (Tehran Province, Saveh, Yal-Abad, in 1990) it was reared on weevil, *Smicronyx robustus* FST. (Col.: Curculionidae) (EBRAHIMI 1993). *E. arctica* is a common species in Europe that has been reported in the Middle East as a parasitoid of various genera of scolytids (NOYES 2007).

***Eurytoma blastophagi* HEDQVIST, 1963 - [PAL]**

Specimens examined: Azərbaycan-e-Shərqi Province, Marand, 15.viii.2003, ex infected dead tree, (H. LOTFALIZADEH), 3 ♀ ♀.

It was bred on infected dead tree branch by *Xylopertha reflexicauda* LESNE (Col.: Bostrychidae) and *Ruguloscolytus mediterraneus* (Col.: Scolytidae). In the literatures it was known as a parasitoid of some scolytid genera such as *Blastophagus*, *Ips*, *Onthotomicus* and *Pityogenes* in China, Norway, Russia, Sweden and Siberia (NOYES 2007). Based on LOTFALIZADEH et al. (2007) it belongs to *E. morio* group of the genus *Eurytoma*.

***Eurytoma iranica* ZEROVA, 2007 - [PAL]**

Specimens examined: Chahar-Mahal-Bakhtiari Province, vi.2003, ex *Osphranteria coerulescens* (Col.: Cerambycidae), (S. ROSHANDEL), 19 ♀ ♀ & 6 ♂ ♂.

It is known just from Iran as parasite of *Osphranteria coerulescens* (Col.: Cerambycidae) larvae in twigs of almond trees (*Amygdalus*) in the central region of Iran. It was originally named *E. iranica* ZEROVA, 2004 while this name was previously preoccupied by *E. iranica* NARENDRAN & LOTFALIZADEH, 1999. Recently, ZEROVA (2007) proposed new name *E. iranica* for this species. She believes it belongs to the *E. robusta* group of the genus *Eurytoma* that have mesosternal carinae (completely delimited epicnemium), pre-orbital carinae, and distinctly developed postgenal carina.

LOTFALIZADEH et al. (2007) added the following derived characters for this group: the emarginate clypeus, the strigose lower face, the narrow interantennal projection, a medioventral tooth on the prepectus and a ventral shelf on the mesopleuron.

It differs from other species with an orbital carina which developed and interrupted occiput, widening fore coxae and long and thin flagellar segments in female (ZEROVA et al. 2004).

**Fam. Eupelmidae**

This family has 6 genera and 21 species those parasite xylophagous beetles in different zoogeographical regions (NOYES 2007). However we found only 2 species - in Iranian collected materials – belonging 2 genera *Eupelmus* and *Eusandalum*. In this family most

species of *Eupelmus* are endoparasitic, and evidence shows that host larvae remain active, continue to feed, and construct a chip cocoon for pupation after being parasitized by them, which indicates that this species is probably a koinobiont (WILLIAMS & LANGOR 2002).

***Eupelmus muellneri* RUSCHKA, 1921 - [PAL]**

In the RADJABI's publication (1991), it has been recorded as *Macroneura muellneri* from Tehran and Markazi Provinces (Fig 3). It is a parasitoid of scolytid, *Ruguloscolytus mediterraneus* and buprestid, *Sphenoptera davatchii* DESCARPENTRIES, 1960.

***Eusandalum inerme* (RATZEBURG, 1848) - [PAL]**

Specimens examined: Fars Province, ii.2005, ex Buprestidae on *Ficus carica*, 3 ♀♀.

This species is a common parasitoid of numerous species of xylophagous beetles from different families: Anobiidae, Bostrichidae, Buprestidae, Cerambycidae and Scolytidae in European countries (Czech Republic, Germany, Hungary, Italy and Slovakia). These specimens were reared on an unknown buprestid species.

**Fam. Pteromalidae**

This family is one of important control agent of xylophagous beetles and belongs 65 known species that attack all of coleopterous xylophagous families. We found 7 species within 7 different genera that widely distributed in Iran (Figs 3 & 4).

***Callocleonimus pulcher* MASI, 1940 - [PAL, AFT]**

Specimens examined: Azarbaijan-e-Sharghi Province, Marand, 12.vii.2007, Malaise trap, (H. LOTFALIZADEH), 1 ♀.

It lives parasitically on Buprestidae but our studied specimen were collected by Malaise trap located near to infected apple tree branches by *Rogulascolytus mediteraneus* (Col.: Scolytidae) and *Xylopertha reflexicauda* (LESNE, 1937) (Col.: Bostrychidae). *C. pulcher* has been reported from Somalia and Turkmenistan (NOYES 2007). This species has not been reported from Iran. Within the subfamily Cleonyminae, the genus *Callocleonimus* has convex and shiny mesepimeron, broadly infumated forewing and basally bare, gaster petiolate.

***Chalcedectus balachowskyi* STEFFAN, 1968 - [PAL]**

In Iran, it was originally recovered from the Rosaceae branch borer, *Osphranteria coerulescens* REDTENBACHER (Col.: Cerambycidae) on *Rosa* (STEFFAN, 1968). Later, SHARIFI & JAVADI (1971) reared it on same host.

***Cheiopachus quadrum* (FABRICIUS, 1787) - [PAL, ORL, NEA, NET]**

Specimens examined: Azərbaycan-e-Shərqi Province, Marand, ix.2002, ex infected dead wood, (H. LOTFALIZADEH), 8 ♀ ♀, 21 ♂ ♂,

This newly reported species from Iran (LOTFALIZADEH & GHARALI 2008) is a widespread parasitoid of xylophagous beetles especially the families Scolytidae and Bostrychidae. It was known as a common parasitoid of small xylophagous beetles, especially on deciduous trees (BOUČEK & RASPLUS, 1996). Such as *C. pulcher*, specimens were collected by Malaise trap located near to infected apple tree branches by *Ruguloscolytus mediterraneus* (Col.: Scolytidae) and *Xylopertha reflexicauda* (Col.: Bostrychidae). BOUČEK & RASPLUS (1994) listed this species in the occasionally introduced species into Northern America before 1900 along its host.

It has two transverse markings on forewings, fore and hind femur distinctly thickened, hind tibia with a row of spines dorsally.

***Dinotiscus colon* (LINNAEUS, 1758) - [PAL, NEA, NET]**

It is widely distributed in the west and northwest of Iran belonging: Ardabil, Zanjan, Hamedan, Kordestan and Kermanshah Provinces also presents in Tehran, Markazi, and Esfahan Provinces (DAVATCHI & CHODJAI 1968, RADJABI 1991) (Fig. 4). It was reared by DAVATCHI & CHODJAI (1968), as *Cheiopachus colon* L. on *Ruguloscolytus mediterraneus* and *Phloeosinus bicolor* BRULLE and these records are considered confirmed, although this species has not been recovered since. Other hosts include several species of the genera *Scolytus*, *Magdalis*, *Ips*, *Hylesinus*, *Phloeotribus* and *Blastophagus* which are bark-boring beetles with similar biology. It is widely distributed in the Holarctic (NOYES 2007). It has collar area sharply carinate.

***Heydenia pretiosa* FÖRSTER, 1856 - [PAL]**

Specimens examined: Azərbaycan-e-Shərqi Province, Marand, 12.vii.2007, Malaise trap, (H. LOTFALIZADEH), 1 ♀.

*Heydenia* FÖRSTER is one of the recorded genera of the subfamily Cleonyminae from Iran (DAVATCHI & CHODJAI 1968, HERTING 1973, RADJABI 1991, LOTFALIZADEH & GHARALI 2008). DAVATCHI & CHODJAI (1968) and HERTING (1973) reported *H. pretiosa* as a parasitoid of xylophagous beetles in Iran (Buprestidae, Scolytidae, Cerambycidae also Curculionidae). This – widely distributed species from Europe to Middle East countries – was reared on *Ruguloscolytus mediterraneus* and *Phloeosinus bicolor* on fruit trees and *Biota orientalis* in Karadj (DAVATCHI & CHODJAI 1968). In addition, RADJABI (1991) recorded it from Tehran, Kordestan and Markazi Provinces on *Sphenoptera davatchii* (Col.: Buprestidae) and Tehran, Hamedan and Zanjan Provinces on *Ruguloscolytus mediterraneus* (Fig. 4). LOTFALIZADEH & GHARALI (2008) reported it as a parasitoid of *Xylopertha reflexicauda* (LESNE, 1937) (Col.: Bostrychidae) or *Ruguloscolytus mediterraneus* EGGRS (Col.: Scolytidae). BOUČEK & RASPLUS (1991) believe it appears on infested dying trees in whole of Europe.



***Rhaphitelus maculatus* WALKER, 1834 - [PAL, NET, NEA, AUS]**

Specimens examined: Azərbaycan-e-Shərqi Province, Marand, ix.2002, ex infected dead wood, (H. LOTFALIZADEH), 4♂♂.

Three species has been known in the genus *Rhaphitelus* so far. *Rhaphitelus maculatus* was collected from Karadj (Tehran Province) and Pars-Abad (Ardabil Province) (DAVATCHI & CHODJAI 1968). Subsequently, RADJABI (1991) reported it from Markazi, Zanjan, Hamedan and Esfahan Provinces as an important agent in control of *Ruguloscolytus mediterraneus* (Fig. 4). This widely distributed species as a parasitoid of xylophagous Coleoptera especially Scolytidae in Iran but there is also some reports on other families such as Curculionidae (NOYES 2007). Such as later species, these specimens were collected by Malaise trap located near to infected apple tree branches by *R. mediteraneus* (Col.: Scolytidae) and *X. reflexicauda* (Col.: Bostrychidae).

***Oxysychus* sp. - [PAL, ORL, AUS, AFT]**

An unknown species of *Oxysychus* DELUCCHI, 1956 was recorded from Tehran and Markazi Provinces on *Sphenoptera davatchii* and *S. kambyeses* (Col.: Buprestidae) by RADJABI (1991).

### Acknowledgment

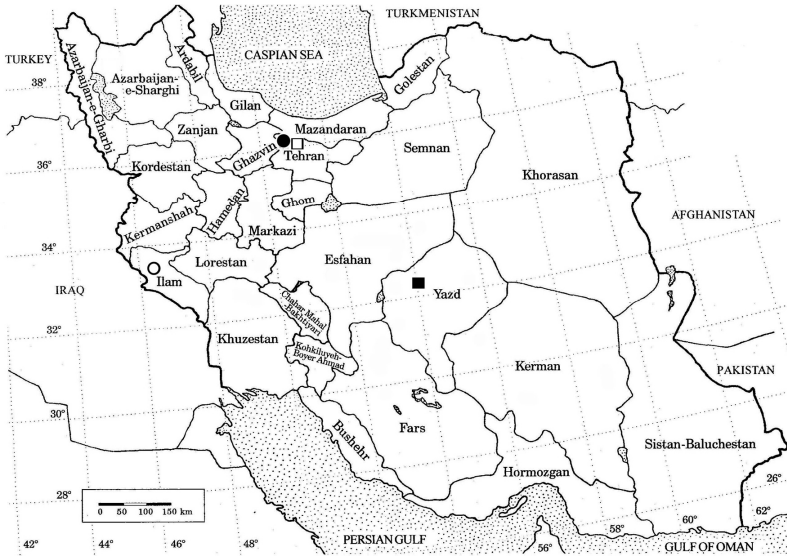
We would like to thank Dr. G. DELVARE for identification of *Varzobia* and Dr. J.S. NOYES for identification of encyrtid species.

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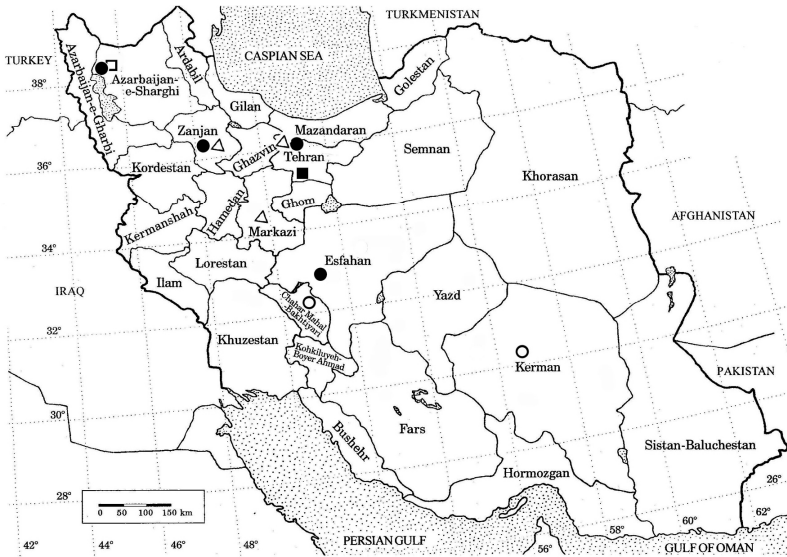
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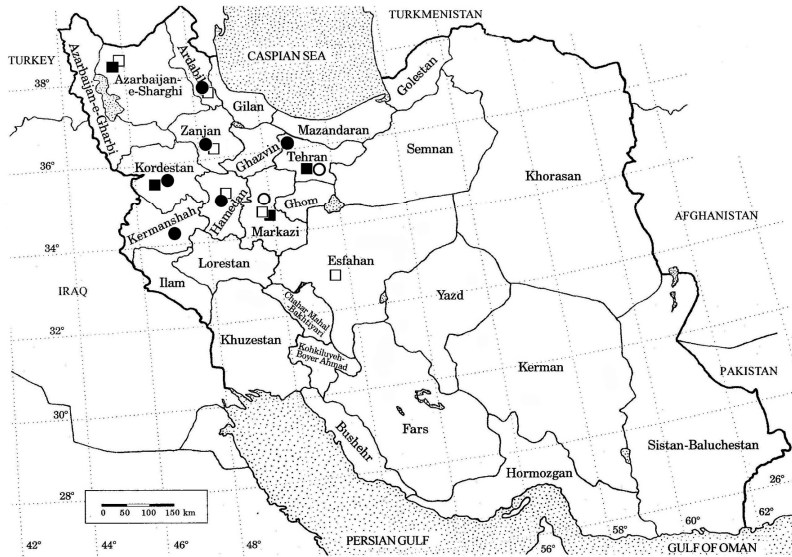
**Fig. 1:** Map of Iran with geographical distribution of studied materials. *Trigonura ruficaudis* ■; *Trigonura sphenoptera* ●; *Heterococcidoxenus ?schlechtendali* ○.



**Fig. 2:** Map of Iran with geographical distribution of studied materials. *Entedon ergias* Δ; *Eurytoma morio* ●; *Eurytoma arctica* ■; *Eurytoma blastophagi* □; *Eurytoma iranica* ○.



**Fig. 3:** Map of Iran with geographical distribution of studied materials. *Eupelmus miellneri*  $\Delta$ ; *Eusandalum inerme*  $\bullet$ ; *Calocleonymus pulcher*  $\blacksquare$ ; *Chalcedectus balachowskyi*  $\square$ ; *Cheiropachus quadrum*  $\circ$ .



**Fig. 4:** Map of Iran with geographical distribution of studied materials. *Dinotiscus colon*  $\bullet$ ; *Heydenia pretiosa*  $\blacksquare$ ; *Rhaphitelus maculatus*  $\square$ ; *Oxysychnus* sp.  $\circ$ .

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