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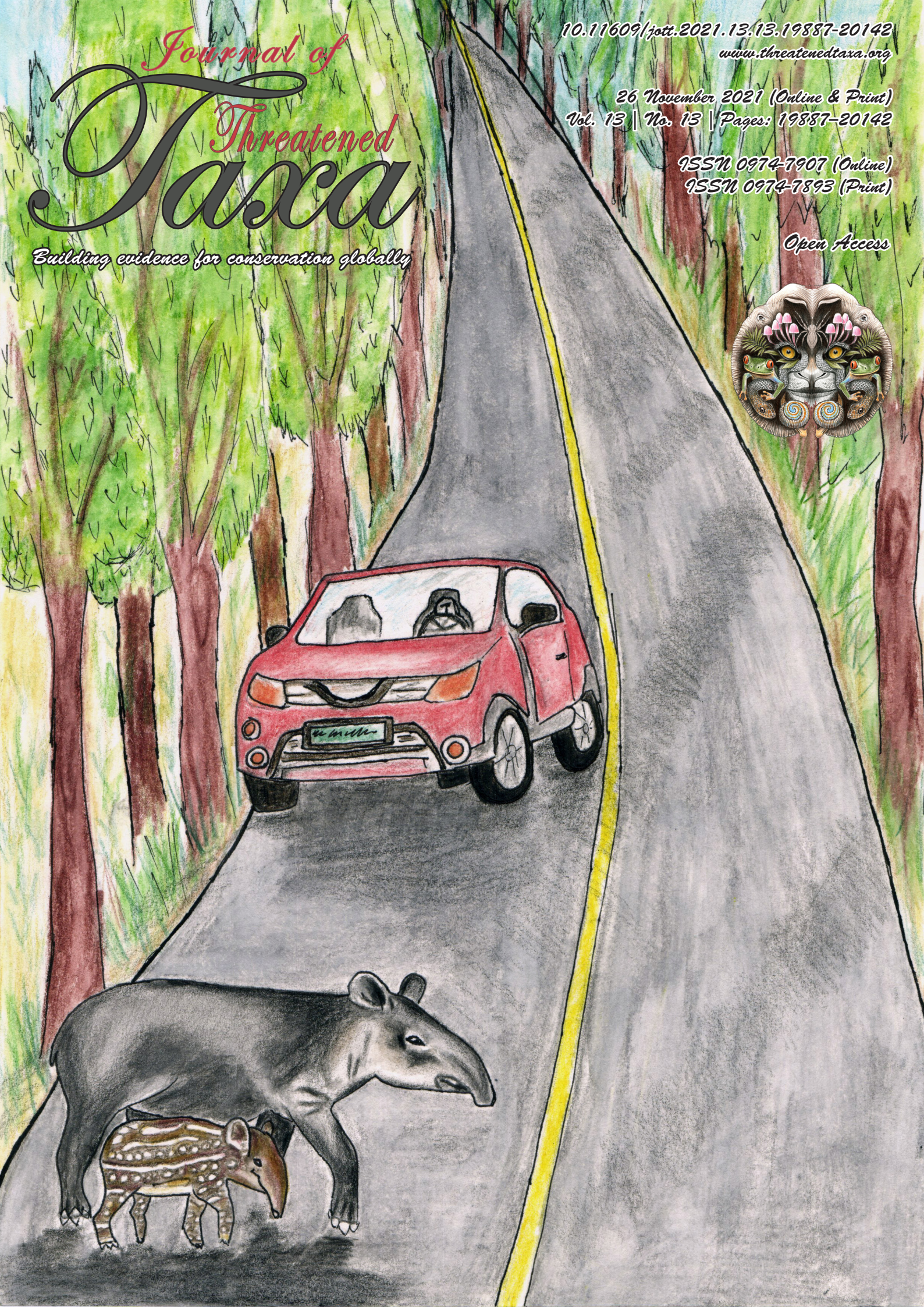
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continued on the back inside cover

Caption: Lowland Tapir *Tapirus terrestris* (Medium—watercolours on watercolour paper) © Aakanksha Komanduri.



An inventory of geometrid moths (Lepidoptera: Geometroidea: Geometridae) of Kalakad-Mundanthurai Tiger Reserve, India

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Abstract: The geometrid moths of Kalakad-Mundanthurai Tiger reserve were studied during the years 2012 to 2016. Since collection of specimens was not permitted, only field notes, accompanied by photo documentation was undertaken. Two-hundred-and-sixty geometrid moths identified to various hierarchical levels of taxa and one new genus for southern India, are reported.

Keywords: Agasthyamalai, biodiversity, Heterocera, KMTR, moth diversity, southern Western Ghats, Tamil Nadu.

Abbreviations: FW—Forewing | HW—Hindwing | KMTR—Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu | KKWS—Kanyakumari Wildlife Sanctuary, Tamil Nadu | MoB—Moths of Borneo | UN—Underside | UP—Upperside | ZFMK—Zoological Research Museum Alexander Koenig, Bonn, Germany.

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Author contributions: GI—conceived and designed the study, surveyed and photographed the moths, prepared the species list, and wrote the manuscript. DS—supported species identifications with the help of literature and comparison with specimens of the ZFMK collection, and editing of the manuscript. SS—supported species identifications and editing of the manuscript during its various drafts. All three authors approve the final version.

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INTRODUCTION

Kalakad-Mundanthurai Tiger Reserve (KMTR) is located at the southern Western Ghats, in the Agasthyamalai range, approximately between 8.416N and 8.883N latitude and 77.166E and 77.583E longitude. It falls within Kanyakumari and Tirunelveli districts of the State of Tamil Nadu, India and is part of the Agasthyamalai Biosphere Reserve. With a core area of 895.39 km², KMTR was established as a tiger reserve in 1988 through the merger of Kalakad Wildlife Sanctuary, Mundanthurai Tiger Reserve, and parts of Veerapuli and Kilamalai reserve forests, from Kanyakumari district. The Nellai Wildlife Sanctuary, encompassing an area of 35.9 km², in the north and 201.36 km² of the Kanyakumari Wildlife Sanctuary towards the south form the buffer area of the reserve. The elevation ranges 100–1,880 m. Thus, a gradient of vegetation ranging from dry scrub to dense evergreen forest is found here. The reserve receives close to 3,000 mm of rainfall from both the south-west and north-east monsoons. It serves as a catchment area for no less than 14 rivers and streams. For this reason, it is sometimes referred to as a river sanctuary. The Agasthyamalai hills, which includes the core area of KMTR, are an important biogeographical ‘hot spot’ within the Western Ghats and a region of endemism in India (UNESCO 2016).

Being a tiger reserve, the biodiversity studies in this region have largely been focussed on mammals, herpetofauna, and plants for many years. Recent studies on invertebrates have been mostly on spiders or butterflies, and moths have not received any attention. This study is an attempt to enumerate the geometrid moths of this reserve. It is the first-of-its-kind study of moth diversity for this region, covering all habitats of the reserve, through seasons over multiple years.

Geometridae (Stephens, 1829) constitute the second largest family of moths in India, with at least 2,043 species listed so far (Kirti et al. 2019; Sondhi et al. 2020; Dey et al. 2021) from India. A large number of these slender moths, are mostly nocturnal, but day flying and crepuscular species are not uncommon. Some geometrids are strongly haired but most are examples of least-haired moths. In the forests of KMTR, we have observed them arrive in large numbers when the mist begins to set in. Protective colouration and camouflage were observed. Polymorphism was noticeable in many species. This paper outlines through photographic records, the diversity of geometrid moths arising out of a five-year survey in KMTR.

Geometrids have been reported from other parts of

Western Ghats too: 77 species from Silent Valley National Park by Mathew & Rahamathulla (1995); six species by Bharmal (2015) from Amboli, Maharashtra and four species by Mishra et al. (2016) from Kodagu. From Kerala there are records of 47 species from Shendurney-Ponmudi by Sondhi et al. (2018). Elenchezian et al. (2014) reported 28 species from Maruthamalai hills and Goyal (2010) described 19 species for his PhD. The last two are the only recently published records from Tamil Nadu and even these studies were restricted to Madurai and Nilgiri districts.

A literature survey of the older Indian records in Moore (1884–7, 1889) or Hampson (1891, 1893) finds no mention of moths from Kalakad or Mundanthurai. A few scattered records of geometrids from ‘Travancore State’ are available. The State of Travancore was dissolved soon after India attained independence and the places under its jurisdiction were distributed between the present States of Kerala and Tamil Nadu. Kanyakumari, from the erstwhile southern part of Travancore State, thus became a part of Tamil Nadu. Published records of geometrid moths from the southern part of the erstwhile Travancore State are not available. Hence it is safe to assume that there are no historical records of moths from this region.

Some moth species have been recorded from KMTR in recent years by other researchers. Ron Brechlin described a sphingid, *Ambulyx sinjaevi* (Brechlin 1998), and a saturniid, *Loepa schintlmeisteri* (Brechlin 2000); *Stauropus thiaucourti*, a notodontid moth, was reported by Schintlmeister (2003); a cossid *Phragmacossia brahmana*, by Yakovlev (2009) and three geometrid species, *Racotis keralaria*, *Ophthalmitis kalakadaria*, and *Hypomecis tamilensis*, were described by Sato (2004, 2014, 2016). All these species were recorded from Manjolai (8.250N and 77.433E), a very small area of a few sq. km. All of them were new to science. There are no other published records of geometrids from KMTR. Thus, most of the moths presented are previously unrecorded, several unidentified and still to be described or species that are range extensions. One of them is a new record for southern India. Hence the moth inventory in this paper is the first attempt to generate a comprehensive list of geometrid moths found in this Tiger Reserve.

MATERIALS AND METHODS

Study sites

The moths listed in this paper were extensively surveyed from within the core area of KMTR during the

years 2012 to 2015, covering most of the months except July and August, primarily due to lack of access during the monsoons. Moths were surveyed very briefly in the year 2016 and again, extensively, in the year 2019. The sites of study were Talayanai, Sengeltheri, Kuthiraivetti, Upper Kothayar, Mundanthurai, and Kannikatti. The list also includes geometrids from one of the buffer zones of KMTR, namely Kanyakumari Wildlife Sanctuary (KKWS), from sites located at Maramalai and Kalikesam (Table 1 & Figure 1–3. Locations and sites of study). Permission for collection was not available from the core or the buffer area of KMTR as the sites are within a legally protected area.

Some moths presented are not part of the planned survey, but were opportunistic observations during the years 2016, 2018, and early 2019. All sites being within the core regions of the Tiger Reserve, surveys were dependent on permissions from forest department, weather conditions, availability of accommodation, and finance. The entire study was self-funded by the first author.

Survey methods

Moths were surveyed using a light trap consisting of a 160W mercury vapour bulb hung above a white cotton sheet measuring 3 x 5 feet (0.9144 x 1.524 meters), stretched between either two posts, trees, window bars, or sometimes, nails on a wall. Wherever electricity was not available (Sengeltheri and Kannikatti), a kerosene or petrol-powered Honda generator was used. The white cloth screen was illuminated starting at 1800 h or 1830 h, depending upon sunset, until 0130 h. Where mains electricity was available, the MV bulb was kept on till 0400 h. Diurnal activity of moths was noted at all locations.

Digital photographs were taken using a Panasonic FZ 200 and a Panasonic FZ 35 with a Lumix lens. Field notes were recorded for morphological details and of features that could not be captured through photography.

Methods for identification

The Tamil Nadu Forest Department discourages collection of specimens, even for research. This is one of the reasons for the poor records of moths and other insects from this region. Despite providing photographic evidence for new range and species records, permission to collect voucher specimens was not granted. Consequently, field notes and digital photography were the only methods available for assessing the diversity. The notes, photographs, comparisons (of photos) with museum specimens from ZFMK, Bonn, published papers,

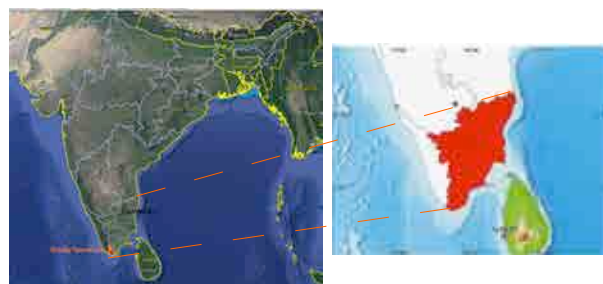


Figure 1. Map of India showing the state of Tamil Nadu.



Figure 2. Map of India showing the general study location in the state of Tamil Nadu



Figure 3. Sites of study in KMTR.

discussions with experts and researchers, and historical records have been the methods used for identification.

Walker (1860–62), Moore (1879, 1884–87), Swinhoe (1890), Hampson (1891, 1893, 1895), Rothschild (1894), Warren (1894, 1897), Prout (1912, 1917, 1920–41), Inoue (1953, 1972), Barlow (1982), Holloway (1983–2011), Butler (1886, 1889), and Scoble et al. (1999) were the

Table 1. Location of study sites along with elevation, habitat, and timeline.

	Place	Latitude	Longitude	Elevation in metres	Habitat type	Timeline in years
1	Talayanai	8.526°N	77.502°E	224	Riparian	2012, 2015
2	Sengeltheri	8.534°N	77.45°E	984	Semi-evergreen	2012, 2015
3	Kuthiraivetti	8.5931°N	77.352°E	1,146	Moist deciduous	2012–14, 2019
4	Upper Kothayar	8.527°N	77.359°E	1,286	Evergreen and montane	2012–14, 2018, 2019
5	Mundanthurai	8.6563°N	77.3332°E	250	Riverine and dry deciduous	2012, 2015
6	Kannikatti	8.732°N	77.226°E	762	Wet evergreen and riparian	2013
7	Maramalai	8.45°N	77.4°E	500	Mixed forest and estates	2012, 2015
8	Kalikesam	8.41°N	77.338°E	115	Riparian	2011–2014

prime sources of reference. Other than these sources, several research papers and books were also consulted. The second author referred extensively with the museum specimens at ZFMK, to arrive at identifications, and the third author used Moths of India website for the same. The classification in the paper, unless specified otherwise, follows that of Murillo-Ramos et al. (2019).

It is an established fact that without a specimen in hand, identification to the level of species is an extremely difficult task for many cryptic moth species. Hence, without specimens and therefore absence of genitalia information, it was not possible to identify all geometrids to the species level. Identifications, in such cases, have been limited to the level of subfamily, tribe or genus. For some individuals, where records or field data were insufficient, we have suggested provisional identifications. From our investigations, we believe that some of these could well be either new species to science or range extensions.

As this was the first comprehensive survey undertaken in this Tiger Reserve, most of the moths were first records for KMTR. They were also first records for the districts of Kanyakumari and Tirunelveli in the state of Tamil Nadu.

Findings from the study

Three-hundred-and-ninety geometrids belonging to five subfamilies were investigated. Only 260 are presented in this paper with identities at different levels. Six taxa were identified to the level of subfamily and six to the level of tribe. While 98 taxa were identified to genus level, 160 taxa, which included males, females as well as morphs, were identified to the level of species. Thirty-four taxa are reported with provisional identifications using Open Nomenclature qualifiers (Box 1). They have been identified to the nearest recognisable species for

Box 1. Open Nomenclature qualifiers (ON)

Abbreviations used to indicate a taxon's provisional status of identification are termed as Open Nomenclature qualifiers. These qualifiers are used by researchers from different disciplines with some variations in interpretations. The qualifiers we have used for provisional identifications in this paper are 'cf' and 'nr'. These terms have been used with the following interpretations:

cf. This is short for the Latin word *confero/conferatur*, meaning, 'to compare with'. We have used it to indicate that the species identification is provisional but is likely to be conclusive when we have more data, when it is further compared or crosschecked with reference materials, or discussed with a specialist of the taxon. The degree of uncertainty is less when compared with the term 'nr'.

nr This is short for 'near'. This qualifier has been used when the moth bears some similarities or resemblances to a known species. It appears closely related but is not identical to it.

comparison, or to a possible species close to them for further study.

Overall, 98 genera and 108 species have been identified. Polymorphism was quite marked in species from subfamilies Ennominae, Larentiinae, and Sterrhinae. Other than *Abraxas leucostola argyrosticta* Hampson, 1893, *Hypomecis tamilensis* Sato, 2016, *Luxiaria hypaphanes* Hampson, 1891, *Ophthalmitis kalakadaria* Sato, 2014, and *Racotis keralaria* Sato, 2004, all the moths presented in this paper (Table 2) are new records for KMTR and, Kanyakumari and Tirunelveli districts of Tamil Nadu, with *Acanthovalva* Krüger, 2001, a newly recorded genus for southern India.

Investigations have pointed to the possibility of some new species among the many tentatively identified or unidentified moth records. We hope this baseline survey report will assist in obtaining permission to collect and thus initiate a more detailed study of moths in this region.

**Table 2. Summary of subfamilies, genera and species presented.**

	Subfamily	Genera	Species with confirmed identity	Species with conditional identity	Species not identified
1	Sterrhinae Meyrick, 1892	12	13	5	3
2	Larentiinae Duponchel, 1845	13	9	2	3
3	Geometrinae Stephens, 1829	23	24	7	3
4	Desmobathrinae Meyrick, 1886	3	3	0	0
5	Ennominae Duponchel, 1845	47	59	20	11

Taxon notes

Details of select genera/species are shared below. The taxon order followed is as given in The Forum Herbulot World List of Family Group Names in Geometridae-Forum Herbulot (2003, updated 2007).

Subfamily Sterrhinae Meyrick, 1892

Plates 1–2 (5–36)

The classification of moths of this subfamily (Table 3) follows the most recent revision by Sihvonen et al. (2020). Of the 34 moths observed, 31 individuals from seven tribes were identified either to the genera or species level. Three individuals could not be identified further. Sihvonen et al. (2020) mention in their paper that a large number of species of this cosmopolitan family, comprising of nearly 3,000 moth-species worldwide, fall under the genera *Idaea* Treitschke, 1825 or *Scopula* Schrank, 1802. This abundance was reflected in our survey too.

Idaea Treitschke, 1825

Plate 2 (23–30)

Idaea Treitschke, 1825 is a genus with hundreds of small and very similar species which are difficult to identify even with voucher specimens in hand. In their absence, we have relied on published records and museum specimens. We report only three individuals of *Idaea* (out of the 10 individuals), whose wing patterns were unique enough to be identified to species level. While researching to confirm *Idaea gemmaria* Hampson, 1896, (Plate 2(23)), we came across Holloway's statement in Moths of Borneo (Holloway 1997) about the taxon "*I. gemmataria*", Hampson (Sri Lanka). On contacting Dr Holloway (pers. comm., 21.ix.2020), he clarified that, "*it was indeed an error arising at some stage between his reading the handwritten name in the museum collection and the final appearance of his text in print! The correct*

name of the species described by Hampson was indeed I. gemmaria". This has helped confirm the identity of the species.

The next most common species were from the genus *Scopula* Schrank, 1802 (Plates 1–2 (15–19)). Out of five individuals observed, two have been identified to the species level.

The key given by Xue et al. (2018) for the pattern of ocellus in the wings, descriptions and comparison with specimens in the ZFMK collection, were used to identify *Problepsis apollinaria* Guenée, [1858] and *P. deliaria* Guenée, [1858] (Plate 1 (13–14)). All of the Sterrhinae listed are new records for KMTR.

Subfamily Larentiinae Duponchel, 1845

Plates 3–4 (37–60)

This is the second largest subfamily amongst Geometridae. Worldwide, 6,200 species (Öunap et al. 2016) have been described so far. We have recorded 24 moths from six tribes. Only nine of them could be identified to the species level. Fourteen larentiines reported belong to the tribe Eupitheciini Tutt, 1896. Of these, the genera *Collix* Guenée, [1858] and *Eois* Hübner, 1818 were the most represented. Three individuals from tribe Eupitheciini could not be identified even to the genus level. All the larentiine moths listed are new records for this region. We also believe that there are possibilities of new eupitheciine species from this region.

Subfamily Geometrinae Stephens, 1829

Plates 4–6 (61–101)

A large number of moths of this subfamily being green in colour, are often referred to as emerald moths. They were seen in large numbers at KMTR. However, the species diversity did not match individual abundance. According to Plotkin & Kawahara (2020), the current checklist of Geometrinae worldwide stands at 2,642 species. We recorded 41 different individuals from which 24 species from 23 genera were identified. Three moths remained unidentified while the remaining were identified to the level of genera or provisionally to the nearest species.

Tribe Comibaenini Inoue, 1961

Plate 4 (66–74)

Comibaena Hübner, [1823] 1816

Plate 4 (66–72)

We report four species and one individual referred for comparison to the nearest species. *Comibaena integranota* Hampson, 1893 and *Comibaena attenuata* Warren, 1896, are differentiated based on the patches

seen in the tornal region of forewing and apex of the hind wing. In *attenuata*, the forewing patch has an irregular projection anteriorly that is separated from the margin. Warren (1896), while describing *attenuata* under the older synonym *Probolosceles attenuata* Warren, 1896, has pointed out that some features of *attenuata* have been mistakenly attributed to the female of *integranota* by Hampson (1893).

***Protuliocnemis* cf. *biplagiata* (Moore, 1887)**

Plate 4 (73)

Protuliocnemis biplagiata (Moore, [1887]) and *P. castalaria* (Oberthür, 1916), are similar in fasciae and genitalia. The number of spurs found in the hind tibia (Holloway 1996) is the only feature to distinguish the two species. Where as *P. biplagiata* has four spurs in the hind tibia, *P. castalaria* has only two ((Prout 1933, Gross-Schmett. Erde 12: 88) in Holloway, 1996). *Protuliocnemis biplagiata* has been reported from Sri Lanka and, northern & northeastern of India and *P. castalaria* only from Khasi hills. This species of *Protuliocnemis* was frequently observed in both the core and the buffer zone of the reserve from the month of October to March. As the data of hind tibia spurs is not available and based on its presence in Sri Lanka, we report this individual provisionally as *P. cf. biplagiata*.

Tribe Hemitheini Bruand, 1846

Plate 5 (77–91)

We report 15 individuals belonging to 11 genera, of which six have been identified to the level of species; four are reported with provisional species identity and four are identified to the genus level. A few are detailed below.

***Pelagodes* Holloway, 1996**

Plate 5 (83)

Moths of this genus were quite abundant in higher altitudes and found at all study sites except Talayani. The genus *Pelagodes* Holloway, 1996, was identified and differentiated from the closely resembling *Thalassodes* Guenée, [1858] based on the hindwing architecture as given by Han & Xue (2011). They report that the outer margin of the hindwing is strongly angled in *Thalassodes* but not so in *Pelagodes*. Species level identification of *Pelagodes* was not attempted in the absence of genitalia details. The presence of *Thalassodes* cannot be ruled out as several individuals remained unidentified. Lack of specimens in hand was a constraint for further investigation.

***Jodis* Hübner, 1823**

Plate 5 (87–89)

Three species of *Jodis* were observed. One has been identified to species level. One is provisionally identified to species level while the third could not be identified beyond the level of genus.

***Jodis pallescens* (Hampson, 1891)**

Plate 5 (88)

Hampson (1893) has described this taxon from Nilgiris as *Thalera pallescens* and the description matches the species reported here. Prout (1934) reported it from Sri Lanka and described *J. pallescens* as a distinct species due to the sharp contrast seen between the green and the white areas. This was quite evident in the moths we observed and the details match the field notes.

***Jodis* nr. *undularia* (Hampson, 1891)**

Plate 5 (87)

Hampson (1893) described it from Nilgiris, and misidentified it as *Thalera caudularia*. It is, according to Prout (1934), widely distributed in India. A yellowish-green moth, it shows the features matching the description given by Hampson. The vertex of the head is white. The whitish antemedial and postmedial lines are dentate, excurved between veins 2 and 4, giving it, at first glance, a greyish-green appearance. The underside is white with shades of greyish-white. As Prout (1934) pointed, the tail of the hindwing is sharp. We, therefore, suggest the species identity tentatively, to facilitate further exploration.

Tribe Nemoriini Gumpenberg, 1887

***Eucylodes albisparsa* (Walker, 1861)**

Plate 5 (92)

Ban et al. (2018) placed *Eucylodes* in the tribe Nemoriini. However, its tribal position is reported as uncertain in the research paper by Murillo-Ramos et al. (2019). The paper also does not assign it to any tribe. We have retained the species in Tribe Nemoriini, after consulting Dr Hausmann (Hausmann, pers. comm. 01.vii.2020) who is one of the co-authors of the 2019 paper.

Eucylodes albisparsa and *E. divapala* (Walker, 1861), are similar species, which fly in southern India. They are best separated by genitalic features. However, Barlow (1982) reports that the latter species found in southern India is more uniformly green and less contrasting than *divapala*. This matches the features in the individual observed by us. Hence, we report this moth as belonging to *Eucylodes albisparsa* complex.



Subfamily Desmobathrinae Meyrick, 1886

Plate 6 (102–105)

Four individuals from three genera are presented here. *Derambila fragilis* (Butler, 1881), *Noreia ajaia* Walker, 1859, *Ozola microniaria* Walker, 1862 and the fourth moth belonging to the genus *Ozola* Walker, [1861] could not be identified to species level.

Derambila Walker, [1863] 1862

Plate 6 (102)

Members of *Derambila* are small, slender, translucent white moths. *Derambila saponaria* (Guenée, [1858]) has been recorded from Travancore and Sri Lanka. Hampson (1895) records it as *Rambara saponaria* Guenée from Travancore. *Rambara* Moore, [1887] is currently treated as a junior synonym of *Derambila* (Scoble et al. 1999). *Derambila fragilis* (Butler, 1881), (Taiwan), described erroneously in the genus *Zanclopteryx* Herrich-Schäffer, [1855], is another similar species. *Zanclopteryx* is a genus with exclusively New World species. Prout (1921) notes that in *fragilis*, the antemedial lines are very few and mostly dissolved into spots. Holloway (1996), states that *D. fragilis* is also found in India and records that the wings are relatively slightly marked and lack the brown suffusion, seen in other species. In *D. saponaria*, the brown transverse markings are well expressed whereas in *D. fragilis*, they are present as dots. Based on the markings on the wings and the distribution given by Hampson & Moore, we report this species as *Derambila fragilis*.

Subfamily Ennominae Duponchel, 1845

Plates 6–13 (106–274)

With no anatomical details being available, members of the largest geometrid subfamily were the most challenging to identify from external morphological only. Along with historical records and published papers, the collections from ZFMK were most useful for identification. Polymorphism was quite vivid in several genera which added to the complexity. Explanations of our conclusions for select taxa are given below.

Tribe Abraxini Warren, 1893

Abraxas Leach, [1815]

Plates 6–7 (106–123)

Specimens of the genus *Abraxas* were found in abundant numbers in Upper Kothayar, Kuthiraivetti, Sengeltheri, and Maramalai. Materials from Kalakad, Nilgiris, and Sri Lanka available in the collections at ZFMK were compared along with descriptions and figures published by Hampson (1891, 1893, 1907),

Swinhoe (1890, 1891), Walker (1862), Warren (1894, 1898), and Prout (1925) for identification. Of the 15 individuals presented here, three are identified to the level of species (Plates 6–13 (106–109)). The rest of the unidentified individuals are in varying shades of grey and bluish-grey, with or without irregular yellow spots that ranged from many to none on the upperside. The underside of these specimens varied from being grey to grey with more or less irregular yellow spots and to one with a completely yellow underside with dark fasciae (Plate 7 (115)), the latter certainly a distinct species, the former probably variations of one species. All these species had yellow heads. The antennae were completely black or grey. The thorax showed varying degrees of greyness. Their legs were grey with yellow coxa. Large black spots on the upper side of the abdominal segment, and smaller ones on the sides and undersides were present. Based on these differences in patterns and colours on the upper and underside, the grey *Abraxas* moths and that with grey upper side and yellow underside have been categorised tentatively as different species. We cannot rule out the fact that some of them are probably just forms of two or more species. Hence collection is needed to investigate further and get greater clarity of this group of moths that were present during all seasons.

Another unidentified *Abraxas* was completely yellow on upper and underside, with grey postmedial fasciae and spots (Plate 7 (121–123)) which bore no resemblance to the two yellow *Abraxas* hitherto described from southern India, namely, *A. luteoaria* Swinhoe, 1890 and *A. germana* Swinhoe, 1891. Both have been described from Nilgiri Hills, but were not spotted at KMTR during our surveys. The second author who is familiar with the southern Indian *Abraxas* species found that the grey and the yellow series of *Abraxas* we have presented does not resemble any existing species. We therefore report them as unidentified species of *Abraxas* that need further investigation.

About 20 species of the genus *Abraxas* have been described from southern India and Sri Lanka at the end of the 19th century and the beginning of the 20th century. Most of them are endemic to the Western Ghats and do not look (Plates 6–13 (110–120)) like typical *Abraxas*, as known from examples seen in the Himalaya or Chinese mountainous regions. Only *A. leucostola* Hampson, 1893, described from Sri Lanka and later described from southern India by Hampson (1907) as *Abraxas argyrosticta* (which is at present treated as subspecies of *leucostola*), resembles the typical *Abraxas*. *A. fasciaria* (Guérin-Ménéville, 1843), *A. poliostrata* Hampson, 1907,

Table 3. Checklist of geometrids of Kalakad-Mundanthurai Tiger Reserve.

	S. Family/ Genus	Tribe/ Species	Author & Year: S. Family/ Tribe/ Genus/ Species	Location	Month and Year of survey
	Sterrhinae Meyrick, 1892	Cosymbiini	Prout, 1911		
1	<i>Chrysocraspeda</i>	sp.1	Swinhoe, 1893	Upper Kothayar	Mar 2014
2	<i>Chrysocraspeda</i>	sp.2	Swinhoe, 1893	Kannikatti, Kuthiraivetti	Feb 2013, Mar 2014
3	<i>Perixera</i>	<i>insitiva</i>	(Prout, 1920)	Kuthiraivetti	Dec 2012
		Cylopodini	Kirby, 1892		
4	<i>Organopoda</i>	sp.	Hampson, 1893	Upper Kothayar	Oct 2018
		Lissoblemmini	Sihvonen & Staude, 2020		
5	<i>Lissoblemma</i>	<i>lunuliferata</i>	(Walker, [1863])	Upper Kothayar	Oct 2018
6	<i>Craspediopsis</i>	sp.	Warren, 1895	Talayanai	Feb 2015
		Rhodometrini	Agenjo, 1952		
7	<i>Traminda</i>	<i>aventiaria</i>	(Guenée, [1858])	Kuthiraivetti	Dec 2012
8	<i>Traminda</i>	<i>mundissima</i> - 3 forms	(Walker, 1861)	Mundanthurai, Talayanai, Kuthiraivetti	Mar 2012, Oct 2012, Feb 2015, Dec 2012
		Scopulini	Duponchel, 1845		
9	<i>Problepsis</i>	<i>deliaria</i>	(Guenée, [1858])	Kuthiraivetti, Sengeltheri, Upper Kothayar, Maramalai	Dec 2011, 2012, 2019, Oct 2012, June 2013, Feb 2012
10	<i>Problepsis</i>	<i>appollinaria</i>	(Guenée, [1858])	Maramalai	Feb 2012
11	<i>Scopula</i>	<i>divisaria</i>	Walker, 1861	Upper Kothayar	Jun 2013
13	<i>Scopula</i>	<i>fibulata</i>	(Guenée, [1858])	Kannikatti	Feb 2013
14	<i>Scopula</i>	<i>nr relictata</i>	(Walker, 1866)	Kuthiraivetti	Mar 2014
15	<i>Scopula</i>	<i>nr actuararia</i>	(Walker, 1861)	Sengeltheri	Feb 2015
16	<i>Scopula</i>	sp.6	Schrank, 1802	Upper Kothayar	Mar 2014
17	<i>Somatina</i>	<i>nr plynusaria</i>	(Walker, [1863])	Sengeltheri	Oct 2012
18	<i>Somatina</i>	<i>rosacea</i>	Swinhoe, 1894	Kuthiraivetti	Mar 2014
19	<i>Somatina</i> or <i>nr</i>		Guenée, [1858]	Kannikatti, Upper Kothayar	Feb 2013, Mar 2014
		Sterrhini	Meyrick, 1892		
20	<i>Lophophleps</i>	<i>phoenicoptera</i>	(Hampson, 1896)	Kalikesam	Jul 2014
21	<i>Lophophleps</i>	<i>purpurea</i>	Hampson, 1891	Sengeltheri	Feb 2015
22	<i>Idaea</i>	<i>gemmaria</i>	Hampson, 1896	Maramalai	Feb 2012
23	<i>Idaea</i>	<i>nr gemmaria</i>	Hampson, 1896	Upper Kothayar	Mar 2014
24	<i>Idaea</i>	<i>violaceae</i>	Hampson, 1891	Maramalai	Feb 2012
25	<i>Idaea</i>	sp.4	Treitschke, 1825	Sengeltheri, Upper Kothayar	Oct 2012, Feb 2015, Mar 2014
26	<i>Idaea</i>	sp.5	Treitschke, 1825	Maramalai	Feb 2012
27	<i>Idaea</i>	sp.6	Treitschke, 1825	Maramalai	Feb 2012
28	<i>Idaea</i>	sp.7	Treitschke, 1825	Sengeltheri	Feb 2015
28	<i>Idaea</i>	sp.8	Treitschke, 1825	Kuthiraivetti	Mar 2014
		Timandrini	Stephens, 1850		
29	<i>Timandra</i>	sp.	Duponchel, 1829	Upper Kothayar	Jun 2013
30	Unidentified Sterrhinae -3		Meyrick, 1892	Sengeltheri, Maramalai	Feb 2015, Feb 2012
	Larentiinae Duponchel, 1845	Asthenini			
31	<i>Acolutha</i>	<i>pictaria</i>	(Moore, 1888)	Upper Kothayar	Mar 2014
32	<i>Polynesia</i>	<i>sunandava</i>	(Walker, 1861)	Kuthiraivetti	Dec 2012, Jan 2019



	S. Family/ Genus	Tribe/ Species	Author & Year: S. Family/ Tribe/ Genus/ Species	Location	Month and Year of survey
		Cidariini	Duponchel, 1845		
33	<i>Ecliptopera</i>	<i>dissecta</i>	(Moore, [1887])	Upper Kothayar, Kuthiraivetti,	Jun 2013, Jan 2019
34	<i>Ecliptopera</i>	<i>muscolor</i>	(Moore, 1888)	Upper Kothayar	Jun 2018
35	<i>Chloroclystis</i>	sp.	Hübner, [1825]	Sengeltheri	Feb 2015
		Incertae sedis			
36	<i>Physetobasis</i>	<i>annulata</i>	(Hampson, 1891)	Kuthiraivetti	Dec 2012
		Eupitheciini	Tutt, 1896		
37	<i>Bosara</i>	<i>albitornalis</i>	(Prout, 1958)	Kuthiraivetti	Dec 2012
38	<i>Eupithecia</i>	sp.	Curtis, 1825	Sengeltheri	Feb 2015
39	<i>Collix</i>	sp.1	Guenée, [1858]	Sengeltheri	Feb 2015
40	<i>Collix</i>	sp.2	Guenée, [1858]	Marmalai	Feb 2012
41	<i>Collix</i>	sp.3	Guenée, [1858]	Marmalai	Feb 2012
42	<i>Eois</i>	sp.4	Hübner, 1818	Marmalai	Feb 2012, 2015
43	<i>Eois</i>	sp.5	Hübner, 1818	Upper Kothayar	Mar 2014
44	<i>Eois</i>	cf. <i>dissimilis</i>	(Moore, 1887)	Kuthiraivetti	Dec 2012
45	<i>Eois</i>	<i>lunulosa</i> form ochraceae	(Moore, [1887])	Kuthiraivetti	Dec 2012
46	<i>Gymnoscelis</i>	cf. <i>admixtaria</i>	(Walker, 1862)	Kuthiraivetti	Dec 2012
47	<i>Ziridava</i>	<i>rubridisca</i>	(Hampson, 1891)	Upper Kothayar	Oct 2018
		Trichopterygini	Warren, 1894		
48	<i>Sauris</i>	sp.1	Guenée, [1858]	Kuthiraivetti	Dec 2012
49	<i>Sauris</i>	sp.2	Guenée, [1858]	Sengeltheri	Oct 2012
		Xanthorhoini	Pierce, 1914		
50	<i>Xanthorhoe</i>	<i>saturata</i>	Guenée, [1858]	Kuthiraivetti	Dec 2012
51	Unidentified Eupethiciini-3		Duponchel, 1845	Kuthiraivetti	Dec 2012, Mar 2014
	Geometrinae Stephens, 1829	Agathiini	Ban & Han, 2018		
52	<i>Agathia</i>	<i>hemithearia</i>	Guenée, [1858]	Kuthiraivetti, Upper kothayar	Mar 2014, Jan 2019
53	<i>Agathia</i>	<i>lycaenaria</i>	(Kollar, 1844)	Upper Kothayar	Jul 2018
54	<i>Agathia</i>	<i>laetata</i>	(Fabricius, 1794)	Kuthiraivetti	Dec 2012
		Archaeobalbini	Viidalepp, 1981		
55	<i>Herochroma</i>	cf. <i>cristata</i>	Warren, 1894	Marmalai, Upper Kothayar	Feb 2012, Mar 2014
56	<i>Lophophelma</i>	<i>ruficosta</i>	Hampson, 1891	Kuthiraivetti, Sengeltheri	Dec 2012, Mar 2014, Jan 2019, Feb 2015
		Comibaenini	Inoue, 1961		
57	<i>Argyrocosma</i>	<i>inductaria</i>	(Guenée, [1858])	Kuthiraivetti, Upper Kothayar, Sengeltheri, Talayanai, Marmalai	Dec 2012, Feb 2015, Feb 2012
58	<i>Chlorochromodes</i>	sp.	Warren, 1896	Talayanai	Feb 2015
59	<i>Comibaena</i>	<i>attenuata</i>	(Warren, 1896)	Upper Kothayar	Mar 2014
60	<i>Comibaena</i>	<i>cassidara</i>	Guenée, [1858])	Mundanthurai, Upper Kothayar, Marmalai	Mar 2012, Oct 2016, Feb 2012
61	<i>Comibaena</i>	cf. <i>striataria</i>	Leech, 1897	Mundanthurai	Mar 2012
62	<i>Comibaena</i>	<i>integranta</i>	Hampson, 1893	Sengeltheri, Marmalai	Feb 2015, Feb 2012
63	<i>Comibaena</i>	<i>fuscidorsata</i>	Prout, 1912	Upper Kothayar, Kuthiraivetti	Mar 2016, Jan 2019
64	<i>Protulioncemis</i>	cf. <i>biplagiata</i>	(Moore, [1887])	Kuthiraivetti, Upper Kothayar, Sengeltheri, Marmalai	Dec 2012, Mar 2014, Oct 2012, Feb 2012

	S. Family/ Genus	Tribe/ Species	Author & Year: S. Family/ Tribe/ Genus/ Species	Location	Month and Year of survey
65	<i>Protulioecnemis</i>	<i>partita</i>	(Walker, 1861)	Upper Kothayar	Jan 2019
		Dysphaniini	Warren, 1895		
66	<i>Dysphania</i>	<i>percota</i>	(Swinhoe, 1891)	Kalikesam	Jul 2014
		Geometrini	Stephens, 1829		
67	<i>Cyclothea</i>	<i>disjuncta</i>	(Walker, 1861)	Sengeltheri	Feb 2015
		Hemitheini	Bruand, 1846		
68	<i>Comostola</i> sp	sp.	Meyrick, 1888	Sengeltheri, Kuthirai-vetti, Maramalai	Oct 2012, Jan 2019, Feb 2012
69	<i>Episothalma</i>	<i>robustaria</i>	(Guenée, [1858])	Upper Kothayar	Dec 2011
70	<i>Hemithea</i>	<i>tritonaria</i>	(Walker, [1863])	Upper Kothayar	Jul 2018
71	<i>Hemithea</i>	<i>wuka</i>	(Pagenstecher, 1886)	Kalikesam	Jul 2014
72	<i>Idioclora</i>	<i>nr caudularia</i>	(Guenée, [1858])	Kuthiravetti, Sengeltheri	Mar 2014, Feb 2015
73	<i>Orothalassodes</i>	<i>hypocrites</i>	(Prout, 1912)	Kuthiravetti, Upper Kothayar	Jan 2019
74	<i>Pelagodes</i>	sp.	Holloway, 1996	All sites except Talayanai	Mar 2011, Dec 2012, Mar 2013, June 2014, Feb 2012,'15, Jan 2019
75	<i>Pentheochlora</i>	<i>cf. uniformis</i>	Hampson, 1891	Kuthiravetti	Dec 2012
76	<i>Spaniocentra</i>	sp.	Prout, 1912	Maramalai	Mar 2012
77	<i>Berta</i>	<i>cf. chrysolineata</i>	Walker, 1863	Upper Kothayar	Oct 2018
78	<i>Jodis</i>	<i>nr undularia</i>	(Hampson, 1891)	Upper Kothayar	Mar 2014
79	<i>Jodis</i>	<i>pallenscens</i>	(Hampson, 1891)	Upper Kothayar	Mar 2014
80	<i>Jodis</i>	sp.3	Hübner, [1823]	Kuthiravetti	Jun 2013
81	<i>Microloxia</i>	<i>indecretata</i>	(Walker, [1863])	Talayanai	Feb 2015
82	<i>Microloxia</i>	sp.2	Warren, 1893	Mundanthurai	Mar 2012
		Nemoriini	Gumpenberg, 1887		
83	<i>Eucyclodes</i>	<i>gavissima</i>	(Walker, 1861)	Sengeltheri	Oct 2012
84	<i>Eucyclodes</i>	<i>albisparsa</i> complex	(Walker, 1861)	Sengeltheri	Oct 2012
		Ornithospilini	Ban & Han, 2018		
85	<i>Ornithospila</i>	<i>lineata</i>	(Moore, 1872)	Kuthiravetti	Jan 2019
86	<i>Ornithospila</i>	<i>submonstrans</i>	(Walker, 1861)	Kuthiravetti	Dec 2012, Jan 2019
		Pseudoterpnini	Warren, 1893		
88	<i>Pingasa</i>	<i>dispensata</i> M, F	(Walker, 1866)	Kuthiravetti	Dec 2012
89	<i>Pingasa</i>	<i>ruginaria</i>	(Guenée, [1858])	Upper Kothayar, Sengeltheri, Kuthiravetti, Maramalai	Mar 2014, Feb 2015, Dec 2012, Jan 2019, Feb 2012, Feb 2015
90	Unidentified Geometrinae-3		Leach, 1815	Maramalai, Mundanthurai	Feb 2012, Mar 2012
	Desmobathrinae Meyrick, 1886	Desmobathrini	Meyrick, 1886		
91	<i>Noreia</i>	<i>ajaia</i> M	(Walker, 1859)	Upper Kothayar	Jun 2013
92	<i>Ozola</i>	<i>microniaria</i>	Walker, 1862	Kuthiravetti, Sengeltheri	Mar 2014, Feb 2015
93	<i>Ozola</i>	sp.	Walker, 1861	Sengeltheri	Feb 2015
94	<i>Derambila</i>	<i>fragilis</i>	(Butler, 1881)	Sengeltheri	Feb 2015
	Ennominae Duponchel, 1845	Abraxini	Warren, 1894		
95	<i>Abraxas</i>	<i>leucostola argyrosticta</i>	Hampson, 1893	Upper Kothayar, Kuthiravetti, Maramalai	Jan 2019, Dec 2012, Feb 2012
96	<i>Abraxas</i>	<i>fasciaria</i>	Guerin-Meneville, 1843	Sengeltheri, Upper Kothayar, Kuthiravetti,	Oct. 2012, Jan 2019
97	<i>Abraxas</i>	<i>Poliostrata</i> M, F	Hampson, 1907	Kuthiravetti	Dec. 2012



	S. Family/ Genus	Tribe/ Species	Author & Year: S. Family/ Tribe/ Genus/ Species	Location	Month and Year of survey
98	<i>Abraxas</i>	(grey)sp.4	Leach, [1815] 1830	Upper Kothayar, Kuthiraivetti, Sengeltheri	Dec 2012, Oct 2013, Feb 2015, Jan 2019
99	<i>Abraxas</i>	(grey)sp.5	Leach, [1815]1830	Upper Kothayar	Mar 2014
100	<i>Abraxas</i>	(grey)sp.6	Leach, [1815]1830	Upper Kothayar,	Jan 2019, Feb 2012.
101	<i>Abraxas</i>	(grey)sp.7	Leach, [1815]1830	Upper Kothayar	Jan 2019
102	<i>Abraxas</i>	(grey)sp. 3 forms	Leach, [1815]1830	Upper Kothayar, Kuthiraivetti, Sengeltheri, Maramalai.	Jan 2019, June 2013, Mar 2014, Feb 2015, Feb 2012
103	<i>Abraxas</i>	(yellow)sp.8	Leach, [1815]1830	Upper Kothayar, Sengeltheri	Mar 2014, Mar 2019, Feb 2015
		Baptini	Forbes, 1948		
106	<i>Borbacha</i>	cf. <i>pardaria</i>	Guenée, [1858]	Kuthiraivetti, Maramalai	Dec 2012, Feb 2012
107	<i>Synegia</i>	<i>imitaria</i>	(Walker, 1861)	Upper Kothayar	Mar 2014
108	<i>Yashmakia</i>	<i>erythra</i> M	(Hampson, 1891)	Upper Kothayar	June 2018
109	<i>Yashmakia</i>	<i>conflagrata</i> F	(Hampson, 1912)	Upper Kothayar	June 2018
110	<i>Lomographa</i>	<i>inamata</i>	(Walker, [1861]1860)	Kuthiraivetti, Maramalai	Dec 2012, Jan 2019, Feb 2012
111	<i>Platycerota</i>	<i>vitticostata</i>	(Walker, [1863])	Upper Kothayar	June 2013
		Boarmiini	Duponchel, 1845		
112	<i>Alcis</i>	<i>nilgirica</i>	Hampson, 1891	Kuthiraivetti, Upper Kothayar, Sengeltheri	Dec 2012, June 2013 Mar 2014, Oct 2012, Feb 2015
113	<i>Amblychia</i>	cf. <i>angeronaria</i>	Guenée, 1858	Maramalai, Upper Kothayar	Feb 2012, June 2018
114	<i>Amraica</i>	<i>recursaria</i>	Walker, 1860	Sengeltheri,	Feb 2015
115	<i>Catoria</i>	cf. <i>sublavaria</i> F	Guenée, [1858]	Kuthiraivetti, Upper Kothayar, Sengeltheri,	Dec 2012, Feb 2015, Jan 2019
116	<i>Chorodna</i>	<i>strixaria</i>	(Guenée, [1858])	Upper Kothayar	Mar 2014
117	<i>Cleora</i>	<i>alienaria</i> M 5 forms	Walker, 1860	Kuthiraivetti, Upper Kothayar, Sengeltheri, Maramalai	Dec 2012, June 2013, Jan 2019, Feb 2012, 2015
118	<i>Cleora</i>	<i>alienaria</i> F	(Walker, 1860)	Kuthiraivetti	Jan 2019
119	<i>Cleora</i>	sp.3	Curtis, 1825	Kuthiraivetti	Jan 2019
120	<i>Cleora</i>	<i>injectaria</i> or nr.	(Walker, 1860)	Kuthiraivetti	Dec 2012
121	<i>Ascotis</i>	cf. <i>imparata</i> F	(Walker, 1860)	Kuthiraivetti	Dec 2012, Jan 2019
122	<i>Cusiala</i>	<i>boarmoides</i>	Moore, [1887]	Talayanai, Sengeltheri	Oct 2012, Feb 2015
123	<i>Cusiala</i>	<i>raptaria</i>	Walker, 1860	Sengeltheri	Feb 2015
125	<i>Cusiala</i>	<i>raptaria</i> form <i>determinata</i>	Walker, 1860	Mundanthurai	Mar 2012
126	<i>Cusiala</i>	<i>raptaria</i> <i>distermi-nata</i> - variant	Walker, 1860	Kuthiraivetti, Talayanai	Dec 2012, Feb 2015
127	<i>Cusiala</i>	<i>raptaria</i> <i>distermi-nata</i> - variant	Walker, 1860	Kuthiraivetti,	Dec 2012
128	<i>Cusiala</i>	<i>raptaria</i> form <i>rufifasciata</i>	Walker, 1860	Sengeltheri	Feb 2015
129	<i>Cusiala</i>	<i>raptaria</i> form <i>suisasa</i> M	Walker, 1860	Mundanthurai, Kuthiraivetti	Feb 2015, Dec 2012
130	<i>Cusiala</i>	<i>raptaria</i> -6 forms	Walker, 1860	Mundanthurai, Kuthiraivetti, Talayani, Sengeltheri	Mar 2012, Oct 2012, Dec 2012, Feb 2015, Jan 2019
131	<i>Ectropis</i>	cf. <i>dentilineata</i>	(Moore, 1868)	Kuthiraivetti	Jan 2019
132	<i>Ectropis</i>	<i>bhurmitra</i>	(Walker, 1860)	Maramalai	Feb 2012
133	<i>Dasyboarmia</i>	cf. <i>inouei</i>	(Sato, 1987)	Sengeltheri, Kuthiraivetti	Feb 2015 March 2014
134	<i>Gasterocome</i>	<i>polyspathes</i>	Prout, 1934	Upper Kothayar, Sengeltheri, Maramalai	Mar 2014, Oct 2012, Feb 2015, Feb 2012
135	<i>Hypomecis</i>	<i>pallida</i> 1M, 4F	(Hampson, 1891)	Upper Kothayar	Jun 2013

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136	<i>Hypomecis</i>	<i>trancissa</i>	(Walker, 1860)	Maramalai	Feb 2012
137	<i>Hypomecis</i>	<i>tamilensis</i>	Sato, 2016	Mundanthurai, Talayanai	Mar 2012, Feb 2015
138	<i>Hypomecis</i>	<i>separata</i>	(Walker, 1860)	Maramalai	Feb 2012
139	<i>Hyposidra</i>	<i>talaca</i>	(Walker, 1860)	Upper Kothayar, Kuthiraivetti, Maramalai	Feb 2012, Dec 2012. Mar 2014
140	<i>Hyposidra</i>	<i>violescens</i> M, F	Hampson, 1895	Kuthiraivetti, Maramalai	Dec 2012, Feb 2012
141	<i>Hyposidra</i>	sp. 3	Guenée, [1858]	Upper Kothayar	Jan 2019
142	<i>Ophthalmitis</i>	cf. <i>herbidaria</i>	(Guenée, [1858])	Sengeltheri	Oct 2012
143	<i>Ophthalmitis</i>	<i>kalakadaria</i>	Sato, 2014	Sengeltheri	Feb 2015
144	<i>Psilalcis</i>	cf. <i>subtochracea</i> M, F	(Hampson, 1902)	Kuthiraivetti, Sengeltheri, Talayanai, Maramalai	Dec 2012, Jan 2019, Oct 2012. Feb 2015, Feb 2012
145	<i>Psilalcis</i>	sp.2	Warren, 1893	Sengeltheri	Feb 2015
146	<i>Psilalcis</i>	sp.3	Warren, 1893	Sengeltheri	Feb 2015
147	<i>Psilalcis</i>	sp.4	Warren, 1893	Maramalai	Feb 2012
148	<i>Racotis</i>	<i>keralaria</i>	Sato, 2004	Kuthiraivetti, Upper Kothayar, Sengeltheri, Maramalai	Dec 2012, Jan 2019, Feb 2015, Feb 2012
149	<i>Ruttellerona</i>	cf. <i>cessaria</i>	(Walker, 1860)	Kuthiraivetti	Dec 2012
150	<i>Ruttellerona</i>	cf. <i>pseudocessaria</i>	Holloway, [1994]	Upper Kothayar	Jan 2019
151	<i>Biston</i>	<i>strigaria</i>	(Moore, 1879)	Kuthiraivetti, Sengeltheri, Maramalai	Dec 2012, Feb 2015, Feb 2012
		Unidentified Boarmiini	Duponchel, 1845	Kuthiraivetti	June 2013
		Caberini	Duponchel, 1845		
152	<i>Astygisa</i>	sp.	Walker, 1864	Upper Kothayar	Mar 2014
153	<i>Petelia</i>	<i>medardaria</i> M	Herrich-Schäffer, [1856]	Maramalai, Upper Kothayar, Kuthiraivetti	Feb 2012, Jun 2013, Jan 2019, Dec 2012, Mar 2014, Jan 2019
154	<i>Petelia</i>	<i>distracta</i> F	(Walker, 1860)	Kuthiraivetti, Sengeltheri, Upper Kothayar	Dec 2012, Oct 2012, Feb 2015, Jan 2019
155	<i>Petelia</i>	<i>immaculata</i> 2M, 2F	Hampson, 1893	Kuthiraivetti	Dec 2012, Mar 2014, Jan 2019
156	<i>Petelia</i>	<i>fasciata</i>	Moore, 1868		
157	<i>Petelia</i>	sp.3	Herrich-Schäffer, 1855	Kuthiraivetti	Dec 2012
158	<i>Hyperpyra</i>	<i>lutea</i>	(Stoll, [1781])	Upper Kothayar	Mar 2014
		Cassymini	Holloway, 1994		
159	<i>Heterostegane</i>	<i>subtessellata</i> M, F	(Walker, [1863])	All sites	Feb 2012, 2015, Mar 2012, 2014, June 2014, Jan 2019
160	<i>Heterostegane</i>	cf. <i>tritocampsis</i> M, F	(Prout, 1934)	Sengeltheri, Talayanai	Feb 2015
161	<i>Heterostegane</i>	sp.3	Hampson, 1893	Maramalai	Feb 2015
162	<i>Zamarada</i>	cf. <i>excisa</i>	Hampson, 1891	Kuthiraivetti, Sengeltheri, Maramalai	Dec 2012, Oct 2012, Feb 2012
		Ennomini	Duponchel, 1845		
163	<i>Ourapteryx</i>	<i>marginata</i>	(Hampson, 1891)	Kuthiraivetti, Kannikatti, Upper Kothayar, Sengeltheri, Maramalai	Dec 2012, Feb 2013, Mar 2014, Oct 2015, Feb 2012, 2015
164	<i>Ourapteryx</i>	<i>peermaadiata</i> -yellow and white	Thierry-Mieg, 1903	Kuthiraivetti-yellow Upper Kothayar-both	Mar 2014
		Eutoeini	Holloway, 1994		
165	<i>Calletaera</i>	<i>postvittata</i>	(Walker, 1861)	Upper Kothayar	Jun 2018
166	<i>Luxiaria</i>	<i>emphatica</i>	Prout, 1925	Kuthiraivetti	Dec 2012
167	<i>Luxiaria</i>	<i>hypaphanes</i> M	Hampson, 1891	Sengeltheri, Kuthiraivetti, Upper Kothayar	Oct 2012, Dec 2012, Jan 2019, Mar 2014

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168	<i>Luxiaria</i>	<i>phyllosaria</i>	(Walker, 1860)	Upper kothayar	Jan 2019
169	<i>Luxiaria</i>	sp.4	Walker, 1860	Kuthiravetti	Jan 2019
170	<i>Zeheba</i>	nr <i>aureata</i> 2M, 1F	Moore, [1887]	Sengeltheri,	Oct 2012, Feb 2015
171	<i>Zeheba</i>	cf. <i>aureatoides</i>	Holloway, [1994]	Sengeltheri, Kuthiravetti	Feb 2015, Dec 2012
		Gonodontini	Forbes, 1948		
172	<i>Gonodontis</i>	<i>pallida</i>	(Butler, 1880)	Maramalai	Feb 2012
		Hypochrosini	Guenée, 1858		
173	<i>Fasceliina</i>	<i>plagiata</i>	(Walker, 1866)	Upper Kothayar, Maramalai,	Feb 2012
174	<i>Fasceliina</i>	<i>Chromataria</i> -M5 forms, 1F	Walker, 1860	Upper Kothayar	Oct 2018
175	<i>Achrosis</i>	<i>incitata</i> complex-2 forms	(Walker, 1862)	Kuthiravetti, Upper Kothayar	Mar 2014, Jan 2018
176	<i>Achrosis</i>	<i>intexta</i>	(Swinhoe, 1891)	Kuthiravetti	Mar 2014
177	<i>Achrosis</i>	sp.4 4M	Guenée, [1858]	All sites	All survey years.
178	<i>Achrosis</i>	sp.4 1F	Guenée, [1858]	Kuthiravetti, Sengeltheri	Dec 2012, Feb 2015
179	<i>Achrosis</i>	sp. 4F	Guenée, [1858]	Kuthiravetti	Dec 2012
180	<i>Celenna</i>	<i>festivaria</i>	(Fabricius, 1794)	Kannikatti, Upper Kothayar	Feb 2013, Mar 2014
181	<i>Celenna</i>	<i>festivaria</i> and form <i>formosensis</i>	(Fabricius, 1794)	Kuthiravetti Upper Kothayar	Mar 2014, Feb 2013, Mar 2014
182	<i>Corymica</i>	<i>deducta</i>	(Walker, 1866)	Upper Kothayar	Jun 2018
183	<i>Corymica</i>	sp.	Walker, 1860	Kannikatti	Feb 2013
184	<i>Hypochrosis</i>	<i>hyadaria</i> - <i>chlorozonaria</i> complex-3 forms	(Guenée, [1858]) - (Walker, 1861)	Kuthiravetti, Upper Kothayar, Sengeltheri, Maramalai	Dec 2012, Mar 2014, Feb 2015, Feb 2012, 2015
185	<i>Omiza</i>	<i>miliaria</i> F-3 forms	Swinhoe, 1890	Kuthiravetti, Upper Kothayar, Sengeltheri, Maramalai	Dec 2012, Mar 2014, Oct 2012, Feb 2015, Feb 2012, Jan 2019
186	<i>Omiza</i>	<i>miliaria</i> M-2 forms	Swinhoe, 1890	Kuthiravetti	Mar 2014
		Incertae sedis			
187	<i>Eumelea</i>	<i>ludovicata</i> M	Guenée, [1858]	Kuthiravetti	Dec 2012
188	<i>Eumelea</i>	sp.2	Duncan [&Westwood], 1841	Kuthiravetti, Sengeltheri	Dec 2012 Feb 2015
		Macariini	Guenée, 1858		
189	<i>Acanthovalva</i>	sp.	Krüger, 2001	Talayanai	Feb 2015
190	<i>Chiasmia</i>	<i>eleonora</i>	(Cramer, [1780])	Kuthiravetti, Upper Kothayar, Sengeltheri	Dec 2012, Mar 2014, Feb 2015,
191	<i>Chiasmia</i>	<i>inchoata</i>	Walker, 1861	Maramalai, Kuthiravetti	Feb 2012, Dec2012, Feb2015
192	<i>Chiasmia</i>	<i>myandaria</i>	(Walker, [1863])	Maramalai	Feb 2012
193	<i>Chiasmia</i>	<i>nora</i>	(Walker, [1861])	Kuthiravetti, Upper Kothayar, Sengeltheri	Dec 2012, Mar 2014, Feb 2015
194	<i>Chiasmia</i>	<i>ornatataria</i>	(Leech, 1897)	Maramalai	Feb 2012
195	<i>Chiasmia</i>	<i>ozararia</i>	(Walker, [1860])	Upper Kothayar	Oct 2018
196	<i>Chiasmia</i>	<i>perfusaria</i>	(Walker, 1866)	Kuthiravetti	Dec 2012
197	<i>Chiasmia</i>	<i>triangulata</i>	(Hampson, 1891)	Maramalai	Feb 2012
198	<i>Chiasmia</i>	cf. <i>normata</i> .	(Walker, 1861)	Talayanai	Feb 2015
199	<i>Chiasmia</i>	sp.11	Hübner, [1823]	Maramalai	Feb 2012
200	<i>Chiasmia</i>	sp.12	Hübner, [1823]	Kuthiravetti	Dec 2012
201	<i>Chiasmia</i>	sp.13	Hübner, [1823]	Maramalai	Feb 2012
202	<i>Chiasmia</i>	sp.14	Hübner, [1823]	Kuthiravetti, Sengeltheri	Dec 2012, Feb 2015
203	<i>Isturgia</i>	<i>disputaria</i> group	Krüger, 2001	Maramalai	Feb 2012

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204	<i>Isturgia</i>	<i>disputaria</i>	Guenée, [1858]	Talayanai	Feb 2015
		Plutodini	Warren, 1894		
205	<i>Plutodes</i>	<i>nilgirica</i>	Hampson, 1891	Kuthiraivetti, Upper Kothayar	Dec 2012, June 2013, Jan 2019
206	<i>Plutodes</i>	<i>pseudocyclaria</i>	Kirty & Goyal, 2011	Kuthiraivetti, Upper Kothayar	Dec 2012, Jan 2019
		Scardamiini	Warren, 1894		
207	<i>Aplochlora</i>	sp. 2 forms	Warren, 1893	Sengeltheri, Upper, Kothayar, Kuthiraivetti	Oct 2012, Mar 2014
208	<i>Scardamia</i>	<i>metallaria</i>	Guenée, [1858]	Kuthiraivetti	Mar 2014

and *A. latizonata* Hampson, 1907, being white with grey or black pattern, are less similar. All the other *Abraxas* species from southern India show rather untypical coloration, grey or brown or yellow, sometimes with shining surface. Moths of the genus *Abraxas* are known to be toxic and their conspicuous appearance is a very significant and successful signal to predators which therefore avoid them, hence their abundance in many habitats, and presence of more than a hundred species across Europe to Australia. Why do species of southern Indian *Abraxas* not exhibit the typical kind of mimicry but prefer a rather mimetic appearance is a point for future research?

Tribe Boarmiini Duponchel, 1845

Plate 7–10 (130–190)

Cleora Curtis, 1825

Plate 8 (138–146)

Individuals identified as *Cleora alienaria* (Walker, 1860), (Plates 8 (138–144)) were quite common in KMTR. They were especially abundant in higher altitudes where they were recorded during most months of the year, except during April and May. The species has conspicuous pattern elements and their identity was determined with the help of literature sources and comparison with specimens in the ZFMK collection. Males were seen to be polymorphic; we have recorded five different variants which made identification even more difficult. A further problem is the existence of a very similar species, *C. fraterna* (Moore, 1888), described from Sikkim. *Cleora alienaria* was described from Sri Lanka and has a generally more southern distribution, but *C. fraterna* may perhaps occur also in the south. Externally both are not distinguished with certainty without details of their genitalia, which are very different. As there is no existing record of *fraterna*'s presence in the south we report these as *Cleora alienaria*.

Cleora acaciaria (Boisduval, 1833), reported in Goyal's PhD thesis (Goyal 2010; Pl. 36) from the Western Ghats is a misidentification of *C. alienaria*, as is evident from the comparison of genitalia figures depicted in the thesis and in Holloway, [1994] (Moths of Borneo, Part 11). The name *C. acaciaria* is valid today only for the species flying on Réunion Islands, extending perhaps to Mauritius.

Cleora nr *injectaria* (Walker 1860), (Plate 8 (145)), recorded during the surveys, could not be confirmed to be true *injectaria* from the available information including distribution ranges, though it looks very similar to the typical, dark grey form of *injectaria* that is known to fly in montane habitats, from where this particular specimen was photographed. It is tentatively identified to the nearest possible species as *C. nr injectaria* for further investigation. True *C. injectaria* is known to be a lowland species, occurring mostly at seashore-areas with mangrove and along riverines (Holloway 1994; Kendrick 2015).

Externally, *Cleora* sp. 3. (Plate 8 (146)) is a member of the *Carecomotis*-group (Fletcher, 1953), but it bears resemblance to several species of this group. Of these, *C. falculata* (Fletcher, 1953), and *C. onycha amplissima* (Fletcher 1953), were reported from erstwhile Travancore. The holotype and paratype of *C. falculata* and the paratype of *C. onycha amplissima* are from this region. The study site from which *Cleora* sp. 3 was observed and photographed was earlier part of Travancore. A very similar species of *Cleora*, also of the *Carecomotis*-group, was recorded as *C. propulsaria* by Goyal from southern India in his thesis (Goyal 2010, Plate 37). On comparison of the genitalia Plates of *C. falculata*, *C. onycha amplissima* (Fletcher, 1953), and *C. propulsaria* (Holloway, [1994]) with that presented in his thesis, it is seen that the species reported by him is *falculata* and not *propulsaria*. *Cleora* sp. 3, therefore, could belong to any one of these three species. Without



genitalic information, this remains identified as another species of *Cleora*.

Ascotis Hübner, 1825

Plate 8 (147)

Ascotis cf. *imparata* (Walker, 1860) (Plate 8 (147), female) was a species difficult to identify. Pattern and coloration are extremely similar to *C. alienaria* (Walker, 1860), but this was ruled out since this individual had narrower wings and was larger in wingspan (>45 mm). In size, this wingspan compared well with that reported for *C. fraterna* (Moore, 1888). But without any discerning characters (males of *Ascotis* with simple antennae would be easy to distinguish from males of *Cleora* with strongly pectinated antennae) and with scarce evidence of the presence of *fraterna* in southern India we at first, provisionally identified it as a species near *alienaria*. After further comparative studies the 2nd author could identify it as a female of *A. imparata*, described from Nepal and “Hindustan”, although not yet recorded from southern India. We believe that the presence of *imparata* cannot be excluded and it is unlikely, that the South Indian individuals may be members of any other closely related species.

Examination of genitalia is needed to identify this moth which was observed frequently in KMTR.

Cusiala Moore, 1887

Plates 8–9 (148–160)

Thirteen individuals of *Cusiala* Moore are reported. There are two species of *Cusiala* that fly in India, *C. boarmoides* Moore, [1887] and *C. raptaria* Walker, 1860. Both are polymorphic but at KMTR the latter was observed to be more widely polymorphic. *Cusiala boarmoides*, the type species described from Sri Lanka, flies both in northern and southern India but *C. raptaria* is reported only from southern India (Hampson 1895). The only distinguishable external difference between the two species (Moore 1887; Hampson 1895) is the postmedial band of the hindwing. In *boarmoides*, it is angled beyond the cell instead of curved as in *raptaria*. In the absence of any other clearly identifiable characteristics based on external morphology, to differentiate *boarmoides* from the typical *raptaria* of southern India, we have presented one individual as *C. boarmoides* (Plate 8 (148)), and all others are designated *C. raptaria*.

Hampson (1895) determined the species *determinata*, *rufifasciata* and *suiasasa* as forms of *C. raptaria*. Our elementary investigation suggests that these determinations, too, need investigation. In addition, the sexual polymorphism, that this genus

displays, too, needs investigation. These three forms were not the only ones that we found in our study sites. There were variants in the form *determinata*, a black variant form, and several other with variable wing markings were observed. Twelve *Cusiala raptaria* that includes the described and undescribed forms (Plates 8–9 (149–160)) are reported. The existence of a wide variety of previously undescribed forms among *C. raptaria* require a more thorough investigation of the genitalic features to understand this genus and its species, as well as its sexual variations. Several other variants seen have been omitted from this paper, for want of detailed descriptions. This further underscores the importance of permitting collection to correctly document the diversity and furthering the scientific knowledge.

Hypomecis Hübner, 1821

Plate 9 (164–171)

Four species of *Hypomecis* – *H. transcissa* (Walker, 1860), *H. separata* (Walker, 1860), *H. tamilensis* Sato, 2016 and *Hypomecis pallida* (Hampson, 1891), are reported in this paper. Dark and light forms of *H. separata* are reported from the buffer area of the reserve. *Hypomecis tamilensis* is a species that was described from KMTR by Sato (2016). *H. pallida* was quite abundant in our study sites. The females of this species are polymorphic (Plate 9 (164–167)) and were found more abundantly and frequently than males. The postmedial fasciae on their wings varied from shades of light and dark grey with brownish or blackish tinge.

H. pallida had been earlier described as a member of the genus *Narapa* Moore, 1887, which later was placed as a junior synonym under *Hypomecis* (Scoble 1999; Hausmann, pers. comm. 29.vi.2019). Preliminary studies of the type-species of *Narapa*, *N. adamata* Felder & Rogenhofer, 1875, from Sri Lanka, by the second author (2nd author, unpublished data), which included analysis of male genitalia indicate that *Narapa* should be treated as a distinct genus in future again.

Several individuals that bore close resemblance to *pallida*, but differing in size, wing shape and markings were observed in the study sites, especially at Kuthiraivetti and Upper Kothayar. We believe that collection and further investigation is likely to reveal new data.

Tribe: Caberini Duponchel, 1845

Plate 10 (191–200)

Ten individuals, belonging to three genera, namely *Astygisa* Walker, 1864, *Petelia* Herrich-Schäffer, 1855, and *Hyperythra* Guenée, [1858], are reported.

***Petelia* Herrich-Schäffer, 1855**

Plate 10 (191–198)

Members of this genus were common in KMTR and were sighted during all surveys at all sites except Talayanai. Four species of *Petelia* – *Petelia medardaria* Herrich-Schäffer, [1856], *P. immaculata* Hampson, 1893, *P. distracta* (Walker, 1860), and *P. fasciata* Moore, 1868, are reported in this paper. One individual could not be identified to species level. All four species are differentiated by the pattern of lines and spots on the wings.

Three almost straight, and almost parallel transverse lines in the forewing are typical to *medardaria* (Plate 10 (191)). Black apical patches are sometimes present in the forewings.

A curved medial line in the forewing, curved toward apex near costa and towards base near hind-margin is typical to *immaculata*. Females of *Petelia* species show wide variation, which the second author has noticed from the collections at ZFMK. This was evident in the two individuals of *immaculata* we have presented. The elements of black pattern near forewing apex which is typical of the females in *immaculata* (Hampson, 1893) was present in one and absent in another female (Plate 10 (196–197)). This pattern is lacking in males.

Identification of *P. distracta* (Plate 10 (192)), was difficult as the facies of *distracta* bears resemblance with that of *medardaria* female and *P. delostigma* Prout, 1932. The fasciae, however, have some discernable differences. The medial line in *delostigma* is curved more towards the tornus unlike in *distracta* in which it runs straight towards the inner margin. *Petelia delostigma* is larger than *distracta* and has not been reported from India. The black spots in *distracta* lie very close to the medial line almost touching it, whereas in the female of *medardaria* the spots lie well below the medial line, closer to the outer margin of the HW. Given these differences we conclude that the individual is *P. distracta*.

In *P. fasciata* (Plate 10 (193)), the antemedial and medial line of the forewing are diffused and rufous-brown with the postmedian band also being rufous-brown, but ill-defined and wavy. Diffused transverse greyish fascies between the rufous bands on both wings, a grey centred blackish discal spot in the HW and a marginal row of black spots form the markings of this species.

The markings on the *Petelia* sp. 5 (Plate 10 (198)) bear similarity to *immaculata*, but the presence of additional patterns on the hindwings require a more thorough investigation, hence it remains unidentified at

the species level.

Tribe: Ennomini Duponchel, 1845

***Ourapteryx* Leach, 1814**

Plate 11 (207–209)

We report two species, the white *Ourapteryx marginata* (Hampson, 1891) (Plate 11 (207)), and the yellow *Ourapteryx peermaadiata* Thierry-Mieg, 1903 (Plate 11 (208)). The yellow *O. peermaadiata* was first described by Thierry-Mieg in 1903. Hampson (1907) described it again as *Uraapteryx ebuleata palniensis* from Palani Hills, Tamil Nadu and Inoue (1993) redescribed *peermaadiata* placing *O. ebuleata palniensis* as a junior synonym of *peermaadiata*. This is the only yellow coloured *Ourapteryx* that flies in southern India. The third author who is researching *Ourapteryx* species of India (3rd author, unpublished data) has recorded a white morph of *O. peermaadiata* from southern India which has also been recorded in KMTR (Plate 11 (209)). Wing-shape and all pattern elements are exactly the same in both forms, but genitalia have not been compared yet.

Comparisons of genitalia presented by Inoue (1993) with that reported by Goyal in his PhD thesis (Goyal 2010, Plate 57) show that *O. peermaadiata* has been incorrectly described as *O. devikulamensis* sp. n.

Tribe Eutoeini Holloway, 1994

Plate 11 (210–219)

***Zeheba* Moore, [1887]**

Plate 11 (216–219)

Four individuals that we report are only tentatively identified. The second author has compared these individuals (Plate 11 (216–219)) to the material of an undescribed *Zeheba* from Sri Lanka in the ZFMK collection. Based on external morphology, these individuals from KMTR resemble the material at the museum.

Males and females of *Zeheba* are easily distinguished. While both have simple, unpectinated antennae, the hindwing margin is dentate in males, but is smooth, broader and angled in the middle (at vein M3) in females (Plate 11 (216)). *Zeheba marginata* that Moore (1884) describes and figures in Lepidoptera of Ceylon (Moore, 1884–7) is a female of the yet-to-be described *Zeheba* species from Sri Lanka. True *Z. marginata* was described from Java by Walker in 1886 and is likely to be extralimital to India. The female we report is very similar to the female described by Moore, erroneously as *Z. marginata*.

The presence of this undescribed species in southern



India is further confirmed from another erroneous record of *Zeheba marginata* in Goyal's PhD thesis (Goyal 2011; pl. 1). The genitalia details of the male presented in the thesis are identical to the male genitalia of the undescribed Sri Lankan material in ZFMK collection, which the second author has dissected and studied (2nd author, unpublished data).

These individuals (Plate 11 (216–218)) also bear strong resemblance to *Z. aureata* Moore, [1887], a Himalayan species, but the genitalia of the *aureata* are quite distinctly different (2nd author, unpublished data). We report them tentatively as *Z. nr aureata* but they require a detailed investigation to confirm the species identity.

The individual in Plate 11 (219) is a male which is larger than the other three Individuals, half-white (or pale-yellow), including the broader wing borders, and with almost-hyaline basal part of hindwing. Without genitalic details its identity cannot be determined with certainty, but likely belongs to *Z. aureatoides* Holloway, [1994], described from Borneo, but with a wider distribution to Sulawesi and Peninsular Malaysia (Holloway, [1994]; coll. ZFMK), Thailand, Myanmar (coll. ZFMK, unrecorded) and perhaps, as a new record, to southern India. Examination of specimens would be necessary to investigate further to prove this.

Tribe Hypochrosini Guenée, 1858

Plates 11–12 (221–246)

Achrosis Guenée, [1858]

Plates 11 (221–223); Plate 12 (226–230)

Several individuals of the genus *Achrosis* were observed, mostly in the wet evergreen or moist deciduous habitats. Of the seven individuals of this genus presented in this paper, *A. intexta* (Swinhoe, 1891) (Plate 11 (223)) is identified with certainty, because of its conspicuous pattern and coloration and as it is the only species of the *intexta*-group known from South India (type-locality: Kanara, southwestern India). Other species of the *intexta*-group are known from Peninsular Malaysia, Borneo and Sumatra (Holloway [1994], the Philippines (ZFMK, not yet recorded).

We report another two individuals (Plate 11 (221 & 222)) with pattern and coloration of *Achrosis incitata* (Walker, 1862) (type-locality: northern India, Darjeeling). Both of them differ considerably from each other and may be members of two different species. From southern India (Nilgiri Hills), Swinhoe (1891) described *Zomia miscella* as new to science which Hampson (1895) synonymized with "*Prionia*" *incitata*, indicating that

incitata flies throughout India. Swinhoe later opines that *miscella* is a southern form of *incitata*. A further species of this group was described from Sri Lanka as *Timandra? serpentaria* (Walker, 1866), which certainly may also occur in the extreme south of India. Identification of two Individuals we recorded of the *incitata*-group is only possible by dissection of genitalia; hence further investigation is required.

Holloway (1994) described a new species close to *A. incitata* from Borneo and Sumatra and in the process reviewed what he calls the *incitata* complex. According to him almost all species of this complex are allopatric (except his new Bornean species which overlaps with the Sumatran species) and all are distinguished by differences in the male genitalia.

The two individuals we report as *A. incitata* (Plate 11 (221 & 222)) may be one among the three species of *incitata* complex that fly in southern India or Sri Lanka or they could be a new species of the *incitata* complex. Further investigation is required.

We also report one unattributed species, *Achrosis* sp. 4 (Plate 12 (226–230)). The ZFMK, too, has specimens of this species that do not match any described so far in their collection. More than one form of the male was observed but only a single female was spotted during the survey. Neither *Achrosis* sp. 4 nor the *incitata* complex resemble *Achrosis euchroes* (Prout, 1917), described from Nilgiris, which also does not find mention in the *incitata*-complex described by Holloway [1994], as it did not occur in Borneo.

Celenna festivariorum (Fabricius, 1794)

Plates 11–12 (224–225)

Two forms of *Celenna festivariorum* Fabricius were found flying from March to August. They were found only in two sites of the survey (Table 3). The typical form of *festivariorum* where the green patches are separated in the forewing, was less frequently seen than the form where the green bands were fused completely (Plate 11 (224)) and formed a large green patch on the FW. Although this species is common in India, there has been no report of racial differences so far. This form with the large fused bands that is dominant in Taiwan was named *formosensis* by Inoue (1964) and treated as a subspecies of *festivariorum*. Holloway [1994] reports that the genitalia of ssp. *formosensis* described by Inoue resemble those of the Indian nominal subspecies *C. festivariorum festivariorum* and he therefore confirms it as a subspecies.

Celenna centraria Snellen, 1880, described from Sumatra, but also occurring in Borneo, is reported by Kirti et al. (2019) as found in the Andaman Islands.

The fused pattern on the forewing of *centraria* is quite different from the species we are reporting here. Holloway [1994] states and figures that the genitalia of *centraria* differ strongly from those of *festivaria*. Until further investigation is undertaken, we report both forms as *C. festivaria*.

***Fascellina chromataria* Walker, 1860**

Plate 12 (234–238)

These moths were seen from the month of June onwards till November. Four males and one female recorded is presented here. Sexual dimorphism is well marked; the female was yellowish-brown with cream coloured antemedial and postmedial lines. The postmedial line had cream spots at regular intervals. The wing colour in males ranged from shades of greenish-brown, brown to black (Plate 12 (235–238)). The submarginal fascia was white in three forms, while in the fourth, the brown form, there was merely a white speck near the excavated tornal margin (Plate 12 (237)). Each of the differently coloured forms were seen in different months and did not fly together.

The hindwing of the underside of the males were chrome-yellow, as their name suggests. The basal parts of the forewing were yellow, red-brown around the postmedial line; the postmedial regions being a mix of brownish-red. A greyish angled line and a patch near the apex of FW was also observed. *Fascellina chromataria* was described from Sri Lanka, and it has been reported from the Shendurney Wildlife Sanctuary in Kerala (Sondhi et al. 2018). Forests of KMTR and Shendurney Wildlife Sanctuary are part of Agasthyamalai Biosphere Reserve. The female seen in KMTR (Plate 12 (234)) is similar to the female collected and identified from Shendurney and therefore is identified as *Fascellina chromataria*. As we also observed more than one form of *chromataria* males, we report this group of four males and one female as *Fascellina chromataria* complex. Examination of specimens are needed to determine whether the individuals of this complex are morphs, subspecies or different species.

***Hypochrosis hyadaria* (Guenée, [1858]) - *H. chlorozonaria* (Walker, 1861)**

Plate 12 (239–241)

Hypochrosis hyadaria is treated at present as a single species with a large number of described subspecies (Holloway [1994]; Scoble et al. 1999), distributed allopatrically from India, over large areas of southeastern Asia and the Malayan archipelago. *Hypochrosis chlorozonaria* Walker, 1861, described from

Sri Lanka, is treated as a related, but distinct species. It was later described again as *Numaria galbulata* (Felder & Rogenhofer, 1875) and *Marcala sulphurens* (Moore, [1887]), from Sri Lanka. *Hypochrosis galbulata* and *H. sulphurens* are just different forms of the same variable species, *chlorozonaria*. Unlike the description of *hyadaria* given by Hampson (1895), the facies described by Moore for these two forms of *chlorozonaria* match well with the facies of the individuals (Plate 12 (239–241)) we have recorded. Holloway (1994) states, “India through S.E. Asia”, as the geographical range for *hyadaria*. Evidence of *hyadaria* flying in southern India comes from the surveys at Shendurney Wildlife Sanctuary by Yash Sondhi (Sondhi et al. 2018). It is possible that both the species—*hyadaria* and *chlorozonaria*—could be found flying together in this region. Investigations through examination of the genitalia of collected specimens alone can provide their correct identity. Therefore, we report these three individuals as forms of *Hypochrosis hyadaria* or *chlorozonaria*.

Tribe Macariini Guenée, 1858

Plate 12–13 (250–269)

The identities of various moths in this tribe were investigated by referring to Krüger’s (2001) extensive work on African species and a range of global macariine species, and the review of this tribe by Scoble & Krüger (2002). The details given in the works of Hampson (1891, 1895), Moore (1884–7), and Walker (1862) were also consulted. Some macariine genera can be identified based on wing colour, shape, and pattern (Scoble & Krüger 2002). However, genitalia structure is the most reliable feature for identification of moths from this tribe.

The macariine taxonomy is still in flux as several species from the Oriental region, including some from India, have not yet been described, as is evident from this paper. Nineteen macariine individuals have been observed and are classified here in three genera, namely, *Acanthovalva* Krüger, 2001, *Chiasmia* Hübner, [1823] 1816, and *Isturgia* Hübner, [1823] 1816.

***Acanthovalva* Krüger, 2001**

Plate 12 (250)

The general features of this moth match the description given for *Acanthovalva* by Krüger (2001). Further investigation about the species requires collection and examination of genitalia. Although he could not examine any specimens, Krüger suggests that *Tephria fumosa* (Hampson, 1895) from Nilgiris may be closely related to *Acanthovalva bilineata* (Warren, 1895)



from South Africa, extending, if verified, the range of this genus to the Oriental region. This is the first record of the genus *Acanthovalva* from southern India.

***Chiasmia* Hübner, [1823] 1816**

Plate 12–13 (251–266)

Fourteen macariine species belonging to the genus *Chiasmia* Hübner are reported. Four of them could be identified only to genus level. One is presented with a provisional identification and nine of them are identified to species level using the various published records listed throughout in this paper.

We report here that the ZFMK has a group of four specimens named *C. ablataria* Swinhoe, collected from the Nilgiri Hills. Externally, they bear close resemblance to the unidentified *Chiasmia* sp. 13 (Plate 13 (265)). However, our research did not yield any more information, such as the year Swinhoe described this species, whether it is a synonym for a described taxon or any literature on it. The name is missing even from the list in Scoble et al. (1999.) This, again, underscores the importance of collecting moths for an accurate description and identification.

***Isturgia* Hübner, [1823] 1816**

Plate 13 (267–269)

***Isturgia disputaria* (Guenée, [1858])**

The various species of *Isturgia* have been broadly placed under five groups by Krüger (2001). One of them is the *Isturgia disputaria* group. We report two taxa that belong to it. Both are tentatively identified, as details of genitalia are not available.

We have identified a female from Talayanai (Plate 13 (269)) as *Isturgia disputaria* Guenée. It is identified by the strong, black fasciae of the forewings. The description of the fasciae matches that given by Hampson (1895). Hampson (1895) also states that the southern Western Ghats forms appear generally paler and ochreous. Krüger (2001) mentions that the HW median line in *disputaria* may be faint or absent, while Hampson records the HW “with sinuous median line”. These lines are partly visible in our Plate, but minor variations in fascia could also be a geographical phenomenon, in our opinion.

The second taxon (Plate 13 (267–268)) we report as *Isturgia*—a male and a female observed at Maramalai (a higher elevation site in the buffer zone of the Reserve)—also belongs to the *I. disputaria* group. It bears some resemblance to the former taxon, but has much weaker transverse fasciae. It may be just a form or variation of the latter, but may also be related to or conspecific with *I. pulinda* (Walker, 1860), from Sri Lanka. A year later, Walker (1861) described another *Isturgia*, *I. deerraria*,

from South Africa, which was subsequently reported by several authors ((Agenjo 1974: 4; Herbulot 1978: 161; Fletcher 1978a: 77; Wiltshire 1952: 172; 1980: 197; 1990: 135; Hermosa 1985: 28; Hausmann 1991: 138) in Krüger (2001) as a subspecies of *I. pulinda*. Krüger (2001), after examining the genitalia of the type-specimens, concluded that the African species *I. deeraria* was not conspecific with *I. pulinda*. Based on the fasciae we believe that this *Isturgia* from Maramalai may be related to *I. pulinda* or may even be a new species. The real identity can only be decided after the study of the genitalia of collected individuals.

Isturgia catalaunaria Guenée, [1858] was also listed as a macariine species from India (Kirti et al. 2019). Krüger (2001) has recorded this to be a misidentification, as this is a species from southern Spain and southern Africa, so extralimital to India.

CONCLUSION

Investigating 390 moths through photographs and without specimens in hand to refer to, was a daunting task. In the absence of specimens, we have attempted to assign as precise species identities as deemed possible, but many uncertainties in species identities can only be clarified through collection and examination of specimens. We have also attempted to compile the many historical records that lay scattered among different resources, and contemporary published papers on Geometridae, for easy access to future researchers. Many geometrids are flower feeders, hence important pollinators of plants in forests. Their presence is likely to help forests flourish. As most geometrids are polyphagous, their varied larval host plants are also crucial, and require protection of their habitats in the Western Ghats, an area of high endemism. Given the diversity observed by the first author in these forests, we hope that these preliminary findings will stimulate further research on the geometrid moths of KMTR.

REFERENCES

- Anonymous 2021 - <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/asia-and-the-pacific/india/agasthyamala/> Last accessed 13 August 2021
- Ban, X., N. Jiang, R. Cheng, D. Xue & H. Han (2018). Tribal classification and phylogeny of Geometrinae (Lepidoptera: Geometridae) inferred from seven gene regions. *Zoological Journal of the Linnean Society* 184(3): 653–672. <https://doi.org/10.1093/zoolinnean/zly013>
- Barlow, H.S. (1982). An introduction to the moths of S.E. Asia. *Malayan Nature Society*, Kuala Lumpur, 305 pp., 51 pls.

- Beccaloni, G., M. Scoble, I. Kitching, T. Simonsen, G. Robinson, B. Pitkin, A. Hine & C. Lyal (Editors) (2003). The Global Lepidoptera Names Index (LepIndex). Last accessed 13 August 2021. <https://www.nhm.ac.uk/our-science/data/lepindex/lepindex/>
- Beljaev, E.A. (2007). Taxonomic changes in the emerald moths (Lepidoptera: Geometridae, Geometrinae) of East Asia, with notes on the systematics and phylogeny of Hemitheini. *Zootaxa* 1584: 55–68.
- Brechlin, R. (1998). Sechs neue indoaustralische Schwärmerarten (Lepidoptera, Sphingidae). *Nachrichten des Entomologischen Vereins Apollo*, Frankfurt am Main, N.F. 19(1): 23–42.
- Brechlin, R. (2000). Zwei neue Arten der Gattung *Loepa* Moore, 1859 (Lepidoptera: Saturniidae). *Nachrichten des Entomologischen Vereins Apollo*, Frankfurt am Main, N.F. 21(3): 165–170.
- Butler, A.G. (1881). Descriptions of new Genera and Species of Heterocerous Lepidoptera from Japan. *The Transactions of the Entomological Society of London* 1881: 1–25.
- Butler, A.G. (1886). *Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum*. Part VI, London, 89 pp., 19 pls.
- Butler, A.G. (1889). *Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum*. Part VII, London, 176 pp., 18 pls.
- Choi, S.W. & S.S. Kim (2013). Six new records of *Idaea* Treitschke (Lepidoptera: Geometridae, Sterrhinae) from Korea. *Entomological Research* 43: 27–33.
- Choi, S.W. (2012). Taxonomic review of the genus *Asthena* Hübner (Lepidoptera: Geometridae) in Korea. *Entomological Research* 42: 151–157. <https://doi.org/10.1111/j.1748-5967.2012.00450.x>
- Cotes, E.C. & C. Swinhoe (1887). *A Catalogue of Moths of India. Pt. 1-Sphinges*. The Trustees of the Indian Museum, Calcutta, 40 pp.
- Cui, L., D. Xue & N. Jiang (2019). A review of *Organopoda* Hampson, 1893 (Lepidoptera, Geometridae) from China, with description of three new species. *Zootaxa* 4651(3): 434–444. <https://doi.org/10.11646/zootaxa.4651.3.2>
- Cui, L., D. Xue, N. Jiang (2019). A review of *Timandra* Duponchel, 1829 from China, with description of seven new species (Lepidoptera, Geometridae). *ZooKeys* 829: 43–74. <https://doi.org/10.3897/zookeys.829.29708>
- Dey, P., V.P. Uniyal, A. Hausmann & D. Stüning (2021). Revision of the genus *Prometopidia* Hampson, 1902, with description of the new species *P. joshimathensis* sp. nov. from West-Himalaya and its subspecies *P. j. yazakii* ssp. nov. from Nepal (Lepidoptera: Geometridae, Ennominae). *Zootaxa* 4980(1): 28–44.
- Elanchezian, M., C. Gunasekaran & A.A. Deepa (2014). A study on moth diversity in three different habitats of Maruthamalai Hill, Western Ghats, South India. *Global Journal for Research Analysis* 3(12): 136–138.
- Fletcher, D.S. (1953). A revision of the genus *Carecomotis* (Lep. Geometridae), *Annals and Magazine of Natural History: Series XII*(6): 100–142. <https://doi.org/10.1080/00222935308654403>
- Forum Herbulot (2003): The Forum Herbulot world list of family group names in Geometridae, <<http://www.herbulot.de>>, 11 pp., with updated version of 12.vi.2007 (A. Hausmann ed.). Last accessed on 13 August 2021.
- Govt. of Tamilnadu, Forest department (2009). Monitoring Primates - A guide for Kalakad Mundanthurai Tiger Reserve, https://www.forests.tn.gov.in/pages/view/kalakad_mundanthurai_tr. Last accessed on 13 August 2021.
- Goyal, T. (2010). Taxonomic studies on family Geometridae (Lepidoptera) from Western Ghats of India, PhD thesis. Department of Zoology, Punjab University, 279 pp., 101 pls. Last accessed on 17 November 2020. <http://hdl.handle.net/10603/2894>
- Goyal, T., J.S. Kirti & A. Saxena (2018). Taxonomy of Genus *Agathia* Guenée (Lepidoptera: Geometridae), with description of a new species from Western Ghats, India. *Indian Journal of Entomology* 80(3): 951–959. <https://doi.org/10.5958/0974-8172.2018.00144.X>
- Hampson, G.F. (1891). *Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum*. Part VIII, Taylor & Francis, London, 144 pp., 18 pls.
- Hampson, G.F. (1893). *Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum*. Part IX, Taylor & Francis, London, 182 pp., 21 pls.
- Hampson, G.F. (1895). *The Fauna of British India including Ceylon and Burma, Moths*- Vol. 3. Taylor and Francis, London, 588 pp.
- Hampson, G.F. (1896). *The Fauna of British India including Ceylon and Burma, Moths*- Vol. 4. Taylor and Francis, London, 632 pp.
- Hampson, G.F. (1907). The Moths of India. Supplementary paper to the Volumes in "The Fauna of British India", Series III, Part IX. *Journal of the Bombay Natural History Society* 18: 27–53.
- Hampson, G.F. (1912). The Moths of India. Supplementary paper to the Volumes in "The Fauna of British India". Series IV, Part IV. *Journal of the Bombay Natural History Society* 21(4): 1222–1272.
- Han, H. & D. Xue (2011). *Thalassodes* and related taxa of emerald moths in China (Geometridae, Geometrinae). *Zootaxa* 3019: 26–50.
- Han, H., A.C. Galsworthy & D. Xue (2009). A survey of the genus *Geometra* Linnaeus (Lepidoptera, Geometridae, Geometrinae). *Journal of Natural History* 43 (13–14): 885–922. <https://doi.org/10.1080/00222930802702472>
- Han, H., A.C. Galsworthy & D. Xue (2012). The Comibaenini of China (Geometridae: Geometrinae), with a review of the tribe. *Zoological Journal of the Linnean Society* 165: 723–772.
- Holloway, J.D. (1993[4]). The moths of Borneo (Part 11); Family Geometridae: Subfamily Ennominae. *Malayan Nature Journal* 47: 1–309.
- Holloway, J.D. (1996). The moths of Borneo (Part 9); Family Geometridae: Subfamilies Oenochrominae, Desmobathrinae, Geometrinae. *Malayan Nature Journal* 49: 147–326.
- Holloway, J.D. (1997). The moths of Borneo (Part 10); Subfamilies Sterrhinae, Larentiinae. *Malayan Nature Journal* 51: 1–242.
- Inoue, H. (1953). Notes on some Japanese Larentiinae and Geometrinae (Lepidoptera: Geometridae). *Tinea* 1: 1–18.
- Inoue, H. (1964). Some new subspecies of the Geometridae from the Ryukyu Archipelago and Formosa (Lepidoptera). *Kontyû* 32(2): 335–340.
- Inoue, H. (1993). Redescription of *Oourapteryx peermaadiata* Thierry-Mieg from South India (Lepidoptera: Geometridae, Ennominae). *Lepidoptera Science* 44(3): 117–119. https://doi.org/10.18984/lepid.44.3_117
- Kendrick, R.C. (2002). Moths (Insecta: Lepidoptera) of Hong Kong. PhD Thesis. Department of Ecology and Biodiversity, Hong Kong, University of Hong Kong. 623 pp., 9 pls. <http://hdl.handle.net/10722/31688>. Last accessed on 4 December 2020.
- Kendrick, R.C. (2015). Polymorphism and populations: *Cleora injectaria* (Walker, 1860) (Lepidoptera: Geometridae) at Mai Po Nature Reserve, Hong Kong. *Porcupine!* 35: 8–10.
- Kirti, J.S. & T. Goyal (2011). A new species of *Plutodes* Guenée (Lepidoptera: Geometridae: Ennominae) from Western Ghats of India. *Journal of Applied Biosciences* 37(1): 68–70.
- Krüger, M. (2001). A revision of the tribe Macariini (Lepidoptera: Geometridae: Ennominae) of Africa, Madagascar and Arabia. *Bulletin of the Natural History Museum, London (Entomology Series)* 70(1): 1–502.
- Mathew, G. & V.K. Rahamathulla (1995). Biodiversity in the Western Ghats – A study with reference to moths (Lepidoptera: Heterocera) in the Silent Valley National Park, India. *Entomon* 20(2): 25–33.
- Moore, F. (1867). On the Lepidopterous Insects of Bengal, Part III. *Proceedings of the Zoological Society of London* 1867: 612–686.
- Moore, F. (1879). *Descriptions of New Indian Lepidopterous Insects from the collection of W. Atkinson*. Heterocera, The Asiatic Society of Bengal. Calcutta, 350 pp., 8 pls.
- Moore, F. (1884–7). *The Lepidoptera of Ceylon. Volume 3*. L. Reeve & Co., London, 600 pp., 72 pls.
- Murillo-Ramos, L., G. Brehm, P. Sihvonen, A. Hausmann, S. Holm, H.R. Ghanavi, E. Öunap, A. Truuverk, H. Staude, E. Friedrich, T. Tammaru & N. Wahlberg (2019). A comprehensive molecular phylogeny of Geometridae (Lepidoptera) with a focus on enigmatic small subfamilies. *PeerJ* 7: e7386. <https://doi.org/10.7717/>



- peerj.7386
- Öunap, E., J. Viidalepp & A. Truuverk (2016). Phylogeny of the subfamily Larentiinae (Lepidoptera: Geometridae): integrating molecular data and traditional classifications. *Systematic Entomology* 21(4): 824–843. <https://doi.org/10.1111/syen.12195>
- Plotkin, D. & A.Y. Kawahara (2020). Review of recent taxonomic changes to the emerald moths (Lepidoptera: Geometridae: Geometrinae). *Biodiversity Data Journal* 8: e52190. <https://doi.org/10.3897/BDJ.8.e52190>
- Prout, L.B. (1912). Lepidoptera, Heterocera. Family Geometridae, Subfamily Hemitheinae. *Genera Insecta* 129: 274 pp.
- Prout, L.B. (1917). On new and insufficiently known Indo-Australian Geometridae. *Novitates zoologicae* 24: 293–317.
- Prout, L.B. (1920–1941). The Indo Australian Geometridae. In: Seitz, A. (Ed.). *The Macrolepidoptera of the World*. Vol 12, Stuttgart Verlag des Seitz'schen Werkes (Alfred Kernen), 356 pp. 50 pls.
- Prout, L.B. (1925). Geometrid descriptions and notes. *Novitates Zoologicae* 32: 31–69.
- Prout, L.B. (1929). New species and sub-species of Geometridae. *Novitates Zoologicae* 35: 63–77.
- Prout, L.B. (1929). On the Geometrid Genus *Catoria* Moore. *Novitates Zoologicae* 35: 132–141.
- Prout, L. B. 1933. The Indoaustralian Geometridae, pp. 77–116. In: Seitz, A. (ed.) 1920-1934. *The Macrolepidoptera of the World*. Volume 12: 1-292.
- Prout, L.B. (1934). Geometridae: Subfamilia Sterrhinae. *Lepidopterorum Catalogus*, part LXI: 1–180, W. Junk, Berlin.
- Sato, R. (1987). Taxonomic notes on *Menophra delineata* (Walker) (Geometridae: Ennominae) and its allies from Indo-Malayan region. *Tinea* 12 Supplement: 249–258.
- Sato, R. (2004). Taxonomic notes on *Racotis boarmiaria* (Guenée) (Geometridae, Ennominae) and its allies from the Indo-Malayan region, with description of four new species. *Tinea* 18(2): 130–139.
- Sato, R. (2014). Six new species of the genus *Ophthalmitis* (Geometridae, Ennominae) from Southeast Asia and South India, with taxonomic notes on the related species. *Tinea* 22(5): 318–330.
- Sato, R. (2016). Five new species of the genera *Hypomecis* Hübner, *Ophthalmitis* Fletcher and *Phthonosema* Warren (Geometridae; Ennominae) from the Indo-Malayan region. *Tinea* 23(5): 241–248.
- Schintlmeister, A. (2003). Die Gattung *Stauropus* Germar, 1812 (Lepidoptera: Notodontidae). *Nachrichten des Entomologischen Vereins Apollo*, Frankfurt/Main, N.F. 24(3): 97–118.
- Scoble, J.M. & M. Krüger (2004). A review of the genera of Macariini with a revised classification of the tribe (Geometridae: Ennominae). *Zoological Journal of the Linnean Society* 134: 257–315.
- Scoble, M.J. (1999). *Geometrid Moths of the World - A Catalogue* (Lepidoptera: Geometridae), Vol. 1 & 2, pp. 5–482 & 485–1016. CSIRO Publishing, Collingwood.
- Scoble, M.J. & A. Hausmann [updated 2007]. Online list of valid and available names of the Geometridae of the World. Last accessed on 10 Jan 2021. <http://www.herbulot.de/globalspecieslist.htm>
- Sihvonen, P. (2005). Phylogeny and classification of the Scopulini moths (Lepidoptera: Geometridae, Sterrhinae). *Zoological Journal of the Linnean Society* 143: 473–530.
- Sihvonen, P., L.S. Murillo-Ramos, G. Brehm, H. Staude & N. Wahlberg (2020). Molecular phylogeny of Sterrhinae moths (Lepidoptera: Geometridae): towards a global classification. *Systematic Entomology* 45: 606–634.
- Sondhi, S., D. Nath, Y. Sondhi & K. Kunte (2020). A new species of *Metallophora* Warren, 1895 (Lepidoptera: Geometridae: Geometrinae) and notes on *M. opalina* (Warren, 1893) from eastern Himalaya, India. *Zootaxa* 4838(2): 289–297.
- Sondhi, Y., S. Sondhi, S.R. Pathour & K. Kunte (2018). Moth diversity (Lepidoptera: Heterocera) of Shendurney and Ponmudi in Agasthyamalai Biosphere Reserve, Kerala, India, with notes on new records. *Tropical Lepidoptera Research* 28(2): 66–89. <https://doi.org/10.5281/zenodo.2027709>
- Sondhi, S., Y. Sondhi, P. Roy & K. Kunte (Chief Editors) (2021). *Moths of India*, v. 2.63. Indian Foundation for Butterflies.
- Stünig, D. & V.K. Walia (2009). The genus *Astygisa* Walker, 1864 in India, with description of a new species from western Himalaya (Lepidoptera: Geometridae, Ennominae). *Tinea* 21(1): 9–22.
- Swinhoe, C. (1890). New species of moths from Southern India. *Transactions of the Entomological Society of London* 1891(1): 133–154, pl.8. <https://doi.org/10.1111/j.1365-2311.1891.tb01644.x>
- Thierry-Mieg, P. (1903). Descriptions de Lepidopteres Nocturnes. *Annales de la Société entomologique de Belgique* 47: 382–385.
- Viidalepp, J. (2011). A morphological review of tribes in Larentiinae (Lepidoptera: Geometridae). *Zootaxa* 3136(1): 1–44. <https://doi.org/10.11646/zootaxa.3136.1.1>
- Walker, F. (1860). *List of the specimens of Lepidopterous insects in the collection of the British Museum, London*. Part XX: 1–276.
- Walker, F. (1860). *List of the specimens of Lepidopterous insects in the collection of the British Museum, London*, Part XXI: 1–373.
- Walker, F. (1861). *List of the specimens of Lepidopterous insects in the collection of the British Museum, London*. Part XXII–XXV: 1–826.
- Walker, F. (1862). *List of the specimens of Lepidopterous insects in the collection of the British Museum, London*. Part XXV–XXVI: 1–538.
- Warren, W. (1894). New Genera and Species of Geometridae. *Novitates Zoologicae*, 1: 366–534.
- Warren, W. (1896). New Species of Drepanidae, Thyrididae, Uraniidae, Epiplemididae, and Geometridae in the Tring Museum. *Novitates Zoologicae* 3: 335–420.
- Warren, W. (1897). New Genera and Species of Geometridae. *Novitates Zoologicae* 4: 12–179 & 195–306.
- Xue, D., L. Cui & N. Jiang (2018). A review of *Problepsis* Lederer, 1853 (Lepidoptera: Geometridae) from China, with description of two new species. *Zootaxa* 4392(1): 101–127. <https://doi.org/10.11646/zootaxa.4392.1.5>
- Xue, D., X. Wang & H. Han (2009). A revision of *Episothalma* Swinhoe, 1893, with descriptions of two new species and one new genus (Lepidoptera, Geometridae, Geometrinae). *Zootaxa* 2033: 12–25.
- Yakovlev, R.V. (2009). New taxa of African and Asian Cossidae (Lepidoptera). *Euroasian Entomological Journal* 8(3): 353–361.

Subfamily Sterrhinae: 5–36

Tribe Cosymbiini: 5–7



*5. *Chrysocraspeda* sp.1



6. *Chrysocraspeda* sp.2



7. *Perixera insitiva*

Tribe Cyllopodini: 8



* 8. *Organopoda* sp.



9. *Craspediopsis* sp.



*10. *Lissoblemma lunuliferata*

Tribe Lissoblemmini: 9–10

Tribe Rhodometrini: 11–12



11. *Traminda aventiaria*



12. *Traminda mundissima*



13. *Problepsis apollinaria*



14. *Problepsis deliaria*

Tribe Scopulini: 13–22



15. *Scopula fibulata*



16. *Scopula divisaria*



17. *Scopula nr actuaria*

Plate 1. Geometrids of Kalakad-Mundanthurai Tiger Reserve

18. *Scopula* nr *relictata*19. *Scopula* sp.20. *Somatina rosacea*21. *Somatina* nr *plynusaria*22. cf. *Somatina*.

Tribe Sterrhini: 23–32

23. *Idaea gemmaria*24. *Idaea* nr *gemmaria*25. *Idaea violaceae*26. *Idaea* sp.427. *Idaea* sp.528. *Idaea* sp.629. *Idaea* sp.730. *Idaea* sp.831. *Lophophleps phoenicoptera*32. *Lophophleps purpurea*

Tribe: Timandriini: 33

*33. *Timandra* sp.

Unidentified Sterrhinae: 34–36



34.



35.



36.

Plate 2. Geometrids of Kalakad-Mundanthurai Tiger Reserve

Subfamily Larentiinae: 37–60

Tribe Asthenini: 37–38


*37. *Acolutha pictaria*

38. *Polynesia sunandava*

Tribe Cidariini: 39–41


39. *Ecliptopera dissecta*

*40. *Ecliptopera muscicolor*

41. *Chloroclystis* sp.

42. *Bosara albitornis*

Tribe Eupitheciini: 42–53


43. *Eupithecia* sp.

44. *Collix* sp.1

45. *Collix* sp.2

46. *Collix* sp. 3

47. *Eois* cf. *dissimilis*

48. *Eois lunulosa*

49. *Eois lunulosa* form *ochracea*

50. *Eois* sp. 3

*51. *Eois* sp. 4

52. *Gymnoscelis* cf. *admixtaria*

*53. *Ziridava rubridisca*

Tribe: Incertae sedis: 54


54. *Phisetobasis annulata*

Tribe: Trichopterygini: 55–56


55. *Sauris* sp. 1

56. *Sauris* sp. 2

Tribe: Xanthorhoini: 57


57. *Xanthorhoe saturata*

Plate 3. Geometrids of Kalakad-Mundanthurai Tiger Reserve

Unidentified Eupitheciini: 58–60



58.



59.



60.

Subfamily Geometrinae: 61–101

Tribe Agathiini: 61–63

61. *Agathia lycaenaria*62. *Agathia hemithearia*63. *Agathia laetata*

Tribe Archaeobalbini: 64–65

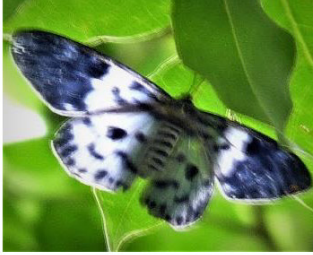
64. *Herochroma* cf. *cristata*65. *Lophophelma ruficosta*66. *Argyrocosma inductaria*

Tribe: Comibaenini: 66–74

67. *Chlorochromodes* sp.68. *Comibaena attenuata*69. *Comibaena cassidara*70. *Comibaena fuscidorsata*71. *Comibaena integranota*72. *Comibaena* cf. *striataria*73. *Protuliocnemis*
cf. *biplagiata*74. *Protuliocnemis partita*

Plate 4. Geometrids of Kalakad-Mundanthurai Tiger Reserve

Tribe Dysphaniini: 75


75. *Dsyphania percota*

Tribe Geometrini: 76


76. *Cyclothea disjuncta*

Tribe Hemitheini: 77–91


77. *Comostola* sp.

78. *Episothalma robustaria*

79. *Hemithea tritonaria*

80. *Hemithea wuka*

81. *Idiochlora* nr *caudularia*

82. *Orothalassodes hypocrites*

83. *Pelagodes* sp.

84. *Pentheochlora* cf. *uniformis*

85. *Spaniocentra* sp.

*86. *Berta* cf. *chrysolineata*

87. *Jodis* nr *undularia*

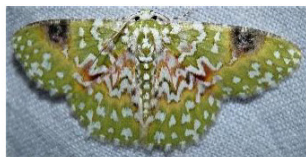
88. *Jodis pallescens*

89. *Jodis* sp.

90. *Microloxia indecretata*

91. *Microloxia* sp.

Tribe Nemoriini: 92–93


92. *Eucyclodes albisparsa*

93. *Eucyclodes gavissima*

Tribe Ornithospilini: 95–96


94. *Ornithospila lineata*

95. *Ornithospila submonstrans*

Plate 5. Geometrids of Kalakad-Mundanthurai Tiger Reserve

Tribe Pseudoterpnini: 96–98

96. *Pingasa ruginaria*97. *Pingasa dispensata* ♂98. *Pingasa dispensata* ♀

Unidentified Geometrinae: 99–101



99.



100.



101.

Subfamily Desmobathrinae: 102–105

102. *Derambila fragilis*103. *Noreia ajaia* ♂104. *Ozola microniaria* ♀105. *Ozola* sp.

Subfamily Ennominae: 106–274

Tribe Abraxini: 106–123

106. *Abraxas leucostola*
argyrosticta107. *Abraxas fasciaria*108. *Abraxas poliostrata* ♂109. *Abraxas poliostrata* ♀110. *Abraxas* sp.4

111. (UN)

112. *Abraxas* sp.5

113. (UN)

114. *Abraxas* sp.6(UP)

Plate 6. Geometrids of Kalakad-Mundanthurai Tiger Reserve



115. *Abraxas* sp.6 (UN) 116. (UP) ← *Abraxas* sp. 7 → 117.(UN) 118.*Abraxas* sp. /form 119. *Abraxas* sp./form



120. *Abraxas* sp./form 121. ← *Abraxas* sp. 8.(UP) → 122. 123. (UN) sp.8

Tribe Baptini: 124–129



124. *Borbacha* cf. *pardaria*

125. *Lomographa* *inamata*

126. *Platycerota* *vitticostata*



*127. *Synegia* *imitaria*

*128. *Yashmakia* *erythra* ♂

*129. *Yashmakia* *conflagrata* ♀

Tribe Boarmiini: 130–190



130. *Alcis* *nilgirica* ♀ -UP

131. *Alcis* *nilgirica* ♀ -UN

132. *Alcis* *nilgirica* ♂

*133. *Amblychia* cf. *angeronaria*

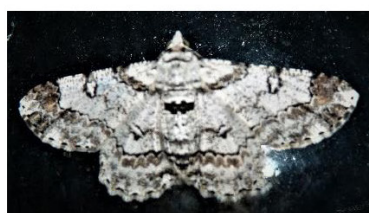


134. *Amraica* *recursaria*

135. *Catoria* cf. *sublavaria* ♀ UP & 136.UN

137. *Chorodna* *strixaria*

Plate 7. Geometrids of Kalakad-Mundanthurai Tiger Reserve

138. *Cleora alienaria* ♀-UP139. *Cleora alienaria* ♀- UN140. *Cleora alienaria* ♂

141. Typical form



142. Variant



143. Colour variant



144. Colour variant

← *Cleora alienaria* ♂ →

145. *Cleora nr injectaria*146. *Cleora* sp. 3147. *Ascotis cf. imparata* ♀148. *Cusiala boarmoides*149. *Cusiala raptaria*150. *Cusiala raptaria* form *disterrinata*151. *Cusiala raptaria*,
form *disterrinata* -variant152. *Cusiala raptaria*, form
disterrinata - variant153. *Cusiala raptaria*, form
rufifasciata154. *C raptaria*, form *suasasa*155. Undescribed variants of *Cusiala raptaria*

156.

Plate 8. Geometrids of Kalakad-Mundanthurai Tiger Reserve



157.

158.

159.

160.

Undescribed variants of *Cusiala raptaria*

161. *Ectropis bhurmitra*

162. *Ectropis* cf. *dentilineata*

163. *Gasterocome polyspathes*


164. ♂



165. ♀



166. ♀



167. ♀

Hypomecis pallida

168. *Hypomecis separata*

169. *H. separata*, dark form

170. *Hypomecis tamilensis*

171. *Hypomecis transcissa*

172. *Hyposidra talaca*

173. *Hyposidra violescens* ♀

174. *H. violescens* ♂

175. *Hyposidra* sp.

176. *Dasyboarmia* cf. *inouei*

177. *Ophthalmitis* cf. *herbidaria*

178. *Ophthalmitis kalakadaria*

179. *Psilalcis* cf. *subtochracea* ♀

180. *Psilalcis* cf. *subtochracea* ♂

181. *Psilalcis* sp.2

Plate 9. Geometrids of Kalakad-Mundanthurai Tiger Reserve

182. *Psilalcis* sp.3 ♀183. *Psilalcis* sp. 4 ♂184. *Racotis keralaria*185. *Ruttellerona* cf. *cessaria**186. *Ruttellerona* cf. *pseudocessaria*187. *Biston strigaria*

Unidentified Boarmiini: 188–190

Tribe Caberini: 191–200



188.



189.



190.

191. *Petelia medardaria* ♂192. *Petelia distracta* ♀193. *Petelia fasciata*194. *Petelia immaculata* ♂195. *Petelia immaculata* ♂196. *Petelia immaculata* ♀197. *Petelia immaculata* ♀198. *Petelia* sp.5*199. *Astygisa* sp.200. *Hyperythra lutea*

Tribe Cassymini: 201–206

201. *Heterostegane subtessellata* ♂202. *Heterostegane subtessellata* ♀203. *Heterostegane* cf. *tritocampsis* ♀204. *Heterostegane* cf. *tritocampsis* ♂205. *Heterostegane* sp. 3

Plate 10. Geometrids of Kalakad-Mundanthurai Tiger Reserve

Tribe: Ennomini: 207–209


206. *Zamarada* cf. *excisa*

207. *Ourapteryx marginata*

208. *Ourapteryx peermaadiata* 209.*


Tribe Eutoeini: 210–219


*210. *Calletaera postvittata*

211. *Luxiaria emphatica*

212. *Luxiaria hypaphanes* 213*.

214. *Luxiaria phyllosaria*

215. *Luxiaria* sp.4

216. *Zeheba* nr *aureata* ♀

217. *Zeheba* nr *aureata* ♂

Tribe Gonodontini: 220


218. *Zeheba* nr *aureata* ♂

219. *Zeheba* cf. *aureatoides*

220. *Gonodontis pallida*

Tribe Hypochrosini: 221–246


221. *Achrosis incitata* complex 222*.

223. *Achrosis intexta*

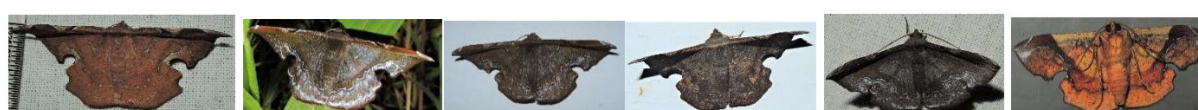
224. *Celenna festivaria*
form *formosensis*



225. *Celenna festivaria* 226. *Achromis* sp. 4 ♂ 227. 228. 229.



230. *Achromis* sp. 4 ♀ 231. *Corymica* sp. *232. *Corymica deducta* 233. *Fascellina plagiata*



234. ♀ 235. ♂ 236. ♂ 237. ♂ 238(a). ♂ 238(b). ♀

← **Fascellina chromataria* complex →



239. 240. 241. 242. *Omiza miliaria* ♂
← *Hypochrosis hyadaria* - *Hypochrosis chlorozonaria* →



*243. *Omiza miliaria* ♂ 244. *Omiza miliaria* ♀ 245. *Omiza miliaria* ♀ 246. *Omiza miliaria* ♀

Tribe Incertae sedis: 247–249



247. *Eumelea ludovicata* 248. (UP) *Eumelea* sp. 2 249. (UN)

Tribe Macariini: 250–269



250. *Acanthovalva* sp. 251. *Chiasmia eleonora* 252. 253. *Chiasmia myandaria*

Plate 12. Geometrids of Kalakad-Mundanthurai Tiger Reserve


254. *Chiasmia inchoata* (UP)

255. *C. inchoata* (UN)

256. *C. inchoata*-variant

257. *Chiasmia nora*

258. *Chiasmia ornataria*

*259. *Chiasmia ozararia*

260. *Chiasmia perfusaria*

261. *Chiasmia triangulata*

262. *Chiasmia* cf. *normata*

263. *Chiasmia* sp.11

264. *Chiasmia* sp.12

265. *Chiasmia* sp. 13

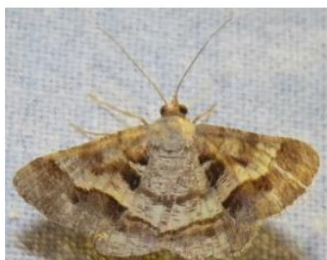
266. *Chiasmia* sp.14


267. ♂

Isturgia disputaria group


268. ♀

Tribe Plutodini: 270–271


269. *Isturgia disputaria*

270. *Plutodes nilgirica*

271. *Plutodes pseudocyclaria*

Tribe Scardamiini: 272–274



272.

Aplochloa sp.


273.


274. *Scardamia metallaria*

Plate 13. Geometrids of Kalakad-Mundanthurai Tiger Reserve. © Images with * are contributions from Thalavaipandi. All others are those of the first author.

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Article

An inventory of geometrid moths (Lepidoptera: Geometroidea: Geometridae) of Kalakad-Mundanthurai Tiger Reserve, India

– Geetha Iyer, Dieter Stüning & Sanjay Sondhi, Pp. 19887–19920

Communications

Roadkills of Lowland Tapir *Tapirus terrestris* (Mammalia: Perissodactyla: Tapiridae) in one of its last refuges in the Atlantic Forest

– Aureo Banhos, Andressa Gatti, Marcelo Renan de Deus Santos, Leonardo Merçon, Ilka Westermeyer, Natália Carneiro Ardente, Luis Francisco Oliveira Pereira Gonzaga, Lucas Mendes Barreto, Lucas Damásio, Tomas Lima Rocha, Vitor Roberto Schettino, Renata Valls, Helena Godoy Bergallo, Marcos Vinicius Freitas Silva, Athelson Stefanon Bittencourt, Danielle de Oliveira Moreira & Ana Carolina Srebek-Araujo, Pp. 19921–19929

Scientific contributions and learning experiences of citizen volunteers with a small cat project in Sanjay Gandhi National Park, Mumbai, India

– Shomita Mukherjee, R. Nandini, P.V. Karunakaran & Nayan Khanolkar, Pp. 19930–19936

Seasonal food preferences and group activity pattern of Blackbuck *Antelope cervicapra* (L., 1758) (Mammalia: Cetartiodactyla: Bovidae) in a semi-arid region of western Haryana, India

– Vikram Delu, Dharambir Singh, Sumit Dookia, Priya & Kiran, Pp. 19937–19947

Studies on the habitats of Grey Francolin *Francolinus pondicerianus* (J.F. Gmelin, 1789) (Galliformes: Phasianidae) in northern districts of Tamil Nadu, India

– M. Pandian, Pp. 19948–19955

Recovery of vulture population in roosting and scavenging areas of Bastar and Bijapur, Chhattisgarh, India

– Sushil Kumar Dutta, Muntaz Khan, P.R.S. Nagi, Santosh Durgam & Surabhi Dutta, Pp. 19956–19963

A geographical assessment of Chariganga and Arpara Beel (wetlands) of Nadia, West Bengal as a habitat of wetland birds

– Mehedi Hasan Mandal, Arindam Roy & Giasuddin Siddique, Pp. 19964–19975

Phenotypic plasticity in *Barilius vagra* (Hamilton, 1822) (Teleostei: Danionidae) from two geographically distinct river basins of Indian Himalaya

– Sumit Kumar, Sharali Sharma & Deepak Singh, Pp. 19976–19984

Taxonomic notes, a new species, and a key to Indian species of the click beetle genus *Cryptalaus* Ôhira, 1967 (Coleoptera: Elateridae: Agrypninae)

– Harshad Parekar & Amol Patwardhan, Pp. 19985–19999

Niche overlap of benthic macrofauna in a tropical estuary: diurnal variation

– Mário Herculano de Oliveira, Lidiane Gomes de Lima, Caroline Stefani da Silva Lima, Jéssica de Oliveira Lima Gomes, Francieli Ferreira Paiva, Graciele de Barros, Carlinda Raily Medeiros & Joseline Molozzi, Pp. 20000–20010

Diversity of aquatic insects and biomonitoring of water quality in the upper Ganga River, a Ramsar site: a preliminary assessment

– Kritish De, Arkojyoti Sarkar, Kritika Singh, Virendra Prasad Uniyal, Jeyaraj Antony Johnson & Syed Ainul Hussain, Pp. 20011–20018

Patterns of forest cover loss in the terrestrial Key Biodiversity Areas in the Philippines: critical habitat conservation priorities

– Bernard Peter O. Daipan, Pp. 20019–20032

The woody flora of Shettihalli Wildlife Sanctuary, central Western Ghats of Karnataka, India - A checklist

– Kanda Naveen Babu, Kurian Ayushi, Vincy K. Wilson, Narayanan Ayyappan & Narayanaswamy Parthasarathy, Pp. 20033–20055

Reproductive biology of *Ophiorrhiza caudata* C.E.C. Fisch. (Rubiaceae), an endemic and endangered creeping perennial herb of the Western Ghats, India

– Maria Theresa, Appukuttan Kamalabai Sreekala & Jayalakshmi Mohanlal, Pp. 20056–20065

Short Communications

Successful rescue, medical management, rehabilitation, and translocation of a Red Panda *Ailurus fulgens* (Mammalia: Carnivora: Ailuridae) in Arunachal Pradesh, India

– Jahan Ahmed, Sorang Tadap, Millo Tasser, Koj Rinya, Nekibuddin Ahmed & Sunil Kyarong, Pp. 20066–20071

A rare photographic record of Eurasian Otter *Lutra lutra* with a note on its habitat from the Bhagirathi Basin, western Himalaya, India

– Ranjana Pal, Aashna Sharma, Vineet Kumar Dubey, Tapajit Bhattacharya, Jeyaraj Antony Johnson, Kuppusamy Sivakumar & Sambandam Sathyakumar, Pp. 20072–20077

The first record of Medog Gliding Frog *Rhacophorus translineatus* Wu, 1977 (Anura: Rhacophoridae) from Chhukha District, Bhutan

– Sonam Lhendup & Bal Krishna Koirala, Pp. 20078–20083

First record of a freshwater crab, *Maydelliathelphusa masoniana* (Henderson, 1893) (Decapoda: Brachyura: Gecarcinucidae) from West Bengal, India

– Ram Krishna Das, Pp. 20084–20089

Butterflies of Amrabad Tiger Reserve, Telangana, India

– Deepa Jaiswal, B. Bharath, M. Karuthapandi, Shrikant Jadhav, S. Prabakaran & S. Rehanuma Sulthana, Pp. 20090–20097

An enumeration of the flowering plants of Kyongnosla Alpine Sanctuary in eastern Sikkim, India

– Sudhansu Sekhar Dash, Subhajit Lahiri & Ashiho Asoshii Mao, Pp. 20098–20117

A new record of psychrotrophic *Paecilomyces formosus* (Eurotiales: Ascomycota) from India: morphological and molecular characterization

– Skarma Nonzom & Geeta Sumbali, Pp. 20118–20123

Notes

Study on incidence and pathology of gastrointestinal parasitic infections in Nilgai *Boselaphus tragocamelus* in Hisar, Haryana, India

– Maneesh Sharma, B.L. Jangir, D. Lather, G.A. Chandratre, V. Nehra, K.K. Jakhar & G. Narang, Pp. 20124–20127

An unusual vocalization of Brown Hawk-Owl *Ninox scutulata* (Raffles, 1822) (Aves: Strigiformes: Strigidae) recorded from Kerala, India

– Riju P. Nair & Shine Raj Tholkudiyil, Pp. 20128–20129

New distribution data on the genus *Maripanthus* Maddison, 2020 (Araneae: Salticidae) from southern India

– A. Asima, John T.D. Caleb, Dhruv A. Prajapati & G. Prasad, Pp. 20130–20132

On the IUCN status of *Boesenbergia albolutea* and *B. rubrolutea* (Zingiberaceae) and typification of *B. rubrolutea*

– K. Aishwarya & M. Sabu, Pp. 20133–20135

New records of mass seeding *Cephalostachyum latifolium* Munro (Poaceae) along the mid-elevation broadleaved forest of Sarpang district, Bhutan

– Jigme Tenzin, Sangay Nidup & Dago Dorji, Pp. 20136–20139

Response

If habitat heterogeneity is effective for conservation of butterflies in urban landscapes of Delhi, India? Unethical publication based on data manipulation

– Sanjay Keshari Das & Rita Singh, Pp. 20140–20142

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