Revised phylogenetic analysis of Indian species of genus *Macrophya* Dahlbom (Hymenoptera: Symphyta; Tenthredinidae: Tenthredininae)

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Abstract

Revised phylogenetic analysis was performed for 14 species of the genus *Macrophya* (Hymenoptera: Tenthredinidae) using the phylogenetic analysis package PAUP, based on 15 of the morphological characters most commonly used for *Macrophya* species identification. Species descriptions were derived primarily from "Indian Sawflies Biodiversity" vol. II Saini (2007), Saini and Bharti (1996), Saini *et al.* (1996), and Saini and Vasu (1997). The results are discussed in terms of evolutionary trends or biological maxim that "nature prefer to modify the already existing structures so as to cope with new needs."

Keywords: *Phylogenetic analysis, Macrophya, Evolutionary trends.*

Introduction

The genus *Macrophya* (Hymenoptera: Tenthredinidae) is widely distributed genus with its representatives available in almost all main regions of the globe. With regard to its affinities, it shares most of its characters with *Pachyprotasis* Hartig. Even within *Macrophya* the range of characters is so wide that time to time many of its subgenera were proposed (Malaise, 1945) and because of no distinct boundaries they all got merged (Ross, 1937; Gibson, 1980). Today none of its subgenus is considered to be valid (Abe and Smith,1991). The genus *Macrophya* was first described by Dahlbom (1835) as a subgenus of *Tenthredo* Linnaeus, on the basis of body shape, length and form of antenna. He divided this subgenus into two subsections "A" and "B". Hartig (1837) applied names to these two subsections using *T. (Macrophya)* for subsection "B" and *T.(M.) (Pachyprotasis)* for subsection "A". Both of these were later recognised as valid genera by Westwood (1840).

The genus is characterized by venation as in *Pachyprotasis,* but the anal cell may have a cross vein. Malar space mostly shorter than the diameter of an ocellus. The hind legs are strongly built, and the knees reaching and mostly exceeding the apex of the abdomen (Saini, 2007). The larval stages feed on variety of wild herbs, shrubs and trees. Generally adults feed on pollens, flower nectar or leaf juice exuding from wounds caused by strong mandibles. However, many robust species indulge in zoophagy (Cameron,1882; Rohwer,1913; Benson,1938; Malaise,1945; Naito,1988 and Goulet,1996).

The purpose of present study is to trace the long evolutionary history which modified generalizations into specializations of extreme form to suit the circumstances in which subsequently insects dwelled. Parsimony analysis is used to investigate phylogenetic relationships among *Macrophya* species, using data based on morphological characters most commonly used for *Macrophya* identification. With the help of literature contributed by Saini *et al.* (1996) and Saini and Vasu (1997) some different characters were used to trace phylogeny of genus *Macrophya*.

Materials and Methods

Species descriptions were derived primarily from "Indian Sawflies Biodiversity" vol. II Saini (2007), Saini and Bharti (1996), Saini *et al.* (1996), and Saini and Vasu (1997) and the characters used in the analysis were those given comparably for all, or almost all, species. *Tenthredo rufipodus* Saini and Bharti, 1996 was also included in the analysis as the outgroup. Revised phylogenetic analysis was carried with a computer program PAUP version 4.0, with more characters as compared to earlier study (Saini and Kaur,2010), has been used to infer the phylogeny (Swofford, 2000). In total 15 morphological characters were used in the phylogenetic analysis. These were:

1.Forewing: (0-without infuscated band, 1-with infuscated band)

2.Body colour: (0-not metallic blue, 1-metallic blue)

3.Clypeus: (0-not triangularly incised up to 1/4 of its length, 1- triangularly incised up to 1/4 of its length)
4. Frontal area: (0-not below level of eyes, 1-below level of eyes)
5. Average length of body of female: (0-10 mm, 1-above 10mm, 2-below 10mm)
6. Subapical teeth of tarsal claw: (0-smaller than apical teeth, 1-longer or equal to apical teeth)
7. Labrum: (0-with rounded anterior margin, 1-with truncate or subtruncate anterior margin, 2-with slightly emarginate anterior margin)
8. Median fovea: (0-absent, 1-distinct, 2-indistinct)
9. Supraantennal tubercles: (0-insignificant, indistinct or not raised, 1-raised or significant)
10. Circumocellar furrow: (0-fine or clear, 1-distinct, 2-indistinct, 3-sharp)
11. Postocellar area: (0-flat, 1-subconvex, 2-slightly raised, 3-fine)
12. Mesoscutellum: (0-slightly or roundly raised or elevated, 1-subconvex, 2-prismatic, 3- flat)
13. Mesepisternum: (0-roundly raised, 1-obtusely raised, 2-depressed not obtusely raised)
14. Antenna length: (0-2 times or more than 2 times of head width;1-less than 2 times of head width)
15. Hind femora: (0-hardly reaching apex of abdomen, 1-exceeding apex of abdomen)

Table-1: Presence or absence data for fifteen characters for 14 species of the genus *Macrophya* as used in the phylogenetic analysis; *T. rufipodus* Saini and Bharti, 1996 is included as an outgroup.

Character → / Species ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M. andreasi Saini and Vasu, 1997	0	0	0	0	2	1	0	1	0	3	1	0	-	1	1
M. brancuccii Muche, 1983	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1
M. formosana Rohwer, 1916	0	0	0	0	1	1	1	2	1	3	1	0	0	1	1
M. gopeshwari Saini *et al.,* 1986	0	0	0	1	2	1	1	1	1	0	0	2	1	0	1
M. khasiana Saini *et al.,* 1996	0	0	0	1	0	1	1	1	1	0	1	0	1	1	1
M. maculicornis Cameron, 1899	0	0	0	1	1	1	0	1	1	0	0	0	0	0	1
M. manganensis Saini *et al.,* 1996	0	0	1	0	0	1	2	2	1	3	0	0	1	1	1
M. naga Saini and Vasu, 1997	1	0	0	0	2	1	1	2	0	1	1	1	-	0	1
M. planata (Mocsary, 1909)	0	0	0	1	1	1	0	2	1	2	1	2	1	0	1
M. pompilina Malaise, 1945	1	1	0	1	0	1	0	2	1	3	1	1	0	0	1
M. pseudoplanata Saini *et al.,* 1996	0	0	0	1	1	1	0	1	0	1	0	3	1	0	1
M. regia Forsius, 1930	0	1	0	1	2	1	1	0	0	3	2	0	0	1	1
M. rufipodus Saini *et al.,* 1996	0	0	0	0	2	1	1	2	1	1	0	1	0	0	1
M. verticalis Konow, 1998	0	0	0	1	2	0	1	0	1	0	0	0	1	1	1
T. rufipodus Saini and Bharti,1996	0	0	0	0	2	0	0	1	1	1	3	0	2	1	0

Discussion

The outgroup taxon *T. rufipodus* got separated from all species of genus *Macrophya* on the basis of postocellar area fine (Character 11, state 3), mesepisternum depressed not obtusely raised (Character 13, state 2) and hind femora hardly reaching apex of abdomen (Character 15, state 0). The derived consensus tree identified two groupings to be present in the cladogram. In the first group *M. khasiana* got isolated from *M. verticalis*, *M. brancuccii*, *M. regia*, *M. gopeshwari*, *M. planata*, *M. maculicornis* and

Results

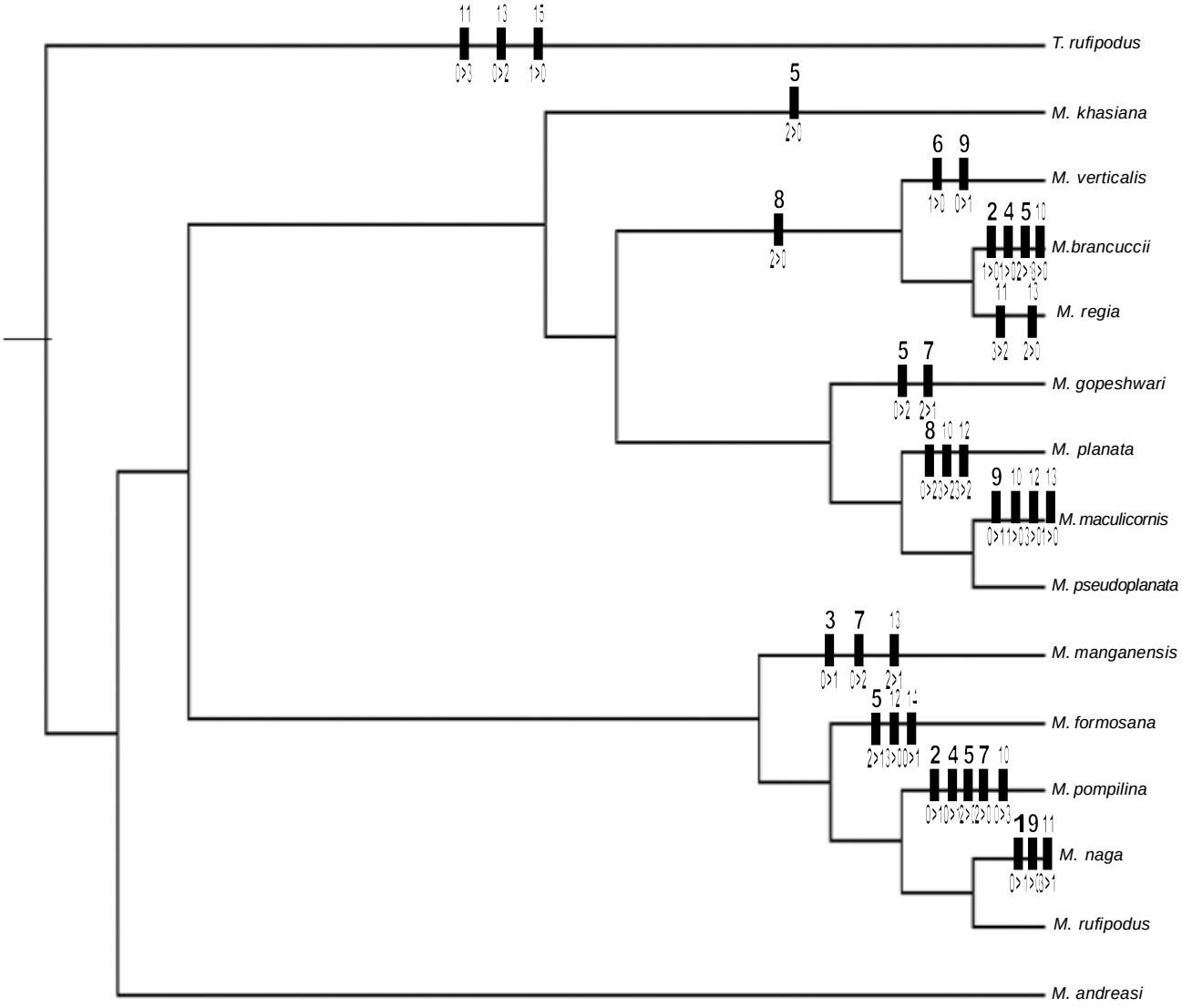

Fig. 1. Strict consensus tree for 14 species of *Macrophya* derived from the 7 most parsimonious trees calculated from the data in Table 1 ; outgroup = *Tenthredo rufipodus* Saini and Bharti,1996 . Character of the ingroup have been optimized by fast transformation as implemented in PAUP. Character numbers are above the hashmarks; state changes are shown below with the respective primitive and derived conditions reported by a '>'. 7 trees were found using the computer program PAUP version 4.0, with the shortest tree requiring 28 steps, a consistency index (CI) of 0.50, a retention index (RI) of 0.55 and rescaled consistency index (RC) of 0.28.

M. pseudoplanata on the basis of average length of body of female is 10mm (Character5, state 0). *M. verticalis*, *M. brancuccii* and *M. regia* due to absence of median fovea got separated from *M. gopeshwari*, *M. planata*, *M. maculicornis* and *M. pseudoplanata*. *M. brancuccii* and *M. regia* are sister species and got isolated from *M. verticalis* due to characters 6 and 9. *M. gopeshwari* can be distinguished from *M. planata*, *M. maculicornis* and *M. pseudoplanata* due to average length of body below 10mm (Character 5, state 2) and labrum with subtruncate anterior margin (Character 7, state 1). *M. planata* on basis of characters 8, 10 and 12 got isolated from sister species *M. maculicornis* and *M. pseudoplanata*. Due to triangularly incision in clypeus, labrum with slightly emarginated anterior margin and mesepisternum obtusely raised *M. manganensis* got separated from *M. formosana*, *M. pompilina*, *M. naga* and *M. rufipodus* and all these species showed monophyly as indicated by homologue 6. *M. naga* and *M. rufipodus* at the base of cladogram got separated from closely related species *M. pompilina* due to characters 2, 4, 5, 7 and 10. *M. naga* and *M. rufipodus* on basis of characters 1, 9 and 11 got separated from each other. So, extremely specialized forms descended by gradual changes leads to accumulation of certain appropriate features which represents body organization acquired to become complex so as to meet requirements which also underlies the biological maxim.

References

Abe, M. and Smith, D.R. 1991. The genus–group names of Symphyta (Hymenoptera) and their type species.Esakia, Fukuoka 31: 1-115.

Benson,R.B. 1938. On the classification of sawflies (Hymenoptera, Symphyta). The Entomologist'smonthly Magazine 75: 110-113.

Cameron,P. 1882. A monograph of the British phytophagous Hymenoptera vol. I. London: The Ray Society.

Dahlbom, A.1835. Conspectus Tenthredinidum, Siricidum, Oryssinorum, Scandinaviae, quas Hymenopterum fmilias. Hafiniae: Kongl Swenska Wetenskaps Academiens Handlingar 1-16.

Gibson, A.P. 1980. A revision of the genus *Macrophya* Dhlbom (Hymenoptera: Symphyta: Tenthredinidae) of North America. Memois of the Entomological Society of Canada 114: 166.

Goulet, H. 1996. Revision of the Nearctic species of the arcuata group of the genus *Tenthredo* with notes on the higher classification of the Tenthredinini (Hymenoptera, Symphyta, Tenthredinidae). Contributions of the American Entomological Institute, Gainesville 29(2): 1-135.

Hartig, T. 1837. Die Familien der Blattwespen und Holzwespen. Berlin : Haude und Spener.

Malaise, R. 1945. Tenthredinoidea of South-Eastern Asia with a general zoogeographical review. Opuscula Entomologica, Lund supplement 4: 1-288.

Naito, T. 1988. Systematic position of the genus *Rocalia* (Hymenoptera, Tenthredinidae) feeding on fern spores, with description of a new species from Japan. Kontyû 56(4): 798-804.

Rohwer, S.A. 1913. Notes on the feeding habits of adult sawflies (Hymenoptera: Symphyta). Proceedings of the Entomological Society of Washington 15: 148-149.

Ross, H.H. 1937. A generic classification of the Nearctic sawflies (Hymenoptera: Symphyta). Illinois Biological Monographs, 34: 173.

Saini, M.S. 2007. Indian Sawflies Biodiversity (Keys, Catalogue & Illustrations) vol. II. Subfamily Tenthredininae Sans Genus *Tenthredo* L. Dehradun: Bishen Singh, Mahendra Pal Singh Publishers.

Saini, M.S. and Bharti, H. 1996. Addition of five new species to the Indian *Tenthredo* Linnaeus (Tenthredinidae, Hymenoptera) from North–west India. Annals of Entomology 14(2): 61–68.

Saini, M.S., Bharti, H. and Singh, D. 1996. Taxonomic revision of genus *Macrophya* Dalhbom (Hymenoptera, Symphyta, Tenthredinidae; Tenthredininae) from India. Deutsche Entomologische Zeitschrift 43(1): 129–154.

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Saini, M.S. and Vasu, V. 1997. Present position of *Macrophya* Dahlbom from India (Hymenoptera, Tenthredinidae; Tenthredininae). Journal of Entomological Research 21(3): 237 – 243.

Swofford, D.L. 2000. PAUP: Phylogenetic analysis using parsimony version 4.0. USA: Sinauer Associates, Sunderland, Massachusetts.

Westwood, J.O. 1840. Synopsis of the Genera of British Insecta. In: Westwood, J.O. (ed.). An Introduction to Modern Classification of Insects, 2: 158.