A study on the Braconidae (Hymenoptera) of Khorasan province and vicinity, Northeastern Iran

Najmeh Samin, Hamid Sakenin, Sohrab Imani & Mahmood Shojai

Abstract. The fauna of Braconidae (Hymenoptera) from Khorasan province and vicinity, northeastern Iran is studied in this paper. Totally 21 species from 13 genera and 9 subfamilies (Agathidinae, Alysinae, Brachistinae, Braconinae, Cheloninae, Euphorinae, Hormiinae, Opiinae, Rogadinae) were collected. Of these, 3 species: *Aleiodes* (*Aleiodes*) *esenbeckii* (Hartig), *Bracon* (*Orthobracon*) *epitriptus* Marshall and *Perilitus* (*Townesilitus*) *bicolor* (Wesmael) are new records for Iran.

Samenvatting. Studie van de Braconidae (Hymenoptera) van de provincie Khorasan en omgeving, Noordoost-Iran

Tijdens de studie nar de Braconidae van de provincie Khorasan in Noordoost-Iran werden 21 soorten vastgesteld behorend tot 13 genera en 9 subfamilies (Agathidinae, Alysinae, Brachistinae, Braconinae, Cheloninae, Euphorinae, Hormiinae, Opiinae, Rogadinae). Drie soorten, *Aleiodes* (*Aleiodes*) *esenbeckii* (Hartig), *Bracon* (*Orthobracon*) *epitriptus* Marshall en *Perilitus* (*Townesilitus*) *bicolor* (Wesmael), worden voor het eerst uit Iran gemeld.

Résumé. Etude des Braconidae (Hymenoptera) de la province de Khorasan et environs, Nord-Est de l'Iran

A l'occasion de l'étude des Braconidae de la province de Khorasan (Nord-Est de l'Iran), 21 espèces furent observées, appartenant à 13 genres et 9 sous-familles (Agathidinae, Alysinae, Brachistinae, Braconinae, Cheloninae, Euphorinae, Hormiinae, Opiinae, Rogadinae). Trois espèces, *Aleiodes* (*Aleiodes*) *esenbeckii* (Hartig), *Bracon* (*Orthobracon*) *epitriptus* Marshall et *Perilitus* (*Townesilitus*) *bicolor* (Wesmael), sont mentionnées ici pour la première fois d'Iran.

Keywords: Braconidae – Faunistics – New record – Khorasan – Iran.

Sakenin, H.: College of Agriculture, Islamic Azad University, Ghaemshahr Branch, Mazandaran, Iran. hchelave@yahoo.com.

Samin, N.: Young Researchers Club, Science and Research Branch, Islamic Azad University, Tehran, Iran. n_samin63@yahoo.com.

Imani, S. & Shojai, M.: Department of Entomology, Islamic Azad University, Science and Research Branch, Tehran, Iran.

Introduction

The Braconidae constitute one of the most species-rich families of insects with an estimated 50,000 species worldwide. Among extant groups, the sister group of the Braconidae is the Ichneumonidae, an equally enormous group (Sharkey & Wahl 1992, Quicke *et al*. 1999). The vast majority of braconids are primary parasitoids of other insects, especially upon the larval stages of Coleoptera, Diptera, and Lepidoptera but also including some hemimetabolus insects (aphids, Heteroptera, Embiidina). As parasitoids they almost invariably kill their hosts, although a few only cause their hosts to become sterile and less active. These beneficial insects play an efficient role in biological control programs all over the world (Matthews 1974, Shaw & Huddleston 1991, Shaw 1995). Parasitoids exert negative effects on their hosts, both at the individual and population level. This ecological feature can be used to develop biological control programs, i.e. "the use of living organisms [called biological control agents] to control the population density or impact on a specific pest organism,

making it less abundant or less damaging than it would otherwise be". More than a thousand biological control agents are currently in use worldwide and most of them are parasitoid insects used to control phytophagous insect pests (Wharton 1993, Godfray 1994, Eilenberg *et al*. 2001). There is no consensus on the number of braconid subfamilies, but Sharkey (1993) proposed the following 29: Adeliinae, Agathidinae, Alysiinae, Amicrocentrinae, Aphidiinae, Apozyginae, Braconinae, Cardiochilinae, Cheloninae, Doryctinae, Dirrhopinae, Euphorinae, Gnamptodontinae, Helconinae, Homolobinae, Ichneutinae, Khoikhoiinae, Macrocentrinae, Meteoridiinae, Meteorinae, Microgastrinae, Miracinae, Neoneurinae, Opiinae, Orgilinae, Rogadinae, Sigalphinae, Trachypetinae, and Xiphozelinae.

Khorasan (consisting of three different parts: northern, Razavi, and southern provinces) is one of the largest Iranian provinces located in East and North-eastern Iran, having boundaries with Afghanistan and Turkmenistan too. This paper, which is a part of large project on Iranian Braconidae, deals with the fauna of Braconidae in this part of Iran.

Material and Methods

Specimens were collected by sweeping net and malaise traps in different regions of the Khorasan province in Northeastern Iran and vicinity (Kerman, Golestan, Sistan-Baluchestan, and Semnan provinces). Sampling was conducted between 2000 and 2007 and the collected specimens were killed with ethyl acetate or put in alcohol and sent to Dr. V. I. Tobias of Russia for identification. In addition to the mentioned collecting methods, some preserved specimens in the collections of Ferdowsi University of Mashhad and Science & Research Branch were used in this paper. Classification, nomenclature and distributional data of Braconidae suggested by Yu *et al*. (2006) have been followed..

Results

In total 21 species from 13 genera and 9 subfamilies were collected from Khorasan province and vicinity. The list of species is given below.

Subfamily Agathidinae Haliday, 1833
Genus *Agathis* Latreille, 1805

Agathis anglica Marshall, 1885

Material: Golestan province: Gorgan, 1♀, June 2000.

Distribution outside Iran: Oriental, Palaearctic (Albania, Armenia, Austria, Azerbaijan, Bulgaria, China, China-Taiwan, Croatia, Cyprus, Finland, France, Germany, Greece, Hungary, Italy, Kazakhstan, Mongolia, Morocco, Netherlands, Poland, Romania, Russia, Slovenia, Spain, Sweden, Switzerland, Syria, Tajikistan, Turkey, Ukraine, United Kingdom, former Yugoslavia).

Subfamily Alysinae Leach 1815
Genus Chorebus Haliday 1833

Chorebus* (*Chorebus*) *tumidus (Tobias, 1966)

Material: Golestan province: Bandar-Torkman, 3♀, September 2001.

Distribution outside Iran: Palaearctic (Turkmenistan, former Yugoslavia).

Chorebus* (*Phaenolexis*) *gedanensis (Ratzeburg, 1852)
Material: Khorasan province: Mashhad, Neyshabour, 1♂, 2♀, no date.
Distribution outside Iran: Palaearctic (Bulgaria, Germany, Italy, Kazakhstan, Netherlands, Poland, Russia, Sweden, United Kingdom).
Chorebus* (*Stiphrocera*) *flavipes (Goureau, 1851)
Material: Kerman province: Jiroft, 2♀, October, 2002.
Distribution outside Iran: Palaearctic (Denmark, France, Germany, Ireland, Kazakhstan, Poland, Russia, Spain, United Kingdom, former Yugoslavia).

Genus *Dinotrema* Forster, 1862

Dinotrema* (*Dinotrema*) *amoenidens (Fischer, 1973)
Material: Golestan province: Mareveh-Tappeh, 1♀, no date.
Distribution outside Iran: Oriental, Palaearctic (Austria, China, Greece, Poland).

Subfamily Brachistinae Foerster, 1862
Genus *Eubazus* Nees von Esenbeck, 1812

Eubazus* (*Brachistes*) *tibialis (Haliday, 1835)
Material: Khorasan province: Kashmar, 1♂, June 2000.
Distribution outside Iran: Palaearctic (Belgium, Bulgaria, Croatia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Russia, Serbia, Slovakia, Sweden, Switzerland, Ukraine, United Kingdom, former Yugoslavia).

Genus *Schizoprymnus* Foerster, 1862

Schizoprymnus angustatus (Herrich-Schäffer, 1838)
Material: Golestan province: Gonbad, 2♀, August 2000.
Distribution outside Iran: Palaearctic (Azerbaijan, Finland, Germany, Hungary, Italy, Kazakhstan, Lithuania, Moldova, Mongolia, Russia, Spain, Sweden, Switzerland, Ukraine).
Schizoprymnus nigripes (Thomson, 1892)
Material: Sistan-Baluchestan province: Zabol, 1♂, October 2006.
Distribution outside Iran: Palaearctic (former Czechoslovakia, Hungary, Kazakhstan, Korea, Moldova, Russia, Sweden).
Schizoprymnus parvus (Thomson, 1892)
Material: Khorasan province: Serakhs, 1♂, November 2002.
Distribution outside Iran: Palaearctic (Finland, Germany, Greece, Hungary, Kazakhstan, Mongolia, Netherlands, Sweden).

Subfamily Braconinae Nees von Esenbeck, 1811
Genus *Bracon* Fabricius, 1804

Bracon* (*Bracon*) *robustus Hedwig, 1961
Material: Khorasan province: Kashmar, 1♂, 2♀, November 2002.
Distribution outside Iran: Eastern Palaearctic.
Bracon* (*Lucobracon*) *meyeri Telenga, 1936
Material: Khorasan province: Serakhs, 1♂, 1♀, November 2002.
Distribution outside Iran: Palaearctic (Kazakhstan, Moldova, Mongolia, Russia, Turkey).
Bracon* (*Orthobracon*) *epitriptus Marshall, 1885
Material: Khorasan province: Fariman, 1♀, July 2006. **New record for Iran**.
Distribution outside Iran: Palaearctic (Armenia, Austria, Azerbaijan, Belarus, China, Georgia, Germany, Greece, Hungary, Italy, Kazakhstan, Korea, Lithuania, Moldova, Mongolia,

Netherlands, Poland, Romania, Russia, Slovenia, Switzerland, Turkey, Ukraine, United Kingdom, former Yugoslavia).

Genus *Coeloides* Wesmael, 1838

Coeloides rossicus (Kokujev, 1902)

Material: Khorasan province: Mashhad (Grape orchard), 1♂, September 2006.

Distribution outside Iran: Nearctic, Palaearctic (Afghanistan, Belgium, Canada, Czech Republic, Finland, Germany, Hungary, Kazakhstan, Lithuania, Poland, Russia, Sweden, U.S.A., Ukraine).

Subfamily Cheloninae Foerster, 1862

Genus *Chelonus* Panzer, 1806

Chelonus* (*Chelonus*) *szepligetii Dalla Torre, 1898

Material: Khorasan province: Torbat Heydarieh, 2♂, 1♀, September 2006.

Distribution outside Iran: Palaearctic (Azerbaijan, Croatia, Hungary, Turkey, former Yugoslavia).

Subfamily Euphorinae Foerster, 1862

Genus *Myiocephalus* Marshall, 1898

Myiocephalus boops (Wesmael, 1835)

Material: Khorasan: Mashhad, 1♂, May 2000.

Distribution outside Iran: Nearctic, Oriental, Palaearctic (Belgium, Bulgaria, Canada, China, Czech Republic, Finland, France, Georgia, Germany, Ireland, Korea, Lithuania, Norway, Poland, Russia, Switzerland, U.S.A., United Kingdom).

Genus *Perilitus* Nees von Esenbeck, 1819

Perilitus* (*Townesilitus*) *bicolor (Wesmael, 1835)

Material: Semnan province: Shahrood, 1♀, November 2007. **New record for Iran**.

Distribution outside Iran: Palaearctic (Albania, Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Kazakhstan, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Romania, Russia, Serbia, Spain, Sweden, Switzerland, United Kingdom, former Yugoslavia).

Subfamily Hormiinae Foerster, 1862

Genus *Pseudobiosteres* Hedwig, 1961

Pseudobiosteres blaciformis Hedwig, 1961

Material: Khorasan province: Birjand, 1♂, October 2001. Kerman province: Jiroft, 2♀, August 2005.

Distribution outside Iran: Central Palaearctic.

Pseudobiosteres imperfectus Hedwig, 1961

Material: Khorasan province: Torbat-Jam, 2♂, March 2002.

Distribution outside Iran: Central Palaearctic.

Subfamily Opiinae Blanchard, 1845

Genus *Biosteres* Foerster, 1862

Biosteres* (*Biosteres*) *longicauda (Thomson, 1895)

Material: Khorasan province: Serakhs, 1♂, November 2002.

Distribution outside Iran: Palaearctic (Austria, China, Czech Republic, Denmark, Finland, France, Germany, Italy, Lithuania, Moldova, Russia, Slovenia, Sweden, Switzerland, former Yugoslavia).

Subfamily Rogadinae Foerster, 1862
Genus Aleiodes Wesmael, 1838

Aleiodes* (*Aleiodes*) *esenbeckii (Hartig ,1838)

Material: Khorasan province: Mashhad, 1♀, 1♂, November 2006. **New record for Iran**.

Distribution outside Iran: Oriental, Palaearctic (Afghanistan, Austria, China, Czech Republic, Germany, Hungary, Japan, Korea, Lithuania, Mongolia, Norway, Russia, Spain, Taiwan, former Yugoslavia).

Aleiodes* (*Heterogamus*) *testaceus (Telenga, 1941)

Material: Kerman province: Jiroft, 1♀, August 2005.

Distribution outside Iran: Oriental, Palaearctic (Afghanistan, Algeria, Austria, Azerbaijan, Belgium, Bulgaria, China, Croatia, Czech Republic, Finland, France, Georgia, Germany, Greece, Hungary, India, Italy, Kazakhstan, Lithuania, Mongolia, Netherlands, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkmenistan, Ukraine, United Kingdom, Uzbekistan, former Yugoslavia).

Discussion

The fauna of Iranian Braconidae was poorly studied, but recently some valuable faunistic papers were published (Ghahari *et al*. 2009a, b, c, d). Also, upon the several collected specimens from different regions of Iran, many other papers are in preparation. Although the fauna of Khorasan province has been studied in this paper, this province is the largest region in Iran and therefore the very diverse fauna of Braconidae will result in many new records and probably new species are expected to be discovered after more exact surveys. Therefore, the faunistic works on braconids of Khorasan province can be an important research topic for the researchers. Also, since Iran is a large country with various geographical regions and climates, faunistic surveys in different regions of Iran are necessary for the identification of Iranian Braconidae. A checklist of Iranian Braconidae was published by Fallahzadeh & Saghaei (2009) without perfect attention to all the resources on Iranian Braconidae, e.g. Ghahari *et al*. (2009a, b, c, d). A checklist is a type of informational aid used to reduce failure by compensating for potential limits of human memory and attention. Therefore, it is expected that a checklist contains all the data on the subject and a checklist with deficiencies is not usable and helpful for researchers. This is the main reason why all systematic checklists must be prepared by authorized specialists or at least edited by them carefully.

Braconids are one of the powerful parasitoids with an efficient role as biological control in almost all agro-ecosystems; therefore conservation of them is necessary for their augmentation. Decreasing of pesticide applications in fields and gardens is one of the effective strategies for supporting natural enemies. Parasitic wasps operate at a high trophic level and, because of their biology, tend to be highly specialised, sometimes having very narrow host ranges with at least local monophagy as a frequent outcome. Despite difficulties in precisely defining "Habitat" (Elton 1966, Dennis *et al*. 2003) and picking it out from a continuum involving also niche and biotope, considering the performance and interactions of organisms from that stance is fundamentally important (Southwood 1977).

Although not all insect parasitoids are parasitic wasps (Eggleton & Belshaw 1992, 1993) and, indeed, not all organisms having an essentially identical functional biology are even insects (Eggleton & Gaston 1990), parasitic wasps are an overwhelmingly large group, comprising about a quarter of the entire British insect fauna, and this account will be largely focused on them. Apart from habitat fragmentation, one of the profound changes over the past half century in Britain has been the increase in insecticides applied in agriculture. As these have become increasingly sophisticated and insect-specific, fears about their direct effect on vertebrate life have been largely controllable, and very little research has been directed towards their effect on off-crop non-target insect populations, although the phenomenon of pest resurgence (Hardin *et al.* 1995) and economic concern for the effect of insecticides on within-crop natural enemies of the target species has resulted in little research relevant to the crop environment. However, both short-term and long-term studies seem to be lacking on the relative toxicity to different insect groups (and trophic levels) of low dosages of pesticides, i.e. at off-crop levels, having disruptive effects on insect development (Shaw 2006). As a persistent collector of a wide range of the early stages of terrestrial insects and arachnids from which to rear parasitoids, we have a reasonably rich experience of "good" and "bad" sites, regarding "good" ones as the places where common and widespread phytophagous insects have rare parasitoids (rare insects in the host groups tend also to be present, of course, but it is the parasitoid fauna of the common and more widespread hosts that is most indicative). Trying to think of what fairly reliably constitutes this "goodness" in a site of a particular biotope, we can think of three habitat factors: (i) reasonably large size, (ii) continuity, at whatever successional stage, and (iii) for parasitoids of folivores, its effective isolation from conventional arable or orchard agriculture. It seems to us that this last is a crucial factor in habitat quality that we may be overlooking, and it may help also to explain why brownfield sites (typically surrounded by buildings, not arable agriculture) and even suburban gardens rather paradoxically hold good populations of uncommon insects, sometimes including otherwise very elusive species of parasitoids (e.g. Owen *et al*. 1981). An ongoing study comparing overall parasitoid food webs on organic and conventional farms may provide some measure of biodiversity loss at this trophic level associated with agrochemicals, but otherwise too little formal attention has been paid to the possibility that this is a major problem (Shaw 2006).

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