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An Illustrated Key to the Subfamilies of Family Braconidae (Ichneumonoidea: Hymenoptera) from District Okara, Pakistan

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Abstract: To collect the parasitic fauna of Hymenoptera, from Okara district, Malaise traps and net sweepings were used. The specimens were identified up to subfamily level. This study yield eight subfamilies, i.e., Agathidinae, Alysiinae, Braconinae, Cardiochilinae, Doryctinae, Microgastrinae, Opiinae and Rogadinae of Braconidae from the area of study. Out of these, seven (except Microgastrinae) were new records from Pakistan. An illustrated key to the subfamilies is presented for easy future identifications. The economic importance of each subfamily was discussed briefly.

Key words: Systematics, parasitoids, Ichneumonoidea, braconidae

Introduction

Parasitic Hymenoptera are important as biological control agents of various agricultural pests and are thus responsible for substantial economic and environmental benefits. Ichneumonoidea is one of the largest assemblages within parasitica, of which, the members of family Braconidae are parasitoids of economically important insect-pests and have been heavily involved in many classical biological control programs. Most of the braconids are endoparasitoids, although a large number are ectoparasitoids as well. Being so specialized also gives braconids a potential as indicators of environmental richness and stability (Shaw and Huddleston, 1991).

Braconidae is the second largest family of Hymenoptera, with at least 40,000 species worldwide. The family is cosmopolitan in distribution. Illustrated keys have been published to the subfamilies of Braconidae mentioning variable number of subfamilies (Van Achterberg, 1976, 1990). Tobias *et al.* (1995) mentioned 20 subfamilies of Braconidae from the European part of the USSR and presented keys upto the species level to the fauna of the region. From Britain 25 subfamilies have been mentioned with brief discussion of taxonomic characters, biology and host association of each group (Shaw and Huddleston, 1991). Naumann *et al.* (1991) mentioned 24 subfamilies from Australia. However, more recently during the treatment of world hymenopterous fauna, a total of 29 subfamilies of Braconidae have been mentioned (Whal and Sharkey, 1993). Braconidae have also been subjected to rigorous phylogenetic analysis to determine relationships among the subfamilies. An attempt to present the phylogenetic analysis of the subfamilies of Braconidae included the morphological and biological characters of larvae and adults (Van Achterberg, 1984). Later on a more comprehensive work presented the phylogeny of the subfamilies of Braconidae which was based upon cladistic analysis (Quicke and Van Achterberg, 1990). Despite heavy criticism by phylogeneticists like Wharton *et al.* (1992), Quicke and Van Achterberg (1990) provides a basic skeleton of relationships among the braconid subfamilies.

The braconids are among one of well-explored groups of Hymenoptera, however, despite its great economic importance, the group has largely remained neglected taxonomically in Pakistan, except for only a few scattered efforts on microgastrine wasps (Anjum and Malik, 1978; Beg and Inayatullah, 1980; Mushtaque and Mohyuddin, 1987;

Shami and Mohyuddin, 1992).

As a first step towards exploring the braconid fauna from our agro-ecosystem, present project was initiated. This study represents classification of the family upto subfamily level, resulting in new records of several economically important subfamilies from this region. An illustrated key to the subfamilies is presented and economic importances of each subfamily is discussed briefly.

Materials and Methods

The Okara district of Punjab consists of fertile agricultural lands where major crops like cotton, sugarcane, rice, wheat and maize etc. are grown over a considerable area. Owing to this diversity, the district was selected to document braconid parasitoid fauna from its agro-ecosystem and repeated collections were made from ten selected localities of the area during 1998-99.

Adult braconids were collected in 70% alcohol by using hand net and Malaise traps. In laboratory these specimens were cleared in a dilute (5 to 10%) pure soap solution, soaked and rinsed in water and dehydrated in ascending alcohol series. Specimens from absolute alcohol were then air dried and mounted on card points with water-based secotone glue. These specimens were identified by using Wild M3B binocular microscope (10X × 6.4X, 10X × 16X, 10X × 40X) upto subfamily level. Line drawings were prepared to illustrate the key to subfamilies.

Results

This study reveals eight economically important subfamilies of Braconidae, out of which, seven (except Microgastrinae) have been recorded for the first time from Pakistan. Presence of such a large number of specimens (about 200), from only a single district clearly indicate the richness of parasitoid fauna in our agro-ecosystem. If properly documented, preserved and encouraged, these parasitoids can play an important role in the biological control of vital pests like lepidopterous borers of crops such as, cotton, sugarcane, rice, maize, as well as, fruit-trees and vegetables.

Key to the subfamilies of family Braconidae:

- 1 Mandibles exodont, not touching each other when closed, with three or more teeth (Fig. 1). Alysiinae
- Mandibles endodont, overlapping each other when closed, with one or two teeth (Fig. 2) 2

2. Hypoclypeal depression wide and deep (Fig. 2); clypeus strongly concave3
- Hypoclypeal depression absent (Fig. 3); clypeus straight to convex5
3. Occipital carina absent, hindwing with vein M + Cu much less than half as long as vein M (Fig. 9)Braconinae
- Occipital carina complete (Fig. 4); hindwing with vein M + Cu more than half as long as vein M (Fig. 10)4
4. Fore tibia with longitudinal row of spines on inner surface (Fig. 7); hind coxa with small antero-lateral process (Fig. 8); forewing with only two submarginal cells (Fig. 11)Doryctinae
- Fore tibia wallow spines, hind coxa without ankli(J lateral process; forewing always with these submarginal cells (Fig. 12)Rogadinae
5. Spiracles of T₁ on light coloured membranous area and not on sclerotized notum (Fig. 5); forewing M + Cu entirely sclerotized6
- Spiracles of T₁ in or near margins of strongly sclerotized notum (Fig. 6); basal half of forewing M + Cu unsclerotized7
6. Antenna with 16 flagellomeres,Microgasreinae
7. Forewing marginal cell greatly narrow; 2 Cu-a of forewing absent (Fig. 13)Agathidinae
- Forewing marginal cell much wider; 2Cu-a of forewing present (Fig. 14)Opiinae

Economic importance of the subfamilies of braconidae

Agathidinae

Material examined: 1♀, Satgarha, 20-vii-99, M. Illyas.

Economic importance: Whal and Sharkey (1993) have discussed the biology of subfamily. The group is cosmopolitan in distribution. Most of members are solitary parasitoids of important lepidopterous pests of our crops and fruit trees such as, pink bollworm of cotton and citrus leaf minor etc.

Alysiinae

Material examined: 1♂, Satgarha, 20-vii-99, M. Illyas; 1♂, Gogera, 24-vi-99, M. Illyas; 1♂, Renala Khurd, 1-vii-99, M. Illyas; 1♀, Renala Khurd, 1-vii-99, M. Illyas.

Economic importance: The biology of this subfamily has been discussed by Shaw and Huddleston (1991). This is a cosmopolitan subfamily. Members of the subfamily are larval parasitoids of the dipterous flies feeding in animal dung, rotting vegetable matter and different fungi, as well as, the dipterous leaf miners of Agromyzidae.

Braconinae

Material examined: 2♀, 7-1/R, 28-vi-99, M. Illyas; 2♀, Satgarha, 1 5-vi-99, M. Illyas; 1♀, Atari, 7-vii-99, M. Illyas; 3♀, Jandraka, 30-vii-99, M. Illyas; 7♀, Gaimber, 15-vii-99, M. Illyas; 2♀, Basirpur, 18-vi-99, M. Illyas; 1♀, Gogera, 21vi-99, M. Illyas; 1♀, Chuchak, 24-vii-99, M. Illyas; 4♀, Shergarh, 15-vi-99, M. Illyas; 1♀, Gogera, 21-vi-99, M. Illyas; 2♀, Chuchak, 24-vii-99, M. Illyas; 2♂, 7-1/R, 28-vi99, M. Illyas; 1♂, Jandraka, 30-vii-99, M. Illyas; 3♂, Gaimber, 15-vii-99, M. Illyas; 1♂, Renala Khurd, 1-vii-99, M. Illyas; 2♂, Atari, 7-vii-99, M. Illyas; 1♂, Satgarha, 20-vii-

99, M. Illyas; 1♀, Chuchak, 24-vii-99, M. Illyas; 1♀, Satgarha, 20-vii-99, M. Illyas; 1♀, Gogera, 21-vi-99, M. Illyas; 1♂, Basirpur, 18-vi-99, M. Illyas; 1♀, Chuchak, 24vii-99, M. Illyas; 1♀, Gogera, 21-vi-99, M. Illyas; 1♀, 711R, 28-vi-99, M. Illyas; 1♀, Basirpur, 18-vi-99, M. Illyas; Shergarh, 15-vi-99, M. Illyas; 1♂, Gaimber, 15-vii-99, M. Illyas; 1♂, Gogera, 21-vi-99, M. Illyas; 1♂, Atari, 7-vii99, M. Illyas; 1♂, Atari, 7-vii-99, M. Illyas; 1♂, Satgarha, 20-vii-99, M. Illyas; 1♂, Atari, 7-vii-99, M. Illyas; 1♀, Jandraka, 30-vii-99, M. Illyas; 1♀, Gogera, 21-vi-99, M. Illyas; 1♀, 7-1/R, 28-vi-99, M. Illyas; 1♀, Renala Khurd, 1vii-99, M. Illyas; 1♀, Gogera, 26-vi-99, M. Illyas; 1♂, 7-1/R, 28-vi-99, M. Illyas; 1♂, Gogera, 21-vi-99, M. Illyas; 2♂, Renala Khurd, 1-vii-99, M. Illyas; 1♂, Jandraka, 30-vii-99, M. Illyas; 4♂, Satgarha, 20-vii-99, M. Illyas; 1♂, Chuchak, 24-vii-99, M. Illyas; 1♂, Atari, 7-vii-99, M. Illyas; 1♀, Jandraka, 30-vii-99, M. Illyas; 2♂, 7-1/R, 28-vi-99, M. Illyas; 2♂, Satgarha, 20-vii-99, M. Illyas; 2♂, Chuchak, 24vii-99, M. Illyas; 1♂, Gaimber, 15-vii-99, M. Illyas; 2♂, Atari, 7-vii-99, M. Illyas; 1♀, Chuchak, 24-vii-99, M. Illyas; 1♀, Satgarha, 15-vi-99, M. Illyas; 19, 7-1/R, 28-vi-99, M. Illyas; 1♀, Satgarha, 20-vii-99, M. Illyas; 2♂, Satgarha, 20vii-99, M. Illyas; 1♂, Chuchak, 24-vii-99, M. Illyas; 1♂, Gogera, 21-vi-99, M. Illyas.

Economic importance: The members of this subfamily are distributed worldwide. This is most abundant and commonly met subfamily of braconids in our agroecosystem, i.e., about 45% of the total collection of braconids consist of braconines. These are highly important parasitoids, as they parasitize the larvae and pupae of destructive pests like, the coleopterous larvae feeding on roots, foliage and fruits of forest trees, wood-boring lepidopterous larvae, coccids and pyrrillids.

Cardiophilinae

Material examined: 1♀, Renala Khurd, 1-vii-99, M. Illyas; 39, Jandraka, 30-vii-99, M. Illyas; 1♀, Satgarha, 20-vii-99, M. Illyas; 1♂, Gogera, 24-vi-99, M. Illyas; 1♂, Renala Khurd, 1-vii-99, M. Illyas.

Economic importance: This subfamily is cosmopolitan in distribution, however, its members are more likely to occur in tropical or arid climates (Dangerfield and Austin, 1995). Almost all cardiophilines are endoparasitic. They are highly important in any agro-ecosystem because they feed upon pests belonging to lepidopterous families Pyralidae and Noctuidae (Huddleston and Walker, 1988). Cardiophilines are important in biological control programs as they have been recorded from destructive pests like *Heliothis* and *Helicoverpa* species (Dangerfield and Austin, 1995).

Doryctinae

Material examined: 1♀, 7-1/R, 28-vi-99, M. Illyas; 1♀, Gaimber, 15-vii-99, M. Illyas; 1♀, Renala Khurd, 1-vii-99, M. Illyas.

Economic importance: Small Doryctinae wasps are cosmopolitan in distribution. This is the third representative subfamily of the cyclostome assemblage of Braconidae (Braconinae and Rogadinae are the other two). Members of this subfamily are economically very important as they parasitize the larvae of one of the most important pest families of Lepidoptera, i.e., Pyralidae. They are also parasitoids of wood boring Coleopterous larvae, as well as adult earwigs.

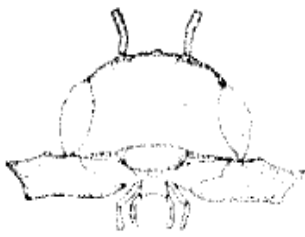


Fig. 1

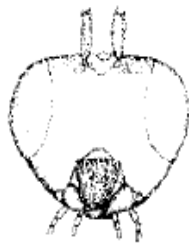


Fig. 2

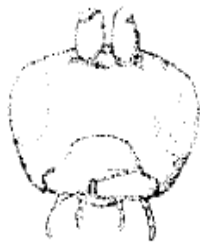


Fig. 3



Fig. 4

Fig. 1-4

- 1: Alysiniinae, frontal view of head showing exociont and mandibles
- 2: Braconinae, frontal view of head showing endociont and a deep hypoclypeal depression
- 3: Microgasterinae, frontal view of head showing absence of hypoclypeal depression
- 4: Flogadinae, lateral view of head showing complete occipital carina



Fig. 5



Fig. 6



Fig. 7



Fig. 8

Fig. 5-8

- 5: Cardiachilinae, spiracles of T on lateral membranous area
- 6: Agathidinae, spiracles of T on margins of strongly sclerotized notum
- 7: Doryctinae, foretibia showing longitudinal row of spines
- 8: Doryctinae, hindcoxa with antero-lateral process



Fig. 9

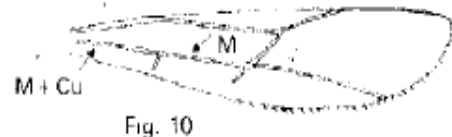


Fig. 10



Fig. 11

Fig. 9-11

- 9: Bracominae, hindwing showing vein M + Cu less than half of vein M
- 10: Rogadinae, hindwing showing vein M + Cu + more than half of vein M
- 11: Doryctinae, forewing showing presence of only 2 submarginal cells

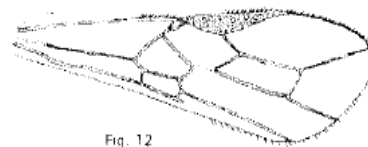


Fig. 12



Fig. 13

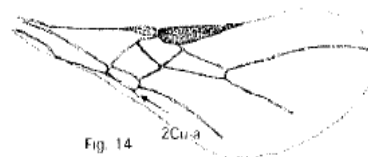


Fig. 14

Fig. 12-14

- 12: Rogaeinae, forewing showing presence of three submarginal cells
- 13: Agathidinae, forewing showing narrow marginal cell and absence of 2Cu-a
- 14: Opiinae, forewing showing wide marginal cell and presence of 2Cu-a

Microgastrinae

Material examined: 8♂, Shergarh, 15-vi-99, M. Illyas; 3♂, Gaenber, 15-vi-99, M. Illyas; 3♂, Jandraka, 30-vii-99, M. Illyas; 4♂, Renala Khurd, 1-vii-99, M. Illyas; 1♂, Gogera, 21 vi 99, M. Illyas; 3♂, Chuchak, 24-vi-99, M. Illyas; 7♂, Atari, 7-vii-99, M. Illyas; 7♂, Basirpur, 18-vi-99, M. Illyas; 8♂, 7-1/R, 28-vi-99, M. Illyas; 3♂, Gogera, 24-vi-99, M. Illyas; 1♂, Satgarha, 20-vii-99, M. Illyas; 1♀, Renala Khurd, 1-vii-99, M. Illyas; 4♀, Chuchak, 24-vii-99, M. Illyas; 1♀, Gogera, 21-vi-99, M. Illyas; 2♀, Shergarh, 15-vi-99, M. Illyas; 2♀, Gaimber, 15-vi-99, M. Illyas; 2♀, Atari, 7-vii-99, M. Illyas; 1♀, Jandraka, 30-vii-99, M. Illyas.

Economic importance: This is the second most abundant and most commonly met subfamily of Braconidae after Braconinae with about 1400 described species. About 3540% of the total collection of braconids from our agroecosystem consists of microgastrines. Microgastrines are distributed worldwide. They enjoy the status of most important single group of parasitoids against highly injurious lepidopterous pests. They attack macrolepidopterous, as well as, microlepidopterous pests and more than 100 species of this group have been used in biological control programs (Whitfield, 1995). Microgastrines are larval parasitoids of pests like cabbage moth, potato moth, budworms, armyworms, cutworms, cotton bollworms, maize and rice borers and leaf-miners etc.

Opiinae

Material examined: 2♀, Satgarha, 20-vii-99, M. Illyas.

Economic importance: This is a large subfamily of Braconidae with about 1300 described species, which have cosmopolitan distribution. The wasps belonging to Opiinae are important as parasitoids of dipterous fruit flies and leaf minors (Shaw and Huddleston, 1991).

Rogadinae

Material examined: 1♀, Satgarha, 20-vii-99, M. Illyas; 1♀, Jandraka, 30-vii-99, M. Illyas; 1♀, Basirpur, 18-vi-99, M. Illyas; 1♀, Jandraka, 30-vii-99, M. Illyas; 1♀, Renala Khurd, 1-vii-99, M. Illyas.

Economic importance: The group is fairly large in size with about 800 described species and is distributed around the world. Members of this subfamily are parasitoids of a wide range of hosts and feed on lepidopterous, dipterous, coleopterous and hymenopterous insects. Some have been found to be associated even with the termite nests.

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