Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(4): 678-692

Received: 28-05-2017
Accepted: 29-06-2017

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Diversity of Tortricid Moths (Lepidoptera: Tortricidae) in Kashmir division, Jammu & Kashmir, India

Mushtaq Ganai and Zakir Khan

Abstract
The present study was carried out in districts Anantnag, Ganderbal, Kupwara, Kargil and Leh of J&K State during 2010-2012. The whole collection of 2217 tortricid moth specimens comprised of 30 species out of five species (*Acleris birdi* sp. nov., *Choristoneura pseudofumiferana* sp. nov., *Clepsis kupwari* sp. nov., *Eucosma gundai* sp. nov. and *Rhopobota pseudonaevana* sp. nov.) were reported as new to science, two species [(*Crocidosema plebejana* Zeller and *Matsumuraeses phaseoli* (Matsumura)] as new to Jammu & Kashmir and one species (*Grapholita molesta* Busck) new to India. In this study, highest diversity and evenness indices were observed in Anantnag (H′ = 1.26268, J = 0.854825), followed by Kupwara (H′ = 1.22247, J = 0.827603) while as lowest were observed in Leh (H′ = 0.94035, J = 0.636610), respectively, the highest dominance index was observed in Leh (D = 0.363390). Results also indicated highest relative abundance of *Rhopobota naevana* (14 %) followed by *Archips cantinus* (12%) and *Clepsis rurinana* (10%).

Keywords: Tortricid moth, Bio diversity, Fauna, Kashmir, Ladakh

1. Introduction
Among moths, the Tortricidae is one of the largest families of so called micro-lepidoptera, second only to the Gelichiidae in number of described species [1] with over 10000 species in approximately 1050 genera and a large number still to be recorded, especially in the tropics. Though, worldwide in distribution, the family is more strongly represented in temperate and tropical upland regions than lowland tropics and probably reaches its greatest diversity in the moss forests of tropical latitudes [2]. Members of this family are characterized by a combination of characters such as rough scaled head above, short scaling of frons, thread like antenna, unscaled proboscis, very small or vestigial maxillary palpi, porrect or upcurved three segmented labial palpi, absence of tympanum, presence of chaetosema and ocelli and flat ovipositor lobes [3]. Fore tibia is with epiphysis and tibial spur formula of 0-2-4. Wing-coupling mechanism is fernate type, chorda and M-stem often developed in discal cell and hind wing often with cubital pectin at base of CuA and CuP is usually present [4].
Tortricid moths from the Indo-Pak sub-continent were collected and identified from various localities by Meyrick [5], Diakonoff [6], Rose and Pooni [7] and Razowski [8]. Around the globe the tortricid biodiversity has been studied by Bradley [9], Madsen [10], Kawabe [11], Brown [12] and Razowski [13]. The economic importance of these moths arises almost entirely from the activities of the larvae. They have chewing-type mouthparts and are among the world's greatest pests [14] as most of these cause major economic damage in agriculture and horticulture on wide variety of crops including pome fruits, stone fruits, citrus fruits, grapes, ornamental crops, tea, coffee, cereals and cotton.
The common name "leaf roller" has been applied to this family owing to its larval habit of shelter building by folding or rolling leaves of the food plants [15]. The larvae of these moths employ a wide range of feeding strategies, many have the habit of leaf rolling some are gall makers, root borers, fruit borers, flower feeders etc. [16]. This family has been further divided into three subfamilies Tortricinae, Olethreutinae and Chlidanotinae [17]. In general, members of the subfamily Tortricinae tend to be polyphagous, while Olethreutinae have narrower host range and hosts of Chlidanotinae are poorly known. In case of Kashmir division of Jammu & Kashmir state, 64 species of tortricid moths have been reported [18], although no exhaustive study has been performed and the few works that have been published offer only little information about tortricid moth diversity.

Keeping in view their economic importance, the present investigation was undertaken to study the diversity of tortricid moths in Kashmir division of Jammu & Kashmir.

2. Materials and Methods

For this study, intensive and extensive collection-cum-survey tours were conducted to capture different tortricid moth species from far-flung localities of different areas of Kashmir and Ladakh from March 2010 to November 2012. Since these moths being nocturnal in behaviour, their collection was done during night with the help of portable bucket type light traps fitted with 125 W mercury vapour lamp and mercury vapour lamp hung along a white cloth sheet secured to a wall or directly over a plain white wall to protect wings and scales from damage due to overcrowding during trapping in bucket of light trap. In this method specimen tubes with a piece of cotton soaked in benzene and a piece of blotting paper placed over it, were used for trapping and killing the moths. Chargeable electric lamp was also used for collection purpose in some areas where electricity supply was not available. For this study, the collection was done in five districts viz. Anantnag, Ganderbal, Kupwara, Kargil and Leh based on their accessibility, differing elevation, and habitat type. The surveyed areas included both plains and hilly places and elevation extremes examined for the study ranged from 1700 meters to 3000 meters. Sampling was done fortnightly in each district from March to November during 2010-2012.

2.1 Processing and preservation

The collected individuals were killed with benzene or ethyl acetate vapours in the killing bottles, transferred into butter paper envelops and were brought to the laboratory, where these were properly stretched in the small adjustable wooden stretching boards or thermocol sheets after pinning through the mid of mesothorax. Before stretching, the specimens were relaxed on blotting paper placed over water soaked cotton sterilized with phenol in an airtight Petri dish and left for 4-6 hours. The stretched specimens were then oven dried for 72 hours at 60ºC and preserved in the insect storage boxes, fumigated with naphthalene balls. Before the specimens were preserved in the boxes, each was furnished with data such as name of the locality, locality altitude, date of collection, and name of the collector etc.

2.2 Sorting of collected specimens

The sorting of collected adult moths was done on the basis of external morphological characters like scales on frons and vertex, presence of chaetosema, labial palpi, maxillary palpi, antennae, proboscis, wing venation, maculation and coastal fold, colour and markings of thorax, abdominal characters, position and number of tibial spurs etc.

2.3 Identification

All the specimens after sorting were identified with the help of relevant literature [19] especially the Tort fauna of Korea, Guide to tortricid moths of America at the first instance. To achieve this important objective, an exhaustive search of Biological Abstracts, Entomological Abstracts, Zoological Records, and Net surfing led to the collection of large number of references and procurement of research papers. A communication channel was also established with the eminent taxonomists (Joseph Razowski, Poland and John W. Brown USDA) currently working on family Tortricidae around the globe. The identification was confirmed by sending adult, wing and genitalia photographs to above mentioned tortricid experts for examination and validation of species. Identified adult moths were then photographed with the help of digital camera attached to Stereo zoom Olympus microscope and deposited in the insect collection museum of bio-systematic laboratory in the Division of Entomology, SKUAST-K, Shalimar campus, Srinagar.

2.4 Statistical analysis

Data for studying diversity of tortricid moths was analyzed by using Index of species diversity [20], Evenness index [21], Index of dominance [22], Species richness [23] and relative abundance formulae as follows.

1. Index of species diversity [20]

Index of species diversity (H´) = $-\Sigma$ pi $\log_{10}$ pi

Where pi = Important probability of each species (Ni/N)
Ni = Important value of each species
N = Total of important value

2. Evenness index [21].

Evenness index (J) = H´/Log_{10} S

Where H´ = Shannon Wieners index
S = Number of species

3. Index of dominance [22].

Index of dominance (D) = 1-J

Where J = Evenness index

4. Measurement of species richness [23].

Margalef's index = (S-1)/Log_{10} N

Where S = total number of species
N = total number of individuals in the sample

5. Relative abundance (R)

$R = n/N \times 100$

Where n = number of individuals in one species
N = number of individuals in all the species

3. Results

Over the course of this study, a total of 2217 tortricid moth specimens were captured from diverse localities of Kashmir and Ladakh by using light trap operated from dusk to dawn. The total collection was comprised of 30 species belonging to 18 genera, 6 tribes and 2 subfamilies out of five species (*Acleris birdi* sp. nov., *Choristoneura pseudofumiferana* sp. nov., *Clepsis kupwari* sp. nov., *Eucosma gundai* sp. nov. and *Rhopobota pseudonaevana* sp. nov.) were reported as new to science, two species [(*Crocidosema plebejana* Zeller and *Matsumuraeses phaseoli* (Matsumura)] as new to Jammu & Kashmir and one species (*Grapholita molesta* Busck) new to India (Table 1).

Systematic Account
Family-Tortricidae
Subfamily-Tortricinae
Tribe-Archipini
Genus *Archips* Hubner, 1822, *Syst.-alphab. Verz.* 58
***Archips cantinus* Razowski, 2006**

cantinus Razowski, 2006 (*Archips*), *Acta Zool. Cracov.* 49B: 122.

Material examined: Salia, 02.v.10-1♂; 02.ix,12-1♂; Gutlibag, 06.v.10-3♂; 11,ix.10-2♂; 09.ix.11-2♂, 1♀; Kundalgam, 10.v.10-1♂; 01.viii.12-6♂,2♀; Kargil, 18.v.10-1♂.

***Archips naltarica* Razowski, 2006**

naltarica Razowski, 2006 (*Archips*), *Acta Zool. Cracov.* 49B: 122.

Material examined: Hiller, 03.v.10-1♂; Handwara, 09.v.10-1♂; 21.viii.10-2♂,1♀; 19.vi.11-2♂; 30.vii.12-3♂,2♀; Khalsi, 19.v.10-1♂; 31.vii.10-3♂,1♀; 11.v.11-2♂; 28.vi.11-3♂,1♀;

01.vii.11-2♂,1♀; 12.v.12-1♂; 19.vii.12-3♂,1♀; 19.viii.12-1♂.

Genus *Choristoneura* Lederer, Lederer, 1859, *Wien. ent. Monatschr.* 3: 426.

***Choristoneura colyma* Razowski, 2006**

colyma Razowski, 2006 (*Coristoneura*), *Acta Zool. Cracov.* 49B: 123.

Material examined: Akingam, 06.vi.10-1♂; Lolab, 14.vi.10-1♂, Sonamarg, 11. vii. 10-1♂; 05. viii. 10-1♂,1♀; 20. viii.11-2♂; 16. viii.12-3♂, 2♀; Gawran, 14. vii.10-1♂, 1♀; Kupwara, 20. vii. 10-2♂,1♀; 27.viii. 12-2♂, 1♀; Aru, 11. viii. 10-1♂.

***Choristoneura pseudofumiferana* sp. nov.**

Material examined: Ranipora, 05.vi.10-1♂; Lolab, 14.vi.10-1♂; 28.viii.11-2♂; 27.viii.12-2♂,1♀; Gund, 10.vii.10-1♂; Gawran, 14.vii.10-1♂; Kupwara, 20.vii.10-2♂,1♀; 11.vii.11-2♂; Sonamarg, 5.viii.10-1♂; Seerhamdan, 09.viii.10-2♂.

Genus *Clepsis* Guenee, Guenee, 1845, *Annls Soc. ent. Fr* (2)3: 149.

***Clepsis rurinana* (Linnaeus, 1758)**

rurinana Linnaeus, 1758 (*Phalaena* (*Tortrix*)), *Systema Naturae* (*10th ed.*): 823.

Phalaena Tortrix modeeriana Linnaeus, 1761: 347.

Material examined: Salia, 02.v.10-1♂; 22.v.12-1♂; 02.ix.12-3♂,1♀; Gutlibag, 06.v.10-2♂; 08.vii.11-5♂, 3♀; 04.v.12-2♂,1♀.

***Clepsis kupwari* sp. nov.**

Material examined: Kupwara, 20.vii.10-1♂; Aru,11.viii.10-1♂; 22.vii.11-1♂.

***Clepsis translucida* (Meyrick, 1908)**

translucida (Meyrick, 1908) (*Cacoecia*), J. Bombay nat. Hist. Soc., 18: 616.

Cacoecia translucida Meyrick, 1908.

Material examined: Kangan, 09.vi.10-1♀; 10.vi.11-1♀; 15.vi.12-1♀; Leh, 01.viii.10-1♀; Shargol, 03.viii.10 1♀; Sonamarg, 5.viii.10-2♀; 20.viii.11-3♀.

Genus *Neocalyptis* Diakonoff, Diakonoff, 1941, Treubia, vol. 18, p. 407.

***Neocalyptis chlansignum* Razowski, 2006**

chlansignum Razowski, 2006 (*Neocalyptis*), *Acta Zool. Cracov.* 49B: 125.

Material examined: Khalsi, 31.vii.10-1♂; 01.vii.11-3♂; 25. ix.11-1♂; 22.vi.12-2♂.

Table 1: Classification of reported species.

S. No.	Family	Sub family	Tribe	Genus	Species
1	Tortricidae	Tortricinae	Archipini	*Archips* Hubner	*Archips cantinus* Razowski
2					*Archips naltarica* Razowski
3				*Choristoneura* Lederer	*Choristoneura colyma* Razowski
4					*Choristoneura pseudofumiferana* sp. nov.*
5				*Clepsis* Guenee	*Clepsis rurinana* (Linnaeus)
6					*Clepsis translucida* (Meyrick)
7					*Clepsis kupwari* sp. nov.*
8				*Neocalyptis* Diakonoff	*Neocalyptis chlansignum* Razowski
9					*Neocalyptis ladakhana* Razowski
10				*Pandemis* Hubner	*Pandemis thomasi* Razowski
11				*Homona* Walker	*Homona coffearia* (Nietner)
12					*Homona nakaoi* Yasuda
13			Tortricini	*Acleris* Hubner	*Acleris orphnocycla* (Meyrick)
14					*Acleris birdi* sp. nov.*
15			Cnephasiini	*Cnephasia* Curtis	*Cnephasia hunzorum* Diakonoff
16		Olethreutinae	Olethreutini	*Celypha* Hubner	*Celypha constructa* (Meyrick)
17			Eucosimini	*Eucosma* Hubner	*Eucosma conterminana* (Guenee)
18					*Eucosma gundai* sp. nov. *
19					*Eucosma tetraplana* (Moschler)
20				*Rhopobota* Lederer	*Rhopobota naevana* (Hubner)
21					*Rhopobota pseudonaevana* sp. nov.*
22				*Pelochrista* Lederer	*Pelochrista teleopa* Razowski
23				*Crocidosema* Zeller	*Crocidosema plebejana* Zeller**
24				*Gibberifera* Obraztsov	*Gibberifera obscura* Diakonoff
25				*Lepteucosma* Diakonoff	*Lepteucosma charassuncus* Razowski
26					*Lepteucosma srinagara* Razowski,
27			Grapholitini	*Cydia* Hubner	*Cydia pomonella* (Linnaeus)
28				*Grapholita* Treitschke	*Grapholita molesta* Busck***
29				*Matsumuraeses* Issiki	*Matsumuraeses capax* Razowski &Yasuda
30					*Matsumuraeses phaseoli* (Matsumura)**

*= New to Science, **= New to Jammu & Kashmir, ***= New to India.

***Neocalyptis ladakhana* Razowski, 2006**

ladakhana Razowski, 2006 (*Neocalyptis*), *Acta Zool. Cracov.* 49B: 125.

Material examined: Kharbo, 25.vi.10-1♂; 26.vi.11-1♂; 17.vii.12-5♂, 1♀; Khalsi, 27.vi.10-1♂; 31.vii.10-2♂, 1♀; 01.vii.11-3♂, 1♀; 12.v.12-2♂; 22.vi.12-2♂, 1♀; 19.viii.12-3♂,2♀; 10.ix.12-2♂; Silikchi, 27.vii.10-1♂, 1♀.

Genus *Pandemis* Hubner, Hubner, [1825] 1816, *Verz. bekannter Schmett.* 388.

***Pandemis thomasi* Razowski, 2006**

thomasi Razowski, 2006 (*Pandemis*), *Acta Zool. Cracov.* 49B: 124.

Material examined: Kangan, 09.vi.10-2♂; 14.vii.12-3♂, 1♀; 15.viii.12-3♂, 1♀; Gund, 10.vii.10-2♂, 1♀; Kupwara, 20.vii.10-2♂; 27.viii.11-2♂; 28.v.12-1♂.

Genus *Homona* Walker, Walker, 1863, *List Specimens lepid. Insects Colln. Br. Mus.*28: 424.
***Homona coffearia* (Nietner, 1861)**
coffearia Nietner, 1861 (*Tortrix*), *Obs. Enem. Coff. Tree Ceylon*: 24.
Homona picrostacta Meyrick, 1921.
Godana simulana Walker, 1866.
Material examined: Gund, 10.vii.10-1♂; 15.vii.12-2♂,1♀; Sonamarg, 5.viii.10-1♂; Aru.11.viii.10-1♂,1♀; Dardpora, 19.viii.10-1♂.

***Homona nakaoi* Yasuda, 1969**
nakaoi Yasuda, 1969 (*Homona*), *Bull. Univ. Osaka Pref.* (*B*) 21: 168.
Material examined: Ranipora, 05.vi.10-1♂; Gawran, 14.vii.10-2♂; Kupwara, 20.vii.10-1♂; 28.vii.12-1♂; Sirgufara, 15.viii.10-1♂.

Tribe-Tortricini
Genus *Acleris* Hubner, Hubner, [1825] 1816, *Verz. bekannter Schmett.* 384
***Acleris orphnocycla* (Meyrick, 1937)**
orphnocycla Meyrick in Caradja & Meyrick, 1937 (*Peronea*), *Dt. ent. Z. Iris* 51: 178.
Peronea orphnocycla Meyrick in Caradja & Meyrick, 1937.
Material examined: Wailnagbal, 04.vi.10-1♂; Kangan, 09.vi.10-2♂; 21.viii.11-3♂, 1♀; 14.vii.12-5♂,1♀; 15.viii.12-3♂,1♀; Lolab, 14.vi.10-2♂, 1♀; 12.vii.11-4♂, 2♀; 29.vii.12-4♂.

***Acleris birdi* sp. nov.**
Material examined: Kupwara, 20.vii.10-1♂; 28.vii.12-2♂; Silikchi, 27.vii.10-2♂; Khalsi, 31.vii.10-1♂; 19.vii.12-1♂; Leh, 01.viii.10-1♂; 19.viii.12-3♂; Drass, 04.viii.10-2♂; Seerhamdan, 09.viii.10-1♂; Dardpora, 19.viii.10-1♂.

Tribe-Cnephasiini
Genus *Cnephasia* Curtis, Curtis, 1826, *Br. Ent.* 6: folio100.
***Cnephasia hunzorum* Diakonoff, 1971**
Cnephasia (*Anoplocnephasia*) *hunzorum* Diakonoff, 1971: 174
Material examined: Wailnagbal, 04.vi.10-1♂; Kangan, 09.vi.10-1♂,1♀; 21.viii.11-3♂, 2♀; 16.ix.12-1♂; Gund, 10.vii.10-3♂, 1♀; 10.vi.11-1♂; 15.vii.12-4♂.

Subfamily-Olethreutinae
Tribe-Olethreutini
Genus *Celypha* Hubner, Hubner, [1825] 1816, *Verz. bekannter Schmett.* 382.
***Celypha constructa* (Meyrick, 1922)**
constructa Meyrick, 1922 (*Argyroploce*), *Exotic Microlepid.* 2: 526.
Material examined: Kangan, 09.vi.10-1♂; 15.viii.12-2♂; Dardpora, 19.viii.10-1♂; Sonamarg, 06.vii.11-1♂; Lolab, 12.vii.11-1♂; Deesu, 26.vii.11-1♂.

Tribe-Eucosimini
Genus *Eucosma* Hubner, Hubner, 1823, *Zutr.Samml.exot.Schmett.* 2: 28.
***Eucosma conterminana* (Guenee, 1845)**
conterminana Guenee, 1845 (*Catoptria*), *Annls Soc.ent. Fr.* (2) 3: 189.
Catoptria conterminana Guenée, 1845, *Annls Sc.ent. Fr.*, (2)3: 189.
Eucosma caecimaculata Duponchel, 1835, *Hist. Nat. Lépid. Papillons Fr.*, 9: pl. 249.
Material examined: Gutlibag, 06.v.10-1♂; 08.vii.11-1♂; Kundalgam, 10.v.10-1♂; 26.viii.11-1♂; Kangan, 09.vi.10-1♂; 12.ix.10-1♂; 10.vi.11-1♂,1♀; 11.ix.11-1♂; 14.vii.12-3♂, 1♀.

***Eucosma gundai* sp. nov.**
Material examined: Gund, 10.vii.10-2♂; 06.v.12-1♂; 15.vii.12-4♂; Sonamarg, 5.viii.10-2♂; 15.ix.12-1♂; Kangan, 10.vi.11-2♂; 21.viii.11-3♂; 15.viii.12-2♂.

***Eucosma tetraplana* (Moschler, 1866)**
tetraplana Moschler, 1866 (*Grapholitha*), *Berl. Ent. Z.* 10: 148.
Material examined: Gawran, 14.vii.10-2♂; Silikchi, 27.vii.10-1♂; Sirgufara, 15.viii.10-2♂; Brariangan, 14.vi.11-1♂; Kharbo, 26.vi.11-1♂.

Genus *Rhopobota* Lederer, Lederer, 1859, *Wien. ent. Monatschr.* 3: 366.
***Rhopobota naevana* (Hubner, 1817)**
naevana Hubner, [1814-1817] (*Tortrix*), *Samml. Eur. Schmett.* 7: pl. 41 fig. 261.
Tortrix naevana (Hubner, 1817):pl.41, fig.261.
Tortrix unipunctana (Haworth, 1811):454.
Lithographia geminana Stephens, 1852:99.
Material examined: Akingam, 06.vi.10-5♂, 1♀; Kangan, 09.vi.10-2♂, ♀; 10.vi.11-3♂,2♀; 21.viii.11-12♂,4♀; 16.ix.12-1♂.

***Rhopobota pseudonaevana* sp. nov.**
Material examined: Lolab, 14.vi.10-2♂; 12.vii.11-4♂, 1♀; 29.vii.12-6♂,2♀; Gawran, 14.vii.10-2♂, 1♀; Kupwara, 20.vii.10-2♂; 27.viii.12-5♂,2♀; Sirgufara, 15.viii.10-3♂, 2♀; 10.vii.12-3♂, 1♀; Dardpora, 19.viii.10-4♂, 2♀.

Genus *Pelochrista* Lederer, Lederer, 1859, *Wien. ent. Monatschr.* 3: 331.
***Pelochrista teleopa* Razowski, 2006**
teleopa Razowski, 2006 (*Pelochrista*), *Acta Zool. Cracov.* 49B: 129.
Pelochrista telopea Razowski, 2006
Material examined: Khalsi, 31.vii.10-1♂; 19.vii.12-2♂; Shargol, 03.viii.10-1♂; Pahalgam.10.viii.10-1♂, 1♀; Sonamarg, 5.viii.10-1♂.

Genus *Crocidosema* Zeller, Zeller, 1847, *Isis von Oken* (*Leipzig*) 1847(10): 721.
***Crocidosema plebejana* Zeller, 1847**
plebejana Zeller, 1847 (*Crocidosema*), *Isis von Oken* (*Leipzig*) 1847 (10): 721.
Crocidosema plebeiana Zeller
Crocidosema ptiladelpha Meyrick, 1917
Crocidosema synneurota Meyrick, 1926
Crocidosema? insulana Aurivililus, 1922
Material examined: Ganjipora, 07.vi.10-2♂; Kupwara, 20.vii.10-1♂; Batkoot, 15.vii.10-2♂; Khalsi, 31.vii.10-1♂; 08.viii.11-1♂; Aru, 11.viii.10-2♂; Kokernag, 15.vi.11-1♂; Panikhar, 02.vii.11-1♂; Lolab, 12.vii.11-2♂; 29.vii.12-2♂.

Genus *Gibberifera* Obraztsov, Obraztsov, 1946, *Z. Wien. ent. Ges.* 30: 35.
***Gibberifera obscura* Diakonoff, 1964**
obscura Diakonoff, 1964 (*Gibberifera*), *Verff. Zool. Staatsamml. Mnchen* 8: 48.
Material examined: Akingam, 06.vi.10-2♂; Gund, 10.vii.10-

1♂; Gawran, 14.vii.10-3♂,1♀; Sonamarg, 5.viii.10-1♂; 15.ix.12-2♂; Seerhamdan, 09.viii.10-2♂; Hutmurah, 19.v.11-1♂; Kangan,10.vi.11-2♂; 14.vii.12-2♂; 15.viii.12-2♂,1♀.

Genus *Lepteucosma* Diakonoff, Diakonoff, 1971, *Verff. Zool. Staatsamml. Mnchen*15: 179.

***Lepteucosma charassuncus* Razowski, 2006**

charassuncus Razowski, 2006 (*Lepteucosma*), *Acta Zool. Cracov.*49B: 128.

Material examined: Ganjipora, 07.vi.10-1♂; Gawran, 14.vii.10-2♂, 1♀; Kupwara, 20.vii.10-2♂; 27.viii.11-3♂,2♀; Pahalgam.10.viii.10-3♂,1♀.

***Lepteucosma srinagara* Razowski, 2006**

srinagara Razowski, 2006 (*Lepteucosma*), *Acta Zool. Cracov.* 49B: 127.

Material examined: Gund, 10.vii.10-1♂; Gawran, 14.vii.10-1♂; Brariangan, 14.vi.11-1♂; Batkoot, 23.vii.11-1♂,1♀; Gutlibag, 08.vii.11-1♂.

Tribe-Grapholitini

Genus *Cydia* Hubner, Hubner, [1825] 1816, *Verz. bekannter Schmett.* 375.

***Cydia pomonella* (Linnaeus, 1758)**

pomonella Linnaeus, 1758 (*Phalaena* (*Tortrix*)), *Systema Naturae* (*10th ed.*): 538.

Phalaena (*Tortrix*) *pomonella* Linnaeus, 1758

Phalaena Tortrix aeneana Villers, 1789

Carpocapsa splendana ab. glaphyrana Rebel, 1941

Material examined: Khalsi, 27.vi.10-1♂; 01.vii.11-1♂; 19.vii.12-1♂, 1♀; Kharbo, 26.vi.11-1♂; Kargil, 04.vii.11-1♂, 1♀; Mulbek, 18.vii.12-2♂, 1♀; Sankoo, 18.viii.12-2♂, 1♀.

Genus *Grapholita* Treitschke, Treitschke, 1829, in Ochsenheimer, *Schmett. Eur.* 7: 232.

***Grapholita molesta* Busck, 1916**

molesta Busck, 1916 (*Laspeyresia*), *J. Agric. Res.* 7: 373.

Laspeyresia molesta Busck, 1916.

Cydia molesta: Karsholt and Razowski, 1996: no. 5107.

Grapholita molesta: Park, 1983: 667-668, 965, pl. 4.

Material examined: Gutlibag, 08.vii.11-1♂, 1♀; Lar, 22.viii.11-1♂; Nagbal, 13.vi.12-1♂; Gund, 15.vii.12-2♂,1♀; Kangan, 15.viii.12-1♂,1♀.

Genus *Matsumuraeses* Issiki, Issiki, 1957, in Esaki *et al.*, *Icones heterocerorum Japonicorum in coloribus naturalibus* 1: 57.

***Matsumuraeses capax* Razowski &Yasuda, 1975**

capax Razowski & Yasuda, 1975: 99.

Matsumuraeses ochreocervina sensu Danilevsky & Kuznetzov, 1968: 239.

Material examined: Kangan, 07.vii.11-1♂; 15.viii.12-1♂; Handwara, 13.vii.11-1♂,1♀; Leh, 07.viii.11-1♂; Kundalgam, 26.viii.11-1♂.

***Matsumuraeses phaseoli* (Matsumura, 1900)**

phaseoli (Matsumura): Razowski, 1960: 385.

Semasia phaseoli Matsumura, 1900: 197.

Semasia elutana Kennel, 1900: 147.

Thiodia azukivora Matsumura 1910:165.

Material examined: Kupwara, 20.vii.10-1♂; Gutlibag, 08.vii.11-1♂; Lolab, 14.vi.10-2♂, 1♀; 12.vii.11-2♂; Silmoo, 12.viii.11-2♂; Lar, 22.viii.11-2♂.

Further tribe Archipini was found most diverse at species level with 12 species followed by Eucosimini with 10 species while as tribes Cnephasiini and Olethreutini were found to be least diverse with one species each(Fig. 1). Also *Rhopobota naevana* (Hubner**)** was the most dominant species in terms of relative abundance (14.47%) followed by *Archips cantinus* Razowski (12.81%), while as *Grapholita molesta* Busck was found least dominant (0.40%) (Fig. 2).

The diversity indices for various tortricid moth species at various localities given in Table 2 indicated that species diversity was found highest in Anantnag (H′ = 1.23693) followed by Kupwara (H′=1.18888) and lowest in Leh (H′=0.99781). Results of present study also revealed that evenness index, index of dominance and richness were 0.837392, 0.162608 and 8.494294 in Anantnag, 0.783443, 0.216557 and 7.384377 in Ganderbal, 0.804863, 0.195137 and 8.222310 in Kupwara, 0.755707, 0.244293 and 7.320583 in Kargil and 0.675510, 0.324490 and 6.084232 in Leh district, respectively (Table 2).

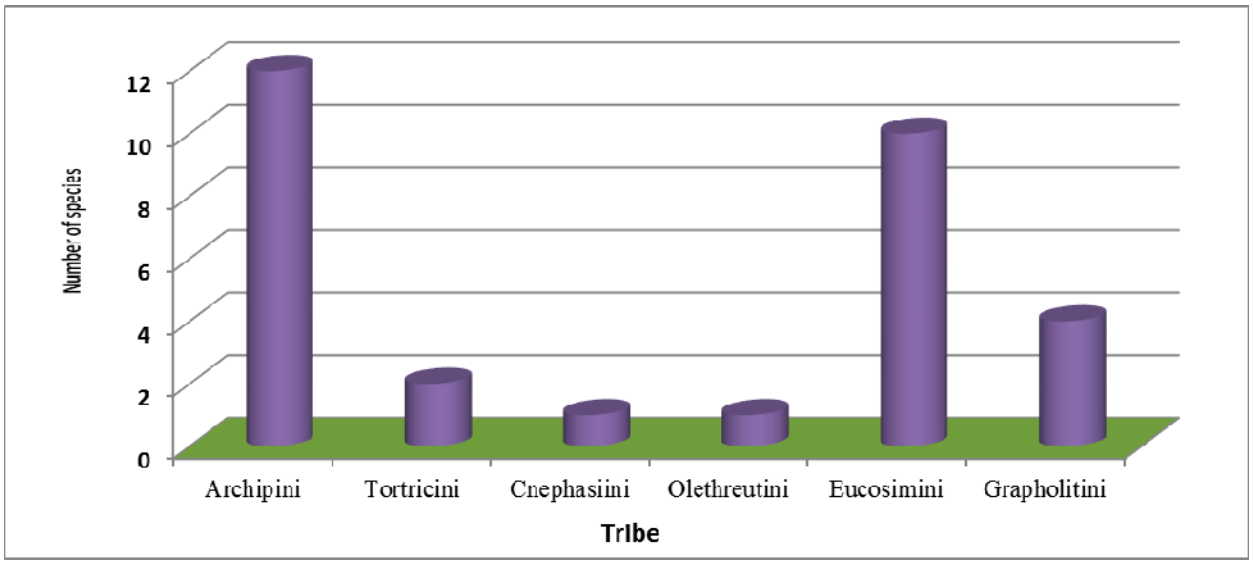


Fig 1: Tribe wise species of Tortricid moths caught by light trap in Kashmir and Ladakh during 2010-2012.

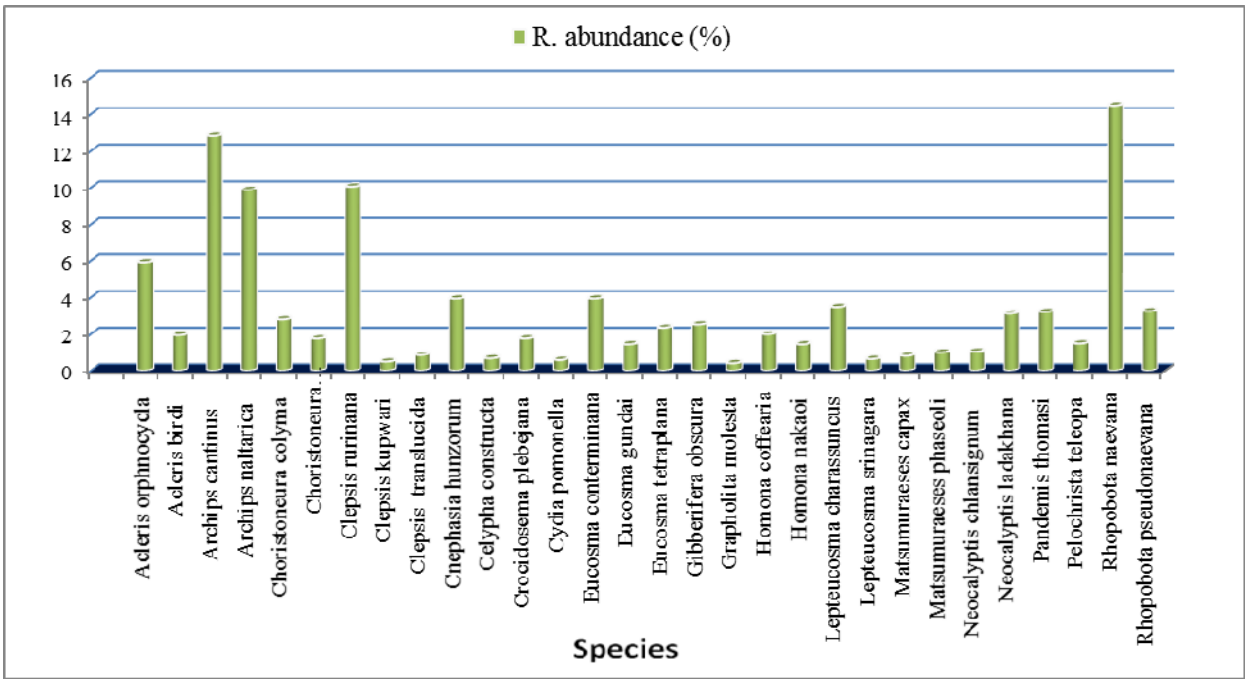
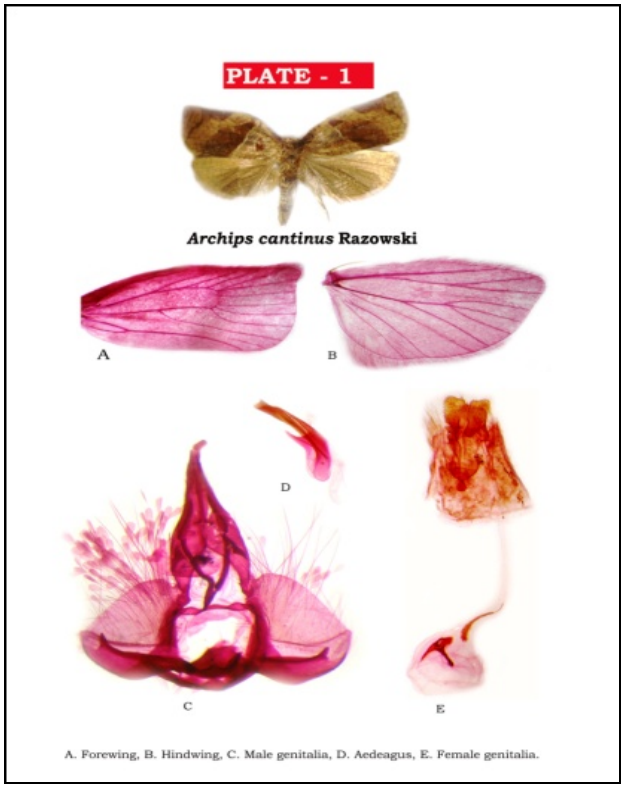


Fig 2: Relative abundance of studied Tortricid moth species in Kashmir and Ladakh.

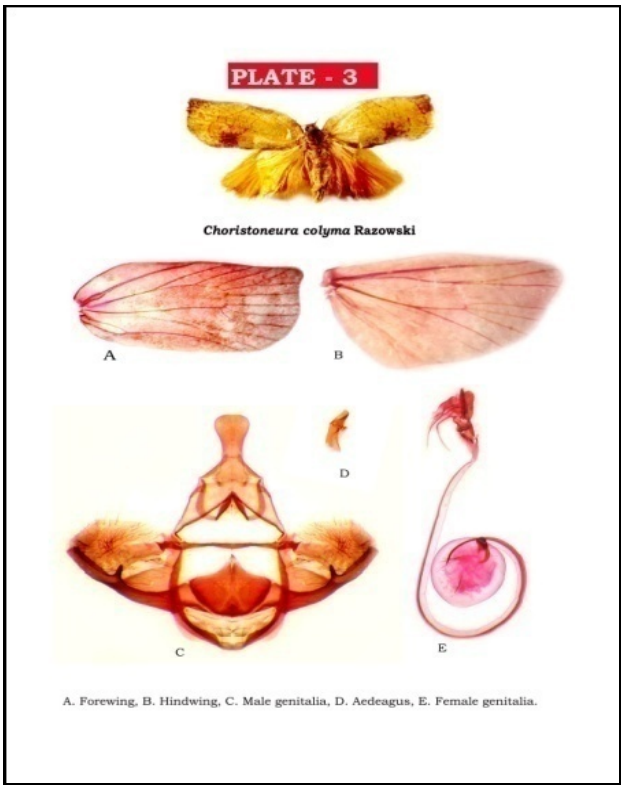
Table 2: Diversity indices of tortricid moths in Kashmir and Ladakh.

S. No.	District	Total No. of species	Index			
			Diversity Index (H)	Evenness Index (J)	Index of Dominance (D)	Species Richness (M)
1.	Anantnag	25	1.23693	0.837392	0.162608	8.49424
2.	Ganderbal	21	1.15724	0.783443	0.216557	7.384377
3.	Kupwara	24	1.18888	0.804863	0.195137	8.222310
4.	Kargil	18	1.11627	0.755707	0.244293	7.320583
5.	Leh	15	0.99781	0.675510	0.324490	6.084232

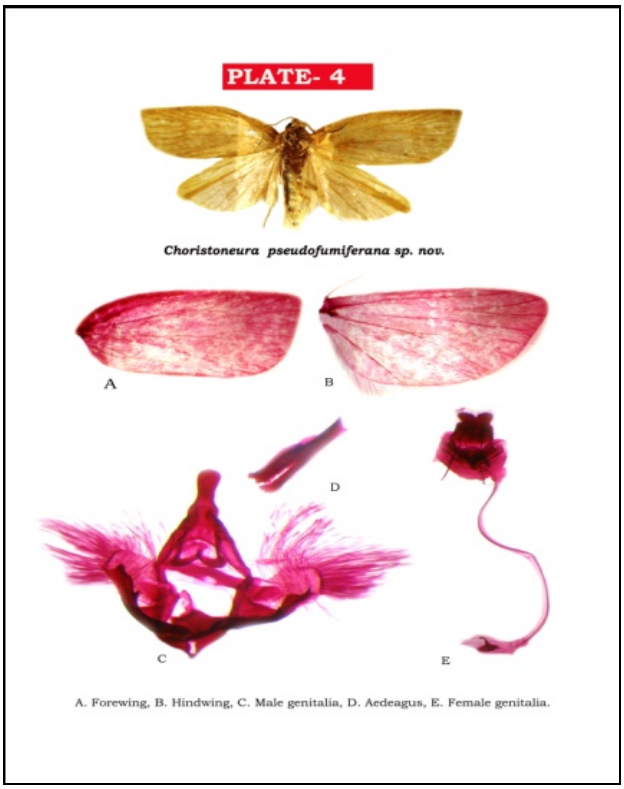


1. *Archips cantinus* Razowski,

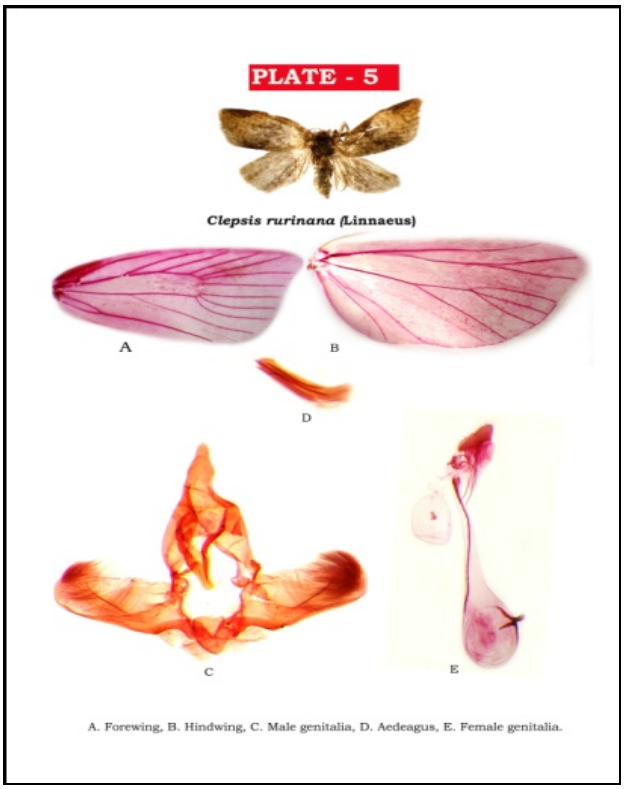
2. *Archips naltarica* Razowski.



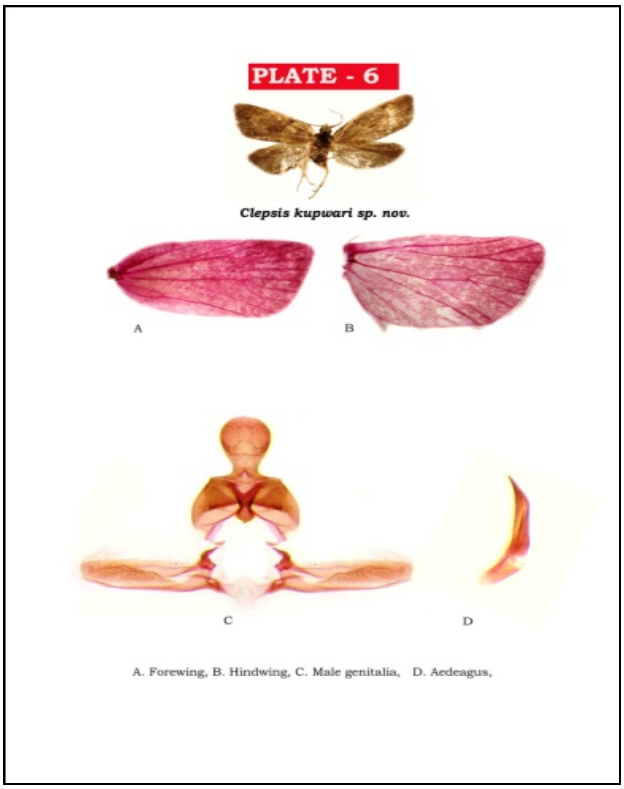
3. *Choristoneura colyma* Razowski,



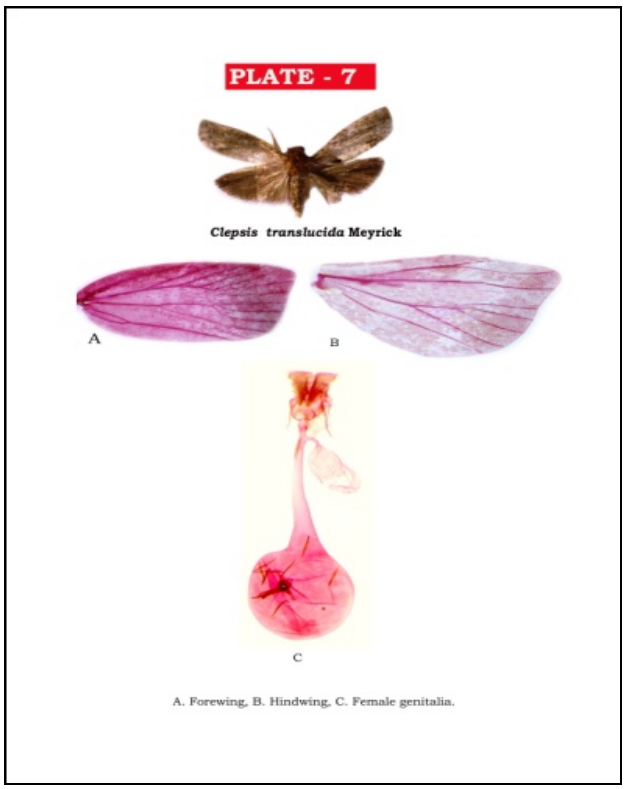
4. *Choristoneura pseudofumiferana* sp. nov.



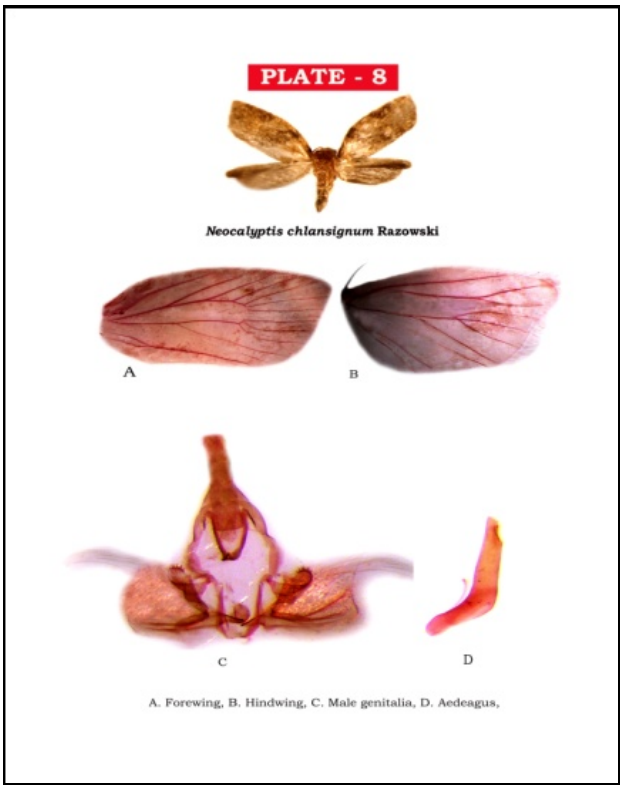
5. *Clepsis rurinana* Linnaeus,



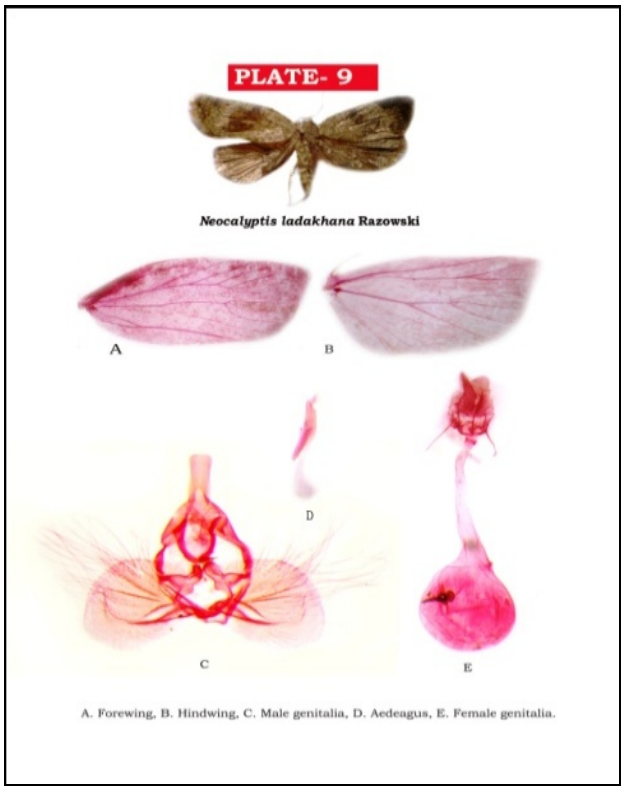
6. *Clepsis kupwari* sp. nov.



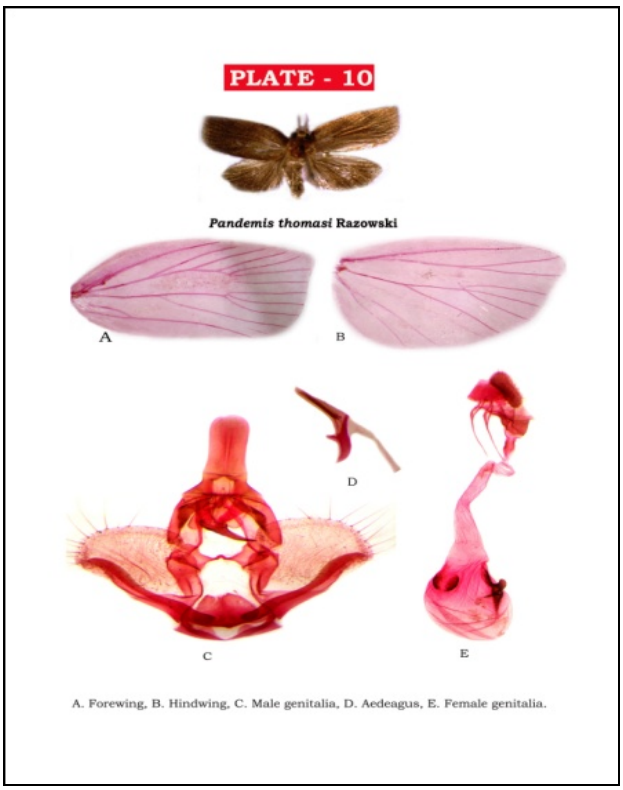
7. *Clepsis translucida* Meyrick,



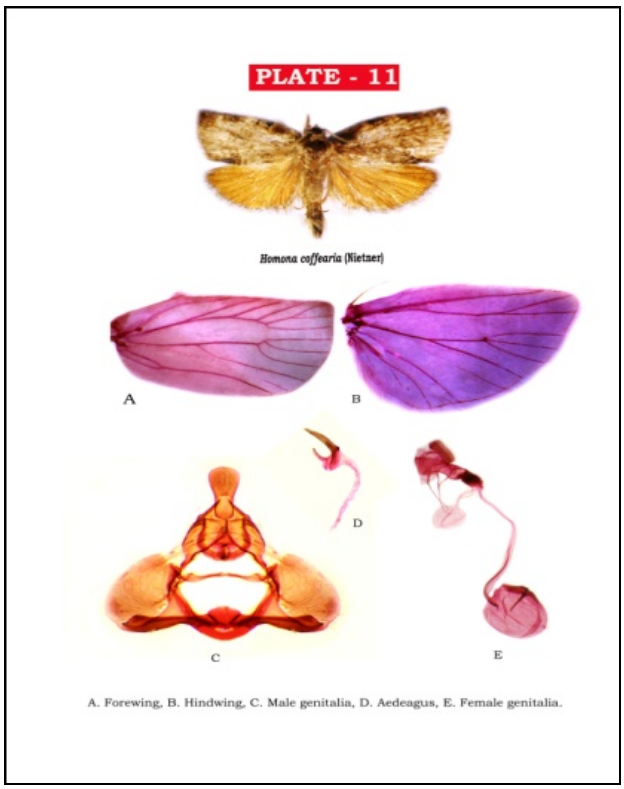
8. *Neocalyptis chlansignum* Razowski.



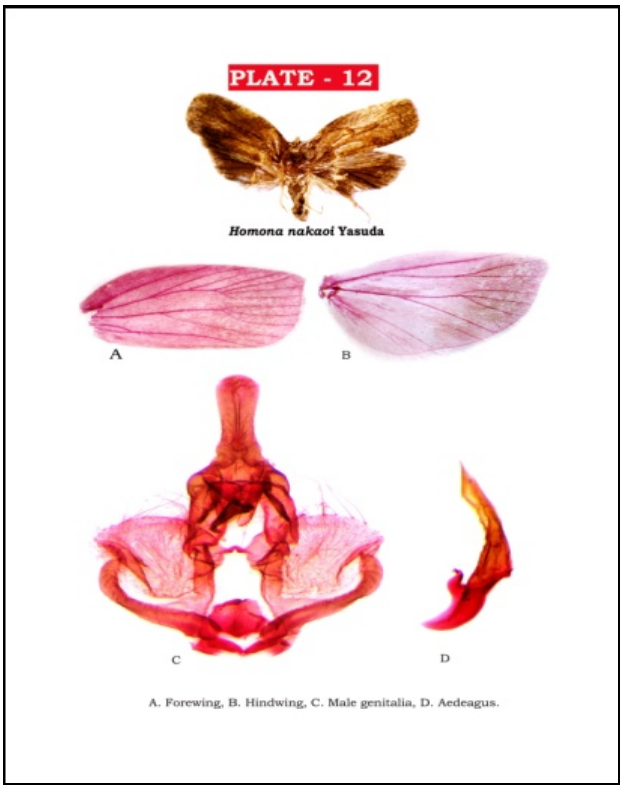
9. *Neocalyptis ladakhana* Razowski.



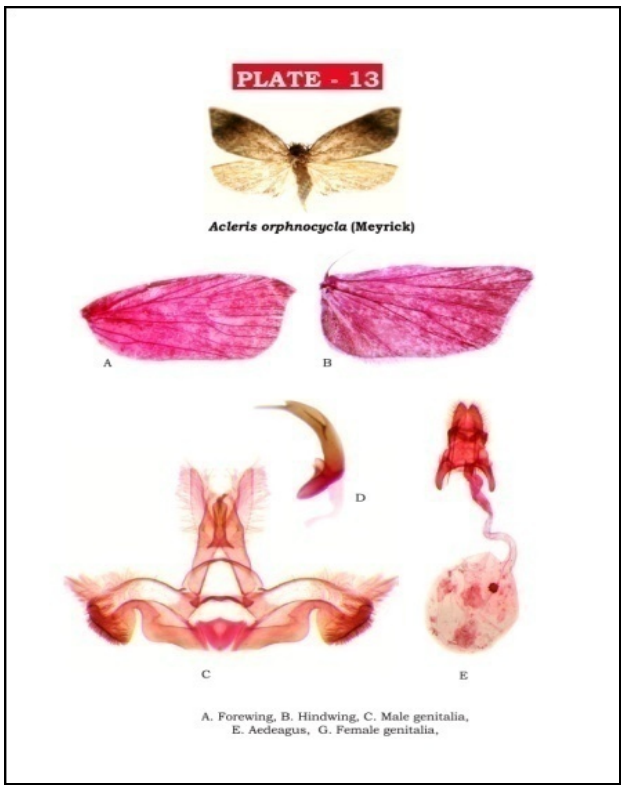
10. *Pandemis thomasi* Razowski.



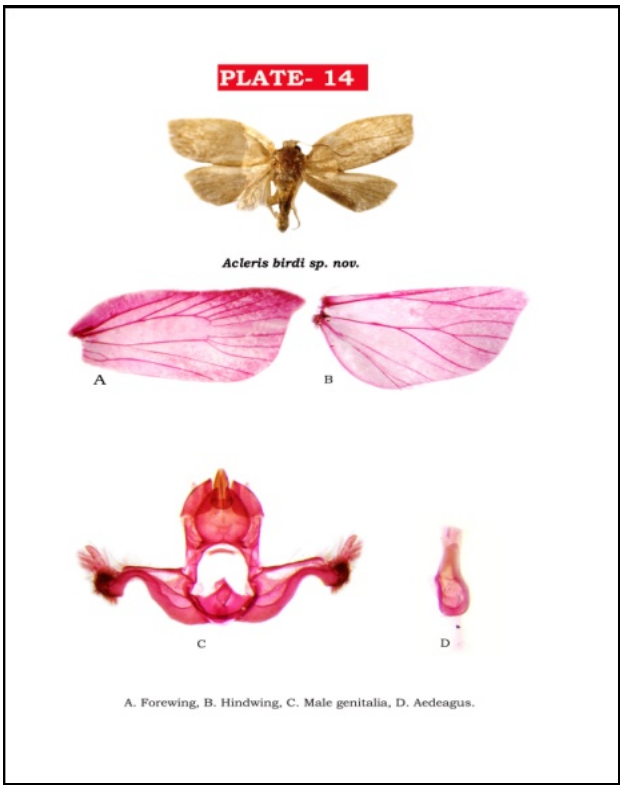
11. *Homona coffearia* Nietner,



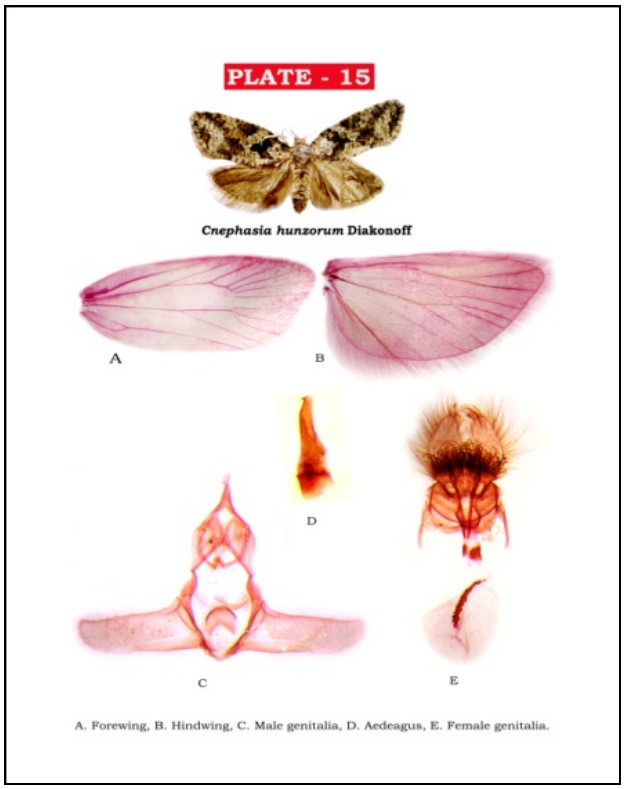
12. *Homona nakaoi* Yasuda.



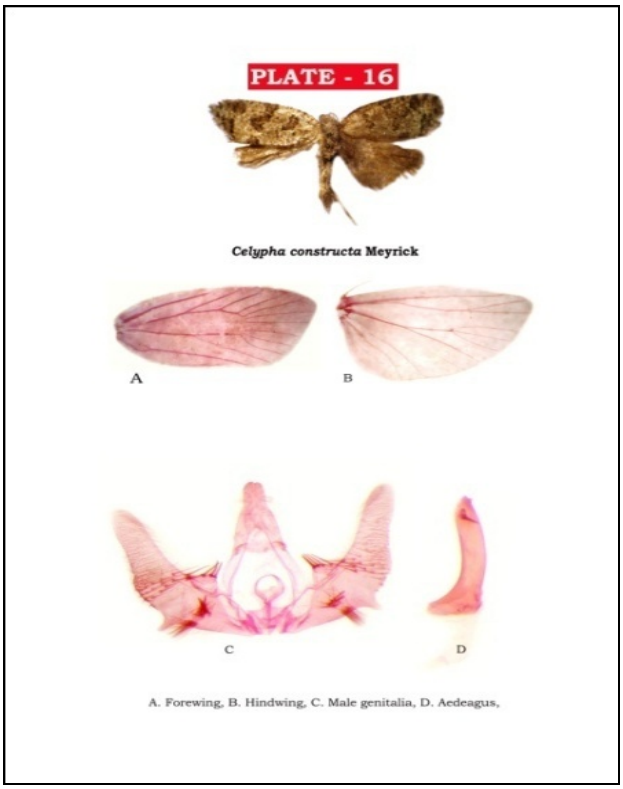
13. *Acleris orphnocycla* Meyrick.



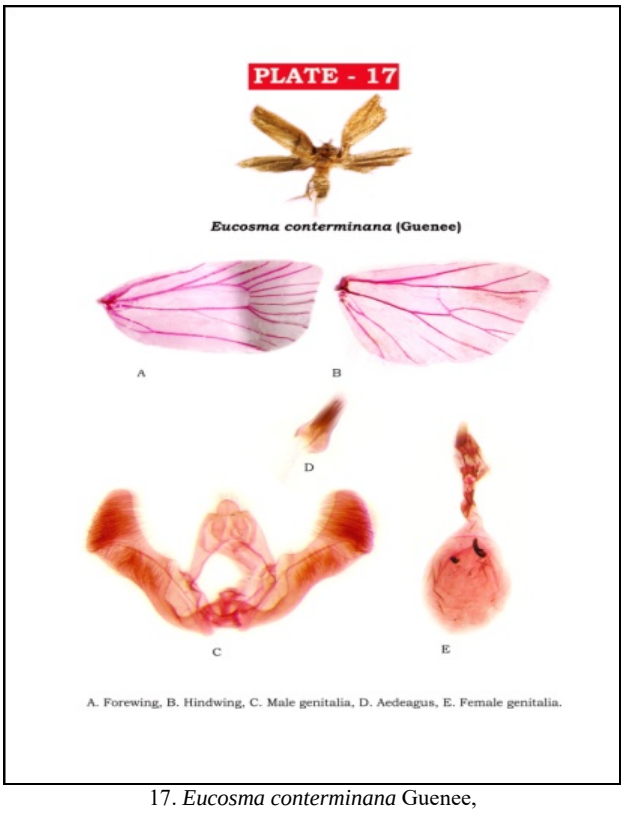
14. *Acleris birdi* sp. nov.



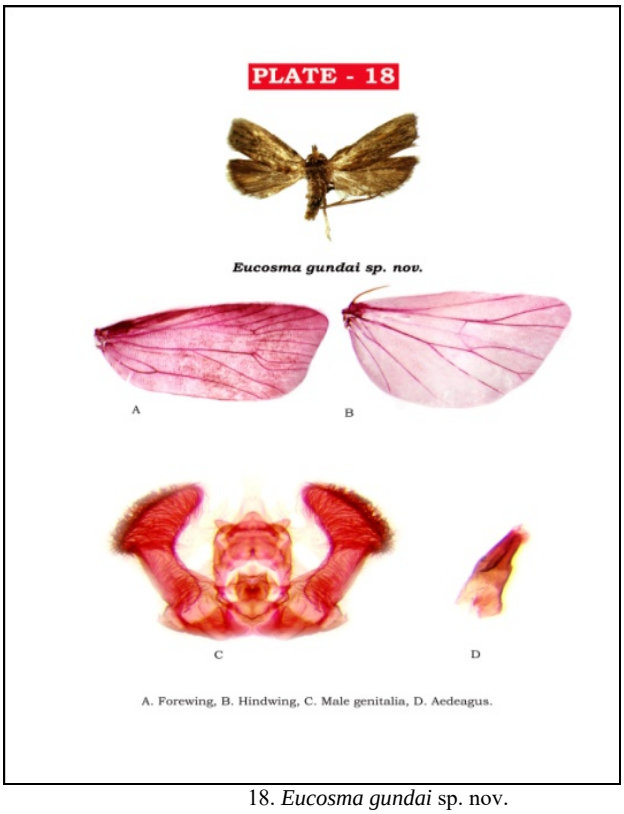
15. *Cnephasia hunzorum* Diakonoff,



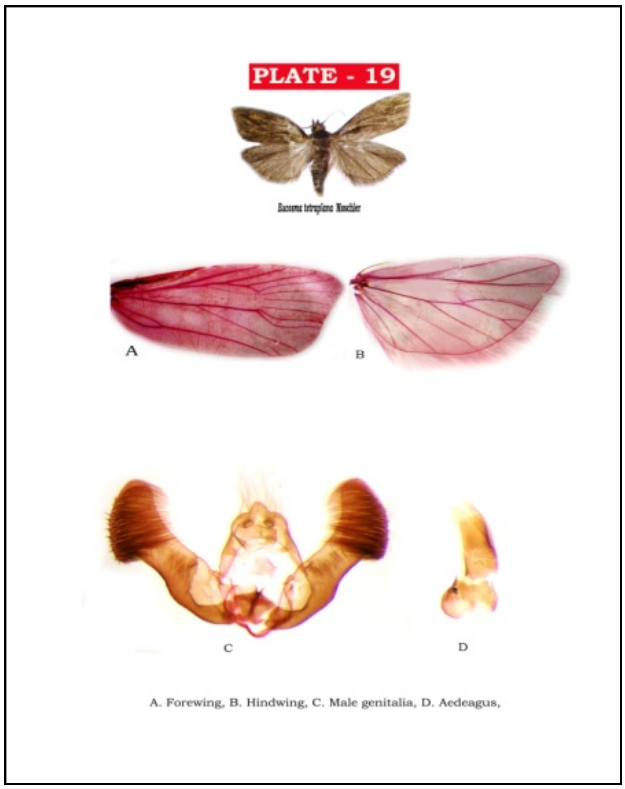
16. *Celypha constructa* Meyrick,



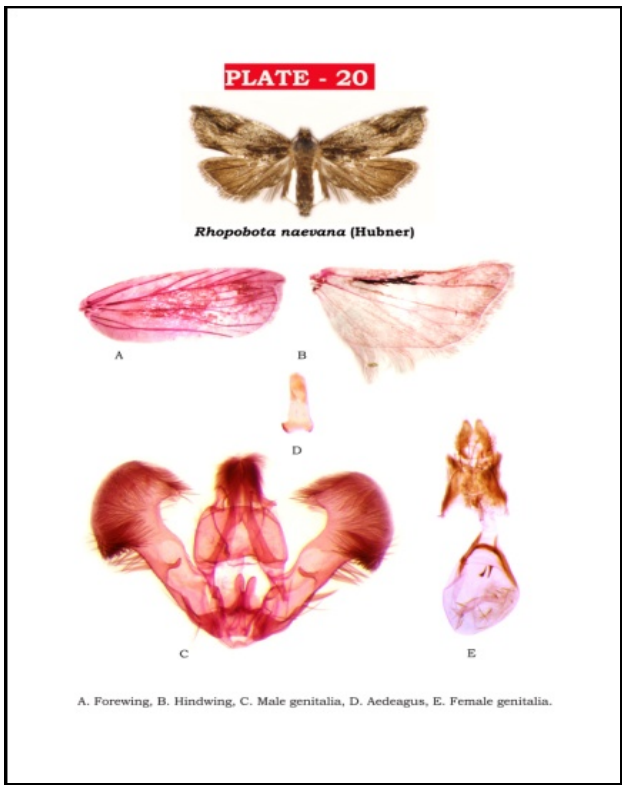
17. *Eucosma conterminana* Guenee,



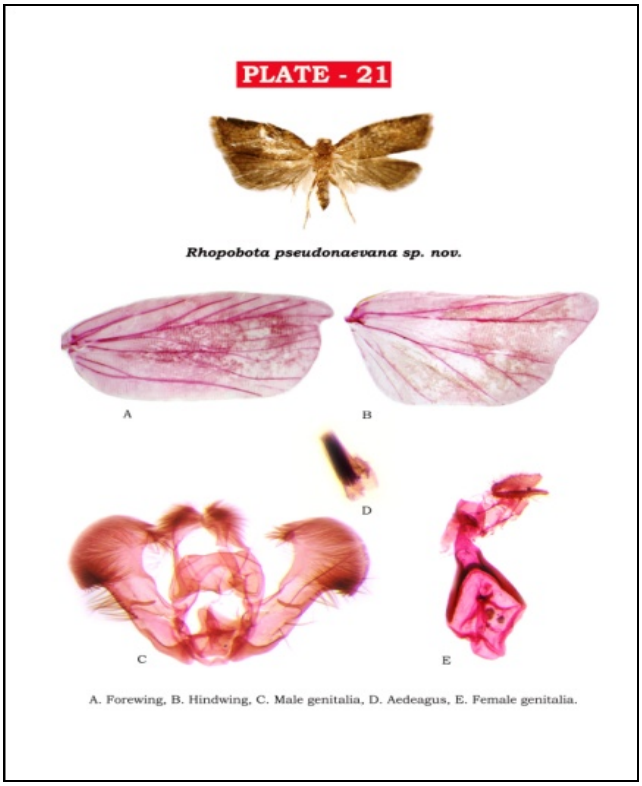
18. *Eucosma gundai* sp. nov.



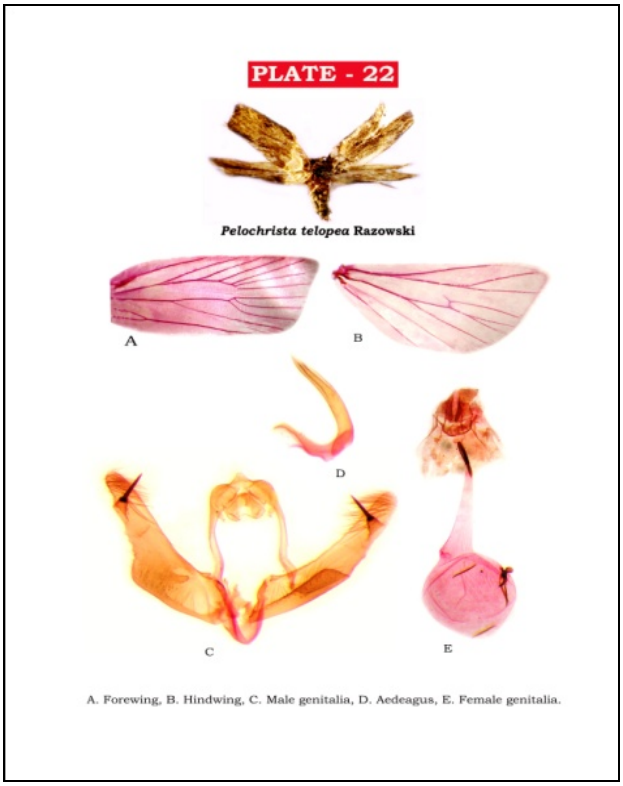
19. *Eucosma tetraplana* Moschler,



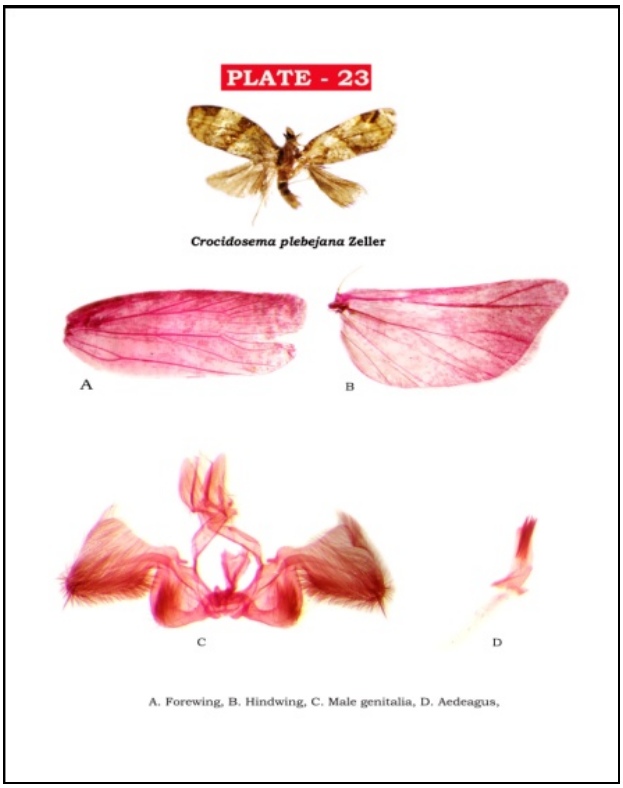
20. *Rhopobota naevana* Hubner.



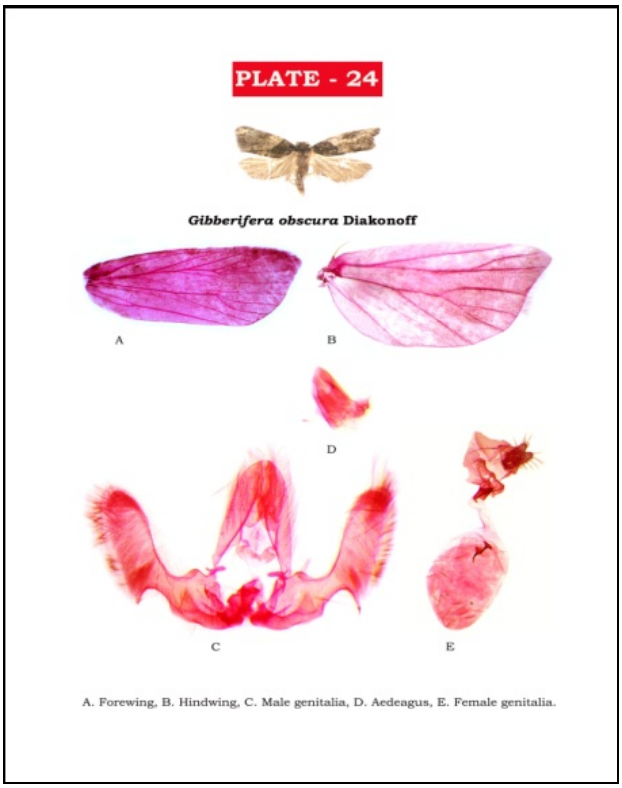
21. *Rhopobota pseudonaevana* sp. nov.



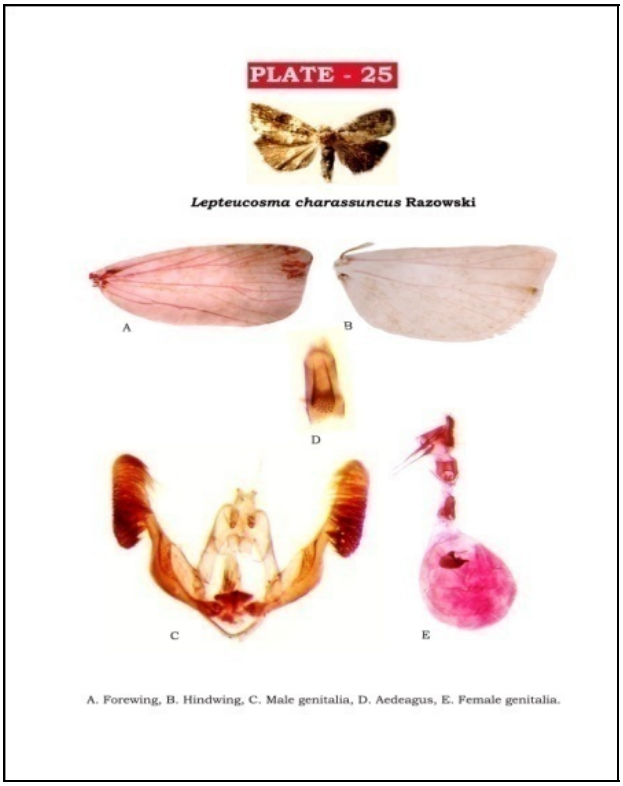
22. *Pelochrista teleopa* Razowski.



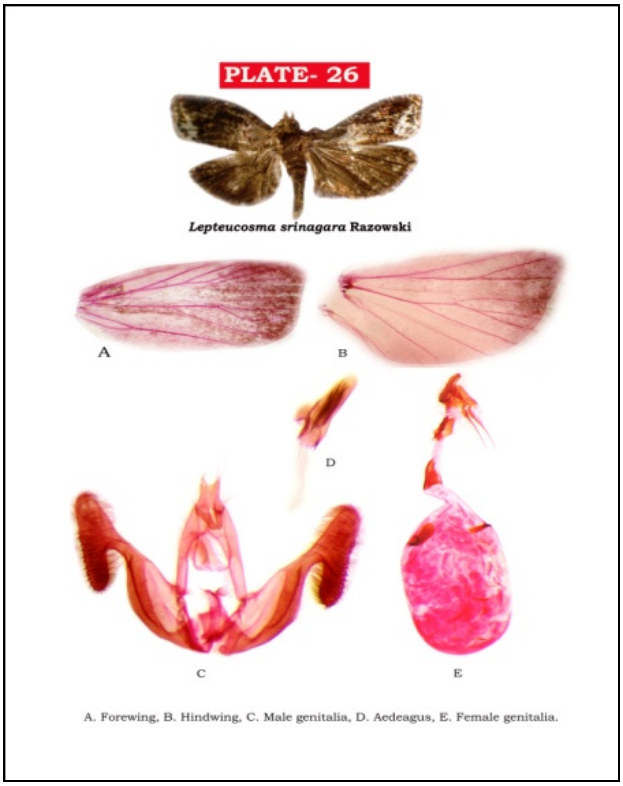
23. *Crocidosema plebejana* Zeller,



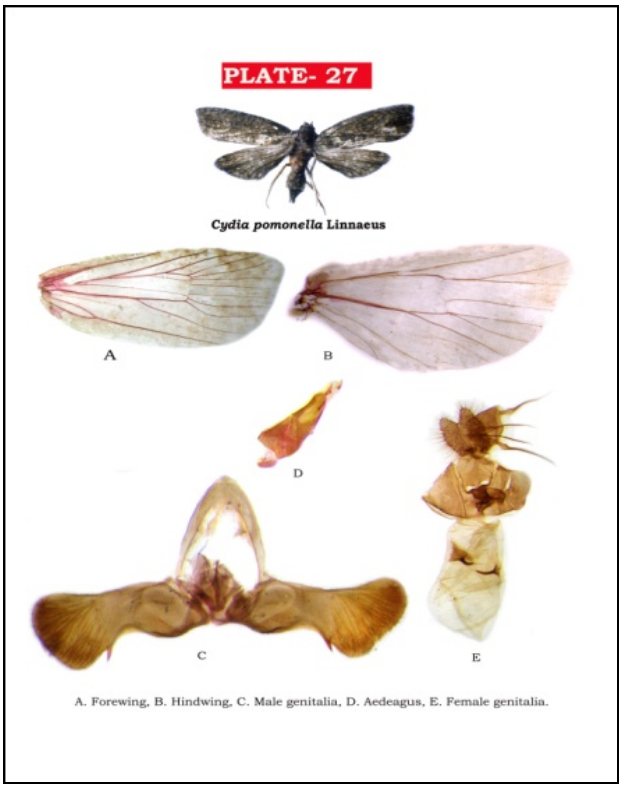
24. *Gibberifera obscura* Diakonoff.



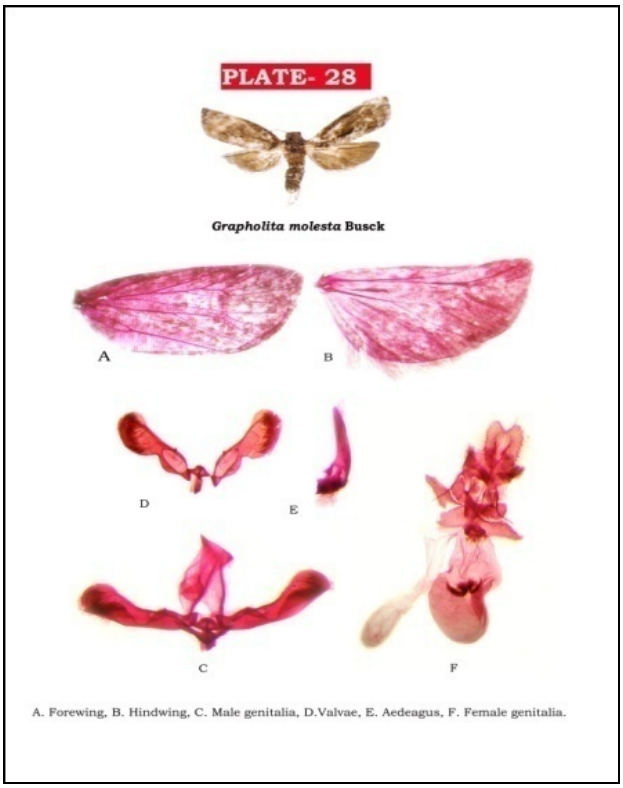
25. *Lepteucosma charassuncus* Razowski,



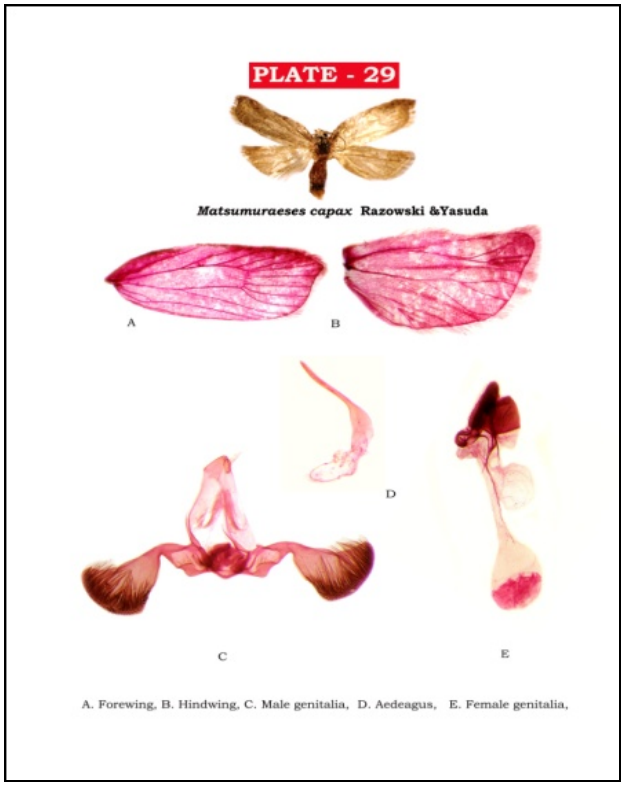
26. *Lepteucosma srinagara* Razowski.



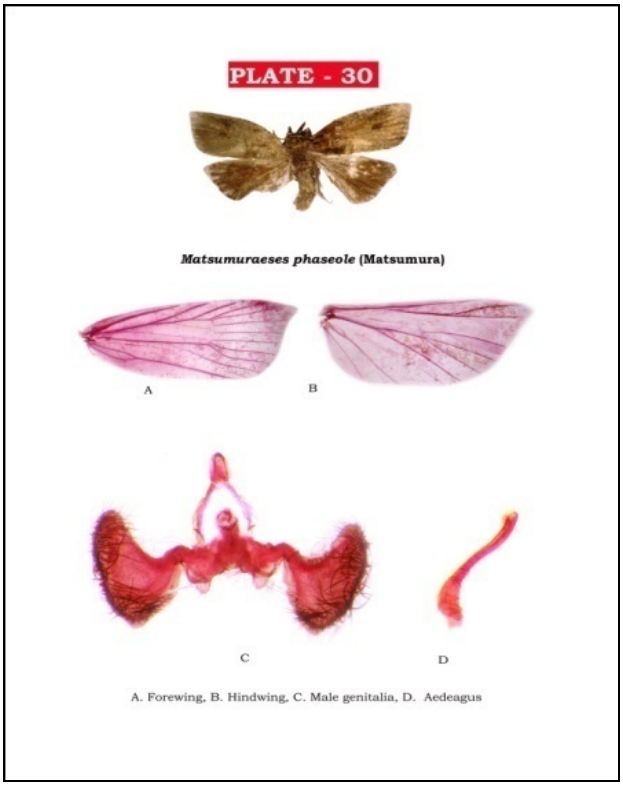
27. *Cydia pomonella* Linnaeus.



28. *Grapholita molesta* Busck.



29. *Matsumuraeses capax* Razowski &Yasuda,



30. *Matsumuraeses phaseoli* Matsumura.

Plate

4. Discussion

he present investigation reported 2217 specimens captured from diverse localities of Kashmir which comprised of 30 species belonging to 18 genera, 6 tribes and 2 subfamilies out of five species (*Acleris birdi* sp. nov., *Choristoneura pseudofumiferana* sp. nov., *Clepsis kupwari* sp. nov., *Eucosma gundai* sp. nov. and *Rhopobota pseudonaevana* sp. nov.) have been reported as new to science, two species [(*Crocidosema plebejana* Zeller and *Matsumuraeses phaseoli* (Matsumura)] as new to Jammu & Kashmir and one species (*Grapholita molesta* Busck) new to India. Diakonoff [6] also described five species of tortricids from north-west

Karakoram which were later on incorporated as belonging to Jammu and Kashmir, while as Razowski [8] reported two genera and sixteen species as new from Kashmir and Ladakh. Further in this study, tribe Archipini was found most diverse at species level with 12 species followed by Eucosimini with 10 species while as tribes Cnephasiini and Olethreutini were found least diverse with one species each. Moreover *Rhopobota naevana* (Hubner**)** was found most dominant specie in terms of relative abundance (14.47%) followed by *Archips cantinus* Razowski (12.81%) while as *Grapholita molesta* Busck was found least dominant (0.40%). Data further indicated highest species diversity in Anantnag (H' = 1.23693) followed by Kupwara (H' = 1.18888) and lowest in Leh (H' = 0.99781). Kumar *et al.* [24] also observed the highest diversity and evenness of lepidoptera in spring and least in winter. Further evenness index, index of dominance and richness were found as 0.837392, 0.162608 and 8.494294 in Anantnag, 0.783443, 0.216557 and 7.384377 in Ganderbal, 0.804863, 0.195137 and 8.222310 in Kupwara, 0.755707, 0.244293 and 7.320583 in Kargil and 0.675510, 0.324490 and 6.084232 in Leh district, respectively.

5. Conclusion

From present study it was concluded that the population of Tortricid moths is effected by climatic factors and vegetation or forests, as results indicates that the diversity and evenness indices were observed highest in warm and more vegetated districts i.e. Anantnag (1.23693 and 0.837392) and Kupwara (1.18888 and 0.804863) while as lowest were recorded in cold and less vegetated district i.e. Leh (0.99781 and 0.675510). However, the highest (0.324490) index of dominance was observed in district Leh and lowest (0.162608) in Anantnag. Further number of areas Kashmir division of Jammu & Kashmir still remain insufficiently explored. Moreover, biology and pest status of number of species this economically important group are also less studied. Therefore, steps need to be taken for more collection in such under or unexplored areas.

6. Acknowledgements

Authors are grateful to Division of entomology SKUAST-Kashmir for giving necessary permissions and constant support. Thanks are also due to Dr. V. V. Ramamurthy, Principal Scientist, Entomology, ICAR, New Delhi for his encouragement during the course of this study.

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