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A survey of moth (lepidoptera: Heterocera) diversity from Cachar district, Assam

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Abstract
An assessment of moth species was conducted at Irongmara, a rural setting in the Cachar district of Assam in order to track down the diversity and species richness of the faunal group at the concerned site. Considering the need for a dependable data, this faunistic appraisement was carried out through light trapping and opportunistic sampling which revealed a total of 70 moth species belonging to 64 genera under 23 sub families of 12 diverse families under 8 superfamilies belonging to 4 clades.

Keywords: Assessment, Cachar, checklist, diversity, moths

Introduction

An enormous proportion, more than a half, of animal biodiversity on earth is being contributed by the insect fauna (Wolda, 1978) [1]. However, the assessment and quantification of these ecologically requisite creatures, distributed extensively over a range of ecosystems, climatic regimes and altitudes, appears to be scarce globally (Shashank *et al*., 2022) [2]. This faunal assemblage serves as a prime interest group to assess the anthropogenic effects on various ecosystems (Parikh *et al*., 2021) [3].

Lepidoptera, one of the largest orders of class Insecta comprising of 1,60,000 described extant species worldwide includes two popularly distinct groups- 18,000 butterflies and 1,42,000 moths (Subhalaxmi, 2018; Kawahara *et al*., 2019) [4, 5]. Nocturnal moths constitute more than 75% of lepidopteran species diversity (Kawahara *et al*., 2018) [6]. Subhalaxmi (2018) [4] reported that India harbours over 12,000 moth species but the count is far from being accurate as a major work stands in need of preparing a comprehensive list. Majorly, the extensive documentation of Indian moth fauna was carried out in the pre-independent period by Hampson (1892, 1894, 1895, 1896) [7, 8, 9, 10], Fletcher (1920, 1932, 1933) [11, 12, 13], Moore (1882, 1884) [14, 15] and Bell and Scott (1937) [16] notably. But it is often felt that a systematic taxonomic exercise is required with supplemental modern surveys to update the current status and distribution of moths globally.

Moths, owing to their predominant nocturnal habits, are the least explored creatures of the insect world (Kehimkar, 2002) [17]. Presently, this group is in highlight due to their vital characteristics with respect to conservation (Arandhara, 2018) [18] and pollination (MacGregor *et al*., 2015) [19], as agricultural pests (Sharma, 2011; Sharma & Bisen, 2013) [20, 21], food for various organisms such as humans (Zagrobelny *et al*., 2009) [22], birds, bats and insect species, (LeCroy *et al*., 2013; Devoto *et al*., 2010; MacGregor *et al*., 2015) [23, 24, 19] and model organisms in scientific research (Roe and Just, 2009) [25].

This faunal group qualifies for an appropriate subject for ecological studies because of being easily allured by light traps, thereby effectuating an efficient and comparable estimation of species richness and abundance (Choi, 2008) [26]. However, moth research in the Cachar district of Assam demands significant additions and consideration since both preliminary and comprehensive studies are scanty. Studies suggest substantial faunistic surveys, complemented with proper identification and documentation, to species or subspecies levels, provide dependable data for conservation and management of diverse habitats (Chandra & Sambath, 2013) [27].

The present work explores the diversity and species richness of moth fauna at Irongmara in the Cachar district of Assam and presents an inventory of all recorded families with an aim to provide baseline data for further long-term studies.

Methodology

Cachar district, positioned in the southernmost part of Assam (Fig 1), lies between 92˚24′ E and 93˚15′ E longitude and 24˚22′ N and 25˚8′ N latitude. A faunistic assessment was executed at Irongmara, a rural setting in the Cachar district of Assam which is a part of the Indo-Burma hotspots. The survey spanned from March 2015 to February 2016 every fortnight between 19:00 to 23:00 hrs. Moth species were recorded by light trapping and opportunistic sampling. All moths, attracted to light traps and detected during opportunistic sampling, were photographed and documented. Moths were identified and classified following available literature, Hampson (1892, 1894, 1895, 1896) [7, 8, 9, 10], Bell & Scott (1937) [16], Subhalaxmi (2018) [4] and van Nieukerken *et al*. (2011) [28] respectively. Also, online databases such as the Moths of India (http://www.mothsofindia.org; Sondhi *et al*., 2023) [29] and LEPINDEX (Beccaloni *et al*. 2003) [30] were referred for identification and taxonomic details. The entire study was conducted ensuring humane treatment towards moths and other animals. A geographical map of the study area has been constructed using QGIS (Version 3.30.3 's-Hertogenbosch) [31].

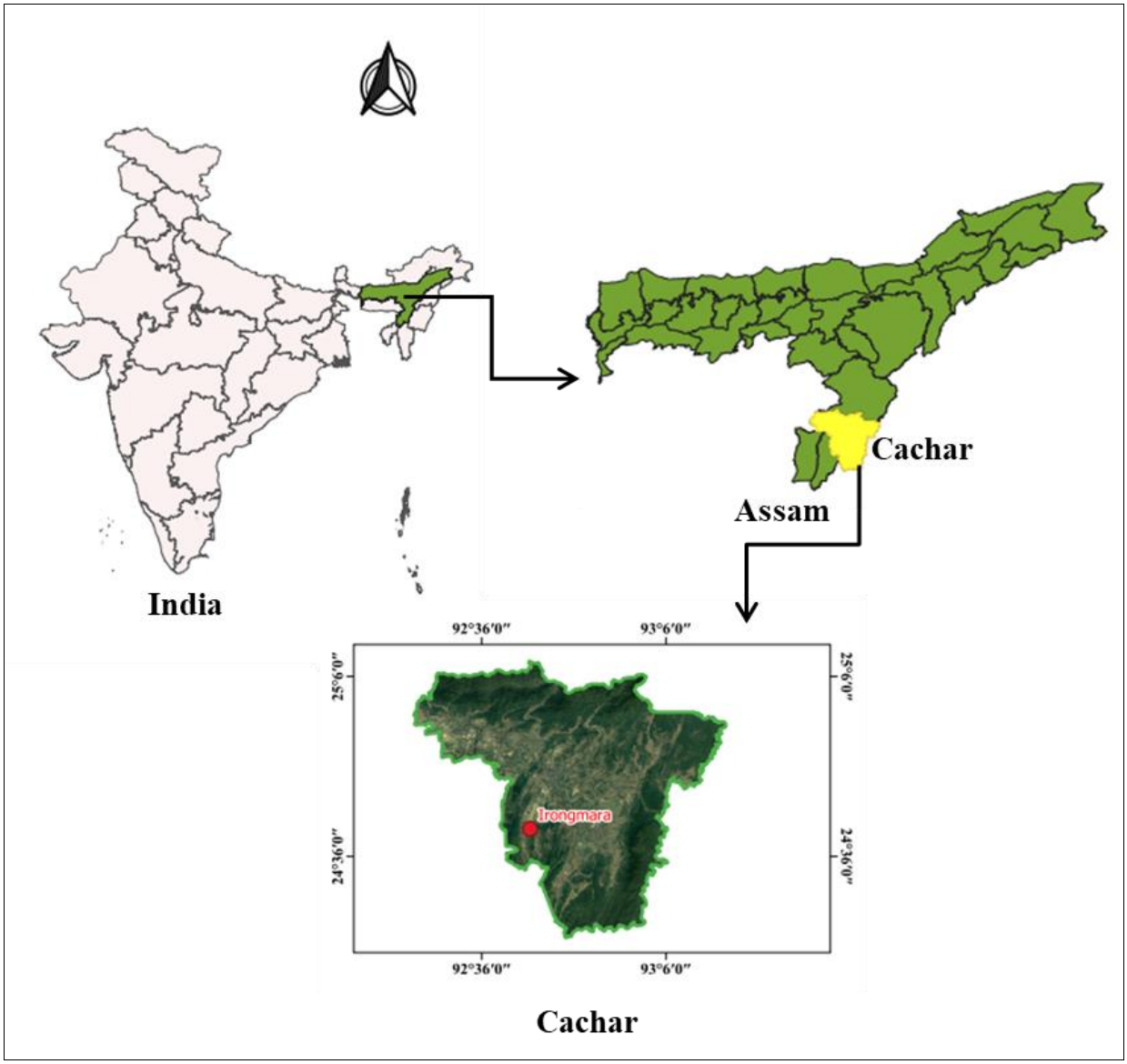


Fig 1: Irongmara, study area in Cachar, Assam, India.

Results

The faunistic survey, conducted at Irongmara in the Cachar district of Assam, revealed a total of 70 moth species belonging to 64 genera under 23 sub-families of 12 diverse families under 8 super-families (Table 1). Of all the recorded species, 24 belonged to Erebidae family, 18 belonged to Crambidae family, 12 were from Geometridae family, 4 from Zygaenidae family, 3 from Noctuidae family, 2 from Sphingidae and 1 from Hepialidae, Lasiocampidae, Pyralidae, Uraniidae and Thyrididae families each (Table 1). In the present study, Erebidae dominated with 34% of all the recorded species followed by the families Crambidae (26%), Geometridae (17%), Zygaenidae (6%) and Noctuidae (4%). The other moth families such as Sphingidae and Limacodidae represented 3% each, Hepialidae and Thyrididae represented 2% each and the families Lasiocampidae, Pyralidae and Uraniidae had the least species richness that accounted 1% each of the total recorded species (Fig 2). The study reported 4 clades of this faunal group *viz*. Neolepidoptera including Hepialoidia, Apoditrysia including Zygaenoidea, Obtectomera including Thyridoidea and Pyraloidea and Macroheterocera including the superfamilies Lasiocampoidea, Bombycoidea, Geometroidea and Noctuoidea respectively.

Table 1: Family-wise checklist of species recorded from the study site, Irongmara, Cachar, Assam.

Sl. No.	Common name	Scientific name	Sub-Family	Super-Family
Family: Hepialidae				
1.		*Endoclita signifer* Walker, 1856		Hepialoidea
Family: Limacodidae				
1.		*Parasa sp.* Moore, 1859	Limacodinae	Zygaenoidea
2.		*Phocoderma sp.* Butler, 1886	Limacodinae	Zygaenoidea
Family: Zygaenidae				
1.	Drury's Jewel	*Cyclosia papilionaris* Drury, 1773	Chalcosiinae	Zygaenoidea
2.		*Eterusia aedea aedea* Clerck, 1759	Chalcosiinae	Zygaenoidea
3.		*Gynautocera papilionaria* Guérin-Méneville, 1831	Chalcosiinae	Zygaenoidea

s4.		*Tryphanophora semihyalina* Kollar, 1844	Chalcosiinae	Zygaenoidea
Family: Thyrididae				
1.		*Striglina sp.* Guenée, 1877	Striglininae	Thyridoidea
Family: Pyralidae				
1		*Hypsopgia sp.* Hübner, 1825	Pyralinae	Pyraloidea
Family: Crambidae				
1.	Rice leaf-folder moth	*Cnaphalocrocis medinalis* Guenée, 1854	Spilomelinae	Pyraloidea
2.		*Cnaphalocrocis patnalis* Bradley, 1981	Spilomelinae	Pyraloidea
3.		*Dichocrocis sp.* Lederer, 1863	Spilomelinae	Pyraloidea
4.		*Ecpyrrhorrhoe sp.* Hübner, 1825	Pyraustinae	Pyraloidea
5.		*Elophila sp.* Hübner 1822	Acentropinae	Pyraloidea
6.		*Eurrhyparodes bracteolalis* Zeller, 1852	Spilomelinae	Pyraloidea
7.		*Glyphodes caesalis* Walker, 1859	Spilomelinae	Pyraloidea
8.		*Herpetogramma sp.* Lederer, 1863	Spilomelinae	Pyraloidea
9.		*Lamprosema commixta* Butler, 1879	Spilomelinae	Pyraloidea
10.		*Nausinoe pueritia* Cramer, 1780	Spilomelinae	Pyraloidea
11.		*Palpita pajnii* Kirti & Rose, 1992	Spilomelinae	Pyraloidea
12.		*Parapoynx stagnalis* Zeller, 1852	Acentropinae	Pyraloidea
13.		*Parapoynx fluctuosalis* Zeller, 1852	Acentropinae	Pyraloidea
14.		*Parotis sp.* Hübner, 1831	Spilomelinae	Pyraloidea
15.		*Patania iopasalis* Walker, 1859	Spilomelinae	Pyraloidea
16.		*Scirpophaga sp.* Treitschke, 1832	Schoenobiinae	Pyraloidea
17.		*Spoladea recurvalis* Fabricius, 1775	Pyraustinae	Pyraloidea
18		*Diaphania indica* Saunders, 1851	Spilomelinae	Pyraloidea
Family: Lasiocampidae				
1.		*Gastropacha pardale* Walker, 1855	Lasiocampinae	Lasiocampoidea
Family: Sphingidae				
1.		*Pergesa acteus* Cramer, 1779	Macroglossinae	Bombycoidea
2.		*Theretra pallicosta* Walker, 1856	Macroglossinae	Bombycoidea
Family: Uraniidae				
1.	Grey Swallowtail Moth	*Micronia aculeata* Guenée, 1857	Microniinae	Geometroidea
Family Geometridae				
1.	Milkweed Emerald	*Agathia lycaenaria* Kollar, 1844	Geometrinae	Geometroidea
2.		*Agathia sp.* Guenée, 1858	Geometrinae	Geometroidea
3.	False Tiger Moth	*Dysphania militaris* Linnaeus, 1758	Geometrinae	Geometroidea
4.	Red Banded Geometer	*Hyperythra lutea* Stoll, 1781	Ennominae	Geometroidea
5.		*Hyposidra infixaria* Walker, 1860	Ennominae	Geometroidea
6.		*Maxates coelataria* Walker, 1861	Geometrinae	Geometroidea
7.		*Metapercnia ductaria* Walker, 1862	Ennominae	Geometroidea
8.		*Oenospila flavifusata* Walker, 1861	Geometrinae	Geometroidea
9.		*Pingasa sp.* Moore, 1887	Geometrinae	Geometroidea
10.		*Problepsis sp.* Lederer, 1853	Sterrhinae	Geometroidea
11.	Bird Dropping Looper	*Problepsis vulgaris* Butler, 1889	Sterrhinae	Geometroidea
12.		*Scopula sp.* Schrank, 1802	Sterrhinae	Geometroidea
Family: Erebidae				
1.	Castor Semi-Looper	*Achaea janata* Linnaeus, 1758	Erebinae	Noctuoidea
2.	Black-Spotted Arctornis	*Arctornis submarginata* Walker, 1855	Lymantriinae	Noctuoidea
3.		*Artaxa sp.* Walker, 1855	Lymantriinae	Noctuoidea
4.	White-Underwing Artena	*Artena dotata* Fabricius, 1794	Erebinae	Noctuoidea
5.	Orange Underwing Snout Tiger	*Asota caricae* Fabricius, 1775	Aganainae	Noctuoidea
6.		*Asota plana* Walker, 1854	Aganainae	Noctuoidea
7.		*Barsine sp.* Walker, 1854	Arctiinae	Noctuoidea
8.		*Bastilla sp.* Swinhoe, 1918	Erebinae	Noctuoidea
9.	Clouded Tiger	*Creatonotos transiens* Walker, 1855	Arctiinae	Noctuoidea
10.		*Cyana adita* Moore, 1859	Arctiinae	Noctuoidea
11.		*Hypercompe scribonia* Stoll, 1790	Arctiinae	Noctuoidea
12.		*Episparis liturata* Fabricius, 1787	Pangraptinae	Noctuoidea
13.		*Ercheia cyllaria* Cramer, 1779	Erebinae	Noctuoidea
14.		*Erebus caprimulgus* Fabricius, 1781	Erebinae	Noctuoidea
15.		*Hulodes carnea* Guenée, 1852	Calpinae	Noctuoidea
16.		*Ischyja sp.* Hübner, 1823	Erebinae	Noctuoidea
17.		*Mocis frugalis* Fabricius, 1775	Erebinae	Noctuoidea
18.		*Mocis undata* Fabricius, 1775	Erebinae	Noctuoidea
19.		*Nyctemera adversata* Schaller, 1788	Arctiinae	Noctuoidea
20.		*Psimada quadripennis* Walker, 1858	Calpinae	Noctuoidea
21.		*Rusicada sp.* Walker, 1857	Scoliopteryginae	Noctuoidea
22.		*Spilarctia tamangi* Thomas, 1994	Arctiinae	Noctuoidea

23.	Hand maiden moth	*Syntomoides imaon* Cramer, 1780	Arctiinae	Noctuoidea
24.		*Thyas coronata* Fabricius, 1775	Erebinae	Noctuoidea
Family: Noctuidae				
1.	Knot Grass	*Acronicta rumicis* Linnaeus, 1758	Acronictinae	Noctuoidea
2.		*Ataboruza sp.* Holloway, 2009	Acontiinae	Noctuoidea
3.		*Condica sp.* Walker, 1856	Condicinae	Noctuoidea

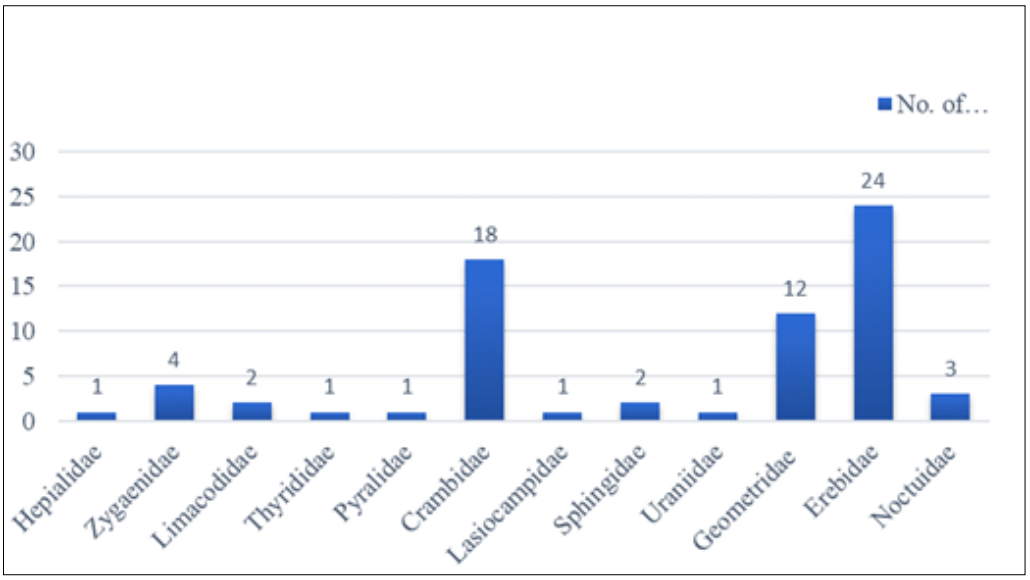
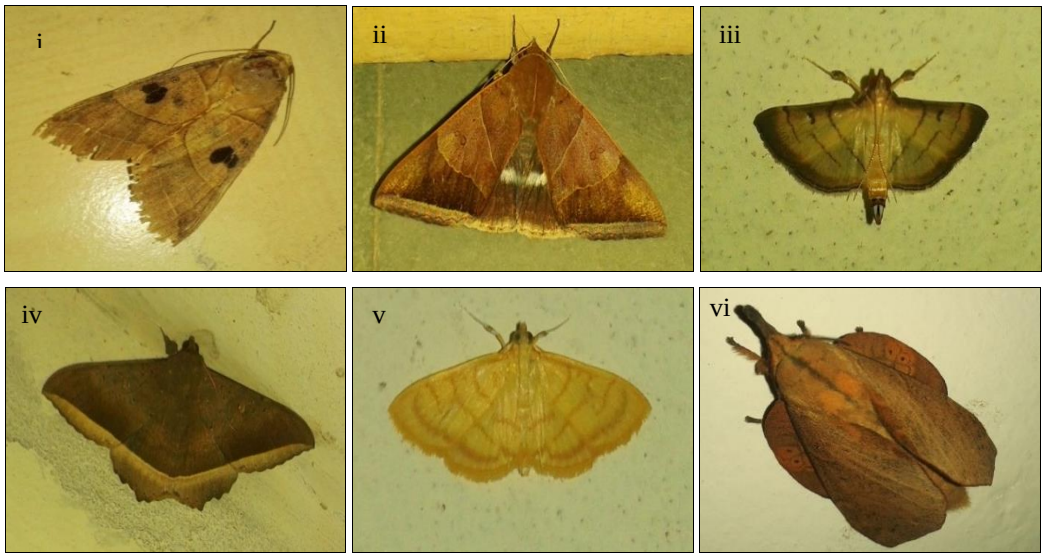


Fig 2: Bar diagram denoting family-wise distribution of moth fauna at the study site, Irongmara, Cachar, Assam.

Discussion

Being remotely situated, the present site of interest severely lacks attention concerning diversity studies, especially with respect to moths. Researchers from diverse genres agree to the fact that a preliminary checklist bears great significance in providing a core data for further studies. But a complete absence of such records for the concerned site and subject seems to have posed a hindrance to the conservation of moths. Moreover, the natives of the concerned locale, owing to lack of environmental education and awareness, greatly undervalue the contributions of moths on environment and people. Thus, concerted and evidence-based actions must be taken up to ensure successful conservation of these often-neglected creatures through active participation of all stakeholders from farmers and local people to researchers and policy-makers (Deb *et al*., 2015; Fox *et al*., 2021) [32, 33]. The present study sheds light on the fact that the concerned area, severely under-studied and scarcely documented, harbours an array of diversity, promising the exploration of some new species only at the expense of long-term surveys. Also, a major finding during the study was the lack of conservation status of this diverse faunal group and hence it is highly suggested to conduct further studies and enlist the moth species into the respective six schedules of the Wildlife (Protection) Act, 1972.

Photoplates



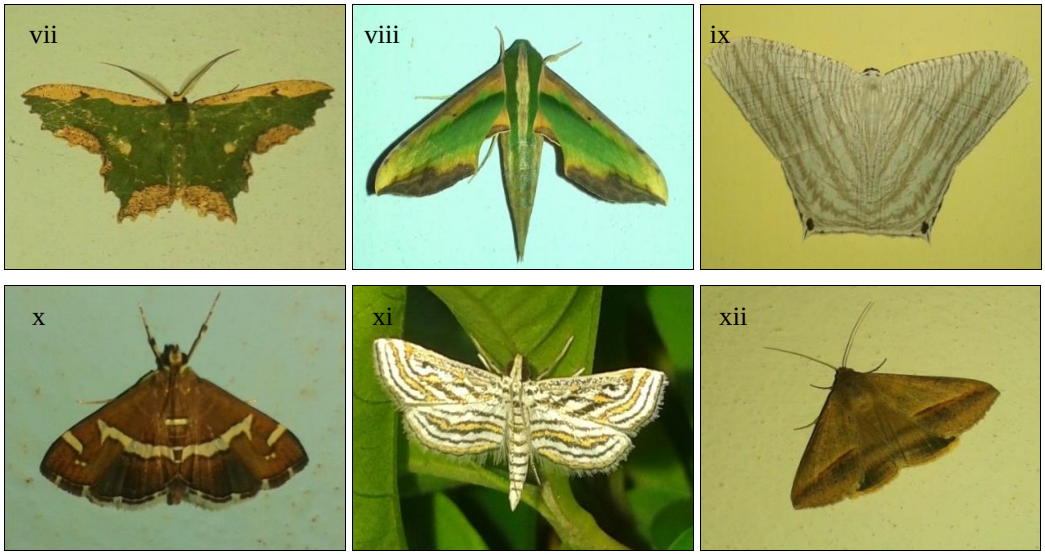


Fig 3: i-xii represents various moths encountered at the study site.

i. *Thyas coronata* ii. *Artena dotata* iii. *Cnaphalocrocis patnalis* iv. *Hulodes carnia* v. *Ecpyrrhorrhoe sp*. vi. *Gastropacha pardale* vii. *Maxates coelataria* viii. *Pergasa acteus* ix. *Micronia aculeata* x. *Spoladea recurvalis* xi. *Parapoynx fluctuosalis* xii. *Mocis frugalis*

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Conflict of Interest Statement
The authors declare no conflict of interest.

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