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A contribution to the braconid wasps (Hymenoptera: Braconidae) from the forests of northern Iran

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A b s t r a c t : The fauna of braconid wasps (Hymenoptera: Ichneumonoidea: Braconidae) from the forests of northern Iran is studied in this paper. Altogether 29 species from 20 genera and 10 subfamilies (including, Agathidinae, Alysinae, Aphidiidae, Braconinae, Cheloninae, Euphorinae, Helconinae, Microgastrinae, Opiinae, Orgilinae) were collected from the forests. They are dealt with here together with their general distribution.

K e y w o r d s : Braconidae, forest, Guilan, Golestan, Mazandaran, Iran.

Introduction

Braconidae (Hymenoptera: Ichneumonoidea) is the second largest family of Hymenoptera, with more than 40,000 species (SHARKEY 1993). The family is cosmopolitan and diverse in all areas, with no strong preference for tropical or temperate regions or for wet or dry habitats (WHARTON 1993). Braconidae are thus almost wholly beneficial and includes a large number of species that are effective enough to exert a definite regulatory impact on the increase of numerous important plant pests (TOBIAS 1995; GHAHARI et al. 2006).

Sustainable biological diversity has become one of the principal goals of conservation. Gradually the goals have moved from concern for specifically threatened species to the broader desire to protect ecosystems, thereby allowing many more species to benefit. As a result, a variety of methods has been devised for quantifying the diversity of species within an ecosystem. The most thorough analysis of biodiversity in an ecosystem would be an inventory of all taxa and their relative abundances. Such inventories are prohibited by the ultimate size of the data sets, as well as the time requirement and the difficulty in getting sufficient scientific and financial support (KIM 1993; GHAHARI et al. 2008). Researchers have thus been looking for ways to assess biological diversity by using a single species or a small indicator group to represent the overall set of species in a community (LEWIS & WHIETFIELD 1999).

In general, insects provide many critically important ecosystem services (WILSON 1987; KIM 1993; SAMWAYS 1994; HAMMOND 1995). Insects are well suited to monitoring landscape changes because of they are abundant, species rich, and ubiquitous in occurrence (ROSENBERG et al. 1986). Among the insects, the Hymenoptera, and in particular the parasitoid wasps are among the most species rich and biologically diverse taxa (LASALLE & GAULD 1993; PETRICE et al. 2004).

Braconid wasps represent one of the most diverse and abundant of the parasitoid groups (SHAW & HUDDLESTON 1991; LASALLE & GAULD 1993). They are typically parasitoids of other insects, parasitizing and ultimately killing their hosts. Their most common hosts are the larvae of Lepidoptera, Coleoptera, and Diptera (WHARTON et al. 1997). They occur in very diverse habitats and are highly abundant in cool temperate regions (LASALLE & GAULD 1993; WHARTON 1993; QUICKE & KRUFT 1995). Braconid species tend to attack and feed on a very narrow range of hosts, and they are limited by specialized biological and behavioral adaptations (WHITFIELD & WAGNER 1988; SHAW & HUDDLESTON 1991; WHARTON 1993; SHAW 1994). Such a high degree of specialization gives braconid wasps strong potential to be sensitive indicators of environmental richness and stability (SHAW & HUDDLESTON 1991).

Materials and Methods

Specimens were colleted by malaise trap from the forests of different regions of northern Iran (Southern areas of Caspian Sea). These sampled regions were different forests of three provinces including, Guilan, Golestan and mazandaran which included the largest forests in Iran. Malaise traps work well for collecting braconid wasps because most species are fliers, and because the herb-shrub layer sampled by this trap has been found to be richer in braconid wasps than other parts of the canopy (PAPP 1994). The traps are tent-like structures made of fine mesh fabric netting. The version we used has a matte black, vertical center panel that reduces its visibility, and blocks the passage of flying insects. The top of the trap is roof-shaped and higher at one end. The insects gather at the highest point in the "roof" and then exit into a collecting chamber with a removable container filled with killing agent (TOWNES 1972; GAULD & BOLTON 1988). We used identical standardized traps so the samples were replicates (MATTHEWS & MATTHEWS 1983; OWEN 1983). In addition to the malaise trap, sweep netting on floor of some forests and also rearing the aphids' puparia top of leaf in optimum condition (25±2°C, 65±5 % RH, 14: 10 L: D) for emergence of aphidiid parasitoids were used. The collected specimens were killed with ethyl acetate and mounted on triangular labels or in vials filled by ethanol 75 % and were examined with a stereoscopic binocular microscope.

Species list

Totally 29 braconid species from 20 genera and 10 subfamilies were collected from the forests of northern Iran. The list of species is given below.

Subfamily A g a t h i d i n a e HALIDAY 1833

Genus *Agathis* LATREILLE 1804

Agathis umbellatarum NEES VON ESENBECK 1814

M a t e r i a l : Guilan province: Chaboksar (1♀), September 2006.

G e n e r a l d i s t r i b u t i o n : Germany, Austria, Balearic Islands, Dalmatia, France, Caucasia, Hungary, Middle Asia, Spain, Portugal, Russia, Sicily, Azerbaijan, Uzbekhistan, Tajikistan, Bulgaria, Cyprus, Greece, Turkey, Yugoslavia, Kazakhstan, North Africa.

R e m a r k : 1♀ from Austria, Piesting, Lower Austria, leg. Tschek. Probably mentioned for Austria for the first time.

Agathis lugubris (FOERSTER 1862)

M a t e r i a l : Golestan province: Salikandeh (2♀♀), September 2004.

G e n e r a l d i s t r i b u t i o n : Germany, Ireland, England, Switzerland, Poland, France, Netherlands, Norway, Turkey.

Agathis malvacearum LATREILLE 1805

M a t e r i a l : Guilan province: Lahijan (1♀), September 2006.

G e n e r a l d i s t r i b u t i o n : Austria, Germany, Greece, England, Spain, Italy, Corsica, Hungary, Mongolia, Poland, Yugoslavia, Bulgaria, France, Turkey, Netherlands.

R e m a r k : There are examples from Greece (Rhodos), leg. Mavromoustaklis, and Austria, Lower Austria, in the collection of the Natural History Museum Vienna. The two countries are probably mentioned for the first time.

Agathis melpomene NIXON 1986

M a t e r i a l : Mazandaran province: Ramsar (1♀), June 2007.

G e n e r a l d i s t r i b u t i o n : Andorra, Austria, Italy, Mongolia, Poland, Bulgaria, Hungary, Turkey.

Genus *Baeognatha* KOKUJEV 1903

Baeognatha armeniaca TELENGA 1955

M a t e r i a l : Guilan province: Chaboksar (1♂), September 2006.

G e n e r a l d i s t r i b u t i o n : Austria, Russia, Turkey.

Genus *Bassus* FABRICIUS 1804

Bassus tumidulus (NEES von ESENBECK 1814)

M a t e r i a l : Mazandaran province: Ramsar (1♀), June 2007.

G e n e r a l   d i s t r i b u t i o n : Austria, Belgium, England, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Russia, Siberia, Sweden, Switzerland, Turkey, Yugoslavia.

R e m a r k : There are two ♀ ♀ from Austria (Burgenland = Eastern Austria, and Tyrol) in the collection of the Natural History Vienna. Probably reported from Austria for the first time.

Subfamily A l y s i n a e LEACH 1815

Genus *Chorebus* HALIDAY 1833

Chorebus (*Chorebus*) *longicornis* (NEES VON ESENBECK 1811)

M a t e r i a l : Mazandaran province: Chalus (1♀), July 2007.

G e n e r a l   d i s t r i b u t i o n : Austria, Belgium, Czech Republic, Faeroe Islands, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Madeira Islands, Netherlands, Poland, Russia, Spain, Sweden, Ukraine, United Kingdom, former Yugoslavia.

Chorebus (*Chorebus*) *uliginosus* (HALIDAY 1839)

M a t e r i a l : Mazandaran province: Savadkooh (1♀, 1♂), September 2003.

G e n e r a l   d i s t r i b u t i o n : Belgium, Germany, Ireland, Lithuania, Netherlands, Poland, Romania, Sweden, Ukraine, United Kingdom.

Genus *Dinotrema* FORSTER 1862

Dinotrema (*Dinotrema*) *cratocera* (THOMSON 1895)

M a t e r i a l : Golestan province: Minoodasht (1♀), September 2004.

G e n e r a l   d i s t r i b u t i o n : Austria, Former Czechoslovakia, Hungary, Korea, Sweden.

Subfamily A p h i d i i n a e HALIDAY 1833

Genus *Adialytus* FOERSTER 1862

Adialytus salicaphis (FITCH 1855)

M a t e r i a l : Mazandaran province: Ghaemshahr (1♀, 1♂), May 2007.

G e n e r a l   d i s t r i b u t i o n : Andorra, Bulgaria, Canada, China, Croatia, former Czechoslovakia, Finland, France, Georgia, Germany, Greece, Hungary, India, Iran, Iraq, Italy, Japan, Kazakhstan, Korea, Mexico, Moldova, Pakistan, Poland, Russia, Slovakia, Sweden, Tajikistan, Turkey, U.S.A., Uzbekistan, former Yugoslavia.

Genus *Aphidius* NEES VON ESENBECK 1819

Aphidius matricariae HALIDAY 1834

M a t e r i a l : Golestan province: Gorgan (4♀♀, 2♂♂), August 2004.

G e n e r a l d i s t r i b u t i o n : Algeria, Andorra, Bermuda, Bulgaria, Canada, Canary Islands, Chile, China, Cyprus, former Czechoslovakia, Egypt, Finland, France, Georgia, Germany, Greece, Guam, Hungary, India, Iran, Iraq, Ireland, Israel, Italy, Latvia, Lebanon, Lithuania, Macedonia, Madeira Islands, Morocco, Netherlands, Norway, Pakistan, Peru, Poland, Portugal, Réunion, Slovakia, Slovenia, South Africa, Spain, Turkey, U.S.A., Ukraine, United Kingdom, Uzbekistan, former Yugoslavia, Zimbabwe.

Genus *Diaeretiella* STARÝ 1960

Diaeretiella rapae (M'INTOSH 1855)

M a t e r i a l : Mazandaran province: Savadkooh (4♀♀, 1♂), September 2003.

G e n e r a l d i s t r i b u t i o n : Afghanistan, Algeria, Andorra, Argentina, Australia, Austria, Azerbaijan, Azores, Bermuda, Brazil, Bulgaria, Canada, Canary Islands, Cape Verde Islands, Chile, China, Croatia, Cuba, Cyprus, former Czechoslovakia, Egypt, Finland, France, Georgia, Germany, Greece, Guam, Hungary, India, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Korea, Kyrgyzstan, Latvia, Lebanon, Libya, Macedonia, Madeira Islands, Mexico, Moldova, Mongolia, Morocco, Netherlands, New Zealand, Norway, Pakistan, Peru, Poland, Portugal, Puerto Rico, Russia, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Syria, Tajikistan, Turkey, Ukraine, United Kingdom, Uruguay, Uzbekistan, Venezuela, former Yugoslavia.

Genus *Praon* HALIDAY 1833

Praon (*Praon*) *volucre* (HALIDAY 1833)

M a t e r i a l : Golestan province: Gorgan (3♀♀), August 2004.

G e n e r a l d i s t r i b u t i o n : Algeria, Andorra, Argentina, Austria, Azerbaijan, Belgium, Bosnia Herzegovina, Bulgaria, Canary Islands, Chile, China, Czech Republic, Denmark, Egypt, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, India, Iran, Iraq, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Kyrgyzstan, Lebanon, Lithuania, Macedonia, Madeira Islands, Moldova, Mongolia, Montenegro, Morocco, Netherlands, Norway, Pakistan, Poland, Portugal, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, Tajikistan, Turkey, Ukraine, United Kingdom, Uzbekistan, former Yugoslavia.

Genus *Trioxys* HALIDAY 1833

Trioxys (*Trioxys*) *pallidus* (HALIDAY 1833)

M a t e r i a l : Golestan province: Salikandeh (1♀), September 2004.

G e n e r a l d i s t r i b u t i o n : Andorra, Bulgaria, China, Czech Republic, Finland, France, Georgia, Germany, Greece, Hungary, India, Iran, Iraq, Israel, Italy, Latvia, Lithuania, Moldova, Montenegro, Morocco, Netherlands, Poland, Russia, Serbia, Slovakia, Spain, Sweden, Tajikistan, Turkey, U.S.A., United Kingdom, Uzbekistan, former Yugoslavia.

Subfamily B r a c o n i n a e NEES VON ESENBECK 1811

Genus *Bracon* FABRICIUS 1804

Bracon (*Bracon*) *fulvipes* NEES 1834

M a t e r i a l : Mazandaran province: Sari, Neka (5♀♀), June 2006.

G e n e r a l d i s t r i b u t i o n : One of the most common *Bracon* species in the Palearctic Region, Austria, Belgium, Caucasus, Central Asia, England, Far East, Finland, France, Germany, Greece, Hungary, Italy, Kazakhstan, Mongolia, the Netherlands, Poland, Russia, Spain, Sweden, former Yugoslavia.

Bracon (*Bracon*) *pectoralis* WESMAEL 1838

M a t e r i a l : Golestan province: Kordkoy, Nokandeh (2♀♀, 1♂), September 2004.

G e n e r a l d i s t r i b u t i o n : Albania, Austria, Azerbaijan, Belgium, Bulgaria, Caucasia, England, France, Germany, Hungary, Italy, Kazakhstan, Russia, Spain, Tunisia, Turkmenistan, Ukraine, Yugoslavia.

Bracon (*Rostrobracon*) *urinator* (FABRICIUS 1798)

Material: Mazandaran province: Amol (2♂♂), October 2006.

General Distribution: Austria, Albania, Belgium, Caucasus, China, France, Germany, Greece, Hungary, India, Iran, Italy, Kazakhstan, Mongolia, the Netherlands, Portugal, Russia, Siberia, Spain, Syria, Tajikistan, Tunisia, Turkey.

R e m a r k : There are examples from Austria and Tunisia in the collection of the Natural History Museum Vienna. These two countries are probably new to the list of distribution.

Subfamily C h e l o n i n a e FOERSTER 1862

Genus *Chelonus* PANZER 1806

Chelonus bidens TOBIAS 1976

M a t e r i a l : Mazandaran province: Behshahr, Neka (5♀♀, 3♂♂), July 2003. Golestan province: Gorgan, Minoodasht (4♀♀, 2♂♂), August 2004.

G e n e r a l d i s t r i b u t i o n : South Russia, Kazakhstan, Turkey.

Chelonus microsomus TOBIAS 1964

M a t e r i a l : Mazandaran province: Babol (1♀), April 2003.

G e n e r a l d i s t r i b u t i o n : Kazakhstan, Turkey.

Chelonus ocellatus ALEXEEV 1971

M a t e r i a l : Mazandaran province: Savadkooh, Alasht (3♀♀), September 2003.

G e n e r a l d i s t r i b u t i o n : Crimea, Middle Asia, Turkey.

Subfamily Euphorinae FOERSTER 1862

Genus *Allurus* FOERSTER 1862

Allurus lituratus (HALIDAY 1835)

Material: Mazandaran province: Ghaemshahr (1♂), September 2003.

General distribution: Belgium, Bulgaria, Canada, China, Finland, France, Georgia, Germany, Greece, Ireland, Kazakhstan, Lithuania, Poland, Sweden, United Kingdom.

Genus *Dinocampus* FOERSTER 1862

Dinocampus coccinellae (SCHRANK 1802)

Material: Mazandaran province: Sari (1♀), June 2006.

General distribution: Albania, Algeria, Argentina, Australia, Austria, Azerbaijan, Belgium, Brazil, Bulgaria, Canada, Canary Islands, Chile, China, Cyprus, Czech Republic, Egypt, Fiji, Finland, France, Germany, Greenland, Hungary, India, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Madeira Islands, Moldova, Netherlands, New Zealand, Norway, Peru, Poland, Russia, Serbia, Slovakia, Switzerland, Syria, Turkey, U.S.A., United Kingdom, Uruguay, Vietnam, former Yugoslavia.

Subfamily Helconinae FOERSTER 1862

Genus *Aspicolpus* WESMAEL 1838

Aspicolpus borealis (THOMSON 1892)

Material: Golestan province: Gorgan (1♀), August 2004.

General distribution: Hungary, Iran, Russia, Sweden, Switzerland.

Subfamily Microgastrinae FOERSTER 1862

Genus *Apanteles* FOERSTER 1862

Apanteles (*Apanteles*) *carpatus* (SAY 1836)

Material: Mazandaran province: Kiakola (1♂), October 2003.

General distribution: Argentina, Armenia, Australia, Bermuda, Brazil, Canada, China, Croatia, Democratic Republic of Congo, Fiji, Finland, France, Germany, Ghana, Grenada, Hungary, Japan, Latvia, Lithuania, Malaysia, Moldova, Mongolia, Mozambique, New Zealand, Peru, Poland, Puerto Rico, Romania, Russia, South Africa, Spain, Switzerland, Tanzania, Turkey, Turkmenistan, U.S.A., United Kingdom, Vietnam.

Genus *Cotesia* CAMERON 1891

Cotesia ofella (NIXON 1974)

M a t e r i a l : Mazandaran province: Behshahr (1♀), July 2003.

G e n e r a l d i s t r i b u t i o n : Belgium, Czech Republic, Finland, Germany, Hungary, Iran, Italy, Netherlands, Poland, Slovakia, Spain, Switzerland, Turkey, Ukraine, United Kingdom.

Cotesia zygaenarum (MARSHALL 1885)

M a t e r i a l : Mazandaran province: Amol (1♀, 1♂), October 2006.

G e n e r a l d i s t r i b u t i o n : Albania, Armenia, Austria, Azerbaijan, China, Czech Republic, Finland, France, Germany, Hungary, Italy, Japan, Korea, Macedonia, Moldova, Poland, Russia, Serbia, Slovakia, Switzerland, Turkey, United Kingdom, former Yugoslavia.

Genus *Microgaster* LATREILLE 1805

Microgaster rufipes NEES VON ESENBECK 1834

M a t e r i a l : Guilan province: Lahijan (1♀), September 2006.

G e n e r a l d i s t r i b u t i o n : Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Sweden, United Kingdom.

Subfamily O p i i n a e BLANCHARD 1845

Genus *Opius* WESMAEL 1835

Opius (*Misophthora*) *monilicornis* FISCHER 1962

M a t e r i a l : Mazandaran province: Ghaemshahr (1♀), October 2003.

G e n e r a l d i s t r i b u t i o n : Algeria, Jordan, Maroc, Moldova, Spain, Syria, Turkey.

R e m a r k : There are several ♀♀♂♂ in the collection of the Natural History Museum Vienna from Morocco and Syria. These two countries are probably new to the list of distribution.

Subfamily O r g i l i n a e ASHMEAD 1900

Genus *Orgilus* HALIDAY 1833

Orgilus (*Orgilus*) *pimpinellae* NIEZABITOWSKI 1910

M a t e r i a l : Mazandaran province: Savadkooh (1♂), September 2003.

G e n e r a l d i s t r i b u t i o n : Afghanistan, Austria, Bulgaria, Czech Republic, Germany, Greece, Hungary, Ireland, Italy, Kazakhstan, Korea, Lithuania, Moldova, Mongolia, Norway, Poland, Romania, Russia, Serbia, Switzerland, Turkey, Ukraine, United Kingdom, former Yugoslavia.

Discussion

The results of this research indicated that there is a diverse fauna of Braconidae in the forests of northern Iran including, Guilan, Golestan and Mazandaran provinces. Forest of northern Iran included diverse flora with very interesting and even rare tree species (HASSAN ZADEH et al. 1993). Several insect pests especially in the orders Lepidoptera, Coleoptera and Hymenoptera are injurious to these trees. Several natural enemies especially the parasitoids of superfamily Ichneumonoidea have powerful and efficient role in control of forest pests. However, the forests in northern Iran are very vast and with restricted samplings we can not collect and determine all the braconid species of them. Therefore, it is expected that this research will be carried on by other researchers who are interested in Iranian Braconidae or finding new data about the forests' wonderful fauna.

Forests tend to be extremely large continuous areas with gradual boundaries, thus quantitative evaluation of controls becomes very difficult and expensive. Some unique ecological attributes are present in relatively complex forest environments including a diversity of species, ages, intraspecific genetic composition, spacing and stocking levels (DAHLSTEN & MILLS 1999). Intensively managed forests, even-aged stands, plantations of single and mixed species and seed orchards resemble agriculture, but even these usually exist in a variety of different conditions. It is important to look at some of these ecological attributes in detail as the opportunities for biological control vary depending on the environment and species involved (BAKER 1972).

The collector of natural enemies has an advantage in the relatively uniform forested regions because only minor regional differences are usually exhibited. However, any widely distributed pest or a pest introduced in a number of locations in a large forest region would make any colonization program long in term. PSCHORN-WALCHER (1977) maintains that the great differences between forest and agroecosystems dictate a different approach to biological control in forestry from agriculture. The approach to biological control in agriculture, where there is much less predictability because of continuous disturbance, can be faster using trial and error releases until the best natural enemy is found. With forest insects pre-introduction studies are desirable in order to understand the interrelationships of the various natural enemies and finally to select the most likely natural enemies for success. Natural enemy complexes of forest insects can be chosen with a higher degree of predictability for successful introductions and therefore pre-introduction studies are justified (BERRYMAN 1967; RYAN 1987). Studying the parasitoid complex in detail provides information on those species that might be good colonizers, those that would operate at low or high population levels, those that were monophagous or polyphagous, those attacking early or late life stages, those that could adapt to some degree of inbreeding and could then withstand initial low number colonization, or prolonged laboratory rearing, and those that were cleptoparasitoids and then could be selected out (PSCHORN-WALCHER 1977).

A variety of approaches in biological control including importation, augmentation and conservation have been used. The major efforts have been in North America (Canada and the United States) and the classical approach of importation has been the most commonly used. Undoubtedly this is because the highest proportion of introduced forest pests occur in North America (PSCHORN-WALCHER 1977). The majority of insects are lepidopteran and hymenopteran defoliators (sawflies). Since these insects are relatively large hosts it may explain why 9 of the 15 tachinid flies established in biological control attempts were used in forests. It seems that Lepidoptera and Hymenoptera are more commonly pests in the less disturbed, contiguous forest regions. Also forests are not as intensively managed as agricultural ecosystems and it may explain why Homoptera, which are common subjects for biological control in agriculture, are not as common as forest pests.

Nevertheless, the HOKKANEN & PIMENTEL (1984) analysis concluded that success in biological control was about 75 % higher for the new associations. These conclusions were disputed by GOEDEN & KOK (1986) using biological control examples. They explain that the data used included cacti, which are not representative of target weeds, and that there were inaccuracies with some other examples. DAHLSTEN & WHITMORE (1987) analyzing the 286 examples of successful biological control used by HOKKANEN & PIMENTEL (1984) showed that there was a significant advantage for old associations in terms of complete versus intermediate versus partial success. The use of new associations as the preferred method for biological control is also contradicted by the analyses of HALL & EHLER (1979) and HALL et al. (1980), who found that the establishment rate of natural enemies was significantly higher for introduced pests, the complete success of importations against introduced pests was higher but not statistically significant and the general rate of success for introduced pests higher than for native pests. There appear to be some other misinterpretations in the data of HOKKANEN & PIMENTEL (1984) who used the reference by CLAUSEN (1978) for much of their information.

The effects of natural enemies can be enhanced by various manipulations of the organisms themselves or by alteration of their environment, such approaches being extremely promising for native pests. Although augmentation and conservation can be distinguished theoretically, it is difficult to distinguish them in practice (BERRYMAN, 1967; RABB et al. 1976). The two tactics were defined by DEBACH (1964) as to manipulation of natural enemies themselves (augmentation) or their habitat (conservation). Neither approach has been used extensively in forestry, most literature being from agriculture (DEBACH & HAGEN 1964; VAN DEN BOSCH & TELFORD 1964; STERN et al. 1976; RIDGWAY et al. 1977). Augmentation is either by periodic colonization or inoculation, development of adapted strains by artificial selection or inundation (DEBACH & HAGEN 1964). The tactic may involve either entomopathogens, parasitoids or predators.

Attempts have been made with inoculation of several parasitoids against forest pests in Europe and South America (TURNOCK et al. 1976). Inoculations were made of *Rhizophagus* against *D. micans* in Russia, France and Britain and of the nematode *Deladenus* against *S. notilio* in Australia. OTTO (1967) reviewed a number of the programs and concluded that good results were obtained primarily in pin forests against dipterous and lepidopterous larvae. Effective protection of coniferous forests using ants has been achieved against five lepidopterans and three sawfly pests in Germany, Switzerland, Italy, Russia, Poland and Czechoslovakia (TURNOCK et al. 1976).

The physical environment in forests may be changed to favor natural enemies. Parasitoids and predators can be benefited by encouraging specific plants for food, shelter and protection from their natural enemies (BUCKNER 1971; SAILER 1971).

It appears that disturbance in the forest caused displacement of many of the common wasps, while at the same time drawing in species not normally found there. Disturbance may increase the species diversity and overall numbers of braconid wasps, at least in the short run. This may be caused in part by the increased primary productivity of disturbed systems, which is usually greater than that of climax associations. Current theory suggests that the highest species diversities should be found in relatively undisturbed to moderately disturbed habitats (PETRAITIS et al. 1989; PETRICE et al. 2004). Some level of disturbance may act to increase species diversity, but if the disturbance is too severe or too frequent, species may be lost from the community. The levels of disturbance in these forest systems, at least at the local level, appears to be relatively extreme, especially in the pine-hardwood seed-tree treatment (LEWIS & WHIETFIELD 1999).

Other factors may be influencing the wasp community. First, the undisturbed areas may naturally have lower total wasp population densities that are more difficult to sample by Malaise trap. In undisturbed forests, braconid wasps and their natural host populations may be low in numbers but high in overall species diversity (HUFFAKER & MESSENGER 1964; LASALLE 1993). Wasps in undisturbed forests may also be more fully stratified vertically, and thus more difficult to completely sample by Malaise trap (LEWIS & WHIETFIELD 1999).

Second, in more disturbed treatments, open areas become covered with early succession flowering plants and weeds that attract pollinators and phytophagous insects. Some species of braconid wasps normally not common in these forests may be drawn to clearings by an exploitable temporary host population on successional plants. The flowering plants themselves are also attractive to many adult braconid wasps, and both males and females of a variety of species have been observed to visit flowers for nectar and (especially) pollen (SHAW & HUDDLESTON 1991; JERVIS et al. 1993).

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Zusammenfassung

Die Fauna der Braconiden (Raupenwespen; Hymenoptera: Ichneumonoidea: Braconidae) der Wälder des nördlichen Iran wird im gegenwärtigen Beitrag studiert. Es wurden insgesamt 29 Arten aus 20 Gattungen und 10 Subfamilien (nämlich Agathidinae, Alysiinae, Aphidiinae, Braconinae, Cheloninae, Euphorinae, Helconinae, Microgastrinae, Opiinae, Orgilinae) in den Wäldern gesammelt. Diese werden hier zusammen mit ihrer allgemeinen Verbreitung mitgeteilt.

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