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Studies on External Male and Female Genitalia of Five Species of *Miresa* Walker (Lepidoptera: Limacodidae) with New Species and New Record from Western Ghats, India

Amit Katewa and P.C. Pathania[1]

National Center for Vector Borne Diseases Control, Ministry of Health & Family Welfare, Delhi-110 054, India
[1]High Altitude Regional Centre, Zoological Survey of India, Saproon, Solan-173 211, India
E-mail: amitkatewa@gmail.com

***Abstract*:** The communication deals with the examination of external male and female genitalia of five species of genus *Miresa* Walker. Out of which, four species i.e., *M. albipuncta* Herrich-Schäffer, *M. decedens* Walker, *M. argentifera* Walker, *M. nivaha* Moore were already known to literature. Besides, one species i.e., *M. chandani* sp. nov. is being described for the first time and *M. argentifera* Walker has been recorded for the first time from India. The updated information on their distribution will be helpful in the conservation of these species.

***Keywords*:** Genus, *Miresa* Walker, Species, Male & female genitalia, New species

Genus *Miresa* was erected by Walker in 1855 for its type-species *albipuncta* Herrich-Shaffer. Hampson (1892), in his fauna volume, divided this genus under two sections and studied a total number of six species with five from India and mainly relied upon external morphological characters and did not studied the external male and female genitalic characters. During present study on Limacodidae from the Western Ghats in India, authors observed that only few references are available on species under *Miresa* genus, hence the study was undertaken to observe the distribution of species under *Miresa* in area under reference for further studies for their conservation.

MATERIAL AND METHODS

The adult moths were collected with the help of portable light trap (Fig. 1) or fluorescent lights at night hours from different localities of Western Ghats of India (Fig. 2). The external morphological characters were studied for description of species. To study wing venation, permanent slides (Common (1970), Zimmerman (1978) has been followed. For the study of external male genitalia, methodology given by Robinson (1976) was followed. The diagrams of genitalia were drawn using stereo zoom binocular. The terminology given by Klots (1970) has been followed in the present studies for nomenclature purpose. All the collections were deposited in the Insect Museum, Department of Zoology & Environmental Sciences, Punjabi University, Patiala.

RESULTS AND DISCUSSION

Miresa Walker

Miresa Walker 1855. *List. Lep. Ins. Br. Mus*. 5: 1115.

Type-species: *Miresa albipuncta* Herrich-Shaffer.

Diagnosis: Antenna broadly bipectinate over the basal half; labial palpusupcurved, not reaching beyond frontal tuft, third segment incospicuous; mid and hind tibia with terminal pairs of spurs; forewing rufous brown with yellowish patches, a silvery white postmedial, associated with a central white triangle, costa nearly straight, apex rounded, termen convex, tornus rounded, R_3 and R_4 and R_5 stalked; hindwing pale yellow, rounded; male genitalia with well sclerotizeduncus, tip forming a spine; female genitalia with two signa.

Key to the studied species of genus *Miresa* Walker

1.	Male genitalia with valva furnished with few small hairs distally ….....….	*albipuncta* Herrich-Schäffer
-	Male genitalia with valva with a tuft of hairs distally …	2
2.	Male genitalia with valva with costa concave at base …	*decedens* Walker
-	Male genitalia with valva with costa convex at base	3
3.	Aedeagus with two spine-like cornuti ……..	*argentifera* Walker
-	Aedeagus without cornuti……..	4
4.	Valva with costal region relatively less sclerotized, uncus beset with short hairs ……..	*nivaha* Moore
-	Valva with costal region strongly sclerotized, uncus beset with rather long hairs	*chandani* sp. nov.

***Miresa albipuncta* Herrich-Schäffer (Plate 1, Figs.- A to H)**

Nyssia albipuncta Herrich-Schäffer, 1854. *Aussereurop. Schmett. L.f.* 179.

Miresa albipuncta Herrich-Schäffer, Samml. asussereur. Schmett. i., fig. 179; C. & S. no. 1305; Forsayeth, Trans. Ent. Soc. 1884, pl. 14, figs. 8 a-c (larva and pupa).

Miresa guttifera Walker, Cat. v, p. 1124; C. & S. no. 1312.

Male: Alar expanse 34 mm. Vertex and frons green; antennae bipectinate upto basal half, distal half serrated, brown; labial palpus porrect, light brown, second segment larger than third, third segment hardly visible; thorax fulvous yellow with a fine brown streak in middle; forewing with costa straight, apex quadrate, termen straight, tornus rounded, anal margin nearly straight, ground colour red-brown, a silvery white spot beyond the lower angle of cell, cilia red-brown; hindwing oval, ochreous, suffused with red brown towards costa, cilia yellowish; legs thickly covered with brown scales, tarsi with yellowish scales; abdomen fulvous yellows.

Wing venation : Forewing with Sc ending beyond middle of costal margin, R_1 from cell, R_2, R_3, R_4 and R_5 stalked, M_1 beyond upper angle, M_2 and M_3 on a short stalk originating from lower angle, Cu_1 before lower angle of cell, Cu_2 from cell, 1A and 2A present, 3A forked at base; hindwing with $Sc+R_1$ originating before middle of cell, Rs and M_1 stalked, M_2 towards middle of discocellulars, M_3 from lower angle, Cu_1

Fig. 1. Area surveyed

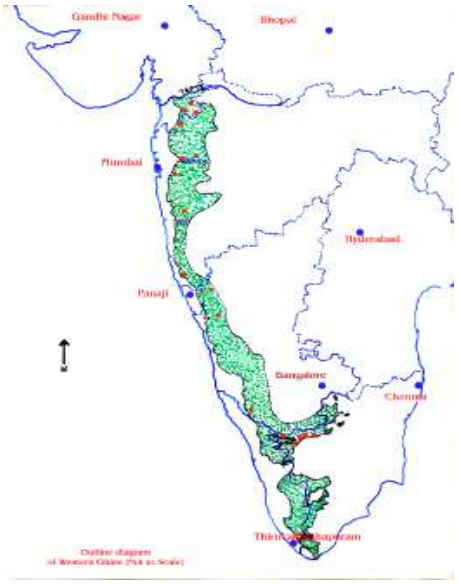

Fig. 2. Portable light trap

Table 1. Localities visited during the study and their geographical information

State	District	Locality	Geographical coordinates	Altitude
Gujarat	The Dangs	Ahwa	20.7606° N, 73.6912° E	520mASL
Karnataka	Chikmaglur	Kallathi Falls	13.5486° N, 75.7891° E	960mASL
	Dakshina Kannada	Gundya	12.8278° N, 75.5714° E	40mASL
	Kodagu	Baghamandala	12.3866° N, 75.5287° E	900mASL
		Medikeri	12.4244° N, 75.7382° E	1100mASL
	Uttar Kannada	Kulgi	15.1664° N, 74.6373° E	360mASL
		Ganeshgudi	15.2843° N, 74.5302° E	480mASL
		Jog Falls	14.2004° N, 74.7922° E	480mASL
		Kulgi	15.1664° N, 74.6373° E	360mASL
Kerala	Idukki	Marayoor	10.2762° N, 77.1615° E	960mASL
		Vallakadavu	8.4750° N, 76.9195° E	780mASL
	Kollam	Shendurney	8.8578° N, 77.2175° E	70mASL
	Palakkad	Mukkali	11.0587° N, 76.5402° E	560mASL
	Pathanamthitta	Vadaserikara	9.3307° N, 76.8209° E	30mASL

and Cu_2 from cell, 1A, 2A and 3A present.

Male genitalia: Male genitalia with uncus strongly built, highly sclerotized, much broader at base, setosed with long hair-like setae, tip blunt; gnathos biarmed at base with both the arms conjoint at second half, tip rounded; tegumen well formed, shoulder V-shaped; vinculum small, U-shaped; saccus small oval; valva well sclerotized, sparsely setosed with hair-like setae, flap-like, costa and sacculus not well marked, harpe and ampulla absent, cucullus and valvulla not differentiated; juxta flap-like; aedeagus moderately long and narrow, well sclerotized, almost straight, without spines, ductus ejaculatorius enters subapically.

Female genitalia: Not studied.

Material examined: India: Kerala: Dist. Idukki, Vallakadavu, 780mASL, 11.ix.2004, 01♂, coll. Amit Katewa; Karnataka: Dist. Chikmaglur, Kallathi Falls, 960mASL, 26.vii.2004, 01♂; Gujarat: Dist. The Dangs, Ahwa, 520mASL, 29.ix.2005, 01♂, coll. Amit Katewa.

Old distribution: Throughout India and Ceylon (Hampson, 1892).

Hampson (1892) reported the species *albipuncta* Herrich-Schäffer from throughout India and Ceylon without mentioning any specific locality from where it has earlier been collected. The present study will be helpful to mark particular areas about the availability of the species, under reference, for designing further studies on its biology and conservation. Alongwith this contribution, the male genitalia of this species is illustrated and studied in detail for the first time. The species can be easily differentiated from other species due to the presence of a silvery-white spot beyond the lower angle of cell and a faint silvery postmedial line on the forewing.

***Miresa decedens* Walker (Plate 2, Figs. A to H)**

Miresa decedens Walker, 1855. *List. Lep. Ins. Br. Mus*. **5**:1125.

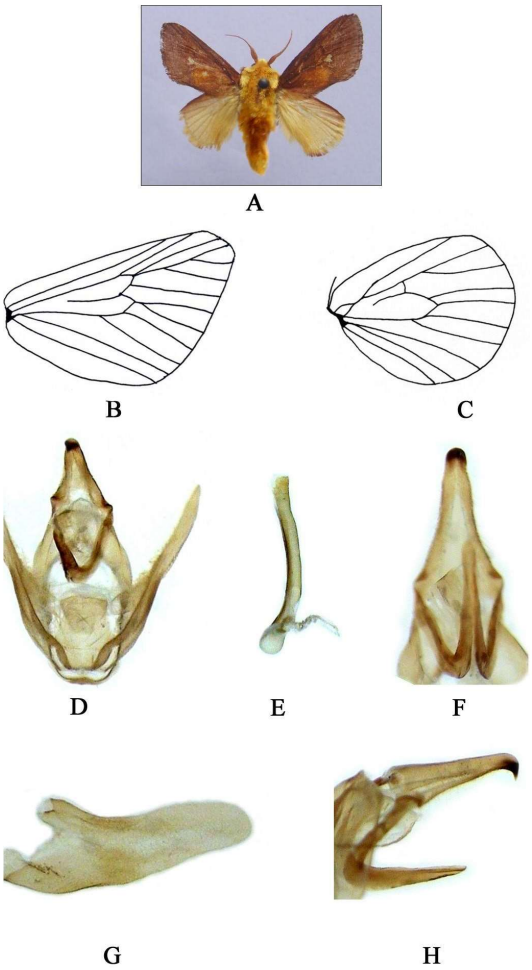

Plate-1: *Miresa albipuncta* Herrich-Schäffer

Figs.- A= Adult, B=Forewing, C= Hindwing, D= Male external genitalia, E= Aedeagus, F= Uncus and Gnathos ventral view, G= Valva, H= Uncus and Gnathos lateral view

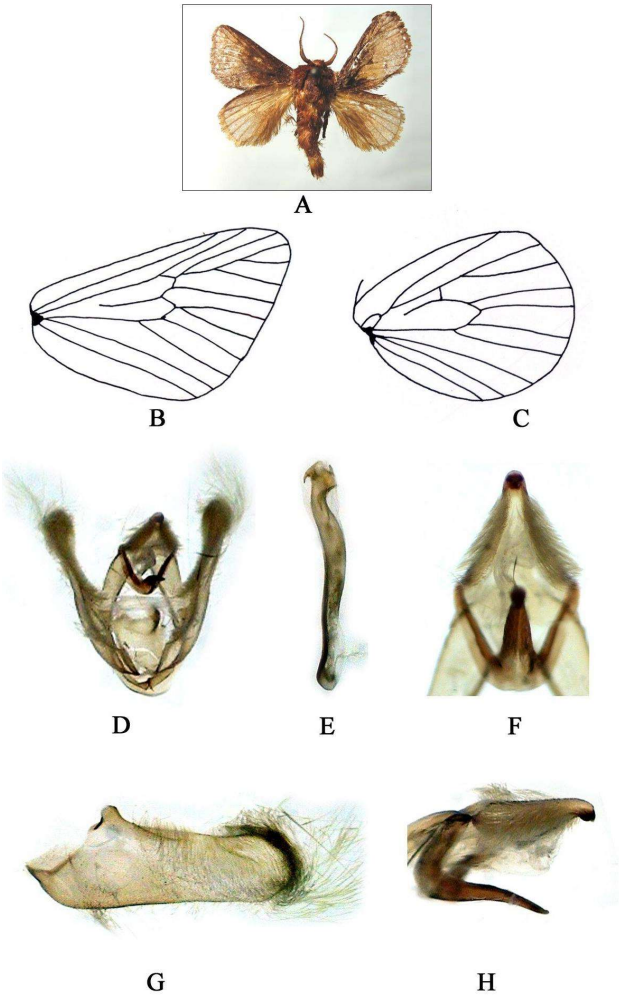

Plate-2: *Miresa decedens* Walker

Figs.- A= Adult, B=Forewing, C= Hindwing, D= Male external genitalia, E= Aedeagus, F= Uncus and Gnathos ventral view, G= Valva, H= Uncus and Gnathos lateral view

Male: Alar expanse : 31 mm. Vertex brown; frons green with a brown streak in middle; antennae bipectinate up to basal half, distal half serrated, brown; labial palpus porrect, brown, second segment larger than third, third segment hardly visible; thorax green with brown tinge, a streak in middle, brown at sides; forewing with costa straight, apex quadrate, termen slightly convex, tornus rounded, anal margin convex, ground colour dark brown, a broken ill-defined postmedial silvery line, curved from costa to M_3, some silvery scales towards outer margin; hindwing oval, dark brown, cilia dark brown at costal margin, rest dull brown; legs thickly cloathed with rusty red scales tinged with yellow; abdomen dull brown.

Wing venation : Forewing with Sc ending before posterior one-fourth of costal margin, R_1 arising from the posterior one-third of cell, R_2 arising in the posterior one-third of cell, R_3, R_4 and R_5 stalked, stalk originating from upper angle of cell, M_1 and M_2 almost straight and parallel to each other, M_3 arising from lower angle of cell, CuA_1 arising just before lower angle of cell, CuA_2 arising before posterior one-fourth of cell, CuP well developed, 1A+2A straight; hindwing with $Sc+R_1$ anastomosing with Rs basally after origin, Rs and M_1 connate at upper angle of cell, M_2 arising near M_3 than M_1, M_3 arising from lower angle of cell, CuA_1 arising well before lower angle of cell, CuA_2 arising beyond middle of cell, CuP well developed, 1A+2A and 3A present, well developed, gently diverging distally.

Male genitalia : Male genitalia with uncus strongly built, highly sclerotized, much broader at base, setosed with long hair-like setae, tip blunt; gnathos biarmed at base with both the arms conjoint at second half, tip rounded; tegumen well formed, shoulder V-shaped; vinculum small, U-shaped; saccus small oval; valva well sclerotized, densely setosed with hair-like setae, flap-like, costa and sacculus not well marked, harpe and ampulla absent, cucullus and valvulla not differentiated; juxta flap-like; aedeagus moderately long and broad, well sclerotized, slightly curved at middle, two prominent spines present near tip, ductus ejaculatorius enters subapically.

Female genitalia: Not studied.

Material examined : India: Karnataka: Dist. Dakshina Kannada, Gundya, 40mASL, 28.vii.2004, 02♂♂; Dist. Uttar Kannada Kulgi, 360mASL, 16.vii.2007, 01♂, coll. Amit Katewa.

Hampson (1892) reported the species *decendens* Walker from Nilgiris and Assam.

***Miresa argentifera* Walker(Plate 3, Figs. A to H)**

Miresaargentifera Walker, 1855. *List. Lep. Ins. Br. Mus.* **5**: 1124.

Male and Female : Alar expanse : 30 mm; 36 mm. Vertex brown, frons green with a brown streak in middle; antennae bipectinate upto basal half, distal half serrated in male, simple in female, brown; labial palpus porrect, brown, second segment larger than third, third segment hardly visible; thorax green with a fine brown streak in middle, brown at sides; forewing with costa straight, apex quadrate, termen slightly convex, tornus rounded, anal margin convex, ground colour brown, a broken ill-defined postmedial silvery line, curved from costa to Cu_2, then straighter and more prominent to inner margin, some silvery scales towards outer margin, a series of silvery marginal spots; hindwing oval, brown, cilia brown at costal margin to tornus, yellow at anal margin; legs thickly cloathed with rusty red scales tinged with yellow; abdomen yellow with some brown scales at few starting segments.

Wing venation: Forewing with Sc ending beyond middle of costal margin, R_1 from cell, R_2, R_3, R_4 and R_5 stalked, M_1 beyond upper angle, M_2 and M_3 on a short stalk originating from lower angle, Cu_1 before lower angle of cell, Cu_2 from cell,

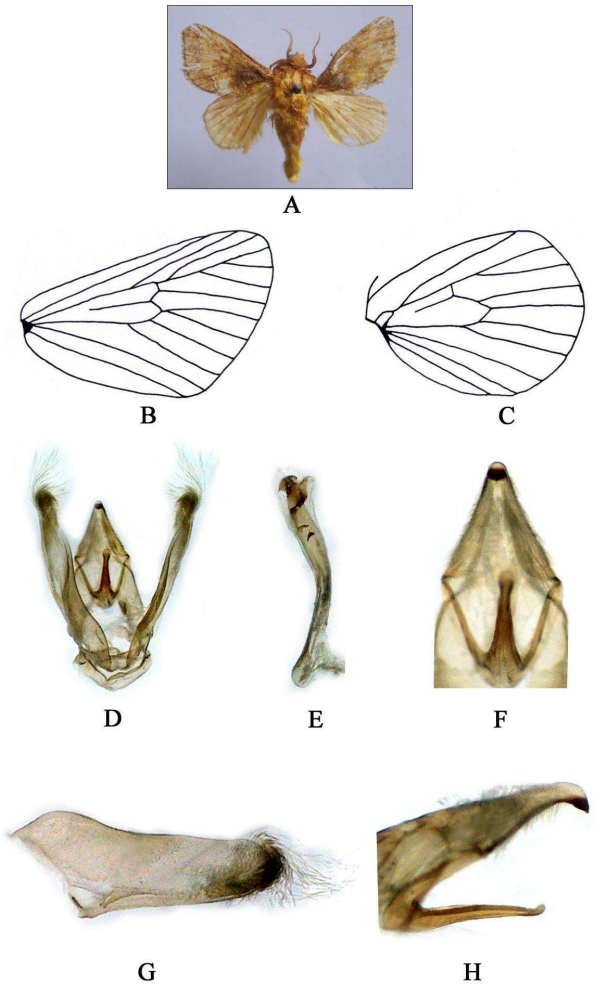

Plate-3: ***Miresa argentifera*** **Walker**

Figs.- A= Adult, B=Forewing, C= Hindwing, D= Male external genitalia, E= Aedeagus, F= Uncus and Gnathos ventral view, G= Valva, H= Uncus and Gnathos lateral view

1A and 2A present, 3A forked at base; hindwing with Sc+R_1 originating before middle of cell, Rs and M_1 stalked, M_2 towards middle of discocellulars, M_3 from lower angle, Cu_1 and Cu_2 from cell, 1A, 2A and 3A present.

Male genitalia: Male genitalia with uncus strongly built, broad at base, tapering towards tip, setosed with fine setae, tip giving the appearance of bird's beak; gnathos present; tegumen well sclerotized; vinculum U-shaped; saccus present; valva simple, without any projections, broad towards distal end, tip blunt with long hairlike setae; transtilla membranous; juxta simple, flap-like; aedeagus long and narrow, slightly curved, bulbuous at distal end, hook-like structure present at proximal end, three or four cornuti present, ductus ejaculatorious enters subapically.

Female genitalia: Not studied.

Material examined: India: Kerala: Dist. Idukki, Vallakadavu, 780mASL, 10.ix.2004, 03♂♂, 11.ix.2004, 01♂; Dist. Palakkad, Mukkali, 560mASL, 19.ix.2004, 01♂, 21.ix.2004, 01♂, 22.ix.2004, 01♂, 01♀; Dist. Idukki, Marayoor, 960mASL, 15.ix.2004, 01♂; Dist. Kollam, Shendurney, 70mASL, 03.ix.2004, 07♂♂; Dist. Pathanamthitta, Vadaserikara, 30mASL, 07.ix.2004, 02♀♀, coll. Amit Katewa; Karnataka: Dist. Uttar Kannada, Jog Falls, 480mASL, 24.vii.2004, 01♂; Dist. Kodagu, Medikeri, 1100mASL, 25.ix.2003, 01♀; Dist. Kodagu, Baghamandala, 900mASL, 31.vii.2004, 01♂; Dist. Uttar Kannada, Ganeshgudi, 480mASL, 20.vii.2004, 04♂♂; Dist. Uttar Kannada, Kulgi, 360mASL, 16.vii.2004, 01♂, coll. Amit Katewa.

Old distribution: Ceylon (Hampson, 1892).

In view of aforesaid distribution, the species *argentifera* Walker is recorded for the first time from India.

***Miresa nivaha* Moore (Plate-4, Figs. A to H)**

Miresa nivaha Moore, 1858-59. *Cat. Lep. Mus. E.I.C.* **2**: 413.

Male and Female : Alar expanse 32 mm, 40 mm. Vertex and frons dark brown; antennae bipectinate upto basal half, distal half serrated in male, simple in female, brown; labial palpus porrect, dark brown, second segment larger than third, third segment hardly visible; thorax dark brown; forewing with costa straight, apex quadrate, termen straight, tornus rounded, inner margin straight, ground colour dark brown, a broken ill-defined postmedial silvery line, more prominent in inner margin, a series of silvery marginal spots; hindwing oval, silky brown with yellowish tinge, cilia dark at tips; legs cloathed with dark brown scales; abdomen rusty red.

Wing venation : Forewing with Sc ending before posterior one-fourth of costal margin, R_1 arising from the posterior one-third of cell, R_2 arising in the posterior one-third of cell, R_3, R_4 and R_5 stalked, stalk orginating from upper angle of cell, M_1 and M_2 almost straight and parallel to each other, M_3 arising from lower angle of cell, CuA_1 arising just before lower angle of cell, CuA_2 arising before posterior one-fourth of cell, CuP well developed, 1A+2A straight; hindwing with Sc+R_1 anastomosing with Rs basally after origin, Rs and M_1 connate at upper angle of cell, M_2 arising near M_3 than M_1, M_3 arising from lower angle of cell, CuA_1 arising well before lower angle of cell, CuA_2 arising beyond middle of cell, CuP well developed, 1A+2A and 3A present, well developed, gently diverging distally.

Male genitalia : Male genitalia with uncus strongly built, highly sclerotized, much broader at base, setosed with long hair-like setae, tip blunt; gnathos biarmed at base with both the arms conjoint at second half, tip rounded; tegumen well formed, shoulder V-shaped; vinculum small, U-shaped; saccus small oval; valva well sclerotized, densely setosed with hair-like setae, flap-like, costa and sacculus not well

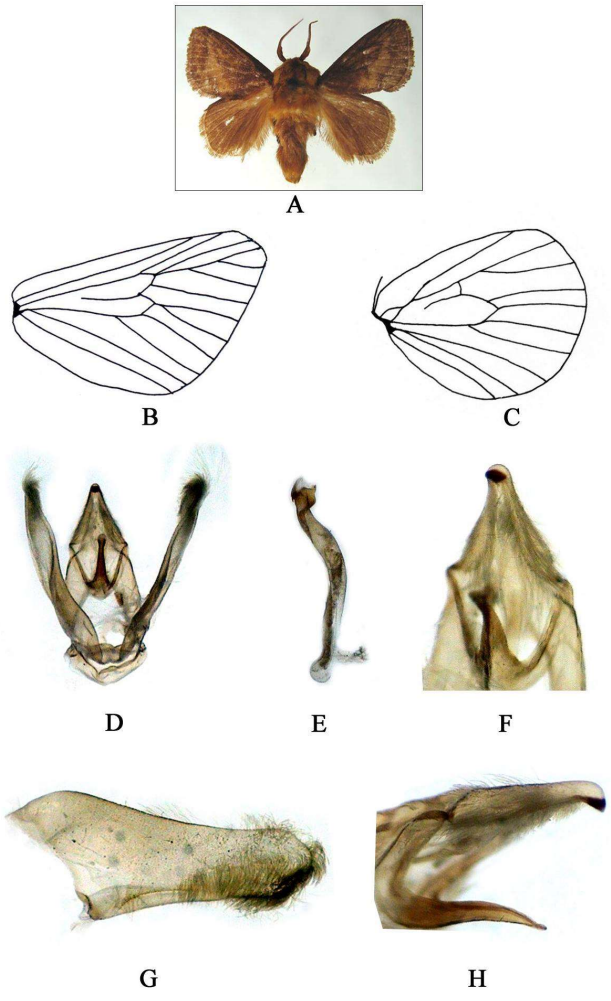

Plate-4: *Miresa nivaha* Moore

Figs.- A= Adult, B=Forewing, C= Hindwing, D= Male external genitalia, E= Aedeagus, F= Uncus and Gnathos ventral view, G= Valva, H= Uncus and Gnathos lateral view

marked, harpe and ampulla absent, cucullus and valvulla not differentiated; juxta flap-like; aedeagus moderately long and broad, well sclerotized, highly curved, two small spines present near tip, ductus ejaculatorius enters subapically.

Female genitalia: Not studied.

Material examined: India: Kerala: Dist. Idukki, Vallakadavu, 780mASL, 10.ix.2004, 01♂; Dist. Palakkad, Mukkali, 560mASL, 22.ix.2004, 02♂♂; Dist. Kollam, Shendurney, 70mASL, 03.ix.2004, 01♂, coll. Amit Katewa; Karnataka: District Uttar Kannada, Ganeshgudi, 480mASL, 21.vii.2004, 01♂; Dist. Uttar Kannada, Jog Falls, 480mASL, 29.vii.2004, 01♂; Dist. Uttar Kannada, Kulgi, 360mASL, 17.vii.2004, 02♂♂; Dist. Dakshina Kannada, Gundya, 40mASL, 28.vii.2004, 04♂♂, coll. Amit Katewa.

Distribution: The species *nivaha* Moore has earlier been reported from a single locality *i.e.,* Canara in Karnataka by Hampson (1892). However, the same has been collected from the aforesaid localities of the said state for the first time. Its collection from the state of Kerala is a new record.

***Miresa chandani* sp. nov. (Plate-5, Figs. A to H)**

Male: Alar expanse : 28 mm. Vertex and frons dark brown; antennae basal half bipectinate, distal half serrated, brown; labial palpus upturned, reaching upto frons, second larger than third, third segment hardly visible, dark brown; thorax dark silky brown; forewing with costa straight, apex quadrate, termen convex, tornus rounded, anal margin straight, ground colour dark silky brown, a broken ill-defined postmedial line from beyond middle of costa to nearly middle of anal margin, some silvery scales towards outer margin cilia silky brown; hindwing with costa convex, apex rounded, termen convex, tornus rounded, anal margin convex, ground colour light silky fuscous, cilia silky fuscous; legs covered with dark silky brown scales, hind tibia with long brown scales which darkest at tip; abdomen silky brown; anal tuft fuscous.

Wing venation: Forewing with Sc ending beyond middle of costal margin, R_1 from cell, R_2, R_3, R_4 and R_5 stalked, M_1 beyond upper angle, M_2 and M_3 on a short stalk originating from lower angle, Cu_1 before lower angle of cell, Cu_2 from cell, 1A and 2A present, 3A forked at base; hindwing with $Sc+R_1$ originating before middle of cell, Rs and M_1 stalked, M_2 towards middle of discocellulars, M_3 from lower angle, Cu_1 and Cu_2 from cell, 1A, 2A and 3A present.

Male genitalia : Male genitalia with uncus strongly built, slightly wavy, setosed with long setae, tip blunt, highly sclerotized; gnathos pointed; tegumen moderately broad, long; vinculum short, U- shaped; saccus present; valva simple, without any projection, costa and succulus well-marked, tip blunt, dressed with long hair-like setae; transtilla membranous; juxta short; aedeagus long and narrow, slightly curved, a pair of well formed spines present on distal end, vesica small, membranous, without any bifurcation, cornuti absent, ductus ejaculatorious enters subapically.

Female genitalia: Not studied.

Material examined: Holotype: India: Karnataka: Dist. Uttar Kannada, Kulgi, 360mASL, 17.vii.2004, 01♂, coll. Amit Katewa.

Larval host plant: Unknown.

Etymology: The species is named as *chandani* sp. nov. on the basis of an academician and poet.

Remarks: A phenon/complex comprising forty-four specimens has been identified into four already known species *i.e., Miresa albipuncta* Herrich-Schäffer, *Miresa decedens* Walker, *Miresa argentifera* Walker and *Miresa nivaha* Moore. One of the individuals collected from the locality Ganeshgudi is though completely congeneric to the aforesaid species, yet differ from them in respect of maculation of the wings, shape of the aedeagus and

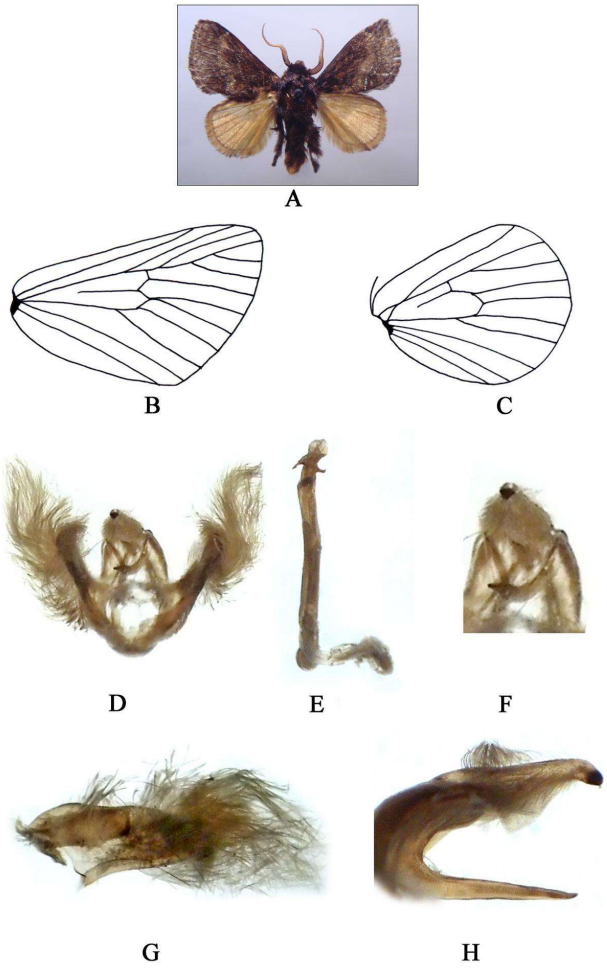

Plate-5: *Miresa chandani* sp. nov.

Figs.- A= Adult, B=Forewing, C= Hindwing, D= Male external genitalia, E= Aedeagus, F= Uncus and Gnathos ventral view, G= Valva, H= Uncus and Gnathos lateral view

structure of the valvae. This specimen could neither be identified from any of the museums nor relevant literature (Cai, 1986; Holloway, 1986; Chang, 1989; Epstein, 1996; Epstein, and Corrales, 2004 and Dubatolov and Strel'tsov, 2005) and hence is named and described as a new species *Miresa chandani* sp. nov.

During the present communication, survey-cum-collection led to the collection of as many as 45 representatives of genus *Miresa* Walker from the different localities of the Western ghats. On sorting, whole phenon was divided into five species. Out of which, four could be identified through literature and the identification was confirmed by comparison of these species with the identified collections of genus *Miresa* Walker from IARI, New Delhi. However, one species could not be identified from any source of identification, hence is described here as new to science. External male and female genitalia of all the studied species have been described and illustrated in full details for the first time. In this work, one species i.e., *M. argentifera* Walker has been reported for the first time from India.

CONCLUSIONS

The communication has information on taxonomy and distribution of five species of genus *Miresa* Walker. Out of which, four species i.e., *M. albipuncta* Herrich-Schäffer, *M. decedens* Walker, *M. argentifera* Walker, *M. nivaha* Moore were already known to literature, however, it is addition of newer localities to their distribution may help future studies on the species under reference. Besides, one species i.e., *M. chandani* sp. nov**.** is being described for the first time and *M. argentifera* Walker has been recorded for the first time from India. The communication may help in the conservation of these species.

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Abbreviations: 1A+2A= Vein representing fused first and second anal vein, 3A= Third anal vein, cua1= Fist anterior cubital vein, cua2 = Second Anterior cubital vein, cup = Posterior cubital vein, M1= First median vein, M2= Second median vein, M3= Third median vein, R1= First radial vein, R2= Second radial vein, R3= Third radial vein, R4= Fourth radial vein, R5= Fifth radial vein, Rs= Radial sector, Sc= Subcostal vein, Sc+R1= Stalk of subcostal and first radial vein, sp. nov.= New species.

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