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Research Article

THE ENCYRTIDAE FAUNA (HYMENOPTERA: CHALCIDOIDEA) OF MADHYA PRADESH, INDIA: AN UPDATED CHECKLIST AND DISTRIBUTION

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ABSTRACT

The present study investigates the diversity and distribution of encyrtid parasitoids (Hymenoptera: Encyrtidae) in Madhya Pradesh, India, based on recent field surveys and a review of existing host records. A total of 126 specimens were collected from six districts using sweep nets, yellow pan traps and Malaise traps. Detailed morphological examination resulted in the identification of 27 species belonging to 18 genera. Among these, 25 species and 13 genera are newly recorded from Madhya Pradesh. The findings increase the known diversity of Encyrtidae in the state from 15 to 39 species. The study also documents their associated host records, highlighting the ecological importance of encyrtid parasitoids as natural enemies and their potential role in biological pest management.

Keywords: Encyrtidae, Parasitoid, Biological control, Natural enemies, Host Record, Taxonomy.

INTRODUCTION

Encyrtidae (Hymenoptera: Chalcidoidea) is one of the largest parasitic wasp families which accommodates 4700 species under 500 genera worldwide (Kang, 2024). In India, this wasp group contains 748 species under 147 genera (Rameshkumar *et al*., 2025). It plays a crucial role in biological control program as potential natural enemies. It targets various pest populations predominantly mealybugs and scale insects as well as Lepidoptera, Diptera, ticks and spiders also. They act as either parasitoids or hyper-parasitoids of their arthropod hosts. Madhya Pradesh, the second largest state of India composed of diverse ecosystem from forests to open grassland and the neighboring states like, Uttar Pradesh, Maharashtra and Rajasthan having rich diversity of Encyrtidae but Madhya Pradesh itself holds a few records of this parasitoid group with only fifteen species. This study aims to update the distributional records of Encyrtidae in Madhya Pradesh and to document the host records of the parasitoids by reviewing existing literature.

MATERIALS AND METHODS

One recent survey was conducted across various districts in Madhya Pradesh (Map 1) and a total number of 126 Encyrtidae were collected. The methods used to collect specimens include, net sweeping, yellow pan trap and malaise trap. The collected specimens were stretched and mounted on rectangular card, studied by a stereo zoom microscope (LEICA INVESTA 3) and the photographs have been taken by Nikon DS-Ri2 camera attached to NIKON - SMZ25 microscope and processed by the NIS-Elements BR Analysis v5.20.00 software. The identified specimens were deposited to National Zoological Collection, Zoological Survey of India, Kolkata with proper registration number.

RESULTS AND DISCUSSION

The results of the study revealed that 27 species of encyrtid parasitoids have been identified and documented from Madhya Pradesh which are listed below.

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Genus - *Acerophagus* Smith, 1880

1. *Acerophagus papayae* Noyes & Schauff, 2003
Material examined: INDIA: Madhya Pradesh, Kandwa, Kothi, Omkareswar road, 17♀♀ (22.2246° N, 76.0967° E), 25.ix.2024, (Coll. A. Rameshkumar)
Host: *Paracoccus marginatus* in papaya tree (Noyes & Schauff, 2003).

Genus - *Aenasius* Walker, 1846
2. *Aenasius advena* Compere, 1937
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 1♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar)
Host: *Ferrisia virgata* & *Planococcus citri* on coffee, cashew, hibiscus, cotton, citrus, guava, etc. (Hayat, 2006; UCD, 2026).

3. *Aenasius arizonensis* (Girault, 1915)
Chalacspis arizonensis Girault, 1915
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 2♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar)
Host: *Phenacoccus solenopsis* on cotton, sunflower, tobacco and Brinjal (Hayat, 2009)

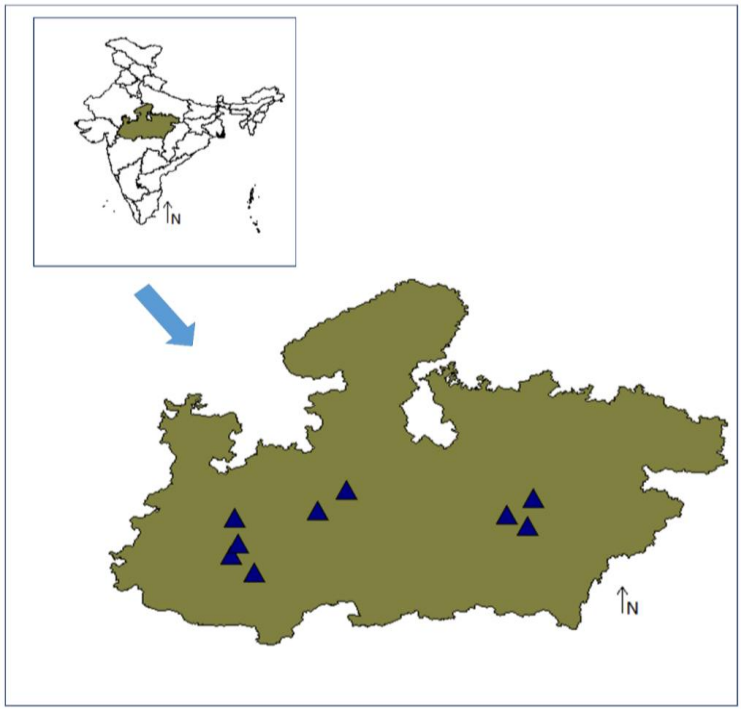
Genus - *Anagyrus* Howard, 1896
4. *Anagyrus chrysos* Noyes & Hayat, 1994
Anagyrus chrysos Noyes & Hayat, 1994: 80, 176-178, F, M. Holotype F: India, Lucknow (BMNH)
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 2♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar).
Host: *Rastrococcus iceryoides* on *Mangifera indica, Capparis* sp., *Citrus* sp. and *Acasia* sp. (Hayat, 2006).

5. *Anagyrus subnigricornis* Ishii, 1928
Anagyrus subnigricornis Ishii, 1928: 89-90, F. Holotype F: Japan, near Nagasaki (NIAS)
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 2♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar).
Host: *Pseudococcus* sp. (Noyes and Hayat, 1994)

6. *Anagyrus jenniferae* Noyes & Hayat, 1994
Anagyrus jenniferae Noyes & Hayat, 1994: 79, 164-166, F, M. Holotype F: India, 25 kms west of Mudigere (BMNH)
Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 1♀♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).
Host: Unknown

Genus - *Anomalicornia* Mercet, 1921
7. *Anomalicornia tenuicornis* Mercet, 1921
Anomalicornia tenuicornis Mercet, 1921: 86-87, M = F. Holotype F: Spain, Madrid, El Pardo (MCNM)
Material examined: IN.DIA: Madhya Pradesh, Jabalpur, Bhamki, 11♀♀ (23.1435 °N, 79.6734 °E), 05.x.2024, (Coll. A. Rameshkumar).
Host: Unknown

Genus - *Apoleptomastix* Kerrich, 1982
8. *Apoleptomastix bicoloricornis* (Girault, 1915)
Leptomastix bicoloricornis Girault, 1915a: 152-153, F. Lectotype F [designated by Noyes & Hayat, 1994: 265]
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 6♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar).
Host: *Coccidohystrix insolita* (Shamim & Shafee, 1984); *Brevennia rehi* on rice (Noyes & Hayat, 1994)



Map 1. Showing the collection Sites of Madhya Pradesh, India.

9. *Apoleptomastix rufiscapus* Kerrich, 1982
Apoleptomastix rufiscapus Kerrich, 1982: 422-424,427, F, M. Holotype F: India, Tamil Nadu, 3 kms east of Manjalar Dam (BMNH)
Material examined: India: Madhya Pradesh, Ujjain, Ninora, 3♀♀ (23.0856°N, 75.8171 °E), 23.ix.2024, (Coll. A. Rameshkumar).
Host: *Nipaecoccus viridis* (Shamim & Shafee, 1984)
Genus - *Callipteroma* Motschulsky, 1863
10. *Callipteroma sexguttata* Motschulsky, 1863
Callipteroma sexguttata Motschulsky, 1863: 37, M. Syntype M: Sri Lanka, Mt Patannas (ZMMU)
Material examined: INDIA: Madhya Pradesh, Ujjain, Ninora, 7♀♀ (23.0865 °N, 75.8171 °E), 23.ix.2024, (Coll. A. Rameshkumar).
Host: *Birendracoccus saccharifolii* (Green, 1908) (Pseudococcidae) on sugarcane in India (Noyes & Hayat, 1994).
Genus - *Cheiloneurus* Westwood, 1833
11. *Cheiloneurus bangalorensis* (Subba Rao, 1957)
Chrysopophagus bangalorensis Subba Rao, 1957a: 382-383, F, M. Holotype F: India, Bangalore (NPCI)
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 9♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar).
Host: *Antonina* sp. on grass (Hayat, 1972); *Antonina graminis* (Subba Rao, 1957a)
12. *Cheiloneurus quadricolor* (Girault, 1915)
Cristatithorax quadricolor Girault, 1915a:157, F. Holotype F: Australia, (QMB)
Material examined: INDIA: Madhya Pradesh, Indore, Malendi village, 5♀♀ (22.4985 °N, 75.7741 °E), 22.ix.2024, (Coll. A. Rameshkumar).
Host: *Dryinid* sp. via *pyrilla* sp. (Mani, 1939), *Brevennia rehi* on *Oryza sativa* (Nalini, 2011)
13. *Cheiloneurus nankingensis* Li & Xu, 2020
Cheiloneurus nankingensis Li & Xu, in Li et al., 2020: 25, female, male. Holotype female, Nanjing city, Jiangsu Province, China (NAU).
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 2♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar).
Host: Hyperparasitoid on *Aenasius arizonensis* which is primary parasitoid on *Phenacoccus solenopsis* (Zeya et al. (2022).
Genus - *Encyrtus* Latreille, 1809
14. *Encyrtus infelix* (Embleton, 1902)
Comys infelix Embleton, 1902: 223 (footnote). Lectotype F [designated by Graham, 1969: 308] (Zool. Museum, Cambridge).
Material examined: INDIA: Madhya Pradesh, Bhopal, Semri, 4♀♀ (23.5371 °N, 77.4079 °E), 30.ix.2024, (Coll. A. Rameshkumar).
Host: *Ceroplastes* sp., *Saissetia* sp., *Pulvinaria* sp., *Saissetia* sp. (Coccidea) (UCD community, 2026).
Genus - *Homalotylus* Mayr, 1876
15. *Homalotylus albiclavatus* (Agarwal, 1970)
Neoaenasioidea albiclavatus Agarwal, 1970: 27, F. Holotype F: India, Aligarh (ZDAMU)
Material examined: India: Madhya Pradesh, Indore, IISR guest house campus, 4♀♀ (22.6826 °N, 75.8695 °E), 21.ix.2024, (Coll. A. Rameshkumar).
Host: *Pullus* sp. on *Coffea canephora*, *Coccidohystrix insolita* (Hayat, 2006; UCD community, 2026).
Genus - *Leptomastix* Foerster, 1856
16. *Leptomastix tsukumiensis* Tachikawa, 1963
Leptomastix tsukumiensis Tachikawa, 1963: 66-68, F. Holotype F: Japan (ELKU)
Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 7♀♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).
Host: Mealybug on *Citrus* sp. (Shafee, 1971) and coccid on *Ficus* sp. (Noyes & Hayat, 1994)
Genus - *Manicnemus* Hayat, 1981
17. *Manicnemus indicus* (Mani & Saraswat, 1974)
Tetralophidea indica Mani & Saraswat, 1974: 77-79, M. Holotype M: India, Mahstr., Panchgani (USNM).
Material examined: INDIA: Madhya Pradesh, Sehore, Mahodiya village, 3♀♀ (23.2084 °N, 77.0006 °E), 01.x.2024, (Coll. A. Rameshkumar).
Host: *Greenaspis divergens* on grass (Shafee et al., 1975)
Genus - *Microterys* Thomson, 1876
18. *Microterys nietneri* (Motschulsky, 1863)
Encyrtus nietneri Motschulsky, 1863:55, F. Sri Lanka, Mt. Patannas (ZMMS)
Material examined: India: Madhya Pradesh, Indore, IISR guest house campus, 5♀♀ (22.6826 °N, 75.8695 °E), 21.ix.2024, (Coll. A. Rameshkumar).
Host: *Coccus hesperidum*, *Lecanium* sp., *Parasaissetia nigra*, *Saissetia coffeae*, *Saissetia oleae*, *Saissetia* sp., *Pulvinaria* sp. and *Rastrococcus iceryoides* on various host plants (Hayat, 2006; UCD community, 2026).
Genus - *Monstranusia* Trjapitzin, 1964
19. *Monstranusia antennata* (Narayanan, 1960)
Cerapterocerus antennatus Narayanan, 1960: 122-123, F. Holotype F: India, Delhi (NPCI)
Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 1 ♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).
Host: Unknown.
Genus - *Neocladia* Perkins, 1906
20. *Neocladia calicutana* (Hayat, 2003)
Paracladella calicutana Hayat, 2003a: 229, F. Holotype F: India, Calicut (NPCI)
Material examined: INDIA: Madhya Pradesh, Jabalpur, Gosalpur, 2♀♀ (23.3984 °N, 80.0501 °E), 06.x.2024, (Coll. A. Rameshkumar).
Host: Unknown.
Genus - *Neodusmetia* Kerrich, 1964
21. *Neodusmetia sangwani* (Subba Rao, 1957)
Dusmetia sangwani Subba Rao, 1957a: 385-386, F, M. Holotype F: India, Bangalore (NPCI)
Material examined: INDIA: Madhya Pradesh, Indore, Malendi village, 14♀♀ (22.4985 °N, 75.7741 °E), 22.ix.2024, (Coll. A. Rameshkumar).
Host: *Antonina* sp. on grass (Hayat, 1981) and *Cynodon* sp. (Shafee et al., 1975)
Genus - *Ooencyrtus* Ashmead, 1900

22. *Ooencyrtus segestes* Trjapitzin, 1965

Ooencyrtus segestes Trjapitzin, 1965: 320-321, F. Holotype F: Indonesia, Komodo Island (ZIASP)

Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 4♀♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).

Host: Unknown.

Genus - *Prochiloneurus* Silvestri, 1915

23. *Prochiloneurus albifuniculus* (Hayat, Alam & Agarwal, 1975)

Prochiloneuroides albifuniculus Hayat, Alam & Agarwal, 1975: 61, 62-64, F. Holotype F: India, Ut. Prad., Lakhimpur (BMNH).

Material examined: INDIA: Madhya Pradesh, Jabalpur, Gosalpur, 2♀♀ (23.3984 °N, 80.0501 °E), 06.x.2024, (Coll. A. Rameshkumar).

24. *Prochiloneurus puchellus* Silvestri, 1915

Prochiloneurus pulchellus Silvestri, 1915b: 351-352, F. Eritrea, Nefasit (IEUN)

Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 3♀♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).

Host: *Centrococcus* sp. on *Leucas Cephalotus*, *Pupalia lappacea* and *Wittania somnifera* (Hayat, 1981).

25. *Prochiloneurus rex* (Girault, 1920)

Achrysopophagus rex Girault, 1920b: 188, F. Holotype F: Philippines, Manila (USNM)

Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 3♀♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).

Host: Unknown.

Genus - *Proleurocerus* Ferriere, 1935

26. *Proleurocerus fulgoridis* Ferriere, 1935

Proleurocerus fulgoridis Ferriere, 1935: 402-403, F. Syntpes: India, Bangalore and Closepet (BMNH)

Material examined: INDIA: Madhya Pradesh, Indore, Malendi village, 2♀♀ (22.4985 °N, 75.7741 °E), 22.ix.2024, (Coll. A. Rameshkumar).

Host: Eggs of *Eurybrachys tomentosa* (Ferriere, 1935)

27. *Proleurocerus litoralis* Hayat & Kazmi, 1996

Proleurocerus litoralis Hayat & Kazmi, 1996: 19-20, F. Holotype F: India, Calicut Univ. Campus (BMNH)

Material examined: INDIA: Madhya Pradesh, Jabalpur, Paprikalam village, 4♀♀ (22.9581 °N, 79.9676 °E), 04.x.2024, (Coll. A. Rameshkumar).

Host: Egg masses of *Eurybrachys tomentosa* (Fulgoridae) on *Shorea robusta* tree trunks. (Singh, 2010).

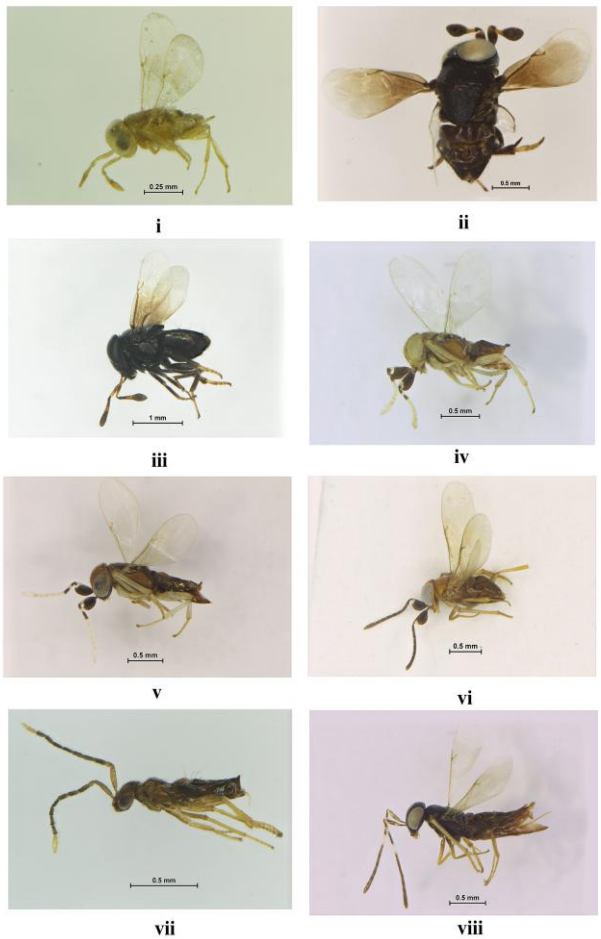


Figure i-viii: i. *Acerophagus papayae,* ii. *Aenasius advena*, iii. *Aenasius arizonensis*, iv. *Anagyrus chrysos,* v. *Anagyrus jenniferae*, vi. *Anagyrus subnigricornis* vii. *Anomalicornia tenuicornis* viii. *Apoleptomastix bicoloricornis.*

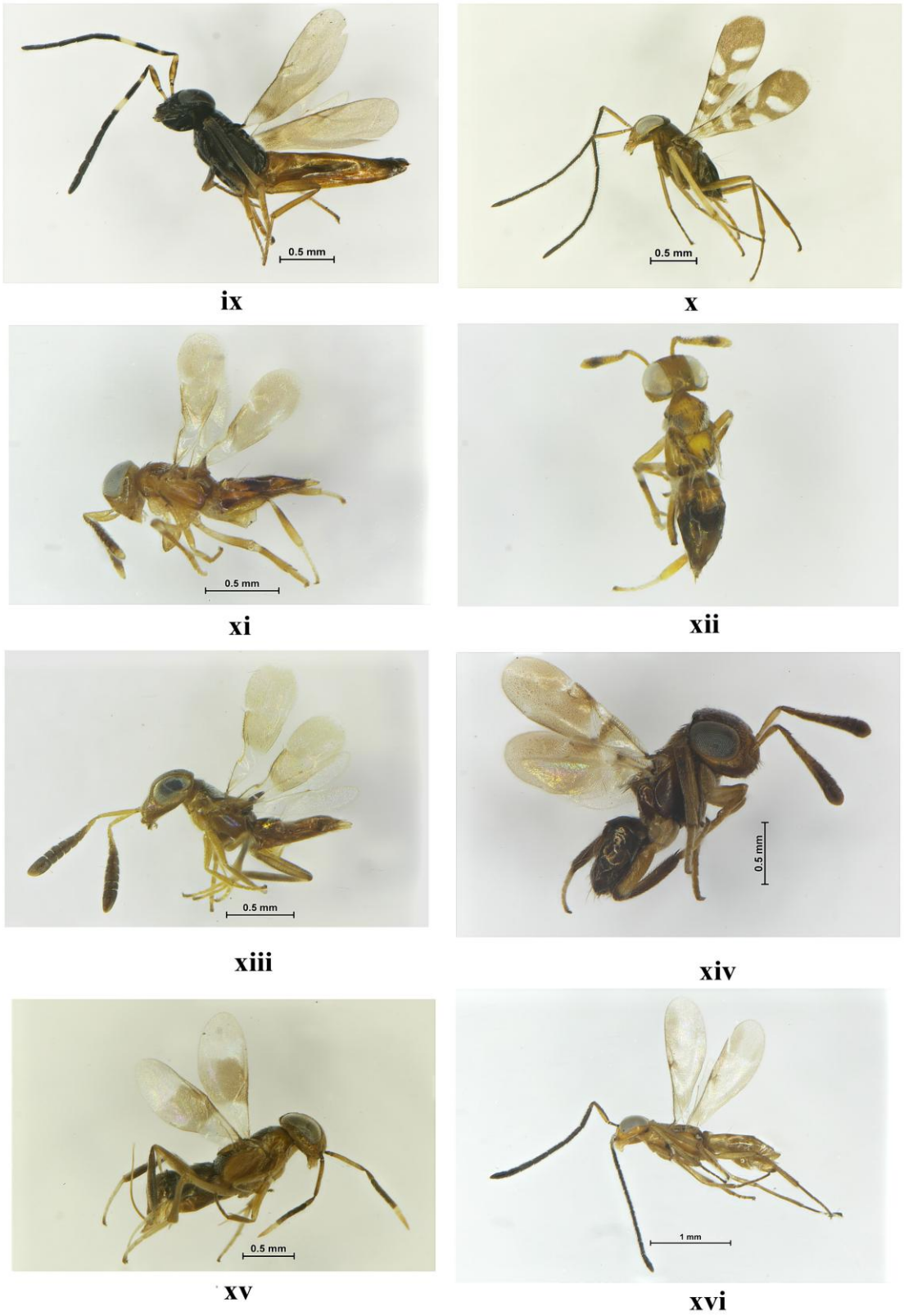


Figure ix-xvi: ix. *Apoleptomastix rufiscapus*, x. *Callipteroma sexguttata*, xi. *Cheiloneurus bangalorensis*, xii. *Cheiloneurus quadricolor*, xiii. *Cheiloneurus nankingensis.* xiv. *Encyrtus infelix,* xv. *Homalotylus albiclavatus.* xvi. *Leptomastix tsukumiensis.*

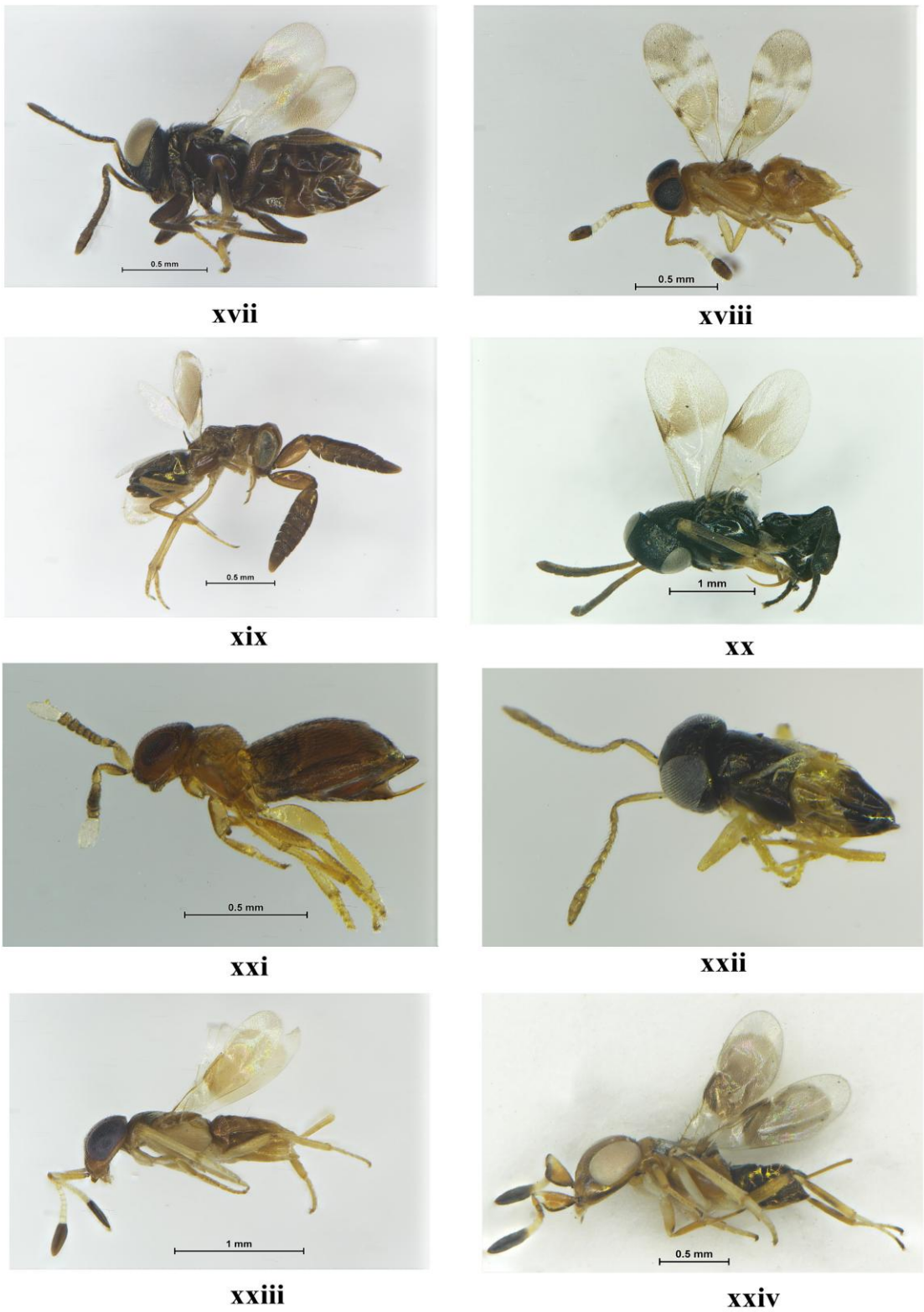


Figure xvii-xxiv: xvii. *Manicnemus indicus,* xviii. *Microterys nietneri,* xix. *Monstranusia antennata,* xx. *Neocladia calicutana,* xxi. *Neodusmetia sangwani* xxii. *Ooencyrtus segestes,* xxiii. *Prochiloneurus albifuniculus,* xxiv. *Prochiloneurus puchellus.*

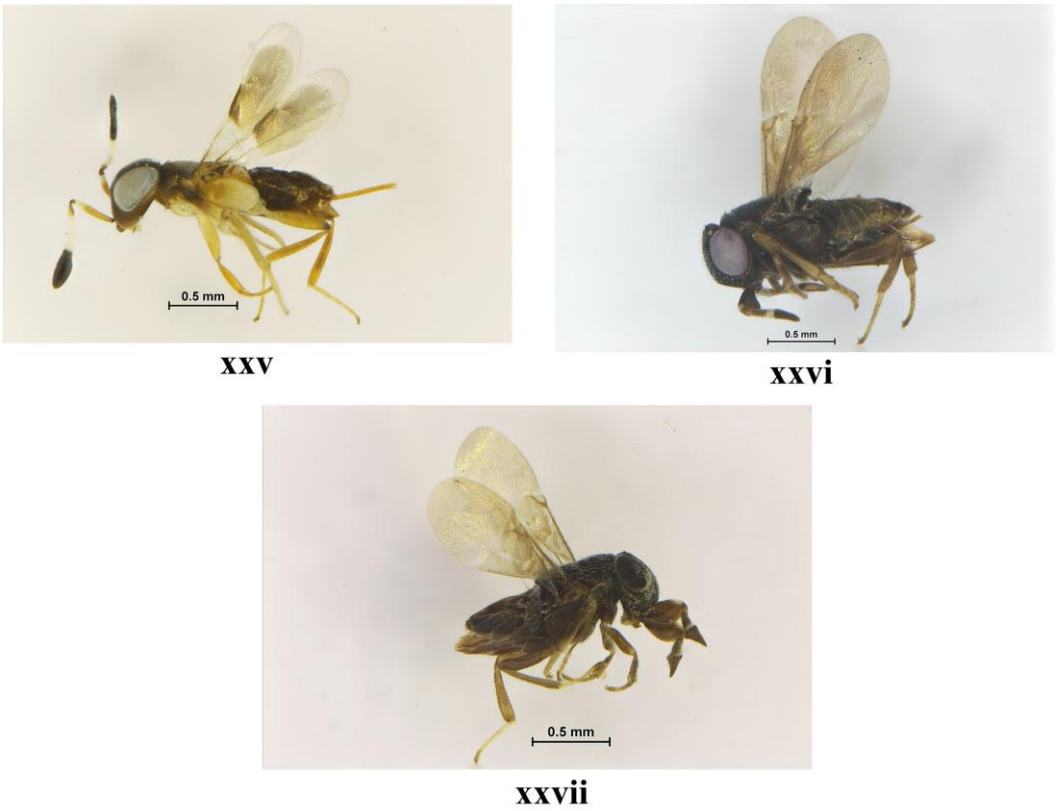


Figure xxv-xxvii: xxv. *Prochiloneurus rex*, xxvi. *Proleurocerus fulgoridis*, xxvii. *Proleurocerus litoralis.*

Previous records indicate that Madhya Pradesh has 15 species of Encyrtidae across 12 genera (Rameshkumar et al., 2025). In the present study, we examined 123 Encyrtidae specimens collected during recent surveys across six districts of Madhya Pradesh. Our findings reveal 27 species spanning 18 genera, with 25 species and 13 genera newly recorded for the state. Consequently, this study increases the documented diversity of Encyrtidae in Madhya Pradesh from 15 to 39 species (Table 1). Notably, *Cheiloneurus nankingensis* Li & Xu, 2020, originally described from China and first reported in India from Kerala by Zeya et al. (2022), is now recorded from Madhya Pradesh.

Table.1. Checklist of Encyrtidae from Madhya Pradesh.

Sl No	Host Association	Species Name	Distribution
1	*Mealybug parasitoid* (Psudococcidae)	****Acerophagus papayae*** Noyes & Schauff, 2003	IN: KA, MH, MP and TN.
2		***Aenasius advena*** Compere, 1937	IN: AN, DL, GA, GJ, KR, KA, MP, MH, PB, TN, UT, UP
3		****Aenasius arizonensis*** (Girault, 1915)	IN: AP, HR, MH, MP
4		***Aenasius indicus*** (Narayanan and Subba Rao, 1961)	IN: DL, HP, KL, MP, OD, PB, UT, UP, MP
5		***Anagyrus chrysos*** Noyes & Hayat, 1994	IN: KA, MP, MH, TN, UP
6		****Anagyrus subnigricornis*** Ishii, 1928	IN: TN, MP
7		****Anagyrus jenniferae*** Noyes & Hayat, 1994	IN: HR, KA, KL, MP.
8		****Apoleptomastix bicoloricornis*** (Girault, 1915)	IN: AP, DL, J & K, JH, KA, KL, RH, TN, UP, WB, MP
9		****Apoleptomastix rufiscapus*** Kerrich, 1982	IN: DL, JH, KA, KL, TN.

10		***Blepyrus insularis*** (Cameron, 1886)	IN: DL, GA, KA, KL, MP, MH, OD, TN, UT, UP, WB.
11		***Callipteroma sexguttata*** Motschulsky, 1863	IN: DL, KR, KL, MP, MH, OD, RJ, TN, UP.
12		***Callipteroma testacea*** Motschulsky, 1863	IN: DL, HP, KA, KL, MP, MH, UP.
13		***Ericydnus sheopurensis*** Kaneria & Singh, 2020	IN: MP
14		***Leptomastix nigrocincta*** Risbec, 1959	IN: AN, AP, DL, KA, KL, MP, TN, UP.
15		***Leptomastix nigrocoxalis*** Compere, 1928	IN: AP, GA, HR, HP, KA, KL, MH, OD, PY, PN, TN, UT, UP, WB, MP.
16		****Leptomastix tsukumiensis*** Tachikawa, 1963	IN: AP, BH, DL, JH, KA, KL, OD, TN, UP, WB, MP
17		****Neodusmetia sangwqani*** (Subba Rao, 1957)	IN: AN, AP, AS, DL, KA, KL, PY, RJ, TN, UP, MP
18		****Prochiloneurus albifuniculus*** (Hayat, Alam & Agarwal, 1975)	IN: AS, HP, RH, UP, MP.
19		****Prochiloneurus puchellus*** Silvestri, 1915	IN: AP, BH, GO, HR, KA, KL, MH, PN, TN, UP, MP
20		****Encyrtus infelix*** (Embleton, 1902)	IN: AS, MP
21		***Lakshaphagus fusiscapus*** (Agarwal, 1965)	IN: KA, MP, MH, RJ, TN, UP.
22	Scale Insect parasitoid (Coccidae, Diaspididae,	***Lamennaisia ambigua*** (Nees, 1834)	IN: AP, TN, JH, KA, KL, OD, UT, UP, MP
23	Cerococcidae)	****Manicnemus indicus*** (Mani & Saraswat, 1974)	IN: AS, BH, DL, JH, KA, KL, MH, OD, RJ, UP, MP
24		***Metaphycus gilvus*** Compere, 1957	IN: KA, MP, PJ, UP.
25		****Microterys nietneri*** (Motschulsky, 1863)	IN: KA, KL, UP, MP
26		****Cheiloneurus bangalorensis*** (Subba Rao, 1957)	IN: AN, AP, ASS, DL, KA, KL, RH, TN, UT, UP, WB, DN, MP.
27	Hyperparasitoid	****Cheiloneurus quadricolor*** (Girault, 1915)	IN: AN, AP, DL, HP, KA, KL, MH, RJ, TN, UT, UP, MP.
28		****Cheiloneurus nankingensis*** Li & Xu, 2020	IN: KL, MP.
29		****Prochiloneurus puchellus*** Silvestri, 1915	IN: AP, BH, GO, HR, KR, KL, MH, PN, TN, UP.
30		****Prochiloneurus rex*** (Girault, 1920)	IN: UP
31		****Ooencyrtus segestes*** Trjapitzin, 1965	IN: AP, AS, BH, DL, KR, TN, UP.
32	Egg Parasitoid	***Proleuroceroides pyrillae*** (Crawford, 1916)	IN:MH, RJ
33		****Proleurocerus fulgoridis*** Ferriere, 1935	IN: AP, KL, KA, MH, TN.
34		****Proleurocerus litoralis*** Hayat & Kazmi, 1996	IN: KL, KA, UT.
35		****Anomalicornia tenuicornis*** Mercet, 1921	IN: AP, DL, KA, KL, RJ, TN, PY, ML, MH, NL, AS, MN.
36		***Mayridia caerulea*** (Hayat and Verma, 1978)	IN: AP, MP, UP.
37	Others	****Monstranusia antennata*** (Narayanan, 1960)	IN: DL, TN, MH, OD, UP, MP
38		****Neocladia calicutana*** (Hayat, 2003)	IN: KL, SK.
39		****Homalotylus albiclavatus*** (Agarwal, 1970)	IN: HP, JH, KA, KL, RJ, TN, UP, WB.

*New record to Madhya Pradesh.

IN-India**. AN**-Andaman & Nicobar Islands, **AP**-Andhra Pradesh, **AS**- Assam, **BH**- Bihar, **DL**-Delhi, **D&N**- Dadra and Nagar Haveli, **GJ**- Gujarat, **GA**- Goa, **HP-** Himachal Pradesh, **HR**-Haryana, **JH**- Jharkhand, **J&K**- Jammu and Kashmir, **KA**-Karnataka, **KL**- Kerala, **PB**- Punjab, **MH**- Maharashtra, **MP**- Madhya Pradesh, **ML**-Meghalaya, **MN**- Manipur, **NL**- Nagaland, **OD**- Odisha, **PY**- Puducherry, **RJ**-Rajasthan,**TN**- Tamil Nadu, **UP**- Uttar Pradesh, **UK**- Uttarakhand, **WB**- West Bengal.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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