SHILAP Revta. lepid., 50 (199) septiembre 2022: 497-524 eISSN: 2340-4078 ISSN: 0300-5267
https://doi.org/10.57065/shilap.65

Faunistic account on the Heterocera of Tirthan Valley, Great Himalayan National Park Conservation Area: a preliminary checklist (Insecta: Lepidoptera)

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Abstract

The Present study represents 165 species belonging to 17 families, reported from Tirthan valley of Great Himalayan National Park Conservation Area. The study was conducted in April 2018 to July 2019. Family Erebidae and Geometridae was found dominated with 45 species each followed by Crambidae 30 species. With this addition of moth species, Great Himalayan National Park Conservation area is now home to 385 species of moths. The study was conducted for the first time in the Tirthan valley of Great Himalayan National Park Conservation Area.
KEY WORDS: Insecta, Lepidoptera, Heterocera, diversity, Greater Himalaya, India.

Informe faunístico sobre los Heterocera del Valle de Tirthan, Parque Nacional del Gran Himalaya área de conservación: una lista de comprobación preliminar (Insecta: Lepidoptera)

Resumen

El presente estudio representa 165 especies pertenecientes a 17 familias, registradas del Valle de Tirthan del Área de Conservación del Parque Nacional del Gran Himalaya, India. El estudio se llevó a cabo desde abril de 2018 hasta julio de 2019. Las familias Erebidae y Geometridae fueron dominantes con 45 especies cada una, seguidas por Crambidae 30 especies. Con esta adición de especies de Heterocera, el Área de Conservación del Parque Nacional del Gran Himalaya alberga ahora 385 especies. El estudio se realizó por primera vez en el Valle de Tirthan del Área de Conservación del Parque Nacional del Gran Himalaya.
PALABRAS CLAVE: Insecta, Lepidoptera, Heterocera, diversidad, Gran Himalaya, India.

Introduction

Insects are the most diverse animal group present on earth and show extreme level of adaptability probably in all kinds of habitats (HARRINGTON & STORK, 1995; LANDRES *et al*., 1988). Lepidoptera shows second highest diversity (BENTON, 1995) and act as indicators of healthy ecosystem and human activities (KOCHER & WILLIAMS, 2000). Majority of species are dull coloured with exceptions of few members of families like Zygaenidae and Choreutidae. Lepidoptera are also economically important as members of family Bombycidae produce expensive silk. Many of the moth species feed on both living and dead decaying plant material (FRIEDRICH, 1986; PORTER, 1997; ROBINSON *et al*., 2001; KENDRICK, 2002; SHARMA & RAMAMURTHY, 2010). According to Srivastava, 2002 Heterocera act as an integral part of the wildlife ecosystems, indicators of

environment, pollinate flowers and occupy a huge place in food web. Certain species are co-evolved with Lepidoptera pollinated flowers, these plants open their flower generally at night because of the nocturnal behaviour of many of the Heterocera, the structure of flowers are only feasible to specific species to suck nectar out of the long tubes due to the presence of long proboscis.

Heterocera are one of the main groups of insects which are well described taxonomically as well as by diversity and abundance (GHAZOUL, 2002). CHANDRA (2011) compiled data of Indian insects in which Heterocera are known through 13,359 species under 78 families. After that, many new taxa have been described and many checklists, catalogues, and books on Heterocera from India have been published (SINGH *et al*., 2014; KIRTI, 2015, 2016; CHANDRA *et al*., 2019; JOSHI *et al*., 2019; KIRTI *et al*., 2019) and it is hopeful that the number of species from India is more than that at present.

Previously very few studies have been documented the record of moth diversity from Himachal Pradesh. Various studies have documented the Heterocera from Kullu, Kangra, Dharamshala, Dharamshala (BUTLER, 1886; REV. HOCKING, 1888; MANI & SINGH, 1962; COTES & SWINHOE, 1887-1889), HAMPSON (1892-1896) in Fauna of British India, in general Himachal Pradesh (WALIA, 2005; ROSE & PATHANIA, 2004) and Chamba (SEKHON & SINGH, 2015). 17 species of Heterocera were previously reported from Great Himalayan National Park Conservation Area (UNIYAL & MATHUR, 1998). Recent inventory published by ZSI (CHANDRA *et al*., 2019), reported 237 species of Heterocera belonging to 16 families. However, the authors skipped exploring the Tirthan valley of the Great Himalayan National Park Conservation Area. With this particular aim, the study was conducted to document the moth diversity of Tirthan Valley of the conservation area.

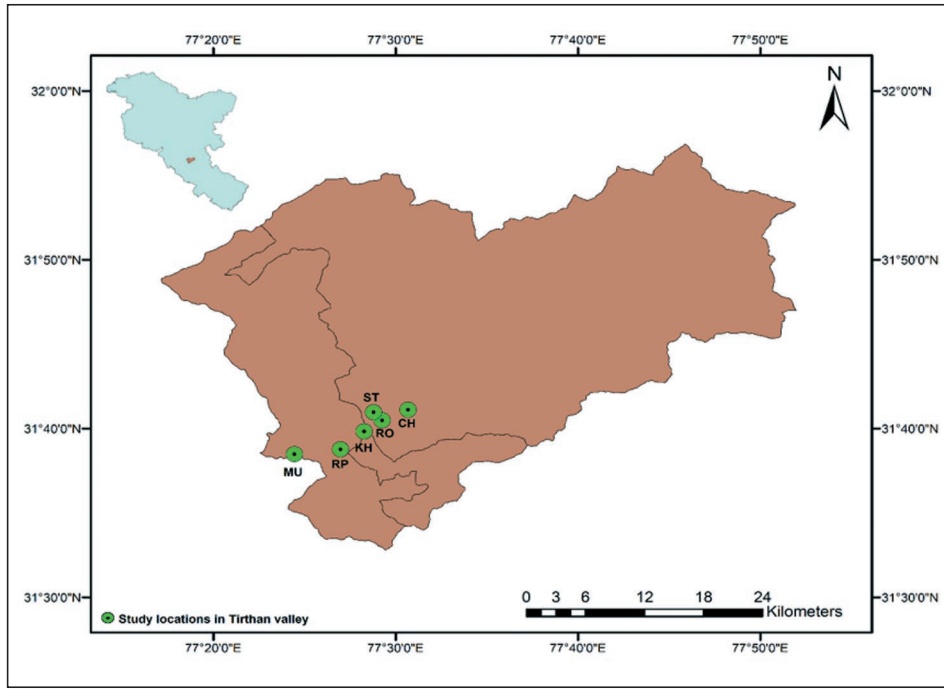

Figure 1.– Map represents the study locations in the Tirthan valley of Great Himalayan National Park Conservation Area.

Study Area

The study was performed in the Tirthan valley of Great Himalayan National Park Conservation Area (GHNPCA) located in the Kullu District of Himachal Pradesh. It was established in 1984 and was added in the UNESCO list of World Heritage Sites on 23 June 2014. The National Park is spread across four valleys which include Thirthan valley, Sainj valley, Parvati valley, and Jiva Nala. It includes a total area of 1,171 km^2 and an altitudinal range of between 1500 and 6000 m (Figure 1). The region is highly mountainous and covered with alpine, glacial, temperate, and subtropical forests. Seasons are broad: summer (Apr-Jun), rainy (Jul-Sep), and winter (Oct-Mar). The study was performed in six different locations of the valley (Table 1).

Methods

The consolidated information from Heterocera was compiled as a result of the surveys conducted in the area from April 2018- July 2019 as a part of the Department of Science and Technology under National mission for Sustaining the Himalayan Ecosystem (DST-NMSHE) research project. Light trapping was conducted in the six different regions of the valley. Mercury light trapping (160W) method was used to attract the species in different habitats of GHNPCA. No specimens were collected during these surveys and only photographs were taken by the author Amar Paul Singh. However, photographs of all the species are provided for better understanding of the wing coloration and wing maculation. Species were identified using various literature ROBINSON *et al*. (1994), KONONENKO & PINRATANA (2005), ZOLOTUHIN & PINRATANA (2005), SCHINTLMEISTER & PINRATANA (2007), PINRATANA & CERNY (2009), SONDHI & SONDHI (2016) and SHUBHALAXMI (2018) as well as web sources like https://www.inaturalist.org/, http://treenymph.org/wg-moths/.

Results

A total of 165 species belonging to 17 families were reported (Table 2). Family Erebidae and Geometridae was found dominated with 45 species, Crambidae 30 species and least number of species were found in Tortricidae, Uraniidae and Zygaenidae (Figure 2). 17 species similar to previous studies (CHANDRA *et al*., 2019) were found from Tirthan valley. A total of 147 species were reported for the first time from the conservation area. Photographs of the species were taken by Amar Paul Singh and the locality of each species is provided in Table 1.

Discussion

Due to its large latitude and high altitude, the Indian Himalayas are home to numerous biomes and habitats, which represent a central scene where different elements of biogeographic fauna are mixed. The introspection of the known diversity of Himalayan Lepidoptera is of immediate concern because of constant fluctuations in Global climate (SANYAL *et al*., 2018). A. G. Butler, a British entomologist described 227 species of Indian Rhopalocera in his seminal publication (1886) *"On the Lepidoptera Collection in India*", a large part of which is found in the Indian Himalayas like Darjeeling, Sikkim and the north-eastern part. Walia and Anju in 2005 conducted an exclusive study of Geometridae in Chandigarh and Himachal Pradesh, reporting 184 species. CHANDRA *et al*. (2019) reported 237 species of Heterocera under 178 genera belonging to 45 subfamilies of 16 families from the Sainj regions of Great Himalayan National Park Conservation area. Geometridae was found most dominated with 96 species followed by Erebidae 44 species and Noctuidae 41 species in their study. Whereas in Tirthan valley we concluded that the diversity of Erebidae is comparatively high. With this Great Himalayan National Park Conservation area is home to a total of 385 species of Heterrocera. Heterocera species like are a highly diverse and ecologically important group of insect species that play numerous key roles in particular ecosystems like herbivory, prey for birds and bats, pollination, and are

also potential indicators of ecosystem health and environmental fluctuations across a wide variety of landscapes (ERHARDT & THOMAS, 1991; KITCHING *et al*., 2000; SUMMERVILLE & CRIST, 2004). Great Himalayan National Park Conservation area representing such diversity of the Heterocera indicating a healthy ecosystem in terms of such factors.

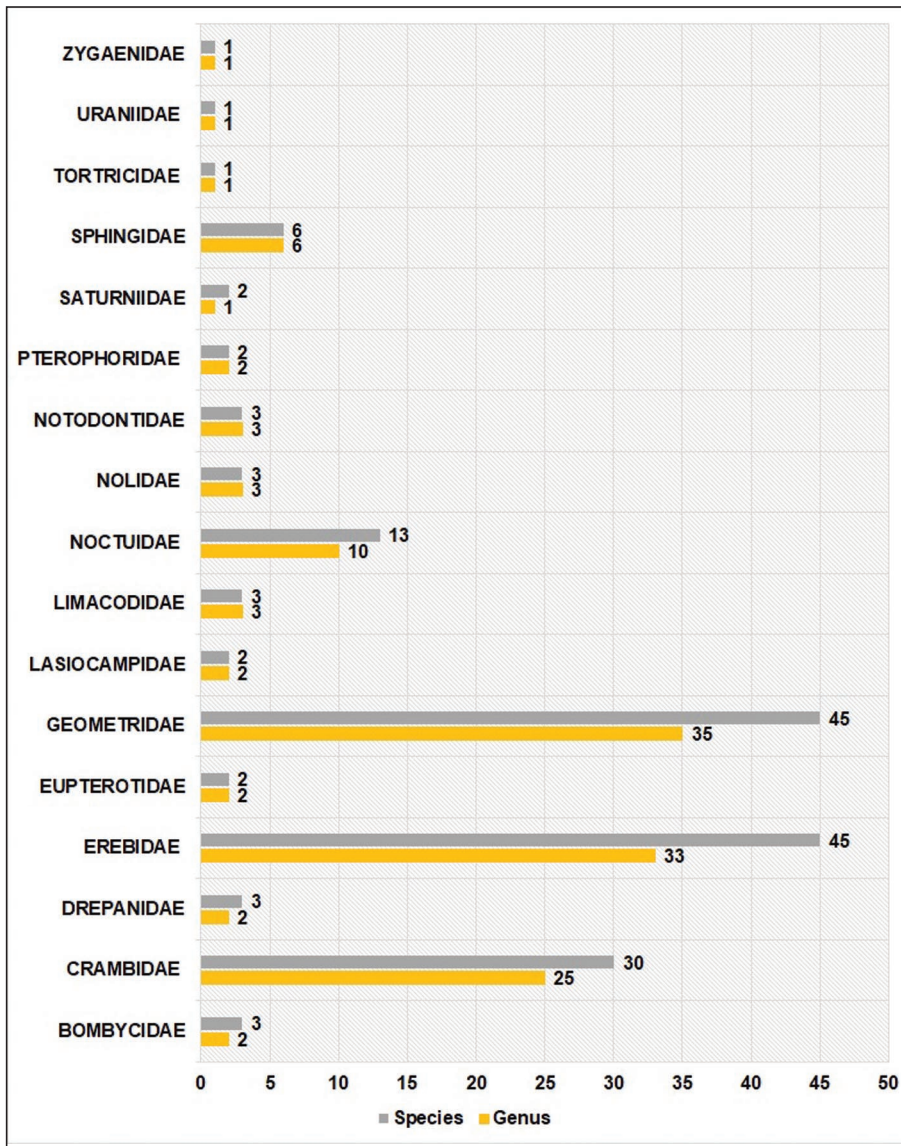

Figure 2.– Bar depicts the total number of genus and species of moths representing different families reported from Tirthan valley.

Acknowledgments

We wish to express our sincere thanks and gratitude to the Department of Science and Technology under National mission for Sustaining the Himalayan Ecosystem (DST-NMSHE). We would like to thank Director, Dean, Wildlife Institute of India for providing the necessary facilities to carry out the work. Thanks are due to the Mr. Nikhil Singh Kahera for his support and assistance during the fieldwork. The authors are also thankful of Deven Mehta for providing *Actias maenas* photograph.

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(Recibido para publicación / *Received for publication* 20-II-2022)
(Revisado y aceptado / *Revised and accepted* 26-III-2022)
(Publicado / *Published* 30-IX-2022)

Table 1.– Catalog of Heterocera of Tirthan valley, Great Himalayan National Park Conservation area. MU (Mungla), KH (Kharoncha), RP (Ropa), RO (Rola), CH (Cholocha), ST (Shilt).

Sr. No.	Species	Location	Photograph
	BOMBYCIDAE		
1	*Bombyx huttoni* (Westwood, 1847) *	MU	Plate 1
2	*Trilocha varians* (Walker, 1855)	MU	Plate 1
3	*Trilocha* sp.	KH	Plate 1
	CRAMBIDAE		
4	*Herpetogramma luctuosalis* (Guenée, 1854)	MU	Plate 1
5	*Omiodes indicata* (Fabricius, 1775)	KH	Plate 1
6	*Palpita warrenalis* (Swinhoe, 1894)	MU	Plate 1
7	*Scirpophaga incertulus* (Walker, 1863)	RP	Plate 1
8	*Chabula acamasalis* (Walker, 1859)	MU	Plate 1
9	*Eoophyla peribocalis* (Walker 1859)	KH	Plate 1
10	*Glyphodes bicolor* (Swainson, 1821)	MU	Plate 1
11	*Heliothela ophideresana* (Walker, 1863)	MU	Plate 2
12	*Herpetogramma bipunctalis,* (Zeller, 1872)	MU	Plate 2
13	*Nausinoe geometralis* (Guenée, 1854)	MU	Plate 2
14	*Parapoynx stagnalis* (Zeller, 1852)	MU	Plate 2
15	*Parotis marginata* (Hampson, 1893)	MU	Plate 2
16	*Patania violacealis* (Guillermet, 1996)	RP	Plate 2
17	*Talanga sexpunctalis* (Moore, 1887)	RP	Plate 2
18	*Endocrosis flavibasalis* (Moore, 1867)	MU	Plate 2
19	*Aethaloessa calidalis* (Guenée, 1854)	MU	Plate 2
20	*Cirrhochrista fumipalpis* (C. Felder, R. Felder & Rogenhofer, 1875)	KH	Plate 2
21	*Cnaphalocrocis poeyalis* (Boisduval, 1833)	MU	Plate 3
22	*Maruca vitrata* (Fabricius, 1787) *	MU	Plate 3
23	*Omiodes diemenalis* (Guenée, 1854)	KH	Plate 3
24	*Sameodes cancellalis* (Zeller, 1852)	KH	Plate 3
25	*Spoladera recurvalis* (Fabricius, 1775)	RP	Plate 3
26	*Hymenia perspectalis* (Hübner, 1796)	MU	Plate 3
27	*Palpita asiaticalis* (Inoue, 1994)	MU	Plate 3
28	*Pycnarmon cribrata* (Fabricius, 1794)	MU	Plate 3
29	*Agrotera scissalis* (Walker, 1866)	MU	Plate 3
30	*Cnaphalocrocis medinalis* (Guenée, 1854) *	MU	Plate 3
31	*Diaphania indica* (Saunders, 1851)	KH	Plate 4
32	*Cotachena pubescens* (Warren, 1892)	RP	Plate 4
33	*Palpita* sp.	RP	Plate 4
	DREPANIDADE		
34	*Tridrepana albonotata* (Moore, 1897) *	MU	Plate 4
35	*Deroca* sp.	RO	Plate 4
36	*Tridrepana* sp.	MU	Plate 4
	EREBIDAE		
37	*Aglaomorpha plagiata* (Walker, 1855)	MU	Plate 4
38	*Areas galactina* (Hoeven, 1840)	MU, RP	Plate 4
39	*Asota caricae* (Fabricius, 1775) *	MU, KH, RP	Plate 4
40	*Cyana puella* (Drury, 1773)	MU	Plate 4
41	*Cyana detrita* (Walker, 1854)	MU	Plate 5

42	*Cyana bianca* (Walker, 1856)	MU	Plate 5
43	*Cyana coccinea* (Moore, 1878)	MU	Plate 5
44	*Hulodes caranea* (Cramer, 1780)	RO	Plate 5
45	*Oruza divisa* (Walker, 1862)	MU, RO	Plate 5
46	*Callindra principalis* (Kollar, 1844)	MU, RO	Plate 5
47	*Creatonotos transiens* (Walker, 1855) *	MU, KH, RP	Plate 5
48	*Creatonotos gangis* (Linnaeus, 1763)	MU, KH, RP	Plate 5
49	*Olene inclusa* (Walker, 1856)	RO	Plate 5
50	*Somena scintillans* (Walker, 1856) *	MU	Plate 5
51	*Himala argentea* (Walker, 1855)	MU	Plate 6
52	*Juxtarctia multiguttata* (Walker, 1855)	MU	Plate 6
53	*Lyclene obsolete* (Moore, 1878)	MU	Plate 6
54	*Olepa ricini* (Fabricius, 1775)	MU	Plate 6
55	*Spirama retorta* (Clerck, 1764)	RO	Plate 6
56	*Spilarctia comma* (Walker, 1856) *	RP	Plate 6
57	*Syntomoides imaon* (Cramer, 1779)	MU, RO	Plate 6
58	*Brunia antica (*Walker, 1854)	MU	Plate 6
59	*Eressa confinis* (Walker, 1854)	MU, RP, KH	Plate 6
60	*Mangina argus* (Kollar, 1847)	RO	Plate 6
61	*Lymantria incerta* (Walker, 1855)	RP	Plate 7
62	*Grammodes geometrica* (Fabricius, 1775)	RP	Plate 7
63	*Trigonodes hyppasia* (Cramer, 1779)	KH	Plate 7
64	*Artaxa diagramma* (Boisduval, 1844)	MU	Plate 7
65	*Calliteara grotei* (Moore, 1859)	MU	Plate 7
66	*Euproctis chrysorrhoea* (Linnaeus, 1758)	MU	Plate 7
67	*Arctornis l-nigrum* (Müller, 1764)	KH	Plate 7
68	*Euproctis inconcisa* (Walker, 1865)	MU	Plate 7
69	*Mocis frugalis* (Fabricius, 1775)	MU	Plate 7
70	*Mocis undata* (Fabricius, 1775)	MU	Plate 7
71	*Hypena obacerralis* (Walker, 1859) *	MU	Plate 8
72	*Cladarctia quadriramosa* (Kollar, 1844)	MU	Plate 8
73	*Spilosoma impleta* (Walker, 1864)	MU	Plate 8
74	*Spilarctia* sp.	MU, RP	Plate 8
75	*Mocis* sp.	MU	Plate 8
76	*Lymantria* sp. 1.	MU	Plate 8
77	*Lymantria* sp. 2.	MU	Plate 8
78	*Spilosoma* sp.	MU	Plate 8
79	*Anomis* sp.	KH	Plate 8
80	*Laelia* sp.	KH	Plate 8
81	*Zueobata* sp.	MU	Plate 9
82	*Hypena* sp.	RP	Plate 9
	EUPTEROTIDAE		
83	*Ganisa plana* (Walker, 1855)	MU, KH	Plate 9
84	*Eupterote* sp.	MU	Plate 9
	GEOMETRIDAE		
85	*Agathia carissima* (Butler, 1878)	MU, KH, RO	Plate 9
86	*Agathia lycaenaria* (Kollar, 1844)	MU, KH	Plate 9
87	*Comibaena cassidara* (Guenée, 1857)	KH	Plate 9
88	*Pingasa ruginaria* (Guenée, 1857)	MU	Plate 9

89	*Problepsis vulgaris* (Butler, 1889)	KH	Plate 9
90	*Rhomborista monosticta* (Wehrli, 1924)	RP	Plate 9
91	*Thalassodes veraria* (Guenée, 1858)	RO	Plate 10
92	*Fascellina chromataria* (Walker, 1860)	RO	Plate 10
93	*Cleora alienaria* (Walker, 1860)	MU	Plate 10
94	*Corymica spatiosa* (Prout, 1925)	KH	Plate 10
95	*Hyposidra talaca* (Walker, 1860)	MU, KH, RP	Plate 10
96	*Ourapteryx sciticaudaria* (Walker, 1863)	KH	Plate 10
97	*Ourapteryx clara* (Butler, 1880)	KH	Plate 10
98	*Parapholodes fuliginea* (Hampson, 1891)	MU	Plate 10
99	*Hypomecis transcissa* (Walker, 1860)	RP	Plate 10
100	*Hypomecis cineracea* (Moore, 1888)	RP	Plate 10
101	*Chrysocraspeda olearia* (Guenée, 1857)	MU	Plate 11
102	*Timandra correspondens* (Hampson, 1895) *	MU, KH	Plate 11
103	*Anisodes absconditaria* (Walker, 1863)	RP	Plate 11
104	*Ectropis bhurmitra* (Walker, 1860)	RP	Plate 11
105	*Boarmia separata* (Walker, 1863)	RP	Plate 11
106	*Abraxas sylvata* (Scopoli, 1763) *	MU	Plate 11
107	*Alcis deversata* (Staudinger, 1892)	RP, ST	Plate 11
108	*Alcis repandata* (Linnaeus, 1758)	ST	Plate 11
109	*Pelagodes antiquadraria* (Inoue, 1976)	MU	Plate 11
110	*Semiothisa perfusaria* (Walker, 1866)	MU	Plate 11
111	*Electrophaes corylata* (Thunberg, 1792)	CH	Plate 12
112	*Ascotis selenaria* ([Denis & Schiffermüller], 1775)	MU	Plate 12
113	*Biston regalis* (Moore, 1888) *	MU	Plate 12
114	*Chiasmia emersaria* (Walker, 1861)	MU	Plate 12
115	*Comibaena albimarginata* (Warren, 1893)	MU	Plate 12
116	*Ecliptopera postpallida* (Prout, 1940) *	RO	Plate 12
117	*Ecliptopera relata* (Butler, 1880)	RO	Plate 12
118	*Iotaphora iridicolor* (Butler, 1880)	MU	Plate 12
119	*Eumelea ludovicata* (Guenée, 1858)	MU	Plate 12
120	*Comostola laesaria* (Walker, 1861)	MU	Plate 12
121	*Comostola maculate* (Moore, 1867)	MU	Plate 13
122	*Scopula* sp. 1.	MU	Plate 13
123	*Scopula* sp. 2	MU	Plate 13
124	*Maxates* sp.	MU	Plate 13
125	*Fascellina* sp.	KH	Plate 13
126	*Euphiya* sp.	KH	Plate 13
127	*Euithecia* sp.	MU	Plate 13
128	*Thyatira* sp.	KH	Plate 13
129	*Chorodna* sp.	MU	Plate 13
	LASIOCAMPIDAE		
130	*Gastropacha pardale* (Walker, 1855)	MU	Plate 13
131	*Trabala vishnou* (Lefebvre, 1827) *	MU	Plate 14
	LIMACODIDAE		
132	*Miresa argentifera* (Walker, 1855)	RP	Plate 14
133	*Parasa pastoralis* (Butler, 1855)	RP	Plate 14
134	*Thosea* sp.	MU	Plate 14

	NOCTUIDAE		
135	*Bastilla cramera* (Moore, 1885)	MU	Plate 14
136	*Oraesia emarginata* (Fabricius, 1794)	MU	Plate 14
137	*Calyptra thalictri* (Borkhausen, 1790)	MU	Plate 14
138	*Calyptra parva* (Banziger, 1979)	MU	Plate 14
139	*Chalciope mygdon* (Cramer, 1777)	MU	Plate 14
140	*Spodoptera litura* (Fabricius, 1775) *	MU	Plate 14
141	*Chrysodeixis chalcites* (Esper, 1789)	MU	Plate 15
142	*Thysanoplusia orichalcea* (Fabricius, 1775) *	MU	Plate 15
143	*Aegocera venulia* (Cramer, 1777)	RP, KH	Plate 15
144	*Batracharta* sp.	KH	Plate 15
145	*Xanthopastis* sp.	MU	Plate 15
146	*Thysanoplusia* sp. 1.	MU	Plate 15
147	*Thysanoplusia* sp. 2.	MU	Plate 15
	NOLIDAE		
148	*Carea angulata* (Fabricius, 1793)	MU	Plate 15
149	*Westermannia superba* (Hübner, 1823)	KH	Plate 15
150	*Tyana marina* (Warren, 1916)	RP	Plate 15
	NOTODONTIDAE		
151	*Phalera raya* (Moore, 1859)	MU	Plate 16
152	*Micromelalopha* sp.	MU	Plate 16
	PTEROPHORIDAE		
153	*Diacrotricha* sp.	MU	Plate 16
154	*Emmelina* sp.	KH	Plate 16
	SATURNIIDAE		
155	*Actias selene* (Hübner, [1807])	MU, KH	Plate 16
156	*Actias maenas* (Doubleday, 1847)	MU	Plate 16
	SPHINGIDAE		
157	*Acherontia lachesis* (Fabricius, 1798)	MU	Plate 16
158	*Agrius convolvuli* (Linnaeus, 1758)	MU	Plate 16
159	*Nephele hespera* (Fabricius, 1775)	MU	Plate 16
160	*Pergesa acteus* (Cramer, 1779)	RP	Plate 16
161	*Ambulyx substrigilis* (Westwood, 1847)	MU	Plate 17
162	*Theretra* sp.	KH	Plate 17
	TORTRICIDAE		
163	*Archips* sp.	RP	Plate 17
	URANIIDAE		
164	*Epiplema reticulata* (Moore, 1888)	MU	Plate 17
	ZYGAENIDAE		
165	*Campylotes histrionicus* (Westwood, 1839)	MU	Plate 17

PLATE 1


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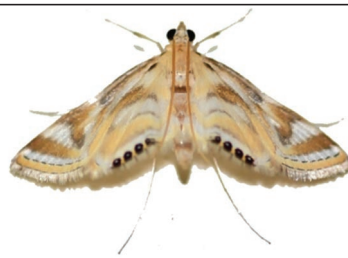
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PLATE 2


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PLATE 3


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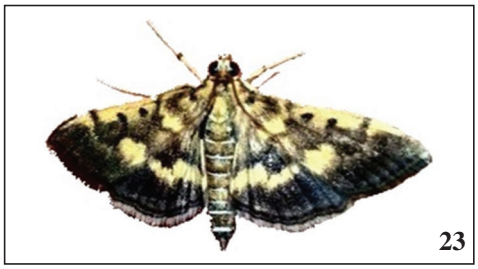
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PLATE 4


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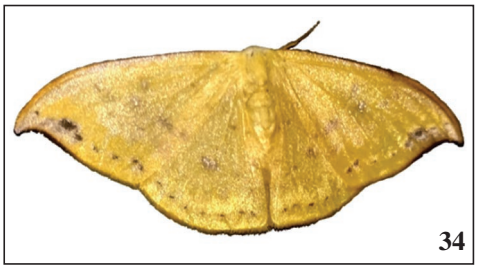
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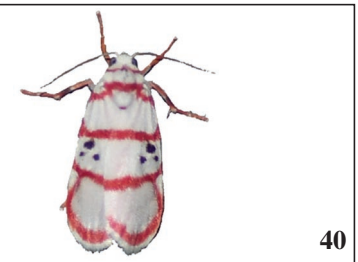
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PLATE 5


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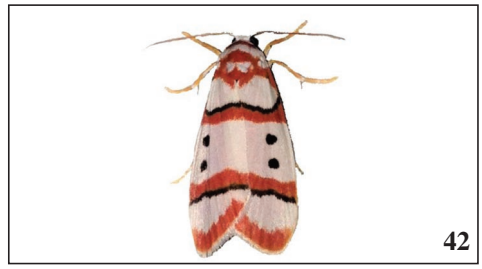
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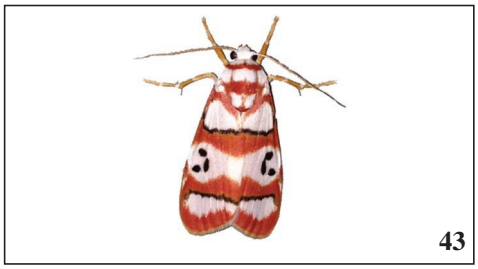
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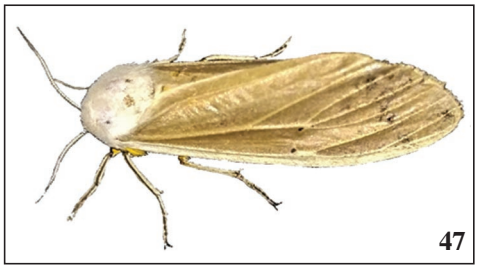
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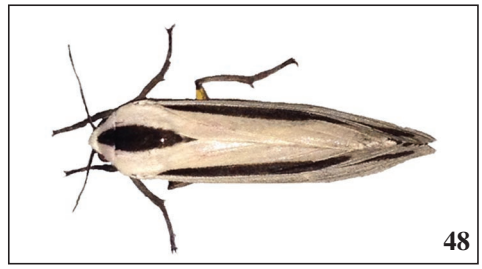
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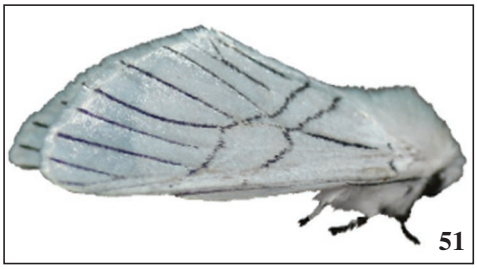
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PLATE 7


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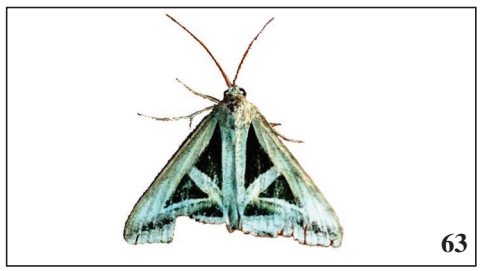
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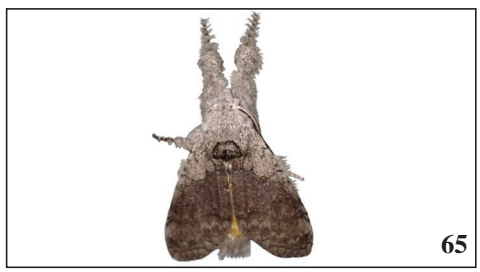
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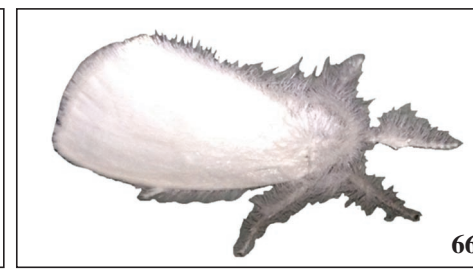
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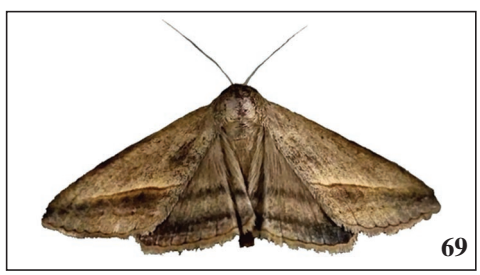
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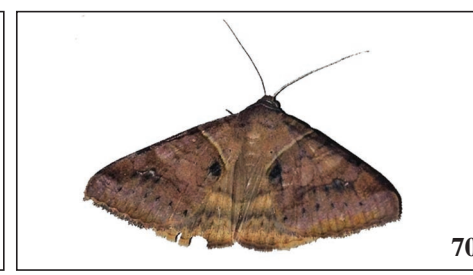
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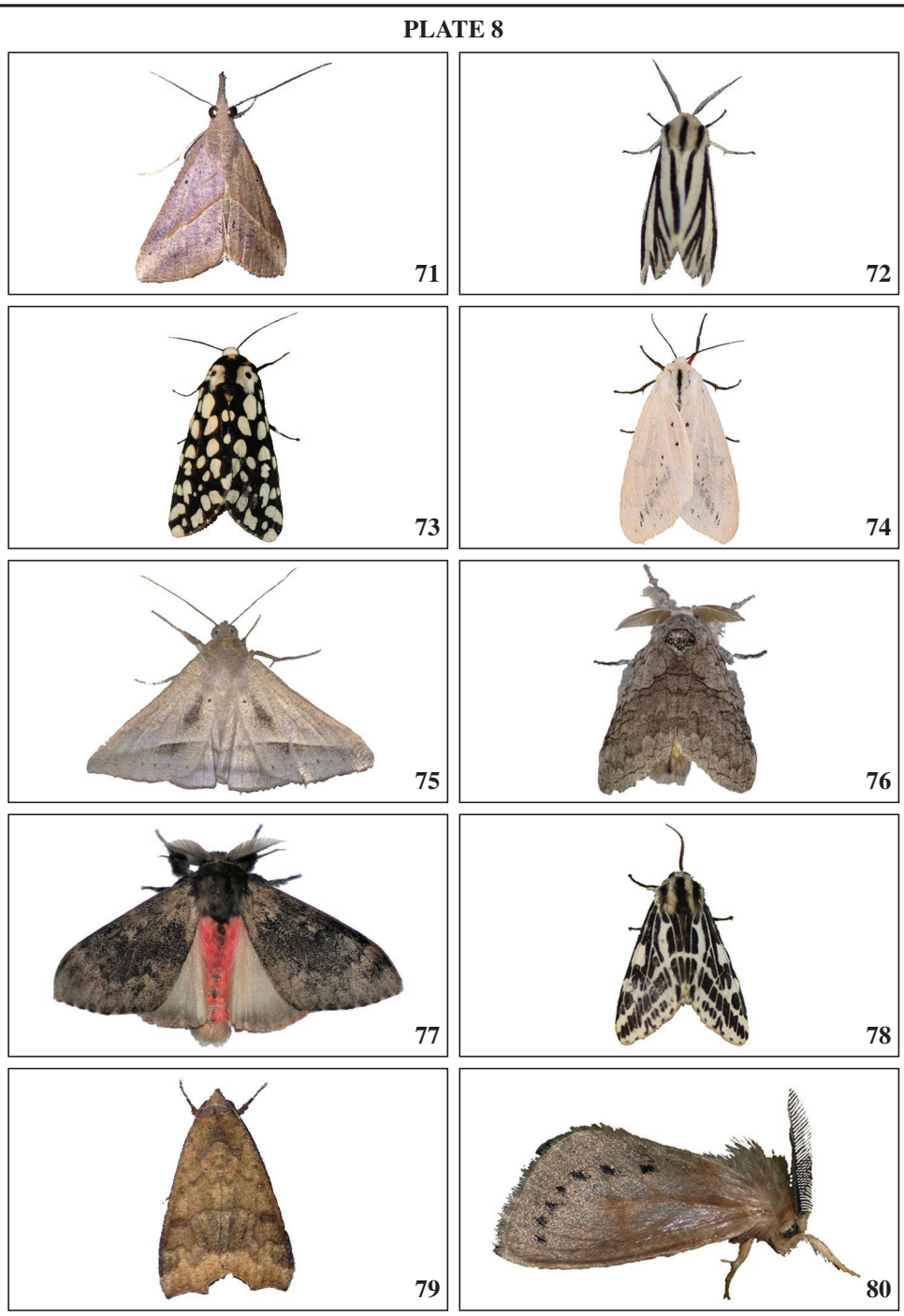

PLATE 9


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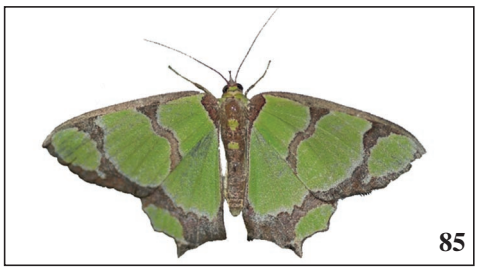
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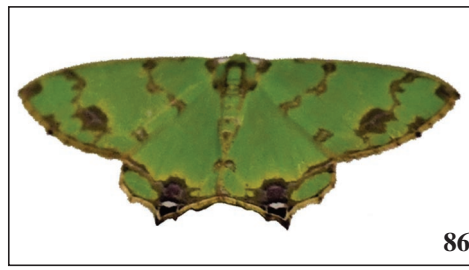
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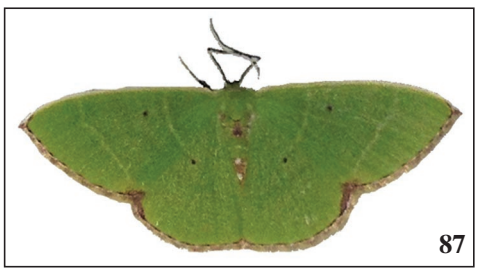
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PLATE 10


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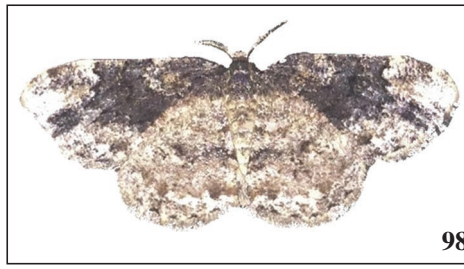
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PLATE 11


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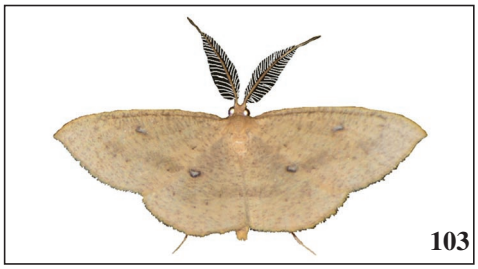
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PLATE 12

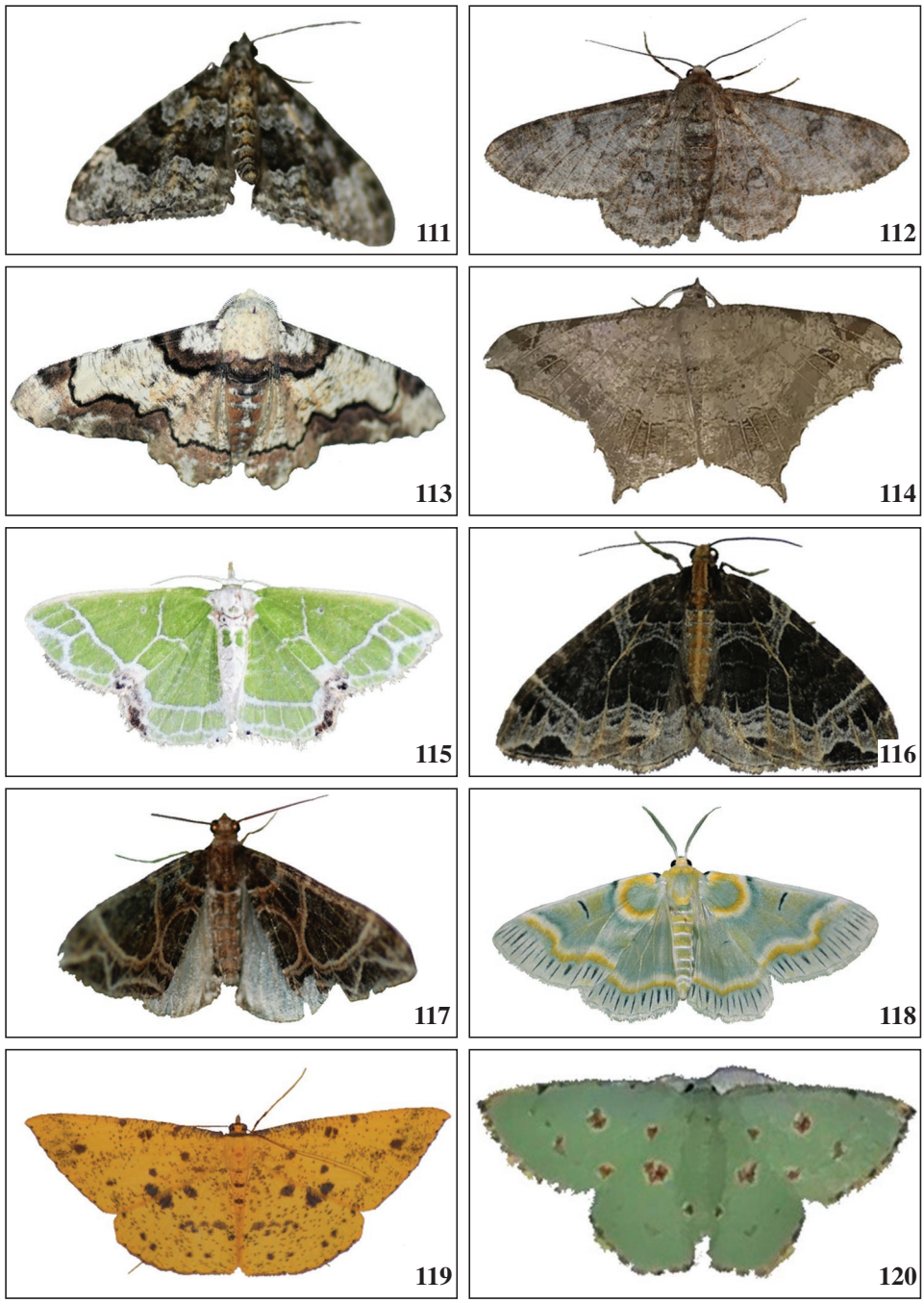

PLATE 13

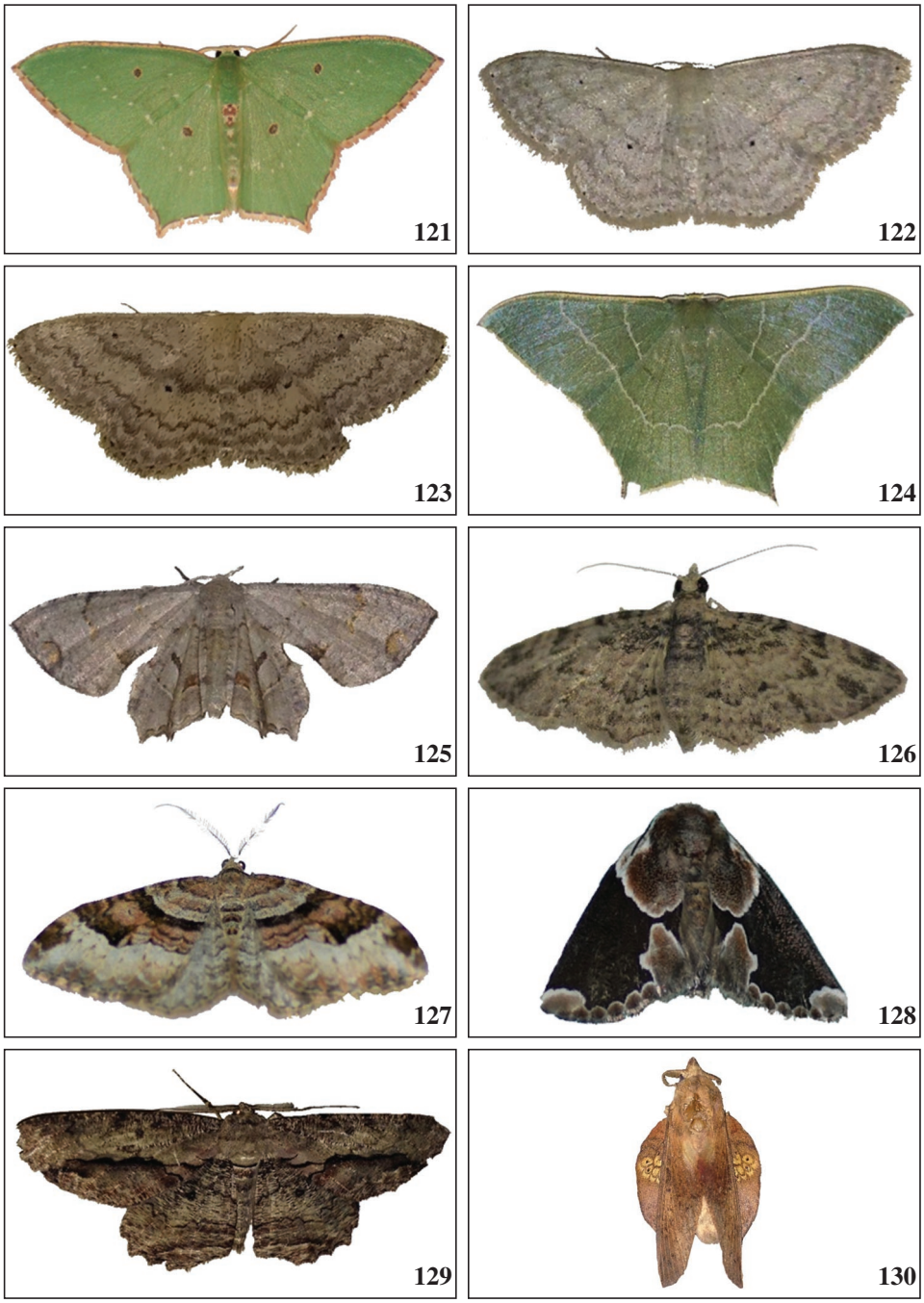

PLATE 14


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PLATE 15


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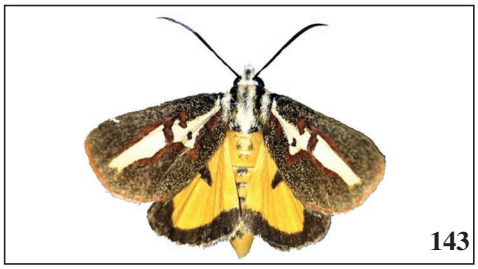
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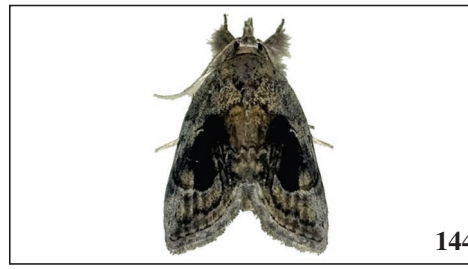
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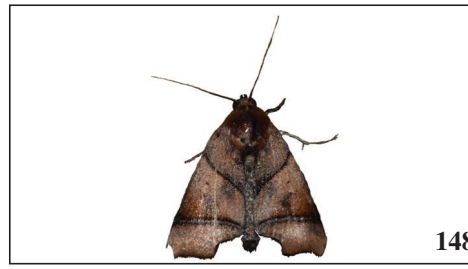
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PLATE 16


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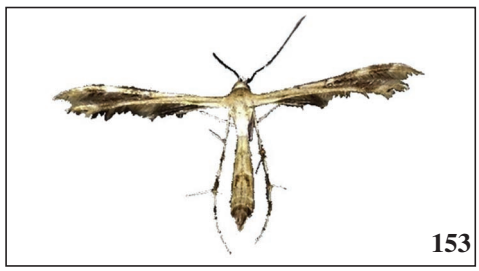
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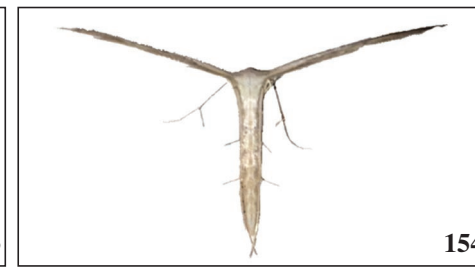
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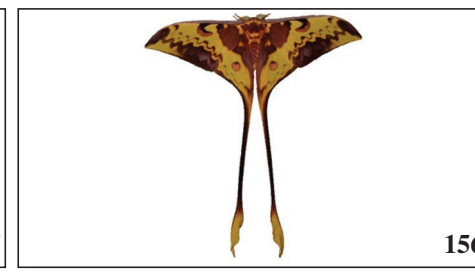
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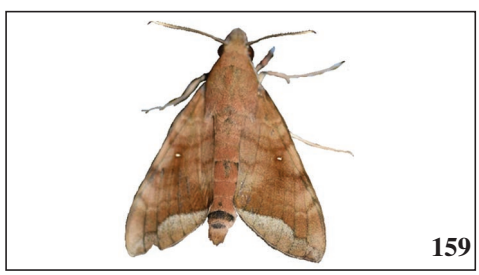
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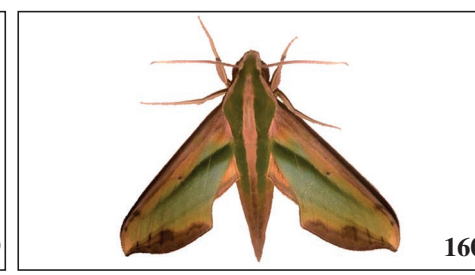
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PLATE 17

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