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The Status of Moths with Special Reference to the Sohagi Barwa Wildlife Sanctuary, Uttar Pradesh, India

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Abstract: Moth caterpillars have a considerable impact on plant populations because they eat leaves. Moths also play an important role in plant reproduction by pollinating plants, especially those that bloom at night and produce seeds. The current study was carried out regarding the status of moths at the Sohagi Barwa Wildlife Sanctuary in the Terai area of Uttar Pradesh. During the study, 146 species from 18 families were found, the Erebidae, Crambidae, and Geometridae families predominated; however, smaller numbers of the Noctuidae, Pyralidae, Eupterotidae, Lecithoceridae, Limacodidae, Nolidae, Thyrididae, Autostichidae, Bombycidae, Depressariidae, Gelechiidae, Hyblaeidae, Notodontidae, Tineidae, and Sphingidae families were present; but they were less abundant.

Keywords: Moths, Insect, Sohagi Barwa Wildlife Sanctuary, Biodiversity, Pollinators

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Introduction

Forests naturally include insects, which are essential for preserving the composition and structure of ecosystems. Studying insects can also make it much easier to understand ecological concepts such as chemical ecology, population dynamics, and predator–parasite relationships. (Sharma *et al.*, 2023). With a remarkable variety of colours and patterns, moths are among the most successful and varied creatures on the planet. Because they affect a wide range of creatures and are essential to the environment, moths play a significant role in biodiversity. Even though certain species are regarded as pests, moths generally benefit the earth more than they harm it. They are crucial to terrestrial ecology as pollinators of plants, herbivores of both wild and farmed plants, and prey for a wide range of rodent, bird, and bat species (Regier *et al.*, 2009; Bates *et al.*, 2014; Rathaur *et al.*, 2024). Moth evaluations are crucial for every habitat because moths are

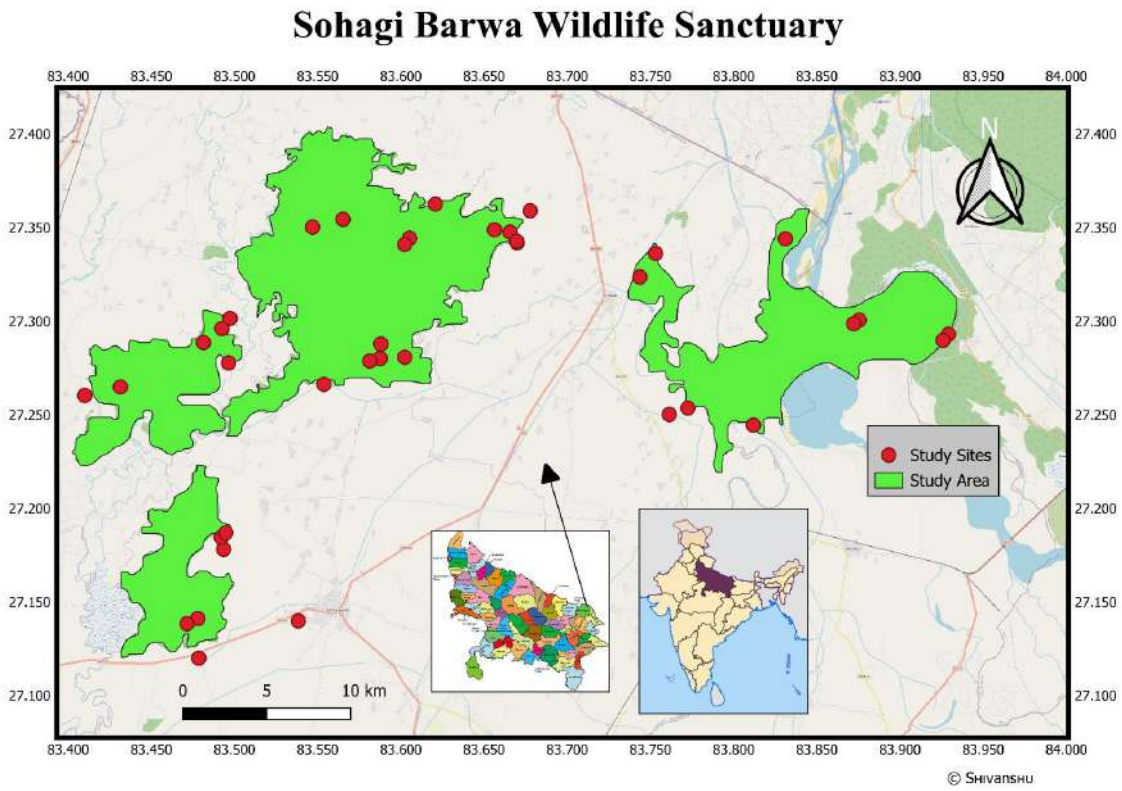


Fig. 1: Study Area with Major Accessed Sites Locations.

used as bioindicators in ecosystems. The current study was carried out regarding the status of moths at the Sohagi Barwa Wildlife Sanctuary in the Terai area of Uttar Pradesh

Materials and Methods

The current study was carried out at the Sohagi Barwa Wildlife Sanctuary (Fig. 1) in the Terai area of Uttar Pradesh, India. The Sanctuary is situated in the Maharajganj district of Uttar Pradesh, India. The coordinates are -- 26° 58' and 27° 25' N and 83° 23' and 84° 10' E. The Gandak River serves as the primary outflow for the 428.2 km^2 Sanctuary. The Sanctuary is bounded by the Valmiki Tiger Reserve in Bihar and by the international border between India and Nepal. The Sanctuary includes seven forest ranges: Pakdi, Madhwaliya, Laxmipur, North Chouk, South Chouk, Seopur, and Nichlaul. Approximately 75% of the land is covered with sal woodland, with additional wet areas supporting the growth of Jaamun (*Syzigium cumini*), Gutal (*Trewia nudiflora*), Semal (*Bombax ceiba*), Khair (*Acacia catechu*) trees.

The moth species were assessed via the line transect method for diurnal moths and the light trap approach for nocturnal moths. Three distinct seasons were used for the investigation. The first was conducted before the rainy season, the second was conducted during the rainy season, and the third was conducted during the post-rainy season. The data are supported by direct observations and images captured via a Canon 7D SLR camera.

Results and Discussion

The study found 146 species of 123 genera from 18 families. The Erebidae (40 Species of 34 Genera), Crambidae (35 Species of 28 Genera), and Geometridae (21 Species of 17 Genera) families being the most prevalent. The Noctuidae (10 Species of 8 Genera), Pyralidae (8 Species of 8 Genera), Eupterotidae (2 Species of 1 Genera), Lecithoceridae (3 Species of 1 Genera), Limacodidae (7 Species of 7 Genera), Nolidae (4

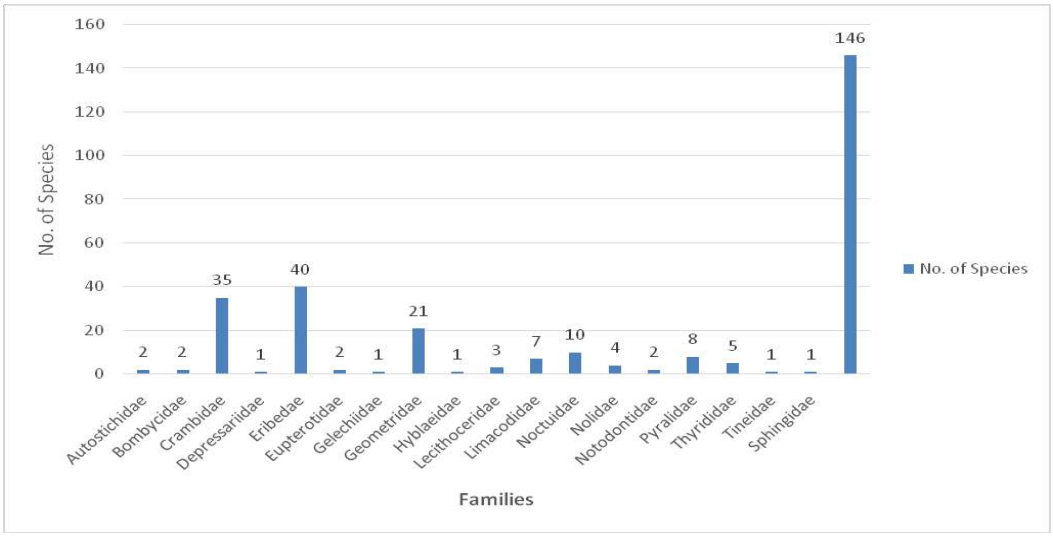


Fig. 2: Number of species vs families.

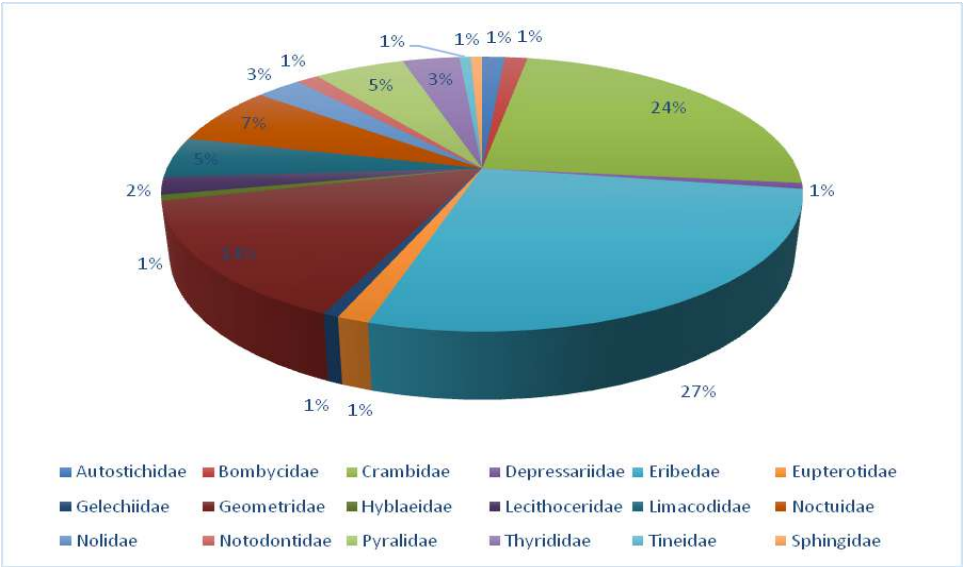


Fig. 3: Percentage occurrence of families.

Species of 4 Genera), Thyrididae (5 Species of 4 Genera), Autostichidae (2 Species of 2 Genera), Bombycidae (2 Species of 2 Genera), Depressariidae (1 Species of 1 Genera), Gelechiidae (1 Species of 1 Genera), Hyblaeidae (1 Species of 1 Genera), Notodontidae (2 Species of 2 Genera), Tineidae (1 Species of 1 Genera), and Sphingidae (1 Species of 1 Genera) families were also present, but in smaller numbers. Figurtes 2 and 3 illustrate number of species vs families and percentage occurrence of families, respectively. Table 1 displays names of species with their respective family's name, common name and their author's name. Figure 4 depicts photographs of moths present in the study area.

According to Beck *et al.* (2002), Fiedler and Schulze (2004), and Sutrisno (2010), undisturbed primary forests exhibit higher moth species richness than disturbed ecosystems. Moth populations have declined significantly in several nations, including the UK, US, Germany, Sweden, India, Netherlands, Siberia, and New Zealand (Dar and Jamal, 2021).

In this study, 40 and 35 species of the Eribedae and Crambidae families, respectively, were

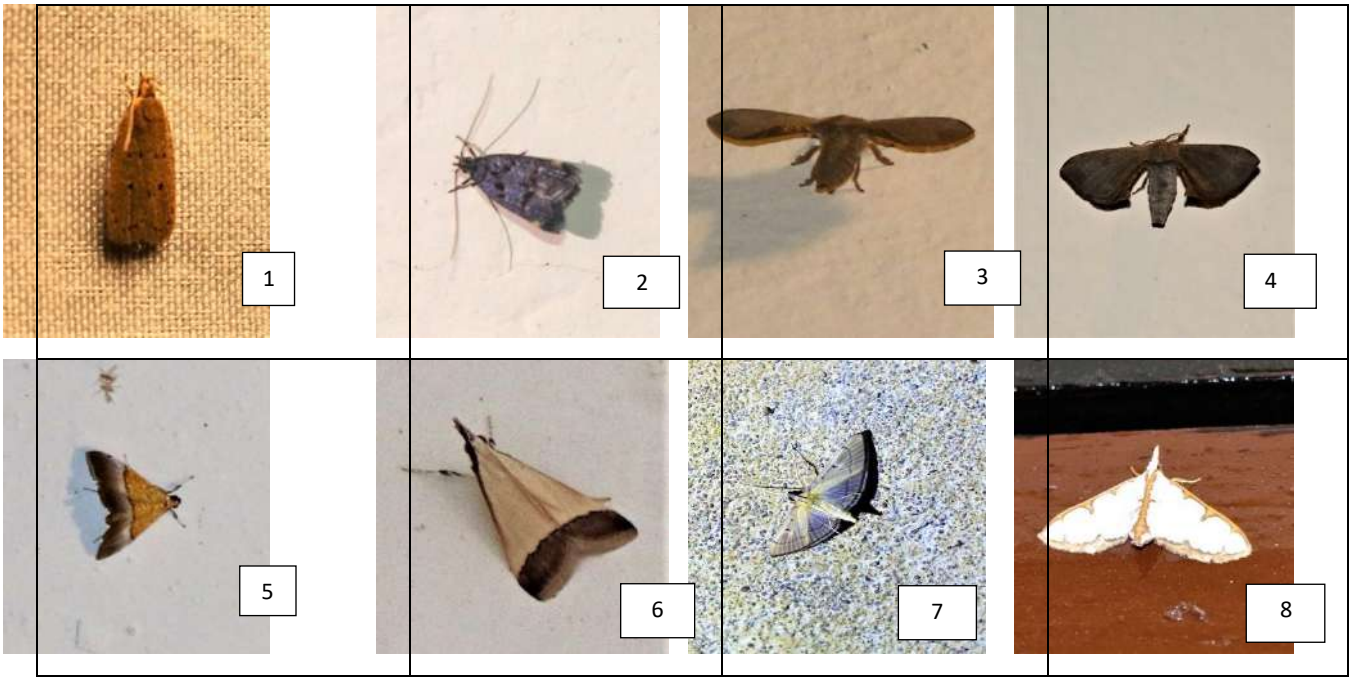
Table 1; Names of species with their respective family's name, common name and their author's name

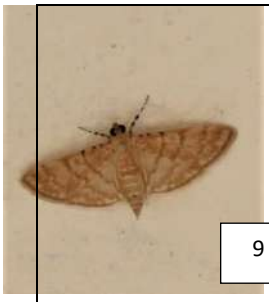
S. No.	Family	Species	Comman Name	Author
1.	Autostichidae	*Symmoca signatella*	-	Hübner, 1825,
2.		*Autosticha kyotensis*	Kyoto Moth	Matsumura, 1931
3.	Bombycidae	*Bombycinae-genera spp.*	Silkworm Moths	Latreille,1802
4.		*Trilocha varians*	Greenish Silk-Moth	Walker, 1855
5.	Crambidae	*Agrotera scissalis*	-	Walker, 1866
6.		*Autocharis fessalis*	-	Swinhoe, 1886
7.		*Bradina admixtalis*	-	Walker, 1859
8.		*Cirrhochrista brizoalis*	-	Walker, 1859
9.		*Cnaphalocrocis trapezalis*	Trapeze Moth	Lederer, 1863
10.		*Cnaphalocrocis medinalis*	Rice Leafroller	Guenée, 1854
11.		*Cnaphalocrocis rutilalis*	Botys Rutilalis	Walker, 1859
12.		*Crambidae-genera spp.*	Snout Moths	Latreille, 1810
13.		*Crambus perlella*	Satin Grass-Moth	Scopoli, 1763
14.		*Crocidolomia pavonana*	Cabbage Cluster	Fabricius, 1794
15.		*Dysallacta negatalis*	Karanj Leaf Borer	Walker, 1859
16.		*Ecpyrrhorrhoe spp.*	Teak Leaf Skeletonizer	Moore, 1886
17.		*Elophila spp.*	Grass Moths	Hübner, 1822
18.		*Glyphodes bicolor*	Bicoloured Pearl	Swainson, 1821
19.		*Hellula undalis*	Cabbage Webworm	Fabricius, 1781
20.		*Herpetogramma rudis*	-	Warren, 1892
21.		*Herpetogramma licarsisalis*	Grass Webworm	Walker, 1859
22.		*Hymenia perspectalis*	Spotted Beet Webworm Moth	Hübner, 1796
23.		*Lamprosema tampiusalis*	-	Walker, 1859
24.		*Marasmia trapezalis*	Trapeze Moth, Maize Webworm	Guenée, 1854
25.		*Nacoleia charesalis*	Botys Molusalis	Walker, 1859
26.		*Omiodes indicata*	Soybean Leaf Folder	Fabricius, 1775
27.		*Parapoynx diminutalis*	Hydrilla Leafcutter Moth	Snellen, 1880
28.		*Parapoynx stagnalis*	Rice Caseworm	Zeller, 1852
29.		*Pygospila tyres*	Spotted Grass Moth	Cramer, 1780
30.		*Ramila acciusalis*	-	Walker, 1859
31.		*Scirpophaga incertulas*	Yellow Stem Borer	Walker, 1863
32.		*Scirpophaga nivella*	Sugarcane Top Borer, White Rice Borer	Fabricius 1794
33.		*Scirpophaga spp.*	Top Shoot Borers	Treitschke 1832 ,
34.		*Spoladea recurvalis*	Beet Webworm Moth; Banded Sable	Fabricius, 1775
35.		*Syllepte nigriflava*	-	Swinhoe, 1894
36.		*Syllepte straminalis*	-	Guenée, 1854
37.		*Gadessa attemptalis*	-	Snellen, 1890
38.		*Pagyda salvalis*	-	Walker, 1859

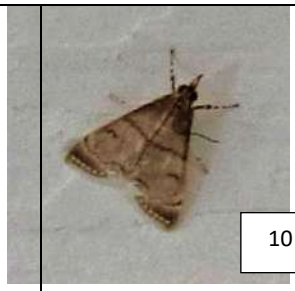
39.		*Tatobotys biannulalis*	Makunda Moth	Walker, 1866
40.	Depressariidae	*Agonopterix sp.*	Flat-Body Moth	Hübner,1825
41.	Erebidae	*Achaea janata*	Castor Semi-Looper	Linnaeus, 1758
42.		*Amata cyssea*	Handmaiden Moth	Stoll, 1782
43.		*Anomis mesogona*	-	Walker, 1858
44.		*Asota caricae*	Tropical Tiger Moth	Fabricius, 1775
45.		*Autoba silicula*	Earhead Worm	Swinhoe, 1897
46.		*Britha pactalis*	-	Walker, 1859
47.		*Casama vilis*	-	Walker, 1865
48.		*Cyana puella*	Phalaena Puella	Drury, 1773
49.		*Erebus hieroglyphica*	White-Barred Owl Moth	Drury, 1773
50.		*Erebus macrops*	Common Owl Moth	Linnaeus, 1768
51.		*Eressa confinis*	Tiger Moth	Walker, 1854
52.		*Eublemma olivacea*	Brinjal Leaf Roller	Walker, 1858
53.		*Fodina stola*	-	Guenée, 1852
54.		*Gesonia spp.*	-	Walker, 1859
55.		*Grammodes geometrica*	Noctua Geometrica	Fabricius, 1775
56.		*Herminiinae genera spp.*	Litter Moths	Leach, 1815
57.		*Hydrillodes spp. 1*	Litter Moths	Guenée, 1854
58.		*Hydrillodes spp. 2*	Litter Moths	Guenée, 1855
59.		*Hypocala violacea*	-	Butler, 1879
60.		*Hypsoropha sp.*	Necklace Moth	Hübner in 1818
61.		*Lithosiini-genera spp.*	Lichen Moths	Billberg, 1820
62.		*Lymantria marginata*	Dark Mango Tussock Moth	Walker, 1855
63.		*Miltochrista ila*	-	Moore, 1860
64.		*Miltochrista obsoleta*	-	Moore, 1878
65.		*Miltochrista rubricosa*	Arctelene Rubricosa	Moore, 1878
66.		*Miltochrista semifascia*	-	Walker, 1854
67.		*Mocis frugalis*	Sugarcane Looper	Fabricius, 1775
68.		*Mocis undata*	Brown Striped Semi Looper	Fabricius, 1775
69.		*Nygmiini-genera spp.*	Tussock Moths	Holloway, 1999
70.		*Oglasa hypenoides*	-	Moore, 1881
71.		*Ophiusa tirhaca*	Green Drab	Cramer, 1777
72.		*Pericyma umbrina*	-	Guenée, 1852
73.		*Progonia kurosawai*	Fanfoot	Owada, 1987
74.		*Stictane sp.*	-	Hampson, 1900
75.		*Syntomoides imaon*	Handmaiden Moth	Cramer, 1779
76.		*Chalciope mygdon*	Triangular-Striped Moth	Cramer, 1777
77.		*Episparis liturata*	-	Fabricius, 1787
78.		*Eudocima cajeta*	Fruit-Piercing Moth	Cramer, 1775
79.		*Hypena obacerralis*	-	Walker, [1859]
80.		*Nagia linteola*	-	Guenée, 1852

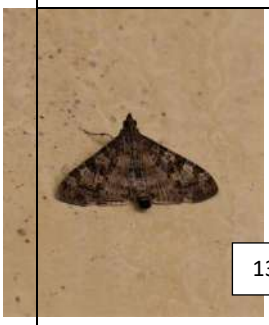
81.	Eupterotidae	*Eupterote undata*	Monkey Moth	Blanchard, 1844
82.		*Eupterote hibisci*	Monkey Moth	Fabricius 1775
83.	Gelechiidae	*Anarsia spp.*	-	Zeller, 1839
84.	Geometridae	*Biston suppressaria*	Tea Looper	Guenée, 1858
85.		*Boarmiini-genera spp.*	-	Duponchel, 1845
86.		*Chiasmia fidoniata*	-	Guenée, 1858
87.		*Chiasmia hypomochla*	-	Turner 1917
88.		*Ectropidia shoreae*	-	Prout, 1934
89.		*Heterostegane tritocampsis*	-	Prout, 1934
90.		*Hypomecis transcissa*	Looper Moth	Walker 1860
91.		*Hypomecis lioptilari*	-	Swinhoe, 1903
92.		*Maxates spp.*	Emerald Moths	Moore,1887
93.		*Parapholodes fuliginea*	-	Hampson, 1891
94.		*Pelagodes antiquadraria*	Emerald Moth	Inoue, 1976
95.		*Pleuroprucha insulsaria*	Common Tan Wave Moth	Guenée, 1857
96.		*Rhodometra sacraria*	Vestal	Linnaeus, 1767
97.		*Scopula spp.*	-	Schrank, 1802
98.		*Scopula spp.*	-	Schrank, 1803
99.		*Sterrhinae-genera spp.*	-	Meyrick, 1892
100.		*Eupitheciini-genera spp. 1*	Pugs	Tutt, 1896
101.		*Eupitheciini-genera spp. 2*	Pugs	Tutt, 1897
102.		*Hyposidra talaca*	Black Looper	Walker, 1860
103.		*Ornithospila aviculari*	-	Guenée, 1857
104.		*Traminda mundissim*	-	Walker, 1861
105.	Hyblaeidae	*Hyblaea puera complex*	Teak Defoliator	Cramer, 1777
106.	Lecithoceridae	*Lecithoceridae genera spp 1*	Long Horned Moths	Le Marchand 1947
107.		*Lecithoceridae genera spp 2*	Long Horned Moths	Le Marchand 1948
108.		*Lecithoceridae genera spp 3*	Long Horned Moths	Le Marchand 1949
109.	Limacodidae	*Aergina hilaris*	-	Westwood, 1848
110.		*Birthamoides junctura*	-	Walker, 1865
111.		*Cheromettia apicata*	Saddleback Caterpillar	Moore, 1879
112.		*Lithacodes spp.*	-	Herrich-Schäffer, 1854
113.		*Parasa pastoralis*	Slug Moths	Butler, 1885
114.		*Thespea bicolor*	-	Walker, 1855
115.		*Thosea spp.*	Cup Moths	Walker, 1855
116.	Noctuidae	*Acontia spp.*	-	Ochsenheimer, 1816
117.		*Amyna spp.*	-	Guenée, 1852
118.		*Athetis spp.*	-	Hubner,1821
119.		*Athetis transversa*	-	Walker, 1858
120.		*Paectes subapicalis*	-	Walker, 1858, 1857
121.		*Polymixis dubia*	-	Duponchel, 1836.
122.		*Sesamia inferens*	Pink Rice Stem Borer	Walker, 1856

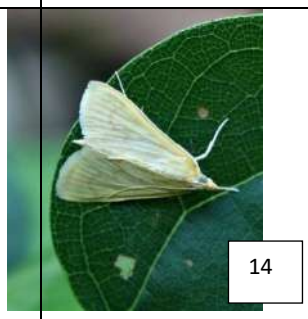
123.		*Spodoptera exigua*	Beet Army-Worm Moth	Hübner, 1808
124.		*Spodoptera spp.*	-	Guenée1852 ,
125.		*Xanthodes intersepta*	-	Guenée, 1852
126.	Nolidae	*Carea angulata*	-	Fabricius, 1793
127.		*Nola taeniata*	-	Snellen, 1875
128.		*Nolinae genera sp.*	-	Bruand, 1846
129.		*Aiteta rufoflava*	-	Walker, 1857
130.	Notodontidae	*Neocerura liturata*	Cerura Liturata	Walker, 1855
131.		*Antheua servula*	-	Drury ,1773
132.	Pyralidae	*Achroia grisella*	Lesser Wax Moth	Fabricius 1794
133.		*Arippara indicator*	Bostra Rufescens	Walker, 1864
134.		*Endotricha ruminalis*	-	Walker, 1859
135.		*Fujimacia bicoloralis*	-	Leech, 1889
136.		*Lamoria spp.*	Plain Lamoria	Walker, 1863
137.		*Mampava rhodoneura*	-	Turner, 1905
138.		*Phycitinae-genera spp.*	-	Zeller, 1839
139.		*Pyralidae-genera spp.*	-	Latreille, 1809
140.	Thyrididae	*Herdonia thaiensis*	-	Inoue, 1993
141.		*Herdonia approximata*	-	Inoue, 1993
142.		*Hypolamprus angulalis*	-	Moore, 1888
143.		*Striglina spp.*	Daincha Leaf Webber	Guenée, 1877
144.		*Thyrididae-genera spp.*	-	Herrich-Schäffer, 1846
145.	Tineidae	*Edosa spp.*	-	Walker, 1886
146.	Sphingidae	*Theretra oldenlandiae*	White-Banded Hunter Hawkmoth	Fabricius, 1775

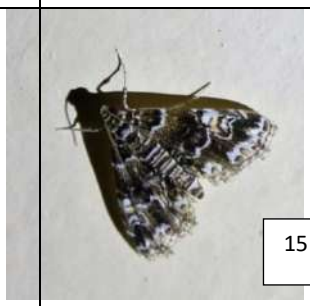


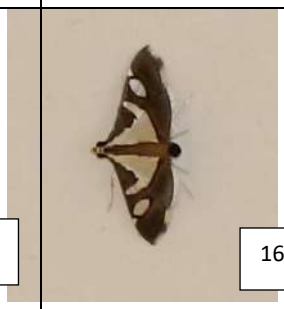


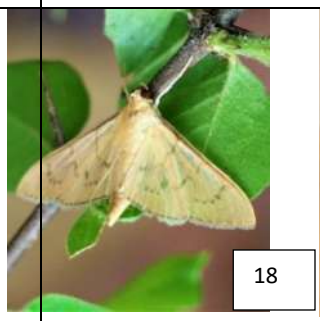


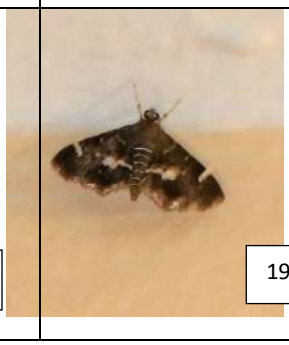












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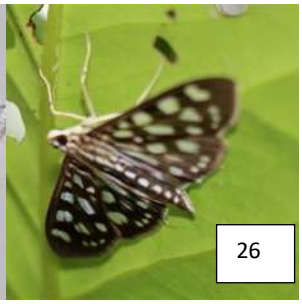

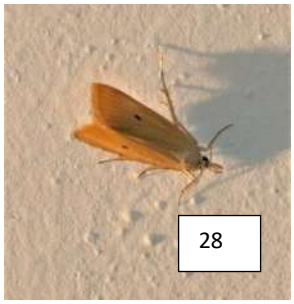

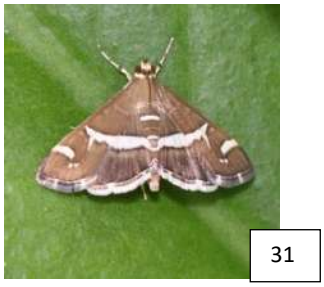

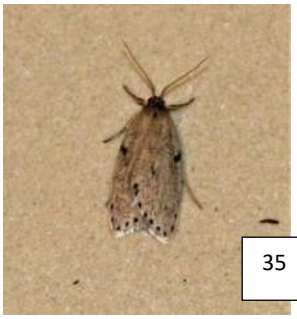

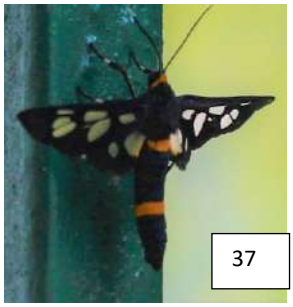

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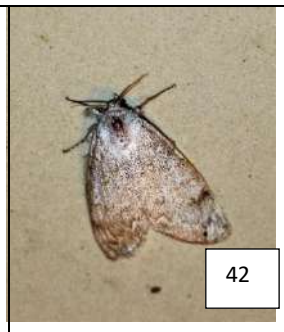
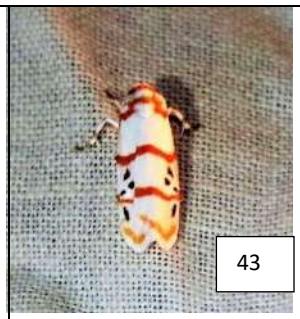
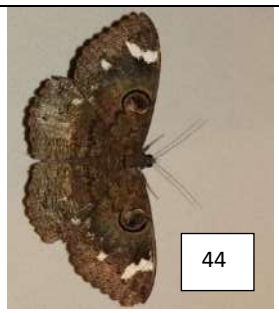
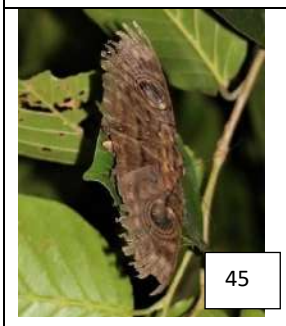
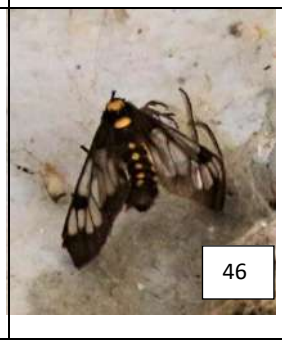
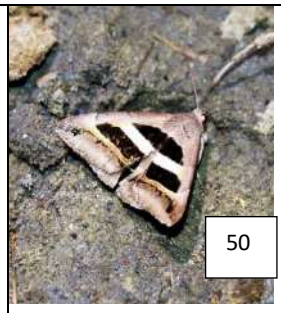


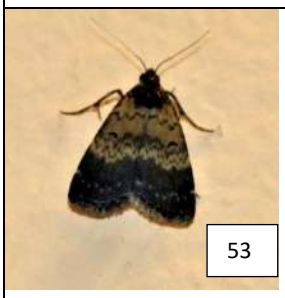


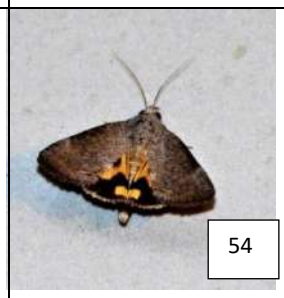


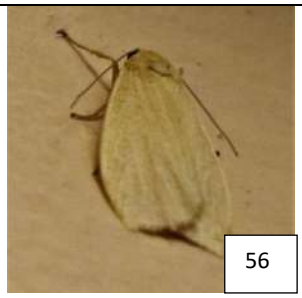


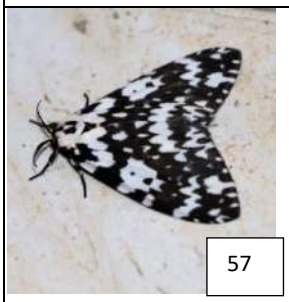


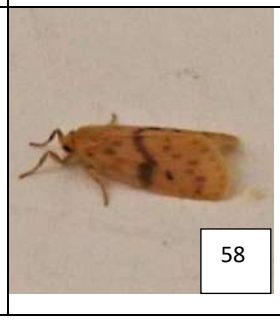


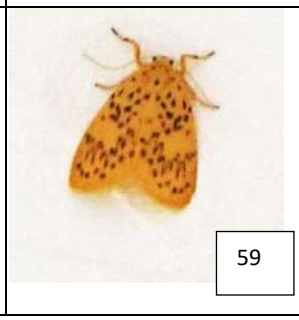


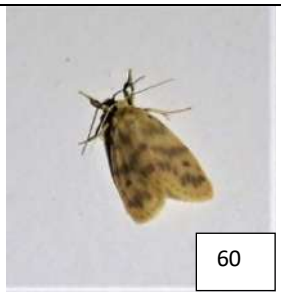




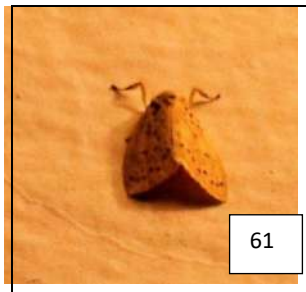


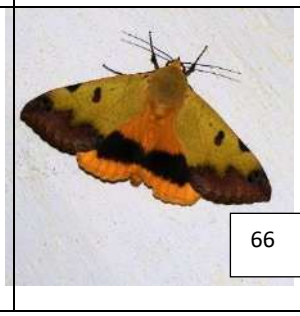


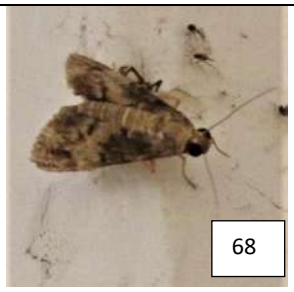


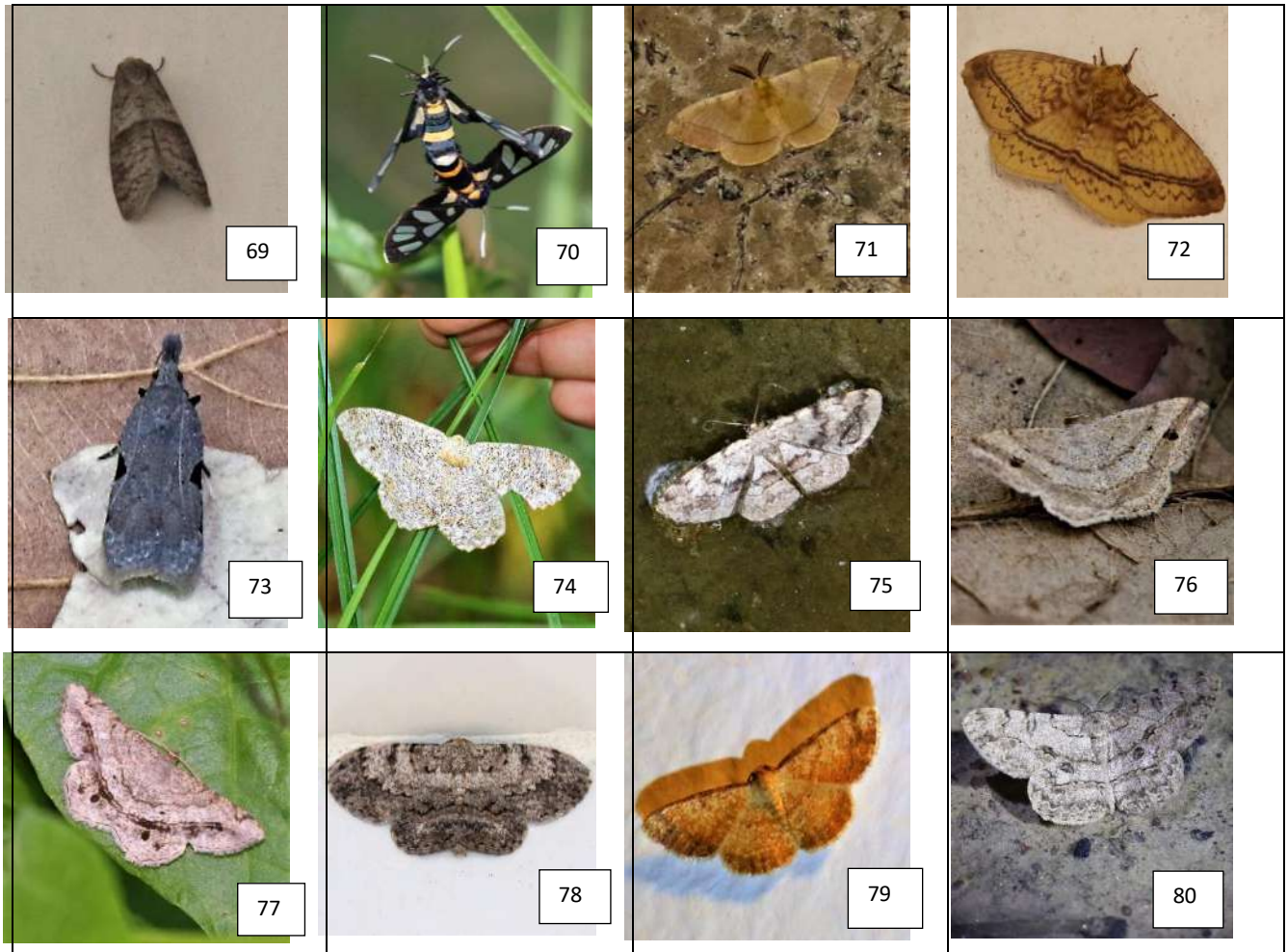


41. Britha pactalis 42. Casama vilis 43. Cyana puella 44. Erebus hieroglyphica 45. Erebus macrops 46. Eressa confinis 47. Eublemma olivacea 48. Fodina stola 49. Gesonia spp. 50. Grammodes geometrica 51. Herminiinae genera spp. 52. Hydrillodes spp. 53. Hydrillodes spp. 54. Hypocala violacea 55. Hypsoropha sp. 56. Lithosiini-genera spp. 57. Lymantria marginata 58. Miltochrista ila 59. Miltochrista obsolete 60. Miltochrista rubricosa

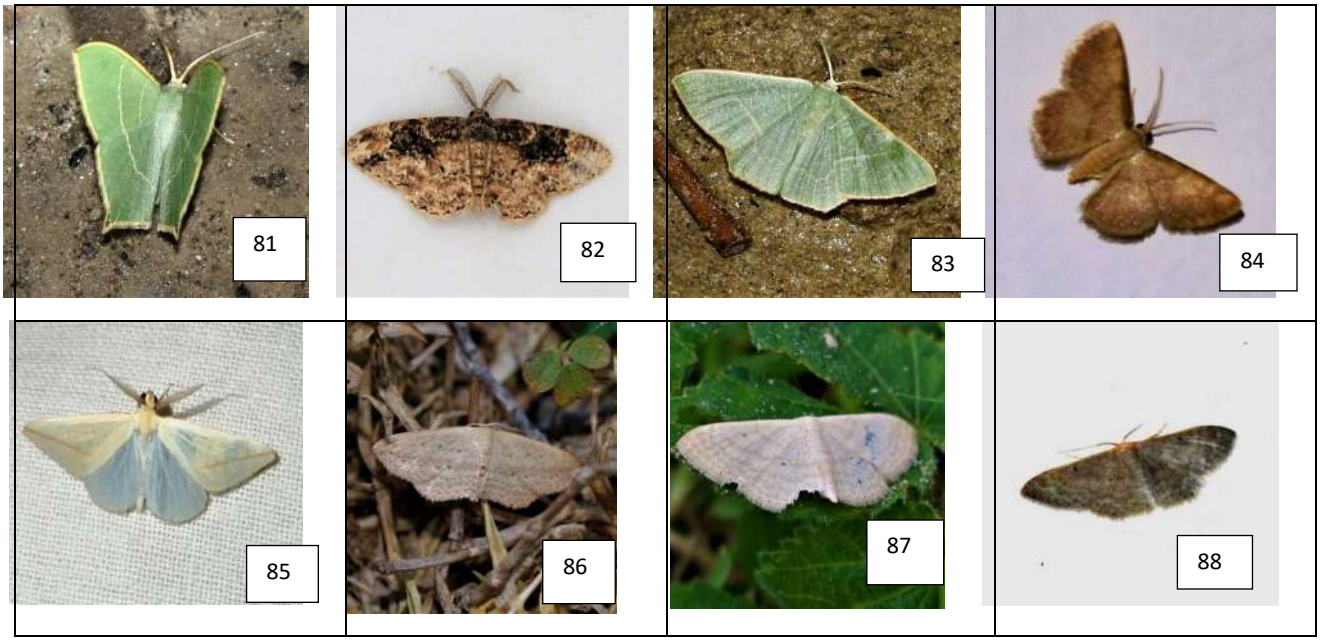


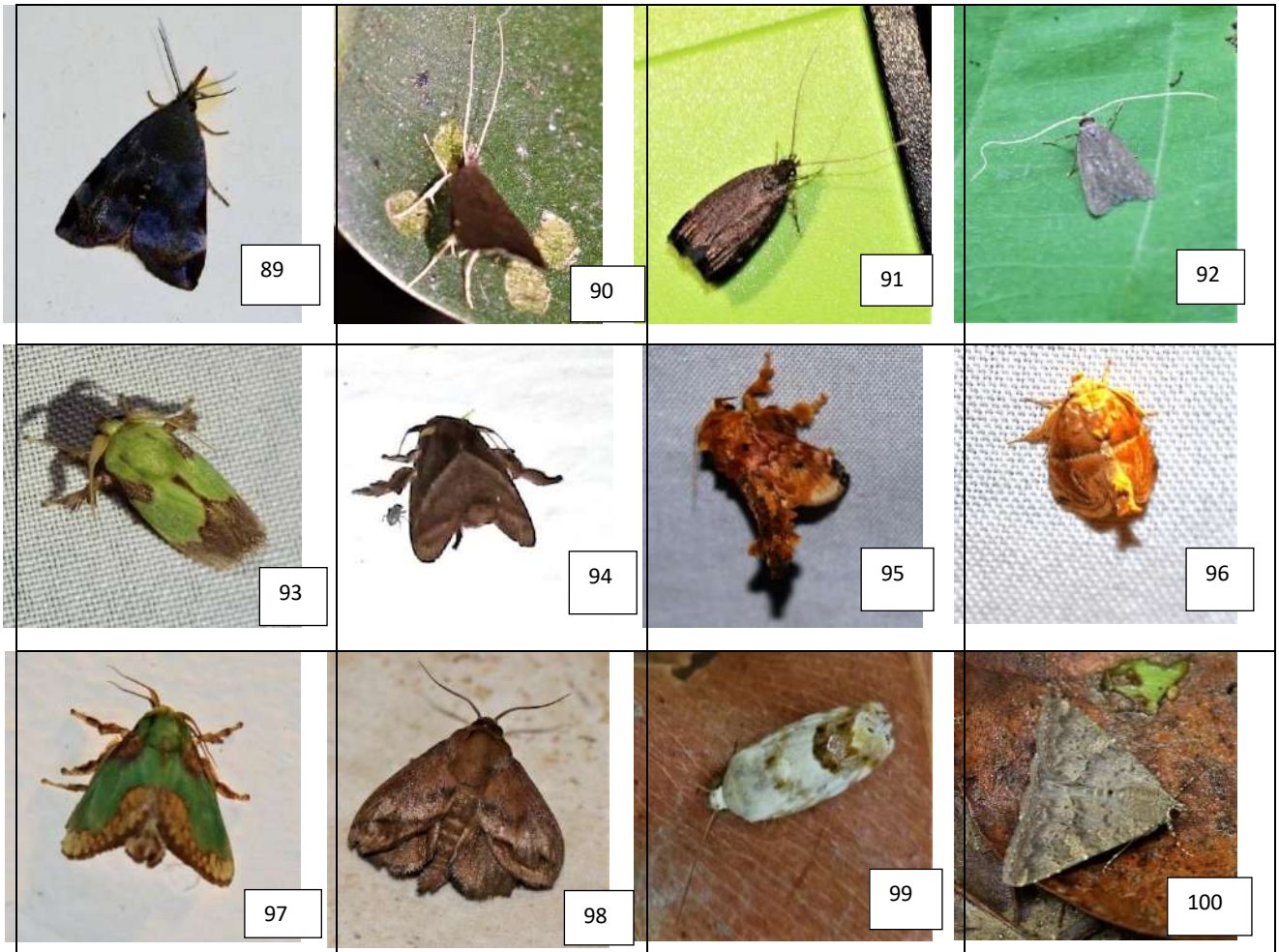




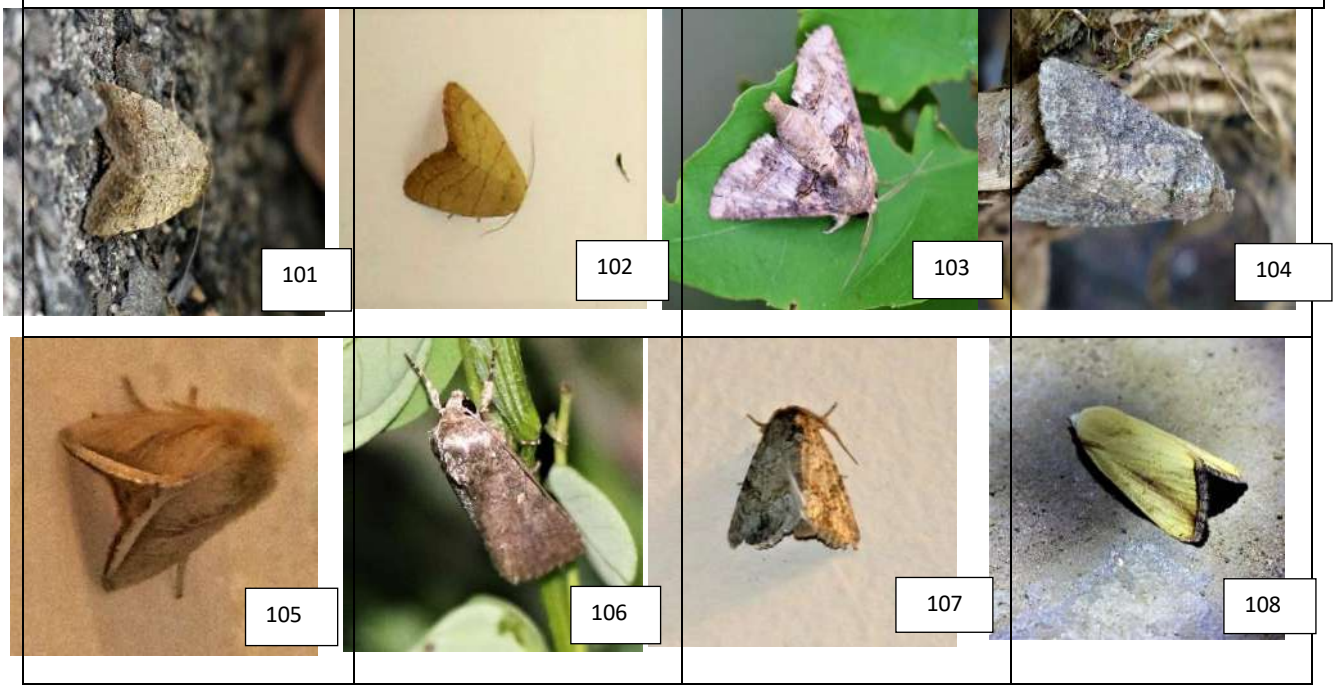


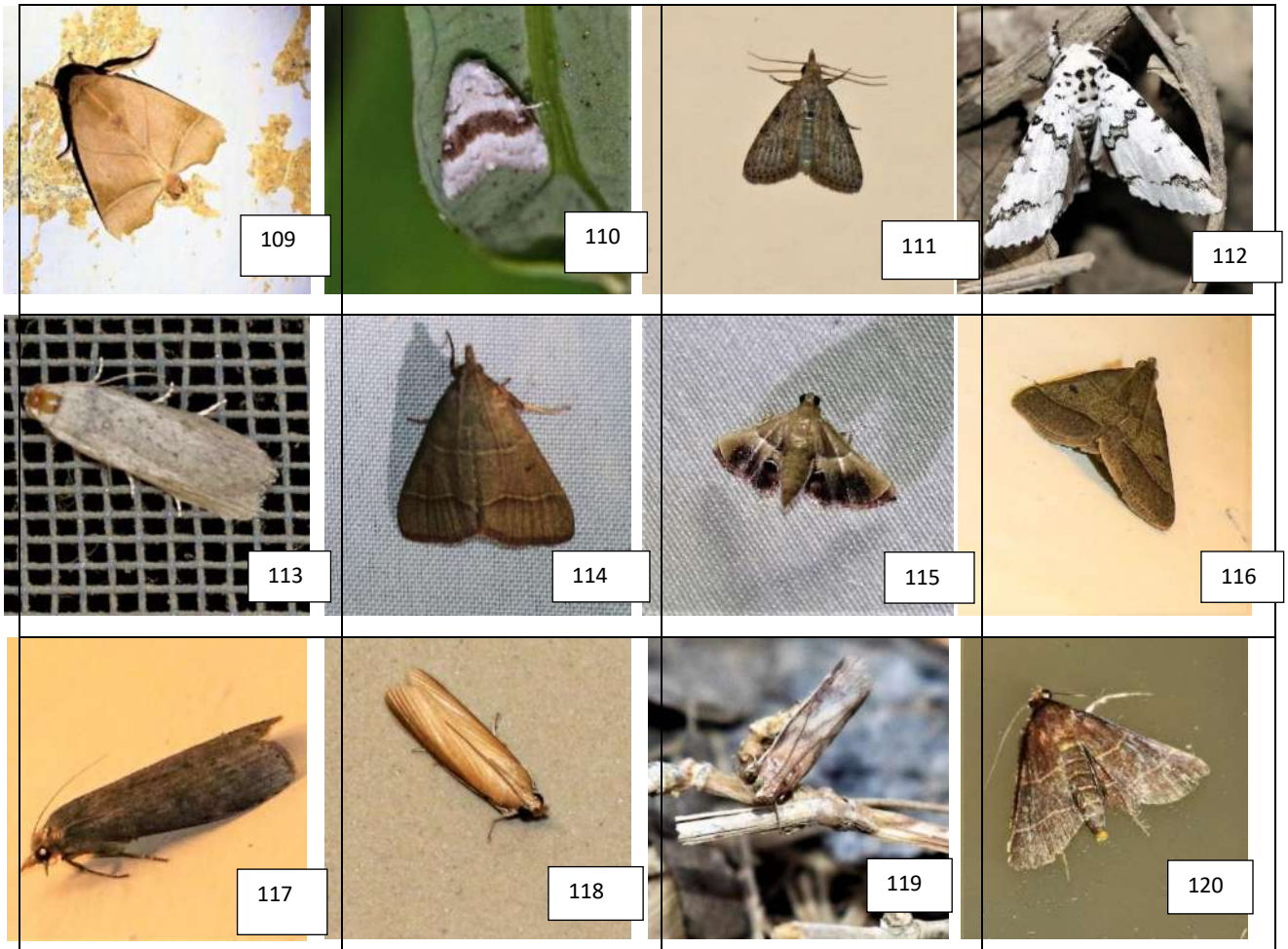
61. Miltochrista semifascia 62. Mocis frugalis 63. Mocis undata 64. Nygmiini-genera spp. 65. Oglasa hypenoides 66. Ophiusa tirhaca 67. Pericyma umbrina 68. Progonia kurosawai 69. Stictane sp. 70. Syntomoides imaon 71. Eupterote hibisci 72. Eupterote undata 73. Anarsia spp. 74. Biston suppressaria 75. Boarmiini-genera spp. 76. Chiasmia fidoniata 77. Chiasmia hypomochla 78. Ectropidia shoreae 79. Heterostegane tritocampsis 80. Hypomecis transcissa



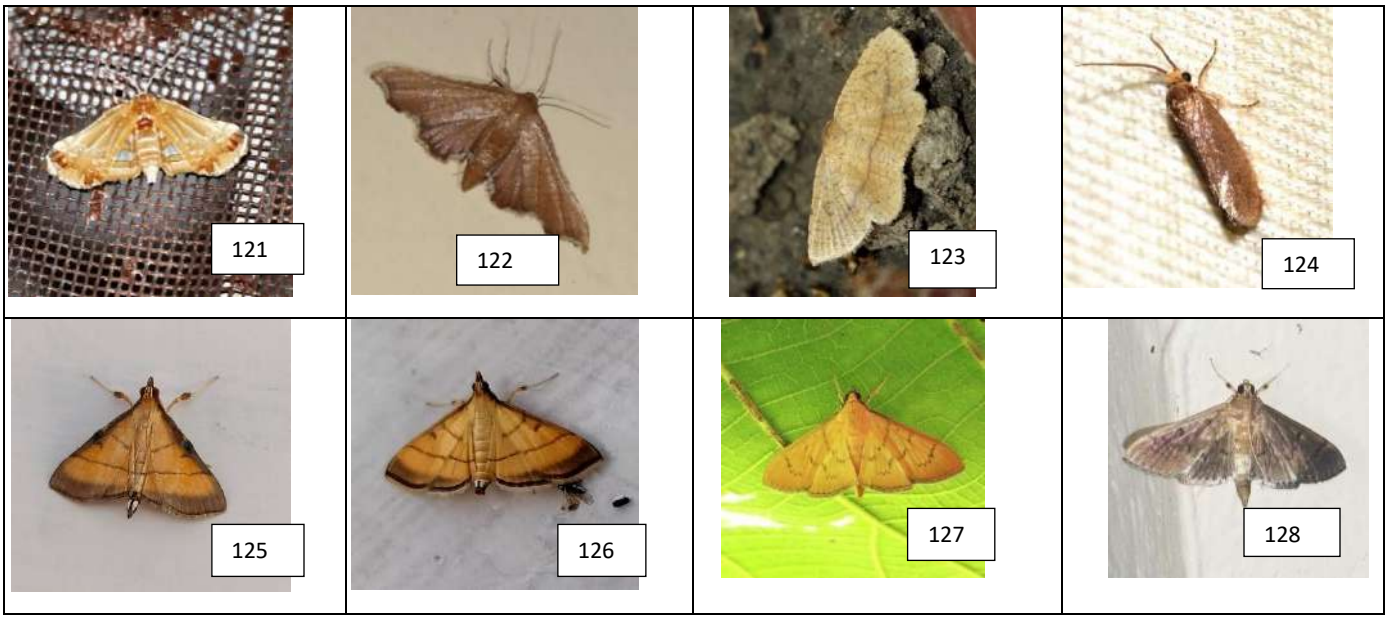


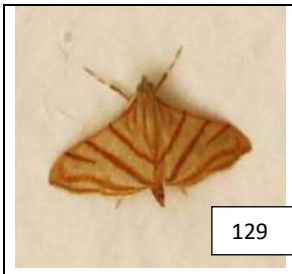
81. Maxates spp 82. Parapholodes fuliginea 83. Pelagodes antiquadraria 84. Pleuroprucha insulsaria 85. Rhodometra sacraria 86. Scopula sp. 87. Scopula spp. 88. sterrhinae-genera spp. 89. Hyblaea puera 90. Lecithoceridae genera spp. 91. Lecithoceridae-genera spp. 92. Lecithoceridae-genera spp. 93. Aergina hilaris 94. Birthamoides juncture 95. Cheromettia apicata 96. Lithacodes spp. 97. Parasa pastoralis 98. Thosea spp. 99. Acontia spp. 100. Amyna spp.





101. Athetis spp. 102. Athetis transversa 103. Paectes subapicalis 104. Polymixis dubia 105. Sesamia inferens 106. Spodoptera exigua 107. Spodoptera spp. 108. Xanthodes intersepta 109. Carea angulate 110. Nola taeniata 111. Nolinae genera spp 112. Neocerura liturata 113. Achroia grisella 114. Arippara indicator 115. Endotricha ruminalis 116. Fujimacia bicoloralis 117. Lamoria spp. 118. Mampava rhodoneura 119. Phycitinae-genera spp. 120. Pyralidae-genera spp.

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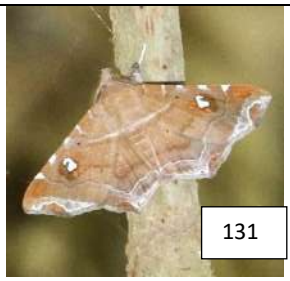
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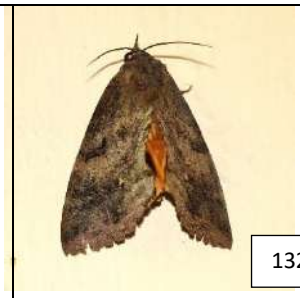
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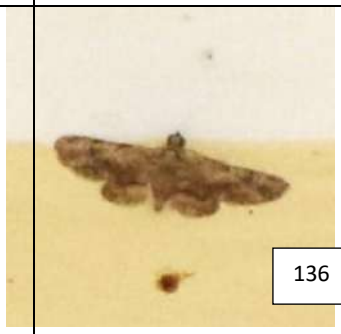
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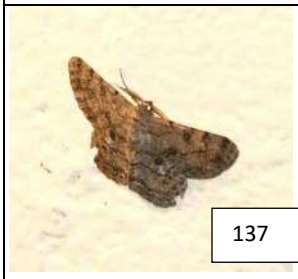
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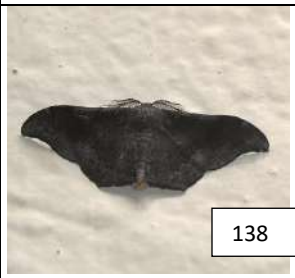
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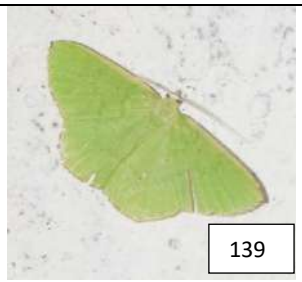
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121. Herdonia thaiensis 122. Hypolamprus angulalis 123. Striglina spp. 124. Edosa spp. 125. Cnaphalocrocis medinalis 126. Cnaphalocrocis rutilalis 127. Gadessa attemptalis 128. Herpetogramma licarsisalis 129. Pagyda salvalis 130. Chalciope mygdon 131. Episparis liturata 132. Eudocima cajeta 133. Hypena obacerralis 134. Nagia linteola 135. Eupitheciini-genera spp. 136.Eupitheciini-genera spp. 137.Hypomecis lioptilaria 138. Hyposidra talaca 139. Ornithospila avicularia 140. Traminda mundissima


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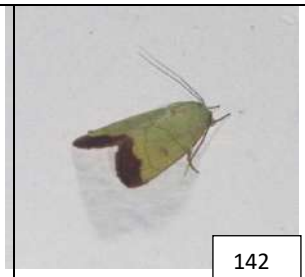
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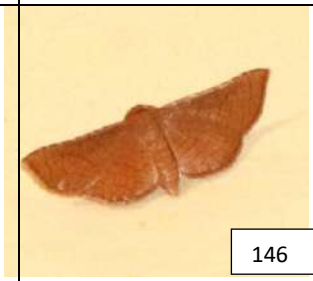
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141. Thespea bicolor 142. Aiteta rufoflava 143. Antheua servula 144. Theretra oldenlandiae 145. Herdonia approximate 146. Thyrididae-genera spp.

notable. These findings indicate that these families are more diversely represented. The greatest number of species is found in the Eribedae family, which indicates more diverse ecological adaptations. Moderate diversity is also shown in the Limacodidae family, which has seven species, and the Geometridae family, which has twenty-one species. These families may be present in greater numbers since they are widely distributed in different habitats and are frequently acknowledged for their adaptability. Families such as Pyralidae and Noctuidae have intermediate species diversity, with 8 and 10 species, respectively. Although these families are not the most numerous, they exhibit an adequate amount of variety and are frequently recognized for their ecological flexibility.

Several families, including Autostichidae, Bombycidae, Eupterotidae, Notodontidae, and Thyrididae, have between two and five species each. The finding suggests that there is less variety among these families, in the investigated area. The families Depressariidae, Gelechiidae, Hyblaeidae, Tineidae, and Sphingidae each have only one species. The lack of representation may indicate that these families are not widely distributed. Despite having few species, families such as Sphingidae- which are frequently recognized as larger, more noticeable species such as hawk moths- may still be ecologically significant in this area. These insects have seen significant declines in variety as a result of habitat loss brought on by forest destruction and unsustainable forest usage, particularly in tropical forests around the equator (Beck *et al.*, 2002).

Conclusion

The present study concludes that in the Sohagi Barwa Wildlife Santuary the Eribedae family has the most species (40) followed by Crambidae (35), and Geometridae (21). There is only one species in each of several families, such as Depressariidae, Gelechiidae, Hyblaeidae, Tineidae, and Sphingidae. This suggests that certain families have greater species richness and others have lower species richness in the study area. This diversity also emphasizes the need for conservation efforts in preserving and protecting the delicate balance of flora and moths in the Sohagi Barwa Wildlife Sanctuary for future generations.

Ethical Statement

The study was permitted by the Forest Department of Uttar Pradesh, India.

Author Contributions

Supervision, reviewing, editing: Kanaujia Amita; survey of moth: Tripathi Prashant, Antil Jyoti; field survey, photography of the moths, identification of the species, reviewing, editing and figures: Rathaur Shivanshu. All authors have read and agreed to the published version of the manuscript.

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Conflict of Interest

The authors declare no conflicts of interest.

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