Introduction to the Mymaridae (Hymenoptera) of Bangladesh

John T. Huber¹, Nurul Islam²

¹ Natural Resources Canada c/o AAFC, 960 Carling Ave., Ottawa, ON, K1A 0C6, Canada ² Forest Entomology Laboratory, Faculty of Forestry, University of Toronto, Toronto, ON, M5S 3B3, CANADA

Corresponding author: John T. Huber (john.huber@agr.gc.ca)

Academic editor: M. Ohl  |  Received 14 March 2017  |  Accepted 12 May 2017  |  Published 22 May 2017

http://zoobank.org/F222D77B-9E8D-4316-B3DD-706DA8D6DC41

Citation: Huber JT, Islam N (2017) Introduction to the Mymaridae (Hymenoptera) of Bangladesh. ZooKeys 675: 75–96. https://doi.org/10.3897/zookeys.675.12713

Abstract
An identification key to the 15 genera of Mymaridae found so far in Bangladesh is given, based on about 520 specimens collected using yellow pan traps placed in agricultural habitats and at the edge of ponds, mainly at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur. Species already reported from Bangladesh are listed and three more are added: Acmopolynema orientale (Narayanan, Subba Rao & Kaur), Himopolynema hishimonus Taguchi, and Mymar pulchellum Curtis.

Keywords
Mymaridae, Bangladesh, identification key, list of genera

Introduction
Ten named species of Mymaridae (Hymenoptera), representing four genera, have been recorded from Bangladesh:

Anagrus flaveolus Waterhouse (Kamal et al. 1993, Sahad and Hirashima 1984), almost certainly a misidentification of A. nilaparvatae Pang & Wang (Triapitsyn 2014); Anagrus incarnatus Haliday (Sahad and Hirashima 1984, Gurr et al. 2011), this is likely a misidentification of A. nilaparvatae (Chiappini 2002: 236);
A. nilaparvatae (Triapitsyn and Berezovskiy 2004, Triapitsyn 2015); A. optabilis (Perkins) (Kamal et al. 1993, Sahad and Hirashima 1984, Trjapitzin 1996); A. perforator (Perkins) (Sahad and Hirashima 1984); Lymaenon uttardeccanus [sic] (Mani & Saraswat) (Sahad and Hirashima 1984) but considered likely to be a misidentification of Gonatocerus longicornis Nees by Zeya and Hayat (1995); L. devitatakus (Mani & Saraswat) (Sahad and Hirashima 1984) but considered likely to be a misidentification of L. pahlgamensis Narayanan by Zeya and Hayat (1995) and this, in turn, synonymized under L. aureus (Girault) by Triapitsyn (2013); L. narayani Subba Rao & Kaur (Sahad and Hirashima 1984); L. munnarus (Mani & Saraswat) (Sahad and Hirashima 1984); Palaeoneura bagicha (Narayanan, Subba Rao & Kaur) (Bhuiya et al. 1997).

In Bangladesh, Kamal et al. (1993) reared A. nilaparvatae (as “flaveolus”) and A. optabilis from the important rice pest Nilaparvata lugens (Stål) (Hemiptera: Delphacidae). Catling and Islam (2013) reported Anagrus sp. and Gonatocerus sp. from rice fields. No definite statements about deposition of voucher depositories are given for most of the previously recorded specimens. Gapud (1992) mentioned that there were no decent reference collections of insect pests and their natural enemies in any institution in Bangladesh. His list of 11 species of Mymaridae were all from Indian records. However, voucher specimens of at least one of the species (P. bagicha) mentioned in the literature above may be in the Department of Zoology, University of Chittagong, Chittagong and the specimens (probably in Oudeman’s fluid) collected by Kamal et al. (1993) are likely in the Bangladesh Rice Research Institute, Gazipur.

We present an identification key to the genera and illustrate the head, antennae, and wings of females of 13 of them (females of Dicopus and Cosmocomoidea not yet collected).

Methods

Yellow pan traps three-quarters filled with water and a few drops of liquid detergent to break the surface tension were placed in small plot experimental fields and at the edge of ponds during June and August, 2007 at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur and, for the pond traps, at Kalni Village, Gazipur. A few specimens were also collected in December, 2008, and January, 2009. The plots were planted with lady’s finger [okra]—Abelmoschus esculentus (L.) Moench (Malvaceae), brinjal [eggplant]—Solanum melongena L. (Solanaceae), white gourd—Benincasa hispida Cogn. (Cucurbitaceae), amaranthus—Amaranthus tricolor L. (Amaranthaceae), long bean—Vigna unguiculata (L.) Walp subsp. sesquipedalis (Fabaceae), and hyacinth bean—Lablab purpureus L. subsp. bengalensis (Fabaceae). Trap catches were washed and preserved in 70% ethanol. All Mymaridae were later extracted from
the ethanol, critical-point dried, and mounted on cards. Representative specimens of all but two of the genera were slide mounted in Canada balsam, using the method described in Huber (2015). Photographs of the head, antenna, and wings were taken with a ProgRes C14plus digital camera attached to a Nikon Eclipse E800 compound microscope, and a selection of the resulting layers combined electronically and edited in Zerene Stacker™. Specimens are deposited in the Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario, Canada, and the University of Rajshahi, Motihar, Rajshahi, Bangladesh. Abbreviations used in the key are: fl$_x$ for funicle segment, and mps for multiporous plate sensilla.

**Results**

The breakdown of the $\approx$ 520 card- and slide-mounted specimens is approximately as follows (some specimens of the two most commonly collected genera, *Anagrus* and *Lymaenon*, were kept in gelatin capsules): *Acmopolynema* 2, *Anagrus* (*Anagrus*) + *Anagrus* (*Paranagrus*) 160, *Anaphes* 62, *Camptoptera* 6, *Cosmocomoidea* 1, *Dicopus* 2, *Erythmelus* 2, *Gonatocerus* 53, *Himopolynema* 6, *Lymaenon* 140, *Mymar* 27, *Palaeoneura* 3, *Polynema* (*Polynema*) + *P.* (*Dorypolynema*) 26, *Ptilomymar* 2, *Stethynium* 26. Two genera, *Cosmocomoidea* and *Dicopus*, are represented by one or two males only so are not included in the key.

**Key to genera. Females.**

(Arrows on figures indicate many of the key features to be observed)

1 Fore wing without membrane for over half its length, then widening suddenly into an oval membranous area with its apical half dark brown (Fig. 24); hind wing a short stalk without membrane (Figs 24, 25); face with toruli abutting transverse trabecula (Fig. 22); antenna with extremely long scape constricted medially and fl$_2$ extremely long, about half the length of the funicle (Fig. 23) .......................................................................................... *Mymar* Curtis

- Fore wing with membrane for all of its length, variously shaped and not in-fuscated with brown as above; face with toruli separated by at least one torular diameter from transverse trabecula; antenna not as above, the scape not as long and not constricted medially and fl$_2$ not much different in length from remaining funicle segments.................................................................2

2(1) Funicle 8-segmented (Figs 15, 19, 20), though fl$_1$ may be very short and inconspicuous (Fig. 31) ..............................................................................................................................................3

- Funicle with 7 or fewer (almost always 6) segments, if with 7 segments fl$_1$ often minute, ringlike (Fig. 9) ........................................................................................................................................6
3(2) Face with a distinct subantennal groove extending from each torulus to mouth margin (Fig. 13); toruli separated by at least half a torular diameter from transverse trabecula (Figs 13, 19); hind wing relatively wide, the distance between anterior and posterior margins at most about the length of a setae on the wing membrane (Figs 16, 21)

− Face without subantennal grooves; toruli abutting transverse trabecula (Fig. 30); hind wing extremely narrow, the distance between anterior and posterior margins at most about the length of a setae on the wing membrane (Fig. 32)

.................................................................4

4(3) Fore wing bare or almost so behind venation; subantennal grooves almost in contact with each other but if not then with distance between them at junction with mouth margin much less than half the distance from a groove to preorbital groove at lateral margin of face ..........Cosmocomoidea Howard

− Fore wing with at least one row of microtrichia, but usually with numerous scattered microtrichia behind venation; subantennal grooves with distance between them at junction with mouth margin at least half distance from a groove to preorbital groove at lateral margin of face ........................................5

5(4) Antenna with \(f_2\) and \(f_3\) longer than either \(f_1\) or \(f_4\) (Fig. 15); stigmal vein with apex oblique (Fig. 16); face with distance between antennal grooves less than distance between subantennal groove and preorbital groove (Fig. 13); ocellar triangle with 2 setae between posterior ocelli (Fig. 14) ..... Gonatocerus Nees

− Antenna with \(f_2\) subequal to either \(f_1\) or \(f_4\) (Figs 19, 20); stigmal vein with apex truncate (Fig. 21); face with distance between antennal grooves equal to or greater than distance between subantennal groove and preorbital groove (Fig. 19); ocellar triangle with 3 setae ............Lymaenon Walker

6(2) Funicle 7-segmented (apparently 6-segmented in one genus because \(f_2\) often ringlike [Fig. 9]) ............................................7

− Funicle 6-segmented ................................................................................8

7(6) Head in anterior view quite wide ventrally, the genae only slightly converging; mandibles directed medially, their apices crossing each other, the head not appearing beaklike; antenna with \(f_2\) ringlike (Fig. 9); fore wing evenly wide along its length distal to venation and distinctly curved near apex (Fig. 10); gaster separated from propodeum by a distinctly narrow petiole, the mesosphragma thus not extending posteriorly into gaster...... Camptoptera Förster

− Head in anterior view quite narrow ventrally, the genae strongly converging; mandibles directed ventrally and narrowing apically, their apices usually not crossing each other and giving head a beak-like appearance; antenna with \(f_2\) about as long as preceding and following segments; fore wing much narrower medially along much of its length distal to venation then distinctly widening near apex; gaster widely joined to propodeum by a wide petiole barely distinguishable from propodeum or gaster, so mesosphragma projecting posteriorly well into gaster........................................... Dicopus Enock
Introduction to the Mymaridae (Hymenoptera) of Bangladesh

8(6) Metasoma with petiole wide, inconspicuous, not longer than wide............9
– Metasoma with petiole narrow, conspicuous, and clearly longer than wide....12

9(8) Face with distinct subantennal groove extending from each torulus to mouth margin (Fig. 33); antenna with clava 3-segmented (Fig. 33); fore wing with distinct lobe posterior to and just distal to apex of stigmal vein (Fig. 34) .......

.................................................................Stethynium Enock
– Face without subantennal grooves; antenna with clava 1-segmented (Figs 4, 11) or 2 segmented (Fig. 7); fore wing usually without or with only a slight lobe (Figs 5, 8), rarely with a more distinct lobe posterior to and just distal to apex of stigmal vein (Fig. 27) ..............................................................................10

10(9) Mandibles fully developed and crossing each other when closed, with 3 teeth; head in lateral view with eye clearly separated from back of head by distinct gena.................................................................11
– Mandibles greatly reduced to minute stubs without teeth, and maxilla elongate; head in lateral view with eye in contact with back of head, the gena almost entirely absent; fore wing membrane rather sparsely and unevenly covered with microtrichia concentrated mainly in apical half of wing beyond venation apex (Fig. 12) ..................................................Erythmelus Enock

11(10) Vertex with ocellar triangle surrounded by a stemmaticum (seen as white lines) (Fig. 4); clava in lateral view usually asymmetrical, with its dorsal margin strongly curved and ventral margin straight (Fig. 4); fore wing narrow, without marginal and medial spaces and without socketed seta at apex of retinaculum .......A. (Anagrus Haliday) and Anagrus (Paranagrus Perkins)
– Vertex with ocellar triangle not surrounded by a stemmaticum; clava in lateral view symmetrical, with both dorsal and ventral margins equally curved (Figs 6, 7); fore wing with marginal and medial spaces and with a socketed seta at apex of retinaculum (Fig. 8) ..................................Anaphes Haliday

12(8) Propodeum medially either with a single carina, at least near posterior margin, or apparently without carinae.................................................................13
– Propodeum medially with two submedian carinae, either forming a V or closely parallel posteriorly then diverging near dorsellum to form a Y, or bulging medially to form an oval .................................................................14

13(12) Fore wing with posterior margin behind venation not or scarcely lobed (Fig. 29) ................. P. (Polynema Haliday) and Polynema (Dorypolynema Subba Rao)
– Fore wing with posterior margin behind venation distinctly lobed (Fig. 27)...

.................................................Palaeoneura Waterhouse

14(12) Face with a small pit medial to each torulus (Fig. 17); antenna usually with funicle segments short (Fig. 17); fore wing without thickened setae ..............

......................................................Himopolynema Taguchi
– Face without pits between toruli (Fig. 1); antenna usually with funicle segments, especially fl₂ longer (Fig. 2); fore wing with at least a few, thickened blunt microtrichia mainly on the dark areas (Fig. 3)...............Acmopolynema Ogloblin
Figures 1–3. Acmopolynema orientale, female 1 head, anterior 2 antenna 3 wings. Scale bars for 1, 2 = 200 μm, 3 = 500 μm.
Introduction to the Mymaridae (Hymenoptera) of Bangladesh

Figures 4, 5. *Anagrus (Anagrus)* sp., female 4 head, anterior + antenna (inset is upper face and vertex) 5 wings. Scale bars = 200 μm.
Figures 6–8. *Anaphes* sp., female 6 head, anterior + antenna 7 antenna 8 wings. Scale bars = 200 µm.
Figures 9, 10. *Camptoptera* sp., female 9 head, anterior + antennae 10 wings. Scale bars = 100 μm.
Figures 11, 12. *Erythmelus* sp., female 11 head, anterior + antennae 12 wings. Scale bars = 100 μm.
Introduction to the Mymaridae (Hymenoptera) of Bangladesh

Figures 13–16. *Gonatocerus* sp., female 13 head, anterior 14 head, posterior 15 antenna 16 wings. Scale bars = 100 μm.
Figures 17, 18. *Himopolynema hishimonus*, female 17 head, anterior + antennae 18 wings. Scale bars = 100 μm.
Figures 19–21. *Lymaenon* sp., female 19 head, anterior + antenna 20 antenna 21 wings. Scale bars = 200 μm.
Figures 22–25. *Mymar pulchellum*, female 22 head, anterior 23 antenna 24 wings 25 hind wing. Scale bars = 100 μm.
Introduction to the Mymaridae (Hymenoptera) of Bangladesh

Figures 26, 27. *Palaeoneura bagicha*, female 26 head, anterior + antenna 27 wings. Scale bars = 200 μm.
Figures 28, 29. *Polynema* sp., female 28 head, anterior + antenna 29 wings. Scale bars = 200 μm.
Figures 30–32. *Ptilomymar* sp., female 30 head, anterior 31 antenna (inset is clava, ventral) 32 wings. Scale bars = 100 μm.
Figures 33, 34. *Stethynium* sp., female 33 head, anterior + antennae 34 wings. Scale bars = 200 μm.
Introduction to the Mymaridae (Hymenoptera) of Bangladesh

Biology

Published host records exist for at least one species in most of the genera keyed above (Huber 1986). Cicadellidae and related families of Auchenorrhyncha (Hemiptera) are hosts for ten genera: Acmopolynema, Anagrus (Anagrus) + Anagrus (Paranagrus), Cosmocomoidea, Gonatocerus, Himopolynema, Lymaenon, Mymar, Palaeoneura, Polynema (Polynema) and Stethynium (Triapitsyn 2002). The remainder parasitize a variety of hosts. The principal host families only are listed here: Anaphes on Chrysomelidae and Curculionidae, Erythmelus on Tingidae and Miridae. Camptoptera and Dicopus have few or no published host records; they appear to parasitize Coleoptera and Psocoptera, respectively. Hosts are unknown for Ptilomymar which is closely associated with water and almost certainly parasitizes eggs of aquatic insects of some kind.

The various genera were collected in the following crops or habitats (not all specimens had associated plant names):

Amaranthus—Amaranthus tricolor. 5 genera: Anagrus, Anaphes, Himopolynema, Gonatocerus, Mymar.

Brinjal—Solanum melongena. 5 genera: Anagrus, Anaphes, Lymaenon, Mymar, Stethynium.

Lady’s finger—Abelmoschus esculentus. 6 genera: Anagrus, Anaphes, Mymar, Palaeoneura, Polynema, Stethynium.

Hyacinth bean/broad bean—Lablab niger. 6 genera: Anagrus, Anaphes, Himopolynema, Lymaenon, Mymar, Polynema.

Long bean—Vigna unguiculata. 4 genera: Anagrus, Cosmocomoidea, Lymaenon, Palaeoneura.

White gourd—Benincasa hispida. 6 genera: Anagrus, Anaphes, Lymaenon, Mymar, Polynema, Stethynium.

Pond (or near). 10 genera: Anagrus, Anaphes, Camptoptera, Erythmelus, Gonatocerus, Himopolynema, Lymaenon, Mymar, Palaeoneura, Polynema.

Ditch. 6 genera: Acmopolynema, Anagrus, Camptoptera, Dicopus, Ptilomymar, Polynema.

Species and new specimen records

Acronymena orientale (Narayanan, Subba Rao & Kaur). BANGLADESH. Rajshahi: Serajganj, Krishnodia, 1.iii.2011, N. Islam, pan trap (1 female, CNC).

Anagrus optabilis. BANGLADESH. Dhaka: Joydebpur, 14.xii.2011, N. Islam, pan trap (2 females, CNC); BSMR Agricultural University, 19.vi-2006–ii.2007, N. Islam, near pond (1 female, CNC).

Himopolynema hishimonus Taguchi. BANGLADESH. Dhaka: Joydebpur, 14.xii.2011, N. Islam, pan trap (1 female, CNC); Salna, BSMR Agricultural University, 18.vi-1.vii and 2–15.vii.2007, pan trap in Amaranthus field and hyacinth/broad bean field, N. Islam (5 females, CNC).

Mymar pulchellum Curtis. BANGLADESH. Dhaka: Salna, BSMR Agricultural University, 5–25.xii.2011, N. Islam, near pond (1 female, CNC).
Palaeoneura bagicha (Narayanan, Subba Rao & Kaur). BANGLADESH. Dhaka: Kalni, 2–5.vii.2007, N. Islam, pan trap in lady’s finger field (1 female, CNC).

Discussion

Features useful for generic identification of most Mymaridae occur on the head, female antenna, and wings of specimens. Careful study of these structures requires well-mounted specimens on slides and/or good photographs. When these are available most specimens from a given country may be identified correctly to genus on this basis alone, often without having to examine other body parts. The generic identification key was carefully and deliberately constructed to demonstrate this. Features of the antenna and wings are also relatively easy to study on card- or point-mounted specimens. Only a few features of the mesosoma and metasoma were added, where necessary. However, additional features are certainly also useful and are needed when the fauna of an entire region is treated. Those additional features are, of course, widely used in all generic keys to Mymaridae, e.g., Ramesh Kumar et al. (2013) and are essential to define a genus properly.

At the generic level the almost unknown fauna of Mymaridae of Bangladesh, with 15 genera recorded here, is about 40% of the much better studied fauna of India. Ramesh Kumar et al. (2013) recorded about 140 species classified into 31 genera. Since then, Huber (2015) reclassified the species groups of Gonatocerus into separate genera and other genera (new to India, not yet recorded from Bangladesh) have been recorded (e.g., Triapitsyn 2014), bringing the number of Indian genera to almost 40. Many of the genera found in India almost certainly occur also in Bangladesh, as further collecting will undoubtedly reveal. The number of species in Bangladesh will be fewer than in India simply because it does not have the variety of ecosystems and elevational range of its far larger neighbour. At the species level, much more work would be needed to sort out and identify correctly the specimens collected in our study. This can only be done meaningfully in the context of more regional studies that include not only India but preferable the entire Oriental region and Palaearctic areas of eastern Asia.

The greatest number of genera collected was at pond edges. This is perhaps not surprising because it is a much more natural habitat, presumably with many more plant species and potential insect hosts (both terrestrial and aquatic) than experimental field plots planted with a single crop.

Acknowledgements

Professors Dr. Mofazzal Hossain and Dr. Mizanur Rahman, Department of Horticulture (BSMRAU), are thanked for allowing the junior author to set yellow pan traps for collecting parasitic Hymenoptera in their experimental plots. We thank J. Read (CNC) for preparing the excellent images and compiling the plates.
References

Bhuiya BA (Ed.) (1999) An annotated catalogue of parasitic Hymenoptera from Bangladesh. Green Leaf Publishers, London.

Bhuiya BA, Chowdhury SH, Kabir SMH (1997) An annotated list of chalcidoid parasitoids (Hymenoptera) of Coccoidea (Homoptera) on guava in Bangladesh. Bangladesh Journal of Zoology 25(1): 53–63.

Catling D, Islam Z (2013) Diversity and seasonal fluctuations of arthropod fauna in Bangladesh deepwater rice. Bangladesh Rice Journal 17(1&2): 75–104.

Chiappini E (2002) Anagrus elegans (Hymenoptera, Mymaridae), a new egg parasitoid of the rice-feeding planthoppers (Homoptera, Delphacidae) in the Orient. Bollettino di Zoologia Agraria e di Bachicoltura, Serie II, 34(2): 235–241.

Gapud VP (1992) Insect and mite pests of plant crops in Bangladesh and their enemies: a compendium. United States Agency for International Development/Bangladesh Agricultural Research Council/ CHECCI and Co. Consulting Inc., 265 pp.

Gurr GM, Liu J, Read DMY, Catindig JLA, Cheng JA, Lan LP, Heong KL (2011) Parasitoids of Asian rice planthopper (Hemiptera: Delphacidae) pests and prospects for enhancing biological control by ecological engineering. Annals of Applied Biology 158: 149–176. https://doi.org/10.1111/j.1744-7348.2010.00455.x

Huber JT (1986) Systematics, biology, and hosts of the Mymaridae and Mymarommatidae (Insecta: Hymenoptera): 1758–1984. Entomography: An Annual Review for Biosystematics 4: 185–243.

Huber JT (2015) World reclassification of the Gonatocerus group of genera (Hymenoptera: Mymaridae). Zootaxa 3967: 1–184. https://doi.org/10.11646/zootaxa.3967.1.1

Kamal NQ, Karim ANMR, Alam S (1993) A supplement list of rice insect pests and their parasitoids in Bangladesh. Bangladesh Journal of Entomology 3(1&2): 67–71.

Ramesh Kumar A, Manickavasagam S, Poorani J, Malathi C (2013) Indian genera of Mymaridae. World Wide Web electronic publication. ICAR-National Bureau of Agricultural Insect Resources, Bangalore, India. http://www.nbair.res.in/IndianMymaridae/index.php

Sahad KA, Hirashima Y (1984) Taxonomic studies on the genera Gonatocerus Nees and Anagrus Haliday of Japan and adjacent regions, with notes on their biology (Hymenoptera, Mymaridae). Bulletin of the Institute of Tropical Agriculture, Kyushu University 7: 1–78.

Triapitsyn SV (2002) Species-level taxonomy of Mymaridae (Hymenoptera): current status and implications for biological control of leafhoppers of economic importance. In: Melika G, Thuróczy C (Eds) Parasitic wasps. Evolution, systematics, biodiversity and biological control (International symposium, 14–17 May 2001, Kőszeg, Hungary). Agroinform, Kiadó & Nyomba Kft., Budapest, 480 pp.

Triapitsyn SV (2013) Review of Gonatocerus (Hymenoptera: Mymaridae) in the Palearctic region, with notes on extralimital distributions. Zootaxa 3644, 1–178. https://doi.org/10.11646/zootaxa.3644.1.1

Triapitsyn SV (2014) [2013] Notes and corrections on some records of Mymaridae (Hymenoptera: Chalcidoidea) from India. Biosystematica 7(2): 39–41.
Triapitsyn SV (2015) Taxonomy of the genus *Anagrus* Haliday (Hymenoptera: Mymaridae) of the world: an annotated key to the described species, discussion of the remaining problems, and a checklist. Acta Zoológica Lilloana 59 (1–2): 3–50.

Triapitsyn SV, Berezovskiy VV (2004) Review of the genus *Anagrus* Haliday, 1833 (Hymenoptera: Mymaridae) in Russia, with notes on some extralimital species. Far Eastern Entomologist 139: 22.

Trjapitzin SV (1996) Taxonomic notes on the Australian species of *Anagrus* (Hymenoptera Mymaridae). Russian Entomological Journal 4(1-4): 106.