Jatishwor Singh IRUNGBAM

Lepidoptera of Manipur, India: its formation and determinants

School of Doctoral Studies in Biological Sciences
University of South Bohemia in České Budějovice • Faculty of Science
Ph.D. Thesis Series, 2022, No. 1

Jatishwor Singh IRUNGBAM

School of Doctoral Studies in Biological Sciences
University of South Bohemia in České Budějovice
Faculty of Science
Branišovská 1760
CZ-37005 České Budějovice, Czech Republic

Phone: +420 387 776 201
www.prf.jcu.cz, e-mail: sekret-fpr@prf.jcu.cz

Ph.D. Thesis Series, 2022, No. 1

School of Doctoral Studies in Biological Sciences
University of South Bohemia in České Budějovice
Faculty of Science

"Lepidoptera of Manipur, India: its formation and determinants"

Ph.D. Thesis

Jatishwor Singh IRUNGBAM MSc.

Supervisor: RNDr. Zdenek Faltynek Fric, Ph.D.
Institute of Entomology, Biology Centre CAS, České Budějovice

České Budějovice 2022

This thesis should be cited as:

Irungbam, J.S. (2022). *Lepidoptera of Manipur, India: its formation and determinants.* Ph.D. Thesis Series, No. 01. University of South Bohemia, Faculty of Science, School of Doctoral Studies in Biological Sciences, České Budějovice, Czech Republic, I-X + 291pp.

ANNOTATION

The thesis focused on the study of the diversity pattern of moths at the elevational gradient of Shirui Hill and this study also focused on the documentation and understanding of the faunal composition and assemblages of the Lepidoptera at different elevations of Shirui Hill, Manipur, India. Moths on the elevational gradient of Shirui Hill were surveyed using light traps in five transects between 1930 to 2835 m altitude from 2016 to 2019. We recorded 449 moth species in selected nine families (Noctuidae; Erebidae; Notodontidae; Lasiocampidae; Eupterotidae; Saturniidae; Sphingidae; Drepanidae and Geometridae) and the biodiversity pattern studied shows that the species diversity (Shannon diversity and entropy) was significantly related to the elevational gradient. These measures followed a hump-shaped pattern with a peak close to 2036 m, then declined strongly to upper elevations. We observed that the low-elevation areas harbour majority of the moth species found in Shirui Hill, only three families were found throughout the entire elevation gradient. The species turnover and Jaccard index of dissimilarity were high in upper and lower elevations indicating different moth communities, which mix in the middle part of the gradient, likely resulting in accumulated species diversity. Finally, new local and country records, and new species are reported via the contribution of COI barcoding and traditional morphological identification to the knowledge of moth diversity in Shirui Hill, Manipur, India.

DECLARATION

I hereby declare that my Ph.D. thesis is my work alone and that I have used only those sources and literature detailed in the list of references.

Place: *České Budějovice*, date:

Jatishwor Irungbam

This thesis originated from a partnership of Faculty of Science, University of South Bohemia, and Institute of Entomology, Biology Centre of the ASCR, supporting doctoral studies in the Entomology study program.

Přírodovědecká fakulta
Faculty of Science

Jihočeská univerzita v Českých Budějovicích
University of South Bohemia in České Budějovice

BIOLOGY CENTRE CAS

Entomologický ústav
Institute of Entomology

Financial support

This work was supported by grant from the Czech Science Foundation (GA CR: 14-36098G); the Grant Agency of the University of South Bohemia (GA JU 038/2019/P) and the Technology Agency of the Czech Republic (TACR) (SS01010526).

Acknowledgements

First, I express my sincere thanks and profound sense of gratitude to my research supervisor Dr Zdenek Faltynek Fric, for his support and guidance throughout the study. His patience, generous behaviour, ever helping nature, constant encouragement, parental care in my personal and professional life are admirable. I am highly appreciative for his immense knowledge of the subject, most perceptive mind, analytic gaze, a great sense of precision, keen interest, time to time monitoring and positive attitude. I truly appreciate you and your time you spent helping me in many occasions. I express my sincere thanks to School of Doctoral Studies in Biological Sciences, Faculty of Science, University of South Bohemia in České Budějovice for providing me various facilities and the fellowship to complete my research. And Institute of Entomology, Biology Centre, Czech Academy of Science for supporting me by providing employment at the institute and supporting my field and laboratory work throughout my PhD study period.

Nothing would be possible without our collaboration with the local community of the Shirui village in Ukhrul district, Manipur, India for their generous hospitality, support provided and allowing me to work on their ancestral land and helping with fieldwork. This thesis could not exist without the tireless help of my friends, Harmenn Huidrom, Soibam Baleshwor and Bendang Ngangom. Special thanks to the Principal Conservator of Manipur, Department of Forest, Government of Manipur, India for granting us permission to conduct the surveys and collection of materials from Shirui Hill, Ukhrul district and all the other parts of Manipur.

I also thank Dr Alexander Schintlmeister, Museum Witt, München, Germany, Dr Alexey Solovyev, Altai University, Russia for sharing their expertise on the identifying and helping in describing new species of Notodontidae and Limacodidae respectively. I especially thank Mr. Peter Smetacek, Butterfly Research Centre, Bhimtal, India for his kind words and encouragement provided during my entire research period. I also thank, the Principal, Head of the Zoology department and Dr Sachin

Gurule of KTHM College, Nashik, India for hosting me as intern in their institute to complete my thesis.

I would also like to thank my colleagues RNDr Jana Maresova and Dr Alena Sucháčková for their sincere guidance during my molecular works and corrections and suggestions provided during the preparation of manuscripts. Nikolai Ignatev for allowing me to use his photographing equipment's whenever I needed. Mgr. Michal Rindoš, for his suggestions and advices provided during the crucial periods of my studies. I also thank Doc Martin Konvicka for his immense help and support provided during the preparation of manuscripts. Without his support and help, it was not possible for me to produce such quality of manuscripts for publication.

I wanted to take the time to thank my best friend Dr. Shikhin B. Kolhe and his partner Ms Cherryl, Maharashtra, India for his immense support and encouragement provided during my studies.

Lastly, I would like to express my sincere gratitude to my wife, Ms. Meenakshi Irungbam, the one with whom I share my life …. I would simply not have been able to finish my projects and thesis without her unshakeable love, patience, sacrifices made every day. Words cannot express how much you mean to me.

Finally, I thank my parents and family for their support and encouragement provided to achieve my goal.

This thesis is dedicated to the memory of Irungbam Kullabidhu and Irungbam (O) Tathotlei.

List of papers and author's contribution

The thesis is based on the following papers (listed thematically):

I. **Irungbam, J.S.,** Sucháčková, A.B., Konvička, M. & Fric, Z.F. Do shapes of elevational gradients of species richness depend on vertical range studied? The case of Himalayas. **(*Manuscript*)**.

JSI designed the study (80%); compiled and organized the database (100%); data analysis and result interpretation (45%); and manuscript preparation (40%).

II. **Irungbam, J.S.,** Sucháčková, A.B, Konvička, M. & Fric, Z.F. Elevational distribution pattern of moths (Insecta: Lepidoptera) in Shirui National Park, Manipur, India **(*Manuscript*)**

JSI designed the study (90%); led the field sampling (100%); identification of materials (100%); organized the database (100%); and manuscript preparation (60%).

III. Schintlmeister, A. & **Irungbam, J.S.** (2019). *Euhampsonia rubricata* spec. nov. a new moth species from northeastern India and western Myanmar (Lepidoptera: Notodontidae). *Zootaxa*, 4560(1): 195–200. **(IF= 0.949)**

J.S.I. led field sampling (100%); preparation of material and molecular analysis of the material (100%); and manuscript preparation (70%).

IV. **Irungbam, J.S.,** Ahmad, J., Singh, N. & Solovyev, A.V. (2021). Two new species and three new species records of family Limacodidae from northeast India (Lepidoptera: Zygaenoidea). *Journal of Asia Pacific Entomology*. **(*Manuscript*)**

J.S.I. led field sampling (100%); preparation of material and molecular analysis of the material (100%); and manuscript preparation (90%).

V. **Irungbam, J.S.,** Gurule, S.A. & Fric, Z.F. (2020). Lappet moths (Lepidoptera: Lasiocampidae) of Manipur, northeast India: an updated checklist. *Journal of Insect Biodiversity*, 019(2): 024–043.

J.S.I. led field sampling (100%); identified the materials (100%); and manuscript preparation (90%).

VI. **Irungbam, J.S.** & Fric, Z.F. (2021). Checklist of the family Sphingidae Latreille, 1802 (Lepidoptera: Bombycoidea) from Shirui Hill, Manipur, India. *Records of the Zoological Survey of India*, 121(1)/173–194.

J.S.I. led field sampling (100%); identified the materials (100%); and manuscript preparation (90%).

VII. **Irungbam, J.S.,** Schintlmeister, A. & Fric, Z.F. Lesser known Notodontidae Stephens, 1829 (Lepidoptera: Noctuoidea) moths from Manipur, India. **(*Manuscript*)**

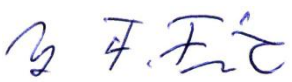
J.S.I. led field sampling (100%); identified the materials (70%); and manuscript preparation (90%).

VIII. **Irungbam, J.S.,** Laishram, R.M., Huidrom, H., Soibam, B.S., Ngangom, A., & Fric, Z.F. (2020). An inventory of the butterflies of Manipur, India (Insecta: Lepidoptera). *Zootaxa*, 4882(1): 1-91. **(IF= 0.949)**

J.S.I. led field sampling (60%); data organization and analysis (90%); identified the materials (80%); and manuscript preparation (90%).

Co-author agreement

Zdenek Faltynek Fric, the supervisor of this thesis and co-author of six presented manuscripts, fully acknowledges the contribution of Jatishwor Singh Irungbam as the first author and his contributions as stated above.



.....

RNDr Zdenek Faltynek Fric

Institute of Entomology, Biology Centre, CAS, Czech Republic

Alexander Schintlmeister, the author of the Chapter III, fully acknowledges the contribution of Jatishwor Singh Irungbam as the second author and his contributions as stated above.

.....

Dr. rer. nat. Alexander Schintlmeister
Museum Witt, München, Germany

Alexey V. Solovyev, the author of the Chapter IV, fully acknowledges the contribution of Jatishwor Singh Irungbam as the second author and his contributions as stated above.

.....

Dr. Alexey V. Solovyev
Ulyanovsk State Pedagogical University, Russia

Table of Contents

GENERAL INTRODUCTION

Grassland habitat with tropical forest at backdrop at Shirui Hill, Manipur, India @JS Irungbam

1. Introduction

Biodiversity is the variety and variability of life forms which is distributed heterogeneously across the Earth (Gaston 2000). Some areas are rich in life forms (for example, moist tropical forests and coral reefs), some are virtually devoid of life (for example, deserts and polar regions), and most fall somewhere in between. Terrestrial biodiversity is usually greater near the equator (Gaston 2000), due to the warm climate and high primary productivity (Field et al. 2009). Biodiversity is richer in the tropics and tropical forest cover less than ten percent of earth's surface and contain about ninety percent of the world's species (Young 2003). Majority of the biodiversity generally tends to cluster in the hotspots (Myers et al. 2000) and has been increasing through time but will be likely to slow in the future as a primary result of human-induced destruction of habitats (Rabosky 2009; Dávalos et al. 2011).

For many ecologists and biogeographers, determining why these differences occur has long been a fundamental objective and constitutes an important, and to many an engrossing challenge (Gaston 2000). The early workers, studying spatial patterns of biodiversity showed that biodiversity richness increases from the poles to the equator, from high elevations to low elevations and from islands to continents (Darwin 1839, 1859; von Humboldt 1849; Wallace 1876, 1878), those patterns being driven by favourable climatic conditions (Wildenow 1805). Indeed, in the past decade has seen an increase of studies documenting broad-scale (geographical) spatial patterns in biodiversity, seeking to explain them, and exploring their implications. Understanding the changes in species diversity and composition along elevational gradients can create powerful insights into the ecological processes that shape the communities. It is useful for identifying the centers of species richness and endemism to prioritize areas for conservation. Understanding these patterns could guide the management of biodiversity and observe the effect of climate change on species richness (Manish et al. 2016; Zhang et al. 2015).

The recent global climate change scenario has already begun to affect the life cycles and geographic ranges of many insects. Elevational increases of species ranges are likely responses to climate warming in the

tropics. Although data are scarce, there are evidence that are taking place in tropical (Pounds et al. 1999; Raxworthy 2008) and temperate (Wilson et al. 2005; Hickling et al. 2006) zones. Macgregor et al. (2019) reported that climate change affected the reproductive cycles of United Kingdom's Lepidoptera by advancing their phenology due to warmer springs, thus increasing the total number of reproductive cycles per year and/or increasing reproductive success within each cycle which leads to consequent population growth and expanding distributions. In many temperate and tropical species, due to warming climate and changes in precipitation, and phenological changes significant poleward shifts of range limits were documented, in even greater numbers (Parmesan 2006; Colwell et al. 2008). Conforming upslope shifts in range boundaries along temperate elevational gradients have also been noticed for both plants and animals (Konvicka et al. 2003). In the tropics, there exists evidence that tropical vertebrates have responded to climate changes by increasing their elevation range in tropical mountains (Pounds et al. 1999; Raxworthy et al. 2008). In temperate regions, multispecies analyses of elevation changes are limited but wherever elevation increases, it appears to be continuing in line with regional temperature increases (Wilson et al. 2005; Hickling et al. 2006). The most considerable studies of elevation change in insects have involved repeated surveys by revisiting the specific sites of previous records to identify possible changes and other taxa (Franco et al. 2006; Chen et al. 2009; Moritz et al. 2008). Unravelling and describing species distributions and diversity, and comprehending the mechanisms shaping these patterns is still one of the main goals in the current research (Hillebrand 2004; Rangel et al. 2018).

2. Lepidoptera as model organism for biodiversity studies

Lepidoptera (Butterflies and moths), with close to 160,000 described extant species (van Nieukerken et al. 2011), are among the best-known and largest groups of insects (i.e., larger are only Hymenoptera, Diptera and Coleoptera) (Grimaldi and Engel 2005). Butterflies are one of the most well-studied groups of insects. They are popular with the public, not simply because many are exceptionally beautiful, very attractive, relatively

easy to identify, with fascinating life cycles, delicate habitat associations, and astonishing interactions with other species, but because they are extraordinarily sensitive to changes in their environment (Dover et al. 2011). For many years, they have been used as model insects (e.g., Warren 1992, Thomas 2005). They are also a valuable environmental indicator group as they react quickly to change, and their presence and abundance do not simply follow vegetation-based indicators (Dennis et al. 2003).

Lepidoptera plays a key role in ecosystem functioning because of their broad range of interactions with other organisms such as herbivores, pollinators, and prey (Kawahara et al. 2019). Most caterpillars of Lepidoptera are primary consumers, comprising a wide spectrum of herbivores on trees, shrubs, forbs, grasses, algae, fungi and lichens; besides, the order includes detritivores and carnivores (Powell et al. 1999; Becerra 2015). Adults either consume liquid substances such as flower nectar, plant saps, juices of rotten fruits or decaying carrion materials, or are simply unable to feed; adult of a few primitive groups scrap plant pollen (Krenn 2010; da Silva et al. 2017). They also serve as an important link within food webs as hosts for parasitoids (Forbes et al. 2018; Narango et al. 2020), substrates for pathogens (Myers and Cory 2015), but also as prey for bats, birds, and many other predators (Fullard and Napoleone 2001; Jacobs et al. 2008; Sam et al. 2017).

Adult Lepidoptera play an essential role as pollinators (MacGregor et al. 2015; Ollerton 2017), and most of the species have specialized host associations with at least a few closely related plants (Novotny et al. 2002; Narango et al. 2020). About 103 nocturnal moths' species from the families Noctuidae, Erebidae and Geometridae were found to carry pollen from 47 insect-pollinated plant species on their bodies, with pollen from Rosaceae, Fabaceae, Apiaceae and Lamiaceae most commonly found (Walton et al. 2020). Lepidoptera also play a leading and close evolutionary interaction with their host plants and their predators (Mikhail et al. 2018). Thus, difference in the structure and diversity of Lepidoptera assemblage can be representative for changes at other trophic levels (Habel et al. 2016; Wagner et al. 2021). Lepidoptera are considered as potential environmental indicators due to its rapid response to changes in climate or vegetation (Sparks et al. 2007; Keret et al. 2020; Kitching 2000).

Geometridae moths have shown upwards elevation shifts on Mt. Kinabalu in responses to the climate change observed in the region, either as a direct physiological response to climate or as a consequence of altered interactions with other species (Chen et al. 2009).

Furthermore, Lepidoptera communities are known to be indicators of habitat changes influencing many other taxa. Their diversities are highly correlated with diversity characteristics of other insects, spiders, but also vertebrates and plants (Barlow et al. 2007; Gardner et al. 2008). They also serve as model for research on mimicry and genetics (Mallet and Hoekstra 2016). And finally, unlike other insects, for Lepidoptera were well developed standardised sampling methods: Pollard transect walks for quantifying relative abundance of individual species (Pollard 1977); the Mark Release-Recapture method, allowing to precisely quantify population sizes, or to measure their dispersal abilities (Turlure et al. 2017); and Time-constrained counts for species richness and abundance (Suman et al. 2021).

Thus, Lepidoptera represent an ideal organism model to study various ecological questions, including biodiversity patterns along ecological and biogeographical gradients.

3. Diversity patterns of biota along elevation in the tropics

The natural layering of ecosystems that occurs at distinct elevations due to varying environmental conditions is known as elevational gradients (Daubenmire 1943). The assortment of habitats along spatial and elevational gradients was reported during the expeditions of geographer Alexander von Humboldt (1799-1804) and Charles Darwin (1831-1836). The important factors in determining altitudinal zones are temperature, humidity, soil composition, and solar radiation, which consequently support different vegetation and animal species (Daubenmire, 1943; Frahm and Gradstein, 1991; Salter et al. 2005). Presently, elevational gradients are among the most powerful "natural experiments' for testing ecological and evolutionary responses of biota to geophysical influences (Körner, 2007). High altitude ecosystems on mountains differ from all other ecosystems as the environment at high altitudes is uniquely harsh.

Variation in species diversity along environmental gradients is a major topic of ecological investigation and has been explained by reference to climate, productivity, biotic interactions, habitat heterogeneity and history (Willig et al., 2004; Qian and Ricklefs, 2004).

Study of biodiversity patterns in elevation gradients are challenging, as abiotic conditions, such as temperature, precipitation, moisture rate and soil, vary quickly with elevation (Marrs et al. 1998; Wolf 1993; Begon et al. 2006). Most of the biodiversity patterns used to linearly decrease along elevation, but numerous recent studies revealed other elevational patterns of biodiversity as well (Rahbek 1995, 2005; McCain and Grytnes 2010). Majority of the elevational gradient studies are found out to be focused on tropics due to the tropical elevational gradients are more varied with the wider range of climatic variations then temperate elevational gradients (Rahbek, 1995). The studies also shows that the maximum biodiversity is reached at a particular middle elevation and depends on the geographical position of the mountains or mountain ranges (Fischer et al. 2011). Kluge et al. (2006) in Costa Rica; Wang et al. (2007) in Tibet; Zhang et al. (2011) in the Qinling Mountains in central China, Mccain (2007) in a temperate climate; Olson (1994) in western Panama; Hausdorf (2006) in Switzerland and Rowe (2009) in Utah shows the similar results of having highest peak of species diversity and richness at mid- elevations. Such a pattern with a peak of biodiversity at a particular elevation is projected as mid-domain effect (Colwell and Hurtt 1994; Colwell et al. 2004) and is the most common one in the tropics (Rahbek 1995).

Similar studies on the patterns in the elevational distribution in species richness has been conducted in the subtropical elevations of Himalayas. Grytnes and Vetaas (2002) observed that in the Nepalese Himalaya the species richness was lower at low and high elevations and they observed highest species richness between 1,500 and 2,500 m and decreases as the elevation increases. Vetaas and Grytnes (2002) observed above 4,000 m, the species richness of vascular plants decreases but the endemism of the species increases in the Nepalese Himalaya. In the Bhabha valley of western Himalaya, Chawla et al. (2008) also observed that species richness decreases along the higher elevational gradient and

endemic plant species increases at higher elevations. These patterns were observed also in the eastern part of Himalayas. Chettri et al. (2010) observed that the peak species richness of reptiles up to 500-1000 m and beyond 3000 m no species. The lizards show the linear declined with the elevation and snakes followed a nonlinear relation peak at 500-1000m. In Sikkim, Acharya and Vijayan (2015) recorded the butterfly species richness shows hump-shaped pattern; highest species richness at 1000 m and sharp decline of species richness up to 3000 m.

4. Patterns of Lepidoptera communities along elevation gradients

A very few studies on the elevation gradients on Lepidoptera are found in comparison to the other taxa. Throughout the world, many studies have been conducted and studied on biodiversity patterns. The patterns depend on the abiotic conditions, such as temperature, precipitation, moisture rate and soil, vary quickly with elevation (Begon et al. 2006; Guo et al. 2013; Zhang et al. 2016). Although biodiversity used to be expected to linearly decrease along elevation, numerous recent studies revealed other elevational patterns of biodiversity as well (Rahbek 1995, 2005; McCain and Grytnes 2010). Species diversity tends to follow four main patterns with rising altitude: decreasing, low plateau, low plateau with mid–elevation peak, and mid–elevation peak of species richness at mid-elevations representing most of the studies (McCain and Grytnes 2010; McCain et al. 2010; Beck et al. 2017). Studies conducted in the Neotropical mountains (Brehm and Fiedler 2003; Brehm et al. 2003, 2005, 2007; Hilt 2005; Hilt and Fiedler 2005; Hilt et al. 2007; Beck and Chey 2008; Fiedler et al. 2008; Pyrcz et al. 2009; Beck et al. 2011; Ignatov et al. 2011; Despland et al. 2012; Molina-Martínez et al. 2013), European mountains (Gutiérrez 1997; Mihoci 2011; Popović et al. 2021), Afrotropical mountains (Axmacher et al. 2004, 2009; Axmacher and Fiedler 2008; Peters et al. 2016; Maicher et al. 2020; Mertens et al. 2021), Australia (Ashton et al. 2011, 2016a; Sam 2011; Odell et al. 2016), and south-eastern Asia (Bhardwaj et al. 2012; Sanyal et al. 2013; Ashton et al. 2016b) support these patterns. These patterns could be explained by several ecological factors, including climate and productivity, species–area relationship, mid–domain effect, effects of ecotone, biotic factors, evolution, and

historical circumstances (Colwell and Lees 2000; Lomolino 2001; McCain 2007; Grytnes and McCain 2007; McCain et al. 2010), but none of the drivers can fully explain the patterns (Beck et al. 2017). The decrease of productivity, plant diversity, and available area (species-area relationship), with increase of extreme conditions probably cause the decrease of Lepidoptera species richness along increasing elevation (Lawton et al. 1987). The mid-altitudinal peak could also be caused by the mid-domain effect, a geometric approach which implies an increasing overlap of species ranges at mid-elevation (Colwell et al. 2005, 2016). However, studies on moths did not reveal the effects of the geometric model on the species richness patterns (Brehm et al. 2007; Beck et al. 2017). Then the mid-altitudinal peak could be simply explained by the favourable conditions at middle elevations (averaged temperature), conditions modulated by the mid-domain effect (Colwell et al. 2016).

5. Manipur Lepidoptera – poorly understood area of Indo-Malayan hotspot

The knowledge on the lepidoptera fauna of Manipur is very limited. There is no definite number of moths and butterflies reported from Manipur so far. Earlier studies on the Lepidoptera fauna of Manipur are recorded by Butler (1885) who has collected butterflies from the Manipur and on the Borders of Assam by Dr George Watt. Butler (1879) and Wood-Mason and de Niceville (1886) have also mentioned records of butterflies from the Cachar district of Assam which is neighbour to Manipur. Only, Tytler (1911-1912, 1914-1915) have extensively collected large number of butterflies from the Naga Hills, and different parts of Manipur (such as Irang river basin, Sebong and Imphal valley). Records on the lepidopterous fauna of Manipur have been reflected in the “Fauna of British India” series of both moths (Hampson, 1892-1896; Bell and Scott, 1937) and butterflies (Bingham, 1905, 1907; Talbot, 1939, 1947).

Several studies have been conducted in the recent past by Zoological Survey of India (ZSI). Expeditions of ZSI to Manipur have recorded many species of i) moths belonging to families Bombycidae, Saturniidae, Arctiidae and Zygaenidae (Bhattacharya, 2004; Gupta, 2004; Majumdar, 2004) and ii) all families of butterflies (106 species) (Gupta,

2004; Mondal and Maulik, 2004; Alfred and Ramakrishna, 2005). Singh et al. (2011) recorded 136 species of butterflies from the Keibul Lamjao National Park, Bishenpur district. Singh and Varatharajan (2015) have listed down 159 species of butterfly in their book published under the guidance of Manipur Biodiversity Board.

Some recent studies lead to the rediscovery and new records of many moths and butterflies in Manipur. Singh and Gogoi (2013) recorded *Pontia daplidice* (Linnaeus, 1758) for the first time in Manipur from Pangei village, just 16 km away from the Imphal valley. Vaidya et al. (2015) reported the range extension of the hawkmoth, *Marumba irata* Joicey and Kaye, 1917 from its previously known distribution range Myanmar, China and at higher elevations of northern Vietnam to the Khonoma, Kohima District of Nagaland and Mao, Senapati district of Manipur. Soibam (2016) recently reported the presence of the IUCN red listed butterfly *Teinopalpus imperialis* Hope, 1843 from the Koubru Hills of Manipur which has been not recorded in Manipur since Tytler (1915). Soibam et al. (2016) also reported *Coladenia indrani uposathra* Fruhstorfer, 1911 as first sighting of the butterfly in Manipur since Tytler (1915) saw the species from Irang River at Tamenglong District and Sebong at Chandel District of Manipur and similarly, with *Apporasa atkinsoni* (Hewitson, [1869]), which was reported by Tytler (1915) from Sebong Village, Manipur, and recently reported from Lokchao Wildlife Sanctuary, Chandel district. Likewise, Irungbam et al. (2020) and Irungbam et al. (2021) reported *Appias galba* (Wallace 1867) and *Amblopala avidiena avidiena* (Hewitson, 1877) as new addition to the Manipur butterfly fauna.

Thus, it is necessary to undertake a study to document the complete fauna of Lepidoptera to understand its species composition of Manipur. Such study is important for filling the gaps in knowledge about the diversity of Lepidoptera fauna of the region.

6. Biodiversity richnes along elevational gradient of the Shirui hill

The state of Manipur is in the North Eastern part of India, surrounded by Indian state of Nagaland on the north, Assam on the west, Mizoram on the south and along the east with Myanmar shares a 352 km long international

border. Situated between latitudes 23°80' N to 25°68' N and longitudes 93°03' E to 94°78' E (Figure 1), Manipur covers a total geographical area of 22,327 km^2 of which 17,418 km^2 (78.01%) is under forest cover. Geographically, Manipur is divided into mountainous hill ranges running north-south abridging the Patkai Hill range and the Lushai Hill range of the extended Arakan Yoma, and a central plain-the valley of Imphal roughly 48 km long and 30 km wide. The hills have elevations ranging from 833 m to 3017 m. At its centre is located the largest Indian freshwater lake (Lake Loktak) in the north-east, covering an area of about 104 km^2. Major forest types in Manipur are Tropical Semi-Evergreen, Dry Temperate forest, Sub-tropical pine and Tropical Moist Deciduous Forests. The state of Manipur is part of the eastern Himalaya Biodiversity Hotspot, which covers parts of Nepal, Bhutan, the northeast Indian states, southeast Tibet (China), and northern Myanmar. It is, like the other parts of north-eastern India, the meeting place of the central Asia and Chinese subdivision of the Palearctic region with the Peninsular India and Malayan subdivision of Oriental region and hence considered very rich in terms of Lepidoptera diversity (Wynther-Blyth 1957).

The Shirui Kashong Peak near Ukhrul is a marvellous hilltop viewpoint located at a height of 2,835 m (24˚N - 25.41˚N; 94˚E - 94.47˚E). Due to its unique diversity of flora and fauna, the area was proposed to conserve as a National Park in 1982 by Government of Manipur (Figure 2.). The proposed park is about 100 km^2 in area and elevation varies from 1,715 m in the foothills to 2,835 m at the Shirui Kashong peak. Rare animals like tiger, leopard, and birds like Blyth s Tragopan and Mrs. Hume s bar-backed pheasant inhabit in the vicinity of the proposed park area. The exotic Shirui lily flower (*Lilium mackliniae*) which is an endangered, blooms on the hilltop during May/June. The area provides the unique opportunity for studying diversity, distribution pattern and seasonal variation in moth assemblages along its variable elevational gradient.

Major forest type in the park area is of East Himalayan wet temperate Forests and major vegetation compose of 5 *Quercus* species (Family Fagaceae) and 7 *Rhododendron* species (Family Ericaceae) at the upper ridges of the mountain in the Park. The other dominating tree species are *Magnolia doltsopa*, *Magnolia cambellii* from Magnoliaceae family;

Pinus kesiya (Khasi Pine) from Pinaceae family; *Castanopsis* species from Fagaceae family; *Phoebe hainesiana* (Bonsum) from Lauraceae family, etc. It offers a combination of high-altitude grasslands and rainforest. A part of the area is quite disturbed due to grazing by large mammals and human activities like agriculture, logging, etc. The area is protected for the IUCN red listed plant *Lilium mackliniae* (Family Liliaceae), thus all the remaining natural habitats are intact.

Figure 1. The map shows the study area, Shirui Hill at Ukhrul district, Manipur, India.

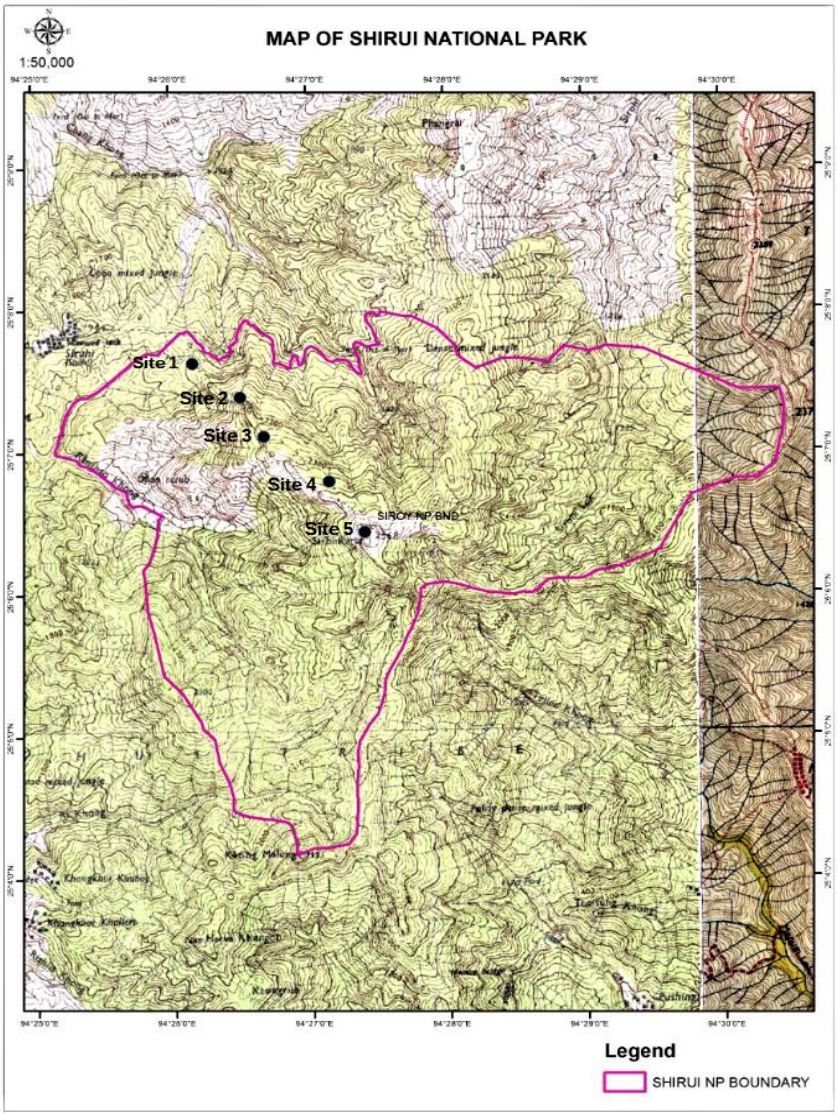


Figure 2. The map shows the area of proposed Shirui National Park situated at Ukhrul district of Manipur, India.

Altogether, these conditions bring an opportunity of a design resembling a long-term experiment in natural conditions. The park is also known for its unique diversity of butterflies, such are IUCN red listed *Bhutanitis lidderdalii*, *Teinopalpus imperialis*, *Papilio machaon* (Papilionidae), *Amblopala avidiena avidiena* (Lycaenidae) and *Callerebia*

suroia (Nymphalidae), but nothing is known about the moth fauna of the region.

7. Aim and scope of the thesis

In this thesis, I focused on the understanding the diversity patterns of moths and butterflies at different elevations in the Himalayan region. Many similar studies have been conducted on the diversity patterns in the western and eastern part of Indian Himalayas, Nepalese and Bhutanese part of Himalayas and Chinese part of Himalayas taking different taxon as model organisms. These studies have provided a clear idea that the elevational diversity patterns of different taxa follow different shapes in the Himalayas, but the most common are mid-elevation peaks or unimodal patterns. The north eastern India harbours huge biodiversity as the region is having a unique fauna due to the conjuncture of the Chinese part of Palearctic region and Indo Malayan realm of fauna. This pattern of studies has never been conducted in this part of India. Thus, it would be interesting to see the results of such studies in the north-eastern part of India.

Firstly, **Chapter I** of the thesis focuses on review on shapes of the diversity patterns shown by the different taxa both plants and animals in the Himalayan region. The results of the review reveal that the most common shape is the unimodal pattern irrespective of taxa studied.

First part of **Chapter II** deals with the diversity patterns studied at Shirui Hill, Manipur on moths as model organism. Our analyses describe the elevational biodiversity patterns along the complete elevational gradient of five families of moths, and describe how these diversity patterns, as well as the elevational ranges of individual family, changes their shape. Parts of the **Chapter II** deals with the faunistic surveys carried out at Shirui Hill, providing a preliminary checklist of moths recorded during the study. A high amount of new regional and country records found in our samples shows the general lack of knowledge on Indian Lepidoptera.

Chapters III and **IV** includes the new faunistic records of species never reported earlier from the Manipur as well as from India. The survey reveals many new moths which are unknown to the science and is supplemented by descriptions of three new species from the family

Limacodidae (2 species) and Notodontidae (1 species) in the current thesis. 10 more new species are identified but awaiting description – Notodontidae (8 new species are identified by Dr Alexander Schintlmeister, Germany), Lasiocampidae (1 new species identified by Dr Siegfried Ihle, Germany) and Crambidae (1 new species identified by Dr Navneet Singh, India)

Chapters V, VI and **VII** provide the complete checklists of the Lappet moths (Lasiocampidae), Hawkmoths (Sphingidae) and Prominent moths (Notodontidae) collected from the Shirui Hill elevational gradient during the study. The checklists provide high turnover of new regional and country records.

Chapter VIII provides the complete checklist of butterflies documented from hills and valleys of Manipur. The study yields many significant discoveries on the butterfly fauna of Manipur. Many significant rediscoveries of rare and endemic butterflies and new faunistic discoveries were made during the study. Thus, we feel that there is necessity to conduct further investigations to record complete butterfly diversity from Manipur. We hope that this paper will form the basis for increased research interest on the butterfly fauna of Manipur, to fill the information gaps that remain.

References

Acharya, B.K. and Vijayan, L. (2015). Butterfly diversity along the elevation gradient of Eastern Himalaya, India. *Ecological Research*, 30: 909–919.

Alfred, J.R.B. and Ramakrishnan (2005). *State Fauna Series 10: Fauna of Manipur. Zoological Survey of India*. pp. 1–16.

Anonymous (1997). *The Wildlife (Protection) Act, 1972 (as amended up to 1993).* 4th updated edn. Natraj Publishers, Dehra Dun, 158pp.

Ashton, L.A., Kitching, R.L., Maunsell, S., Bito, D., and Putland, D. (2011). Macrolepidopteran assemblages along an altitudinal gradient in subtropical rainforest-exploring indicators of climate change. *Memoirs of the Queensland Museum*, 55, 375-389.

Ashton, L.A., Nakamura, A., Basset, Y., Burwell, C.J., Cao, M., Eastwood, R., Odell, E., et al. (2016a). Vertical stratification of moths across elevation and latitude. *Journal of Biogeography*, 43, 59-69.

Ashton, L.A., Odell, E.H., Burwell, C.J., Maunsell, S.C., Nakamura, A., et al. (2016b). Altitudinal patterns of moth diversity in tropical and subtropical Australian rainforests. *Austral Ecology*, 41, 197-208.

Axmacher, J.C., Holtmann, G., Scheuermann, L., Brehm, G., Müller-Hohenstein, K., et al. (2004). Diversity of geometrid moths (Lepidoptera: Geometridae) along an Afrotropical elevational rainforest transect. *Diversity and Distributions*, 10, 293-302.

Axmacher, J.C., and Fiedler, K. (2008). Habitat type modifies geometry of elevational diversity gradients in geometrid moths (Lepidoptera Geometridae) on Mt Kilimanjaro, Tanzania. *Tropical Zoology*, 21, 243-251.

Axmacher, J.C., Brehm, G., Hemp, A., Tünte, H., Lyaruu, H.V., et al. (2009). Determinants of diversity in afrotropical herbivorous insects (Lepidoptera: Geometridae): plant diversity, vegetation structure or abiotic factors?. *Journal of Biogeography*, 36, 337-349.

Barlow, J., Mestre, L.A., Gardner, T.A., and Peres, C.A. (2007). The value of primary, secondary and plantation forests for Amazonian birds. *Biological Conservation*, 136, 212-231.

Becerra, J.X. (2015). On the factors that promote the diversity of herbivorous insects and plants in tropical forests. *Proceedings of the National Academy of Sciences*, 112(19): 6098-6103.

Beck, J., and Chey, V.K. (2008). Explaining the elevational diversity pattern of geometrid moths from Borneo: a test of five hypotheses. *Journal of Biogeography*, 35, 1452-1464.

Beck, J., Brehm, G., and Fiedler, K. (2011). Links between the environment, abundance and diversity of Andean moths. *Biotropica*, 43, 208-217.

Beck, J., McCain, C.M., Axmacher, J.C., Ashton, L.A., Bärtschi, F., Brehm, G., et al. (2017). Elevational species richness gradients in a hyperdiverse insect taxon: a global meta-study on geometrid moths. *Global Ecology and Biogeography*, 26, 412-424.

Begon, M., Townsend, C.R., and Harper, J.L. (2006). *Ecology: from individuals to ecosystems*. Blackwell Publishing, Victoria, Australia.

Bell, T.R.D. and Scott, F.B. (1937). *The Fauna of British India, including Ceylon and Burma. Moths. Vol. 5 (Sphingidae).* Taylor and Francis Ltd, London, 5: 280 (key), 282.

Bhattacharya, D.P. (2004). *Insecta: Lepidoptera: Zygaenidae. In Eds. Editor-Director (2004) State Fauna Series 10: Fauna of Manipur, Part-2 (Insects).* Zoological Survey of India, Kolkata. 591-595 pp.

Bingham, C.T. (1905-1907). *The Fauna of British India, including Ceylon and Burma. (Butterflies). Vol. 1 and 2.* Taylor and Francis Ltd, London.

Bonebrake, T.C., Ponisio, L.C., Boggs, C.L., and Ehrlich, P.R. (2010). More than just indicators: a review of tropical butterfly ecology and conservation. *Biological Conservation*, 143(8): 1831-1841.

Brehm, G., and Fiedler, K. (2003). Faunal composition of geometrid moths changes with altitude in an Andean montane rain forest. *Journal of Biogeography*, 30, 431-440.

Brehm, G., Homeier, J., and Fiedler, K. (2003). Beta diversity of geometrid moths (Lepidoptera: Geometridae) in an Andean montane rainforest. *Diversity and Distributions*, 9, 351-366.

Brehm, G., Pitkin, L.M., Hilt, N., and Fiedler, K. (2005). Montane Andean rain forests are a global diversity hotspot of geometrid moths. *Journal of Biogeography*, 32, 16211627.

Brehm, G., Colwell, R.K., and Kluge, J. (2007). The role of environment and mid-domain effect on moth species richness along a tropical elevational gradient. *Global Ecology and Biogeography*, 16, 205-219.

Butler, A.G. (1879). On a collection of Lepidoptera from Cachar. *Transactions of the Entomological Society of London* :1–8.

Butler, A.G. (1885). On a Collection of Lepidoptera made at Manipur and on the Borders of Assam by Dr. George Watt. *Annals and Magazine of Natural History including Zoology, Botany and Geology XVI*: 298–310+8pls.

Chawla, A., S. Rajkumar, K.N. Singh, B. Lal and Singh, R.D. (2008). Plant Species Diversity along an Altitudinal Gradient of Bhabha Valley in Western Himalaya. *Journal of Mountain Science*, 5: 157-177.

Chen, I.C., Shiu, H.J., Benedick, S., Holloway, J.D., Chey, V.K., Barlow, H.S., et al. (2009) Elevation increases in moth assemblages over 42 years on a tropical mountain. *Proceedings of the National Academy of Sciences*, 106(5): 1479– 1483.

Chettri, B., Bhupathy, S., and Acharya, B.K. (2010). Distribution pattern of reptiles along an eastern Himalayan elevation gradient. India. *Acta Oecologica*, 36: 16-22.

Colwell, R. K. and Hurtt, G.C. (1994). Non biological gradients in species richness and a spurious Rapoport effect. *The American Naturalist*, 144: 570-595.

Colwell, R.K., Rahbek, C. and Gotelli, N.J. (2004). The Mid- Domain Effect and species richness patterns: What we learned so far? *The American Naturalist*, 163: E1-E23.

Colwell, R.K., Rahbek, C., and Gotelli, N.J. (2005). The mid-domain effect: there's a baby in the bathwater. *The American Naturalist*, 166, 149-154.

Colwell, R.K., Brehm, G., Cardelús, C.L., Gilman, A.C., and Longino, J. T. (2008). Global warming, elevational range shifts, and lowland biotic attrition in the Wet Tropics. *Science*, 322(5899), 258– 261.

Colwell, R.K., Gotelli, N.J., Ashton, L.A., Beck, J., Brehm, G., Fayle, T.M., et al. (2016). Midpoint attractors and species richness: modelling the interaction between environmental drivers and geometric constraints. *Ecology Letters*, 19, 1009-1022.

Daubenmire, R.F. (1943). "Vegetational Zonation in the Rocky Mountains". Botanical Review. 9(6): 325–393. doi:10.1007/BF02872481

Dar, A. A. and Jamal, K. (2021). Moths as ecological indicators: A review. *Munis Entomology and Zoology*, 16(2): 833-839.

Darwin, C. (1839). *Journal of the Research into the Geology and Natural History of Various Countries Visited by H.M.S. Beagle, under the Command of Captain Fitzroy, R.N. from 1832 to 1836*. Henry Colburn, London.

Darwin, C. (1859). *On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life.* John Murray, London.

da Silva, D.M., de Freitas Bueno, A., Andradem, K., dos Santos Stecca, C., et al. (2017). Biology and nutrition of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) fed on different food sources. *Scientia Agricola*, 74(1): 18-31.

Dávalos, L.M., Bejarano, A.C., Hall, M.A., Correa, H.L., Corthals, A. and Espejo, O.J. (2011). Forests and drugs: coca-driven deforestation in tropical biodiversity hotspots. *Environmental Science and Technology*, 45(4):1219-27.

Dennis, R.L.H., Shreeve, T.G. and Van Dyck, H. (2003). Towards a functional resource-based concept for habitat: A butterfly biology viewpoint. *Oikos*, 102, 417–426.

Despland, E., Humire, R., and Martín, S.S. (2012). Species richness and phenology of butterflies along an altitude gradient in the desert of Northern Chile. *Arctic, Antarctic, and Alpine research*, 44, 423-431.

Doherty, W. (1889). Notes on Assam butterflies. *Journal of Bombay Natural History Society, Bombay*. 455p.

Dover, J., Warren, M. and Shreeve, T. (2011). *Lepidoptera Conservation in a Changing World.* Springer Netherlands. 383pp.

Evans, W.H. (1927). *The Identification of Indian Butterflies*. Bombay Natural History Society, Bombay, x+302pp+32pl.

Evans, W.H. (1932). *The Identification of Indian Butterflies. 2nd Revised Edition*. Bombay Natural History Society, Bombay, x+454pp+32pl.

Fattorini, S., Di Biase, L., and Chiarucci, A. (2019). Recognizing and interpreting vegetational belts: New wine in the old bottles of a von Humboldt's legacy. *Journal of Biogeography*, 46(8): 1643–1651.

Fiedler, K., Brehm, G., Hilt, N., Sussenbach, D., and Hauser, C.L. (2008). Variation of diversity patterns across moth families along a tropical altitudinal gradient. *Ecological Studies*, 198, 167.

Field, R., Hawkins, B.A., Cornell, H.V., Currie, D.J., Diniz-Filho, J.A.F., et al. (2009). Spatial species-richness gradients across scales: a meta-analysis. *Journal of Biogeography*, 36(1): 132-147.

Fischer, A., M. Blaschke and Bässler, C. (2011). Altitudinal gradients in biodiversity research: the state of the art and future perspectives under climate change aspects. *Waldökologie, Landschaftsforschung und Naturschutz Heft*, 11: 35–47.

Frahm, J-P. and Gradstein, S.R. (1991). An Altitudinal Zonation of Tropical Rain Forests Using Bryophytes. *Journal of Biogeography*, 18(6): 669–678.

Franco, A.M.A., Hill, J.K., Kitschke, C., Collingham, Y.C., Roy, D.B., Fox, R., Huntley, B. and Thomas, C.D. (2006). Impacts of climate warming and habitat loss on extinctions at species' low-latitude range boundaries. *Global Change Biology*, 12: 1545-1553.

Fullard, J.H. and Napoleone, N. (2001). Diel flight periodicity and the evolution of auditory defences in the Macrolepidoptera. *Animal Behavior*, 62: 349-368.

Gardner, T.A., Barlow, J., Araujo, I.S., Ávila-Pires, T.C., Bonaldo, A.B., Costa, J.E., Espostio, M.C., et al. (2008). The cost-effectiveness of biodiversity surveys in tropical forests. *Ecology Letters*, 11, 139150.

Gaston, K. (2000). Global patterns in biodiversity. Nature, 405: 220–227.

Grimaldi, D. and Engel, M.S. (2005). *Evolution of the Insects.* Cambridge Univ Press, Cambridge, UK. p. 772.

Guo, Q., Kelt, D., Sun, Z. Liu, H., Hu, L., Ren, H. and Wen, J. (2013). Global variation in elevational diversity patterns. *Scientific Reports*, 3:3007.

Gupta, I.J. (2004). *Insecta: Lepidoptera: Nymphalidae and Saturniidae*. In Eds. Editor-Director (2004) *State Fauna Series 10: Fauna of Manipur, Part-2 (Insects). Zoological Survey of India, Kolkata*. 541-579.

Grytnes, J.A., and Vetaas, O.R. (2002). Species Richness and Altitude: A Comparison between Null Models and Interpolated Plant Species Richness along the Himalayan Altitudinal Gradient, Nepal. *The American Naturalist,* 159: 294-304.

Grytnes, J.A., and McCain, C.M. (2007). *Elevational trends in biodiversity*. Encyclopedia of biodiversity, 2, 1-8.

Habel, J.C., Segerer, A., Ulrich, W., Torchyk, O., Weisser, W.W. and Schmitt, T. (2016), Butterfly community shifts over two centuries. *Conservation Biology*, 30: 754-762.

Hampson, G.F. (1892-1896). *Fauna of British India including Ceylon and Myanmar. Moths Vol. I to IV*. Taylor and Francis, London.

Hausdorf, B. (2006). Latitudinal and altitudinal diversity patterns and Rapoport effects in north-west European land snails and their causes. *Biological Journal of the Linnean Society*, 87: 309-323.

Hickling, R., Roy, D.B., Hill, J.K., Fox, R. and Thomas, C.D. (2006). The distributions of a wide range of taxonomic groups are expanding polewards. *Global Change Biology*, 12, 450– 455.

Hilt, N. and Fiedler, K. (2005). Diversity and composition of Arctiidae moth ensembles along a successional gradient in the Ecuadorian Andes. *Diversity and Distributions*, 11, 387-398.

Hilt, N. and Fiedler, K. (2006). Arctiid moth ensembles along a successional gradient in the Ecuadorian montane rain forest zone: how different are subfamilies and tribes?. *Journal of Biogeography*, 33, 108-120.

Hilt, N., Brehm, G. and Fiedler, K. (2007). Temporal Dynamics of Rich Moth Ensembles in the Montane Forest Zone in Southern Ecuador. *Biotropica*, 39, 94-104.

Ignatov, I.I., Janovec, J.P., Centeno, P., Tobler, M.W., Grados, J., Lamas, G., and Kitching, I.J. (2011). Patterns of richness, composition, and distribution of sphingid moths along an elevational gradient in the Andes-Amazon region of Southeastern Peru. *Annals of the Entomological Society of America,* 104, 68-76.

Irungbam, J.S., Huidrom, H. and Fric, Z.F. (2021). Sighting of Chinese Hairstreak *Amblopala avidiena avidiena* (Hewitson, 1877) (Lycaenidae: Theclinae) from Shirui Hill: A new record for Manipur, India. *Journal of Bombay Natural History Society*.

Irungbam, J.S., Huidrom, H. and Elangbam, P. (2020). Addition of the butterfly Appias galba (Wallace, 1867) to the fauna of Manipur, India. *Bionotes,* 22(3): 112-113.

Jacobs, D.S., Ratcliffe, J.M., and Fullard, J.H. (2008). Beware of bats, beware of birds: the auditory responses of eared moths to bat and bird predation. *Behavioral Ecology*, 19(6): 1333–1342.

Kawahara, A.Y., Plotkin, D., Espeland, M., Meusemann, K., Toussaint, E.F.A., et al. (2019). Phylogenomics reveals the evolutionary timing and pattern of butterflies and moths. *Proceedings of the National Academy of Sciences*, 116(45): 22657-22663.

Keret, N.M., Mutanen, M.J., Orell, M.I., Itamies, J.H., and Valimaki, P.M. (2020). Climate change-driven elevational changes among boreal nocturnal moths. *Oecologia*, 192(4): 1085–1098.

Kitching, R., Orr, A., Thalib, L., Mitchell, H., Hopkins, M. and Graham, A. (2000). Moth assemblages as indicators of environmental quality in remnants of upland Australian rain forest. *Journal of Applied Ecology*, 37(2): 284-297.

Kluge, J., Kessler, M., and Dunn, R. (2006). What drives elevational patterns of diversity? A test of geometric constraints, climate and species pool effects for pteridophytes on an elevational gradient in Costa Rica. *Global Ecology and Biogeography*, 15: 358-371.

Konvička M., Maradová M., Beneš J., Fric Z., and Kepka P. (2003) Uphill shifts in distribution of butterflies in the Czech Republic: effects of changing climate detected on a regional scale. *Global Ecology and Biogeography*, 12: 403-410.

Korner, C. (2007). The use of “altitude” in ecological research. *Trends in Ecology and Evolution,* 22(11): 569-574.

Krenn, H.W. (2010). Feeding mechanisms of adult Lepidoptera: structure, function, and evolution of the mouthparts. *Annual Review of Entomology,* 55, 307–327.

Lawton, J.H., MacGarvin, M., and Heads, P.A. (1987). Effects of altitude on the abundance and species richness of insect herbivores on bracken. *The Journal of Animal Ecology,* 147-160.

Lomolino, M.V. (2001). Elevation gradients of species-density: historical and prospective views. *Global Ecology and Biogeography,* 10, 3-13.

Macgregor, C.J., Thomas, C.D., Roy, D.B. Beaumont, M.A., Bell, J.R., Brereton, T., Bridle, J.R., et al. (2019). Climate-induced phenology shifts linked to range expansions in species with multiple reproductive cycles per year. *Nature Communications,* 10, 4455.

Marrs, R.H., Proctor, J., Heaney, A., and Mountford, M.D. (1988). Changes in soil nitrogen-mineralization and nitrification along an altitudinal transect in tropical rain forest in Costa Rica. *The Journal of Ecology*, 76, 466-482.

Manish, K., Telwala, Y., Nautiyal, D.C., and Pandit, M.K. (2016). Modelling the impacts of future climate change on plant communities in the Himalaya: a case study from Eastern Himalaya, India. *Modeling Earth Systems and Environment,* 2: 92(1-12).

Maicher V., Sáfián S., Murkwe M., Delabye S., Przybylowicz L., et al. (2020) Seasonal shifts of biodiversity patterns and species’ elevation ranges of butterflies and moths along a complete rainforest elevational gradient on Mount Cameroon. *Journal of Biogeography*, 47: 342-354.

Majumdar, M. (2004). *Insecta: Lepidoptera. In Eds. Editor-Director (2004), State Fauna Series 10: Fauna of Manipur, Part-2 (Insects).* Zoological Survey of India, Kolkata. 515-530.

Magurran, A.E., and McGill, B.J. (2011). *Biological diversity: frontiers in measurement and assessment.* Oxford University Press.

Mallet, J., and Hoekstra, H.E. (2016). Ecological Genetics: A Key Gene for Mimicry and Melanism. *Current Biology*, 26(17): R802-R804,

McCain, C.M. (2007). Could temperature and water availability drive elevational species richness patterns? A global case study for bats. *Global Ecology and Biogeography*, 16: 1-13.

McCain, C.M., and Grytnes, J.A. (2010). Elevational gradients in species richness. *eLS*.

Mertens, J.E.J., Brisson, L., Janeček, Š. Klomberg Y., Maicher V., et al. (2021) Elevational and seasonal patterns of butterflies and hawkmoths in plant-pollinator networks in tropical rainforests of Mount Cameroon. *Scientific Reports*, 11, 9710.

Molina-Martínez, A., León-Cortés, J.L. and Regan, H.M. (2013). Climatic and geometric constraints as driving factors of butterfly species richness along a Neotropical elevational gradient. *Journal of Insect Conservation*, 17, 1169–1180.

Mondal, D.K. and R.D. Maulik (2004). *State Fauna Series 10: Fauna of Manipur*. In Eds. Editor (2004) *State Fauna Series 10: Fauna of Manipur, Part-2 (Insects)*. Zoological Survey of India. pp. 581–590.

Mihoci, I., Hršak, V., Kučinić, M., Stanković, M.V., Delić, A., and Tvrtković, N., (2011). Butterfly diversity and biogeography on the Croatian karst mountain Biokovo: Vertical distribution and preference for altitude and aspect. *European Journal of Entomology*, 108: 623–633.

Mikhail, A., Lewis, J.E., and Yack, J.E. (2018). What does a butterfly hear? Physiological characterization of auditory afferents in Morpho peleides (Nymphalidae). *Journal of Comparative Physiology A*, 204, 791-799.

Myers, N., Mittermeier, R. A., Mittermeier, C. G. Da Fonseca, G. A. B. and Kent, J., (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403(6772): 853–858.

Myers, J.H. and Cory, J.S. (2016). Ecology and evolution of pathogens in natural populations of Lepidoptera. *Evolutionary Applications*, 9(1): 231-247.

Narango, D.L., Tallamy, D.W. and Shropshire, K.J. (2020). Few keystone plant genera support the majority of Lepidoptera species. *Nature Communications*, 11, 5751.

Novotny, V., Miller, S.E., Basset, Y., Cizek, L., Drozd, P., Darrow, K., and Leps, J. (2002). Predictably simple: assemblages of caterpillars (Lepidoptera) feeding on rainforest trees in Papua New Guinea. *Proceedings of the Royal Society of London*, 269, 2337 –2344.

Odell, E.H., Ashton, L.A., and Kitching, R.L. (2016). Elevation and moths in a central eastern Queensland rainforest. *Austral Ecology*, 41, 133-144.

Ollerton, J. (2017). Pollinator Diversity: Distribution, Ecological Function, and Conservation. *Annual Review of Ecology, Evolution, and Systematics*, 48:1, 353-376

Olson, D.M. (1994). The distribution of leaf litter invertebrates along a neotropical altitudinal gradient. *Journal of Tropical Ecology*, 10: 129-150.

Parmesan, C. (2006). Ecological and Evolutionary Responses to Recent Climate Change. *Annual Review of Ecology, Evolution, and Systematics*, 37:1, 637-669.

Parsons, R.E. and K. Cantlie. (1948). The butterflies of the Khasia and Jaintia hills, Assam. *Journal of the Bombay Natural History Society*, 47: 498–522.

Peters, M.K., Hemp, A., Appelhans, T., Behler, C., Classen, A., Detsch, F., Ensslin, A., Ferger, S.W., et al. (2016). Predictors of elevational biodiversity gradients change from single taxa to the multi-taxa community level. *Nature Communications*, 7, 1-11.

Pollard, E, and Yates, T.J. (1993). *Monitoring Butterflies for Ecology and Conservation.* Chapman and Hall, London, UK.

Popović, M., Micevski, B. and Verovnik, R. (2021). Effects of elevation gradient and aspect on butterfly diversity on Galičica Mountain in the Republic of Macedonia (south–eastern Europe). *Animal Biodiversity and Conservation*, 44.1: 67–78,

Pounds, J.A., Fogden, M.P.L. and Campbell, J.H. (1999). Biological response to climate change on a tropical mountain. *Nature*, 398:611–615.

Powell, J.A., Mitter, C. and Farrell, B. (1999). *20. Evolution of Larval Food Preferences*. – In: Kristensen, N.P. (Ed.), *Lepidoptera, Moths*

and Butterflies. Volume 1: Evolution, Systematics, and Biogeography. Walter de Gruyter, Berlin and New York. 403 –422 pp.

Pyrcz, T.W., Wojtusiak, J., and Garlacz, R. (2009). Diversity and distribution patterns of Pronophilina butterflies (Lepidoptera: Nymphalidae: Satyrinae) along an altitudinal transect in north-western Ecuador. *Neotropical Entomology*, 38(6): 716-726.

Qian, H. and Ricklefs, R.E. (2004). Taxon richness and climate in angiosperms: is there a globally consistent relationship that precludes region effects? *The American Naturalist*, 163, 773–779.

Rabosky, D. L. (2009). Ecological limits and diversification rate: alternative paradigms to explain the variation in species richness among clades and regions. *Ecology Letters*, 12(8): 735–743.

Rahbek, C. (2005). The role of spatial scale and the perception of large-scale speciesrichness patterns. *Ecology Letters*, 8, 224-239.

Raxworthy, C.J., pearson, R.G., Rabibisoa, N., Rakotondrazafy, A.M., Ramanamanjato, J.-B., et al. (2008), Extinction vulnerability of tropical montane endemism from warming and upslope displacement: a preliminary appraisal for the highest massif in Madagascar. *Global Change Biology*, 14: 1703-1720.

Rahbek, C. (1995). The elevational gradient of species richness: a uniform pattern? *Ecography*, 18: 2, 200–205.

Robinson, G.S., K.T. Tuck and M. Shaffer (1994). *A Field Guide to the Smaller Moths of South-East Asia.* The Nature History Museum, London, 7-17pp+32pls.

Rowe, R.J. (2009). Environmental and geometric drivers of small mammal diversity along elevational gradients in Utah. *Ecography*, 32: 411-422.

Rosenzweig, M.L. (1995). *Species Diversity in Space and Time*. Cambridge University Press. 435 pp.

Salter, C., Hobbs, J., Wheeler, J. and Kostbade, J. (2005). *Essentials of World Regional Geography.* 2nd Edition. New York: Harcourt Brace. pp. 464–465.

Sam, K., Koane, B., Jeppy, S., Sykorova, J. and Novotny, V. (2017). Diet of land birds along an elevational gradient in Papua New Guinea. *Scientific Reports*, 7, 1-10.

Sanyal A.K., Uniyal V., Chandra K. and Bhardwaj M. (2013). Diversity, distribution pattern and seasonal variation in moth assemblages along altitudinal gradient in Gangotri landscape area, Western Himalaya, Uttarakhand, India. *Journal of Threatened Taxa*, 5(2): 3646-3653.

Singh, I.J. and Gogoi, M.J. (2013). A New Range Record for the Bath White *Pontia daplidice* Linnaeus 1758 (Lepidoptera: Pieridae) for North East India. *Bionotes*. 15(2): 59-60.

Singh, M.I., Gupta, A. and Varatharaja. R. (2011). Butterfly fauna of the Keibul Lamjao National Park, Manipur, north east India. *Current Science,* 101(6): 719–721.

Singh, M.I., and Varatharaja, R. (2015). *Butterflies of Manipur*. Manipur Biodiversity Board, Imphal, Manipur.

Smilauer, P., and Leps, J. (2014). *Multivariate Analysis of Ecological Data using CANOCO 5*. Cambridge University Press.

Soibam, B.S. (2016). Recent sightings of Kaiser-I-Hind *Teinopalpus imperialis* Hope, 1843 (Lepidoptera: Teinopalpani) from Manipur, India. *Journal of Threatened Taxa*, 8(6): 8930–8933.

Soibam, B.S., Huidrom, H. and Irungbam, J.S. (2016). A century later: Tricolored Pied Flat *Coladenia indrani uposathra* Fruhstorfer, 1911 (Hesperiidae: Pyrginae) and Crenulate Oakblue *Apporasa atkinsoni* Hewitson, 1869 (Lycaenidae: Theclinae) reported from Manipur, India. *Journal of Threatened Taxa,* 8(7): 9030–9033.

South, R. (1913). A list of butterflies collected by Captain F.M. Bailey in western China, south-eastern Tibet, and the Mishmi Hills, 1911. *Journal of the Bombay Natural History Society*, 22: 345–615.

Sparks, T.H., Dennis, R.L.H., Croxton, P.J. and Cade, M. (2007). Increased migration of Lepidoptera linked to climate change. *European Journal of Entomology*, 104: 139–143

Suman, A., Ravikanthachari, N. and Kunte, K. (2021). A comparison between time-constrained counts and line transects as methods to estimate butterfly diversity in tropical habitats. *bioRxiv*,

Talbot, G. (1939-1947). *The Fauna of British India, including Ceylon and Burma: Butterflies, Vol. 1 and 2*. Taylor and Francis, London, 506pp.

Thomas, J.A. (2005). Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups. *Philosophical Transactions of the Royal Society B.* 360, 339–357.

Trivellone, V., Bougeard, S., Giavi, S., Krebs, P., Balseiro, D., Dray, S., and Moretti, M. (2017). Factors shaping community assemblages and species co-occurrence of different trophic levels. *Ecology and Evolution*, 7(13): 4745–4754.

Turlure, C, Pe'er, G, Baguette, M, and Schtickzelle, N. (2018). A simplified mark–release–recapture protocol to improve the cost effectiveness of repeated population size quantification. *Methods in Ecology and Evolution,* 9(3): 645– 656.

Tytler, H. C. (1911-1912). Notes on butterflies from the Naga Hills. Part I and II. *Journal of the Bombay Natural History Society*.

Tytler, H. C. (1914-1915). Notes on some new and interesting butterflies from Manipur and the Naga Hills. Part I to III. *Journal of the Bombay Natural History Society.*

Vaidya, A., H. Huidrom and I. J. Singh. (2015). An addition to the known range of *Marumba irata* Joicey and Kaye, 1917 (Lepidoptera: Sphingidae) in north-eastern India. *Journal of Threatened Taxa*, 7(11): 7831–7832.

Van Nieukerken, E.J., Kaila, L., Kitching, I.J., Kristensen, N.P., Lees, D.C., Minet, J., et al. (2011). Order Lepidoptera Linnaeus, 1758. In: Zhang, Z.-Q. (Ed.) Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness. *Zootaxa*, 3148, 212-221.

Vetaas, O.R. and Grytnes, J.A. (2002). Distribution of vascular plant species richness and endemic richness along the Himalayan elevation gradient in Nepal. *Global Ecology and Biogeography*, 11: 291-301.

Von Humboldt, A. (1849). *Aspects of nature, in different lands and different climates; with scientific elucidations.* Lea and Blanchard.

Wagner, D.L., Fox, R., Salcido, D.M., and Dyer, L.A. (2021). A window to the world of global insect declines: Moth biodiversity trends are complex and heterogeneous. *Proceedings of the National Academy of Sciences*, 118 (2) e2002549117.

Wallace, A.R. (1876). *The geographical distribution of animals.* 2 volumes. Macmillan, London.

Wallace, A.R. (1878). *Tropical nature and other essays*. Macmillan, New York. pp. 357.

Walton, R.E., Sayer, C.D., Bennion, H., and Axmacher, J.C. (2020). Nocturnal pollinators strongly contribute to pollen transport of wildflowers in an agricultural landscape. *Biology Letters*, 16(5): 20190877.

Warren, M. S. (1992). *"The conservation of British butterflies" in The Ecology of Butterflies in Britain.* R. L. H. Dennis, Ed., Oxford University Press, New York, NY), pp. 246–274.

Wang, Z., Tang, Z. and Fang, J. (2007): Altitudinal patterns of seed plant richness in the Gaolingong Mountains, south-east Tibet, China. *Diversity and Distribution,* 13: 845-854.

Willdenow, K.L. (1805). *The principles of botany, and vegetable physiology.* Blackwood, Cadell and Davies, London. p. 492.

Willig, M.R., D.M. Kaufman and R.D. Stevens. (2003). Latitudinal gradients of biodiversity: pattern process, scale and synthesis. *Annual Review of Ecology, Evolution, and Systematics*, 34, 273–309.

Wilson, R.J., Gutiérrez, D., Gutiérrez, J., Martínez, D., Agudo, R. and Monserrat, V.J. (2005), Changes to the elevational limits and extent of species ranges associated with climate change. *Ecology Letters*, 8: 1138-1146.

Wilson, R.J., Gutiérrez, D., Gutiérrez, J., Martínez, D., Agudo, R., and Monserrat, V.J. (2005). Changes to the elevational limits and extent of species ranges associated with climate change. *Ecology Letters*, 8, 1138–1146.

Wolf, J.H. (1993). Diversity patterns and biomass of epiphytic bryophytes and lichens along an altitudinal gradient in the northern Andes. *Annals of the Missouri botanical garden*, 928-960.

Wynter-Blyth, M.A. (1957). *Butterflies of the Indian Region.* Bombay Natural History Society, Bombay. 523pp.

Young, A. (2003). Global Environmental Outlook 3 (GEO-3): Past, Present and Future Perspectives. *The Geographical Journal*, 169, p. 120.

Zenker, M.M., DeVries, P.J., Penz, C.M., Teston, J.A., Freitas, A.V.L. and Pie, M.R. (2015). Diversity and composition of Arctiinae moth assemblages along elevational and spatial dimensions in Brazilian Atlantic Forest. *Journal of Insect Conservation*, 19, 129–140.

Zhang, Q.M., Wang, D.X. and Fischer, A. (2011). Vegetation recording in forests: comparison of the Chinese and European approaches. *Archives of Biological Sciences*, 63: 469-476.

Zhang, Z., He, J.S., Li, J. and Tang, Z. (2015). Distribution and conservation of threatened plants in China. *Biological Conservation*, 192: 454–460.

Zhang W, Huang D, Wang R, Liu J, and Du N. (2016). Altitudinal patterns of species diversity and phylogenetic diversity across temperate mountain forests of Northern China. *PLoS ONE*. 11(7):e0159995.

The elevational gradient of Shirui Hill where the study was conducted. © Jatishwor Singh Irungbam

CHAPTER I

Do shapes of elevational gradients of species richness depend on vertical range studied? The case of Himalayas

[1,2]Jatishwor S. Irungbam, [2]Alena B. Sucháčková, [1,2]Martin Konvička and [2]Zdenek F. Fric

Manuscript

Do shapes of elevational gradients of species richness depend on vertical range studied? The case of Himalayas

[1,2]Jatishwor S. Irungbam, [2]Alena B. Sucháčková, [1,2]Martin Konvička and [2]Zdenek F. Fric

[1] Faculty of Science, University of South Bohemia, Branisovská 1760, CZ-37005, České Budějovice, Czech Republic.

[2] Institute of Entomology, Biology Center CAS, Branisovská 1160/31 CZ-37005, České Budějovice, Czech Republic.

[*]Corresponding author

Abstract

We retrieved shapes of elevational species richness gradients (unimodal, decreasing, increasing) from 64 publications, studying Himalayan elevation patterns. We covered both plants and animals, and tested the hypothesis that unimodal gradients, explicable by the geometric mid-domain effect, prevail in the mountains, whereas decreasing or increasing gradients result from studying only short sections of entire altitudinal ranges. Multivariate canonical correspondence analysis was used to relate gradient shapes to their altitude ranges, geography positions, and taxa studied. Across taxa, most of the Himalayan altitudinal gradient display a unimodal shape, with a peak of diversity situated at ca 2500 m a.s.l. for plants, and 2200 m a.s.l. for animals. The gradient shapes were attributable to three intercorrelated predictors: vertical range, maximum elevation, and mean elevation of the gradients. Studies covering sufficiently broad altitudinal range returned unimodal gradients. Studies from the Earth's highest mountain range reveal that surveys covering substantial parts of the elevational range of the mountains result in unimodal elevational gradients, whereas declining or increasing species richness gradients result from incomplete elevation range sampling.

Keywords: Altitude, biogeography, biodiversity gradients, mid-domain effect, mountain biota, unimodal pattern.

Changing species richness, diversity, and community composition with increasing elevation represents a major biogeography gradient on the Earth. It has large effects on biota, as it shapes both plant and animal morphology[1,2], physiology[3], activity patterns [4], reproduction modes[5], spatial distribution[6,7], and diversity and abundance[1]. In this context, the study of biodiversity changes along elevational gradients has offered many opportunities to understand efficiently the processes involved over small spatial scales, while preventing confusion between historical and biogeographical effects between localities[1,8].

Species richness along elevation gradient may: 1) decrease towards higher elevations, or 2) follow a unimodal (hump-shaped) pattern with a peak around middle elevations, or 3) increase towards higher elevations (Figure 1) [9-11]. Decreasing richness with elevation is mechanistically attributable to decreasing temperatures[12] or changing precipitation[13,14], and generally lower net primary productivity[15-17]. In turn, increasing richness reflects the reverse of these mechanisms for cold-adapted species[18,19]. Unimodal patterns are most frequently attributed to the geometry of mountain environments. If species preferences for particular elevations are distributed randomly, and the number of species per elevational band is affected by the species area relationship, the overlaps of species elevational distribution will be highest in a central elevation, resulting in a mid-domain effect[20-22]. Complementarily, if the high and low elevations host diverse biotas with special adaptations and different evolutionary histories, an overlap zone in mid-elevations may appear as hosting diversity peaks[23,24].

Although there may not be a common pattern applicable to all sorts of organisms, it should be kept in mind that elevation gradient studies conducted so far differed in the vertical spans surveyed, different diversity measures, and sampling methods. Nogués-Bravo et al.[25] observed a decisive effect of scale on the shape of species richness patterns, so that studies covering complete elevational ranges of mountains returned unimodal, whereas those only covering upper elevations returned decreasing patterns. Given that a general unimodal pattern appears as a near-linear relationship on short gradients (Figure 1)[26], we predict that for a majority of taxa, the variation in shapes of elevational patterns observed

(decrease, increase, or unimodal) should be attributed by differences in study design, particularly by elevation gradient length.

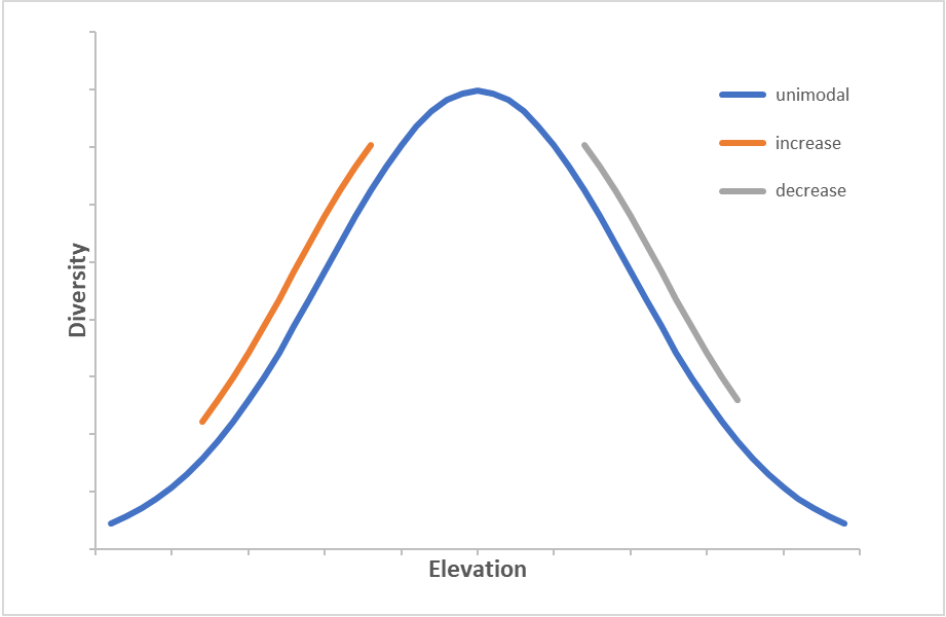
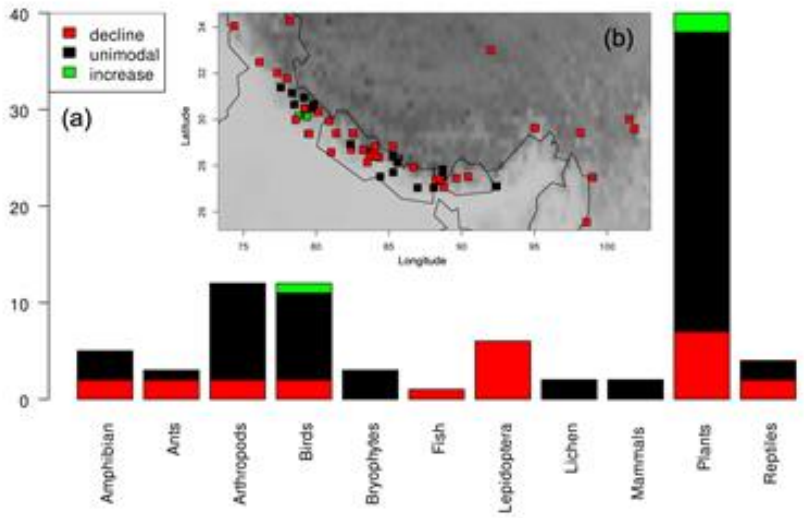


Figure 3. Illustration of our focal prediction regarding the shapes of elevational species richness/diversity gradients observed in elevation gradient studies. If the shapes of gradients covering substantial parts of mountains' vertical range, ideally from piedmonts to the summits, are unimodal, then observations based on short sections of the gradient will appear as near-linear, returning increasing (lower elevations) or decreasing (upper elevations) species richness patterns. Inspired by Nogués-Bravo et al. [25].

To explore this hypothesis, we targeted the Himalayas, the Earth's highest mountain range. These mountains reach from tropic areas affected by monsoon cycles in the south to cold continental deserts in the north, and divide Paleo tropics and Holarctic floral, or Oriental and Palearctic faunal, realms[27]. Owing to their unique biota, several biodiversity hotspots are recognized there (the Himalayas, mountains of southwest China)[28]. Numerous studies describing the elevational gradients originated from the mountains, covering multiple taxonomic groups. Grytnes & Vetaas[29] observed that in the Nepalese Himalayas, the species richness of plants was less at low and high altitudes and observed highest species richness

between 1500 and 2500 m and decreases as the altitude increased. Vetaas & Grytnes[30] observed that above 4000 m, the species richness of vascular plants decreases, but the endemism of the species increases in the Nepalese Himalayas. In the Bhabha Valley of the western Himalayas, Chawla et al.[31] also observed that species richness decreases along the higher elevational gradient and endemic plant species richness increases at higher altitudes. These patterns were observed also in the eastern part of the Himalayas. Chettri et al.[32] observed peak species richness of reptiles up to 500–1000 m, while no reptiles existed above 3000 m. Lizards showed a linear decline with the altitude, while snakes followed a nonlinear relation peak at 500–1000 m. In Sikkim, Acharya & Vijayan[33] recorded that butterfly species richness shows a unimodal pattern highest species richness at 1000 m and sharp decline of species richness up to 3000 m.

Figure 4. A representation of taxa studied (a) with relation to gradient shapes and (b) geographic distribution of 90 elevation studies done in the Himalayan region (see S1 for details of each of study). Gradient shapes indicated by different colors.



We collected published elevational studies and tested potential predictors of the patterns related to elevational gradient range, plus such characteristics of the studies as mean and maximum elevations of the gradients.

Results

In total, we gathered data from 64 publications, reporting 90 separate gradient studies (Supplement S1) with a good representation over the Himalayan region. The highest number of gradient studies targeted plants, followed by birds and arthropods (Figure 2a). Average length of the elevation range was 3393 ± 1607 SD m (minimum 600 m, maximum 7200 m), the mean midpoint elevation was at 2680 ± 743 SD m a.s.l., the lowest point was 0 m a.s.l., and the highest point was 7550 m a.s.l. Only a few of the studies covered almost the complete elevation gradient (Figure 3).

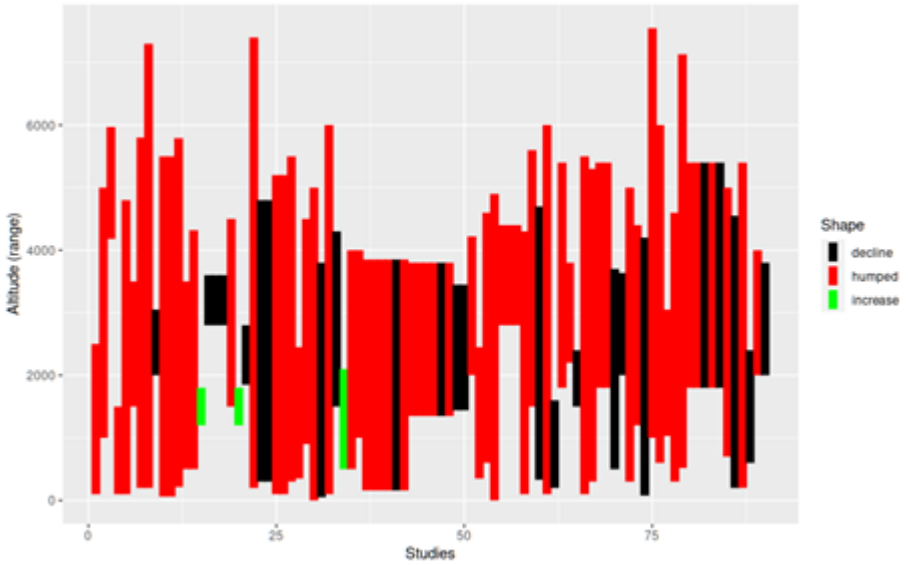


Figure 5. Distribution of elevation ranges of the 90 elevation gradient studies done in the Himalayan region in relation to altitude. Gradient shapes are again indicated by different colors.

The majority of the examined studies from the Himalayan region showed unimodal shapes (N = 63), followed by declines (24), and increases (3) (Figures 2 a, b). The taxa did not differ in proportional representation of gradient shapes (χ^2 = 23.89, df = 18, p = 0.159). For the most frequently studied taxa, **mean peak** was higher situated for plants (2490 m ± 864 SD, maximum: 4625 m) than for animals (2174 ± 601 SD), in which it was higher for birds (2300 m ± 619 SD, maximum: 3000 m) than for arthropods (2140 m ± 488 SD, maximum: 2540 m). A comparison

of peak elevations between plants and animals revealed a marginally significantly higher elevation of plants peaks (t = 1.80, df= 61, P= 0.08).

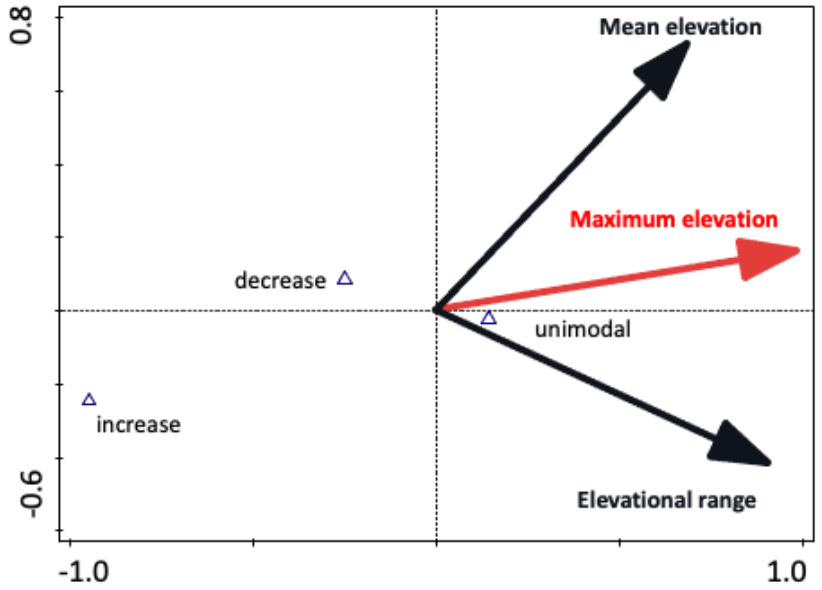


Figure 6. Canonical correspondence analysis biplot illustrating the effects of predictors significant in single-term analyses (cf. Table 1) on elevation gradient shapes (i.e., full model used for forward selection of variables). Maximum elevation, the sole predictor sufficient to explain the pattern, is shown in red.

Single-term CCAs for each predictor (Table 1) showed that the gradient shape was significantly related to mean elevation, maximum elevation, and elevation range, regardless of controlling or not controlling for studied taxa. Longitude was marginally significant, minimum elevation and latitude were without effects. The forward selection from all predictors (Full model: explained variation 15.54%, first axis pseudo-F 3.2, pseudo-P < 0.001, all axes pseudo-F 3.9, pseudo-P < 0.001; Full model with taxonomy covariable: explained variation 19.57%, first axis pseudo-F 3.1, pseudo-P < 0.001, all axes pseudo-F 4.6, pseudo-P < 0.001) returned maximum elevation as a sufficient sole predictor for the gradient shape responses (Figure 4).

Table 1. Result of single-term canonical correspondence analyses relating elevational gradient shapes to variables describing the gradient, ordered by the amount of explained variability. Maximum elevation, the strongest predictor of gradient shapes, was returned as the single predictor also in forward selection based on all variables with significant single effect. The right column with p values is adjusted for Holm correction.

Variable	**Variability explained (%)**	**pseudo-F**	**P**	**P(adj)**
No covariable				
Maximum elevation	12.2	12.2	0.001	0.006
Elevation range	10.5	10.3	0.001	0.006
Mean elevation	6.4	6.0	0.006	0.024
Longitude	2.7	2.5	0.09	0.27
Minimum elevation	1.6	1.4	0.249	0.498
Latitude	0.8	0.7	0.497	0.498
Taxonomy as covariable				
Maximum elevation	13.6	12.3	0.001	0.006
Elevation range	10.7	9.4	0.001	0.006
Mean elevation	9.0	7.7	0.004	0.016
Longitude	3.5	2.8	0.07	0.21
Minimum elevation	2.8	2.2	0.112	0.224
Latitude	0.9	0.7	0.506	0.506

Visualizing the predictors with significant effects showed that high values of maximum elevation, mean elevation, and elevational range were

positively intercorrelated[34], all pointing towards unimodal gradient shape. On the contrary, short gradients (i.e., low values of elevational range) with low maximum and mean elevations revealed either increasing or decreasing species richness/diversity, and low-elevated gradients (i.e., low values of mean and maximum elevation) indicated increase of species richness with altitude (Figure 3). These patterns were retained when treating studied taxa as covariates (Table 1).

Discussion

Across taxa, a great majority of elevational gradient studies in the Himalayan region returned a unimodal altitudinal pattern of species richness. This was typical for gradients covering a broad elevational range, whereas monotonously increasing or decreasing species richness applied for those covering short elevational ranges. In addition, monotonous increases were associated with low mean and maximum gradients' elevations, whereas monotonous decreases were associated with those with high mean elevations. These observations support our original hypotheses that unimodal response of species richness to elevation prevail in Himalayan biota, and those studies reporting decreasing or increasing species richness with altitude covered subsets of the elevational range of the mountains. We agree with the observation of Nogués-Bravo et al.[25] that studying only upper parts of elevational gradients results in apparently decreasing pattern species richness patterns, and with Kessler et al.[35], who insisted on the necessity to cover entire elevational gradients in a global study of ferns.

Our Himalayan analysis supports the prevalence of unimodality for a broad range of taxa in a major mountain range. For the most frequently studied taxa, the species richness peaks were situated in 2000–3000 meters, i.e., in the altitudinal belt of deciduous broadleaf forests (southern Himalayan slopes oriented towards Oriental tropics) or coniferous forests (NE and N slopes, oriented towards Palearctic temperate zones). The high diversity of birds, insects, and many other groups in South Himalayan Mountain forests is a well-established fact[36,37]. Only for plants, some of the diversity peaks (n = 8) reached the subalpine to alpine vegetation (>≈

3000 m). The two highest-elevation richness peaks were reported by Klimes[38] and Bhattarai et al.[39], who nevertheless covered rather short and primarily alpine gradients (elevational ranges 4180–5970 and 2800–4400 m a.s.l., respectively). The other authors reporting plant diversity peaks in alpine elevations covered substantially longer gradients, spanning >3000 altitudinal meters[31-41]. These observations suggest that at least in some parts of the mountains, diversity peaks of Himalayan plants may be located above those of animals. This may reflect the radiation of some plant groups at Himalayan (sub)alpine altitudes[42,43], or high alpha-diversity of some plant groups in high altitude environments, resulting into highly situated plant diversity peaks. Alternatively, the apparently higher-elevated diversity peaks reported for plants may be due to considerably easier sampling of plants, which are immobile and non-cryptic, compared to difficulties with sampling mobile and/or cryptic animals in harsh terrains of high elevations.

Unimodal species richness patterns[44,45] was also reported from other major mountain ranges, both temperate and tropical, the former temperate including, e.g., plants in Norway[46], land snails in Europe[47], mammals in the American Rocky Mountains[48], or beetles and moths in Korea[49]; and the latter tropical including, e.g., leaf litter invertebrates in Panama[9], ferns in Costa Rica[50], moths in tropical mountains world-wide[11], or mammals in the Philippines[51].

Reversing the argument that sampling long elevational gradients results, almost invariably, in unimodal elevational species richness patterns, leads to the conjecture that the uniformly increasing or decreasing richness patterns are results of incomplete vertical sampling. If so, the monotonously decreasing or increasing gradients do not require additional biological explanation. Still, groups whose distribution towards elevational extremes is truncated by their biology likely represent exceptions to the rule. Towards the upper extreme, these most likely include trees, limited by physical limits to their growth[52]; fish, limited in high altitudes by absence of sufficiently large water bodies[53]; and perhaps other ectothermic vertebrates. Groups truncated towards lower elevational limits might include weakly competitive organisms, such as lichens or orchids.

Although the unimodal patterns fit the geometry-derived null hypothesis of mid-domain effect[54], they deserve to be further analyzed regarding underlying physiological, ecological, or evolutionary mechanisms, which may vary among taxa, but also regions of the world. Hu et al.[55] showed that biotas of various functional or climatic guilds and their turnover may effectively, together with climatic data, explain the unimodal pattern shape. Furthermore, high altitude species overlapping in mid-altitudes with lowland species could have originated by autochthonous high-altitude radiations[56]; dispersed to the mountains from higher latitudes, perhaps during periods of cooler climate (cf.[57,58]); or derived from lowland biotas by endemic speciation[59]. In the Himalayas, the diversity of high altitudes is often of Palearctic/Holarctic origin, whereas lowland species are Oriental[60].

Cross-taxon analyses aiming on deciphering the mechanisms behind the unimodal patterns are highly desirable, but the data at hand do not allow them at this moment. The necessary conditions would be complete species lists for the attitudinal points surveyed, together with abundances. Such data would allow relating life history traits of species inhabiting different altitudes to their phylogeny and abiotic conditions. Only a small fraction (n = 3) of the 64 papers considered here reported original data. Without species-level data, it is impossible to understand the peculiarities of composition of individual species communities along the gradients and to explain how the general unimodal pattern of species richness is built.

Methods

Data collection. We searched for publications on species richness along the Himalayan elevational gradients for all taxa using the Google Scholar and Web of Science search engines with “elevational gradient”, “altitudinal gradient”, “Himalayan elevation”, and “Himalayan altitude” as keywords, then searched bibliographies of the publications found through Google Scholar for further relevant studies [accessed December 2020]. We only included publications that reported both abundance (i.e., number of individuals), and either species richness (i.e., the number of species within a defined region) or species diversity (a broadly used diversity index, e.g.,

Shannon's), for all taxa of a focal group, sampled at a minimum of four elevation transects/points and that had equal sampling effort with identical sampling methods at each elevation. If several taxa were used in a single study, we kept the taxa as separate gradient studies. For each study, we extracted a type of the gradient shape ("decline", "unimodal", and "increase" of species richness/diversity along the elevational gradient), studied taxa (distinguishing amphibians, ants, birds, bryophytes, fish, Lepidoptera, lichens, mammals, and reptiles), geographic coordinates (latitude, longitude), and information on elevation used in a study (minimum, mean, and maximum elevation, and elevation range, i.e., the length of the gradient) (See Supplement S1 for details).

Data analyses. We used the gradient shapes (3-states factor: "decline", "unimodal", or "increase") extracted from the studies as a response variable, and recorded variables describing the gradients (studied taxa, longitude, latitude, minimum elevation, mean elevation, maximum elevation, and elevation range) as potential predictors (See S1 for details). Primarily, we used the χ^2 test in R[61] to search for a possible difference of numbers of individual gradient shapes per studied taxa. Then, we employed multivariate Canonical Correspondence Analyses (CCA), which allows testing of various sets of predictors, including their collinearity and variance partitioning, calculated in Canoco 5[62]. First, we tested for the effect of the studied taxon (categorical predictor) on the gradient shapes. Second, we used a set of single-term analyses to inspect the effect of each of the variables on the gradient shapes. Third, we used a forward selection procedure to build a Full model. Both single-term analyses and the complex model were calculated twice, excluding, and including studied taxa category as a covariate.

Acknowledgements. The authors are grateful to the Grant Agency of the University of South Bohemia (GA JU 038/2019/P), and the Technology Agency of the Czech Republic (SS01010526) for their support during data analyses and manuscript preparation.

References

1. Hodkinson, I. D. Terrestrial insects along elevation gradients: Species and community responses to altitude. *Biol*, 80, 489–513 (2005).
2. Smith, R. J., Hines, A., Richmond, S., Merrick, M., Drew, A., & Fargo, R. Altitudinal Variation in Body Size and Population Density of *Nicrophorus investigator* (Coleoptera: Silphidae). *Environ. Entomol.*, 29(2): 290–298 (2020).
3. Vrba, P., Nedvěd, O., Zahradníčková, H., & Konvička, M. More complex than expected: Cold hardiness and the concentration of cryoprotectants in overwintering larvae of five *Erebia* butterflies (Lepidoptera: Nymphalidae). *Eur. J. Entomol.*, 114: 470–480 (2017).
4. Camacho, L. & Avilés, L. Decreasing predator density and activity explain declining predation of insect prey along elevational gradients. *Am. Nat.*, 194(3): 334–343 (2019).
5. Zhao, Z., Du, G., Zhou, X., Wang, M., & Ren, Q. Variations with altitude in reproductive traits and resource allocation of three Tibetan species of Ranunculaceae. *Aust. J. Bot.*, 54(7): 691–700 (2006)
6. Scheffers, B. R., Phillips, B. L., Laurance, W. F., Sodhi, N. S., Diesmos, A. & Williams, S. E. Increasing arboreality with altitude: a novel biogeographic dimension. *Proc. Royal Soc. B*, 280: 20131581 (2013).
7. Wang, J., Zhang, B. & Yao, Y. Pattern of the Upper Limit of Montane Deciduous Broad-Leaved Forests and Its Geographical Interpretation in the East Monsoon Realm of China. *Forests*, 12(9): 1225 (2021).
8. Rasmann, S., Pellissier, L., Defossez, E., Jactel, H. & Kunstler, G. Climate-driven change in plant-insect interactions along elevation gradients. *Funct. Ecol*, 28(1): 46– 54 (2014).
9. Olson, D. M. The Distribution of Leaf Litter Invertebrates Along a Neotropical Altitudinal Gradient. *J. Trop. Ecol.*, 10(2): 129-150 (1994).
10. Rahbek, C. The altitudinal gradient of species richness: a uniform pattern? *Ecography*, 18(2): 200–205 (1995).
11. Beck, J. et al. Patterns or mechanisms? Bergmann's and Rapoport's rule in moths along an elevational gradient. *Community Ecol*, 17(2): 137–148 (2016).

12. Birrell, J. H. et al. Insects in high-elevation streams: Life in extreme environments imperiled by climate change. *Global Change Biology*, 26(12): 5667-6684 (2020).
13. Menéndez, R. How are insects responding to global warming? *Tijdschrift voor Entomologie*, 150, 355–65 (2007).
14. Robinet, C. & Roques, A. Direct impacts of recent climate warming on insect populations. *Integrative Zoology*, 5(2): 132–142 (2010).
15. Ding, T. -S., Yuan, H. -W., Geng, S., Lin, Y. -S. & Lee, P. -F. Energy flux, body size and density in relation to bird species richness along an elevational gradient in Taiwan. *Glob. Ecol*, 14(4): 299-306 (2005).
16. Malhi, Y. et al. The variation of productivity and its allocation along a tropical elevation gradient: a whole carbon budget perspective. *New Phytologist*, 214(3): 1019-1032 (2017).
17. Chen, T., Peng, L., Liu, S. & Wang, Q. Spatio-temporal pattern of net primary productivity in Hengduan Mountains area, China: Impacts of climate change and human activities. *Chin Geogr Sci*, 27, 948–962 (2017).
18. Konvicka, M., Benes, J., Cizek, O., Kuras, T. & Kleckova, I. Has the currently warming climate affected populations of the mountain ringlet butterfly, *Erebia epiphron* (Lepidoptera: Nymphalidae), in low-elevation mountains? *Eur. J. Entomol.*, 113: 295–301 (2016).
19. Storz, J. F. (2021). High-Altitude Adaptation: Mechanistic Insights from Integrated Genomics and Physiology. *Mol. Biol. Evol.*, 38(7): 2677–2691 (2021).
20. Stevens, G. C. The Elevational Gradient in Altitudinal Range: An Extension of Rapoport's Latitudinal Rule to Altitude. *Am. Nat.*, 140(6): 893–911 (1992).
21. Laiolo, P., Pato, J. & Obeso, J. R. Ecological and evolutionary drivers of the elevational gradient of diversity. *Ecol. Lett*, 21(7): 1022–1032 (2018).
22. Moradi, H., Fattorini, S. & Oldeland, J. Influence of elevation on the species–area relationship. *J. Biogeogr.*, 47(9): 2029–2041 (2020).
23. Li, M. & Feng, J. Biogeographical Interpretation of Elevational Patterns of Genus Diversity of Seed Plants in Nepal. *PLoS ONE*, 10(10):e0140992 (2015).

24. Gebrehiwot, K., Demissew, S., Woldu, Z., Fekadu, M., Desalegn, T., & Teferi, E. Elevational changes in vascular plants richness, diversity, and distribution pattern in Abune Yosef mountain range, Northern Ethiopia. *Plant Divers.*, 41(4):220-228 (2019).
25. Nogués-Bravo, D., Araújo, M. B., Romdal, T. & Rahbek, C. Scale effects and human impact on the elevational species richness gradients. *Nature*, 453(7192): 216-219 (2008).
26. Ter Braak, C. J. F. & Prentice, I. C. A theory of gradient analysis. *Adv. Ecol. Res.*, 18: 271–317 (1988).
27. Lomolino, M. V., Riddle, B. & Whittaker, R. *Biogeography: Biological Diversity across Space and Time*. 5th edition. Sinauer Associates, 784 (2016).
28. Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B. & Kent, J. Biodiversity hotspots for conservation priorities. *Nature*, 403(6772): 853–858 (2000).
29. Grytnes, J. A., & Vetaas, O. R. Species richness and altitude: a comparison between null models and interpolated plant species richness along the Himalayan altitudinal gradient, Nepal. *Am. Nat.*, 159: 294–304 (2002).
30. Vetaas, O. R. & Grytnes, J. A. Distribution of vascular plant species richness and endemic richness along the Himalayan elevation gradient in Nepal. *Glob. Ecol*, 11(4): 291–301(2002).
31. Chawla, A., Rajkumar, S., Singh, K. N., Lal, B. & Singh, R. D. Plant Species Diversity along an Altitudinal Gradient of Bhabha Valley in Western Himalaya. *J. Mt. Sci.*, 5(2): 157-177 (2008).
32. Chettri, B., Bhupathy, S., & Acharya, B. K. Distribution pattern of reptiles along an eastern Himalayan altitude gradient. India. *Acta Oecol*, 36(1): 16-22 (2010).
33. Acharya, B. K. & Vijayan, L. Butterfly diversity along the altitude gradient of Eastern Himalaya, India. *Ecol. Res.*, 30(5): 909–919 (2015).
34. Zu, K. et al. Upward shift and elevational range contractions of subtropical mountain plants in response to climate change. *Sci. Total Environ.*, 783-146896 (2021).

35. Kessler, M., Kluge, J., Hemp, A. & Ohlemüller, R. A global comparative analysis of elevational species richness patterns of ferns. *Glob. Ecol*, 20(6): 868-880 (2011).
36. Chandra, K., Kumar, V., Singh, N., Raha, A. & Sanyal, A. K. *Assemblages of Lepidoptera in Indian Himalaya through long term monitoring plots*. Zoological Survey of India, 457 (2019).
37. Ghimire, A. et al. Diversity of birds recorded at different altitudes in central Nepal Himalayas. *Ecol. Indic.*,127, 107730 (2021).
38. Klimes, L. Life-forms and clonality of vascular plants along an altitudinal gradient in E Ladakh (NW Himalayas). *Basic Appl Ecol*, 4(4): 317–328 (2003).
39. Bhattarai, P., Bhatta, K. B., Chhetri, R. & Chaudhary, R. P. Vascular plant species richness along elevation gradient of the Karnali river valley, Nepal Himalaya. *Int. j. plant animal env. sci.,* 4(3): 114-126 (2014).
40. Manish, K., Pandit, M. K., Telwala, Y., Nautiyal, D. C., Koh, L. P., & Tiwari, S. Altitudinal plant species richness patterns and their drivers across non-endemics, endemics and growth forms in the Eastern Himalaya. *J. Plant Res.*, 130(5): 829–844 (2017).
41. Liang, J. et al. Species richness patterns of vascular plants and their drivers along an elevational gradient in the central Himalayas. *Glob. Ecol. Conserv.*, 24: e01279 (2020).
42. Ebersbach, J., Schnitzler, J., Favre, A., & Muellner-Riehl, A. N. Evolutionary radiations in the species-rich mountain genus *Saxifraga* L. *BMC Ecol. Evol*, 17, 119 (2017).
43. Favre, A. et al. Out-of-Tibet: the spatio-temporal evolution of *Gentiana* (Gentianaceae). *J. Biogeogr.*, 43(10): 1967-1978 (2016).
44. Colwell, R. K., Mao, C. X., & Chang, J. Interpolating, Extrapolating, and Comparing incidence-based species accumulation curves. *Ecology*, 85(10): 2717-2727 (2004).
45. Fischer, A., Blaschke, M., & Bässler, C. Altitudinal gradients in biodiversity research: the state of the art and future perspectives under climate change aspects. *Archives of Nature Conservation and Landscape Research*, 11:35–47 (2011).

46. Grytnes, J. A. Species-richness patterns of vascular plants along seven altitudinal transects in Norway. *Ecography*, 26(3): 291-300 (2003).
47. Hausdorf, B. Latitudinal and altitudinal diversity patterns and Rapoport effects in north-west European land snails and their causes. *Biol. J. Linn. Soc.*, 87: 309-323 (2006).
48. Rowe, R. J. Environmental and geometric drivers of small mammal diversity along elevational gradients in Utah. *Ecography*, 32(3): 411–422 (2009).
49. Choi, S. -W., & Thein, P. P. Distribution breadth and species turnover of night-flying beetles and moths on different mainland and island mountains. *Ecol. Res.*, 33(1): 237-247 (2018).
50. Kluge, J., Kessler, M. & Dunn, R. R. What drives elevational patterns of diversity? A test of geometric constraints climate and species pool effects for pteridophytes on an elevational gradient in Costa Rica. *Glob. Ecol*, 15(4): 358–371 (2006).
51. Heaney, L. R. Small Mammal Diversity Along Elevational Gradients in the Philippines: An Assessment of Patterns and Hypotheses. *Glob. Ecol*, 10(1), 15–39 (2001).
52. Koch, G. W., Sillett, S. C., Jennings, G. M. & Davis, S. D. The limit to tree height. *Nature*, 428: 851–854 (2004).
53. Jacobsen, D. Low oxygen pressure as a driving factor for the altitudinal decline in taxon richness of stream macroinvertebrates. *Oecologia*, 154: 795–807 (2008).
54. Dunn, R. R., McCain, C. M., & Sanders, N. J. When Does Diversity Fit Null Model Predictions? Scale and Range Size Mediate the Mid-Domain Effect. *Glob. Ecol*, 16(3), 305–312 (2007).
55. Hu, Y. et al. Birds in the Himalayas: What drives beta diversity patterns along an elevational gradient? *Ecol. Evol*, 8(23): 11704–11716 (2018).
56. Wiens, J. The niche, biogeography and species interactions. *Philos. Trans. R. Soc. Lond., B, Biol. Sci.*, 366(1576), 2336–2350 (2011).
57. Varga, Z. S. & Schmitt, T. Types of oreal and oreotundral disjunctions in the western Palearctic. *Biol. J. Linn. Soc. Lond.*, 93(2): 415-430 (2008).

58. Louy, D. et al. Molecules and models indicate diverging evolutionary effects from parallel altitudinal range shifts in two mountain Ringlet butterflies. *Biol. J. Linn. Soc. Lond.*, 112(3), 569–583 (2014).
59. Nicolas, A. H., Morenob, J. S., Ortiz-Movliav, C. & Palacio, R. D. Biogeographic regions and events of isolation and diversification of the endemic biota of the tropical Andes. *PNAS*, 115(31): 7985-7990 (2018).
60. Kindlmann, P. *Himalayan biodiversity in the changing world*. Springer Science & Business Media, 226 pp. (2012).
61. RC Team. R: *A language and environment for statistical computing. R Foundation for Statistical Computing*, Vienna, Austria. (2020).
62. Šmilauer, P. & Leps, J. *Multivariate Analysis of Ecological Data using CANOCO 5*. Cambridge University Press. (2014).

Loepa sikkima recorded on the light trap at the Shirui Hill. @JS Irungbam

CHAPTER II

Elevational distribution pattern of the moths (Insecta: Lepidoptera) in Shirui Hill, Manipur, India

[1,2*]Jatishwor S. Irungbam, [2]Alena B. Sucháčková, [1,2]Martin Konvička and [2]Zdenek F. Fric

Manuscript

Pages 49-88 Unpublished data

Euhampsonia rubricata newly described from the Shirui Hill. Manipur, India @JS Irungbam

CHAPTER III

Euhampsonia rubricata spec. nov., a new moth species from northeastern India and western Myanmar (Lepidoptera: Notodontidae)

Alexander Schintlmeister [1] & Jatishwor Singh Irungbam[2]

Zootaxa (2019), 4560(1): 195–200
https://doi.org/10.11646/zootaxa.4560.1.12
(IF= 0.949)

Zootaxa 4560 (1): 195–200
https://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4560.1.12
http://zoobank.org/urn:lsid:zoobank.org:pub:9FCB76FE-0926-4A9C-A768-538BC1A5E895

Euhampsonia rubricata spec. nov., a new moth species from northeastern India and western Myanmar (Lepidoptera: Notodontidae)

ALEXANDER SCHINTLMEISTER[1] & JATISHWOR SINGH IRUNGBAM[2]

[1] *Dr. Alexander Schintlmeister, Calberlastr. 3, D-01326 Dresden. E-mail: schintlm@aol.com*
[2] *M. Sc. Jatishwor Singh Irungbam, Institute of Entomology, Biology Center CAS, Branisovská 1160/31 CZ-37005, České Budějovice; Faculty of Science, University of South Bohemia, Branisovská 1760, CZ-37005, České Budějovice.*
E-mail: jatishwor.irungbam@gmail.com

Abstract

A new notodontid species, *Euhampsonia rubricata* **spec. nov.**, is described from NW India and W Myanmar and compared to its eastern sister species *E. sinjaevi* Schintlmeister, 1997. The female genitalia of the latter are illustrated for the first time. A full synonymic list of the genus *Euhampsonia* is provided.

Key words: Lepidoptera, Notodontidae

Introduction

During field work by the second author in the Shirui Hills (state of Manipur, India) in 2016, a notodontid moth unknown for Indian fauna was collected at light. It was later identified to be closely related to *Euhampsonia sinjaevi* Schintlmeister, 1997. The latter species was described from northern Vietnam, Mt. Fan-si-pan, and is distributed in southern China (Yunnan, Sichuan, Shaanxi), Vietnam, Laos, northern Thailand and eastern Myanmar (Schintlmeister & Pinratana, 2007: 44, Schintlmeister 2013: 45). The species from Manipur differs significantly in external appearance and male genitalia from *sinjaevi* and is described here as a distinct species.

Euhampsonia rubricata spec. nov.

Holotype: ♂, India, Manipur, Shirui Hills, 25°07'24.81" N, 94°26'28.80"E, 2198 m, 12. vii. 2016, leg. Irungbam, J. S., (barcoded IJ-285)—in coll. A. Schintlmeister, Dresden.

Paratypes (16 ♂♂): 11 ♂♂, India, Manipur, Shirui Hills, 25°07'24.81" N, 94°26'28.80" E, 2198 m, 12. vii. 2016, leg. Irungbam, J. S., genitalia slides GU 66-65, IJ 281, IJ 284, IJ 282, IJ 283, IJ 286, IJ 288; 3 ♂♂, Shirui Hills, 25°6'40.40"N, 94°27'12.35"E, 2425 m, leg. Irungbam, J. S., genitalia slides IJ 291, IJ 293, IJ 294; 2 ♂♂, W Myanmar, Chin state, Kennedy Peak, summit near Pagoda, 2690 m, 18. v. 2001, 2690 m, leg. Stefan Naumann (genitalia slide GU 66-70).

Etymology. The species is named for its reddish-brown (lat: rubricata) external appearance, particularly in the hind wings, that distinguishes it from its closely related sister species *sinjaevi.*

Diagnosis. Forewing length (measured from base to right apex of forewing) ♂♂ 35—36 mm, 2—3 mm smaller than a series (n > 50) of *Euhampsonia sinjaevi* from Vietnam and Yunnan. The new species resembles *E. sinjaevi* (figs. 5-8) but differs by darker reddish brown coloured wings (figs. 1-4). The discal spot on the forewing is large and yellowish, sometimes somewhat indistinctly marked. Along vein M_2 between the discal spot and the outer margin, a contrasting yellow streak occurs; this streak is less contrasting and more brownish tinged in *sinjaevi*. Presence of a forewing streak distinguishes *rubricata* and *sinjaevi* from all other members of *Euhampsonia*. The remaining forewing pattern in the series from Manipur is indistinct and consists of brownish

Accepted by R. Zahiri: 8 Oct. 2018; published: 22 Feb. 2019

basal, median and postmedian fasciae. Both paratype males from western Myanmar are richer in their forewing pattern and displays more fasciae, partly marked as brown spots. The outer margin of the forewings shows deep, irregular indentations, a characteristic feature of all *Euhampsonia*. The hind wings of *rubricata* are darker reddish brown than those of *sinjaevi.* The female of *rubricata* is unknown.

The male genitalia of *E. rubricata* (figs. 9-11) resemble those of *E. sinjaevi* (figs. 12, 14) The uncus of *rubricata* is pointed at its tip, slightly broader and shorter than in *sinjaevi.* The socii are acute at their apices and characteristically elbowed (approximately 100°). In *sinjaevi* the socii are longer, gently curved and much more slender. The valval costa of *rubricata* is club shaped at its apex and displays a large projection half way out; this process is rounded at its tip in *rubricata*, but acute in *sinjaevi*. Overall, the valva of *rubricata* is narrower than that of *sinjaevi*. The phallus of *rubricata* is short and straight, with a long, hook-shaped process at its apex; in some individuals a small second spine arises from this apical process (fig. 10). In *sinjaevi* a pair of short processes of variable shape arise from the phallus tip. The everted endophallus in both species (figs. 9, 11, 14) displays a well sclerotized carina, but no cornuti. In both species, the 8th sternum bears a large V-shaped mesal notch on its posterior margin, with the notch in *sinjaevi* being somewhat deeper. The anterior margin of sternum 8 bears a wide apodeme, which is transverse in *rubricata*, but slightly convex in *sinjaevi.* In both species, the 8th tergum is squarish and gently bilobed at its posterior margin.

Molecular diagnosis. We barcoded three specimens of *E. rubricata*, including the holotype (IJ-285). For comparison, we barcoded two additional species of *Euhampsonia*; *E. niveiceps* (Walker) and *E. sinjaevi*. We also supplied the dataset for 28 of other samples of the genus *Euhampsonia* available from BOLD (DNA Barcode data from BOLD, Barcode of Life Database, cf. Ratnasingham and Hebert 2007) and we used barcodes from *Dudusa nobilis* and *Gangarides vardena* as outgroups. We calculated the genetic distances using Kimura 2-p substitution model and we constructed the Maximum Likelihood tree using more proper GTR+G model and 1000 bootstrap replicates in Mega-X (Kumar, *et al*. 2018). The species is sister to *E. sinjaevi* (Fig. 15). The minimal genetic difference from its sister species, *E. sinjaevi* is 5.4%. The interspecific difference is 1.5% of the variability.

Habitat. *E. rubricata* is currently known from the Shirui Hills, Manipur (northeastern India) and from Kennedy Peak, Chin state (western Myanmar). It occurs at altitudes between 2200 m to 2700 m above sea level. The type locality, Shirui Hills in the Ukhrul district of Manipur, has a cold climate, with temperatures between 3°C and 33°C. The Shirui Hill are covered with clouds almost throughout the year but receive rain from May to the beginning of October. Average annual rainfall in the region is approximately 1763.7 mm. Vegetation in the area is dominated by various *Rhododendron* and *Quercus* species (Fig. 16). The region is not densely populated, but the area surrounding the forest is heavily disturbed due to anthropogenic activities such as seasonal cultivation, illegal felling of trees, burning of the forest, and grazing by domesticated animals; nearly all the natural vegetation has been disturbed. The habitat is classified as Tropical Semi Evergreen forests (Champion & Seth 1968).

Full references to the genus *Euhampsonia* and its taxa on specific level, including subspecies, synonymy, type locality and type depository are given in Schintlmeister (2013): 154. *Euhampsonia* includes the following species:

Euhampsonia Dyar, 1897

albocristata Kishida & Wang, 2003—SE China.
cristata (Butler, 1877)—Japan, Far East Russia, Korean Peninsula, China, Taiwan, E China, Laos, Thailand.
formosana (Matsumura, 1925)—Taiwan.
niveiceps (Walker, 1865)—Himalaya (N India, Nepal).
roepkei Holloway, 1983—Malayan peninsula, S Thailand, Borneo, Palawan, Sumatra, Java.
rubricata **spec. nov.—**NE India (Manipur), W Myanmar.
serratifera Sugi, 1994—China, Vietnam, Laos, Thailand, Myanmar.
sinjaevi Schintlmeister, 1997—S China, Vietnam, Laos, Thailand, E Myanmar.
splendida (Oberthür, 1880)—Far East Russia, Korean Peninsula, Japan, E China.

Acknowledgements

The second author was funded for this project through the Czech Science Foundation (GA CR: 14-36098G) and the Grant Agency, University of South Bohemia (GA JU 152/2016/P).

FIGURES 1–8. Adults of *Euhampsonia rubricata* **spec. nov.** and *E. sinjaevi* Schintlmeister, 1997.

Fig. 1 *Euhampsonia rubricata* **spec. nov.:** ♂, India, Manipur, Shirui Hills, 25°07'24.81"N, 94°26'28.80"E, 2198 m, 12. vii. 2016, leg. Irungbam, **holotype.**

Fig. 2 *Euhampsonia rubricata* **spec. nov.:** ♂, India, Manipur, Shirui Hills, 25°07'24.81"N, 94°26'28.80"E, 2198 m, 12. vii. 2016, leg. Irungbam, **holotype,** underside.

Fig. 3 *Euhampsonia rubricata* **spec. nov.:** ♂, India, Manipur, Shirui Hills, 25°07'24.81"N, 94°26'28.80"E, 2198 m, 12. vii. 2016, leg. Irungbam, **paratype.**

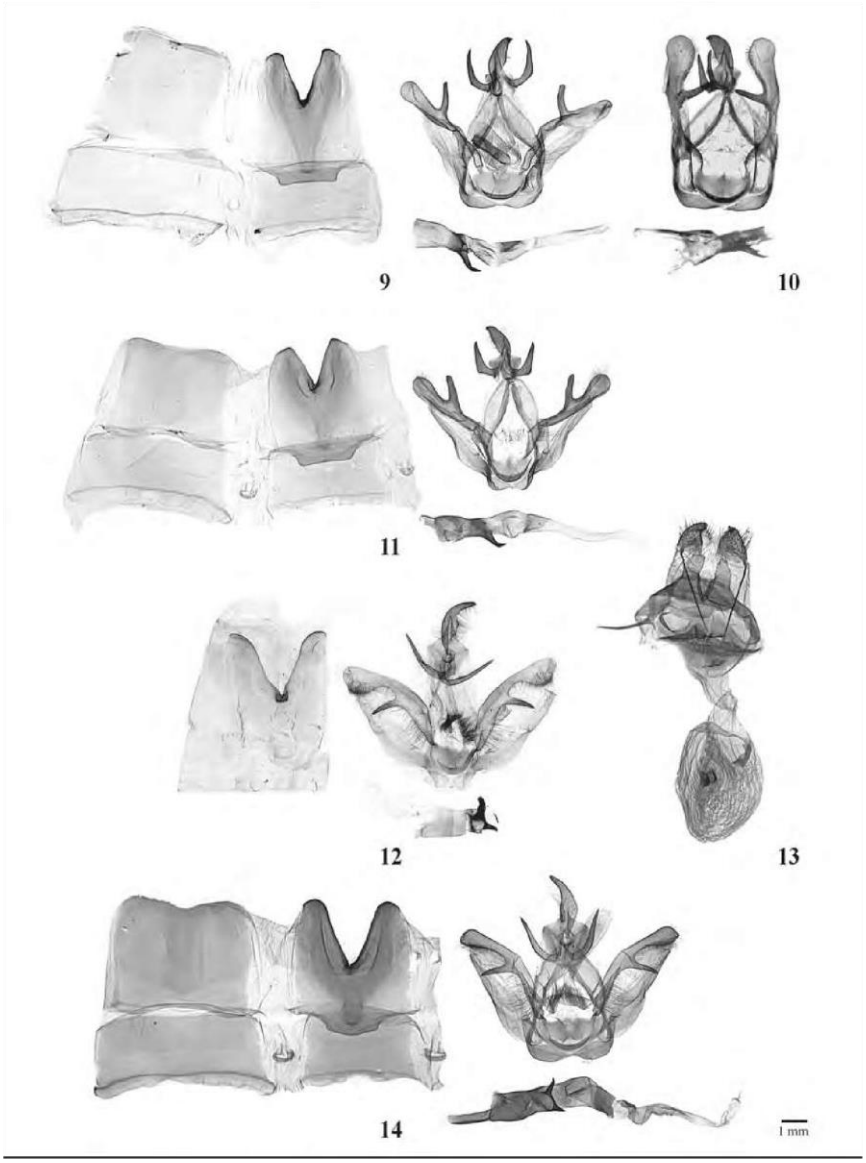
Fig. 4 *Euhampsonia rubricata* **spec. nov.:** ♂, W Myanmar, Chin state, Kennedy Peak, summit near Pagoda, 2690 m, 18. v. 2001, 2690 m, leg. Stefan Naumann (genitalia slide GU 66-70), **paratype.**

Fig. 5 *Euhampsonia sinjaevi* Schintlmeister, 1997: ♂, N Vietnam, Mt. Fan-si-pan, N-Seite, Cha-Pa, 22°15'N, 103°45'E, 2.200 m, 9. vii. 1994, leg. Brechlin & Schintlmeister, **holotype.**

Fig. 6 *Euhampsonia sinjaevi* Schintlmeister, 1997: ♀, China, Yunnan, Yunlong, 13 km N Caojian, Fengshuining Mts., 25°46'E, 99°06'E, 2.460 m, 20. v.–9. vi. 1999, leg. local collectors (genitallia slide GU 66-67).

Fig. 7 *Euhampsonia sinjaevi* Schintlmeister, 1997: ♂, China, Shaanxi, Qin Ling Mts., 40 km S Xi'An, 1.850 m, 33°52'N 108°50'E, 22.–24. vi. 2004, leg. V. Sinjaev (genitalia slide GU 66-68)**.**

Fig. 8 *Euhampsonia sinjaevi* Schintlmeister, 1997: ♀, China, Yunnan, Yunlong, 13 km N Caojian, Fengshuining Mts., 25°46'E, 99°06'E, 2.460 m, 20. v.–9. vi. 1999, leg. local collectors.



FIGURES 9–14. Genitalia of *Euhampsonia rubricata* **spec. nov.** and *E. sinjaevi* Schintlmeister, 1997

Fig. 9 *Euhampsonia rubricata* **spec. nov.:** Genitalia slide GU 66–65, ♂, India, Manipur, Shirui Hills, 25°07'24.81"N, 94°26'28.80"E, 2198 m, 12. vii. 2016, leg. Irungbam, **paratype.**

Fig. 10 *Euhampsonia rubricata* **spec. nov.:** Genitalia slide IJ283, ♂, India, Manipur, Shirui Hills, 25°07'24.81"N, 94°26'28.80"E, 2198 m, 12. vii. 2016, leg. Irungbam, **paratype.**

Fig. 11 *Euhampsonia rubricata* **spec. nov.:** Genitalia slide GU 66-70, ♂, W Myanmar, Chin state, Kennedy Peak, summit near Pagoda, 2690 m, 18. v. 2001, 2690 m, leg. Stefan Naumann, **paratype.**

Fig. 12 *Euhampsonia sinjaevi* Schintlmeister, 1997: Genitalia slide GU 25–74, ♂, N Vietnam, Mt. Fan-si-pan, N-Seite, Cha-Pa, 22°15'N, 103°45'E, 2.200 m, 9. vii. 1994, leg. Brechlin & Schintlmeister, **paratype.**

Fig. 13 *Euhampsonia sinjaevi* Schintlmeister, 1997: Genitallia slide GU 66-67, ♀, China, Yunnan, Yunlong, 13 km N Caojian, Fengshuining Mts., 25°46'E, 99°06'E, 2.460 m, 20. v.—9. vi. 1999, leg. local collectors.

Fig. 14 *Euhampsonia sinjaevi* Schintlmeister, 1997: Genitalia slide GU 66-68, ♂, China, Shaanxi, Qin Ling Mts., 40 km S Xi'An, 1.850 m, 33°52'N 108°50'E, 22.–24. vi. 2004, leg. V. Sinjaev.

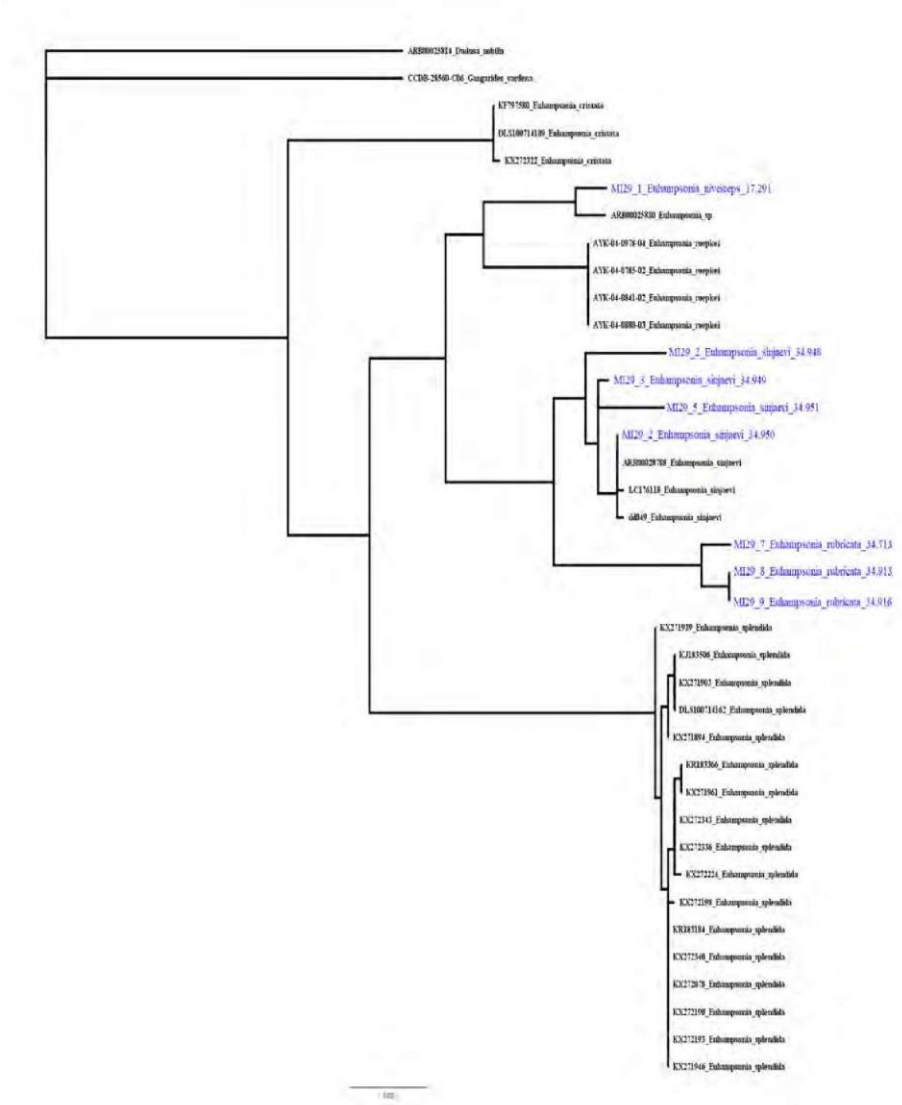


FIGURE 15. Maximum Likelihood tree of *Euhampsonia* based on GTR+G substitution model. Values above branches show bootstrap probability based on 1000 iterations.

FIGURE 16. Habitat of *Euhampsonia rubricata* spec. nov. at Shirui Hills, Manipur, NE India.

References

Champion, H.G. & Seth, S.K. (1968) *A Revised Forest Types of India.* Manager of Publications, Government of India, Delhi, 1968 pp.

Kumar, S., Stecher, G., Li, M., Knyaz, C. & Tamura, K. (2018) MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. *Molecular Biology and Evolution*, 35, 1547–1549. https://doi.org/10.1093/molbev/msy096

Ratnasingham, S. & Hebert, P.D.N. (2007) BOLD: The Barcode of Life Data System (www.barcodinglife.org). *Molecular Ecology Notes*, 7, 355–364. https://doi.org/10.1111/j.1471-8286.2007.01678.x

Ratnasingham, S. & Hebert, P.D.N. (2013) A DNA-based registry for all animal species: Thw Barcode Index Number (BIN) System. *PloS ONE*, 8 (7), e66213. https://doi.org/10.1371/journal.pone.0066213

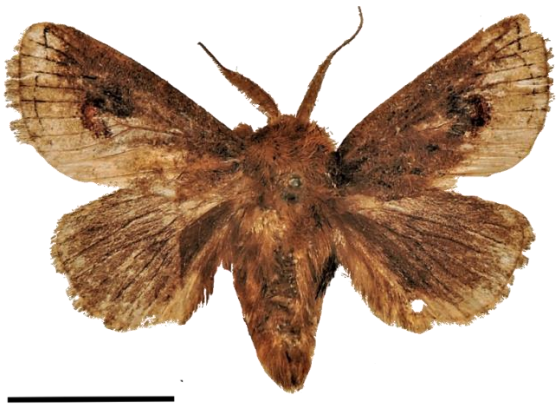
Schintlmeister, A. (1997) Moths of Vietnam with special reference to Mt. Fan-si-pan. Family: Notodontidae. *Entomofauna Supplement*, 9, 33–248.

Schintlmeister, A. (2008) *Palaearctic Macrolepidoptera. Vol. 1. Notodontidae.* Apollo Books, Stenstrup, 482 pp., 40 pls.

Schintlmeister, A. (2013) *World Catalogue of Insects. Vol. 11. Notodontidae & Oenosandridae (Lepidoptera).* Brill, Leiden-Boston, 605 pp.

Schintlmeister, A. & Lourens, J.H. (2010) The Philippine Notodontidae (Lepidoptera). *Quadrifina*, 8, 1–349.

Schintlmeister, A. & Pinratana, A. (2007) *Moths of Thailand. Vol. 5. Notodontidae.* Brothers of St. Gabriel, Bangkok, 320 pp., 45 pls.



Squamosa wungchanngamii sp. n. Paratype, from Shirui Hill, Manipur, India. @JS Irungbam

CHAPTER IV

Two new species and three new record species of family Limacodidae from northeast India (Lepidoptera: Zygaenoidea)

Jatishwor S. Irungbam[a,b,*], Jalil Ahmad[c], Navneet Singh[c] & Alexey V. Solovyev[d]

Manuscript

Pages 97 to 115 Unpublished data

Lebeda nobilis, Lasiocampidae, photographed from Shirui Hill, Manipur ©JS Irungbam

CHAPTER V

Lappet moths (Lepidoptera: Lasiocampidae) of Manipur, north east India: an updated checklist

Jatishwor Singh Irungbam[1,2,4], Sachin Arjun Gurule[3,5] & Zdeněk Faltýnek Fric[2,6]

Journal of Insect Biodiversity, (2020), 019(2): 024–043

J. Insect Biodiversity 019 (2): 024–043
https://www.mapress.com/j/jib

Article

ISSN 2538-1318 (print edition)
J. Insect Biodiversity
ISSN 2147-7612 (online edition)

https://doi.org/10.12976/jib/2020.19.2.1
http://zoobank.org/urn:lsid:zoobank.org:pub:50F288DB-11E1-45AD-B936-38FE6EC5C5E0

Lappet moths (Lepidoptera: Lasiocampidae) of Manipur, north east India: an updated checklist

JATISHWOR SINGH IRUNGBAM[1,2,4], SACHIN ARJUN GURULE[3,5] & ZDENĚK FALTÝNEK FRIC[2,6]
[1]*Faculty of Science, University of South Bohemia, Ceske Budejovice, Czech Republic – 37005*
[2]*Biology Centre, Czech Academy of Science, Institute of Entomology, Ceske Budejovice, Czech Republic – 37005*
[3]*Entomology Research Center and Department of Zoology, MVP's K.T.H.M. College, Nashik, Maharashtra, India – 422002*
[4] *jatishwor.irungbam@gmail.com; http://orcid.org/0000-0002-3003-6624*
[5] *sachin.gurule@yahoo.com; http://orcid.org/0000-0002-9309-8099*
[6] *zdfric@gmail.com; http://orcid.org/0000-0002-3611-8022*

Abstract

An updated checklist of 35 species of Lasiocampidae from Manipur is presented in this report. The survey has been carried out for assessment of Lasiocampidae fauna of Shirui Mountains and surrounding areas of Manipur during 2016 to 2019. The materials collected during the survey were identified from 15 genera containing 24 species. 17 species were reported for the first time from Manipur. The 5 species *viz. Euthrix improvisa, Eteinopla narcissus, Kunugia burmensis, Kunugia xichangensis,* and *Arguda viettei* are new addition to known Indian Lasiocampidae fauna.

Key words: Lasiocampidae, Moth, Manipur, North East India, New record, Shirui Mountain

Introduction

Manipur lies in the North-East India bounded by Nagaland on the north, Assam on the west, Mizoram on the south and along the east with Myanmar sharing about 352 km long international border. Manipur located between 23°83'–25°68' N and 93°03'–94°78' E and covers a total geographical area of 22,327 km^2 of which 17,418 km^2 (78.01%) is under forest cover. Geographically, Manipur is divided into mountain ranges running north to south abridging the Patkai and the Lushai Hill range of the extended Arakan Yoma and a central plain-the valley of Imphal. The altitude of hills ranging from 833 m to 3017 m. Major forest types in the area is tropical semi-evergreen, dry temperate forest, sub-tropical pine and tropical moist deciduous forests. The Manipur is part of the eastern Himalayan Biodiversity Hotspot, which covers parts of Nepal, Bhutan, the northeast Indian states, southeast Tibet (China), and northern Myanmar. It is the meeting place of the central Asia and Chinese subdivision of the Palearctic Region with the Peninsular India and Malayan subdivision of Oriental Region supporting rich lepidopteran diversity (Wynther-Blyth 1957).

Lasiocampidae Harris is one of the diverse families of moths having nocturnal and crepuscular habit. The Lasiocampidae are commonly known as Lappet moths due to presence of decorative skin flaps on prolegs of their caterpillars. Lasiocampidae are small to large sized insects with wingspan ranges between 20–180 mm (Zolotuhin & Pinratana 2005). The body is stout, remarkably hairy often provided with broad triangular or rounded forewings and almost circular small hind wings, lacking wing-coupling. Adults often sexually dimorphic being females are larger than males; occasionally females are brachypterous. The family Lasiocampidae consists of 1,952 species (224 genera) worldwide (Van Nieukerken *et al*. 2011).

Till date, India best-consolidated account of Lasiocampidae fauna is with 54 species published by Hampson (1892) in his "The Fauna of British India including Ceylon and Burma". In Indian Himalayas and north east India (Sikkim and Arunachal Pradesh), recent studies conducted by Zoological survey of India reports the presence of 39 species of Lasiocampidae (Sanyal *et al.* 2018). Few records have been found on studies undertaken in different north east Indian states about Lasiocampidae fauna: 20 species in Meghalaya (Mondal & Maulik 1998); 21 species in Manipur (Mondal & Maulik 2004); 3 species in Mizoram (Gupta & Maulik 2007); 2 species in Tawang, Arunachal Pradesh (Chandra & Sambath 2013); and 11 species in Tinsukia, Assam (Arandhara *et al.* 2017).

 Received: 15 Jul. 2020; Accepted by Houhun Li: 22 Aug. 2020; published: 30 Sept. 2020

The first author has undertaken survey between 2016–2019 to sample lepidopteran insects on the different habitats in the different elevations of Shirui Mountains and surrounding areas. The Lasiocampidae constitute a substantial part of all captured lepidopteran specimens. Herewith, reporting the several species not previously recorded from Manipur.

Material and methods

The Lasiocampidae specimens were collected by the first author through intensive light trapping at Shirui Mountains during March–April (spring), June–July (monsoon) and September–October (post-monsoon) between 2016 to 2019. At each sampling sites, 3 traps (a modified Robinson trap with LED+UV lights) and a white sheet (3 X 4 m dimension) with LED+UV lights were used during the night catch. All the sampled target moths were manually collected and killed in the field, dried by silica gel and kept for later identification at laboratory. Genitalia preparations were carried out following the standard methods (Robinson 1976). Unless stated otherwise, all the materials collected are in the possession of first author.

Identification of the materials was based on the morphological characteristics and genitalia descriptions provided in published literatures. Classification follows Zolotuhin *et al*. (2012) and distribution records (for global and local) of each individual species were referred from the following literatures: Hampson (1892), Holloway (1987), Kishida (1992, 1993, 1994, 1995), Zolotuhin & Witt (2000a, 2000b), Zolotuhin (1992, 2002), Zolotuhin *et al*. (1997), Mondal & Maulik (1997, 1998, 2004), Zolotuhin & Pinratana (2005), Gupta & Maulik (2007), Smetacek (2008), Zolotuhin & Ihle (2008), Zolotuhin & Perekrasnov (2009), Prozorov (2010), Sergeev & Zolotuhin (2010), Shubhalaxmi *et al.* (2011), Hauenstein *et al*. (2011), Gurule & Nikam (2013), Sood *et al.* (2015), Sondhi & Sondhi (2016), Arandhara *et al.* (2017), Sanyal *et al.* (2018), Shah *et al.* (2018), Kaleka *et al.* (2018, 2019), Irungbam & Irungbam (2018), Saini *et al*. (2018, 2019) and website of Moths of India (Sondhi *et al*. 2020).

Results

The updated checklist of 35 species of lappet moths from Manipur has been presented in Appendix 1. This updated checklist prepared on the basis of material collected from Shirui Mountains during the 2016 to 2019 and the historical records of Manipur. In the present study, total 24 species of Lasiocampidae identified from 15 genera of which as much as 17 species reported for the first time from Manipur. The 5 species *viz. Euthrix improvisa, Eteinopla narcissus, Kunugia burmensis, Kunugia xichangensis, Arguda viettei* are new addition to known Indian Lasiocampidae fauna.

Family Lasiocampidae Harris, 1841

Subfamily Lasiocampinae Harris, 1841

Tribe Lasiocampini Harris, 1841

Genus *Amurilla* Aurivillius, 1902

***Amurilla rubra* (Hampson, 1896)**
Metanastria rubra Hampson, 1896; *Fauna Brit. India,* 4: 486. Type-locality: Northern India.

***Amurilla rubra rubra* (Hampson, 1896)**
(Figs 1–2 ♀, 3–4, ♂; Fig. 57)
Metanastria rubra Hampson**,** 1896; *Fauna Brit. India,* 4: 486. Type-locality: Northern India.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 24.VII.2017, 12–13.IX.2019, 2♂♂, 2♀♀; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.44560° E,

12.VII.2016, 13.IX.2019, 5♂♂, 1♀, leg. Irungbam J.S. and party. (Genitalia slide: IJ1210 & IJ2300, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 55–62 mm; ♀, 74–78 mm. Length of forewing: ♂, 31–33 mm; ♀, 40–44 mm. Ground color is dark blackish brown. Forewing: reddish costal and anal zones; traces of medial fasciae in the form of yellow strokes. Hindwing: dark rosy basal field. Both pair of wings are semitransparent. Head and thorax bright yellow; tegulae dark brown; abdomen reddish brown with darker dorsal spots.

Distribution. Northern-India (Manipur); Nepal and north western Myanmar.

Comments. First record for Manipur.

Tribe Selenepherini Tutt, 1902

Genus *Euthrix* (Meigen, 1830)

***Euthrix decisa* (Walker, 1855)**

(Figs 5–6, ♂; Fig. 58)

Lasiocampa decisa Walker, 1855; *List Spec, lepid. Insects Colln Br. Mus.,* 6: 1441. N 23.

Type-locality: India, Sylhet.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 13.IX.2019, 2♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ227, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 38–42 mm. Length of forewing: 17–20 mm. ♀ not examined. Bodies with Dark rosy brown to chestnut. Forewing: Dark rosy brown to chestnut; Tornal field often with silver-bluish scales; Shape of dark grey postmedial fascia strongly varies from almost straight diagonal to distinctly curve in anal area. Hindwing: with uniform brownish grey.

Distribution. India (Uttarakhand, West Bengal, Sikkim, Manipur); Nepal and Bangladesh.

Comments. The species was expected to be present in Manipur (Mondal & Maulik 2004). The present record form Shirui Hills confirms the presence of species in Manipur.

***Euthrix fox* Zolotuhin & Witt, 2000**

(Figs 7–8, ♀, 9–10, ♂; Fig. 59)

Euthrix fox Zolotuhin & Witt, 2000; *Entomofauna* Suppl*.,* 11(3): 34.

Type-locality: N. Vietnam, Mt. Fan-si-pan, Cha pa, 2400 m, 22º15’ N, 103º46’E.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 12.VII.2016, 2♀♀; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 25.VII.2017, 13.IX.2019, 2♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2313, IJ2879 & IJ2881, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 40–46 mm; ♀, 49–55 mm. Length of forewing: ♂, 20–23 mm; ♀, 26–30 mm. Body rose violet in color. Forewing: with yellowish brown sub-costal and radial zone; large rounded silver-white discal spot. Three transversal lines present: strong, rosy, postmedial, crossing the wings diagonally, almost parallel to costal margin from the top to cubital zone where they break and end up almost perpendicular in anal margin. A weak antemedial line is situated in basal part of the wing sometimes absent. External line toothed, greyish and outlined by silver scales.

The females are more strongly drawn in their reddish-brown basic color, the other drawing systems are also clearer, but they do not differ significantly from the males,

Distribution. India (Himachal Pradesh, Manipur); Vietnam; Laos; northern Thailand and southern China.

Comments. First record for Manipur.

***Euthrix improvisa* (de Lajonquiere, 1978)**

(Figures 11–12, ♂; Figure 60)

Philudoria improvisa de Lajonquiere, 1978*; Annls Soc. ent. France,* **14**(3): 390, pl. 1 G, fig. 7.

Type-locality: Cochinchina, Tuyen Quang.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 13.IX.2019, 2♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2312, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 32 mm; ♀, 50 mm. Length of forewing: ♂, 18 mm; ♀, 22 mm.

Body and wings are dark rosy brown to chestnut color. Forewing: tornal area with silver-bluish scales making the area prominent; Postmedial fascia dark grey and strong, diagonal, slightly curved in the anal area; A very weak discal spot, yellowish, elongated and completely reduced. Hindwing: with uniformly brownish grey.

The females are significantly larger and usually darker brown in color than the males they have a great clear light-yellow discoidal spot on the forewings.

Distribution. India (Manipur); Northern Thailand and northern Vietnam.

Comments. First record for Manipur as well as for India.

Genus *Eteinopla* de Lajonquiere, 1979

***Eteinopla narcissus* Zolotuhin, 1995**

(Figs 13–14, ♂; Fig. 61)

Eteinopla narcissus Zolotuhin**,** 1995; *Tinea,* 14(3): 160, figs 9, 19.

Type-locality: northern Thailand.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 2♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 13.IX.2019, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ228, IJ229 & IJ998, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 43–45 mm. Length of forewing: 23–24 mm. ♀ not examined. Forewing: with brownish grey, semitransparent, forewings with reddish brown, weakly undulated diagonal line. External margin rounded not scalloped. Discal spot divided into two, white, the lower one with brown center. Hindwing: with yellowish tint.

Distribution. India (Manipur); North-eastern Myanmar; northern Vietnam; northern Thailand and southern China.

Comments. First record for Manipur as well as for India.

***Eteinopla signata* (Moore, 1879)**

(Figs 15–16, ♂; Fig. 62)

Odonestis signata Moore, 1879; *In*: Hewitson and Moore, *Descr. new Indian lepid. Insects Colln late Mr W.S. Atkinson,* (1): 76.

Type-locality: India, Darjeeling.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 12.VII.2016, 1♂; Manipur, Ukhrul district, Shirui Hills (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 12.VII.2016, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ1178, coll. Irungbam J.S.).

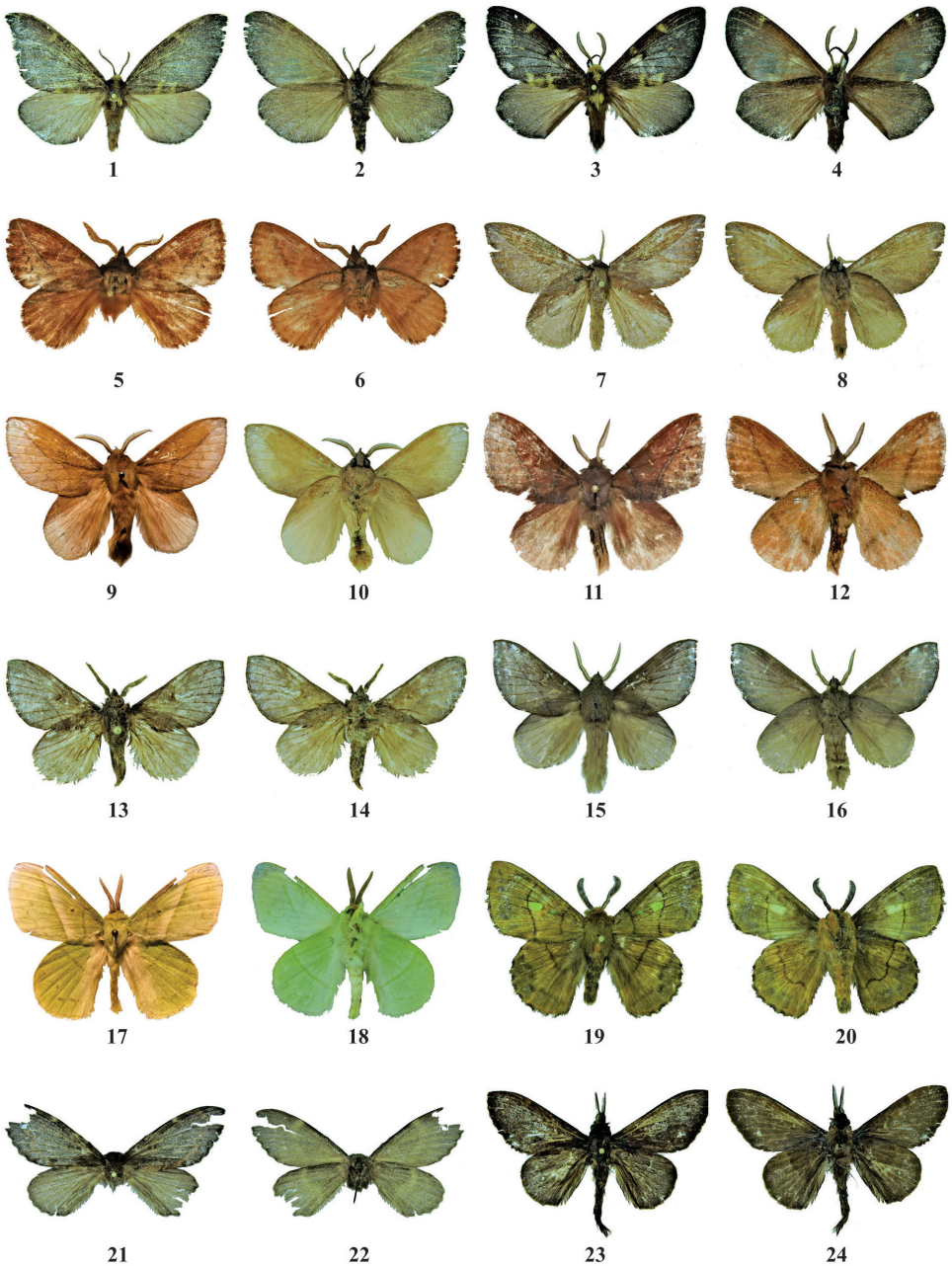
Diagnosis. Expanse: ♂, 30–38 mm. Length of forewing: 17–22 mm. ♀ not examined. Bodies and wings covered with grey and brownish scales. Forewing: with acute apex and slightly scalloped outer margin. Pattern on the forewing consists of undulate to dentate dark grey postmedia, distinctly curved in cubital zone to the basis of the wing. External line weak, not typical for all specimens, formed by a few grey scales. External field grey, often semitransparent. Discal spot white usually divided into two, the lower part sometimes with reddish inner scales. Hindwing: light brownish-rosy.

Distribution. India (West Bengal, Sikkim, Manipur); Nepal; Bhutan; southern China; Laos; Thailand; Vietnam and Peninsular Malaysia.

Comments. The species was expected to be present in Manipur (Mondal & Maulik 2004). The present record form Shirui Hills confirms the presence of species in Manipur.

Tribe Trabaliini Tutt, 1902

Genus *Trabala* Walker, 1856



Figures 1–24. Adults of Lasiocampidae (odd numbers dorsal view; even numbers ventral view). **1–2,** female of *Amurilla rubra rubra* (Hampson, 1896); **3–4,** male of *A. rubra rubra* (Hampson, 1896); **5–6,** *Euthrix decisa* (Walker, 1855); **7–8,** female of *E. fox* Zolotuhin & Witt, 2000; **9–10,** male of *E. fox* Zolotuhin & Witt, 2000; **11–12,** male of *E. improvisa* (de Lajonquiere, 1978); **13–14,** male of *Eteinopla narcissus* Zolotuhin, 1995; **15–16,** male of *E. signata* (Moore, 1879); **17–18,** male of *Trabala vishnou* (Lefebvre, 1827); **19–20,** male of *Crinocraspeda torrida* (Moore, 1879); **21–22,** female of *Kunugia burmensis* (Gaede, 1932); **23–24,** male of *K. burmensis* (Gaede, 1932)

***Trabala vishnou* (Lefebvre, 1827)**

(Figs 17–18, ♂; Fig. 63)

Gastropacha vishnou Lefebvre, 1827; *Zool. J.,* (3): 207.

Type-locality: [India] Madras.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 24.VII.2019, 12.IX.2019, 4♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 12.VII.2016, 4♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2100 & IJ2102, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 40–57 mm; ♀, 68–82 mm. Length of forewing: ♂, 21–29 mm; ♀, 38–46 mm. Forewing: ground color is light apple-green in males; medial lines darker, prominent, straight, the postmedial line bordered on the medial facing side by lighter scales. Discal spot very small or absent in some specimens, point like, blackish. External line smooth, toothed, greyish.

The females are significantly larger, their basic color varies from light green to yellow in all shades. The forewings have a large, brown field with a typical discal spot. A partly interrupted dark line runs through the median area and continues into the disc region of the hind wings. Irregular dark, crescent-shaped drawings stand on the outer edge of the front and hind wings. The light-yellow abdomen bears a strong anal bush with the hair stuck to the female's eggs.

Distribution. India (Himachal Pradesh, Punjab, Uttarakhand, Karnataka, Maharashtra, West Bengal, Meghalaya, Arunachal Pradesh, Assam, Manipur); north-eastern Pakistan; Nepal; Bhutan; Sri Lanka; Myanmar, China; Cambodia; Laos; Thailand; Vietnam and Malaysia.

Comments. The species was expected to be present in Manipur (Mondal & Maulik 2004). The present record form Shirui Hills confirms the presence of species in Manipur. Hampson

Genus *Crinocraspeda* Hampson, 1893

***Crinocraspeda torrida* (Moore, 1879)**

(Figs 19–20, ♂; Fig. 64)

Gastropacha torrida Moore, 1879; *In*: Hewitson and Moore, *Descr. new Indian lepid. Insects Colln late Mr. W. S. Atkinson,* (1): 76, pl. 3, fig. 19.

Type-locality: India, Darjeeling.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 24.VII.2019, 12.IX.2019, 5♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 13.IX.2019, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2311, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 35–39 mm; ♀, 51–62 mm. Length of forewing: ♂, 20–22 mm; ♀, 28–34 mm. Ground color of the wings is dark yellow brown to brown, medial lines darker, concave, non-serrate. Discal spot dark brownish, accompanied distally by an apple-green, semicircular spot or patch which is diagnostic. External line smooth, spotted grey, sometimes flecked with silver-bluish scales. Cilia blackish.

The females are much larger than the males, possess an apple-green ground colour with a distinctive brown discoidal patch. The sub median area is brown, adjoining the inner margin of the forewing, bordered on both sides by a brown line. The hindwing bears a slightly smaller brown patch at the discoidal vein. In the postdiscal area rows of small dots form irregularly shaped bands which extend up to the apical area of the forewing. The abdomen is tipped with a black brush of hair scales, which cover the freshly laid eggs.

Generally, the females look very similar to those of *Trabala vishnou*.

Distribution. India: (Uttarakhand, West Bengal, Sikkim, Meghalaya, Arunachal Pradesh, Assam, Manipur); Nepal; Bhutan; Myanmar; southern northern China; Laos; Thailand and northern Vietnam.

Comments. Recorded earlier from Manipur by Hampson (1892) and Mondal & Maulik (2004).

Tribe Pinarini Kirby, 1892

Genus *Kunugia* Nagano, 1917

***Kunugia burmensis* (Gaede, 1932)**

(Figs 21–22, ♀, 23–24, ♂; Fig. 65)

Dendrolimus burmensis Gaede, 1932; *In*: Seitz, *Großschmett. Erde, vol. II, suppl.*: 123.

Type-locality: Myanmar (Karen Hills).

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 24.VII.2019, 10♂♂ 2♀♀; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 3♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ208 & IJ212, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 53–58 mm; ♀, 62–65 mm. Length of forewing: ♂, 26–28 mm; ♀, 32–34 mm. Forewing: with very dark chocolate-brown ground colour making dark wing pattern invisible, dark yellowish-brown transverse fasciae are typical, all more prominent on costal and dorsal edge. External line spotted, blackish; external margin dark, with blackish scales. Hindwing: dark brown with vague yellowish band; discal spot white, very small but prominent, on proximal third of the wing.

Distribution. India (Manipur); Myanmar; south-western China and northern Vietnam.

Comments. First record for Manipur as well as for India.

***Kunugia fulgens* (Moore, 1879)**

(Figs 25–26, ♂; Fig. 66)

Lebeda fulgens Moore, 1879; *In*: Hewitson and Moore, *Descr. new Indian lepid. Insects colln late Mr Atkinson*, (1): 81.

Type-locality: Darjiling.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 12.IV.2019, 2♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ996, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 60–63 mm. Length of forewing: 29–33 mm. ♀ not examined. Forewing: narrow, elongate with protruding apex; dark yellow brown, darker in costal and external fields. There are several serrated, dark brown or dark grey, transverse fasciae and solitary dots and spots between all these fasciae. Apical field often covered with dark grey scales. Discal spot very small to reduced, white, rounded or point-like. Hindwing: rounded, brownish-yellow, without pattern.

Distribution. India (Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh, Manipur); Nepal; Myanmar; southern China; north and north-eastern Thailand and Vietnam.

Comments. First record for Manipur.

***Kunugia latipennis* (Walker, 1855)**

(Figs 27–28, ♂; Fig. 67)

Lebeda latipennis Walker, 1855*; List spec. Lepid. Insects Colln Brit. Mus.* 6: 1457.

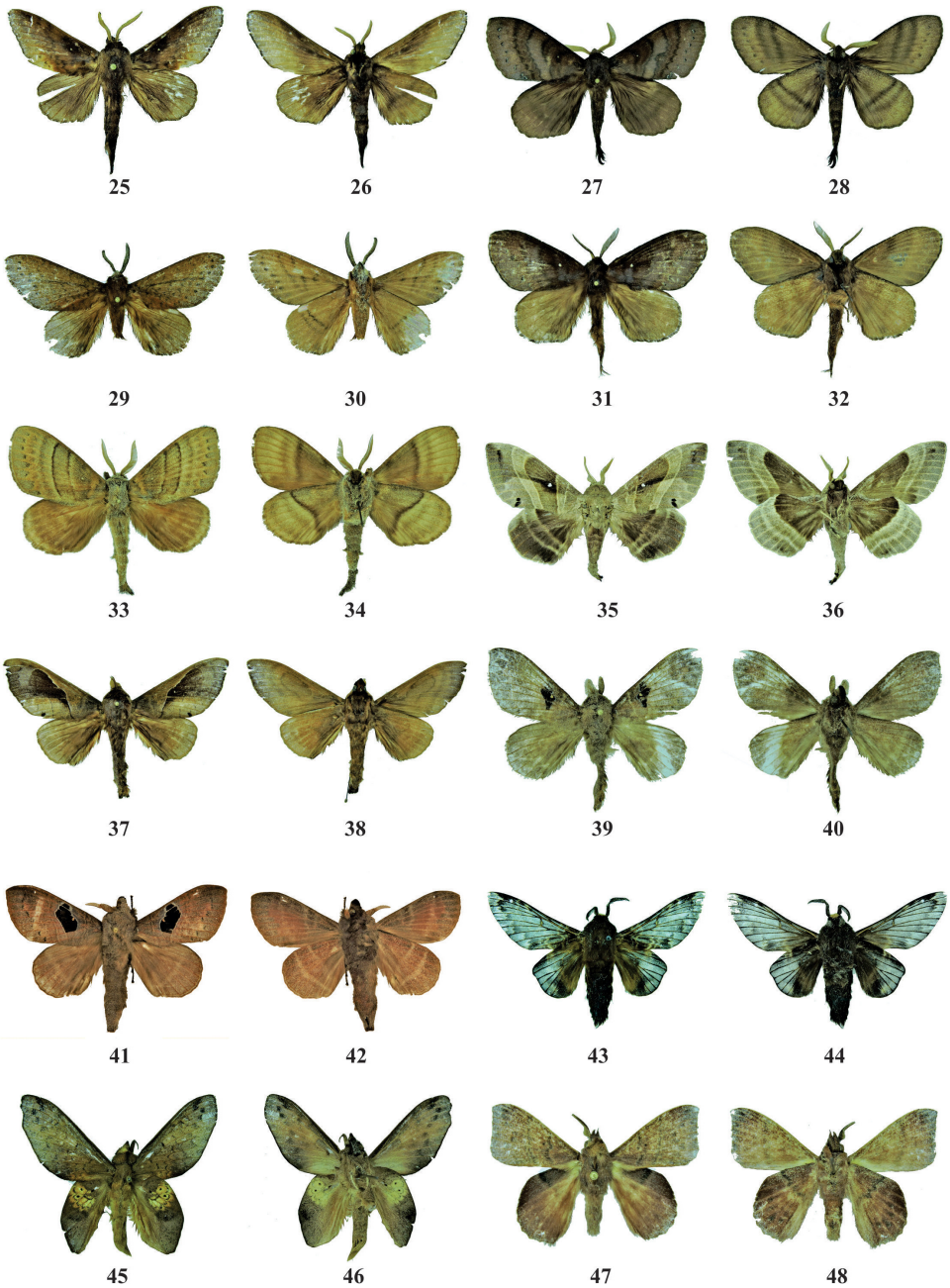
Type-locality: Northern India.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 3♂♂; Imphal West district, Langol Reserve Forest near Shiv Temple, 24.8449° N, 93.9195° E, 949 m asl., 24.IX.2017, 13♂♂; Imphal East district, Matai village, Kameng-Luwangsangbam bypass, 24.8571° N, 93.9021° E, 797 m asl., 24.IX.2017, 5♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ941, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 72–89 mm. Length of forewing: 34–43 mm. ♀ not examined. Bodies and both pairs of wings reddish-brown to violet-brown, abdomen sometimes lighter. Forewing: with dark brown, toothed, curved transverse medial lines, serrated fuscous markings; antemedial, medial postmedial lines present; a sub marginal dotted line; cilia brown; underside brown, medial and postmedial lines paler. Hindwing: with ground color reddish-brown; antemedial line indistinct; medial and postmedial lines paler; sub marginal line indistinct; underside brown, medial and postmedial lines paler.

Distribution. India (Uttarakhand, Chhattisgarh, West Bengal, Sikkim, Assam, Meghalaya, Mizoram, Manipur); Nepal; Bhutan; Myanmar; southern China; Thailand; Sumatra; Borneo and Palawan.

Comments. First record for Manipur.



Figures 25–48. Adults of Lasiocampidae (odd numbers dorsal view; even numbers ventral view). **25–26,** male of *Kunugia fulgens* Moore, 1879; **27–28,** male of *K. latipennis* (Walker, 1855); **29–30,** male of *K. lineata* (Moore, 1879); **31–32**, male of *K. vulpina* (Moore, 1879); **33–34,** male of *K. xichangensis* (Tsai and Liu, 1962); **35–36,** male of *Lebeda nobilis* Walker, 1855; **37–38**, male of *Paralebeda femorata* (Ménétriés, 1858); **39–40,** male of *Metanastria aconyta* (Cramer, 1777); **41–42,** male of *M. gemella* de Lajonquiere, 1979; **43–44,** male of *Pyrosis fulviplaga* (de Joannis, 1929); **45–46,** male of *Estigena philippinensis swanni* Tams, 1973; **47–48,** male of *Arguda viettei* de Lajonquiere, 1977.

***Kunugia lineata* (Moore, 1879)**

(Figs 29–30, ♂; Fig. 68)

Lebeda lineata Moore, 1879; *In*: Hewitson and Moore. *Descr. new Indian lepid. Ins. Colln late Atkinson,* (1): 81.

Type-locality: India, Darjeeling.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 2♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 1♂; Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112° N and 94.4534° E, 25.VII.2019, 3♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ230 & IJ241, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 48–58 mm; ♀, 80 mm. Length of forewing: ♂, 22–27 mm; ♀, 34 mm. Forewing: with ground color reddish-brown, crossed by four grey, irregular toothed curved indistinct lines; a distinct streak from base to sub marginal area; a series of black sub marginal spots; cilia brown; underside reddish-brown, longitudinal line indistinct.; Hindwing: with ground color reddish-brown; antemedial line obsolete; medial line paler; cilia brown; underside reddish-brown. Females are usually larger than males.

Distribution. India (Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Sikkim, Arunachal Pradesh, Manipur); Nepal; Bhutan; Myanmar; southern China; northern Thailand; Laos and northern Vietnam.

Comments. First record for Manipur.

***Kunugia vulpina* (Moore, 1879)**

(Figs 31–32, ♂; Fig. 69)

Lebeda vulpina Moore, 1879; *In*: Hewitson and Moore. *Descr. new Indian lepid. Ins. Colln late Atkinson,* (1): 81.

Type-locality: India, Darjeeling.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 12.VII.2016, 1♂; Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112°N, 94.4534°E, 12.VII.2016, 5♂♂; Imphal East district, Matai village, Kameng-Luwangsangbam bypass, 24.8571° N, 93.9021° E, 797 m asl., 24.IX.2017, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ699, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 64–70 mm. Length of forewing: 27–29 mm. ♀ not examined. Forewing: dark reddish-brown to blackish brown with blackish; vague, stepped basal, medial and external lines, the latter often with blackish and whitish or greyish dots. Clear diagnostic characters are silky shine of transversal fields situated between basal and antemedial lines as well as postmedial line and its shadow. Zone between postmedial shadow and external line is bright orange brown in dark forms or of the same coloration as ground colour in light forms. Discal spot white, small but prominent, on proximal quarter of the wing. Hindwing: lighter, rosy-brown.

Distribution. India (West Bengal, Manipur); Bhutan; southern China; northern Vietnam and north Thailand.

Comments. First record for Manipur.

***Kunugia xichangensis* (Tsai & Liu, 1962)**

(Figs 33–34, ♂; Fig. 70)

Dendrolimus xichangensis Tsai & Liu, 1962; *Act. Ent. Sinica,* 11: 248, 252 figs.

Type-locality: China, Szechuan, Xichang.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 9♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 1♂; Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112° N, 94.4534° E, 12.VII.2016, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ218, IJ221, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 55–60 mm. Length of forewing: 27–29 mm. ♀ not examined. Forewing: Light brown; basal, curved transverse medial lines, with blackish and greyish dots. Discal spot white, small but prominent, on proximal quarter of the wing. Hindwing: lighter with ground color reddish-brown; medial and postmedial lines paler; sub marginal line indistinct; underside brown, medial lines paler.

Distribution. India (Manipur); Myanmar and China.

Comments. First record for Manipur as well as for India.

Genus *Lebeda* Walker, 1855

***Lebeda nobilis* Walker, 1855**

Lebeda nobilis Walker,1855; *List. Spec, lepid. Insects Colln Br. Mus.,* 6: 1456.
Type-locality: Nepal and Silhet.

***Lebeda nobilis nobilis* Walker, 1855**

(Figs 35–36, ♂; Fig. 71)
Lebeda nobilis Walker,1855; *List. Spec, lepid. Insects Colln Br. Mus.,* 6: 1456.
Type-locality: Nepal and Silhet.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 24.VII.2019, 7♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 1♂; Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112°N, 94.4534°E, 25.VII.2019, 5♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2098, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 79–98 mm. Length of forewing: 39–46 mm. ♀ not examined. Body reddish brown-grey without pattern. Abdominal tuft often with dark brown apex. Forewing: brownish grey with four concave, cream-brownish, transversal lines and stepped externa, outlined dorsally by greyish scales. Dark brown to blackish longitudinal stroke in R-Cu cellular reaching M-branch and widening in the external area into a dark triangle. Hindwing: darker, greyish brown, with two lighter transversal bands and lighted costal field.

Distribution. India (Jammu and Kashmir, Uttarakhand; Maharashtra, Goa, West Bengal, Sikkim, Assam, Meghalaya, Nagaland, Manipur); Nepal; Bhutan; Bangladesh and northern Thailand.

Comments. The species was expected to be present in Manipur (Mondal & Maulik 2004). The present record form Shirui Hills confirms the presence of species in Manipur.

Genus *Paralebeda* Aurivillius, 1894

***Paralebeda femorata* (Ménétriés, 1858)**

Lasiocampa femorata Ménétriés, 1858; *Bull. Acad. Imp. Sei. St. Petersburg*, **17**(24): 218, d.
Type-locality: [Russia] Amur region.

***Paralebeda femorata karmata* Zolotuhin, 1996**

(Figs 37–38, ♂; Fig. 72)
Paralebeda femorata karmata Zolotuhin, 1996; *Entomofauna*, 17(13): 249, fig. 6.
Type-locality: north-western Pakistan, Hazara, Nathiagali, 2400–2600 m.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 12.VII.2016, 2♂♂; Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 24.VII.2019. 10♂♂ 8♀♀; Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112° N, 94.4534° E, 12.VII.2016, 24.VII.2019, 3♂♂ 6♀♀; Manipur, Ukhrul district, Shirui Hills (Site 5), Imphal-Jessami road, 2835 m asl., 25.1069° N, 94.4456° E, 13.IX.2019, 1♀, leg. Irungbam J.S. and party. (Genitalia slide: IJ770, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 79–98 mm. Length of forewing: 39–46 mm. ♀ not examined. Forewing: with ground colour fuscous, females brown; markings black; antemedial line distinct; medial loop broader, medial portion prominent with hump starting from inner margin, reaching below costa, upper zone of loop darker and reddish-brown; a prominent dark black spot on tornus; postmedial line indistinct; submarginal dotted line present; underside fuscous, loop and tornal spot distinct. Hindwing: with ground colour fuscous without any distinct pattern; antemedial and postmedial lines obsolete; medial line paler; underside fuscous.

Distribution. India (Jammu and Kashmir, Himachal Pradesh, Punjab, Uttarakhand, Manipur); north western Pakistan; Nepal; Bhutan; northeastern and eastern China; northern Vietnam and Russia.

Comments. First record from Manipur.

Genus *Metanastria* Hübner, 1820

***Metanastria aconyta* (Cramer, 1777)**

(Figs 39–40, ♂; Fig. 73)

Phalaena-Bombyx acontia Cramer, 1777; *Pap. Exot.*, 2: 51, pl. 131, fig. A.

Type-locality. Sikkim, Bengalen, Canara (Nordindien).

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 24.VII.2019, 1♂; INDIA, Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 2♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2568, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 48–60 mm. Length of forewing: 24–30 mm. ♀ not examined. Forewing: short and broad, reddish brown, not semitransparent, with large dark chocolate-brown medial speck strongly outlined with whitish scales. Discal spot distinct, whitish, semilunar; external greyish, stepped. Hindwing: reddish brown, with vague darker transversal bands. Anal tuft with very dark coloured scales.

Distribution. India (Karnataka, Kerala, Sikkim, Manipur); Nepal and eastern Thailand.

Comments. The species was expected to be present in Manipur (Mondal & Maulik, 2004). The present record form Shirui Hills confirms the presence of species in Manipur.

***Metanastria gemella* de Lajonquiere, 1979**

(Figs 41–42, ♂; Fig. 74)

Metanastria gemella de Lajonquiere, 1979; *Ann. Soc. entomol. France, N.S.,* 15: 686 - 688, pi. 1, D, E, figs. 4-6, 8.

Type-locality: North-eastern Sumatra.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 10.VII.2016, 23.VII.2019, 13♂♂; Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 24.VII.2019, 7♂♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 12.VII.2016, 13.IX.2019, 24.VII.2019, 2♂♂; Imphal East district, Matai village, Kameng-Luwangsangbam bypass, 24.8571° N, 93.9021° E, 797 m asl., 24.IX.2017, 3♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2568, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 41–48 mm. Length of forewing: 23–25 mm. ♀ not examined. Forewing: narrow and elongated, reddish brown with four vague concave, bluish, transversal lines and stepped reddish externa; median zone is almost completely dark, chocolate brown; discal spot small, yellowish, round or semilunar. Hindwing: greyish brown without distinct pattern.

Distribution. India (Arunachal Pradesh, Tripura, Manipur); Nepal; southern and south eastern China; Vietnam; northern and western Thailand; Malaysia; Sumatra and Borneo.

Comments. First record for Manipur.

Genus *Pyrosis* Oberthür, 1880

***Pyrosis fulviplaga* (de Joannis, 1929)**

(Figs 43–44, ♂; Fig. 75)

Bhima fulviplaga de Joannis, 1929; *Ann. Soc. ent. France,* 48: 563.

Type-locality: [Vietnam] Hoang su phi.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 13.IX.2019, 5♂♂; Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112° N, 94.4534° E, 13.IX.2019, 2♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2317, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 39–45 mm; ♀, 75 mm. Length of forewing: ♂, 23–25 mm; ♀, 38 mm. Forewing: semitransparent, blackish, with indistinct whitish transversal fasciae. External band present as a vague blackish fascia bordered on both sides by semitransparent fields. Discal spot indistinct, narrow, yellowish to dark yellow. Hindwings reddish brown with semitransparent outer field, blackish anal spot and narrow citron yellow transverse bands. Body dark red-brown, front with cream colored hairs.

Distribution. Northern India (Manipur); Nepal; Myanmar; Northern Vietnam and northern Thailand.

Comments. First record for Manipur.

Tribe Gastropachini Neumoegen and Dyar, 1893

Genus *Estigena* Moore, [1860] 1858–1859

***Estigena philippinensis* (Tams, 1935)**

Gastropacha pardale philippinensis Tams, 1935; *Mem. Mus. Royal Hist. Nat. Belgique*, 4(12): 51, pl. III, fig. 9.

Type-locality. Philippines, Luzon, subprov. Benguet, Klondyke.

***Estigena philippinensis swanni* (Tams, 1935)**

(Figs 45–46, ♂; Fig. 76)

Gastropacha pardale swanni Tams, 1935, *Mem. Mus. Royal Hist. Nat. Belgique,* 4(12): 52, text fig. 3.

Type-locality: Upper Burma, Htawgaw.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 4), Imphal-Jessami road, 2425 m asl., 25.1112° N, 94.4534° E, 25.VII.2019, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ2868, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 39–45 mm. Length of forewing: 23–25 mm. ♀ not examined. The species is very close to *E. pardale*. *E. philippinensis* can be differentiated from *E. pardale* by having valvar position at distal position, hook shaped with serrate outer margin.

Distribution. India (Manipur); Pakistan; Nepal; Bhutan; Andaman Islands, Southern China; Thailand; Laos; Vietnam; Myanmar; Borneo; Sumatra; and the Philippines.

Comments. First record for Manipur. Tams (1935) reviewed the genera *Estigena* Moore, *Stenophylloides* Hampson, and *Tauscheria* Bryk and listed under *Gastropacha* Ochsenheimer. Later, the status of genus *Estigena* was re-established based on the DNA analysis and morphological characters (Prozorov 2010).

Tribe Odonestini Tutt, 1902

Genus *Odonestis* Germar, 1812

***Odonestis pruni* (Linnaeus, 1758)**

Phalaena pruni Linnaeus, 1758, Syst. Nat. (Ed. 10) 1: 498.

Type-locality: Germania.

***Odonestis pruni oberthueri* Tams, 1935**

(Figs 51–52, ♀, 53–54, ♂; Fig. 79)

Odonestis pruni oberthueri Tams, 1935; *Mem. Mus. Royal Hist. nat. Belg*., 4(12): 57, pl. 6: 8, 9; pl. 8: 5.

Type-locality: [China, Sichuan] “frontiere orientale du Tibet”.

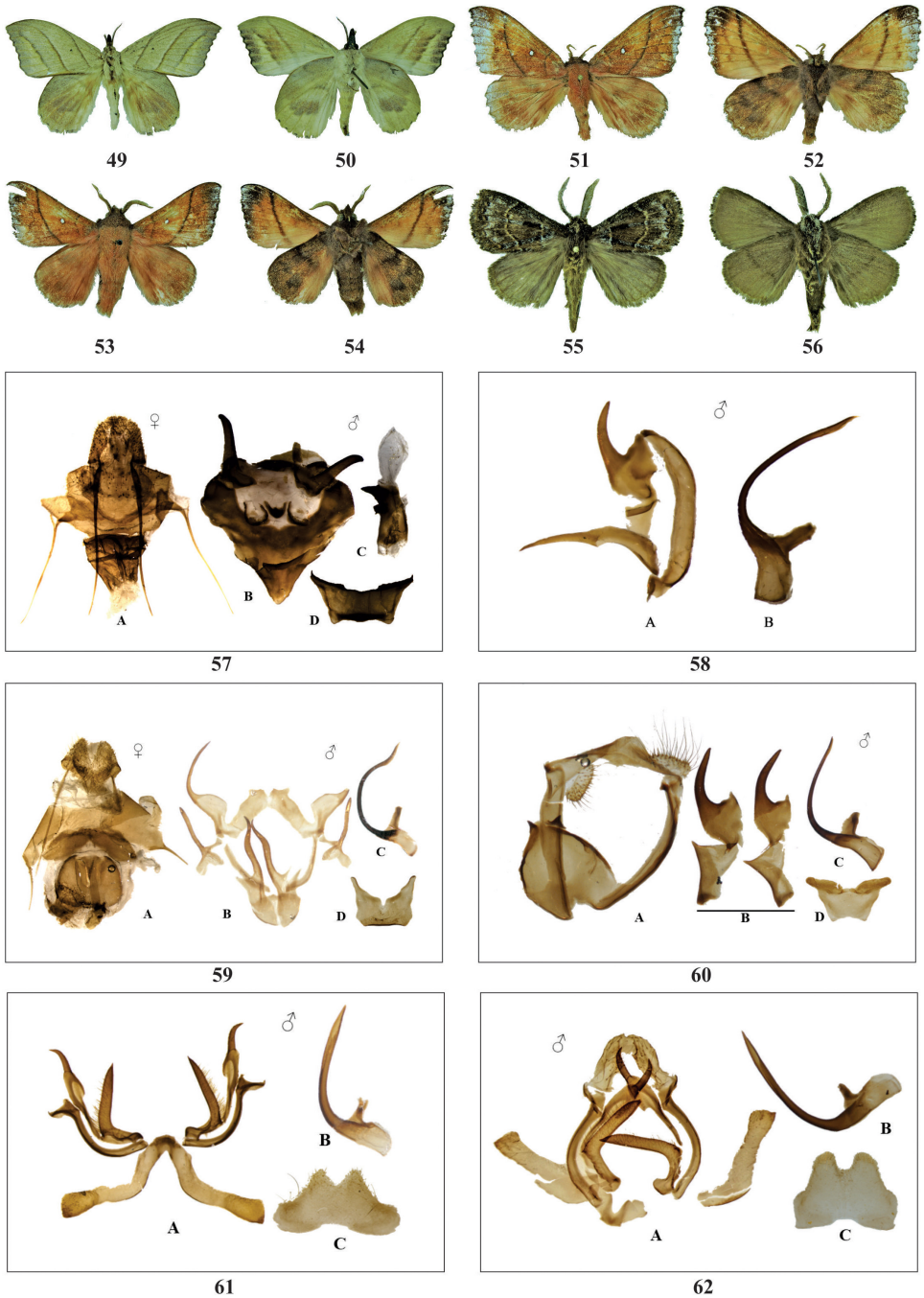
Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 24.VII.2019, 2♂♂, 2♀♀, leg. Irungbam J.S. and party. (Genitalia slide: IJ2307, IJ2308, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 44–46 mm; ♀, 55–58 mm. Length of forewing: ♂, 24–27 mm; ♀, 27–30 mm. Wing ground colour reddish orange, with a brown pattern. Sub marginal fasciae are distinct, obviously darker than the rest of the wing. Outer margin of both wings is dentate. White round discal spot is typical for the forewing. Postmedial fascia is fine but distinct, strongly concave; antemedial fascia is weak, concave and external is fine dentate.

Females are generally larger than males.

Distribution. India (Assam, Manipur); Nepal; Bhutan and southern China.

Comments. First record for Manipur.



Figures 49–62. 49–56. Adults of Lasiocampidae (odd numbers dorsal view; even numbers ventral view). **49–50,** female of *Arguda vinata nepalina* Kishida, 1992; **51–52,** male of *Odonestis pruni oberthueri* Tams, 1935; **53–54,** male of *O. pruni oberthueri* Tams, 1935; **55–56**. Male of *Baodera khasiana* (Moore, 1879): **57–62.** Genitalia of Lasiocampidae**. 57**, female (A) and male (B–D) genitalia of *Amurilla rubra rubra* (Hampson, 1896); **58,** male genitalia (A–B) of *Euthrix decisa* (Walker, 1855); **59,** female (A) and male (B–D) genitalia of *E. fox* Zolotuhin & Witt, 2000; **60,** male (A–D) genitalia of *E. improvisa* (de Lajonquiere, 1978); **61,** male (A–C) genitalia of *Eteinopla narcissus* Zolotuhin, 1995; **62,** male (A–C) genitalia of *E. signata* (Moore, 1879).

Tribe Argudini Zolotuhin, 2010

Genus *Arguda* Moore, 1879

***Arguda viettei* de Lajonquiere, 1977**

(Figs 47–48, ♂; Fig. 77)

Arguda viettei de Lajonquiere, 1977; *Bull. Soc. Ent. France,* 82: 178, pl. 1C, fig. 5.

Type-locality: North-eastern Sumatra, Dairi, 1,600m.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 1♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ949, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 32–37 mm. Length of forewing: 16–18 mm. ♀ not examined. Bodies and wings reddish brown, both medias light, outlined from both sides with greyish scales. Hindwings without any pattern, with costal color same as in the forewings but the rest part of the wings is dark reddish brown.

Distribution. India (Manipur); Myanmar; southern China; northern Thailand; northern Vietnam; Borneo and Sumatra.

Comments. First record for Manipur as well as for India.

***Arguda vinata* Moore, 1865**

Arguda vinata Moore, 1865; *Proc. Zool. Soc. London*: 820.

Type-locality: Sikkim, Darjeeling.

***Arguda vinata nepalina* Kishida, 1992**

(Figs 49–50, ♀; Fig. 78)

Arguda nepalina Kishida, 1992; *Moths Nepal 1* (Tinea 13 Suppl. 2): 77, fig. 55; pi. 20:3.

Type-locality: Nepal, Godavari.

Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 13.IX.2019, 2♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ646, coll. Irungbam J.S.).

Diagnosis. Expanse: ♂, 47–53 mm; ♀, 51–72 mm. Length of forewing: ♂, 24–27 mm; ♀, 27–37 mm. Forewing: rosy cream with three diagonal, almost greyish-brown lines, both medias have a yellowish outline; Discal spot small but distinct, black, point like. Hindwing: without pattern; the costal field the same colour with the forewing but the rest of the wing dark reddish-brown.

Females larger and lighter in color.

Distribution. India (West Bengal, Sikkim, Arunachal Pradesh, Manipur); Nepal; southern China; northern Thailand and northern Vietnam.

Comments. First record for Manipur.

Systematic position uncertain

Genus *Baodera* Zolotuhin, 1992

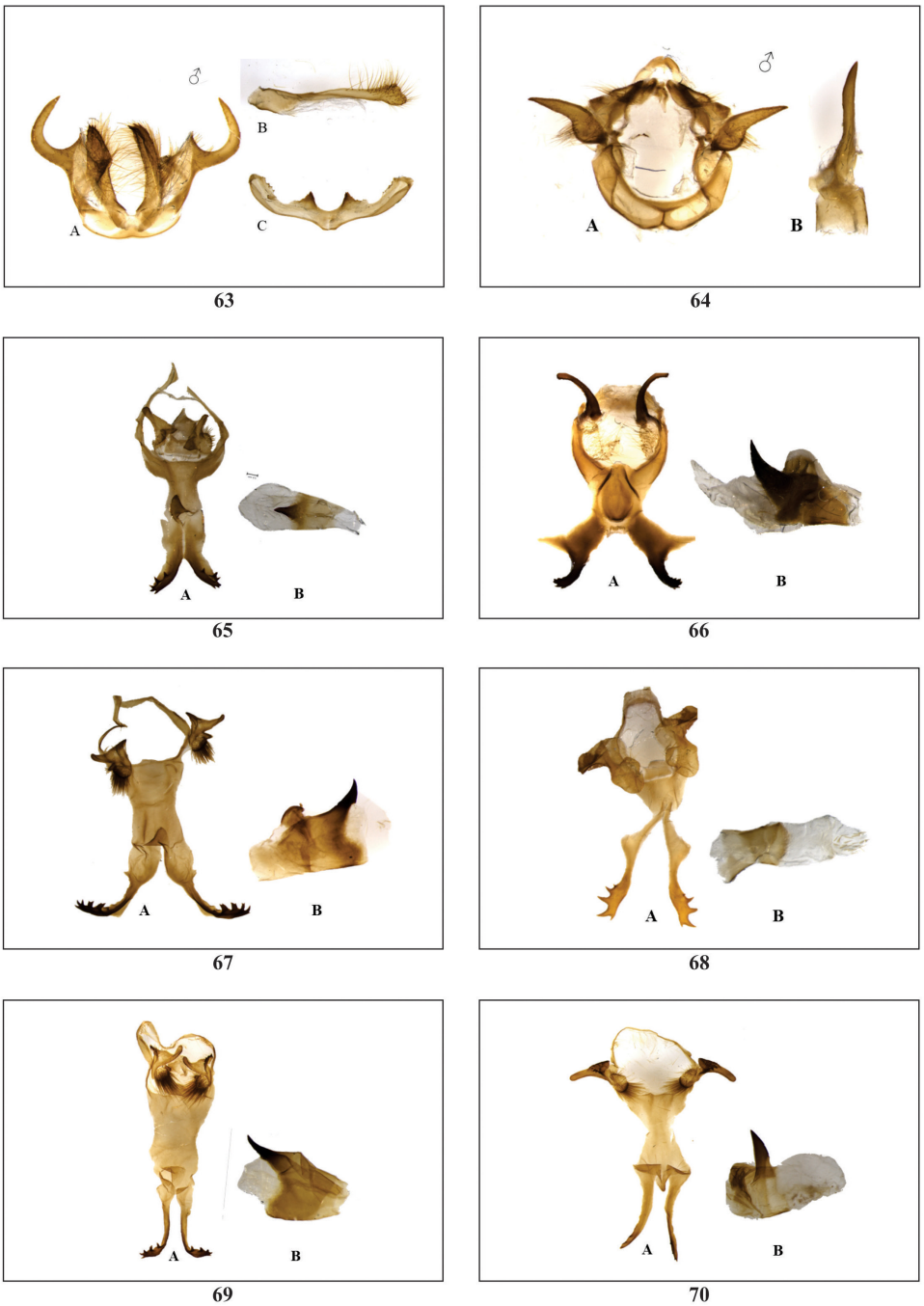
***Baodera khasiana* (Moore, 1879)**

(Figs 55–56, ♂; Fig. 80)

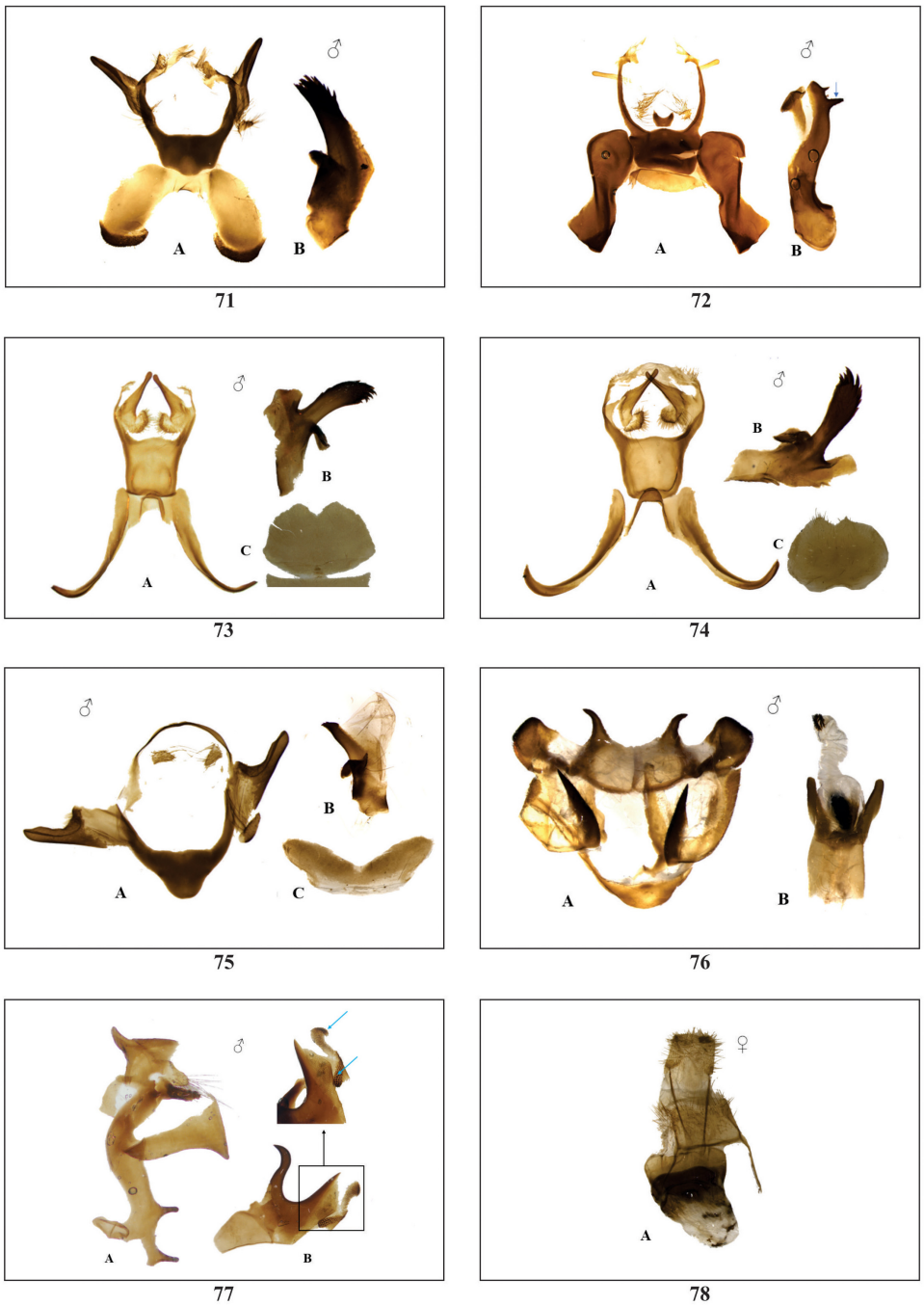
Trichiura khasiana Moore, 1879; *In*: Hewitson and Moore, *Desc. New Indian lipid. Insects Colln late Mr. Atkinson*, 1: 82.

Type-locality: Khasia Hills.

Diagnosis. Expanse: ♂, 38–48 mm. Length of forewing: 19 mm. ♀ not examined. Upper side dark vinous-brown: Fore wing with ferruginous-brown veins and black longitudinal interspaces speckled with grey; crossed by three black pale bordered lines - the first sub basal, second discal, and third marginal, the middle band wavy, the outer zigzag and ochreous-speckled; hind wing with very indistinct darker sub basal band. Underside uniform brown: fore wing with a few grey speckles at the apex; hind wing with indistinct sub basal darker band. Antennae, head, palpi, thorax, and legs dark brown; abdomen paler.



Figures 63–70. Genitalia of Lasiocampidae. **63,** male (A–C) genitalia of *Trabala vishnou* (Lefebvre, 1827); **64**, male (A–B) genitalia of *Crinocraspeda torrida* (Moore, 1879); **65,** male (A–B) genitalia of *Kunugia burmensis* (Gaede, 1932); **66,** male (A–B)genitalia of *K. fulgens* Moore, 1879; **67,** male (A–B) genitalia of *K. latipennis* (Walker, 1855); **68,** male (A–B) genitalia of *K. lineata* (Moore, 1879); **69,** male (A–B) genitalia of *K. vulpina* (Moore, 1879); **70,** male (A–B) genitalia of *K. xichangensis* (Tsai and Liu, 1962).

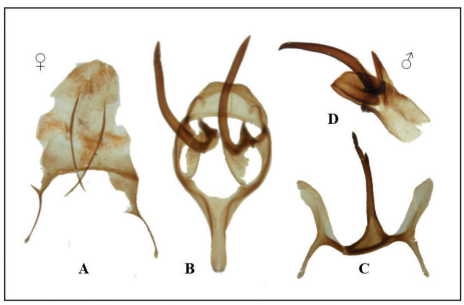


Figures 71–78. Genitalia of Lasiocampidae. **71**, male (A–B) genitalia of *Lebeda nobilis* Walker, 1855; **72,** male (A–B) genitalia of *Paralebeda femorata* (Ménétriés, 1858); **73,** male (A–C) genitalia of *Metanastria aconyta* (Cramer, 1777); **74,** male (A–C) genitalia of *M. gemella* de Lajonquiere, 1979; **75,** male (A–C) genitalia of *Pyrosis fulviplaga* (de Joannis, 1929); **76,** male (A–B) genitalia of *Estigena philippinensis swanni* Tams, 1973; **77,** male (A–B) genitalia of *Arguda viettei* de Lajonquiere, 1977; **78**, female (A) genitalia of *Arguda vinata nepalina* Kishida, 1992.

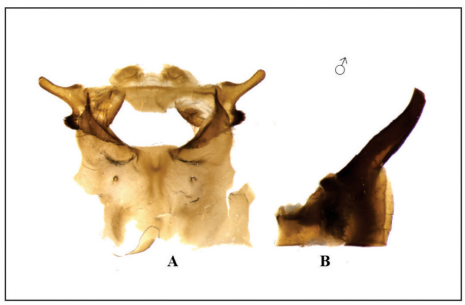
Material examined. INDIA, Manipur, Ukhrul district, Shirui Hills, Shirui Guest House (Site 1), 3 km NE of Shirui village, Imphal-Jessami road, 1930 m asl., 25.1264° N, 94.4357° E, 12.VII.2016, 24.VII.2019, 3♂♂; Manipur, Ukhrul district, Shirui Hills (Site 2), 3 km NE of Shirui village, Imphal-Jessami road, 2036 m asl., 25.1235° N, 94.4407° E, 12.VII.2016, 1♂; Manipur, Ukhrul district, Shirui Hills mid-point (Site 3), 3 km NE of Shirui village, Imphal-Jessami road, 2198 m asl., 25.1171° N, 94.4456° E, 12.VII.2016, 13.III.2019, 23.VII.2019, 9♂♂, leg. Irungbam J.S. and party. (Genitalia slide: IJ244, IJ246, coll. Irungbam J.S.).

Distribution. India (Sikkim, Meghalaya, Assam, Manipur); Nepal; Bhutan; Myanmar and southern China.

Comments. First record for Manipur.



79



80

Figures 79–80. Genitalia of Lasiocampidae. **79,** female (A) and male (B–C) genitalia of *Odonestis pruni oberthueri* Tams, 1935; **80,** male (A–B) genitalia of *Baodera khasiana* (Moore, 1879).

Acknowledgements

The authors are grateful to Dr. Siegfried Ihle, Filderstadt, Germany and Dr. Vadim V. Zolotuhin, Russia for their help in identifying the materials and critical comments on the early stage of manuscript. First and second authors thankful to, Dr. V.B. Gaikwad, Principal, and Dr. V.R. Kakulte, Head Department of Zoology, K.T.H.M. College, Nashik, India for providing the opportunity to work in collaboration during the identification of materials and draft of this manuscript. The first author is thankful to Czech Science Foundation (GACR: 14-36098G) and Grant Agency, University of South Bohemia (GA JU 038/2019/P) for their financial support during the field visits and field equipment. PCCF (Wildlife), Government of Manipur is acknowledged for providing the permit (No. 3/22/2006/WL and No. 3/22/2019-WL) for collection and survey at Shirui Hills, Ukhrul district.

References

Arandhara A., Barman S., Tanti R. & Boruah A. 2017. Macro moths of Tinsukia district, Assam: A provisional inventory. *Journal of Entomology and Zoology Studies* 5(6): 1612–1621.

Chandra K. & Sambath S. 2013. Moth diversity of Tawang District, Arunachal Pradesh, India. *Journal of Threatened Taxa* 5(1): 3565–3570.
https://doi.org/10.11609/JoTT.o2718.966

Gaede M. 1932. Familie: Lasiocampidae. *In*: Seitz, A. *Die Gross-Schmetterlinge der Erde* **2**(Suppl.): 109–125.

Gupta I. J. & Maulik D. R. 2007. Insecta: Lepidoptera: Papilionoidea, Nymphalidae (Danainae), Lasiocampidae and Lymantriidae, pp. 413–426. *In*: *Eds. Fauna of Mizoram, State Fauna Series 14*, Zoological Survey of India, Calcutta, 691 pp.

Gurule S. & Nikam S. 2013. The moths (Lepidoptera: Heterocera) of northern Maharashtra: a preliminary checklist. *Journal of Threatened Taxa* 5(12): 4693–4713.
https://doi.org/10.11609/JoTT.o2555.4693-713

Hampson G. F. 1892. *The Fauna of British India, including Ceylon and Myanmar. Moths 1*. Taylor and Francis, London, Calcutta, Bombay & Berlin, 430 pp.

Hauenstein A., Ihle S., Sinjaev V. V. & Zolotuhin V. V. 2011. The Lasiocampidae of Bhutan (Lepidoptera Lasiocampidae). *Neue Entomologische Nachrichten, Marktleuthen* 67: 27–35.

Holloway J. D. 1987. *Moths of Borneo. Part 3. Lasiocampidae, Eupterotidae, Bombycidae, Brahmaeidae, Saturniidae, Sphingidae*. Southdene Sdn. Bhd., Kuala Lumpur. 199 pp.

Irungbam J. S. & Irungbam M. J. 2018. Two moth species of Lasiocampidae (Lepidoptera: Lasiocampoidea) recorded for the first time in Bhutan. *Journal of Threatened Taxa* 10(11): 12598–12601. https://doi.org/10.11609/jott.3297.10.11.12598-12601

Kaleka A. S., Singh D. & Saini S. 2018. Taxonomic studies on genus *Kunugia* Nagano (Lepidoptera: Bombycoidea: Lasiocampidae) from North-West India. *Annals of Entomology* 36(02): 103–111.

Kaleka A. S., Singh D. & Saini S. 2019. Further studies on two species of the moth genus *Paralebeda* Aurivillius (Lepidoptera: Bombycoidea: Lasiocampidae) from northwestern India. *Journal of Threatened Taxa* 11(12): 14593–14598. https://doi.org/10.11609/jott.4621.11.12.14593-14598

Kishida Y. 1992. Lasiocampidae, pp. 76–79. *In: Moths of Nepal, Part 1. Tinea* 13(Suppl. 2) (Haruta, T., editor). 122 pp.

Kishida Y. 1993. Lasiocampidae. pp. 142. *In: Moths of Nepal, Part 2. Tinea* 13(Suppl. 3) (Haruta, T., editor). 160 pp.

Kishida Y. 1994. Lasiocampidae, pp. 63. *In: Moths of Nepal, Part 3. Tinea* 14(Suppl. 1) (Haruta, T., editor). 171 pp.

Kishida Y. 1995. Lasiocampidae, pp. 38. *In: Moths of Nepal, Part 4. Tinea* 14(Suppl. 2) (Haruta, T., editor). 206 pp.

Mondal D. K. & Maulik D. R. 1997. Insecta: Lepidoptera: Heterocera: Sphingidae, Lasiocampidae, Lymantriidae and Ratardidae, pp. 613–687. *In: Fauna of West Bengal, Part 7, State fauna Series,* 3, Zoological Survey of India, Calcutta, 792 pp.

Mondal D. K. & Maulik D. R. 1998. Insecta: Lepidoptera: Lasiocampidae, Lymantriidae and Ratardidae, pp. 467–488. *In: Fauna of Meghalaya, Part 6, State fauna Series,* 4, Zoological Survey of India, Calcutta, 666 pp.

Mondal D. K. & Maulik D. R. 2004. Insecta: Lepidoptera: Papilionoidea, Bombycoidea and Noctuoidea, pp. 581–590. *In: Fauna of Manipur, State Fauna Series 10,* Zoological Survey of India, Calcutta, 625 pp.

Prozorov A. M. 2010. *Typhonoya* gen. nov. and *Weberolegra* gen. nov. – two new genera for African *Gastropacha* Ochsenheimer, 1810 (Lepidoptera, Lasiocampidae). *Neue Entomologische Nachrichten* 67: 97–106.

Robinson G. S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to microlepidoptera. *Entomologist's gazette* 27: 127–132.

Saini S., Kaleka A. S. & Singh D. 2018. Further studies on three species of genus *Euthrix* Meigen (Lepidoptera: Bombycoidea: Lasiocampidae) from North-West India. *Journal of Environment and Biosciences* 32(2): 279–283.

Saini S., Kaleka A. S. & Singh D. 2019. Studies on three species of genus *Trabala* Walker (Lasiocampidae: Bombycoidea: Lepidoptera) from North West India. *Annals Entomology* 37(01): 19–27.

Sanyal A. K., Mallick K., Khan S., Bandyopadhyay U., Mazumder A., Bhattacharyya K., Pathania P. C., Raha A. & Chandra K. 2018. Insecta: Lepidoptera (Moths), pp. 651–726. *In: Faunal Diversity of Indian Himalaya.* (Chandra, K., Gupta, D., Gopi, K. C., Tripathy, B. & Kumar, V., editors). Zoological Survey of India, Kolkata, India, 872 pp.

Sergeev A. I. & Zolotuhin V. V. 2010. A review of the genus *Odonestis* Germar, 1812 with descriptions of two new species and one new subspecies (Lepidoptera, Lasiocampidae). *Atalanta* 41(3/4): 375–396.

Shah S. K., Das A. & Dutta R. 2018. A Current list of the Moths (Lepidoptera) of West Bengal. *Bionotes* 20(2): 48–52.

Shubhalaxmi V., Kendrick R. C., Vaidya A., Kalagi N. & Bhagwat A. 2011. Inventory of moth fauna (Lepidoptera: Heterocera) of the northern Western Ghats, Maharashtra, India. *Journal of the Bombay Natural History Society* 108(3): 183–205.

Smetacek P. 2008. Moths recorded from different elevations in Nainital district, Kumaon Himalaya, India. *Bionotes* 10(1): 5–15.

Sondhi Y. & Sondhi S. 2016. A partial checklist of moths (Lepidoptera) of Dehradun, Mussoorie and Devalsari in Garhwal, Uttarakhand, India. *Journal of Threatened Taxa* 8(5): 8756–8776. https://doi.org/10.11609/jott.2814.8.5.8756-8776

Sondhi S., Sondhi Y., Roy P. & Kunte K. 2020. Moths of India, v. 2.10. Indian Foundation for Butterflies. Available from: https://www.mothsofindia.org/home [Accessed on 05 July 2020]

Sood R., Pathania P. C. & Rose H. S. 2015. Lappet Moths (Lepidoptera: Lasiocampidae) of north-west India- brief notes on some frequently occurring species. *Biological Forum* 7(2): 841–847.

Tams W. H. T. 1935. Résultats scientifiques du voyage aux Indes Orientales neerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. *Mémoires du Musée royal d'histoire naturelle de Belgique* (Hors serie), 4(12): 33–64.

van Nieukerken E. J., Kaila L., Kitching I. J., Kristensen N. P., Lees D. C., Minet J., Mitter C., Mutanen M., Regier J. C., Simonsen T. J., Wahlberg N., Yen S. -H., Zahiri R., Adamski D., Baixeras J., Bartsch D., Bengtsson B. A., Brown J. W., Bucheli S. R., Davis D. R., Prins J. D., Prins W. D., Epstein M. E., Gentili-Poole P., Gielis C., Hättenschwiler P., Hausmann A., Holloway J. D., Kallies A., Karsholt O., Kawahara A. Y., Koster S., Kozlov M. V., Lafontaine J. D., Lamas G., Landry J. F., Lee S., Nuss M., Park K. -T., Penz C., Rota J., Schintlmeister A., Schmidt B. C., Sohn J. -C., Solis M. A., Tarmann G. M., Warren A. D., Weller S., Yakovlev R. V., Zolotuhin V. V. & Zwick A. 2011. Order Lepidoptera, pp. 212–221. *In: Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness*. (Zhang, Z-Q (ed.). *Zootaxa* 3148. https://doi.org/10.11646/zootaxa.3148.1.41

Wynter-Blyth M. A. 1957. *Butterflies of the Indian Region.* Bombay Natural History Society, Bombay, 523 pp.

Zolotuhin V. V. 1992. *Baodera* gen. nov. for *Trichiura khasiana* Moore, 1879 (Lepidoptera, Lasiocampidae). *Atalanta* 23(3/4): 491–493.

Zolotuhin V. V. 2002. Studies on Asiatic Lasiocampidae (Lepidoptera), 6. Descriptions of new species from India, China and Thailand with further synonymic notes on some Chinese taxa. *Entomologische Zeitschrift* 112: 135–140.

Zolotuhin V. V., Treadaway C. G. & Witt T. J. 1997. The Lasiocampidae (Lepidoptera) of the Philippines. *Nachrichten des Entomologischen Vereins Apollo* 17: 133–222.

Zolotuhin V. V. & Witt T. J. 2000a. The Lasiocampidae of Vietnam. *Entomofauna Suppl.* 11(3): 25–104.

Zolotuhin V. V. & Witt T. J. 2000b. Lasiocampidae of Nepal. pp. 153–163. *In: Moths of Nepal, Part 6. Tinea,* 16(Suppl. 1), (Haruta, T. editor), 163 pp.

Zolotuhin V. V. & Pinratana A. 2005. *The Moths of Thailand 4: Lasiocampidae: An Illustrated Catalogue of the Lasiocampidae (Lepidoptera) in Thailand*. Brothers of St. Gabriel in Thailand, 205 pp. + 28 pls.

Zolotuhin V. V. & Ihle S. 2008. The Lasiocampidae (Lepidoptera) of Laos. *Tinea* 20(4): 1–19. https://doi.org/10.11646/zootaxa.1791.1.1

Zolotuhin V. V. & Perekrasnov A. A. 2009. A review of the *Euthrix laeta* (Walker, 1855) complex with description of a new species and two new subspecies (Lepidoptera, Lasiocampidae). *Atalanta* 41(3/4): 367–374.

Zolotuhin V. V., Efinov R. V., Anikin V. V., Demin A. G. & Knushevitskaya M. V. 2012. Changes in the Suprageneric Classification of Lasiocampidae (Lepidoptera) Based on the Nucleotide Sequence of Gene EF-1α. *Entomological Review* 92(5): 531–547. https://doi.org/10.1134/S0013873812050065

Appendix I: Updated checklist of Lasiocampidae from Manipur, North East India.

* Previously recorded from Manipur but not found in present survey

New records for Manipur.

† New records for India.

Family: Lasiocampidae Harris, 1841
Subfamily: Malacosominae Tutt, 1902
Tribe: Malacosomini Tutt, 1902
1. *Malacosoma indica* (Walker, 1855) *
Subfamily: Lasiocampinae Harris, 1841
Tribe: Lasiocampini Harris, 1841
2. *Amurilla rubra rubra* (Hampson, 1896) #
3. *Amurilla subpurpurea* (Butler, 1881) *
Tribe: Selenepherini Tutt, 1902
4. *Euthrix decisa* (Walker, 1855)
5. *Euthrix fox* Zolotuhin and Witt, 2000 #
6. *Euthrix improvisa* (de Lajonquiere, 1978) # †
7. *Euthrix laeta* (Walker, 1855) *
8. *Eteinopla narcissus* Zolotuhin, 1995 # †
9. *Eteinopla signata* (Moore, 1879)
Tribe: Trabaliini Tutt, 1902
10. *Trabala vishnou* (Lefebvre, 1827)
11. *Crinocraspeda torrida* (Moore, 1879)
Tribe: Pinarini Kirby, 1892
12. *Kunugia burmensis* (Gaede, 1932) # †
13. *Kunugia fulgens* Moore, 1879 #
14. *Kunugia latipennis* (Walker, 1855) #
15. *Kunugia lineata* (Moore, 1879) #
16. *Kunugia vulpina* (Moore, 1879) #
17. *Kunugia xichangensis* (Tsai and Liu, 1962) # †
18. *Lebeda nobilis nobilis* Walker, 1855
19. *Paralebeda femorata* (Ménétriés, 1858) #
20. *Streblote dorsalis* (Walker, 1866) *
21. *Streblote siva* (Lefèbvre, 1827) *
22. *Metanastria aconyta* (Cramer, 1777)
23. *Metanastria gamella* de Lajonquiere, 1979 #
24. *Metanastria hyrtaca* (Cramer, 1779) *
25. *Pyrosis fulviplaga* (de Joannis, 1929) #
26. *Pyrosis undulosa* (Walker, 1855) *
Tribe: Gastropachini Newmoegen and Dyar, 1893
27. *Estigena pardale* (Walker, 1855)
28. *Estigena philippinensis swanni* Tams, 1973 #
Tribe: Odonestini Tutt, 1902
29. *Radhica flavovittata* Moore, 1879*
30. *Odonestis bheroba* (Moore, 1858) *
31. *Odonestis pruni oberthueri* Tams, 1935 #
Tribe: Argudini Zolotuhin, 2012
32. *Arguda viettei* de Lajonquiere, 1977 # †
33. *Arguda vinata nepalina* Kishida, 1992 #
Systematic position uncertain
34. *Baodera khasiana* (Moore, 1879)
35. *Argonestis flammans* (Hampson, 1892) *

Acherontia styx styx (Westwood, 1847), a common hawkmoth at the Shirui Hill, India. @JS Irungbam

CHAPTER VI

Checklist of the family Sphingidae Latreille, 1802 (Lepidoptera: Bombycoidea) from Shirui Hills, Manipur, India

[1,2]Jatishwor S. Irungbam, and [2]Zdenek F. Fric

Records of the Zoological Survey of India, (2021) 121(1)/173–194

DOI: 10.26515/rzsi/v121/i1/2021/153911

Rec. zool. Surv. India: Vol. 121(1)/173–194, 2021
DOI: 10.26515/rzsi/v121/i1/2021/153911

ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

Checklist of the family Sphingidae Latreille, 1802 (Lepidoptera: Bombycoidea) from Shirui Hills, Manipur, India

Jatishwor Singh Irungbam[1,2*] and Zdeněk Faltýnek Fric[2]

[1]*Faculty of Science, University of South Bohemia, Ceske Budejovice – 37005, Czech Republic; Email: jatishwor.irungbam@gmail.com*

[2]*Biology Centre, Czech Academy of Science, Institute of Entomology, Ceske Budejovice – 37005, Czech Republic; Email: zdfric@gmail.com*

Abstract

The present communication consists of the first-ever checklist of Sphingidae Latreille, 1802 comprising thirty-six species under nineteen genera of three subfamilies with twenty-nine new records to Manipur. Of which, two species viz. *Sphinx oberthueri* (Rothschild and Jordan, 1903) and *Theretra tibetiana* Vaglia and Haxaire, 2010 are new records to India. Field sampling was carried out at Shirui Hills, Ukhrul district, Manipur for four years (2016 to 2019) during March-April (Premonsoon), June-July (Monsoon), and September-October (Post-monsoon). The light-trapping method was employed at five localities of different elevations at Shirui Hills.

Keywords: Light-trapping, Manipur, New Record, *Sphinx oberthueri, Theretra tibetiana*

Introduction

The north-east Indian state Manipur lies in between 23°83'-25°68' N and 93°03'-94°78' E bounded by Nagaland on the north, Assam on the west, on the south, and along the east with Myanmar sharing about 352 km long international border. It covers a total geographical area of 22,327 km^2 of which 17,418 km^2 (78.01%) is under forest cover. Geographically, Manipur is divided into mountain ranges running north to south and a central plain-the valley of Imphal. The altitude of hills ranges from 833m to 3017m. The Manipur is part of the eastern Himalayan Biodiversity Hotspot and considered to be rich in floral and faunal diversity. The region is often known as a hot spot of biodiversity of economically important insects. An attempt was made to know the species diversity of Sphingidae inhabiting the Temperate forest of Shirui hills, Ukhrul district Manipur.

Sphingidae are medium to large-sized, heavy-bodied moths with long, narrow, pointed triangular forewing and a short, smaller hind wing which makes them agile fliers. The large eye, powerful thorax, and sharply pointed abdomen, the graceful, high-bred appearance of the whole creature, can hardly be mistaken (Bell and Scott, 1937). The antenna is filiform or setiform in many species but is more or less strongly clubbed in others. There are usually spines on the tibiae. Adults are generally active at night, although some are diurnal or crepuscular in habit. Proboscis usually very long, which is relatively longer than the body in Sphinginae Latreille (1802), and short or vestigial in Smerithinae Grote and Robinson, 1865. They are strong fliers, and many species are important pollinators of night-blooming flowers.

Sphingidae are a very diverse group represented by 1602 species described in 205 genera all over the world (Kitching *et al.*, 2018). The most comprehensive study of Indian Sphingid remains that of Cotes and Swinhoe (1887) with 187 species and Bell and Scott (1937) with 183 species of which 135 species were reported from the eastern Himalayas. More recent faunal studies of Sphingidae in northeastern India are those of Arandhara (2016) (Digboi, Assam; 31 species), Arandhara *et al.*, (2017) (Tinsukia, Assam; 45 species), Khan and Raina (2017) (Sikkim; 22 species), Bortolin *et al.* (1998) (Himachal Pradesh and Meghalaya (Mandal and Ghosh, 1999); 23 species), Athreya (2013) (Arunachal Pradesh; 66 species), Sanyal *et al.* (2018) (Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Sikkim, West Bengal, Arunachal Pradesh; 184 species). Only two species, *Agrius convolvuli* (Linnaeus, 1758) and *Deilephila elpenor*

* *Author for correspondence*

Article Received on: 25.07.2020 Accepted on: 13.11.2020

(Linnaeus, 1758), were recorded from Manipur by Mandal and Ghosh (2004). These earlier studies revealed that little work has been done on the taxonomy, ecology, and distribution of Sphingidae in Manipur. Keeping in view, the importance of the family Sphingidae in the region, the present study has been undertaken to know the species diversity in Manipur.

Material and Methods

Study sites: The moths were collected at Shirui hills ranges in the Ukhrul district of Manipur (Figure 1) at an elevation of 1,730 m - 2,590 m asl. The area is located near the boundary of Myanmar to the east, Shirui village in the west, Choithar village in the south, and Sihai village in the north. It has dense tropical forests all over and temperate forests on the hilltops. Sampling localities, along with their GPS coordinates, altitudes, and habitat types are provided in Table 1.

Collection and Preservation: Intensive light trapping was conducted three times a year during March-April (Pre-monsoon), June-July (Monsoon), and September-October (Post-monsoon) during 2016 to 2019. At each sampling site, 3 light traps (type Robinson trap) and a white sheet (3m X 4m dimension) with LED+UV lights were used during the night catch. All the sampled target moths were manually collected and killed in the field, dried by

Table 1. The localities of the trapping moths at Shirui Hills, Manipur, India

Sr no.	Study sites	GPS coordinates		Altitude m asl
		Latitude	Longitude	
1	Shirui Guest House (Site 1)	25.1264°N	94.4357°E	1930
2	Shirui Hills (Site 2)	25.1235°N	94.4407°E	2036
3	Shirui Hills (Site 3)	25.1171°N	94.4456°E	2198
4	Shirui Rest House (Site 4)	25.1112°N	94.4534°E	2425
5	Shirui Kashong (Site 5)	25.1064°N	94.4579°E	2835

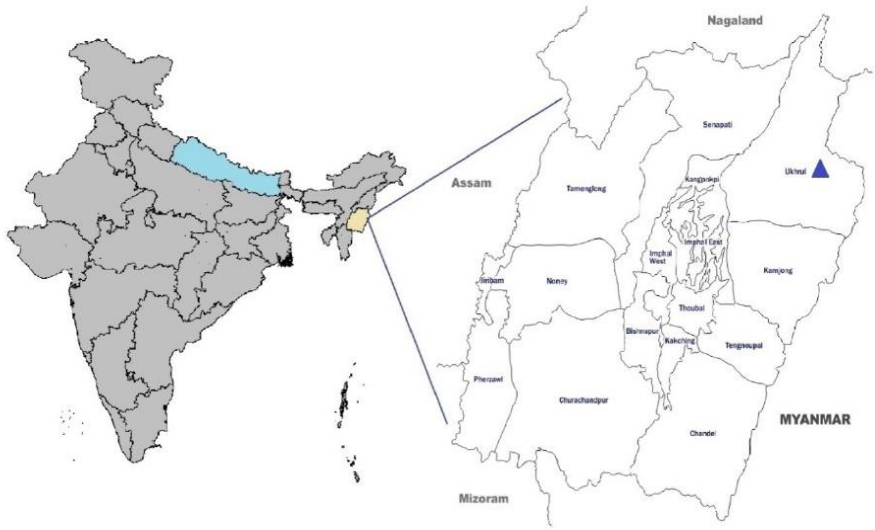


Figure 1. Map showing the study locality Shirui Hills, Ukhrul district, Manipur. (Blue triangle).

silica gel, and kept for later identification. Specimens were photographed using camera (Canon EOS 1100D) in a light box. Genitalia preparations were carried out for those species which are difficult to identify following the standard methods by Robinson (1976). Genitalia were photographed using Olympus SZX16 Stereo Microscope fitted with Promica camera. The photographs are processed using photo editing software (Irfanview vr. 4.54 and CorelDRAW Graphics Suite 2020). All the voucher specimens are deposited in the Museum of Institute of Entomology, Biology Centre, Czech Republic.

Identification of species: The classification and nomenclature follow the Kitching *et al.,* (2018) and Sphingidae Taxonomic Inventory (Kitching, 2020). Identification of the specimens was conducted by comparison with available literature (Bell and Scott, 1937; d'Abrera, 1986; Holloway, 1987; Haruta, 1992, 1994, 1995; Kishida, 1998; Kitching and Cadiou, 2000; Pittaway and Kitching, 2000; Vaglia *et al.,* 2010). The common name of the species follows Chandra *et al.,* (2014). Online repositories available for the moths of Asia (Nakao, 2019), Sphingidae (Pittaway and Kitching, 2020; Pittaway, 2020) were also accessed to confirm the identity of the collected materials.

The recorded global distributions of species were extracted from: D'Abrera (1986), Holloway (1987), Haruta (1992, 1994, 1995), Kitching and Spitzer (1995), Inoue *et al.* (1997), Hogenes and Treadaway (1998), Kitching and Cadiou (2000), Pittaway and Kitching (2000; 2020), Kendrick (2002), Eitschberger and Melichar (2010), Vaglia *et al.* (2010), Fu *et al.* (2013), Rafi *et al.* (2014), Singh and Kitching (2014), Kendrick and Young (2014), Haxaire *et al.* (2017), Ivshin *et al.* (2018), Irungbam and Irungbam (2019), Kishida and Yano, (2020), and for local distributions from: Scott (1941a, 1941b), Mandal and Maulik (1991, 1997), Chandra and Kumar (1992), Chandra (1994), Smetacek (1994, 2008, 2009), Mathew and Rahamathulla (1995), Mandal and Ghosh (1999, 2004), Shubhalaxmi and Chaturvedi (1999), Mandal *et al.* (2000), Chandra and Nima (2007), Majumdar and Kumar (2010), Shubhalaxmi *et al.* (2011), Sambath (2011, 2014), Zolotuhin and Ryabov (2012), Chandra and Sambath (2013), Gurule and Nikam (2013), Ghorpade *et al.* (2013), Chandra *et al.* (2014), Pathania *et al.* (2014), Sharma (2014), Sondhi and Sondhi (2016), Paul *et al.* (2017), Singh *et al.* (2017a, 2017b), Sondhi *et al.* (2018), Kalawate (2018), Shah *et al.* (2018), Sanyal *et al.* (2018), Kathirvelu *et al.* (2019), and Iyer and Kitching (2019).

Results

During the study, 311 specimens belonging to thirty-six species in nineteen genera of family Sphingidae were collected and identified. Among the recorded species, twenty-nine species are reported for the first time from Manipur, of which, *Sphinx oberthueri* (Rothschild and Jordan, 1903) and *Theretra tibetiana* Vaglia and Haxaire, 2010 was recorded for the first time from India. More faunistic surveys are needed in the area so that a complete Sphingidae fauna from Manipur can be compiled.

Systematic Account

In the systematic account, name of the superfamily, family, subfamily, tribe, genus and species is given. Beside this, first reference, material examined, general information on their local (in India) and global distribution, photograph of adults (Figures 1, 2, 3) and male genitalia (Figures 4, 5, 6) is provided.

Superfamily BOMBYCOIDEA Latreille, 1802

Family SPHINGIDAE Latreille, 1802

Subfamily SMERINTHINAE Grote and Robinson, 1865

Tribe ***Smerinthini*** Grote and Robinson, 1865

Genus Craspedortha Mell, 1922

1. ***Craspedortha porphyria porphyria*** (Butler, 1876) - Purple Hawkmoth (Figure 2: A; Figure 4: A)

1876. *Daphnusa porphyria* Butler, *Trans. zool. Soc. Lond.*, **9**: 640.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 3♂, IJ2288, IJ2289, IJ2290, 13.ix.2019 - 2♂, IJ2291, IJ2427, coll. J.S. Irungbam.

Wingspan: ♂, 55 mm. forewing length: 25 mm.

Distribution: India: Northern India (Chandra *et al.,* 2014); Meghalaya (Mandal and Ghosh, 1999); Sikkim (Sanyal *et al.,* 2018); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018); Manipur. *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Vietnam (Kitching and Spitzer, 1995); central Thailand (Inoue *et al.,* 1997); Laos (Kishida and Yano, 2020); Myanmar, southern China (Pittaway and Kitching, 2020).

Larval hostplants: *Vitex canescens* (Lamiaceae) (Eitschberger and Ihle, 2008).

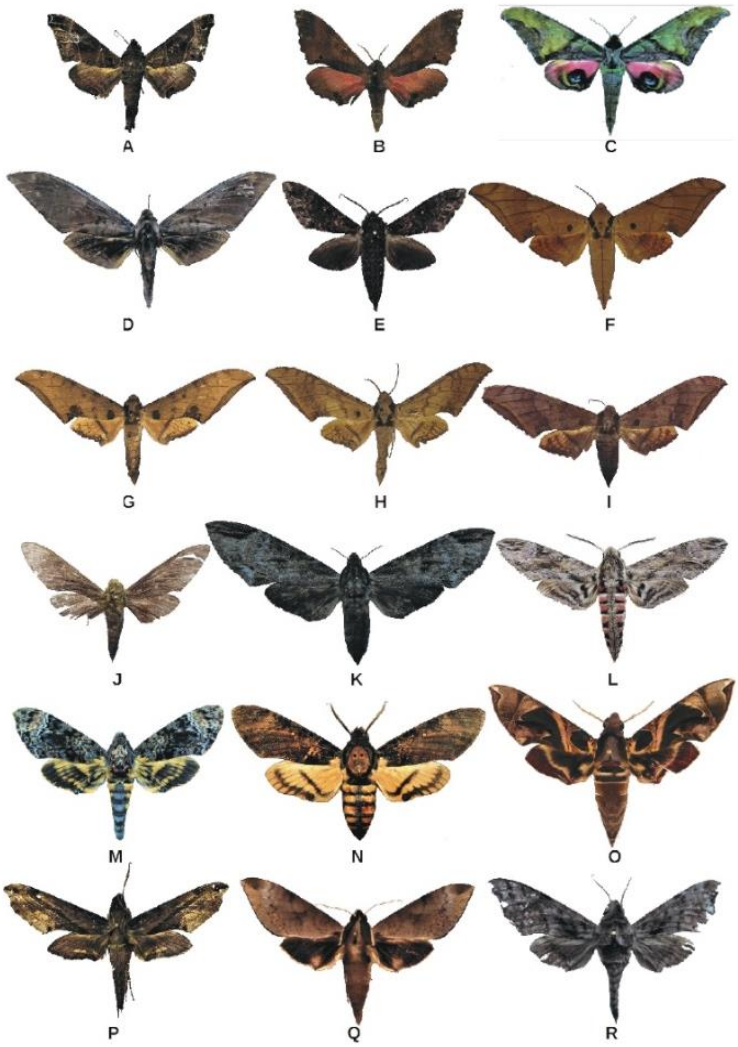


Figure 2. Image of adult Sphingidae: **A.** *Craspedortha porphyria porphyria* (Butler, 1876); **B.** *Marumba irata* Joicy and Kaye, 1917; **C.** *Callambulyx junonia* (Butler, 1881); **D.** *Clanis undulosa gigantea* Rothschild, 1894; **E.** *Dolbina inexacta* (Walker, 1856); **F.** *Ambulyx liturata* Butler, 1875; **G.** *A. ochracea* Butler, 1885; **H.** *A. sericeipennis sericeipennis* Butler, 1875; **I.** *A. maculifera* Walker, 1866 (female); J. *Sphinx oberthueri* (Rothschild and Jordan, 1903); **K.** *Psilogramma discistriga* (Walker, 1856); **L.** *Agrius convolvuli* (Linnaeus, 1758); **M.** *Acherontia lachesis* (Fabricius, 1798); **N.** *A. styx styx* (Westwood, 1847); **O.** *Daphnis hypothous crameri* Eitschberger and Melichar, 2010; **P.** *Eupanacra sinuata* (Rothschild and Jordan, 1903); **Q.** *Acosmerycoides harterti* (Rothschild, 1895); **R.** *Acosmeryx anceus subdentata* Rothschild and Jordan, 1903.

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Marumba*** Moore, (1882)

2. *Marumba irata* Joicey and Kaye, 1917- Puce Swirled Hawkmoth (Figure 2: B)

1917. *Marumba irata* Joicey and Kaye, *Ann. Mag. nat. Hist.* (Ser. 8), **20**(118): 305.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 1♂, IJ1428, coll. J.S. Irungbam.

Wingspan: ♂, 86 mm. forewing length: 45 mm.

Distribution: India: Manipur, Nagaland (Vaidya *et al.,* 2015); Sikkim (Sanyal *et al.,* 2018). *Elsewhere*: northern Vietnam (Kitching and Spitzer, 1995); Myanmar, China (Pittaway and Kitching, 2020).

Larval hostplants: Unknown in India.

Remarks: Previously regarded as a subspecies of *Marumba gaschkewitschii* (Bremer and Grey, 1853), but reinstated as a species by Eitschberger (2012). We proposed the common name of this hawkmoth as Puce Swirled Hawkmoth, "Puce" being the distinctive purplish brown colour of its wing (suggested by Mr. Peter Smetacek).

Genus ***Callambulyx*** Rothschild and Jordan, 1903

3. *Callambulyx junonia* (Butler, 1881) - Eyed Pink-and-Green Hawkmoth (Figure 2: C)

1881. *Ambulyx junonia* Butler, *Illustr. typ. Spec. Lepid. Heterocera Brit. Mus.,* **5**: 9.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 2♂, IJ2320, IJ2668, coll. J.S. Irungbam.

Wingspan: ♂, 102 mm. forewing length: 49 mm.

Distribution: India: Arunachal Pradesh, Nagaland (Pittaway and Kitching, 2020); Sikkim (Sanyal *et al.,* 2018); Manipur. *Elsewhere*: Bhutan (Irungbam and Irungbam, 2019); Vietnam (Kitching and Spitzer, 1995); China (Pittaway and Kitching, 2020).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

Genus Clanis Hübner (1819)

4. *Clanis undulosa gigantea* Rothschild, 1894 - Wavy Velvet Hawkmoth (Figure 2: D)

1894. *Clanis gigantea* Rothschild, *Novit. zool.,* **1**: 96.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 2 (25.1235°N 94.4407°E), 2036 m asl, 12.vii.2016 - 1♂, IJ328, 24.vii.2019 - 1♂, IJ1427; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 25.vii.2019 - 1♂, IJ1607, coll. J.S. Irungbam.

Wingspan: ♂, 150 mm. forewing length: 72 mm.

Distribution: India: Manipur; Meghalaya (Mandal and Ghosh, 1999); Sikkim, Uttarakhand (Sanyal *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.,* 1997); Laos (Kishida and Yano, 2020); Vietnam (Kitching and Spitzer, 1995); Peninsular Malaysia (Borneo) (Holloway, 1987).

Larval hostplants: *Lespedeza thompsoni* (Fabaceae) in north eastern India (Bell and Scott, 1937) and *Lespedeza viatorum* (Fabaceae) in Guangdong, China (Mell, 1922).

Remarks: The species is recorded here for the first time from Manipur.

Tribe **Sphingulini** Rothschild and Jordan, 1903

Genus ***Dolbina*** Staudinger, 1877

5. *Dolbina inexacta* (Walker, 1856) - Common Grizzled Hawkmoth (Figure 2: E)

1856. *Macrosila inexacta* Walker, *List Specimens lepid. Insects Colln. Br. Mus.*, **8**: 208.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 1♂, IJ1608, 13.ix.2019 - 1♀, IJ1609, coll. J.S. Irungbam.

Wingspan: ♂, 72 mm. forewing length: 34 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Himachal Pradesh, Punjab (Pathania *et al.,* 2014); Jammu and Kashmir (Sanyal *et al.,* 2018); Jharkhand (Sambath, 2014); Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu (Shubhalaxmi *et al.,* 2011); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttarakhand (Smetacek, 1994, 2008). *Elsewhere*: Northern Pakistan (Rafi *et al.,* 2014, Haxaire *et al.,* 2017); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam,

2019); China, Myanmar, Thailand (Inoue *et al.,* 1997); Laos (Kishida and Yano, 2020); Vietnam (Kitching and Spitzer, 1995); Peninsular Malaysia (Borneo) (Holloway, 1987); Japan (Pittaway and Kitching, 2020).

Larval hostplants: *Ligustrum robustum*, *Fraxinus* sp., *Osmanthus fragrans* and *Olea* sp. (all in Oleaceae), and *Lonicera* sp. (Caprofoliaceae) in China (Inoue *et al.,* 1997). Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

Tribe **Ambulycini** Butler, 1876

Genus ***Ambulyx*** Westwood, 1847

6. ***Ambulyx liturata liturata*** Butler, 1875 - Violet Gliding Hawkmoth (Figure 2: F; Figure 4: B)

1875. *Ambulyx liturata* Butler, *Proc. zool. Soc. Lond*., **1875**: 250.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 1♂, IJ2495, coll. J.S. Irungbam.

Wingspan: ♂, 120 mm. Forewing length: 56 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Jammu and Kashmir, Sikkim (Sanyal *et al.*, 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Myanmar, Cambodia, China (Pittaway and Kitching, 2020); Hong Kong (Kendrick and Young, 2014); Thailand (Inoue *et al.,* 1997); Vietnam (Kitching and Spitzer, 1995); Laos (Kishida and Yano, 2020).

Larval hostplants: *Quercus* sp. and *Castaniopsis* sp. (both in Fagaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

7. ***Ambulyx ochracea*** Butler, 1885 - Ochreous Gliding Hawkmoth (Figure 2: G; Figure 4: C)

1885. *Ambulyx ochracea* Butler, *Cistulaent.*, **3**: 113.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 2 (25.1235°N 94.4407°E), 2036 m asl, 12.vii.2016 - 1♂, IJ333; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 2♂, IJ1148, IJ1642, 13.ix.2019 - 1♂, IJ2497, coll. J.S. Irungbam.

Wingspan: ♂, 96 mm. Forewing length: 46 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Manipur; Meghalaya (Mandal and Ghosh, 1999); Sikkim (Khan and Raina, 2017); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Hong Kong (Kendrick and Young, 2014); Thailand (Inoue *et al.,* 1997); Vietnam (Kitching and Spitzer, 1995); China, Taiwan, Cambodia, Japan, Korea (Pittaway and Kitching, 2020); Laos (Kishida and Yano, 2020).

Larval hostplants: *Choerospondias fordii* (Anacardiaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

8. ***Ambulyx sericeipennis sericeipennis*** Butler, 1875 - Common Gliding Hawkmoth (Figure 2: H; Figure 4: D)

1875. *Ambulyx sericeipennis* Butler, *Proc. zool. Soc. Lond.,* **1875**: 252.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 2 (25.1235°N 94.4407°E), 2036 m asl, 24.vii.2019 - 1♂, IJ1391; Site 3, 25.1171°N 94.4456°E, 2190 masl, 24.vii.2019 - 2♂, IJ1149, IJ1150; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 13.ix.2019 - 2♂, 1♀, IJ1604, IJ1605, IJ1606, coll. J.S. Irungbam.

Wingspan: 102 mm. Forewing length: 51 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Manipur; Meghalaya (Mandal and Ghosh, 1999); Sikkim, Uttarakhand (Sanyal *et al.,* 2018); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Northern Pakistan (Rafi *et al.,* 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Myanmar, China, Cambodia, Java, Hong Kong (Pittaway and Kitching, 2020); Thailand (Inoue *et al.,* 1997); Laos (Kishida and Yano, 2020); Vietnam (Kitching and Spitzer, 1995); the Philippines (Hogenes, 1998).

Larval hostplants: *Juglans regia* (Juglandaceae), *Engelhardia spicata* (Juglandaceae), *Elaeocarpus* sp. (Elaeocarpaceae), *Quercus* sp. (Fagaceae), *Myricanagi* sp. (Myricaceae), *Betula alnoides* (Betulaceae) and *Rhus* sp. (Anacardiaceae) in India (Bell and Scott, 1937; Inoue *et al.,* 1997).

Remarks: The species is recorded here for the first time from Manipur.

9. *Ambulyx maculifera* Walker, 1866 - Spotted Gliding Hawkmoth (Figure 2: I)

1866. *Ambulyx maculifera* Walker, *List Specimens lepid. Insects Colln Br. Mus*., **35**: 18S.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 1♀, coll. J.S. Irungbam.

Wingspan: ♀, 115 mm. Forewing length: 56 mm.

Distribution: India: Ladakh, Sikkim (Sanyal *et al.,* 2018); Manipur; Meghalaya (Chandra *et al.,* 2014); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

Subfamily SPHINGINAE Latreille, (1802)

Tribe **Sphingini** Latreille, (1802)

Genus ***Sphinx*** Linnaeus, 1758

10. *Sphinx oberthueri* (Rothschild and Jordan, 1903) - Masson Pine Hawkmoth (Figure 2: J; Figure 4: E)

1903. *Hyloicus oberthueri* Rothschild and Jordan, *Novit. zool.,* 9 (suppl.): 119 (key), 149.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 1♂, IJ1429, coll. J.S. Irungbam.

Distribution: India: Manipur. *Elsewhere*: Central and southwestern China, Myanmar, northern Thailand (Inoue *et al.,* 1997).

Diagnosis: Wingspan ♂, 63 mm. forewing length 31 mm. Male genitalia: Uncus elongate, slenderer than in *Sphinx caligineus* (Butler, 1877), slightly dilated before apex, the edge somewhat notched, shortly hooked at apex, the ventral side deeply concave. Gnathos long, sinuate, the lobes slender, subconical, somewhat curved apically. Harpe characteristic, with two short distal processes separated by a rounded sinus, the upper process with one or more marginal teeth, the lower subconical, pointed, slightly curved, narrower and shorter than the upper. Aedeagus produced into a short process that is rounded apically and slightly curved.

Larval hostplants: Pinus massoniana (Pinaceae) in Yunnan, China (Mell, 1922). Unknown in India.

Remarks: The species is recorded here for the first time from Manipur as well as for India.

Genus ***Psilogramma*** Rothschild and Jordan, 1903

11. *Psilogramma discistriga* (Walker, 1856) - Large Brown Hawkmoth (Figure 2: K)

1856. *Macrosila discistriga* Walker, *List Specimens lepid. Insects Colln Br. Mus*., **8**: 209.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 2 (25.1235°N 94.4407°E), 2036 m asl, 23.vii.2019 - 2♂, IJ1416, IJ1812, coll. J.S. Irungbam.

Wingspan: ♂, 131 mm. Forewing length: 62 mm.

Distribution: India: Andaman Islands (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Delhi (Paul *et al.,* 2017); Punjab (Pathania *et al.,* 2014); Jharkhand (Sambath, 2014); Madhya Pradesh (Chandra *et al.,* 2013); Maharashtra (Kalawate, 2008, Shubhalaxmi *et al.,* 2011); Manipur; Meghalaya (Mandal and Ghosh, 1999); Odisha (Mandal and Maulik, 1991); Sikkim (Dudgeon, 1886); Himachal Pradesh, Karnataka, Tamil Nadu (Chandra *et al.,* 2014); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al.,* 2018); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Bangladesh (Bell and Scott, 1937); Myanmar, central and southern China, Indonesia (Pittaway and Kitching, 2020); Hong Kong (Kendrick and Young, 2014); Vietnam (Kitching and Spitzer, 1995); Laos (Kishida and Yano, 2020); Thailand (Inoue *et al.,* 1997); Malaysia (Borneo) (Holloway, 1987); the Philippines (Hogenes, 1998).

Larval hostplants: *Jasminum* sp. (Oleaceae), *Ligustrum* sp. (Oleaceae), *Tectona grandis* (Lamiaceae), *Vitex negundo* (Lamiaceae), and *Callicarpa arborea* (Lamiaceae) in India (Scott, 1941).

Remarks: Previously, *Psilogramma discistriga* (Walker, 1856) was synonymized with *Psilogramma menephron* by Rothschild and Jordan (1903). It was incorrectly synonymized with *Psilogramma melanomera* (Butler, 1875) by Eitschberger (2001), but later reinstated as a species by Eitschberger (2010). The species is recorded here for the first time from Manipur.

Tribe **Acherontiini** Boisduval, (1875)

Genus ***Agrius*** Hübner, (1819)

12. *Agrius convolvuli* (Linnaeus, 1758) - Convolvulus Hawkmoth (Figure 2: L)

1758. *Sphinx convolvuli* Linnaeus, *Syst. Nat.* (Ed. 10), **1**: 490.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 4 (25.1112ºN 94.4534ºE), 2425 m asl, 25.vii.2019 - 2♂, IJ1170, IJ1611, coll. J.S. Irungbam.

Wingspan: ♂, 87 mm. Forewing length: 41 mm.

Distribution: India: Andaman and Nicobar Islands (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Delhi (Paul *et al.,* 2017); Himachal Pradesh, Punjab (Pathania *et al.*, 2014); Jammu and Kashmir (Sanyal *et al.,* 2018); Jharkhand (Sambath, 2014, Singh *et al.,* 2017a); Karnataka (Melichar *et al.,* 2018); Madhya Pradesh (Chandra *et al.,* 2013, Choubey *et al.,* 2017), Maharashtra (Shubhalaxmi *et al.,* 2011, Gurule and Nikam, 2013); Manipur; Meghalaya (Mandal and Ghosh, 1999); Odisha (Mandal and Maulik, 1991); Sikkim (Dudgeon, 1886); Tamil Nadu (Kathirvelu *et al.*, 2019, Iyer and Kitching, 2019); Uttarakhand, Uttar Pradesh (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Throughout the tropical and subtropical Old World; Migratory in large numbers to Mongolia, Siberia and Japan (Holloway, 1987).

Larval hostplants: *Phaseolus* spp. (Fabaceae) in India (Bell and Scott, 1937).

Remarks: The species was earlier recorded from Mao, Senapati district, Manipur by Mandal and Ghosh (2004).

Genus ***Acherontia*** (Laspeyres, 1809)

13. *Acherontia lachesis* (Fabricius, 1798) - Greater Death's Head Hawkmoth (Figure 2: M)

1798. *Sphinx lachesis* Fabricius, *Suppl. Ent. Syst.*: 434.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 4 (25.1112ºN 94.4534ºE), 2425 m asl, 25.vii.2019 - 1♂, IJ1181, coll. J.S. Irungbam.

Wingspan: ♂, 120 mm. Forewing length: 56 mm.

Distribution: India: Andaman and Nicobar Islands (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Jammu and Kashmir (Sanyal *et al.,* 2018); Jharkhand (Sambath, 2014); Karnataka (Melichar *et al.*, 2018); Madhya Pradesh (Chandra *et al.,* 2013, Choubey *et al.,* 2017); Andhra Pradesh, Goa, Gujarat, Maharashtra (Gurule and Nikam, 2013), Manipur, Mizoram, Nagaland (Shubhalaxmi *et al.*, 2011); Meghalaya (Mandal and Ghosh, 1999); Odisha (Mandal and Maulik, 1991); Punjab (Pathania *et al.,* 2014); Sikkim (Dudgeon, 1886); Tamil Nadu (Kathirvelu *et al.,* 2019, Iyer and Kitching, 2019); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Eastern Pakistan (Rafi *et al.*, 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.,* 1997);Laos (Kishida and Yano, 2020); Vietnam (Kitching and Spitzer, 1995); Hong Kong (Kendrick, 2002; Kendrick and Young, 2014); Myanmar, China, Taiwan (Fu *et al.* 2013; Wu *et al.*, 2020); Malaysia (Holloway, 1987); Indonesia, southern Japan, Papua New Guinea, the Hawaiian Islands, Moluccas (Holloway, 1987); the Philippines (Hogenes, 1998).

Larval host-plants: *Erythrina* spp. (Fabaceae), *Jasminum* spp. (Oleaceae), *Solanum tuberosum* (Solanaceae), *Nicotiana tabacum* (Solanaceae), *Tectona grandis* (Lamiaceae), *Datura* sp. (Solanaceae) and other plants (Scott, 1941).

Remarks: The species is recorded here for the first time from Manipur.

14. *Acherontia styx styx* (Westwood, 1847) - Lesser Death's Head Hawkmoth (Figure 2: N)

1847. *Sphinx (Acherontia) styx* Westwood, *Cabinet oriental Ent.:* (88), pl. 42, fig. 3.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 4 (25.1112ºN 94.4534ºE), 2425 m asl, 25.vii.2019 - 1♂, IJ1610, coll. J.S. Irungbam.

Wingspan: ♂, 100 mm. Forewing length: 48 mm.

Distribution: India: Andaman and Nicobar Islands (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.*, 2017); Delhi (Paul *et al.,* 2017); Himachal Pradesh, Meghalaya (Bortolin *et al.,* 1998); Jammu and Kashmir (Sanyal *et al.,* 2018); Jharkhand (Sambath, 2014); Karnataka (Melichar *et al.,* 2018); Madhya Pradesh (Chandra *et al.*, 2013, Choubey *et al.,* 2017); Maharashtra (Shubhalaxmi *et al.,* 2011, Gurule and Nikam, 2013); Manipur; Odisha (Mandal and Maulik, 1991); Rajasthan (Sharma, 2014); Sikkim (Dudgeon, 1886); Tamil Nadu (Kathirvelu *et al.,*

2019, Iyer and Kitching, 2019); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al*., 2018). *Elsewhere*: Pakistan (Rafi *et al*., 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Bangladesh (Bell and Scott, 1937); northern Thailand (Inoue *et al*., 1997); Laos (Kishida and Yano, 2020); Myanmar, China, the Russian Far East (Pittaway and Kitching, 2020); Taiwan (Wu *et al*., 2020); Moluccas (Holloway, 1987).

Larval hostplants: *Sesamum indicum* (Pedaliaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

Subfamily MACROGLOSSINAE Harris, 1839

Tribe **Macroglossini** Harris, 1839

Genus ***Daphnis*** Hübner, (1819)

15. *Daphnis hypothous crameri* Eitschberger and Melichar, 2010 - Jade Hawkmoth (Figure. 2: O)

2010. *Daphnis hypothous crameri* Eitschberger and Melichar, *European Entomologist*, **2**: 67.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 2 (25.1235°N 94.4407°E), 2036 m asl, 24.vii.2019 - 1♂, IJ1412, coll. J.S. Irungbam.

Wingspan: ♂, 110 mm. Forewing length: 53 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Andaman and Nicobar Islands, Assam, Andhra Pradesh, Gujarat, Madhya Pradesh (Chandra *et al*., 2014); Jharkhand (Sambath, 2014); Karnataka (Melichar *et al*., 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Odisha (Mandal and Maulik 1991); Sikkim (Dudgeon, 1886); Tamil Nadu (Iyer and Kitching, 2019); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al*., 2018); West Bengal (Shah *et al*., 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Hong Kong (Kendrick and Young, 2014); Thailand (Inoue *et al*., 1997); Laos (Kishida and Yano, 2020); Malaysia (Holloway, 1987); Taiwan (Wu *et al*., 2020); Sri Lanka, Myanmar, southern China, Indonesia (Pittaway and Kitching, 2020); the Philippines (Hogenes, 1998).

Larval hostplants: *Cinchona* spp., *Wendlandia* spp. and *Uncaria* spp. (all Rubuaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Eupanacra*** Cadiou and Holloway, 1989

16. *Eupanacra sinuata* (Rothschild and Jordan, 1903) - Sinuous Rippled Hawkmoth (Figure 2: P)

1903. *Panacra sinuata* Rothschild and Jordan, *Novit. zool.*, **9** (suppl.): 539.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 24.vii.2019 - 2♂, IJ1182, IJ1652; Site 2 (25.1235°N 94.4407°E), 2036 m asl, 13.ix.2019 - 1♂, IJ2297, coll. J.S. Irungbam.

Wingspan: ♂, 66 mm. Forewing length: 32 mm.

Distribution: India: Arunachal Pradesh (Sanyal *et al*., 2018); Assam, Himachal Pradesh, Sikkim (Chandra *et al*., 2014); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al*., 2018). *Elsewhere*: Nepal (Kishida, 1998); China (Pittaway and Kitching, 2020); Laos (Kishida and Yano, 2020); northern Thailand (Inoue *et al*., 1997); Vietnam (Kitching and Spitzer, 1995).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Acosmerycoides*** Mell, 1922

17. *Acosmerycoides harterti* (Rothschild, 1895) - Hartert's Hawkmoth (Figure 2: Q; Figure 4: F)

1895. *Ampelophaga harterti* Rothschild, *Dt. ent. Z., Iris*, **7**: 299.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 1♂, IJ2500, coll. J.S. Irungbam.

Wingspan: ♂, 84 mm. Forewing length: 41 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013; Sanyal *et al*., 2018); Assam (Arandhara, 2016); Manipur. *Elsewhere*: Bhutan (Irungbam and Irungbam, 2019); Myanmar, China (Pittaway and Kitching, 2020); Thailand (Inoue *et al*., 1997); Vietnam (Kitching and Spitzer, 1995); Laos (Kishida and Yano, 2020).

Larval hostplants: *Vitis* spp. (Vitaceae) and *Saurauia* spp. (Actinidiaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

Figure 3. Image of adult Sphingidae: **A.** *Acosmeryx naga naga* (Moore, (1858)); **B.** *A. pseudonaga* Butler, 1881; **C.** *Deilephila elpenor macromera* (Butler, 1875); **D.** *Hippotion celerio* (Linnaeus, 1758); **E.** *H. rosetta* (Swinhoe, 1892); **F.** *Theretra alecto* (Linnaeus, 1758); **G.** *T. clotho clotho* (Drury, 1773); **H.** *T. tibetiana* Vaglia and Haxaire, 2010; **I.** *T. lucasii* (Walker, 1856); **J.** *T. nessus nessus* (Drury, 1773); **K.** *T. oldenlandiae oldenlandiae* (Fabricius, 1775); **L.** *T. pallicosta* (Walker, 1856); **M.** *Cechetra lineosa* (Walker, 1856); **N.** *C. minor* (Butler, 1875); **O.** *Rhagastis albomarginatus albomarginatus* (Rothschild, 1894); **P.** *R. castor aurifera* (Butler, 1875); **Q.** *R. confusa* Rothschild and Jordan, 1903; **R.** *R. olivacea* (Moore, 1857).

Genus ***Acosmeryx*** Boisduval, (1875)

18. *Acosmeryx anceus subdentata* Rothschild and Jordan, 1903 - Rosy Forest Hawkmoth (Figure 2: R)

1903. *Acosmeryx anceus subdentata* Rothschild and Jordan, *Novit. zool.*, **9** (suppl.): 528.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 2♂, IJ1581, IJ1623, coll. J.S. Irungbam.

Wingspan: ♂, 75 mm. Forewing length: 34 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam (Arandhara, 2016); Himachal Pradesh (Chandra *et al.*, 2014); Jharkhand (Sambath, 2014); Karnataka (Melichar *et al.*, 2018); Kerala (Sondhi *et al.*, 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Sikkim (Dudgeon, 1886); Tamil Nadu, Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Bhutan (Irungbam and Irungbam, 2019); Nepal (Kishida, 1998); Hong Kong (Kendrick and Young, 2014); Thailand (Inoue *et al.*, 1997); Vietnam (Kitching and Spitzer, 1995); Laos (Kishida and Yano, 2020); Malaysia (Borneo) (Holloway, 1987); China, Indonesia (Pittaway and Kitching, 2020); the Philippines (Hogenes, 1998).

Larval hostplants: *Leea* spp., *Cayratia* spp., *Cissus* spp. and *Vitis* spp. (all in Vitaceae) (Inoue *et al.*, 1997).

Remarks: The species is recorded here for the first time from Manipur.

19. *Acosmeryx naga naga* (Moore, 1858) - Common Forest Hawkmoth (Figure 3: A)

1858. *Philampelus naga* Moore, in Horsfield and Moore, *Cat. lepid. Insects Mus. Hon. East-India Company*, **1**: 271.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 6♂, IJ1393, IJ1394, IJ1395, IJ1396, IJ1397, IJ1430; Site 2 (25.1235°N 94.4407°E), 2036 m asl, 13.ix.2019 - 2♂, IJ1392, IJ2336; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 2♂, IJ1151, 1152; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 12.vii.2016- 2♂, IJ336, 1J337, 25.vii.2019 - 2♂, 1♀, IJ1582, IJ1583, IJ584, coll. J.S. Irungbam.

Wingspan: ♂, 104 mm. Forewing length: 50 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Himachal Pradesh, Ladakh, Sikkim, Uttarakhand (Sanyal *et al.*, 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttar Pradesh (Smetacek, 1994, 2008); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Northern Pakistan (Rafi *et al.*, 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); northern Myanmar, Thailand (Inoue *et al.*, 1997); Laos (Kishida and Yano, 2020); Vietnam (Kitching and Spitzer, 1995); peninsular Malaysia (Borneo) (Holloway, 1987); Taiwan (Fu *et al.*, 2013, Wu *et al.*, 2020).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

20. *Acosmeryx pseudonaga* Butler, 1881 - False Common Forest Hawkmoth (Figure 3: B)

1881. *Acosmeryx pseudonaga* Butler, *Illustr. typ. Spec. Lepid. Heterocera Brit. Mus.*, **5**: 2.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 3♂, IJ1814, IJ1845, IJ1846; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 1♀, IJ2499; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 12.vii.2016- 2♂, IJ338, IJ339, 25.VII.2019 - 1♂, IJ1585; Site 5 (25.1069°N 94.4456°E), 2835 m asl, 25.vii.2019 - 1♂, IJ1180, coll. J.S. Irungbam.

Wingspan: ♂, 103 mm. Forewing length: 46 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Manipur; Tripura (Mandal *et al.* 2000). *Elsewhere*: Bhutan (Irungbam and Irungbam, 2019); Hong Kong (Kendrick and Young, 2014); Thailand (Inoue *et al.*, 1997); Laos (Kishida and Yano, 2020).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Deilephila*** (Laspeyres, 1809)

21. *Deilephila elpenor macromera* (Butler, 1875) - Large Elephant Hawkmoth (Figure 3: C)

1875. *Choerocampa macromera* Butler, *Proc. zool. Soc. Lond.*, **1875**: 7.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 1♂, IJ1415; Site 2 (25.1235°N 94.4407°E),

2036 m asl, 12.vii.2016 - 5♂, IJ329, IJ330, IJ331, IJ829, IJ830, 24.vii.2019 - 3♂, IJ1413, IJ1414, IJ1818; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 25.vii.2019 - 4♂, IJ1598, IJ1599, IJ1600, IJ1601, coll. J.S. Irungbam.

Wingspan: ♂, 78 mm. Forewing length: 37 mm.

Distribution: India: Bihar, Himachal Pradesh (Chandra *et al.*, 2014); Manipur (Mandal and Ghosh, 2004); Meghalaya (Mandal and Ghosh, 1999); Sikkim, Uttarakhand (Sanyal *et al.,* 2018); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); northern Myanmar, southern China (Pittaway and Kitching, 2020); northern Thailand (Inoue *et al.,* 1997); northern Vietnam (Kitching and Spitzer, 1995).

Larval hostplants: *Arisaema* spp. and *Amorphophallus* spp. (both Araceae) in India (Bell and Scott, 1937).

Remarks: The species was earlier recorded from Mao, Senapati district, Manipur by Mandal and Ghosh (2004).

Genus ***Hippotion*** Hübner, (1819)

22. *Hippotion celerio* (Linnaeus, 1758) - Silver striped Hawkmoth (Figure 3: D)

1758. *Sphinx celerio* Linnaeus, *Syst. Nat.* (Ed. 10), **1**: 491.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 1♂, IJ2296, coll. J.S. Irungbam.

Wingspan: ♂, 63 mm. Forewing length: 29 mm.

Distribution: India: Andaman and Nicober Islands (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013, Kaleka *et al.*, 2018); Delhi (Paul *et al.*, 2017); Gujarat, Himachal Pradesh, Madhya Pradesh, Uttar Pradesh (Chandra *et al.,* 2014); Jammu and Kashmir, Sikkim, Uttarakhand (Sanyal *et al.,* 2018, Kaleka *et al.*, 2018); Karnataka (Melichar *et al.,* 2018, Kaleka *et al.*, 2018); Maharashtra (Shubhalaxmi *et al.,* 2011, Gurule and Nikam, 2013); Manipur; Meghalaya (Mandal and Ghosh, 1999); Punjab (Pathania *et al.,* 2014, Kaleka *et al.*, 2018); Rajasthan (Sharma, 2014); Tamil Nadu (Iyer and Kitching, 2019); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Tropical Africa, Asia, Australia (Pittaway and Kitching, 2020).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

23. *Hippotion rosetta* (Swinhoe, 1892) - Swinhoe's Striated Hawkmoth (Figure 3: E)

1892. *Choerocampa rosetta* Swinhoe, *Cat. east. and Aust. Lepid. Heterocera Colln Oxf. Univ. Mus.,* **1**: 16.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 1♂, IJ2295, coll. J.S. Irungbam.

Wingspan: ♂, 56 mm. Forewing length: 32 mm.

Distribution: India: Andaman and Nicobar Islands (Chandra and Kumar, 1992); Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Sikkim, Lakshadweep Island, Maharashtra, Uttar Pradesh, West Bengal (Shubhalaxmi *et al.,* 2011); Karnataka (Melichar *et al.,* 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Odisha (Mandal and Maulik, 1991); Tamil Nadu (Iyer and Kitching, 2019); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al.,* 2018). *Elsewhere*: Southern Pakistan (Rafi *et al.,* 2014); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.,* 1997); Hong Kong (Kendrick and Young, 2014); Sri Lanka, eastern Indonesia, southern China, southern Japan, the Maldives Islands, the Solomon Islands, the Torres Straits of New Guinea, Hawaii (Pittaway and Kitching, 2020); Taiwan (Fu *et al.*, 2013, Wu *et al.*, 2020); the Philippines (Hogenes, 1998).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Theretra*** Hübner, (1819)

24. *Theretra alecto alecto* (Linnaeus, 1758) - Levant Hunter Hawkmoth (Figure 3: F)

1758. *Sphinx alecto* Linnaeus, *Syst. Nat.* (Ed. 10), **1**: 492.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 1♂, IJ1426, coll. J.S. Irungbam.

Wingspan: ♂, 65 mm. Forewing length: 31 mm.

Distribution: India: Andaman Islands (Chandra and Kumar, 1992);Arunachal Pradesh (Athreya, 2013); Assam, Himachal Pradesh, Manipur, Maharashtra, Nagaland, Tamil Nadu, Uttar Pradesh (Shubhalaxmi *et al.,* 2011); Jammu and Kashmir (Sanyal *et al.,* 2018); Jharkhand (Singh *et al.,* 2017a); Karnataka (Melichar *et al.,* 2018); Madhya Pradesh (Choubey *et al.,* 2017); Meghalaya

(Mandal and Ghosh, 1999); Punjab (Pathania *et al.,* 2014); Sikkim (Dudgeon, 1886); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Pakistan (Rafi *et al.*, 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Hong Kong (Kendrick and Young, 2014); the Philippines (Hogenes, 1998); Sri Lanka, China, Japan, Indonesia, Greece, Bulgaria, Turkey, Iran, Turkmenistan, Uzbekistan, Kyrgyzstan, Afghanistan, Iraq, Lebanon, Israel, Egypt (Pittaway and Kitching, 2020).

Larval hostplants: *Vitis* sp., *Parthenocissus*, *Cissus* sp., *Leea* sp. (all Vitaceae), *Rubia* sp., *Psychotria* sp. (both Rubiaceae), *Saurauia* sp. (Actinidiaceae), *Dillenia* sp. and *Tetracera* sp. (both Dilleniaceae) (Pittaway and Kitching, 2020).

Remarks: Shubhalaxmi *et al.* (2011) have mentioned the presence of the species in Manipur. The present record from Shirui Hills, confirms its presence in Manipur.

25. *Theretra clotho clotho* (Drury, 1773) - Common Hunter Hawkmoth (Figure 3: G; Figure 5: A)

1773. *Sphinx clotho* Drury, *Illust. nat. Hist. exot. Insects,* 2: index (91).

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 – 4♂, IJ1421, IJ1422, IJ1423, IJ1424; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 – 4♂, IJ1164, IJ1165, IJ1167, IJ1168; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 25.vii.2019 – 1♂, IJ1602, coll. J.S. Irungbam.

Diagnosis: Wingspan ♂, 86 - 96 mm. forewing length 42 - 46 mm. Male genitalia (Figure 5: A): Uncus short and massive. The lateral sétigeres lobes are broad, not very raised and strongly ciliate, but the cilia are short. The apex of the uncus is slightly curved. The harps are characteristic long and spatulate, their surface is cracked. The outer edge is irregularly domed, sometimes rounded and others almost triangular. The internal edge wears a double sclerotic and dentate sheet. Each leaflet is well developed but remains narrow throughout its length. They are clearly toothed. The teeth are small and evenly spaced but vary widely in size and shape.

Distribution: India: Andaman Island (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Gujarat, Himachal Pradesh, Maharashtra, Manipur, Nagaland, Sikkim, Tamil Nadu, Uttar Pradesh (Shubhalaxmi *et al.,* 2011); Ladakh (Sanyal *et al.,* 2018), Jharkhand (Sambath, 2014, Singh *et al.*, 2017a), Karnataka (Melichar *et al.,* 2018), Kerala (Sondhi *et al.,* 2018), Meghalaya (Mandal and Ghosh, 1999), Odisha (Mandal and Maulik 1991), Punjab (Pathania *et al.,* 2014), Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Northern Pakistan (Rafi *et al.,* 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Laos (Kishida and Yano, 2020); Hong Kong (Kendrick and Young, 2014); Taiwan (Fu *et al.,* 2013); Sri Lanka, Myanmar, China, Japan, Indonesia, Sundaland (Pittaway and Kitching, 2020); the Philippines (Hogenes, 1998).

Larval hostplants: Unknown in India.

Remarks: Shubhalaxmi *et al.* (2011) have mentioned the presence of the species in Manipur. The present record from Shirui Hills, confirms its presence in Manipur.

26. *Theretra tibetiana* Vaglia and Haxaire, 2010 -Tibetian Hunter Hawkmoth (Figure 3: H; Figure 5: B)

2010. *Theretra tibetiana* Vaglia and Haxaire, in Vaglia, Haxaire, Kitching and Liyous, *European Entomologist,* **3**(1): 21.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 1♂, IJ1163, 13.ix.2019 - 1♂, IJ1425, coll. J.S. Irungbam.

Diagnosis: Wingspan ♂, 82 - 86 mm. forewing length 39 - 41 mm. Male genitalia (Figure 5: B): In lateral view the uncus is similar to the *clotho*, but its apex is not so curved and is interrupted more abruptly. The harp is globular, outer edge is rounded, but usually invaginates just before the apex. The inner edge bears the double serrated layer and sclerotic characteristic of *clotho,* but this double leaf is totally shifted and crushed towards the apex. It is raised and is slightly curved towards the base of the valve. Only the larger apical teeth are visible. There are usually 4 on the outer leaflet and 2 or 3 on the internal leaflet. At *clotho* the sheets are wide, semi-transparent, are positioned lower on the inner edge and are finely toothed over their entire length. The apical portion is very little or not raised or curved ventrally. The outer edge is regularly domed.

Distribution: India: Manipur. *Elsewhere*: Bhutan (Irungbam and Irungbam, 2019); Hong Kong (Kendrick and Young, 2014); China, South Korea, Japan, northern

Vietnam, northern Laos,northern Thailand (Vaglia *et al*., 2010); Taiwan (Wu *et al*., 2020).

Larval hostplants: Unknown in India.

Remarks: The species is recorded here for the first time from Manipur as well as for India.

27. *Theretra lucasii* (Walker, 1856)- Lucas's Hunter Hawkmoth (Figure 3: I)

1856. *Chaerocampa (sic) lucasii* Walker, *List Specimens lepid. Insects Colln Br. Mus.* **8**: 141.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 4 (25.1112°N 94.4534°E), 2425 m asl, 12.vii.2016 - 1♂, IJ340, coll. J.S. Irungbam.

Wingspan: ♂, 78 mm. forewing length: 37 mm.

Distribution: India: Andaman and Nicober Islands (Chandra and Kumar, 1992); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.,* 2017); Jammu and Kashmir, Sikkim (Sanyal *et al.,* 2018); Karnataka (Melichar *et al.,* 2018); Kerala (Sondhi *et al.,* 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Tamil Nadu (Iyer and Kitching, 2019); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998); Hong Kong (Kendrick and Young, 2014); Sri Lanka, Myanmar, eastern China, Sumatra, Borneo, Java, the Lesser Sunda Islands (Pittaway and Kitching, 2020); the Philippines (Hogenes, 1998).

Larval hostplants: *Impatiens* spp. (Balsaminaceae), *Lagerstroemia* spp. (Lythraceae), *Vitis* spp. (Vitaceae) and *Begonia* spp. (Begoniaceae) in India (Bell and Scott, 1937).

Remarks: The species *T. lucasii* was earlier considered as subspecies of *T. latreillii*, but reinstated distinct species by Moulds *et al.* (2020). Now the species which flies in India through China, Southeast Asia up to Indonesia are *T. lucasii*. *T. lucasii* is replaced in the Maluku Islands by *T. latreillii prattorum* Clark, 1924 and in New Guinea, Australia, the Bismarck Archipelago, and the Solomon Islands by *T. latreillii latreillii* (Macleay, 1826) (Moulds *et al.* 2020). The species is recorded here for the first time from Manipur.

28. *Theretra nessus nessus* (Drury, 1773) - Orange-Sided Hunter Hawkmoth (Figure 3: J)

1773. *Sphinx nessus* Drury, *Illust. nat. Hist. exot. Insects,* 2: index (91).

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 1♂, IJ2498, coll. J.S. Irungbam.

Wingspan: ♂, 107 mm. Forewing length: 49 mm.

Distribution: India: Andaman and Nicobar Islands (Chandra 1994); Arunachal Pradesh, Uttarakhand (Sanyal *et al.,* 2018); Assam (Arandhara *et al.,* 2017); Andhra Pradesh, Gujarat, Goa, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Uttar Pradesh (Shubhalaxmi *et al.,* 2011); Jharkhand (Sambath, 2014, Singh *et al.,* 2017a, 2017b); Kerala (Sondhi *et al.,* 2018); Karnataka (Melichar *et al.,* 2018); Meghalaya (Mandal *et al.,* 2000); Himachal Pradesh, Punjab (Pathania *et al.,* 2014); Rajasthan (Sharma, 2014); Sikkim (Dudgeon, 1886, Khan and Raina, 2017); Tamil Nadu (Iyer and Kitching, 2019);Tripura (Mandal *et al.,* 2000); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Bhutan (Irungbam and Irungbam, 2019); Nepal (Kishida, 1998); Myanmar, southern China, South Korea, Japan, Singapore, Indonesia, Malaysia, Sundaland (Pittaway and Kitching, 2020); Hong Kong (Kendrick, 2002); Thailand (Inoue *et al.,* 1997); Vietnam (Kitching and Spitzer, 1995); Taiwan (Wu *et al.,* 2020); the Philippines (Hogenes, 1998).

Larval host-plants: *Amaranthus* sp. (Amaranthaceae), *Barringtonia* sp. (Lecythidaceae), *Dioscorea* sp. (Dioscoreaceae), *Amorphophallus* sp. (Araceae), *Impatiens* sp. (Balsaminaceae), *Citrullus* sp. (Cucurbitaceae), *Boerhavia* sp. (Nyctaginaceae), *Knoxia* sp. (Rubiaceae), *Morinda* sp. (Rubiaceae), *Oldenlandia* sp. (Rubiaceae), *Pongamia* sp. (Fabaceae), *Spermacoce* sp. (Rubiaceae), *Glossostigma* sp. (Phrymaceae) and *Camellia* sp. (Theaceae) (Pittaway and Kitching, 2020).

Remarks: Shubhalaxmi *et al.* (2011) have mentioned the presence of the species in Manipur. The present record from Shirui Hills, confirms its presence in Manipur.

29. *Theretra oldenlandiae oldenlandiae* (Fabricius, 1775) - White-Banded Hunter Hawkmoth (Figure 3: K)

1775. *Sphinx oldenlandiae* Fabricius, *Syst. Ent.*: 542.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 20.vi.2019 - 1♂, IJ2501, 23.vii.2019 - 1♂, IJ1420, coll. J.S. Irungbam.

Wingspan: ♂, 62 mm. Forewing length: 30 mm.

Distribution: India: Andaman Islands (Chandra, 1994); Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.*, 2017); Chattishgarh, Gujarat, Jammu and Kashmir, Maharashtra, Manipur, Nagaland, Tamil Nadu, Uttar Pradesh (Shubhalaxmi *et al.*, 2011); Delhi (Paul *et al.*, 2017); Himachal Pradesh, Punjab (Pathania *et al.*, 2014); Jharkhand (Sambath, 2014, Singh *et al.*, 2017a, 2017b); Karnataka (Melichar *et al.*, 2018); Madhya Pradesh (Chandra *et al.*, 2013); Meghalaya (Mandal and Ghosh, 1999); Sikkim (Khan and Raina, 2017); Tripura (Mandal *et al.*, 2000); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Pakistan (Rafi *et al.*, 2014); Nepal (Kishida, 1998); Bhutan (Irungbam andIrungbam, 2019); Sri Lanka, northern Afghanistan, Myanmar, China, South Korea, Japan, the Solomon Islands, New Guinea, eastern Russia (Pittaway and Kitching, 2020); Laos (Kishida and Yano, 2020); Hong Kong (Kendrick and Young, 2014); the Philippines (Hogenes, 1998).

Larval hostplants: *Careya* spp. (Lecythidaceae) in India (Bell and Scott, 1937).

Remarks: Shubhalaxmi *et al.* (2011) have mentioned the presence of the species in Manipur. The present record from Shirui Hills, confirms its presence in Manipur.

30. *Theretra pallicosta* (Walker, 1856) - White-Edged Hunter Hawkmoth (Figure 3: L)

1856. *Chaerocampa pallicosta* Walker, *List Specimens lepid. Insects Colln Br. Mus.*, **8**: 145.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 1♂, IJ1169, coll. J.S. Irungbam.

Wingspan: ♂, 77 mm. forewing length: 37 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Karnataka (Melichar *et al.*, 2018); Manipur; Meghalaya (Mandal and Ghosh, 1999); Sikkim (Dudgeon, 1886); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al.*, 2018). *Elsewhere*: Nepal (Kishida, 1998); Thailand (Inoue *et al.*, 1997); Laos (Kishida and Yano, 2020); Vietnam (Kitching and Spitzer, 1995); Hong Kong (Kendrick and Young, 2014); Sri Lanka, Myanmar, Indonesia, peninsular Malaysia (Pittaway and Kitching, 2020).

Larval hostplants: *Aporosa* spp. (Phyllanthaceae) in India and Myanmar (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Cechetra*** Zolotuhin and Ryabov, 2012

31. *Cechetra lineosa* (Walker, 1856) - Striped Green Hawkmoth (Figure 3: M; Figure 5: C)

1856. *Chaerocampa (sic) lineosa* Walker, *List Specimens lepid. Insects Colln Br. Mus.*, **8**: 144.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 3♂, IJ1410, IJ1411, IJ1813; Site 2 (25.1235°N 94.4407°E), 2036 m asl, 24.vii.2019 - 2♂, 1♀, IJ1398, IJ1399, IJ1400, 13.ix.2019 - 2♀, IJ1405, IJ2335; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 2♂, 1♀, IJ1153, IJ1155, IJ2322, 13.ix.2019 - 1♂, 1♀, IJ2323, IJ2324; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 25.vii.2019 - 2♂, 2♀,IJ1586, IJ1590, IJ1591, IJ1595, coll. J.S. Irungbam.

Wingspan: ♂, 93 - 110 mm. Forewing length: 44 – 47 mm.

Distribution: India: Arunachal Pradesh, Ladakh, Sikkim (Sanyal *et al.*, 2018); Assam (Arandhara *et al.*, 2017); Himachal Pradesh, West Bengal (Chandra *et al.*, 2014); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttarakhand (Smetacek, 1994, 2008). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.*, 1997); Taiwan (Fu *et al.*, 2013); Myanmar, southern China, Indonesia, Malaysia (Pittaway and Kitching, 2020); Vietnam (Kitching and Spitzer, 1995).

Larval hostplants: *Saurauia tristyla* (Actinidiaceae), *Impatiens* spp. (Balsaminaceae), *Vitis* spp. (Vitaceae) and *Polygonum* spp. (Polygonaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

32. *Cechetra minor* (Butler, 1875) - Lesser Green Hawkmoth (Figure 3: N; Figure 5: D)

1875. *Chaerocampa (sic) minor* Butler, *Proc. zool. Soc. Lond.*, 1875: 249.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 2 ♂, 2 ♀, IJ1407, IJ1847, IJ1848, IJ1849; Site 2 (25.1235°N 94.4407°E), 2036 m asl, 24.vii.2019 - 1 ♂, IJ1401; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 2 ♂, IJ1159, IJ1160; Site 4 (25.1112°N

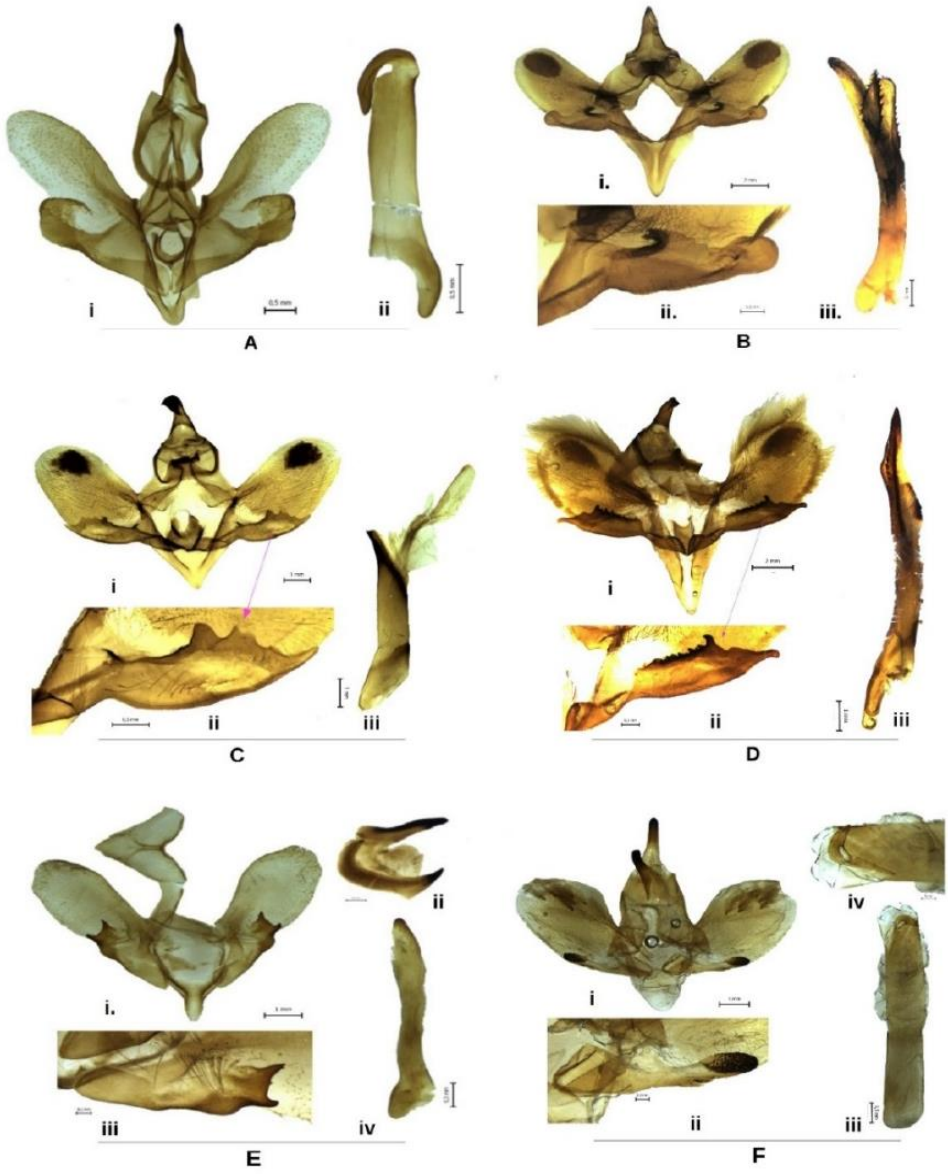


Figure 4. Male genitalia of adult Sphingidae. **A.** *Craspedortha porphyria porphyria* (Butler, 1876): (i) Genital capsule, (ii) Aedaegus. **B.** *Ambulyx liturata* Butler, 1875: (i) Genital capsule, (ii) Harpe, (iii) Aedaegus. **C.** *A. ochracea* Butler, 1885: (i) Genital capsule, (ii) Harpe, (iii) Aedaegus. **D.** *A. sericeipennis sericeipennis* Butler, 1875: (i) Genital capsule, (ii) Harpe, (iii) Aedaegus. **E.** *Sphinx oberthueri* (Rothschild and Jordan, 1903): (i) Genital capsule, (ii) Harpe, (iii) Gnathous, (iv) Aedaegus. **F.** *Acosmerycoides harterti* (Rothschild, 1895): (i) Genital capsule, (ii) Harpe, (iii) Aedaegus, (iv) Phallusarmature.

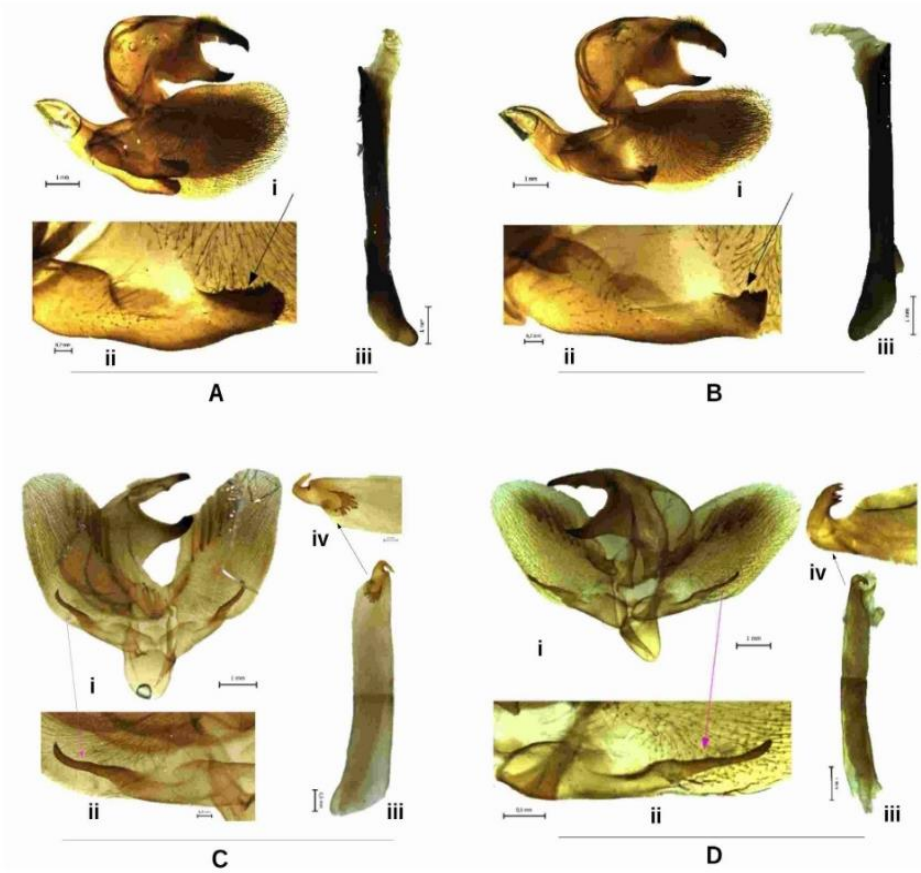


Figure 5. Male genitalia of adult Sphingidae. **A.** *Theretra clotho clotho* (Drury, 1773): (i) Genital capsule, (ii) Harpe, (iii) Aedaegus. **B.** *T. tibetiana* Vaglia and Haxaire, 2010: (i) Genital capsule, (ii) Harpe, (iii) Aedaegus. **C.** *Cechetra lineosa* (Walker, 1856): (i) Genital capsule, (ii) Harpe, (iii) Aedaegus, (iv) Phallus armature. **D.** *C. minor* (Butler, 1875): (i) Genital capsule, (ii) Harpe, (iii) Aedaegus, (iv) Phallus armature.

94.4534ºE), 2425 m asl., 25.vii.2019 - 2 ♂, IJ1596, IJ1597, coll. J.S. Irungbam.

Wingspan: ♂, 76 – 80 mm. Forewing length: 36 – 38 mm.

Distribution: India: Arunachal Pradesh, Sikkim (Sanyal *et al.,* 2018); Himachal Pradesh, West Bengal (Chandra *et al.,* 2014); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttarakhand (Smetacek, 1994, 2008). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.,* 1997); Laos (Kishida and Yano, 2020); China, Japan, Vietnam (Kitching and Spitzer, 1995); Taiwan (Wu *et al.,* 2020).

Larval hostplants: *Saurauia pundiana* (Actinidiaceae), *Amorphophallus* spp. (Araceae) and *Vitis* spp. (Vitiaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

Genus ***Rhagastis*** Rothschild and Jordan, 1903

33. *Rhagastis albomarginatus albomarginatus* (Rothschild, 1894) - Pale-Edged Mottled Hawkmoth (Figure 3: O)

1894. *Metopsilus albomarginatus* Rothschild, *Novitates Zoologicae,* **1**: 78.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 1 ♂, IJ1419, coll. J.S. Irungbam.

Wingspan: ♂, 70 mm. Forewing length: 34 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Manipur; Meghalaya (Chandra *et al.,* 2014); Sikkim (Sanyal *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Hong Kong (Kendrick, 2002; Kendrick and Young, 2014); Myanmar, China, Sumatra, Java, Borneo (Pittaway and Kitching, 2020).

Larval hostplants: *Hydrangea* spp. (Hydrangeaceae) in north-eastern India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

34. *Rhagastis castor aurifera* (Butler, 1875) - Common Mottled Hawkmoth (Figure 3: P)

1875. *Pergesa aurifera* Butler, *Proc. zool. Soc. Lond.*: 7.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 2 (25.1235°N 94.4407°E), 2036 m asl, 24.vii.2019 - 1 ♂, IJ1161; Site 3 (25.1171°N 94.4456°E), 2190 m asl, 24.vii.2019 - 1 ♂, IJ1417, 13.ix.2019 - 1 ♂, IJ2292, coll. J.S. Irungbam.

Wingspan: ♂, 70 mm. Forewing length: 32 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam (Arandhara *et al.*, 2017); Manipur; Meghalaya (Mandal and Ghosh, 1999); Sikkim (Dudgeon, 1886); Uttarakhand (Smetacek, 1994, 2008; Sanyal *et al.,* 2018). *Elsewhere*: Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.*, 1997); southern China, Vietnam (Kitching and Spitzer, 1995).

Larval hostplants: *Amorphophallus* spp. (Araceae) and *Vitis* spp. (Vitiaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

35. *Rhagastis confusa* Rothschild and Jordan, 1903 - Indistinct Mottled Hawkmoth (Figure 3: Q)

1903. *Rhagastis confusa* Rothschild andJordan, *Novit. zool.*, **9** (suppl.): 793 (key), 795.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 3 (25.1171°N 94.4456°E), 2190 m asl, 13.ix.2019 - 2 ♂, IJ2293, IJ2294, coll. J.S. Irungbam.

Wingspan: ♂, 76 mm. Forewing length: 37 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013); Assam, Himachal Pradesh, Sikkim (Chandra *et al.*, 2014); Manipur; Meghalaya (Mandal and Ghosh, 1999); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.*, 2018). *Elsewhere*: Northern Pakistan (Rafi *et al.,* 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.,* 1997), southwestern China (Pittaway and Kitching, 2020); northern Vietnam (Kitching and Spitzer, 1995).

Larval hostplants: *Vitis* spp. (Vitiaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

36. *Rhagastis olivacea* (Moore, 1857) - Olive Mottled Hawkmoth (Figure 3: R)

1872. *Pergesa olivacea* Moore, *Proc. zool. Soc. Lond.*: 567.

Material examined: INDIA, Manipur, Ukhrul District, Shirui Hills, Site 1 (25.1264°N 94.4357°E), 1930 m asl, 23.vii.2019 - 2 ♂, IJ1418, IJ1850; Site 4 (25.1112°N 94.4534°E), 2425 m asl, 25.vii.2019 - 1 ♂, IJ332, coll. J.S. Irungbam.

Wingspan: ♂, 75 mm. Forewing length: 35 mm.

Distribution: India: Arunachal Pradesh (Athreya, 2013), Assam, Jammu and Kashmir, Himachal Pradesh (Pittaway and Kitching, 2020); Manipur; Sikkim (Sanyal *et al.,* 2018); Uttarakhand (Smetacek, 1994, 2008); West Bengal (Shah *et al.,* 2018). *Elsewhere*: Pakistan (Rafi *et al.,* 2014); Nepal (Kishida, 1998); Bhutan (Irungbam and Irungbam, 2019); Thailand (Inoue *et al.,* 1997); Laos (Kishida and Yano, 2020), northern Vietnam (Kitching and Spitzer, 1995), Myanmar, southern China (Pittaway and Kitching, 2020).

Larval hostplants: *Impatiens* spp. (Balsaminaceae) in India (Bell and Scott, 1937).

Remarks: The species is recorded here for the first time from Manipur.

Discussion

As such, there are no particular data available on the number of species of the family Sphingidae from Manipur. Chandra *et al.* (2014) reported the presence of 197 species

of Sphingidae in India. The present study recorded thirty-six species from Shirui hills, Manipur of which, twenty-nine species are new records to Manipur and two species (*S. oberthueri* and *T. tibetiana*) are a new addition to the Sphingidae fauna of India. *S. oberthueri* which was earlier reported from central and southwestern China to northern Thailand (Inoue *et al*., 1996) has now extended its distribution to the west in Manipur, India. *T. tibetiana* which was reported earlier from Tibeteast through Bhutan (Irungbam and Irungbam, 2019) and eastern China, Taiwan, South Korea and Japan, and south to northern Vietnam, northern Laos, andnorthern Thailand (Vaglia et al., 2010) have reported from Manipur in the present study. Three species viz. *A. convolvuli* (Linnaeus, 1758) and *D. elpenor* (Linnaeus, 1758) (Mandal and Ghosh, 2004) and *M. irata* Joicey and Kaye, 1917 (Vaidya et al., 2015) which was reported from Mao, Senapati district were also recorded from Shirui Hills, Ukhrul in the present study. Thus, the present records from the Shirui Hills show the lack of studies on the inventory of Sphingidae fauna in Manipur. Hence, more faunistic surveys are needed in the area so that a complete Sphingidae fauna from Manipur can be compiled.

Acknowledgements

The authors are thankful to Czech Science Foundation (GACR: 14-36098G) and Grant Agency, University of South Bohemia (GA JU 038/2019/P) for their financial support during the field visits and field equipment. PCCF (Wildlife), Government of Manipur is acknowledged for providing the permit (No. 3/22/2006/WL and No. 3/22/2019-WL) for collection and survey at Shirui Hills, Ukhrul district. We also thank the Shirui village authority, Ukhrul and volunteers, Mr. Harmenn Huidrom, Mr. Baleshwor Soibam, Mr. Bendang Ngangom, Mr. Rajiv Atom, Mr. Motilal Irungbam and Mr. Dinesh Soram (Driver) for their support and help provided during the stay and collection of moths at Shirui hills.

References

Athreya, R. 2013. Sphingidae of Arunachal Pradesh, North-east India: Inventory and Image Gallery. Available at: http://www.iiser-pune.ac.in/~rathreya/MothSph/MothSphingidae.html

Arandhara, S. 2016. A Preliminary Checklist on Hawkmoths of Digboi, Assam (Lepidoptera: Bombycoidea: Sphingidae). *Global Journal for Research Analysis*, **5**(10): 348-349.

Arandhara, S., Barman, S., Tanti, R. and Boruah, A. 2017. Macro moths of Tinsukia district, Assam: A provisional inventory. *Journal of Entomology and Zoology Studies*, **5**(6): 1612-1621.

Bortolin, A., Fabiano, F., Sforzi, A. and Bartolozzi, L. 1998. A contribution to the knowledge of the Sphingidae of North India (Insecta, Lepidoptera). Nachrichten des Entomologischen Vereins Apollo (N.F.), **19**(2): 141-148.

Bell, T.R.D. and Scott, F.B. 1937. *The Fauna of British India, including Ceylon and Burma*. Moths, Vol. 5, Sphingidae. Taylor and Francis, London. i-xviii, 1-537pp., 15pls.

Chandra, K. and Kumar, S. 1992. Moths (Heterocera: Lepidoptera) of Andaman and Nicobar Islands. *Journal of Andaman Science Association*, **8**(2): 138-145.

Chandra, K. 1994. Further new records of moths from Andaman and Nicobar Islands. *Journal of Andaman Science Association*, **10**(1 and 2): 17-24.

Chandra, K. and Nema, D.K. 2007. Insecta: Lepidoptera: Heterocera (Moths). In: *Fauna of Madhya Pradesh (including Chhattisgarh), State Fauna Series. Zoological Survey of India*, **15**(1): 347-418.

Chandra, K. and Sambath, S. 2013. Moths diversity of Tawang District, Arunachal Pradesh, India. *Journal of Threatened Taxa*, **5**(1): 3565-3570. http://dx.doi.org/10.11609/JoTT.o2718.966 https://doi.org/10.11609/JoTT.o2718.966

Chandra, K., Kumar, J., Sambath, S. and Mitra, B. 2014. A Catalogue of the Hawkmoths of India (Lepidoptera: Sphingidae). *Bionotes*, **16**(2): 37-47.

Cotes, E.C. and Swinhoe, C. 1887. A Catalogue of Moths of India. Pt. 1. - Sphinges. The Trustees of the Indian Museum, Calcutta, 40pp. https://doi.org/10.5962/bhl.title.29426

D'Abrera, B. 1986. Sphingidae Mundi: Hawk Moths of the World. E.W. Classey, Faringdon, Oxfordshire, 226pp.

Dudgeon, G.C. 1886. A catalogue of the Heterocera of Sikkim and Bhutan, Part 2. *The Journal of the Bombay Natural History Society*, **11**(2): 406-419.

Eitschberger, U. 2001. Neubeschreibungen von Arten in der Gattung *Psilogramma* Rothschild and Jordan, 1903 (Lepidoptera, Sphingidae). *Neue Entomologische Nachrichten, Marktleuthen*, Supplement, **1**: 1-63.

Eitschberger, U. 2010. Checkliste der Taxa des Genus *Psilogramma* Rothschild and Jordan, 1903. 6. BeitragzurKenntnis der Gattung (Lepidoptera, Sphingidae). *Neue Entomologische Nachrichten, Marktleuthen*, **64**: 122-133.

Eitschberger, U. 2012. Revision des *Marumba gaschkewitschii* (Bremer and Grey, 1852)-Artkomplexes (Lepidoptera, Sphingidae). *Neue Entomologische NachrichtenMarktleuthen*, **68**: 1-293.

Eitschberger, U. and Melichar, T. 2010. Die taxa der Gattung *Daphnis* Hübner, 1819, die Neugliederung der Unterarten von *Daphnis* hypothous (Cramer, 1780) mitneuerUnterartbeschreibung und der Neotypusdesignation von *Sphinx hypothous* Cramer, 1780 (Lepidoptera, Sphingidae). *The European Entomologist*, **2**(3-4): 49-91 (in German).

Fu, C.M., Ronkay, L. and Lin, H.H. 2013. Moths of Hehuanshan. Endemic Species Research Institute, Nantou. 557 pp. + 45 colour plates.

Ghorpade, K., Patil, R.R. and Chandaragi, M.K. 2013. Notes on Hawk Moths (Lepidoptera-Sphingidae) in the Karwar-Dharwar transect, peninsular India: a tribute to T.R.D. Bell (1863-1948). Colemania, Number 33, pp. 1-16.

Gurule, S.A. and Nikam, S.M. 2013. The moths (Lepidoptera: Heterocera) of northern Maharashtra: a preliminary checklist. *Journal of Threatened Taxa*, **5**(12): 4693-4713. https://doi.org/10.11609/JoTT.o2555.4693-713

Haruta, T. 1992. Sphingidae, 83-92pp. In: Haruta, T. (ed.). Moths of Nepal (Kishida, 1998), Part 1. Tinea Vol. 13 (Supplement 2). The Japanese Heterocerists' Society, Tokyo. i-xvii, 1-122pp., 1-32 plts.

Haruta, T. 1994. Sphingidae, 154-158 p. In: Haruta, T. (ed.). Moths of Nepal (Kishida, 1998), Part 3. Tinea Vol. 14 (Supplement 1). The Japanese Heterocerists' Society, Tokyo. i-xvii, 1-171 pp., 65-96 plts.

Haruta, T. 1995. Sphingidae. 89pp. In: Haruta, T. (ed.). Moths of Nepal (Kishida, 1998), Part 4. Tinea Vol. 14 (Supplement 2). The Japanese Heterocerists' Society, Tokyo, i-xviii, 1-206pp., 97-128 plts.

Haxaire, J., Gujjar, F. and Saeed, M. 2017. A preliminary list of the Sphingidae of Miandam, Khyber Pakhtunkhwa, north Pakistan (Lepidoptera Sphingidae). *The European Entomologist*, **9**(1): 25-41.

Hogenes, W. and Treadaway C.G. 1998. The Sphingidae (Lepidoptera) of the Philippines. Nachrichten des Entomologischen Vereins Apollo, Supplement, 17: 17-132.

Holloway, J.D. 1987. The Moths of Borneo (Part 3): Lasiocampidae, Eupterotidae, Bombycidae, Brahmaeidae, Saturniidae, Sphingidae. Southdene Sdn. Bhd., Kuala Lumpur, Malaysia, 20pls+199pp.

Inoue, H., Kennett, R.D. and Kitching, I.J. 1997. Moths of Thailand. Vol. 2 (Sphingidae). Brothers of St. Gabriel in Thailand, Bangkok, 149pp.

Irungbam, J.S. and Irungbam, M.J. 2019. Contributions to the knowledge of moths of Bombycoidea Latreille, 1802 (Lepidoptera: Heterocera) of Bhutan with new records. *Journal of Threatened Taxa*, **11**(8): 14022-14050; https://doi.org/10.11609/jott.4358.11.8.14022-14050 https://doi.org/10.11609/jott.4358.11.8.14022-14050

Ivshin, N., Krutov, V. and Romanov, D. 2018. Three new taxa of the genus *Cechetra* Zolotuhin and Ryabov, 2012 (Lepidoptera, Sphingidae) from south-east Asia with notes on other species of the genus. *Zootaxa*, **4450**(1): 1-25. https://doi.org/10.11646/zootaxa.4450.1.1 https://doi.org/10.11646/zootaxa.4450.1.1 PMid:30313854

Iyer, G. and Kitching, I.J. 2019. A preliminary study of the hawkmoth diversity (Lepidoptera: Sphingidae) of Kanyakumari District, Tamil Nadu, India. *Journal of Threatened Taxa*, **11**(5), 13592-13604. https://doi.org/10.11609/jott.4694.11.5.13592-13604

Kalawate, A. S. 2018. On a collection of Moths (Lepidoptera: Heterocera) from the northern Western Ghats of Maharashtra, India. *Zoology and Ecology*, **28**(3): 231-251. https://doi.org/10.1080/21658005.2018.1506378

Kaleka, A.P., Singh, D. and Kaur, P. 2018. Studies on Genus *Hippotion* Hübner(Sphingidae: Lepidoptera) from India. *Journal of Entomological Research*, **2**(1):129-134 https://doi.org/10.5958/0974-4576.2018.00022.1

Kathirvelu, C., Ayyasamy, R. and Karthikeyan, M. 2019. Preliminary checklist of moths (Lepidoptera: Glossata) of Annamalai Nagar, Tamil Nadu. *Journal of Applied and Natural Science*, **11**(2): 404 - 409. https://doi.org/10.31018/jans.v11i2.2063

Kendrick, R.C. 2002. Moths (Insecta: Lepidoptera) of Hong Kong. PhD Dissertation. The University of Hong Kong (Kendrick, 2002), xvi+660pp. Available at: http://hdl.handle.net/10722/31688

Kendrick, R.C. and Young, J.J. 2014. Pictorial Guidebook of Hong Kong Moths, Vol. 1. Hong Kong Lepidopterists' Society, Tuen Mun, Hong Kong, China, 64pp.

Khan, Z.H. and Raina, R.H. 2017. Diversity in family Sphingidae: Lepidoptera from Sikkim Himalaya. *Journal of Entomology and Zoology Studies*, **5**(6): 1903-1907.

Kitching, I.J. 2020. Sphingidae Taxonomic Inventory, Available at: http://sphingidae.myspecies.info/

Kitching, I.J. and Spitzer, K. 1995. An annotated checklist of the Sphingidae of Vietnam. *Tinea*, **14**: 171-195.

Kitching, I.J. and Cadiou, J.M. 2000. Hawkmoths of the World: An Annotated and Illustrated Revisionary Checklist. London and Ithaca (The Natural History Museum, Cornell University Press), viii + 226 pp. https://doi.org/10.1093/aesa/93.5.1195g

Kitching, I.J., Rougerie, R., Zwick, A., Hamilton, C. St Laurent, R., Naumann, S., Mejia, L.B. and Kawahara, A. 2018. A global checklist of the *Bombycoidea* (Insecta: Lepidoptera). *Biodiversity Data Journal*, **6**: e22236. https://doi.org/10.3897/BDJ.6.e22236 PMid:29674935 PMCid:PMC5904559

Kishida, Y. 1998. Sphingidae, 40-42pp. In: Haruta, T. (ed.). Moths of Nepal, Part 4. Tinea Vol. 15 (Supplement 1). The Japanese Heterocerists' Society, Tokyo. i-xviii, 1-206pp., 97-128 plts.

Kishida, Y. and Yano, T. 2020. Sphingidae, 103-109pp. In: Kishida, Y. (ed.). Moths of Laos, Part 1. Tinea Vol. 25 (Supplement 1). The Japanese Heterocerists' Society, Tokyo. 1-224pp., 1-94 plts.

Majumdar, M. and Kumar, J. 2010. Lepidoptera: Sphingidae. pp. 553-568. In: *Fauna of Uttarakhand, State Fauna Series. Zoological Survey of India*, **18**(2): 1-748.

Mandal, D.K. and Ghosh, S.K. 1999. Insecta: Lepidoptera: Sphingidae, Noctuidae and Geometridae. In, *State Fauna of Meghalaya, State Fauna Series. Zoological Survey of India*, **4**(6): 405-465.

Mandal, D.K. and Ghosh, S.K. 2004. Insecta: Lepidoptera: Moths. In, *Fauna of Manipur, State Fauna Series. Zoological Survey of India*, **10**: 531-540.

Mandal, D.K., Ghosh, S.K. and Majumdar, M. 2000. Insecta: Lepidoptera. In, *Fauna of Tripura, State Fauna Series*. Zoological Survey of India, **7**(3): 283-334.

Mandal, D.K. and Maulik, D.R. 1991. Insecta: Lepidoptera: Heterocera: Sphingidae and Geometridae. In: *Fauna of Odisha, State Fauna Series*. Zoological Survey of India, **1**(3): 227-233.

Mandal, D.K. and Maulik, D.R. 1997. Insecta: Lepidoptera: Heterocera: Sphingidae, Lasiocampidae, Lymantriidae and Ratardidae. In: *Fauna of West Bengal, State Fauna Series*. Zoological Survey of India, **3**(7): 613-687.

Mathew, G., and Rahamathulla, V.K. 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.

Mell, R. 1922. Beiträgezur Fauna sinica. Biologie und Systematik der südchinesischenSphingiden, vol. 1 and 2. R. Friedländerand Sohn, Berlin, xxii + 177 pp. + 331 pp. (in German)

Moulds, M.S., Tuttle, J.P. and Lane, D.A. 2020. Hawkmoths of Australia: identification, biology and distribution. Monographs of Australian Lepidoptera - Vol. 13, CSIRO Publishing, Canberra. 414 pp. https://doi.org/10.1071/9781486302826

Nakao, K. 2020. Digital Moths of Asia. Available at: http://www.jpmoth.org/~dmoth/Digital_Moths_of_Asia/Moths%20of%20Asia%20frame_new.html

Pathania, P.C., Sharma, S. and Gill, A.K. 2014. Hawk moths (Lepidoptera: Sphingidae) from north-west Himalaya along with collection housed in National PAU Insect Museum, Punjab Agricultural University, Ludhiana, India. *Biological Forum*, **6**(1): 120-127.

Paul, M., Das, S.K., Singh, R. and Pathania, P.C. 2017. Study and Updated checklist of moths (Lepidoptera: Heterocera) in selected areas of Delhi, India. *International Journal of Current Research*, **9**(08): 56208-56214.

Pittaway, A.R. and Kitching, I.J. 2020. Sphingidae of the Eastern Palaearctic (including Siberia, the Russian Far East, Mongolia, China, Taiwan, the Korean Peninsula and Japan). Available at: http://tpittaway.tripod.com/china/china.htm

Pittaway, A.R. 2020. Sphingidae of the Western Palearctic (including Europe, North Africa, the Middle East, western Siberia and western Central Asia). Available at: http://tpittaway.tripod.com/sphinx/list.htm

Pittaway, A.R. and Kitching, I.J. 2000. Notes on selected species of hawkmoths (Lepidoptera: Sphingidae) from China, Mongolia and the Korean Peninsula. *Tinea*, **16**(3): 170-211.

Rafi, M.A., Sultan, A., Kitching, I.J., Pittaway, A.R., Markhasiov, M., Khan, M.R. and Naz F. 2014. The hawkmoth fauna of Pakistan (Lepidoptera: Sphingidae). *Zootaxa*, **3794**(3): 393-418. https://doi.org/10.11646/zootaxa.3794.3.4 PMid:24870331

Robinson, G.S. 1976. The preparation of slides of *Lepidoptera genitalia* with special reference to microlepidoptera. *Entomologist's Gazette*, **27**: 127-132.

Rothschild, W. and Jordan, K. 1903. A revision of the lepidopterous family Sphingidae. *Novitates Zoologicae*, **9** (Suppl.): i-cxxxv, 1-972, 67 pls.

Sambath, S. 2011. Studies on the Sphingid fauna (Lepidoptera: Heterocera: Sphingidae) of Dalma Wildlife Sanctuary, Jharkhand. Records of the Zoological Survey of India. *Zoological Survey of India*, **111**(1): 25-30. Published by.

Sambath, S. 2014. Taxonomic Studies of Lepidoptera (Insecta) of Dalma Wildlife Sanctuary, Jharkhand (India). Records of the Zoological Survey of India, Occasional Paper No. *Zoological Survey of India*, **359**: 1-103+23 Plates. Published by.

Sanyal, A.K., Mallick, K., Khan, S., Bandyopadhyay, U., Mazumder, A., Bhattacharyya, K., Pathania, P.C., Raha, A. and Chandra, K. 2018. Insecta: Lepidoptera (Moths), 651-726pp. In: Chandra, K., Gupta, D., Gopi, K.C., Tripathy, B. and Kumar, V. (eds.). *Faunal Diversity of Indian Himalaya. Zoological Survey of India*, 1-872pp.

Scott, F.B. 1941. The hawkmoths of Darjeeling and Sikkim. *Journal of the Bengal Natural History Society*, **15**: 134-138.

Shah, S.K., Das, A., Dutta, R. and Mitra, B. 2018. A Current List of the Moths (Lepidoptera) of West Bengal. *Bionotes*, **20**(3): 88-91.

Sharma, G. 2014. Lepidoptera (Butterflies and Moths). pp. 41-104. In Eds., Studies on Odonata and Lepidoptera fauna of foothills of Aravalli Range, Rajasthan. *Records of the Zoological Survey of India, Occasional Paper*, **353**: 1-104.

Shubhalaxmi, V. and Chaturvedi, N. 1999. Abundance and distribution of moths of the families Saturniidae and Sphingidae in Sanjay Gandhi National Park. *Journal of the Bombay Natural History Society*, **96**(3): 379-386.

Shubhalaxmi, V., Kendrick, R.C., Vaidya, A., Kalagi, N. and Bhagwat, A. 2011. Inventory of moth fauna (Lepidoptera: Heterocera) of the Northern Western Ghats, Maharashtra, India. *Journal of the Bombay Natural History Society*, **108**(3): 183-205.

Singh, I.J. and Kitching, I.J. 2014. A first record of *Clanis hyperion* Cadiou and Kitching, 1990 (Lepidoptera: Sphingidae) in Bhutan, and a preliminary checklist of the hawkmoths of Mendrelgang, Bhutan. *Journal ofThreatened Taxa*, **6**(1): 5386-5388. https://doi.org/10.11609/JoTT.o3399.5386-8

Singh, N. Ahmad, J. and Joshi, R. 2017a. Diversity of moths (Lepidoptera) with new faunistic records from North East Jharkhand, India. *Records of the Zoological Survey of India*, **117**(4): 326-340. Published by Zoological Survey of India. https://doi.org/10.26515/rzsi/v117/i4/2017/121289

Singh, N, Ahmad, J. and Joshi, R. 2017b. An Inventory of Moths (Lepidoptera) from Topchanchi WLS, Jharkhand (India). *Journal of Entomology and Zoology Studies*, **5**(4): 1456-1466.

Smetacek, P. 1994. The hawkmoths (Lepidoptera: Sphingidae) of Kumaon, N. India: a probable case of faunal drift. Records of the Zoological Survey of India, Occasional Paper. Zoological Survey of India, **156**: 1-55.

Smetacek, P. 2008. Moths recorded from different elevations in Nainital District, Kumaon Himalaya, India. *Bionotes*, **10**(1): 5-15.

Smetacek, P. 2009. Additions and corrections to the list of moths recorded from different elevations in Nainital district, Kumaon Himalaya, India. *Bionotes*, **11**(4): 117-118.

Sondhi, Y. and Sondhi, S. 2016. A partial checklist of moths (Lepidoptera) of Dehradun, Mussoorie and Devalsari in Garhwal, Uttarakhand, India. *Journal of Threatened Taxa*, **8**(5): 8756-8776. https://doi.org/10.11609/jott.2814.8.5.8756-8776

Sondhi, Z., Sondhi, S., Pathour, S.R. and Kunte, K. 2018. Moth diversity (Lepidoptera: Heterocera) of Shendurney and Ponmudi in Agastyamalai Biosphere Reserve, Kerala, India, with notes on new records. *Tropical Lepidoptera Research*, **28**(2): 66-89.

Vaglia, T., Haxaire, J., Kitching, I.J. and Liyous, M. 2010. Contribution á la connaissance des *Theretra* Hübner, (1819), des complexes *clotho* (Drury, 1773), *boisduvalii* (Bugnion, 1839) et *rhesus* (Boisduval, 1875) d'Asiecontinentale et du Sud-est (Lepidoptera, Sphingidae). *The European Entomologist*, **3**(1): 1-37 (in French).

Vaidya, A, Huidrom, H. and Irungbam, J.S. 2015. An addition to the known range of *Marumba irata*Joicey and Kaye, 1917 (Lepidoptera: Sphingidae) in northeastern India. *Journal of Threatened Taxa*, 7(11): 7831-7832. https://doi.org/10.11609/JoTT.o4200.7831-2

Zolotuhin, V.V. and Ryabov, S.A. 2012. The hawkmoths of Vietnam. Korporatsiya Tekhnologiy Prodvizheniya, Ulyanovsk, 239 pp. (in Russian)

A new *Chalepa* sp. awaiting description, collected from Shirui Hill during the study. © Jatishwor Irungbam

CHAPTER VII

Lesser known and new Notodontidae Stephens, 1829 (Lepidoptera: Noctuoidea) moths from Manipur, India

Jatishwor S. Irungbam[1,2*], Alexander Schintlmeister[3] & Zdenek F. Fric[2]

Manuscript

Pages 161 to 185 Unpublished data

Teinopalpus imperialis imperialis flying high at the upper ridge of the Shirui Hill. @ HHuidrom

CHAPTER VIII

An inventory of the butterflies of Manipur, India (Insecta: Lepidoptera)

Zootaxa (2020), 4882 (1): 001–091
https://doi.org/10.11646/zootaxa.4882.1.1
(IF. 0.95)

Zootaxa 4882 (1): 001–091
https://www.mapress.com/j/zt/

Monograph

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4882.1.1
http://zoobank.org/urn:lsid:zoobank.org:pub:012741DB-2462-4B21-A112-2622DB722852

ZOOTAXA

4882

AN INVENTORY OF THE BUTTERFLIES OF MANIPUR, INDIA (INSECTA: LEPIDOPTERA)

JATISHWOR SINGH IRUNGBAM[1, 2, 9], LAISHRAM RICKY MEITEI[3], HARMENN HUIDROM[4], BALESHWOR SINGH SOIBAM[5], AOMAO NGANGOM[6], BENDANG NGANGOM[7], RONALD MEITEI[8] & ZDENEK FALTYNEK FRIC[2]

[1]*Faculty of Science, University of South Bohemia, Ceske Budejovice, Czech Republic–37005*
jatishwor.irungbam@gmail.com; https://orcid.org/0000-0002-3003-6624
[2]*Biology Centre, Czech Academy of Science, Institute of Entomology, Ceske Budejovice, Czech Republic–37005*
zdfric@gmail.com; https://orcid.org/0000-0002-3611-8022
[3] *Botanical Survey of India, Eastern Regional Centre, Shillong, Meghalaya, India–793003*
ricky.laishram985@gmail.com; https://orcid.org/0000-0001-9579-4357
[4]*Yaiskul Hiruhanba Leikai, Imphal West, Manipur, India–795001*
harshuidrom8@gmail.com; https://orcid.org/0000-0002-7547-4513
[5]*Ningombam Mayai Leikai, Imphal West, Manipur, India–795002*
balesh1moirangcha@gmail.com; https://orcid.org/0000-0002-1515-9204
[6]*Assam Don Bosco University, Azara, Guwahati, Assam, India–781017*
aomoa13@gmail.com; https://orcid.org/0000-0001-7553-9906
[7]*Matai, Mantripukhri, Imphal East, Manipur, India – 795002*
ngbendang@gmail.com; https://orcid.org/0000-0002-7945-1108
[8]*Lamjao, Kakching, Manipur, India -795103*
ronald_meitei@rediffmail.com; https://orcid.org/0000-0003-4298-7483
[9]*Corresponding author*

Magnolia Press
Auckland, New Zealand

Accepted by H. Chiba: 14 Sept. 2020; published: 23 Nov. 2020

JATISHWOR SINGH IRUNGBAM, LAISHRAM RICKY MEITEI, HARMENN HUIDROM, BALESHWOR SINGH SOIBAM, AOMAO NGANGOM, BENDANG NGANGOM, RONALD MEITEI & ZDENEK FALTYNEK FRIC
AN INVENTORY OF THE BUTTERFLIES OF MANIPUR, INDIA (INSECTA: LEPIDOPTERA)
(*Zootaxa* 4882)

91 pp.; 30 cm.

23 Nov. 2020

ISBN 978-1-77688-106-2 (paperback)

ISBN 978-1-77688-107-9 (Online edition)

FIRST PUBLISHED IN 2020 BY

Magnolia Press

P.O. Box 41-383

Auckland 1041

New Zealand

e-mail: magnolia@mapress.com

https://www.mapress.com/j/zt

ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

Table of Contents

Abstract

The butterfly fauna of Manipur is poorly known, and a few sporadic studies were carried out decades ago. In this study, butterflies were photographed and/or collected in 80 localities including revisiting of 12 historical localities in the hills and valleys from Manipur state, India. Butterflies were regularly sampled between 2010 and 2019. In the present checklist, we have included both previously published and recently recorded species: 798 species belong to six families; Papilionidae (52 sp.), Pieridae (39 sp.), Riodinidae (17 sp.), Lycaenidae (225 sp.), Nymphalidae (270 sp.), and Hesperiidae (195 sp.). Eight species were rediscovered during the study; *Byasa latreillei kabrua, Papilio machaon suroia, Lamproptera meges indistincta*, *Bhutanitis lidderdalii lidderdalii, Lethe kangjupkula*, *Una usta usta*, *Arhopala hellenore hellenore* and *Celaenorrhinus munda maculicornis*. Thirty–two species were new records to Manipur; *Papilio agestor agestor*, *Lamproptera curius curius, Appias albina darada*, *Artogeia erutae montana*, *Miletus mallus*, *Flos fulgida fulgida, Cigaritis nipalicus, Rapala rectivitta, Heliophorus kohimensis, H. tamu, Jamides caeruleus, Tarucus venosus, Everes huegelii dipora, Talicada nyseus nyseus, Lestranicus transpectus, Euploea radamanthus radamanthus, Lethe distans, L. dura gammiei, L. latiaris latiaris, L. sura, Neope pulaha, N. yama yama, Zipaetis scylax*, *Algia fasciata fasciata*, *Athyma opaline*, *Pantoporia paraka paraka*, *Kallima knyvettii*, *Celaenorrhinus asmara, Hyarotis adrastus praba*, *Erionota torus*, *Baoris penicillata chapmani*, and *Potanthus mingo ajax* of which, *Miletus mallus* was a new record for India. Ninety species are legally protected in schedules (I, II & IV) of Indian (Wildlife) Protection Act, 1972.

Key words: Butterfly, Manipur, new records, Protected species, rediscovery

Introduction

The state of Manipur (latitude of 23°83'N 25°68'N and a longitude of 93°03'E 94°78'E) of India is a part of the eastern Himalaya Biodiversity Hotspot which covers parts of Nepal, Bhutan, the northeast Indian states, southeast Tibet (China) and northern Myanmar. In addition, the northeastern India is the meeting place of the central Asian and Chinese subdivision of the Palearctic region with the Peninsular India and Malayan subdivision of Oriental region and, hence, considered very rich in terms of Lepidoptera diversity (Wynther–Blyth, 1957).

The earliest published record of Manipur butterflies was that of A.G. Butler (1885) based on the collection of butterflies from the Manipur and on the borders of Assam by Dr. George Watt. In "Lepidoptera Indica", a publication series by Frederic Moore (1890, 1893, 1896, 1899, 1901, 1903) and Col. Charles Swinhoe (1905, 1910, 1911, 1912), a total of 38 species of butterflies were enlisted which were collected by Dr. G. Watt on the Manipur Hills. Later, Lieut. Col. H.C. Tytler (1914) did extensive collection of butterflies in various parts of Manipur including the low lying Hills of Imphal valley, Saitu, Kabrua peak (8,400 feet), Irang and Lengba river basins which is a part of Western Manipur Hills, Sebong (near the Myanmar border which is a part of Eastern Manipur Hills), Shirui village and Siroifui Peak (9,000 feet) in Ukhrul. He not only compiled the list of butterflies, but also described 41 new species and subspecies of butterflies from Manipur and Naga Hills (Tytler, 1914, 1915a, 1915b, 1926, 1927). Further, Tytler (1939, 1940), working on the butterflies of Burma (Myanmar), described 12 species and subspecies of butterflies based on his collections made from Naga Hills and Manipur during 1911 to 1914. Some more records of butterflies from Manipur have been reflected in the butterfly part of "The Fauna of British India" series (Bingham, 1905, 1907; Talbot, 1939, 1947), "Identifications of Indian Butterflies" series by Evans (1923, 1932) and "Butterflies of Indian Region" by Wynter–Blyth (1957).

In the last few decades, few Indian researchers have worked on the butterflies of Manipur. The expeditions of Zoological Survey of India, Kolkata, to Manipur attempted to document the complete butterfly fauna of Manipur. The subsequent publications of the Zoological Survey of India, Kolkata, recorded 87 species of butterflies from Manipur (Gupta, 2004; Majumdar, 2004; Mondal & Maulik, 2004). Later, the survey conducted in the Keibul Lamjao National Park, Bishnupur district, recorded 115 species of butterflies (Singh *et al.,* 2011). In the present study, we attempt to enlist all butterfly species recorded from Manipur through review of published literature and our continuous survey of butterflies in many localities of Manipur.

Certain butterflies in India are protected under the Wildlife Protection Act, 1972 which was enacted by Parliament of India for protection of plants and animal species (Gupta & Mondal, 2005). The Act was amended in October 1980 and included many species and subspecies of butterflies under three Schedules: Schedule I–Animals in this schedule are totally protected throughout the country, live, dead or part thereof. In total, 128 species and subspecies of butterflies are protected in part IV of the Schedule based on "Very Rare" status mentioned by Evans (1932);

Schedule II–Animals in this schedule are protected from controlled exploitation. In total, 307 species and subspecies of butterflies are protected in part II of the Schedule based on "Rare" status by Evans (1932); and Schedule IV–includes generally common animals. Nineteen species and subspecies of butterflies are protected in part II.

Materials and Methods

The paper is based on review of published records and the recent butterfly survey conducted in Manipur state during 2010 to 2019. Butterflies were documented in 80 localities including 12 historical sites in the hills and valleys of the Manipur (Table 1). The surveys were conducted over the pre–monsoon (March–April), monsoon (June–July) and post–monsoon (September–October) seasons. In most of the surveys, the field work was conducted from the morning (09.00 hrs.) till late afternoon or evening (17.00 hrs.) depending on weather conditions. The survey was mainly based on the photography method of the encountered butterflies during the survey, supplemented by collecting of difficult–to–identify species using sweeping net and stored in paper as vouchers for study of genital structures and identification in the laboratory.

TABLE 1. Overview of sampling sites of butterflies during 2010–2019 and historical sites (†) from the published literature.

Sr. No.	Study Sites	GPS Coordinates		Elevation mASL
		Latitude	Longitude	
A	**Bishnupur District**			
1	Karang	24,548960	93,832769	775
2	Keibul Lamjao National Park†	24,485157	93,838537	770
3	Leikoipat†	24,634439	93,761564	782
4	Leimaram	24,722792	93,772375	870
5	Leimatak	24,803668	93,558654	430
6	Thanga	24,532640	93,829722	768
7	Thinungei	24,549850	93,759086	772
8	Thongjao	24,430315	93,926782	779
9	Toubul	24,622173	93,791774	771
10	Waikhong Pine RF	24,417741	93,930874	779
B	**Churachandpur District**			
11	New Lamka†	24,327729	93,705437	835
12	Saikot†	24,327316	93,729547	841
13	Singngat	24,145383	93,592014	967
14	Thanlon	24,266019	93,282380	733
15	Tipaimukh	24,235402	93,025522	202
C	**Imphal East District**			
16	Andro	24,724914	94,026329	824
17	Haraorou	24,909801	93,985612	784
18	Heingang Hills	24,864769	93,962276	783
19	Khundrakpam	24,891769	93,983561	784
20	Kongbamaru	24,976286	93,978053	827
21	Leimakhong Mapal	24,885379	94,075321	821

...Continued on the next page

TABLE 1. (Coniinued)

Sr. No.	Study Sites	GPS Coordinates		Elevation mASL
		Latitude	Longitude	
22	MataiVillage	24,856456	93,914995	804
23	Yaingangpokpi	24,911472	94,123529	812
24	Jiribam	24,784953	93,127238	39
D	**Imphal West District**			
25	Cheiraoching	24,833188	93,937869	782
26	Hiyangthang	24,725554	93,904015	774
27	Iroisemba	24,810529	93,888238	781
28	Kangchup	24,835275	93,807385	820
29	Khurkhul	24,919411	93,834103	838
30	Lamdeng	24,833350	93,886525	793
31	Lamphel Pat	24,833333	93,916667	781
32	Langol Reserve Forest†	24,832070	93,889289	781
33	Phayeng	24,846268	93,810255	820
34	Pheidinga	24,902849	93,884099	796
35	Sekmai	24,966258	93,886635	880
36	Yaral Pat	24,797692	93,989056	782
E	**Senapati District**			
37	Kanglatongbi	24,964410	93,885120	853
38	Keithelmanbi	25,100270	93,944467	994
39	Leikot	24,995486	93,887374	950
40	Sadu Chiru	24,740802	93,746347	1156
41	Saitu†	25,032154	93,905967	1114
42	Turi bari†	25,146393	93,952657	1283
43	Utonglok	24,987091	94,083885	1195
44	Changoubung†	25,184103	93,975542	1184
45	Hengbung†	25,224087	93,997749	1190
46	Karong	25,303152	94,044492	1028
47	Koubru†	25,062600	93,884154	1984
48	Phaibung Khullen†	25,426635	94,336658	1715
49	Song Song†	25,511611	94,134995	1806
50	Tumuyon Khullen†	25,188610	93,979905	1214
F	**Tamenglong District**			
51	Tamenglong	24,986558	93,496141	1130
52	Dailong	25,006315	93,523155	1037
53	Irang River†	24,646158	93,438292	194
54	Khongsang	24,821968	93,474620	531
55	Noney	24,862587	93,623745	335

...Continued on the next page

TABLE 1. (Coniinued)

Sr. No.	Study Sites	GPS Coordinates		Elevation mASL
		Latitude	Longitude	
56	Nungba	24,743303	93,422048	774
57	Tamei	25,158160	93,679951	1102
58	Tupul	24,788468	93,665314	569
G	**Chandel District**			
59	Kwatha Khunou	24,335729	94,277569	515
60	Lailok [Lokchao]	24,257871	94,298064	264
61	Moreh	24,254109	94,298597	214
62	Sebong†	24,380746	94,217980	882
63	Tuipi [Lokchao]	24,322783	94,231194	364
64	Khujailok [Lokchao]	24,272533	94,265572	540
65	Pallel	24,448243	94,024107	815
66	Ikop Pat	24.606619	93.938363	771
67	Komlathabi	24,417775	94,009269	829
68	Waithou Pat	24,679572	93,973660	779
69	Sugnu	24,292659	93,875599	611
H	**Ukhrul District**			
70	Bungpa Khunou	24,817121	94,487228	1425
71	Chingai	25,314042	94,502657	1464
72	Kamjong	24,857044	94,513463	1344
73	Kangkhui	25,099329	94,395881	1879
74	Kasom Khullel	24,676601	94,262894	975
75	Phungyar	24,807640	94,349907	1399
76	Litan	24,94816	94,192840	951
77	Shirui Hills†	25,111887	94,450708	2407
78	Shirui Village	25,129944	94,418852	1889
79	Sihai Khullen	25,168749	94,486982	1839
80	Ukhrul Town	25,097965	94,361596	1899

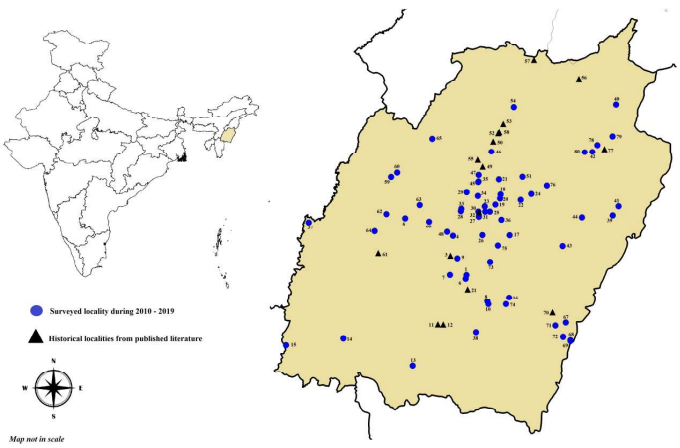
Identifications of the butterflies are based on the original species descriptions in the literature. In addition, the following publications were consulted for species identifications, distributional records and the checklist preparation: Butler (1885); Moore (1890, 1893, 1896, 1899, 1901, 1903); Swinhoe (1905, 1910, 1911, 1912); Bingham (1905, 1907); Tytler (1914, 1915a, 1915b, 1926, 1927, 1939, 1940); Evans (1914, 1927, 1932, 1949, 1957); Talbot (1939, 1947); Wynter–Blyth (1957); Pinratana (1977, 1988); Gupta (2004); Majumdar (2004); Mondal & Maulik (2004); Ek–Amnuay (2006); Kehimkar (2008, 2015); Singh *et al.* (2011); van Gasse (2013); Varshney & Smetacek (2015). We also used web–based resources of Indian butterflies (Kunte *et al*., 2020). Revisional articles on the families was also consulted to prepare the present systematic checklist: Varshney & Smetacek (2015) for family Papilionidae; Braby (2005) and Wahlberg *et al*. (2014) for family Pieridae; Espeland *et al*. (2014) and Seraphim *et al*. (2018) for family Riodinidae; Eliot (1973) for family Lycaeniidae; Wahlberg *et al*. (2003, 2009) for family Nymphalidae and Warren *et al*. (2009) for family Hesperiidae. Other revisional articles on subfamilies and individual genera were also consulted: Limentidinae (Dhungal & Wahlberg, 2018); Apaturinae (Ohshima *et al*., 2010); Libytheinae (Kawahara, 2009); Nymphalinae (Wahlberg *et al*., 2005); Satyrinae (Pena *et al.,* 2006); Coliadinae

(Chiba, 2009); Hesperiinae, Baorini (Fan *et al.,* 2016); Hesperiinae, Aeromachini (Huang *et al*., 2019); Limenitidinae, Neptini (Eliot, 1969); Miletinae, Miletini (Eliot, 1986); Lycaenopsis group (Uemura & Monastyrskii, 2004); Mycalesina & Heteropsis clade (Aduse–Poke *et al*., 2015, 2016; Kodandaramaiah *et al.,* 2010); Spindasis (Boyle *et al*., 2015); *Charaxes* (Aduse–Poke *et al.,* 2009); *Arhopala* (Evans, 1957; Megens *et al.,* 2004); *Neozephyrus* (Howarth, 1957) and Zephyrus hairstreaks (Koiwaya, 2007). General classification and systematics follow Espeland *et al.* (2018). Lastly, Kehimkar (2008, 2015), Varshney & Smetacek (2015) and Kunte *et al.* (2020) were followed to determine the distribution status of the butterflies within India. Identifications of newly recorded species were confirmed by experts of each group via the subject editor.

Results and discussion

The authors have been recording butterflies in the Manipur since 2010 and reporting the record of butterflies from Manipur. However, there has been no comprehensive review of the butterflies of Manipur since that of Tytler (1914, 1915a, 1915b, 1939). Many species that were present or rare then have not yet been recorded from Manipur, while some new records and range extensions have occurred into the region. The annotated list is a compilation of observations made by the authors from 2010–2019 in the valley and surrounding hill areas of Manipur in addition to the available published records. In total, 80 sites in the Manipur were studied and are stated in the Table 1 (Fig. 1). A total of 798 species have been listed down from Manipur, of which 446 species were recorded by the authors themselves (species marked with "asterisk" in Appendix I) during the study and the remainder (352 species) have not been recorded in this study.

Since, we started butterfly survey in Manipur, two species show significant recent range extensions in their distributions in the Manipur; *Pontia daplidice* (Singh & Gogoi, 2013) and *Aglais cashmiriensis* (Irungbam *et al*., 2017b) are from the Eastern Himalayas; Four rediscoveries were made: *Teinopalpus imperialis* (Soibam, 2016), *Callerebia suroia* (Irungbam *et al.,* 2017a), *Coladenia indrani uposathra* and *Apporasa atkinsoni* (Soibam *et al.,* 2016); and two new records *Amblopala avidiena avidiena* (Irungbam *et al., in press*) and *Appias galba* (Irungbam *et al.,* 2020). In the present study, further we report the rediscovery of eight species, which have been not recorded by any researcher in Manipur since reported by Tytler (1914, 1915a, 1915b) and thirty-two species for the first time from Manipur, of which one species are new record for India. Their details and notes are provided below.



FIGURES 1. Map showing the sampling sites of butterflies during 2010–2019 (in Blue Circle) and historical sites from the published literature (in Black Triangle).

Notes on the butterflies rediscovered from Manipur

***Byasa latreillei kabrua* (Tytler, 1915) (Figure 2):** The subspecies was described by Tytler (1915a) based on the males collected from Yakama, Naga Hills and females collected from Manipur in May and June. The present record

of the species from Kabrua Peak in April 2019 is the second known record of the species. The species is rare (Evans, 1932) and protected in India under the schedule II of Indian Wildlife (Protection) Act, 1972. This present report reconfirms the presence of the butterfly in Manipur.

Papilio machaon suroia* Tytler, 1939 (Figure 3):** The subspecies ***suroia was described from the material collected at Shirui (Suroi) Hills Manipur during 1913–1914 by Tytler. The subspecies *suroia* is different from subspecies *verity* from being larger and in having the greater portion of interspace I of hindwing covered with long greyish–brown hairs. During our study, three individuals of the subspecies *suroia* were collected from Shirui hills at 2425 m ASL on April 11, 2017. This present report reconfirms the presence of the butterfly in Manipur.

FIGURES 2–7. Adults of butterflies rediscovered from Manipur**.** 2. Byasa latreillei kabrua (Tytler, 1915); 3. Papilio machaon suroia Tytler, 1939; 4. Lamproptera meges virescens (Butler, 1870); 5. Bhutanitis lidderdalii lidderdalii Atkinson, 1873; 6. Lethe kangjupkula Tytler, 1914; 7. Una usta usta (Distant, 1886).

***Lamproptera meges indistincta* Tytler, 1912 (Figure 4):** The subspecies *indistincta* was described from the Naga Hills by Tytler (1912) and later reported from the Manipur Hills by Tytler (1915a). Since then, none of the researchers have recorded the butterfly from Manipur. In the last decade, the butterfly has been observed very frequently in the lower altitudes of valley and hills of the Manipur. The butterfly was observed from Namthilok, Leimatak, Kongbamaru, Leimaram, Nungba, Tamenglong and Kamjong during the month of April, June, September, October and November. The present report reconfirms the presence of the butterfly in Manipur.

***Bhutanitis lidderdalii lidderdalii* Atkinson, 1873 (Figure 5):** This butterfly was first recorded between August and October from the Naga Hills and Mao of Senapati district, Manipur at elevations between 7500 to 8000 feet by W. Doherty in 1890 (Talbot, 1939). Since then, none of the researchers have recorded the butterfly from Manipur. In the present study, the butterfly was recorded from Shirui Peak in September 2019. The subspecies *lidderdalii* is endemic to Eastern Himalayas, occurring Sikkim eastward into Bhutan, Arunachal Pradesh, Manipur, Nagaland, and N. Myanmar. The subspecies is protected in India under the schedule II of Indian Wildlife (Protection) Act, 1972. The present report reconfirms the presence of the butterfly in Manipur.

***Lethe kangjupkula* Tytler, 1914 (Figure 6):** The butterfly was described from Manipur by Tytler (1914) based on a dry season male collected from Kangjupkul in June 1911 and four dry season male collected from Koubru peak of Manipur valley in July 1911 and 9 males and 5 females of wet season form collected at Zulla valley, Nagaland during October–November 1911. Since then, nobody has seen or collected the species. In the present study, the butterfly was photographed in Mao area, near Manipur–Nagaland border on July 20, 2015. This present report reconfirms the presence of the butterfly in Manipur.

***Una usta usta* (Distant, 1886) (Figure 7):** The butterfly was recorded from Sebong in the Estern Manipur Hills and Irang River, Western Manipur Hills in November (Tytler, 1915b). In the present study, the butterfly was recorded from Thinungei village at Bishnupur district on October 07, 2016. It was also recorded from Kasom Kullen at Ukhrul district on September 14, 2018. These present reports reconfirm the presence of the butterfly in Manipur.

***Arhopala hellenore hellenore* Doherty, 1889 (Figure 8):** Tytler (1915b) reported the butterfly from Sebong and Cachar road in Manipur from November to April. In the present study, the butterfly was recorded from Langol Reserve Forest (900 m ASL) at Imphal West district on 24 May 2016. The butterfly was also recorded at Bungpa Khunou village (1155 m ASL) at Ukhrul district on 23 June 2016. The butterfly is commonly seen in all the recorded areas. These present reports reconfirm the presence of the butterfly in Manipur.

***Celaenorrhinus munda maculicornis* (Elwes & Edwards, 1897) (Figure 9):** Tytler (1915b) reported three males from Sebong in October and one female at Saitu in May. Since then, none of the researchers have recorded the butterfly from Manipur. In the present study, the butterfly was recorded from Kangkhui (1879 m ASL) at Ukhrul district on June 11, 2018. This present report reconfirms the presence of the butterfly in Manipur.

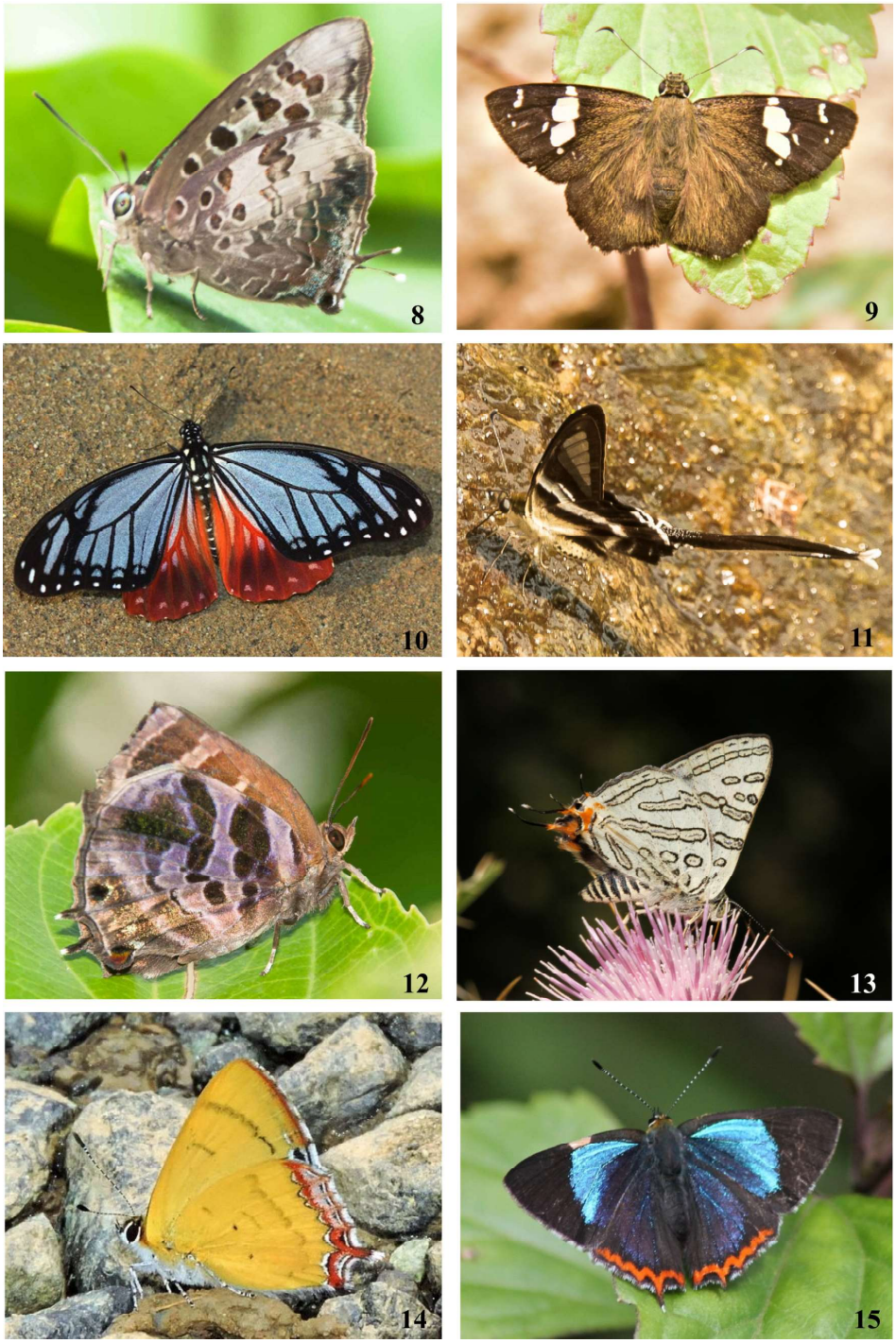
Notes on the newly recorded butterflies from Manipur:

***Papilio agestor agestor* Gray, 1831 (Figure 10)**: Recorded puddling on the sand of riverbed on 5 March 2015 in Thanlon, Churachandpur district at an altitude of 733 m ASL. The butterfly was also recorded from Kangchup, Imphal west district at an altitude of 820 m ASL on 14 April 2016. In India, the butterfly has been recorded from Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh, and Nagaland.

***Lamproptera curius curius* (Fabricius, 1787) (Figure 11)**: The butterfly was reported from the Naga Hills by Tytler (1912). The species was active and seen puddling on mud at Nungba at Tamenglong district during November 2017. In India, the butterfly has been recorded from Arunachal Pradesh, Assam, Meghalaya, Mizoram and Tripura.

***Appias albina darada* (C & R Felder, [1865]) (Figure 32 & 33):** A few individuals were collected from Lokchao riverbed near Tuipi village of Chandel district at an altitude of 364 m ASL in March 2017. The butterfly is fast flier, prefers wooded forest and most of the males settle in vast numbers on wet and damp areas. Both sexes go to rest on the undersides of leaves during the heat of the day (Wynter–Blyth, 1957). In India, the subspecies *darada* has been reported from Andamans & Nicobars Islands, West Bengal, Sikkim, Meghalaya, Arunachal Pradesh, Assam and Mizoram. The subspecies *darada* is legally protected in India under Schedule II of the Wildlife (Protection) Act, 1972.

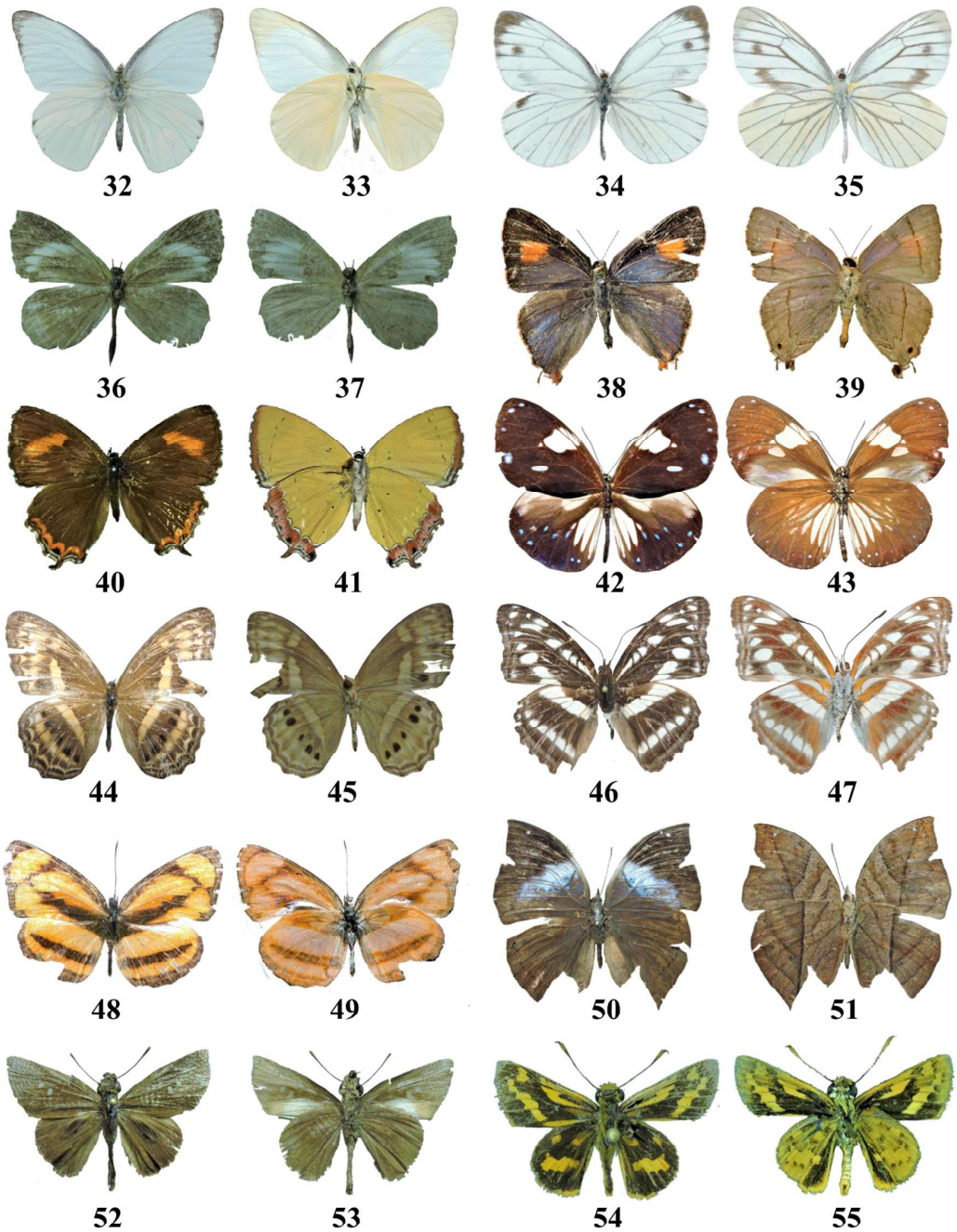
***Artogeia erutae montana* (Verity, 1911) (Figure 34 & 35):** Several individuals were recorded puddling on a hill stream near Sadu–Chiru waterfall area at an altitude of 1156 m ASL in Senapati district in December 2015. Later the butterfly was reported from other parts of Manipur in various seasons. One individual (female) was photographed in Phuba, Senapati district in September 2015, and another individual (male) from Imphal valley in April 2016. The butterfly has been recorded from Sikkim.



FIGURES 8–9. Continuation of adults of butterflies rediscovered from Manipur**. 10–15.** Adults of the newly recorded butterfly species. 8. Arhopala hellenore hellenore Doherty, 1889; 9. Celaenorrhinus munda maculicornis (Elwes & Edwards, 1897); 10. Papilio agestor agestor Gray,1831; 11. Lamproptera curius curius (Fabricius, 1787); 12, Flos fulgida fulgida (Hewitson, 1863); 13. Cigaritis nipalicus (Moore, 1884) (Photo by Milind Bhankare); 14–15. Heliophorus tamu (Kollar, [1844]).

FIGURES 16–23. Continuation of the adults of the newly recorded butterfly species. 16. Jamides caeruleus (Druce, 1873); 17. Tarucus venosus Moore,1882; 18. Everes hugelii dipora (Moore, 1865); 19. Lestranicus transpectus (Moore, 1879); 20 & 21. Talicada nyseus nyseus (Guerin–Meneville, 1843); 22. Lethe distans Butler, 1870 (Photo by Sagar Sarang); 23. L. dura gammiei (Moore, [1892]).

FIGURES 24–31. Continuation of the adults of the newly recorded butterfly species. 24. Lethe latiaris latiaris (Hewitson, 1862); 25. L. sura (Doubleday, [1849]) (Photo by Monsoon J. Gogoi); 26. Neopa pulaha (Moore, [1858]); 27. N. yama yama (Moore, [1858]); 28. Zipaetis scylax Hewitson, 1863; 28. Algia fasciata (C. & R. Felder, 1860); 29. Celaenorrhinus asmara (Butler, 1877); 30. Hyarotis adrastus praba (Moore, [1866]); 31. Erionota torus Evans, 1941.



FIGURES 32–55. Continuation of the adults of the newly recorded butterfly species (even numbers dorsal view; odd numbers ventral view). 32–33. Appias albina darada (C & R Felder, [1865]); 34–35. Artogeia erutae montana (Verity, 1911); 36–37. Miletus mallus (Fruhstorfer, 1913); 38–39. Rapala rectivitta (Moore, 1879); 40–41. Heliophorus kohimensis (Tytler, 1912); 42–43. Euploea radamanthus radamanthus (Fabricius, 1793); 44–45. Algia fasciata fasciata (C. & R. Felder, 1860); 46–47. Athyma opalina (Kollar, [1844]). 48–49. Pantoporia paraka paraka (Butler, 1879); 50–51. Kallima knyvetti de Niceville, 1886; 52–53. Baoris penicillata chapmani (Evans, 1937); 54–55. Potanthus mingo ajax (Evans, 1932).

***Miletus mallus* (Fruhstorfer, 1913) (Figure 36 & 37):** An individual was recorded from the riverbed of Lokchao river at Khujailok, Chandel district (540 m ASL) on 16 April 2017. The butterflies of the genus usually fly in shades of low elevations. The species is known from Myanmar, N. Thailand, Laos, Cambodia, Vietnam. The first record from Manipur and India.

***Flos fulgida fulgida* (Hewitson, 1863) (Figure 12):** On 28 June 2015, an individual was photographed at the forest of Keibul Lamjao National Park at an elevation of 770 m ASL, Bishnupur district. The butterfly was seen sitting on a leaf with its wings closed. In May 2016, another individual was photographed at Langol Reserve forest, Imphal west district at an elevation of 781 m ASL, which lies at the Imphal valley. In India, the butterfly has been recorded from West Bengal and Meghalaya.

***Cigaritis nipalicus* (Moore, 1884) (Figure 13):** An individual was photographed in Song–Song village, Senapati district in June 2017 by Milind Bhankare (Mumbai). In Himalayas, the butterfly is seen from April to June and from August to October and prefers open countryside in the altitude between 915 and 2438 m ASL. The species is legally protected in India under Schedule II of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded from Uttarakhand and Himachal Pradesh.

***Rapala rectivitta* (Moore, 1879) (Figure 38, 39):** An individual was collected in the Shirui Hills near the guest house, Ukhrul district at the altitude 2407 m ASL on 29 March 2017. In India, the butterfly has been recorded from Sikkim, Assam and Nagaland.

***Heliophorus kohimensis* (Tytler, 1912) (Figure 42 & 43):** A few individuals were collected from Shirui Hills near the guest house, Ukhrul district at the altitude 2407 m ASL, feeding on the cow dung in March 2017. Later, the butterfly was photographed at Bungpa Khunou, Kamjong district at the altitude 1425 m ASL in November 2017. In India, the butterfly is reported from Nagaland.

***Heliophorus tamu* (Kollar, [1844]) (Figure 40, 41):** A few individuals were collected from Shirui Hills and Shirui village, Ukhrul district in March 2017 and Kasom Khullen, Kamjong district (1425 m ASL) in April 2018. In India, the butterfly is reported from West Bengal, Sikkim and Arunachal Pradesh.

***Jamides caeruleus* (Druce, 1873) (Figure 16):** Recorded from various localities of valley districts of Manipur. This species is legally protected in India under Schedule II of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded from Arunachal Pradesh. It is a first record from Manipur.

***Tarucus venosus* Moore, 1882 (Figure 17):** An individual was photographed in Kwatha khunou, Yaingangpokpi Lokchao Wildlife Sanctuary, Chandel district at an altitude 515 m ASL in October 2017. We have recorded *T. venosus* and *T. waterstradi dharta* from the same locality in June 2012. In India, the butterfly has been recorded from Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Chandigarh, West Bengal, and Meghalaya. It is a first record from Manipur.

***Everes huegelii dipora* (Moore, 1865) (Figure 18):** A small group of individuals was recorded from the roadside at Litan, Ukhrul district on 27 March 2017. The butterfly was common in the area. the butterflies were also observed during the month of April 2017 at Tuipi, Lailok and Kwatha khunou in Chandel district. The butterfly prefers forest clearings at elevations between 1700 and 1800 m ASL. In India, the subspecies *dipora* has been recorded from Uttarakhand, Meghalaya and Nagaland.

***Lestranicus transpectus* (Moore, 1879) (Figure 19):** Recorded from Litan and Shirui village, Ukhrul district in March–April 2017. The butterfly is also recorded from Kwatha khunou and Yaingangpokpi Lokchao Wildlife Sanctuary in April 2017. It prefers hill forest and flies up to 3000 m ASL. In India, the butterfly has been recorded from West Bengal, Sikkim, Arunachal Pradesh, Meghalaya, Assam and Mizoram.

***Talicada nyseus nyseus* (Guérin–Méneville, 1843) (Figure 20, 21):** The butterfly was encountered in various localities in the Imphal valley in 2017 and 2018. An individual was photographed at Yaiskul, Imphal West district in August 2018. In India, the butterfly has been recorded from throughout India.

***Euploea radamanthus radamanthus* (Fabricius, 1793) (Figure 42, 43):** An individual was collected in Lokchao riverbed near Tuipi village, Chandel district on 05 April 2017. The butterfly prefers hill forest upto 1200 m ASL. This species is legally protected in India under Schedule IV of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded from West Bengal, Assam, Meghalaya, Arunachal Pradesh and Nagaland.

***Lethe distans* Butler, 1870 (Figure 22):** An individual was photographed at Bungpa khunou, Ukhrul District on 17 May 2017. The butterfly prefers hill forest and flies at low elevations between 400 and 1900 m ASL. This species is legally protected in India under Schedule I of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded only from Arunachal Pradesh.

***Lethe dura gammiei* (Moore, [1892]) (Figure 23):** An individual was photographed at Shirui mountain, Ukhrul District during May 2015. The butterfly prefers hill forest and flies up to 1800–2200 m ASL. This species is legally protected in India under Schedule I of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded only from Sikkim and Meghalaya.

***Lethe latiaris latiaris* (Hewitson, 1862) (Figure 24):** An individual was photographed at Lailok stream, Yaingangpokpi Lokchao Wildlife Sanctuary, Chandel district in March 2015. The subspecies *latiaris* is legally protected in India under Schedule II of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded from Sikkim, Arunachal Pradesh, and Nagaland.

***Lethe sura* (Doubleday, [1849]) (Figure 25):** An individual was photographed at Shirui mountain, Ukhrul District in May 2015. The butterfly prefers hill forests and flies upto 1800–2200 m ASL. In India, the butterfly has been recorded from West Bengal, Arunachal Pradesh, Meghalaya, and Nagaland.

***Neope pulaha* (Moore, [1858]) (Figure 26):** An individual was photographed at Kasom khullel, Ukhrul district (975 m ASL) on 13 April 2015. This species is legally protected in India under Schedule II of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded from Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh, and Nagaland.

***Neope yama yama* (Moore, [1858]) (Figure 27):** An individual was photographed at Kasom khullel, Ukhrul district (975 m ASL) on 05 March 2015. This species is legally protected in India under Schedule II of the Wildlife (Protection) Act, 1972. In India, the butterfly has been recorded from Sikkim, Arunachal Pradesh, Meghalaya and Nagaland.

***Zipaetis scylax* Hewitson, 1863 (Figure 28):** An individual was photographed at Yaingangpokpi Lokchao Wildlife Sanctuary, Chandel district during April 2017. The butterfly was active during the day at forest near the Lokchao river. In India, the butterfly has been recorded from Sikkim, Assam, and Arunachal Pradesh.

***Algia fasciata* (C. & R. Felder, 1860) (Figure 44, 45):** Recorded from different locations of Tamenglong district. The butterfly was active during the day at forest near the riverbed. An individual was photographed and collected from Nungba, Tamenglong district on 14 September 2018. This species is legally protected in India under Schedule I of the Wildlife (Protection) Act, 1972. In India, the species has been recorded from West Bengal, Assam, and Meghalaya (Goswami, 2020).

***Athyma opalina* (Kollar, [1844]) (Figure 46, 47):** The butterfly was collected in Nungba (774 m ASL), Tamenglong district on 14 September 2018. In India, the butterfly has been recorded from Jammu & Kashmir, Himachal Pradesh, and Uttarakhand.

***Pantoporia paraka paraka* (Butler, 1879) (Figure 48, 59):** Very common in the forest along the Lokchao river along with other members of the genus. Common at the low elevations up to 900 m ASL. A few individuals were collected from riverbed of Lokchao river in April 2017. In India, the butterfly has been recorded from West Bengal, Assam, and Meghalaya.

***Kallima knyvettii* de Nicéville, 1886 (Figure 50, 51):** A single individual was recorded from the Shirui Hills near the guest house, Ukhrul district (2407 m ASL) on 29 March 2017. Later in the same day, another individual was sighted and collected from Shirui Village, Ukhrul district (1889 m ASL). In India, the butterfly has been recorded from Sikkim, Nagaland, and Arunachal Pradesh.

***Celaenorrhinus asmara* (Butler, 1877) (Figure 29):** An individual was photographed from Kwatha Khunou (515 m ASL), Chandel district on 17 October 2019. The butterfly prefers shaded area in the forest at low elevations. In India, the butterfly has been recorded only from Meghalaya.

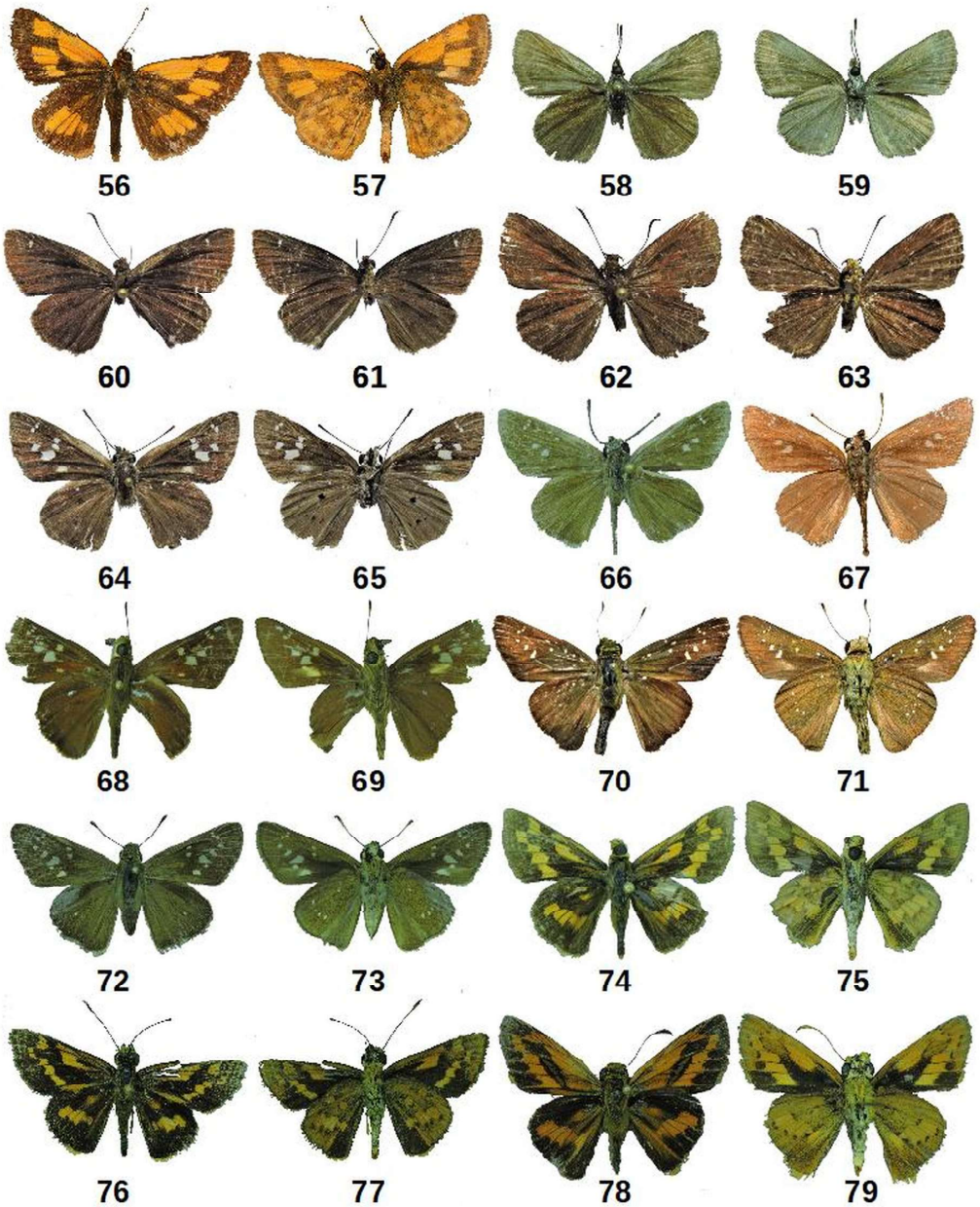
***Hyarotis adrastus praba* (Moore, [1866]) (Figure 30):** An individual was photographed at Bungpa Khunou, Ukhrul district in October 2017. In India, the butterfly has been recorded from Andaman & Nicober Islands, Tamil Nadu, Kerala, Karnataka, Maharashtra, Andhra Pradesh, Uttarakhand, West Bengal, Mizoram, Meghalaya, Assam, Arunachal Pradesh, Tripura and Nagaland. The species is protected in India under the schedule IV of Indian Wildlife (Protection) Act, 1972.

***Erionota torus* Evans, 1941 (Figure 31):** An individual was photographed at Senapati on 08 August 2015 and later another individual was collected at Yaiskul, Imphal west on the evening on 13 July 2017. This is the first official records of this species though it was recorded as *Erionota thrax* before *E. torus* was described. In India, the butterfly has been recorded from Tamil Nadu, Kerala, Karnataka, Maharashtra, West Bengal, Sikkim, Mizoram, Manipur, Assam, Arunachal Pradesh and Tripura.

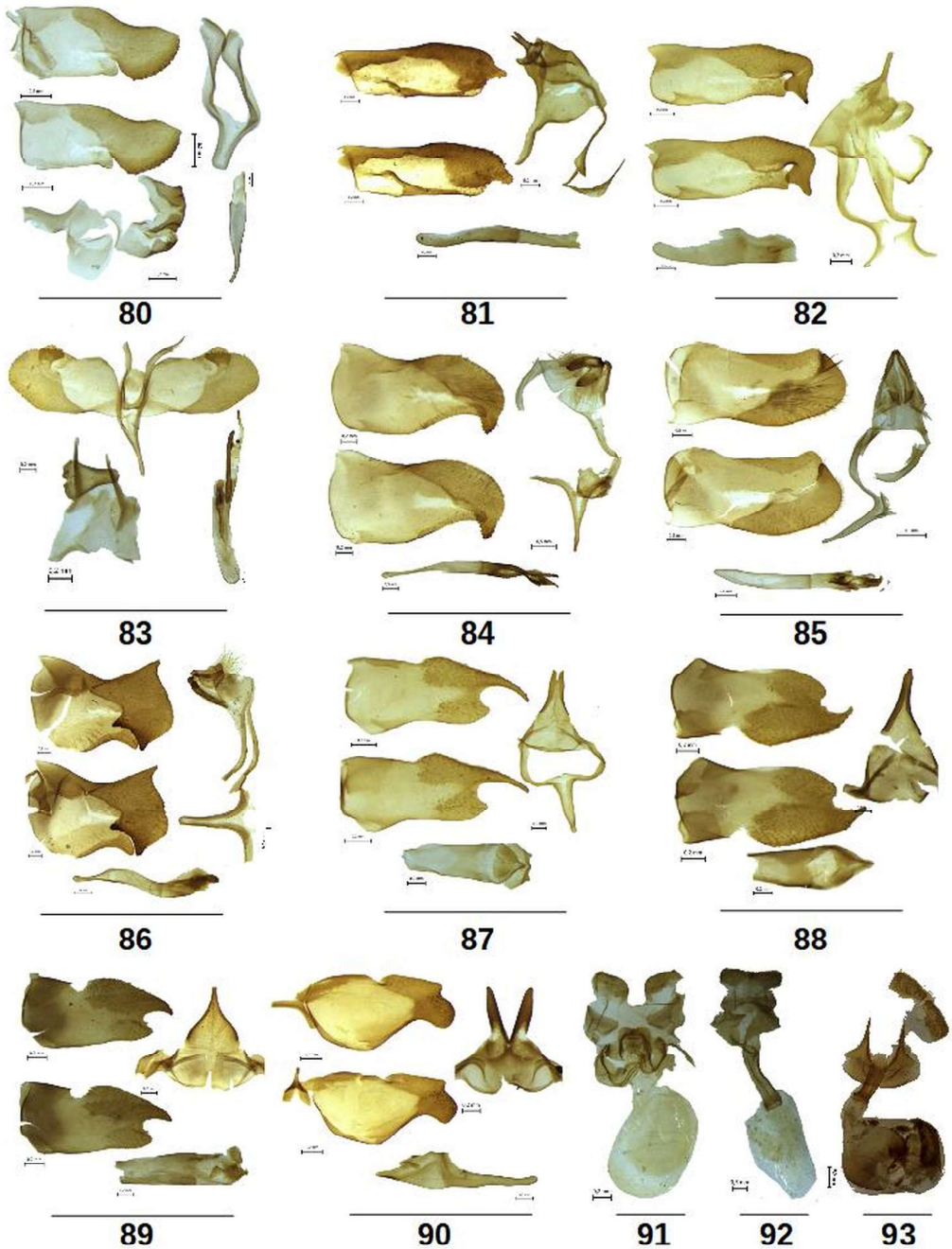
***Baoris penicillata chapmani* (Evans, 1937) (Figure 52, 53, 86):** Recorded from different locations of Yain-

gangpokpi Lokchao Wildlife Sanctuary, Chandel district and Kongbamaru, Imphal east district in April 2017. In India, the butterfly has been recorded from Assam (Gogoi, 2013).

***Potanthus mingo ajax* (Evans, 1932) (Figure 54, 55, 87):** Recorded from Yaingangpokpi Lokchao Wildlife Sanctuary, Chandel district in April 2017. In India, the butterfly has been recorded only from Assam (Gogoi, 2013).



FIGURES 56–79. Adults of Hesperiidae. 56–57. Ampittia maroides de Niceville, 1896 ♀; 58–59. Aeromachus jhora creta Evans,1943 ♂; 60–61. Astictopterus jama olivascens Moore, 1878 ♂; 62–63. Iambrix salsala salsala (Moore, [1866]) ♂; 64–65. Suastus gremius gremius (Fabricius, 1798) ♀; 66–67. Pseudoborbo bevani (Moore, 1878) ♂; 68–69. Pelopidas assamensis (de Niceville, 1882) ♂; 70–71. Pelopidas agna agna (Moore, [1866]) ♂; 72–73. Pelopidas agna agna (Moore, [1866]) ♀; 74–75. Potanthus pseudomaesa cleo (Evans, 1932) ♂; 76–77. Potanthus trachala tytleri (Evans, 1914) ♂; 78–79. Telicota bambusae (Moore, 1878) ♂.



FIGURES 80–93. Male genitalia of Hesperiidae. **91–93.** Female genitalia of Hesperiidae. 80. Aeromachus jhora creta Evans,1943; 81. Astictopterus jama olivascens Moore, 1878; 82. Iambrix salsala salsala (Moore, [1866]); 83. Pseudoborbo bevani (Moore, 1878); 84. Pelopidas assamensis (de Niceville, 1882); 85. Pelopidas agna agna (Moore, [1866]); 86. Baoris penicillata chapmani (Evans, 1937); 87. Potanthus mingo ajax (Evans, 1932); 88. Potanthus pseudomaesa cleo (Evans, 1932); 89. Potanthus trachala tytleri (Evans, 1914); 90. Telicota bambusae (Moore, 1878); 91. Ampittia maroides de Niceville, 1896; 92. Pelopidas agna agna (Moore, [1866]); 93. Suastus gremius gremius (Fabricius, 1798).

TABLE 2. An outline of the taxonomic breakdown of butterflies of the Manipur and the species protected in Indian Wildlife (Protection) Act, 1972 (IWPA).

Sr. no.	Family	Subfamily	Genus	Species	Indian Wildlife (Protection) Act, 1972		
					Schedule–I	Schedule–II	Schedule–IV
1	Papilionidae	2	11	52	2	4	0
2	Pieridae	2	15	39	0	5	2
3	Riodiniidae	1	5	17	0	2	0
4	Lycaenidae	6	93	225	4	18	0
5	Nymphalidae	12	86	270	10	34	2
6	Hesperiidae	4	71	195	0	2	5
		27	281	798	16	65	8

TABLE 3. List of the new species and subspecies described from Naga hills and Manipur based on the collections made by Lieut. Col. H. C. Tytler.

Sr. No.	Accepted name	Original name	Author	Type Locality	Month of recording
1	*Lethe gemina gafuri*	*Pararge gafuri*	Tytler, 1914	Kirbari, Naga hills	July, August, September, October
2	*Callerebia suroia*	*Callerebia suroia*	Tytler, 1914	Mt. Suroifui, Manipur	July, August
3	*Lethe serbonis naganum*	*Lethe serbonis naganum*	Tytler, 1914	Kabru Peak, Manipur; Kirbari, Naga Hills; Takabama, Kohima	August, September
4	*Lethe kanjupkula*	*Lethe kanjupkula*	Tytler, 1914	Kangjupkul & Kabru peak, Manipur; Zulla valley, Naga Hills	June, July, October, November
5	*Lethe kabrua*	*Lethe kabrua*	Tytler, 1914	Kabru Peak, Manipur	June, July, August
6	*Mycalesis evansii*	*Mycalesis evansii*	Tytler, 1914	Imphal, Manipur valley and watershed between Imphal & Barak river	April, June to October
7	*Mycalesis lepcha kohimensis*	*Mycalesis lepcha kohimensis*	Tytler, 1914	Manipur valley, Naga Hills	Spring
8	*Mycalesis francisca albofasciata*	*Mycalesis albofasciata*	Tytler, 1914	Mao, Manipur; Phesima, Kohima, Takabama, Zula valley of Naga Hills	July to October
9	*Charaxes narcaeus lissainei*	*Eulepis lissainei*	Tytler, 1915a	Phesima, Naga Hills	April, May, June
10	*Chitoria naga*	*Apatura sordida naga*	Tytler, 1915a	Yakama, Naga hills; Manipur	June, September, October
11	*Chitoria ulupi florenciae*	*Apatura florenciae*	Tytler, 1915a	Kirbari, Takabama, Jakama, Naga hills	July, August, September
12	*Eulaceura manipurensis*	*Apatura manipurensis*	Tytler, 1915a	Sebong, Eastern Manipur hills	April, May
13	*Euthalia durga splendens*	*Dophla durga splendens*	Tytler, 1915a	near Hills of Ukhrul road	July
14	*Euthalia japroa*	*Euthalia japroa*	Tytler, 1915a	Phesima, Naga Hills	
15	*Bhagadatta austenia purpurascens*	*Bhagadatta austenia purpurascens*	Tytler, 1915a	Dihang R., Abor Hills	June, July
16	*Neptis nemorum phesimensis*	*Neptis nemorum phesimensis*	Tytler, 1915a	Yakama, Naga hills	May, June

...Continued on the next page

TABLE 3. (Continued)

Sr. No.	Accepted name	Original name	Author	Type Locality	Month of recording
17	*Neptis cydippe kirbariensis*	*Neptis kirbariensis*	Tytler, 1915a	Kirbari, Naga hills	June
18	*Neptis namba*	*Neptis namba*	Tytler, 1915a	Nimchugarh, Naga Hills; Cachar road, Manipur	March to October
19	*Pantoporia bieti paona*	*Rahinda paona*	Tytler, 1915a	Kirbari, Naga hills	June, July
20	*Abisara attenuata*	*Abisara attenuata*	Tytler, 1915a	Barak river, western Manipur Hills	March
21	*Byasa latreillei kabrua*	*Papilio kabrua*	Tytler, 1915a	Yakama, Naga Hills; Kabrua hills, Manipur	May, June
22	*Papilio bootes mixta*	*Papilio mixta*	Tytler, 1915a	Kabrua peak, Manipur	June
23	*Papilio kala*	*Papilio kala*	Tytler, 1915a	Kabrua peak, Manipur; Naga hills	July
24	*Logania subfasciata*	*Logania subfasciata*	Tytler, 1915b	Sebong, Manipur	February, April
25	*Calleyna malaena*	*Cyaniris melaenoides*	Tytler, 1915b	Irang river, western Manipur Hills	January, July, December
26	*Oreolyce doherty*	*Cyaniris doherty*	Tytler, 1915b	Kirbari, Naga Hills	July, September, October
27	*Thermozephyrus ataxus zulla*	*Zephyrus ataxus zulla*	Tytler, 1915b	Paona Hills above Kirbari, Naga Hills.	June, July, August
28	*Neozephyrus suroia suroia*	*Zephyrus suroia*	Tytler, 1915b	Mt. Suroifui, Eastern Manipur	June–July, August–September
29	*Shirozuozephyrus paona paona*	*Zephyrus paona*	Tytler, 1915b	Kabrua Peak, Manipur; Paona Peak	June
30	*Shirozuozephyrus jakamensis*	*Zephyrus jakamensis*	Tytler, 1915b	Mt. Suroifui, Manipur; Phesima, Naga Hills	June, July
31	*Chrysozephyrus assamicus*	*Zephyrus assamica*	Tytler, 1915b	Kabrua Peak and Mt. Suroifui, Manipur	July, August
32	*Chrysozephyrus intermedius*	*Zephyrus dumoides*	Tytler, 1915b	Mt. Suroifui, Kabrua Peak, Manipur; Kirbari	June, July, August
33	*Chrysozephyrus kabrua*	*Zephyrus kabrua*	Tytler, 1915b	Kabrua Peak, Manipur; Phesima, Takahama, Naga Hills	June, July, August
34	*Fujiokaozephyrus isangkie doni*	*Zephyrus doni*	Tytler, 1915b	Mt. Suroifui, Manipur	July
35	*Satyrium mackwoodi*	*Thecla saitua*	Tytler, 1915b	Saitu village, Manipur valley	May
36	*Arhopala allata suffusa*	*Arhopala apha suffusa*	Tytler, 1915b	Sebong, Manipur	June
37	*Arhopala ace arata*	*Arhopala arata*	Tytler, 1915b	Sebong, Eastern Manipur; Lengba river, Western Manipur Hills	March, April
38	*Cigaritis evansii*	*Aphnaeus sani evansii*	Tytler, 1915b	Sebong, Manipur; Naga hills	April, June, September, October
39	*Deudorix dohertyi*	*Virachola dohertyi*	Tytler, 1915b	Kirbari, Naga hills	September
40	*Dacalana cotys*	*Camena cotoides*	Tytler, 1915b	Sebong, Manipur	February
41	*Tajuria sebonga*	*Tajuria sebonga*	Tytler, 1915b	Sebong, Manipur	January, February, March, April
42	*Tajuria diaeus diaeus*	*Tajuria thydia*	Tytler, 1915b	Imphal, Manipur	July

...Continued on the next page

TABLE 3. (Continued)

Sr. No.	Accepted name	Original name	Author	Type Locality	Month of recording
43	*Celaenorrhinus pulomaya*	*Celaenorrhinus pila*	Tytler, 1915b	Kirbari, Takabama, Naga Hills	August
44	*Satarupa splendens*	*Satarupa splendens*	Tytler, 1915b	Kirbari, Jakama, Naga Hills	July, September
45	*Satarupa zulla*	*Satarupa zulla*	Tytler, 1915b	Kirbari, Naga Hills	July, September
46	*Mycalesis suaveolens sebonga*	*Mycalesis suaveolens sebonga*	Tytler, 1926	Sebong, Manipur valley and Naga hills	——
47	*Neptis zaida maipuriensis*	*Neptis zaida maipuriensis*	Tytler, 1927	Lengba river, Manipur	April
48	*Arhopala camdeo sebonga*	*Arhopala camdeo sebonga*	Tytler, 1927	Sebong, Manipur	April, June
49	*Papilio krishna manipuri*	*Papilio krishna manipuri*	Tytler, 1939	Kabru Peak, Manipur	June
50	*Papilio machaon suroia*	*Papilio machaon suroia*	Tytler, 1939	Mt. Suroifui, Manipur	——
51	*Lethe goalpara kabruensis*	*Lethe goalpara kabruensis*	Tytler, 1939	Manipur and Naga hills	——
52	*Raphicera satricus kabrua*	*Pararge satricus kabrua*	Tytler, 1939	Manipur and Naga hills	——
53	*Aulocera loha japroa*	*Aulocera loha japroa*	Tytler, 1939	Japro, Naga Hills; Mt. Suroifui, Manipur	September, October
54	*Discophora deo deodoides*	*Discophora deo deodoides*	Tytler, 1939	Naga Hills	February
55	*Charaxes solon nagaensis*	*Charaxes fabius nagaensis*	Tytler, 1940	Nichuguard, Naga hills	——
56	*Euthalia nara nagaensis*	*Euthalia nara nagaensis*	Tytler, 1940	Naga Hills, Manipur	——
57	*Athyma whitei*	*Pantoporia zeroca whitei*	Tytler, 1940	Naga Hills, Manipur	——
58	*Dodona adonira naga*	*Dodona adonira naga*	Tytler, 1940	Naga Hills, Manipur	——
59	*Abisara chela amphifascia*	*Abisara chela amphifascia*	Tytler, 1940	Irang river, western Manipur Hills	March, April

Conclusion

The present checklist of Manipur includes 798 species, which is about 95.6% of species found in NE India and 55.3% of India's total butterfly species list (Wynter–Blyth, 1957). In the present study, we have recorded 446 species of which 8 are rediscovery and 32 species are recorded for the first time from Manipur. Ninety species (i.e., approx. 11.3 % of the species total found in Manipur) in the study area are listed under various schedules of the Indian Wildlife Protection Act, 1972 (Appendix II): 16 species under the schedule I; 65 species under schedule II and 9 species under schedule IV (Gupta & Mondal, 2005). It should be also noted that 352 species have no recent records from Manipur. Many species which were earlier collected and described from Manipur and Naga hills are not recorded during the study (Table 3). Thus, we feel that there is necessity to conduct further investigations to record complete butterfly diversity from Manipur. We hope that this paper will form the basis for increased research interest on the butterfly fauna of Manipur, to fill the information gaps that remain. We hope that the data we have generated will support habitat conservation efforts by helping to establish butterfly inclusive ecotourism models and generating livelihood opportunities for the locals. In addition, we hope that the distribution patterns of individual species and their habitats that we have uncovered will also help in monitoring environmental changes.

Acknowledgements

The first author is grateful to the Grant Agency of the University of South Bohemia (GA JU 038/2019/P) and Czech Science Foundation (GA CR: 14–36098G) for their financial support during the field survey. The authors are also thankful to the PCCF, the Department of Wildlife, Government of Manipur, India for granting us permission to conduct surveys in protected areas and other parts of Manipur. We would like to thank Mr. Peter Smetacek, Butterfly Research Centre, India and Mr. Saito Motoki, The Research Institute of Evolutionary Biology, Japan for their help in the identification of butterflies during the study. We also thanks, Milind Bhankare and Sagar Sarang, Maharashtra and Monsoon Jyoti Gogoi, Assam for providing photographs of *Cigaritis nipalicus, Lethe distans* and *L. sura* respectively. We would like to thank all the volunteers who have help in field surveys and share their observations. Finally, to all the reviewers, who have critically reviewed and given their comments to improve the quality of the manuscript.

References

Aduse-Poku, K., Vingerhoedt, E. & Wahlberg, N. (2009) Out-of-Africa again: A phylogenetic hypothesis of the genus *Charaxes* (Lepidoptera: Nymphalidae) based on five gene regions. *Molecular Phylogenetics and Evolution*, 53 (2), 463–478. https://doi.org/10.1016/j.ympev.2009.06.021

Aduse-Poku, K., Brattström, O., Kodandaramaiah, U., Lees, D.C., Brakefield, P.M. & Wahlberg, N. (2015) Systematics and historical biogeography of the Old-World butterfly subtribe Mycalesina (Lepidoptera: Nymphalidae: Satyrinae). *BMC Evolutionary Biology*, 15, 167. https://doi.org/10.1186/s12862-015-0449-3

Aduse-Poku, K., Lees, D.C., Brattström, O., Kodandaramaiah, U., Collins, S.C., Wahlberg, N. & Brakefield, P.M. (2016) Molecular phylogeny and generic-level taxonomy of the widespread palaeotropical 'Heteropsis clade' (Nymphalidae: Satyrinae: Mycalesina). *Systematic Entomology*, 41, 717–731. https://doi.org/10.1111/syen.12183

Bingham, C.T. (1905) *The Fauna of British India, including Ceylon and Burma (Butterflies), Vol. 1.* Taylor and Francis, London, 511 pp., 10 color pls. https://doi.org/10.5962/bhl.title.100748

Bingham, C.T. (1907) *The Fauna of British India, including Ceylon and Burma (Butterflies), Vol. II.* Taylor and Francis, London, 480 pp., 20 color pls. https://doi.org/10.5962/bhl.title.100748

Boyle, J.H., Kaliszewska, Z.A., Espeland, M., Suderman, T.R., Fleming, J., Heath, A. & Pierce, N.E. (2015) Phylogeny of the Aphnaeinae: myrmecophilous African butterflies with carnivorous and herbivorous life histories. *Systematic Entomology*, 40 (1), 169–182. https://doi.org/10.1111/syen.12098

Braby, M.F. (2005) Provisional checklist of genera of the Pieridae (Lepidoptera: Papilionoidea). *Zootaxa*, 832 (1), 1–16. https://doi.org/10.11646/zootaxa.832.1.1

Butler, A.G. (1885) On a Collection of Lepidoptera made at Manipur and on the Borders of Assam by Dr. George Watt. *The Annals and Magazine of Natural History, London*, Series 5, 16, 298–310. https://doi.org/10.1080/00222938509459884

Chiba, H. & Eliot, J.N. (1991) A revision of the genus *Parnara* Moore (Lepidoptera, Hesperiidae), with special reference to the Asian species. *Tyô to Ga*, 42, 179–194.

Chiba, H. (2009) A revision of the subfamily Coeliadinae (Lepidoptera: Hesperiidae). *Bulletin of the Kitakyushu Museum of Natural History and Human History*, Series A, 7, 1–102.

Dhungel, B. & Wahlberg, N. (2018) Molecular systematics of the subfamily Limenitidinae (Lepidoptera: Nymphalidae). *PeerJ*, 6, e4311. https://doi.org/10.7717/peerj.4311

Ek-Amnuay, P. (2006) *Butterflies of Thailand*. Baan Lae Suan, Bangkok,849 pp.

Eliot, J.N. (1969) An Analysis of the Eurasian and Australian Neptini (Lepidoptera: Nymphalidae). *The Bulletin of the British Museum, Natural History*, Entomology, Supplement 15, 1–1140, 3 pls.

Eliot, J.N. (1973) The higher classification of the Lycaenidae (Lepidoptera): a tentative arrangement. *Bulletin of the British Museum (Natural History)*, Entomology Series, 28 (6), 373–505.

Eliot, J.N. (1986) A review of the Miletini (Lepidoptera: Lycaenidae). *Bulletin of the British Museum (Natural History)*, Entomology Series, 53, 1–105.

Espeland, M., Hall, J.P., DeVries, P.J., Lees, D.C., Cornwall, M., Hsu, Y.-F., Wu, L.-W., Campbell, D.L., Talavera, G., Vila, R., Salzman, S., Ruehr, S., Lohman, D.J. & Pierce, N.E. (2015) Ancient Neotropicalorigin and recent recolonisation: phylogeny, biogeography and diversification of the Riodinidae (Lepidoptera: Papilionoidea). *Molecular Phylogenetics and*

Evolution, 93, 296–306.
https://doi.org/10.1016/j.ympev.2015.08.006
Espeland, M., Breinholt, J., Willmott, K.R., Warren, A.D., Vila, R., Toussaint, E.F.A., Maunsell, S.C., Aduse-Poku, K., Talavera, G., Eastwood, R., Jarzyna, M.A., Guralnick, R., Lohman, D.J., Pierce, N.E. & Kawahara, A.Y. (2018) A comprehensive and dated phylogenomic analysis of butterflies. *Current Biology*, 28 (5), 770–778, e5.
https://doi.org/10.1016/j.cub.2018.01.061
Evans, W.H. (1914) Notes on Indian butterflies. *Journal Bombay Natural History Society*, *Bombay*, 23, 302–310.
Evans, W.H. (1920) A note on the species of the genus *Mycalesis* (Lepidoptera), occurring within Indian limits. *Journal Bombay Natural History Society*, *Bombay*, 27, 354–362, 4 pls.
Evans, W.H. (1927) *The Identification of Indian Butterflies. Vol. I.* Bombay Natural History Society, Bombay, 300 pp., 32 pls.
Evans, W.H. (1932) *The Identification of Indian Butterflies. Vol. II.* Bombay Natural History Society, Bombay, 454 pp., 32 pls.
Evans, W.H. (1949) *A catalogue of the Hesperiidae from Europe, Asia and Australia in the British Museum (Natural History)*. British Museum (Natural History), London, 502 pp.
https://doi.org/10.5962/bhl.title.105941
Evans, W.H. (1957) A revision of the *Arhopala* group of Oriental Lycaenidae (Lepidoptera: Rhopalocera). *Bulletin of the British Museum (Natural History)*, Entomology Series, 5, 85–137.
https://doi.org/10.5962/bhl.part.1508
Fan, X., Chiba, H., Huang, Z., Fei, W., Wang, M. & Sáfián, S. (2016) Clarification of the Phylogenetic Framework of the Tribe Baorini (Lepidoptera: Hesperiidae: Hesperiinae) Inferred from Multiple Gene Sequences. *PLoS ONE*, 11 (7), e0156861.
https://doi.org/10.1371/journal.pone.0156861
Gogoi, M.J. (2013) Notes on some skipper butterflies (Lepidoptera: Hesperiidae) from Panbari Forest and its adjoining areas, Kaziranga-Karbi Anglong, upper Assam, India. *Journal of Threatened Tax*a, 5 (13), 4759–4768.
https://doi.org/10.11609/JoTT.o3340.4759-68
Goswami, R. (2020) *Algia fasciata* (C. & R. Felder, 1860)—Branded Yeoman. *In*: Kunte, K., Sondhi, S. & Roy, P. (Eds.), Butterflies of India. Version 2.86. Indian Foundation for Butterflies. Available from: http://www.ifoundbutterflies.org/sp/2099/Algia-fasciata (accessed 12 April 2020)
Gupta, I.J. (2004) Insecta: Lepidoptera: Nymphalidae and Saturniidae. In: Editor-Director, (Ed.), *State Fauna Series 10. Fauna of Manipur. Part 2. Insects*. Zoological Survey of India, Kolkata, 541-579 pp.
Gupta, I.J. & MondaI, D.K. (2005) *Red Data Book. Part 2. Butterflies of India*. Zoological Survey of India, Kolkata, 535 pp.
Howarth, T.G. (1957) A Revision of the Genus *Neozephyrus* Sibatani & Ito (Lepidoptera: Lycaenidae). *Bulletin of the British Museum (Natural History)*, Entomology Series, 5, 6, 233–272, 105 figs.
Huang, Z.F., Chiba, H., Jin, J., Kizhakke, A.G., Wang, M., Kunte, K. & Fan, X.L. (2019) A multilocus phylogenetic framework of the tribe Aeromachini (Lepidoptera: Hesperiidae: Hesperiinae), with implications for taxonomy and biogeography. *Systematic Entomology*, 44 (1), 163–178.
https://doi.org/10.1111/syen.12322
Irungbam, J.S., Huidrom, H. & Soibam, B.S. (2017a) A century later the Manipur Argus *Callerebia suroia* Tytler, 1914 (Lepidoptera: Nymphalidae: Satyrinae) recorded in its type locality in Manipur, India. *Journal of Threatened Taxa*, 9 (2), 9866–9869.
https://doi.org/10.11609/jott.2931.9.2.9866-9869
Irungbam, J.S., Huidrom, H. & Soibam, B.S. (2017b) Range extension of the Indian Tortoiseshell *Aglais caschmirensis aesis* Fruhstorfer, 1912 (Lepidoptera: Nymphalidae) into the hills of Manipur, India. *Journal of Threatened Taxa,* 9 (10), 10860–10864.
https://doi.org/10.11609/jott.2983.9.10.1086010864
Irungbam, J.S., Huidrom, H. & Elangbam, P. (2020) Addition of the butterfly *Appias galba* (Wallace, 1867) to the fauna of Manipur, India. *Bionotes*, 22 (3), 112-113.
Irungbam, J.S., Huidrom, H. & Fric, Z.F. (2020) The sighting of *Amblopala avidiena* (Hewitson, 1877) Chinese Hairstreak (Lycaenidae: Theclinae) from Shirui Hills, Manipur, India, A new record for Manipur Butterfly fauna. *Journal of the Bombay Natural History Society*. [in press]
Kawahara, A.Y. (2009) Phylogeny of snout butterflies (Lepidoptera: Nymphalidae: Libytheinae): combining evidence from morphology of extant, fossil, and recently extinct taxa. *Cladistics*, 25 (3), 263–278.
https://doi.org/10.1111/j.1096-0031.2009.00251.x
Kehimkar, I. (2008) *The Book of Indian Butterflies.* Bombay Natural History Society and Oxford University Press, New Delhi, 497 pp.
Kehimkar, I. (2016) *Butterflies of India.* Bombay Natural History Society, Mumbai, 528 pp.
Kodandaramaiah, U., Lees, D.C., Müller, C.J., Torres, E., Karanth, K.P. & Wahlberg, N. (2010) Phylogenetics and biogeography of a spectacular Old-World radiation of butterflies: the subtribe Mycalesina (Lepidoptera: Nymphalidae: Satyrini). *BMC Evolutionary Biology*, 10 (172), 1–13
https://doi.org/10.1186/1471-2148-10-172
Koiwaya, S. (2007) *Mushi-Sha's Iconographic Series of Insect 5: The Zephyrus hairstreaks of the world. Vol. I & II.* Mushi-Sha, 558 pp., 256 color pls.
Kunte, K., Sondhi, S. & Roy, P. (2020) Butterflies of India. Version 2.86. Indian Foundation for Butterflies. Available from:

http://www.ifoundbutterflies.org/ (accessed 10 May 2020)
Lang, S.-Y. & Lamas, G. (2016) What is *Lethe hyrania* (Kollar, 1844) (Lepidoptera, Nymphalidae, Satyrinae)? *Zootaxa*, 4072 (3), 396–400.
https://doi.org/10.11646/zootaxa.4072.3.10
Majumdar, M. (2004) *Insecta: Lepidoptera. In*: Editor-Director, (Ed.), *State Fauna. Series 10. Fauna of Manipur. Part 2. Insects*. Zoological Survey of India, Kolkata, pp. 515–530.
Megens, H.-J., Johanvannes, W., Moorsel, C.H.M.V., Pierce, N.E. & de Jong, R. (2004) Molecular phylogeny of the oriental butterfly genus *Arhopala* (Lycaenidae, Theclinae) inferred from mitochondrial and nuclear genes. *Systematic Entomology*, 29 (1), 115–131.
https://doi.org/10.1111/j.1365-3113.2004.00228.x
Mondal, D.K. & Maulik, R.D. (2004) *Insecta: Lepidoptera: Papilionoidea, Bombycoidea & Noctuoidea. In*: Editor-Director, (Ed.), *State Fauna Series 10: Fauna of Manipur. Part 2. Insects*. Zoological Survey of India, Kolkata, pp. 581–590.
Moore, F. (1890) *Lepidoptera Indica. Vol. I. Rhopalocera—Family Nymphalidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 317 pp., 94 pls.
https://doi.org/10.5962/bhl.title.8763
Moore, F. (1893) *Lepidoptera Indica. Vol. II. Rhopalocera—Family Nymphalidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 274 pp., 95 pls.
Moore, F. (1896) *Lepidoptera Indica. Vol. III. Rhopalocera—Family Nymphalidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 254 pp., 94 pls.
Moore, F. (1899) *Lepidoptera Indica. Vol. IV. Rhopalocera—Family Nymphalidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 260 pp., 92 pls.
Moore, F. (1901) *Lepidoptera Indica. Vol. V. Rhopalocera—Family Nymphalidae, Riodinidae, Papilionidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 241 pp., 87 pls.
Moore, F. (1903) *Lepidoptera Indica. Vol. VI. Rhopalocera—Family Papilionidae & Pieridae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 240 pp., 83 pls.
Ohshima, I., Tanikawa-Dodo, Y., Saigusa, T., Nishiyama, T., Kitani, M., Hasebe, M. & Mohri, H. (2010) Phylogeny, biogeography, and host-plant association in the subfamily Apaturinae (Insecta: Lepidoptera: Nymphalidae) inferred from eight nuclear and seven mitochondrial genes. *Molecular Phylogenetics and Evolution*, 57 (3), 1026–1036.
https://doi.org/10.1016/j.ympev.2010.09.018
Peña, C., Wahlberg, N., Weingartner, E., Kodandaramaiah, U., Nylin, S., Freitas, A.V.L. & Brower, A.V.Z. (2006) Higher level phylogeny of Satyrinae butterflies (Lepidoptera: Nymphalidae) based on DNA sequence data. *Molecular Phylogenetics and Evolution*, 40 (1), 29–49.
https://doi.org/10.1016/j.ympev.2006.02.007
Pinratana, A. (1981) *Butterflies in Thailand. Vol 4. Lycaenidae.* Brothers of Saint Gabriel in Thailand, Bangkok, 215 pp.
Pinratana, A. (1983) *Butterflies in Thailand. Vol 2. Pieridae and Amathusiidae.* Brothers of Saint Gabriel in Thailand, Bangkok, 71 pp., 48 color pls.
Pinratana, A. (1985) *Butterflies in Thailand. Vol. 5. Hesperiidae.* Brothers of Saint Gabriel in Thailand. 152 pp., 40 color pls.
Pinratana, A. (1988) *Butterflies in Thailand. Vol. 6. Satyridae, Libytheidae and Riodinidae.* Brothers of Saint Gabriel in Thailand, Bangkok, 60 pp., 44 color pls.
Pinratana, A. (1992) *Butterflies in Thailand. Vol. 1. Papilionidae and Danaidae.* Brothers of Saint Gabriel in Thailand, Bangkok, 91 pp.
Pinratana, A. (1996) *Butterflies in Thailand. Vol. 3. Nymphalidae.* Brothers of Saint Gabriel in Thailand, Bangkok, 109 pp.
Seraphim, N., Kaminski, L.A., Devries, P.J., Penz, C., Callaghan, C., Wahlberg, N., Silva-Brandão, K.L. & Freitas, A.V. (2018) Molecular phylogeny and higher systematics of the metalmark butterflies (Lepidoptera: Riodinidae). *Systematic Entomology*, 43 (2), 407–425.
https://doi.org/10.1111/syen.12282
Singh, I.J. & Gogoi, M.J. (2013) A New Range Record for the Bath White Pontia daplidice Linnaeus 1758 (Lepidoptera: Pieridae) for North East India. Bionotes 15, 2. 59-60.
Smiles, R.L. (1982) The taxonomy and phylogeny of the genus Polyura Billberg (Lepidoptera: Nymphalidae). *Bulletin of the British Museum (Natural History)*, Entomology, 44 (3), 115–237.
Soibam, B. (2016) Recent sightings of Kaiser–I–Hind *Teinopalpus imperialis* Hope, 1843 (Lepidoptera: Teinopalpani) from Manipur, India. *Journal of Threatened Taxa*, 8 (6), 8930–8933.
https://doi.org/10.11609/jott.2871.8.6.8930-8933
Soibam, B.S., Huidrom, H. & Irungbam, J.S. (2016) A century later: Tricolored Pied Flat *Coladenia indrani uposathra* Fruhstorfer, 1911 (Hesperiidae: Pyrginae) and Crenulate Oakblue *Apporasa atkinsoni* Hewitson, 1869 (Lycaenidae: Theclinae) reported from Manipur, India. *Journal of Threatened Taxa*, 8 (7), 9030–9033.
https://doi.org/10.11609/jott.2732.8.7.9030-9033
Singh, M.I., Gupta, A. & Varatharajan, R. (2011) Butterfly fauna of the Keibul Lamjao National Park, Manipur, North East India. *Current Science*, 101 (6), 719–721.
Swinhoe, C. (1905) *Lepidoptera Indica. Vol. VII. Rhopalocera—Family Papilionidae & Lycaenidae.* Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 286 pp.

Swinhoe, C. (1910) *Lepidoptera Indica. Vol. VIII. Rhopalocera—Family Lycaenidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 293 pp.
Swinhoe, C. (1911) *Lepidoptera Indica. Vol. IX. Rhopalocera—Family Lycaenidae*. Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 278 pp.
Swinhoe, C. (1912) *Lepidoptera Indica. Vol. X. Rhopalocera— Family Hesperiidae.* Gildeet and Eivington LD. & St. John's House, Cleekenwell, E.C., London, 293 pp.
Talbot, G. (1939) *The Fauna of British India, including Ceylon and Burma: Butterflies. Vol. 1*. Taylor and Francis, London, 600 pp.
Talbot, G. (1947) *The Fauna of British India, including Ceylon and Burma: Butterflies. Vol. 2*. Taylor and Francis, London, 486 pp.
Tytler, H.C. (1912) Notes on butterflies from the Naga Hills. Part II. *Journal of Bombay Natural History Society,* 21, 588–606.
Tytler, H.C. (1914) Notes on some new and interesting butterflies from Manipur and the Naga Hills. Part I. *Journal of the Bombay Natural History Society*, 23, 216–229, 1 pl.
Tytler, H.C. (1915a) Notes on some new and interesting butterflies from Manipur and the Naga Hills. Part II. *Journal of the Bombay Natural History Society*, 23, 502–515, 4 pls.
Tytler, H.C. (1915b) Notes on some new and interesting butterflies from Manipur and the Naga Hills. Part III. *Journal of the Bombay Natural History Society*, 24, 119–155.
Tytler, H.C. (1926) Notes on some new and interesting butterflies from India and Burma–I. *Journal of the Bombay Natural History Society*, 31 (2), 248–260.
Tytler, H.C. (1927) Notes on some new and interesting butterflies from India and Burma–II. *Journal of the Bombay Natural History Society*, 31 (3), 579–590.
Tytler, H.C. (1939) Notes on some new and interesting butterflies chiefly from Burma–I. *Journal of the Bombay Natural History Society*, 41 (2), 235–252.
Tytler, H.C. (1940) Notes on some new and interesting butterflies chiefly from Burma–II. *Journal of the Bombay Natural History Society*, 42 (1), 109–123.
Uemura, Y. & Monastyrskii, A.L. (2004) A revisional Catalogue of the genus *Ypthima* Hubner (Lepidoptera: Satyridae) from Vietnam. *Bulletin of the Kitakyushu Museum of Natural History and Human History*, Series A, 2, 17–45.
Van Gasse, P. (2013) *Annotated checklist of the Butterflies of the Indo-Burmese region*. Available from: http://flutters.org/home/docs/Butterflies_Of_India_Paul_Van_Gasse.pdf (accessed 15 September 2019).
Varshney, R.K. & Smetacek, P. (2015) *A Synoptic Catalogue of the Butterflies of India.* Butterfly Research Centre, Bhimtal and Indinov Publishing, New Delhi, 261 pp., 8 pls.
Wahlberg, N., Weingartner, E. & Nylin, S. (2003) Towards a better understanding of the higher systematics of Nymphalidae (Lepidoptera: Papilionoidea). *Molecular Phylogenetics and Evolution*, 28 (3), 473–484. https://doi.org/10.1016/S1055-7903(03)00052-6
Wahlberg, N., Brower, A.V.Z. & Nylin, S. (2005) Phylogenetic relationships and historical biogeography of tribes and genera in the subfamily Nymphalinae (Lepidoptera: Nymphalidae). *Biological Journal of the Linnean Society*, 86 (2), 227–251. https://doi.org/10.1111/j.1095-8312.2005.00531.x
Wahlberg, N., Leneveu, J., Kodandaramaiah, U., Peña, C., Nylin, S., Freitas, A.V.L. & Brower, A.V.Z. (2009) Nymphalid butterflies diversify following near demise at the Cretaceous/Tertiary boundary. *Proceedings of the Royal Society Series B Biological Sciences*, 276 (1677), 4295–4302. https://doi.org/10.1098/rspb.2009.1303
Wahlberg, N., Rota, J., Braby, M.F., Pierce, N.E. & Wheat, C.W. (2014) Revised systematics and higher classification of pierid butterflies (Lepidoptera: Pieridae) based on molecular data. *Zoologica Scripta*, 43 (6), 641–650. https://doi.org/10.1111/zsc.12075
Warren, A.D., Ogawa, J.R. & Brower, A.V.Z. (2009) Revised classification of the family Hesperiidae (Lepidoptera: Hesperioidea) based on combined molecular and morphological data. *Systematic Entomology*, 34 (3), 467–523. https://doi.org/10.1111/j.1365-3113.2008.00463.x
Wood-Mason, J. & De Niceville, L. (1886) List of the lepidopterous insects collected in Cachar by Mr. J. Wood-Mason, Part II, Rhopalocera. *Journal of the Asiatic Society of Bengal, Calcutta*, 55, 344–393.
Wynter-Blyth, M.A. (1957) *Butterflies of the Indian Region*. Bombay Natural History Society, Mumbai, 523 pp., 72 pls.
Yokochi, T. (2012) Revision of the Subgenus *Limbusa* Moore, [1897] (Lepidoptera, Nymphalidae, Adoliadini) Part 1. Systematic arrangement and taxonomic list. *Bulletin of the Kitakyushu Museum of Natural History and Human History*, Series A, 8, 19–67.

Appendix I. The checklist of the butterflies reported from Manipur. Species marked with "Asterix" are recorded during the study and species marked with "Hash" are new records for Manipur. Refer Table 1 for the sighting localities.

Systematic Account

Order Lepidoptera Linnaeus, 1758

Superfamily Papilionoidea Latreille, 1802

Family Papilionidae Latreille, [1802]

Subfamily Papilioninae Latreille, [1802]

Tribe Troidini Talbot, 1939

Losaria Moore, 1902

1. *Losaria coon cacharensis* (Butler, 1885)
   Published records: Tytler, 1915a: 513; Talbot, 1939; Van Gasse, 2013.
   Remarks: Not recorded during the study.

Pachliopta Reakirt, [1865]

2. *Pachliopta aristolochiae aristolochiae* (Fabricius, 1775) *
   Published records: Talbot, 1939; Varshney & Smetacek, 2015:1.

   Sighting locality: 2, 4, 17, 19, 27, 32, 68.

Troides Huebner, [1819]

3. *Troides aeacus* (C. & R. Felder, 1860) *
   Published records: Varshney & Smetacek, 2015:2.
   Sighting locality: 68.
4. *Troides helena cerberus* C & R Felder,1865 *
   Published records: Varshney & Smetacek, 2015:2.
   Sighting locality: 22, 68.

Atrophaneura Reakirt, [1865]

5. *Atrophaneura aidoneus* (Doubleday, 1845) *
   Published records: Varshney & Smetacek, 2015:2.
   Sighting locality: 68.
6. *Atrophaneura varuna* Doubleday,1845 *
   Published records: Varshney & Smetacek, 2015:2–3.
   Sighting locality: 4, 72, 47, 68.

Byasa Moore, 1882

7. *Byasa alcinous* (Klug, 1836)
   Published records: Tytler, 1915a: 513.
   Remarks: Not recorded during the study.
8. *Byasa dasarada dasarada* (Moore, 1857) *
   Published records: Varshney & Smetacek, 2015: 3.
   Sighting locality: 47, 77.
9. *Byasa polyeuctes polyeuctes* (Doubleday,1842) *
   Published records: Varshney & Smetacek, 2015.
   Sighting locality: 4, 17, 19, 24.

10. *Byasa latreillei kabrua* (Tytler, 1915) *
    Published records: Tytler, 1915a:513; Talbot, 1939:92; Van Gasse, 2013; Varshney & Smetacek, 2015:3.
    Sighting locality: 55.
11. *Byasa crassipes* (Oberthur, 1893)
    Published records: Tytler, 1915a:513; Talbot, 1939:101; Van Gasse, 2013; Varshney & Smetacek, 2015:3.
    Remarks: Not recorded during the study.
12. *Byasa plutonius tytleri* (Evans, 1923)
    Published records: Tytler, 1915a:513; Talbot, 1939:104; Van Gasse, 2013; Varshney & Smetacek, 2015:3–4.
    Remarks: Not recorded during the study.
13. *Byasa polla* (de Niceville, 1897)
    Published records: Tytler, 1915a:513; Talbot, 1939:92; Van Gasse, 2013; Varshney & Smetacek, 2015:4.
    Remarks: Not recorded during the study.

Tribe Papilionini Linnaeus, 1758

Papilio Linnaeus, 1758

14. *Papilio agestor agestor* Gray,1831 *#
    Sighting locality: 4, 5, 68.
15. *Papilio alcmenor alcemenor* C & R Felder, [1864] *
    Published records: Varshney & Smetacek, 2015:4.
    Sighting locality: 60, 71.
16. *Papilio arcturus arcturus* Westwood, 1842 *
    Published records: Varshney & Smetacek, 2015:4.
    Sighting locality: 4, 60, 77, 78, 80.
17. *Papilio bianor gladiator* Fruhstorfer, 1902 *
    Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015:5.
    Sighting locality: 4, 60, 73.
18. *Papilio bootes mixta* (Tytler, 1915)
    Published records: Tytler, 1915a:514; Talbot, 1939:137; Van Gasse, 2013; Varshney & Smetacek, 2015:5.
    Remarks: Not recorded during the study.
19. *Papilio castor castor* Westwood, 1842 *
    Published records: Varshney & Smetacek, 2015:5.
    Sighting locality: 9, 68.
20. *Papilio clytia clytia* Linnaeus, 1758 *
    Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015:6.
    Sighting locality: 2, 22, 27, 32, 60, 71.
21. *Papilio demoleus demoleus* Linnaeus, 1758 *
    Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015:6.
    Sighting locality: 1, 3, 6, 13, 65, 20, 33, 40.
22. *Papilio helenus helenus* Linnaeus, 1758 *
    Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015:6.
    Sighting locality: 4, 51, 58, 68.
23. *Papilio kala* Tytler, 1915
    Published records: Tytler, 1915a: 514.
    Remarks: Not recorded during the study.
24. *Papilio krishna manipuri* Tytler, 1939
    Published records: Tytler, 1915a: 515; Tytler, 1939: 238; Van Gasse, 2013; Varshney & Smetacek, 2015: 7.
    Remarks: Not recorded during the study.
25. *Papilio machaon suroia* Tytler, 1939 *

Published records: Tytler, 1939: 239; Van Gasse, 2013; Varshney & Smetacek, 2015:7.
Sighting locality: 72, 77, 78, 79.

26. *Papilio memnon agenor* Linnaeus, 1758 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 7.
Sighting locality: 4, 71, 77, 80.
27. *Papilio nephelus chaon* Westwood, 1845 *
Published records: Varshney & Smetacek, 2015: 7.
Sighting locality: 4, 68.
28. *Papilio paris paris* Linnaeus, 1758 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 7.
Sighting locality: 1, 4, 11, 65, 17, 19, 22, 32, 69, 47, 55, 61, 77.
29. *Papilio polytes romulus* Cramer, [1775] *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 8.
Sighting locality: 4, 17, 21, 68.
30. *Papilio paradoxa telearchus* (Hewitson, 1852)
Published records: Moore, 1903:29–31; Tytler, 1915a:514.
Remarks: Not recorded during the study.
31. *Papilio protenor euprotenor* Fruhstorfer, 1908 *
Published records: Varshney & Smetacek, 2015:9.
Sighting locality: 2, 4, 21, 22, 60, 80.
32. *Papilio slateri slateri* Hewitson, 1859 *
Published records: Tytler, 1915a: 514; Varshney & Smetacek, 2015:9.
Sighting locality: 2, 25, 27, 32, 37, 71, 51, 58, 68.

Tribe Leptocircini Kirby, 1896

Graphium Scopoli, 1777

33. *Graphium agamemnon agamemnon* (Linnaeus, 1758) *
Published records: Butler, 1885; Singh *et al*., 2011; Varshney & Smetacek, 2015:9.
Sighting locality: 58, 76.
34. *Graphium agetes agetes* (Westwood, 1843) *
Published records: Varshney & Smetacek, 2015:10.
Sighting locality: 4, 71.
35. *Graphium albociliatis* (Fruhstorfer, 1901)
Published records: Varshney & Smetacek, 2015:10.
Remarks: Not recorded during the study.
36. *Graphium antiphates pompilius* (Fabricius, 1787) *
Published records: Butler, 1885; Moore, 1903:20–23; Varshney & Smetacek, 2015:9.
Sighting locality: 77, 79.
37. *Graphium aristeus anticrates* (Doubleday, 1846)
Published records: Tytler, 1915a: 515; Varshney & Smetacek, 2015:10.
Remarks: Not recorded during the study.
38. *Graphium arycles occidentalis* Page & Treadaway, 2014
Published records: Varshney & Smetacek, 2015:10.
Remarks: Not recorded during the study.
39. *Graphium cloanthus cloanthus* (Westwood,1841) *
Published records: Varshney & Smetacek, 2015:10.
Sighting locality: 4, 60, 79.
40. *Graphium doson axionides* (Page & Treadaway, 2014) *
Published records: Butler, 1885; Varshney & Smetacek, 2015:11.
Sighting locality: 41.

41. *Graphium eurous sikkimica* (Heron, 1899)
Published records: Varshney & Smetacek, 2015: 11.
Remarks: Not recorded during the study.
42. *Graphium eurypylus acheron* (Moore,1885)
Published records: Varshney & Smetacek, 2015: 11.
Remarks: Not recorded during the study.
43. *Graphium macareus lioneli* (Fruhstorfer, 1902) *
Published records: Varshney & Smetacek, 2015:11.
Sighting locality: 32, 24, 49.
44. *Graphium megarus megarus* (Westwood, 1844)
Published records: Varshney & Smetacek, 2015: 12.
Remarks: Not recorded during the study.
45. *Graphium nomius swinhoei* (Moore, 1878) *
Published records: Moore, 1903: 29; Varshney & Smetacek, 2015: 12.
Remarks: Not recorded during the study.
46. *Graphium sarpedon sirkari* Page & Treadaway, 2014 *
Published records: Butler, 1885; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 12.
Sighting locality: 8, 13, 15, 68.
47. *Graphium xenocles phrontis* (de Niceville, 1897)
Published records: Butler, 1885; Moore, 1903: 113–114; Varshney & Smetacek, 2015: 12.
Remarks: Not recorded during the study.

Lamproptera Gray, 1832
48. *Lamproptera curius curius* (Fabricius, 1787) *
Published records: Varshney & Smetacek, 2015: 13.
Sighting locality: 59.
49. *Lamproptera meges virescens* (Butler, 1870) *
Published records: Tytler, 1915a: 515; Van Gasse, 2013; Varshney & Smetacek, 2015: 13.
Sighting locality: 4, 7, 20, 70, 48.

Tribe Teinopalpini Grote, 1899

Meandrusa Moore, 1888
50. *Meandrusa payeni evan* (Doubleday, 1845) *
Published records: Varshney & Smetacek, 2015:13.
Sighting locality: 77.

Teinopalpus Hope, 1843
51. *Teinopalpus imperialis imperialis* Hope, 1843 *
Published records: Tytler, 1915a: 515; Van Gasse, 2013; Varshney & Smetacek, 2015: 13, Soibam, 2016.
Sighting locality: 47, 77.

Subfamily Parnassiinae Swainson, 1840

Tribe Zerynthiini Grote, 1899

Bhutanitis Atkinson, 1873
52. *Bhutanitis lidderdalii lidderdalii* Atkinson, 1873 *
Published records: Moore, 1901: 125; Talbot, 1939: 250; Van Gasse, 2013; Varshney & Smetacek, 2015: 14.

Sighting locality: 77.

Family Pieridae Swainson, 1820

Subfamily Coliadinae Swainson, 1827

Eurema Huebner, [1819]

53. *Eurema andersonii jordani* Corbet & Pendlebury, 1932 *
    Published records: Varshney & Smetacek, 2015: 68.
    Sighting locality: 21, 71, 69.
54. *Eurema blanda silhetana* (Wallace, 1867) *
    Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 68.
    Sighting locality: 4, 51.
55. *Eurema brigitta rubella* (Wallace, 1867) *
    Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 69.
    Sighting locality: 2, 4, 68.
56. *Eurema hecabe hecabe* (Linnaeus, 1758) *
    Published records: Majumdar, 2004: 519; Singh *et al*., 2011; Varshney & Smetacek, 2015: 69.
    Sighting locality: 1, 7, 9, 13, 19, 25, 24, 71, 47, 57, 67, 77.
57. *Eurema laeta sikkima* (Moore, [1906]) *
    Published records: Majumdar, 2004: 519; Varshney & Smetacek, 2015: 69.
    Sighting locality: 2, 4, 7, 32, 51, 68.

Gandaca Moore, [1906]

58. *Gandaca harina assamica* Moore, [1906] *
    Published records: Varshney & Smetacek, 2015: 68.
    Sighting locality: 20, 73, 77, 78.

Dercas Doubleday, [1847]

59. *Dercas lycorias* (Doubleday, 1842)
    Published records: Swinhoe, 1905: 29; Varshney & Smetacek, 2015.
    Remarks: Not recorded during the study.
60. *Dercas verhuelli doubledayi* Moore, [1905]
    Published records: Butler, 1885; Swinhoe, 1905: 31–32; Tytler, 1939: 242; Varshney & Smetacek, 2015:67.
    Remarks: Not recorded during the study.

Catopsilia Huebner, [1819]

61. *Catopsilia pomona* (Fabricius, 1775) *
    Published records: Singh *et al*., 2011.
    Sighting locality: 27, 32, 34, 51, 77.
62. *Catopsilia pyranthe* (Linnaeus,1758) *
    Published records: Singh *et al*., 2011.
    Sighting locality: 71, 60, 77, 79.

Colias Fabricius, 1807

63. *Colias fieldii* Menetries,1855 *
    Published records: Varshney & Smetacek, 2015: 70.
    Sighting locality: 2, 74, 60, 77.

Subfamily Pierinae Swainson, 1820

Tribe Pierini Swainson, 1820

Leptosia Huebner, 1818

64. *Leptosia nina nina* (Fabricius, 1793) *
    Published records: Varshney & Smetacek, 2015: 71.
    Sighting locality: 2, 4, 27, 32, 60, 72.

Pareronia Bingham, 1907

65. *Pareronia avatar avatar* (Moore, [1858]) *
    Published records: Varshney & Smetacek, 2015: 82.
    Sighting locality: 2, 17, 29, 32, 51, 68.
66. *Pareronia valeria hippie* (Fabricius, 1787) *
    Published records: Varshney & Smetacek, 2015: 82.
    Sighting locality: 4, 32, 60, 72.

Ixias Huebner, [1819]

67. *Ixias pyrene sesia* (Fabricius, 1777) *
    Published records: Butler, 1885; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 75.
    Sighting locality: 2, 4, 22, 32, 68.

Hebomoia Huebner, [1819]

68. *Hebomoia glaucippe glaucippe* (Linnaeus, 1758) *
    Published records: Butler, 1885; Singh *et al*., 2011; Varshney & Smetacek, 2015: 82.
    Sighting locality: 2, 4, 17, 32, 68.

Appias Huebner, [1819]

69. *Appias albina darada* (C & R Felder, [1865]) *#
    Sighting locality: 2, 4, 51, 68.
70. *Appias galba* (Wallace, 1867)
    Published records: Butler, 1885; Irungbam *et al.,* 2020.
    Sighting locality: 7.
71. *Appias indra indra* (Moore, 1857) *
    Published records: Butler, 1885; Moore, 1903: 226; Singh *et al*., 2011; Varshney & Smetacek, 2015:77.
    Sighting locality: 2, 32, 60, 71.
72. *Appias lalage lalage* (Doubleday,1842) *
    Published records: Moore, 1903: 222; Talbot, 1939: 387; Varshney & Smetacek, 2015: 77.
    Sighting locality: 2, 20, 23, 27, 30, 71, 8, 76.
73. *Appias lyncida elenora* (Boisduval,1836) *
    Published records: Butler, 1885; Moore, 1903: 194; Majumdar, 2004: 519; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 77.
    Sighting locality: 4, 68.
74. *Appias libythea olferna* Swinhoe, 1890 *
    Published records: Varshney & Smetacek, 2015: 77.
    Sighting locality: 75, 59, 76.

Pontia Fabricius, 1807

75. *Pontia daplidice moorei* (Roeber, [1907]) *
    Published records: Singh *et al*., 2011; Van Gasse, 2013; Singh & Gogoi, 2013; Varshney & Smetacek, 2015: 75.
    Sighting locality: 17, 19, 22, 23, 26.

Pieris Schrank, 1801

76. *Pieris brassicae nepalensis* Gray, 1846 *
    Published records: Tytler, 1915a: 515; Majumdar, 2004: 518; Singh *et al*., 2011; Varshney & Smetacek, 2015: 73.
    Sighting locality: 1, 2, 9, 11, 15, 65, 19, 22, 27, 71, 37, 47, 48, 58, 77, 80.
77. *Pieris canidia indica* Evans, 1926 *
    Published records: Butler, 1885; Moore, 1903: 133; Majumdar, 2004: 518; Singh *et al*., 2011; Varshney & Smetacek, 2015: 73.
    Sighting locality: 1, 2, 9, 15, 19, 25, 33, 36, 69, 74, 73, 47, 50, 55, 60, 73.

Artogeia Verity, 1947

78. *Artogeia erutae montana* (Verity, 1911) *#
    Sighting locality: 4, 17, 19, 22, 23, 71, 77, 78.

Cepora Billberg, 1820

79. *Cepora nadina nadina* (Lucas, 1852) *
    Published records: Butler, 1885; Moore, 1903: 217; Singh *et al*., 2011; Varshney & Smetacek, 2015: 79.
    Sighting locality: 4, 60, 71.
80. *Cepora nerissa phryne* (Fabricius, 1775) *
    Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 80.
    Sighting locality: 20, 22, 53, 71.

Prioneris Wallace, 1867

81. *Prioneris philonome clemanthe* (Doubleday,1842) *
    Published records: Varshney & Smetacek, 2015: 78.
    Sighting locality: 60, 72.
82. *Prioneris thestylis thestylis* (Doubleday,1842) *
    Published records: Butler, 1885; Moore, 1903:187; Varshney & Smetacek, 2015: 79.
    Sighting locality: 4, 37, 71, 51, 60, 63, 77, 78.

Delias Huebner, [1819]

83. *Delias acalis pyramus* (Wallace,1867) *
    Published records: Varshney & Smetacek, 2015: 80.
    Sighting locality: 4, 35, 71, 63.
84. *Delias agostina agostina* (Hewitson, 1852) *
    Published records: Varshney & Smetacek, 2015: 80.
    Sighting locality: 4, 71, 63, 79.
85. *Delias belladonna lugens* Jordan, 1925 *
    Published records: Tytler, 1939: 241; Varshney & Smetacek, 2015: 80.
    Sighting locality: 2, 4, 5, 20, 32, 51, 58, 60, 63, 72.
86. *Delias berinda berinda* (Moore, 1872) *
    Published records: Tytler, 1939: 242; Van Gasse, 2013.
    Sighting locality: 2, 20, 51, 60, 63, 72.
87. *Delias descombesi descombesi* (Boisduval,1836) *
    Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 81.
    Sighting locality: 22, 32, 63, 76.
88. *Delias eucharis* (Drury, 1773) *
    Published records: Varshney & Smetacek, 2015: 81.
    Sighting locality: 4, 28.
89. *Delias hyparete indica* (Wallace, 1867) *
    Published records: Varshney & Smetacek, 2015: 81.
    Sighting locality: 4, 22, 68.

90. *Delias pasithoe dione* (Drury, [1773]) *
Published records: Majumdar, 2004: 517; Singh *et al.,* 2011; Varshney & Smetacek, 2015:82.
Sighting locality: 2, 9, 15, 17, 30, 73, 62, 77.
91. *Delias sanaca oreas* Talbot, 1928 *
Published records: Varshney & Smetacek, 2015: 81.
Sighting locality: 1, 12, 69.

Family Riodinidae Grote, 1895

Subfamily Nemeobiinae Bates, 1868

Tribe Nemeobiini

Zemeros Boisduval, [1836]
92. *Zemeros flegyas indicus* Fruhstorfer,1898 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 84.
Sighting locality: 32, 68.

Stiboges Butler, 1876
93. *Stiboges nymphidia* Butler, 1876
Published records: Varshney & Smetacek, 2015: 87.
Remarks: Not recorded during the study.

Dodona Hewitson, 1861
94. *Dodona adonira naga* Tytler, 1940 *
Published records: Tytler, 1940: 121; Van Gasse, 2013; Varshney & Smetacek, 2015: 84.
Sighting locality: 26, 59, 77.
95. *Dodona dipoea dipoea* Hewitson, 1865 *
Published records: Varshney & Smetacek, 2015: 84.
Sighting locality: 4, 68.
96. *Dodona eugenes venox* Fruhstorfer, 1912 *
Published records: Varshney & Smetacek, 2015: 85.
Sighting locality: 19, 23.
97. *Dodona egeon* (Westwood, [1851])
Published records: Varshney & Smetacek, 2015: 84.
Remarks: Not recorded during the study.
98. *Dodona ouida ouida* Moore, 1866 *
Published records: Varshney & Smetacek, 2015: 85.
Sighting locality: 5, 77.
99. *Dodona longicaudata* Niceville, 1881
Published records: Varshney & Smetacek, 2015: 85.
Remarks: Not recorded during the study.
100. *Dodona deodata* Hewitson, 1876
Published records: Tytler, 1915a: 512; Van Gasse, 2013.
Remarks: Not recorded during the study.

Abisara C. & R. Felder, 1860
101. *Abisara bifasciata angulata* Moore, [1879] *
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 85.
Sighting locality: 4, 25, 32, 71, 60, 72.
102. *Abisara attenuata* Tytler, 1915
Published records: Tytler, 1915a: 512; Van Gasse, 2013; Varshney & Smetacek, 2015: 85.

Remarks: Not recorded during the study.

103. *Abisara chela amplifascia* Tytler, 1940
Published records: Tytler, 1940: 122; Van Gasse, 2013; Varshney & Smetacek, 2015: 86.
Remarks: Not recorded during the study.

104. *Abisara echerius paionea* Fruhstorfer, 1914 *
Published records: Tytler, 1915a: 512; Singh *et al.,* 2011; Van Gasse, 2013; Varshney & Smetacek, 2015: 86.
Sighting locality: 15.

105. *Abisara fylla fylla* (Westwood,1851) *
Published records: Varshney & Smetacek, 2015: 86.
Sighting locality: 72.

106. *Abisara saturata baraka* Bennet, 1950
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 87.
Remarks: Not recorded during the study.

107. *Abisara neophron neophron* (Hewitson, 1861) *
Published records: Varshney & Smetacek, 2015: 86.
Sighting locality: 23.

Taxila Doubleday, 1847

108. *Taxila haquinus fasciata* Moore, 1878 *
Published records: Tytler, 1915a: 512; Van Gasse, 2013; Varshney & Smetacek, 2015: 87.
Sighting locality: 53, 59, 60, 72.

Family Lycaenidae Leach, 1815

Subfamily Poritiinae Doherty, 1886

Poritia Moore, [1866]

109. *Poritia hewitsoni hewitsoni* Moore, [1866] *
Published records: Van Gasse, 2013.
Sighting locality: 26, 68.

110. *Poritia erycinoides trisna* (C. & R. Felder, 1865)
Published records: Tytler, 1915b: 123; Van Gasse, 2013.
Remarks: Not recorded during the study.

Subfamily Miletinae Corbet, 1939

Tribe Miletini Corbet, 1939

Miletus Huebner, [1819]

111. *Miletus chinensis longeana* (de Niceville, 1898) *
Published records: Tytler, 1915b:119; Van Gasse, 2013; Varshney & Smetacek, 2015:91.
Sighting locality: 8, 21.

112. *Miletus boisduvali* Moore, [1858] *
Published records: Tytler, 1915b: 119.
Sighting locality: 2, 8, 9, 21, 76.

113. *Miletus mallus* (Fruhstorfer, 1913) *#
Sighting locality:62, 72.

Allotinus C. & R. Felder, [1865]

114. *Allotinus subviolaceus manychus* Fruhstorfer, 1913

Published records: Tytler, 1915b:119; Eliot, 1986: 14–15; Van Gasse, 2013; Varshney & Smetacek, 2015: 90.
Remarks: Not recorded during the study.

115. *Allotinus horsfieldi* (Moore, [1858]) *
Published records: Tytler, 1915b: 120; Van Gasse, 2013.
Sighting locality: 4.

Logania Distant, 1884

116. *Logania distanti massalia* Doherty, 1891
Published records: Tytler, 1915b: 120; Eliot, 1986: 70–71; Van Gasse, 2013; Varshney & Smetacek, 2015: 90.
Remarks: Not recorded during the study.

117. *Logania watsoniana subfasciata* de Nicéville, 1898
Published records: Tytler, 1915b: 120: Eliot, 1986: 73; Van Gasse, 2013; Varshney & Smetacek, 2015: 90.
Remarks: Not recorded during the study.

Tribe Tarakini Doherty, 1889

Taraka de Niceville, 1890

118. *Taraka hamada mendesia* Fruhstorfer, 1918 *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 91.
Sighting locality: 4, 71, 60, 78.

Tribe Spalgini Toxopeus, 1929

Spalgis Moore, 1879

119. *Spalgis epius epius* (Westwood, 1852) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 91.
Sighting locality: 60, 72.

Subfamily Curetinae Distant, 1884

Curetis Huebner, [1819]

120. *Curetis bulis bulis* (Westwood, 1852) *
Published records: Varshney & Smetacek, 2015: 88.
Sighting locality: 2, 14, 68.

121. *Curetis acuta dentata* Moore,1879 *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 88.
Sighting locality: 11, 15, 30.

Subfamily Theclinae Swainson, 1831

Tribe Theclini Swainson, 1831

Fujiokaozephyrus Koiwaya, 2007

122. *Fujiokaozephyrus tsangkie doni* (Tytler, 1915)
Published records: Tytler, 1915b: 129; Van Gasse, 2013; Varshney & Smetacek, 2015: 97.
Remarks: Not recorded during the study.

Chrysozephyrus Shirôzu & Yamamoto, 1956

123. *Chrysozephyrus dumoides* (Tytler, 1915)
Published records: Tytler, 1915b: 127; Howarth, 1957: 251; Varshney & Smetacek, 2015: 98.
Remarks: Not recorded during the study.

124. *Chrysozephyrus duma* (Hewitson, 1869)
Published records: Tytler, 1915b: 128; Howarth, 1957: 252; Van Gasse, 2013; Varshney & Smetacek, 2015: 98.
Remarks: Not recorded during the study.

125. *Chrysozephyrus intermedius intermedius* (Tytler, 1915)
Published records: Tytler, 1915b: 127; Howarth, 1957: 251; Van Gasse, 2013; Varshney & Smetacek, 2015: 98.
Remarks: Not recorded during the study.

126. *Chrysozephyrus kabrua kabrua* (Tytler, 1915)
Published records: Tytler, 1915b: 128; Howarth, 1957: 243; Van Gasse, 2013; Varshney & Smetacek, 2015: 98.
Remarks: Not recorded during the study.

127. *Chrysozephyrus tytleri tytleri* (Howarth, 1957)
Published records: Howarth, 1957: 249; Van Gasse, 2013; Varshney & Smetacek, 2015: 99.
Remarks: Not recorded during the study.

128. *Chrysozephyrus vittatus vittatus* (Tytler, 1915)
Published records: Tytler, 1915b: 126; Howarth, 1957: 247; Van Gasse, 2013; Varshney & Smetacek, 2015: 99.
Remarks: Not recorded during the study.

129. *Chrysozephyrus zoa zoa* (de Nicéville, 1889)
Published records: Howarth, 1957: 248; Van Gasse, 2013.
Remarks: Not recorded during the study.

Neozephyrus Sibatani & Ito, 1942

130. *Neozephyrus suroia suroia* (Tytler, 1915)
Published records: Tytler, 1915b: 125; Howarth, 1957: 263; Van Gasse, 2013; Varshney & Smetacek, 2015: 99.
Remarks: Not recorded during the study.

Shirozuozephyrus Koiwaya, 2007

131. *Shirozuozephyrus jakamensis* (Tytler, 1915)
Published records: Tytler, 1915b: 130; Howarth, 1957: 267; Van Gasse, 2013; Varshney & Smetacek, 2015: 100.
Remarks: Not recorded during the study.

132. *Shirozuozephyrus khasia* (de Niceville, 1890)
Published records: Tytler, 1915b: 131; Howarth, 1957: 269; Van Gasse, 2013; Varshney & Smetacek, 2015: 100.
Remarks: Not recorded during the study.

133. *Shirozuozephyrus kirbariensis kirbariensis* (Tytler, 1915)
Published records: Tytler, 1915b: 130; Howarth, 1957: 268; Van Gasse, 2013; Varshney & Smetacek, 2015: 100.
Remarks: Not recorded during the study.

134. *Shirozuozephyrus paona paona* (Tytler, 1915)
Published records: Tytler, 1915b: 131; Howarth, 1957: 268; Van Gasse, 2013; Varshney & Smetacek, 2015: 100.
Remarks: Not recorded during the study.

Inomataozephyrus Koiwaya, 2007

135. *Inomataozephyrus assamicus assamicus* (Tytler, 1915)
Published records: Tytler, 1915b: 130; Howarth, 1957: 268; Van Gasse, 2013; Varshney & Smetacek, 2015: 100.
Remarks: Not recorded during the study.

Amblopala Leech, 1893

136. *Amblopala avidiena avidiena* (Hewitson, 1877) *
Published records: Irungbam *et al*., (in Press).
Sighting locality: 77.

Araotes Doherty, 1889

137. *Araotes lapithis lapithis* (Moore, [1858])
Published records: Tytler, 1915b: 142; Varshney & Smetacek, 2015.
Remarks: Not recorded during the study.

Tribe Arhopalini Bingham, 1907

Arhopala Boisduval, 1832

138. *Arhopala aberrans* (de Niceville, [1889])
Published records: Tytler, 1915b: 135; Van Gasse, 2013; Varshney & Smetacek, 2015: 101.
Remarks: Not recorded during the study.

139. *Arhopala aeeta* de Niceville, [1893]
Published records: Evans, 1957: 121; Van Gasse, 2013; Varshney & Smetacek, 2015: 102.
Remarks: Not recorded during the study.

140. *Arhopala abseus indicus* Riley, 1923 *
Published records: Tytler, 1915b: 134; Varshney & Smetacek, 2015: 101.
Sighting locality: 2, 4, 71, 68.

141. *Arhopala amantes amatrix* de Niceville, 1891 *
Published records: Singh *et al.,* 2011; Van Gasse, 2013; Varshney & Smetacek, 2015: 102.
Sighting locality: 4, 22, 72, 60, 63, 72.

142. *Arhopala atrax* (Hewitson, 1862) *
Published records: Tytler, 1915b: 135; Varshney & Smetacek, 2015: 103.
Sighting locality: 27, 56.

143. *Arhopala allata suffusa* (Tytler, 1915)
Published records: Evans, 1957: 93; Van Gasse, 2013; Varshney & Smetacek, 2015: 102.
Remarks: Not recorded during the study.

144. *Arhopala agrata binghami* Corbet, 1946
Published records: Tytler, 1915b: 134; Evans, 1957: 103; Van Gasse, 2013; Varshney & Smetacek, 2015: 102.
Remarks: Not recorded during the study.

145. *Arhopala alax* (Evans, 1932)
Published records: Evans, 1957: 105; Van Gasse, 2013; Varshney & Smetacek, 2015:102.
Remarks: Not recorded during the study.

146. *Arhopala alesia sacharja* Fruhstorfer, 1914
Published records: Evans, 1957:120; Van Gasse, 2013; Varshney & Smetacek, 2015:102.
Remarks: Not recorded during the study.

147. *Arhopala anarte* (Hewitson, 1862)
Published records: Tytler, 1915b:134; Van Gasse, 2013; Varshney & Smetacek, 2015:103.
Remarks: Not recorded during the study.

148. *Arhopala asopia* (Hewitson, 1869)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015:103.

Remarks: Not recorded during the study.

149. *Arhopala aurelia* (Evans, [1925])
Published records: Evans, 1957: 103; Van Gasse, 2013; Varshney & Smetacek, 2015: 103.
Remarks: Not recorded during the study.

150. *Arhopala asinarus tounguva* (Grose–Smith, 1887)
Published records: Tytler, 1915b: 134; Van Gasse, 2013.
Remarks: Not recorded during the study.

151. *Arhopala ariel* (Doherty, 1891)
Published records: Tytler, 1915b: 136.
Remarks: Not recorded during the study.

152. *Arhopala ace arata* Tytler, 1915
Published records: Tytler, 1915b: 135; Evans, 1957: 103; Van Gasse, 2013; Varshney & Smetacek, 2015: 101.
Remarks: Not recorded during the study.

153. *Arhopala bazalus teesta* (de Niceville, 1866) *
Published records: Tytler, 1915b: 134; Varshney & Smetacek, 2015: 104.
Sighting locality: 2, 4, 32, 71, 60, 64, 77.

154. *Arhopala belphoebe belphoebe* Doherty, 1889
Published records: Evans, 1957: 98; Van Gasse, 2013; Varshney & Smetacek, 2015: 104.
Remarks: Not recorded during the study.

155. *Arhopala birmana birmana* (Moore, [1884])
Published records: Tytler, 1915b: 136; Evans, 1957: 129; Van Gasse, 2013; Varshney & Smetacek, 2015: 104.
Remarks: Not recorded during the study.

156. *Arhopala centaurus pirithous* (Moore, [1883]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 104.
Sighting locality: 4, 9, 11, 22, 27, 60, 76.

157. *Arhopala comica* de Niceville, 1900
Published records: Tytler, 1915b: 134; Evans, 1957: 123; Van Gasse, 2013; Varshney & Smetacek, 2015: 104.
Remarks: Not recorded during the study.

158. *Arhopala camdeo sebonga* (Tytler, 1926)
Published records: Tytler, 1915b: 133; Tytler, 1926; Van Gasse, 2013; Evans, 1957: 92.
Remarks: Not recorded during the study.

159. *Arhopala eumolphus eumolphus* (Cramer, [1780]) *
Published records: Tytler, 1915b: 134; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 105.
Sighting locality: 4, 11, 65, 18, 21, 32, 70, 70.

160. *Arhopala fulla ignara* Rilay & Godfrey, 1921
Published records: Varshney & Smetacek, 2015: 105.
Remarks: Not recorded during the study.

161. *Arhopala ganesa watsoni* Evans, 1912
Published records: Tytler, 1915b: 134; Van Gasse, 2013; Varshney & Smetacek, 2015: 105.
Remarks: Not recorded during the study.

162. *Arhopala hellenore hellenore* Doherty, 1889 *
Published records: Tytler, 1915b: 134.
Sighting locality: 65, 21, 32, 70, 70.

163. *Arhopala khamti* Doherty, 1891
Published records: Tytler, 1915b: 135; Varshney & Smetacek, 2015: 106.
Remarks: Not recorded during the study.

164. *Arhopala rama ramosa* (Evans, 1925) *
Published records: Tytler, 1915b: 134; Van Gasse, 2013.
Sighting locality: 65, 21, 32, 70, 70.

165. *Arhopala oenea* (Hewitson, 1869)
Published records: Varshney & Smetacek, 2015: 106.
Remarks: Not recorded during the study.
166. *Arhopala paraganesa zephyretta* (Doherty, 1891)
Published records: Tytler, 1915b: 136; Varshney & Smetacek, 2015: 106.
Remarks: Not recorded during the study.
167. *Arhopala paramuta* (de Nicéville, [1884])
Published records: Tytler, 1915b: 135; Varshney & Smetacek, 2015: 106.
Remarks: Not recorded during the study.
168. *Arhopala perimuta* (Moore, [1858])
Published records: Tytler, 1915b: 135; Varshney & Smetacek, 2015: 107.
Remarks: Not recorded during the study.
169. *Arhopala paralea* (Evans, [1925])
Published records: Evans, 1957: 119; Van Gasse, 2013; Varshney & Smetacek, 2015: 106.
Remarks: Not recorded during the study.
170. *Arhopala nicevillei* Bethune–Baker, 1903
Published records: Evans, 1957: 101; Van Gasse, 2013.
Remarks: Not recorded during the study.
171. *Arhopala singla* (de Niceville, 1885) *
Published records: Varshney & Smetacek, 2015: 107.
Sighting locality: 18, 32, 70, 42.
172. *Arhopala silhetensis silhetensis* (Hewitson, 1862)
Published records: Tytler, 1915b: 133; Evans, 1957: 102; Van Gasse, 2013; Varshney & Smetacek, 2015: 107.
Remarks: Not recorded during the study.

Apporasa Moore, 1884
173. *Apporasa atkinsoni* (Hewitson, 1869) *
Published records: Tytler, 1915b: 133; Varshney & Smetacek, 2015: 108; Soibam *et al.,* 2016.
Sighting locality: 70.

Flos Doherty, 1889
174. *Flos asoka* (de Nicéville, [1884])
Published records: Varshney & Smetacek, 2015: 108.
Remarks: Not recorded during the study.
175. *Flos adriana* (de Nicéville, [1884])
Published records: Varshney & Smetacek, 2015: 108.
Remarks: Not recorded during the study.
176. *Flos chinensis* (C. & R. Felder, [1865])
Published records: Varshney & Smetacek, 2015: 109.
Remarks: Not recorded during the study.
177. *Flos fulgida fulgida* (Hewitson, 1863) *#
Sighting locality: 4, 22, 32, 68.
178. *Flos areste* (Hewitson, 1862)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 108.
Remarks: Not recorded during the study.

Mota de Niceville, 1890
179. *Mota massyla* (Hewitson, 1869) *
Published records: Tytler, 1915b: 133.
Sighting locality: 22, 60, 64, 76.

Surendra Moore, 1879

180. *Surendra quercetorum quercetorum* (Moore, [1858]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 109.
Sighting locality: 10, 20, 21, 32, 71, 46, 53, 60, 80.

Zinaspa de Niceville, 1890

181. *Zinaspa todara distorta* (Moore, [1884]) *
Published records: Tytler, 1915b: 133.
Sighting locality: 4, 23, 32, 70, 63, 76.

Tribe Amblypodiini Doherty, 1886

Amblypodia Horsfield, [1829]

182. *Amblypodia anita gigantea* (Tytler, 1926)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015:110.
Remarks: Not recorded during the study.

Iraota Moore, [1881]

183. *Iraota timoleon timoleon* (Stoll, [1790]) *
Published records: Tytler, 1915b: 133; Varshney & Smetacek, 2015:111.
Sighting locality: 2, 23, 47, 68.

184. *Iraota rochana boswelliana* Distant, 1885
Published records: Tytler, 1915b:133; Van Gasse, 2013; Varshney & Smetacek, 2015:110.
Remarks: Not recorded during the study.

Tribe Catapaecilmatini Eliot, 1973

Catapaecilma Butler, 1879

185. *Catapaecilma major anais* Fruhstorfer,1915 *
Published records: Varshney & Smetacek, 2015: 111.
Sighting locality: 2, 4, 17, 19, 20, 32, 71, 63, 76.

Acupicta Eliot, 1973

186. *Acupicta delicatum* (de Nicéville, 1887)
Published records: Tytler, 1915b: 143.
Remarks: Not recorded during the study.

Tribe Loxurini Swinshoe, 1910

Loxura Horsfield, 1829

187. *Loxura atymnus atymnus* (Stoll, 1780) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 111.
Sighting locality: 2, 4, 32, 60, 79.

Yasoda Doherty, 1889

188. *Yasoda tripunctata tripunctata* (Hewitson, 1863)
Published records: Tytler, 1915b: 142.
Remarks: Not recorded during the study.

Tribe Horagini, Swinhoe, 1910

Horaga Moore, 1881

189. *Horaga onyx onyx* (Moore, 1858) *
    Published records: Varshney & Smetacek, 2015: 112.
    Sighting locality: 4, 20, 27, 32, 71, 71.
190. *Horaga viola* Moore, 1882
    Published records: Tytler, 1915b: 143; Van Gasse, 2013; Varshney & Smetacek, 2015: 113.
    Remarks: Not recorded during the study.

Tribe Cheritrini Swinhoe, 1910

Cheritrella de Niceville, 1887

191. *Cheritrella truncipennis* de Niceville, 1887 *
    Published records: Tytler, 1915b: 142; Varshney & Smetacek, 2015: 113.
    Sighting locality: 53, 71.

Cheritra Moore, 1881

192. *Cheritra freja evansi* Cowan, 1965 *
    Published records: Varshney & Smetacek, 2015: 113.
    Sighting locality:30, 41.

Tribe Aphnaeini Distant, 1884

Cigaritis Donzel, 1847

193. *Cigaritis elima* (Moore, 1877)
    Published records: Varshney & Smetacek, 2015: 94.
    Remarks: Not recorded during the study.
194. *Cigaritis evansii evansii* (Tytler, 1915)
    Published records: Tytler, 1915a: 132; Van Gasse, 2013; Varshney & Smetacek, 2015: 95.
    Remarks: Not recorded during the study.
195. *Cigaritis lohita himalayanus* (Moore, 1884) *
    Published records: Singh *et al*., 2011.
    Sighting locality: 60, 77.
196. *Cigaritis nipalicus* (Moore, 1884) *#
    Sighting locality: 20, 32, 57.
197. *Cigaritis syama peguanus* Moore,1884 *
    Published records: Varshney & Smetacek, 2015: 96.
    Sighting locality: 8, 22, 61.
198. *Cigaritis vulcanus* (Fabricius, 1775)
    Published records: Varshney & Smetacek, 2015: 96.
    Remarks: Not recorded during the study.

Tribe Iolaini Riley, 1956

Ticherra de Nicéville, 1887

199. *Ticherra acte* (Moore, [1858])
    Published records: Varshney & Smetacek, 2015: 113.
    Remarks: Not recorded during the study.

Rathinda Moore, [1881]

200. *Rathinda amor* (Fabricius, 1775)
Published records: Varshney & Smetacek, 2015: 113.
Remarks: Not recorded during the study.

Pratapa Moore, 1881

201. *Pratapa icetas* (Hewitson, 1865)
Published records: Varshney & Smetacek, 2015: 114.
Remarks: Not recorded during the study.
202. *Pratapa deva lila* Moore, 1884 *
Published records: Varshney & Smetacek, 2015: 114.
Sighting locality: 39.

Rachana Eliot in Corbet & Pendlebury, 1978

203. *Rachana jalindra indra* (Moore, [1884])
Published records: Tytler, 1915b: 142.
Remarks: Not recorded during the study.

Dacalana Moore, 1884

204. *Dacalana penicilligera* (de Nicéville, 1890)
Published records: Tytler, 1915b: 140.
Remarks: Not recorded during the study.
205. *Dacalana cotys cotys* (Hewitson, 1865)
Published records: Tytler, 1915b: 140; Van Gasse, 2013; Varshney & Smetacek, 2015: 116.
Remarks: Not recorded during the study.

Tajuria Moore, 1881

206. *Tajuria albiplaga albiplaga* de Niceville, 1887
Published records: Tytler, 1915b: 141; Van Gasse, 2013; Varshney & Smetacek, 2015: 114.
Remarks: Not recorded during the study.
207. *Tajuria cippus longinus* (Fabricius, 1798)
Published records: Tytler, 1915b: 141; Varshney & Smetacek, 2015: 114.
Remarks: Not recorded during the study.
208. *Tajuria deudorix oeta* (de Niceville, 1895)
Published records: Tytler, 1915b: 141; Van Gasse, 2013; Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.
209. *Tajuria diaeus diaeus* (Hewitson, 1865)
Published records: Tytler, 1915b: 141; Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.
210. *Tajuria isaeus tyro* de Niceville, 1895
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.
211. *Tajuria ister* (Hewitson, 1865)
Published records: Tytler, 1915b: 140; Van Gasse, 2013; Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.
212. *Tajuria illurgis* (Hewitson, 1869)
Published records: Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.
213. *Tajuria illurgioides* de Nicéville, 1890
Published records: Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.
214. *Tajuria jehana* Moore, [1884]

Published records: Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.

215. *Tajuria luculenta nela* Swinhoe,1896
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 115.
Remarks: Not recorded during the study.

216. *Tajuria megista megistia* (Hewitson, 1869)
Published records: Tytler, 1915b: 141; Van Gasse, 2013; Varshney & Smetacek, 2015: 116.
Remarks: Not recorded during the study.

217. *Tajuria maculata* (Hewitson, 1865) *
Published records: Tytler, 1915b: 141; Varshney & Smetacek, 2015: 116.
Sighting locality: 2, 20, 22, 71, 60, 76.

218. *Tajuria megista thyia* de Niceville, 1892
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 116.
Remarks: Not recorded during the study.

219. *Tajuria melastigma* de Nicéville, 1887
Published records: Tytler, 1915b: 140; Van Gasse, 2013: 116.
Remarks: Not recorded during the study.

220. *Tajuria sebonga* Tytler, 1915
Published records: Tytler, 1915b: 141.
Remarks: Not recorded during the study.

221. *Tajuria yajna istroidea* de Nicéville, 1887
Published records: Tytler, 1915b:142; Van Gasse, 2013.
Remarks: Not recorded during the study.

Creon de Niceville, 1896

222. *Creon cleobis cleobis* (Godart, 1824) *
Published records: Varshney & Smetacek, 2015: 117.
Sighting locality: 74, 68.

Charana de Nicéville in Marshall & de Nicéville, 1890

223. *Charana mandarina* (Hewitson, [1863]) *
Published records: Tytler, 1915b: 142; Varshney & Smetacek, 2015: 117.
Sighting locality: 2, 4, 30, 60, 72.

Neocheritra Distant, 1885

224. *Neocheritra fabronia fabronia* (Hewitson, [1878])
Published records: Tytler, 1915b: 142; Van Gasse, 2013: 117.
Remarks: Not recorded during the study.

Suasa de Niceville, 1890

225. *Suasa lisides* (Hewitson,1863) *
Published records: Tytler, 1915b: 142; Van Gasse, 2013; Varshney & Smetacek, 2015: 118.
Sighting locality: 4, 68.

Tribe Ramelanini Eliot, 1973

Ancema Eliot, 1973

226. *Ancema blanka minturna* (Fruhstorfer, [1912])
Published records: Varshney & Smetacek, 2015: 118.
Remarks: Not recorded during the study.

227. *Ancema ctesia ctesia* (Hewitson, [1865])

Published records: Varshney & Smetacek, 2015: 118.
Remarks: Not recorded during the study.
Remelana Moore, 1884
228. *Remelana jangala ravata* (Moore, [1865]) *
Published records: Tytler, 1915b:142; Varshney & Smetacek, 2015:118.
Sighting locality: 30, 71.

Tribe Hypolycaenini Swinhoe, 1910

Hypolycaena C. & R. Felder, 1862
229. *Hypolycaena erylus himavantus* Fruhstorfer, 1912 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 119.
Sighting locality: 2, 4, 32, 60, 77, 78.

Chliaria Moore, 1884
230. *Chliaria kina kina* (Hewitson, 1869) *
Published records: Varshney & Smetacek, 2015: 119.
Sighting locality: 9, 21 32, 72, 63.
231. *Chliaria othona othona* (Hewitson, 1865) *
Published records: Varshney & Smetacek, 2015: 119.
Sighting locality: 4, 68.

Zeltus de Niceville, 1890
232. *Zeltus amasa* (Hewitson, 1865) *
Published records: Butler, 1885; Varshney & Smetacek, 2015: 119.
Sighting locality: 24, 60, 76.

Tribe Deudorigini Doherty, 1886

Deudorix Hewitson, 1863
233. *Deudorix gaetulia* de Nicéville, [1893]
Published records: Varshney & Smetacek, 2015: 120.
Remarks: Not recorded during the study.
234. *Deudorix hypargyria hypargyria* (Elwes, [1893])
Published records: Tytler, 1915b: 136; Van Gasse, 2013.
Remarks: Not recorded during the study.
235. *Deudorix dohertyi* (Tytler, 1915)
Published records: Tytler, 1915b: 138.
Remarks: Not recorded during the study.
236. *Deudorix epijarbus amatius* Fruhstorfer, 1912
Published records: Tytler, 1915b: 136; Varshney & Smetacek, 2015: 120.
Remarks: Not recorded during the study.

Virachola Moore, 1881
237. *Virachola isocrates* (Fabricius, 1793) *
Published records: Tytler, 1915b: 138; Varshney & Smetacek, 2015: 120.
Sighting locality: 72, 56, 71.
238. *Virachola perse perse* (Hewitson, [1863])
Published records: Tytler, 1915b: 138; Varshney & Smetacek, 2015: 121.
Remarks: Not recorded during the study.

239. *Virachola kessuma deliochus* (Hewitson,1874)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 120.
Remarks: Not recorded during the study.

Maneca de Nicéville in Marshall & de Nicéville, 1890
240. *Maneca bhotea* (Moore, 1884)
Published records: Tytler, 1915b: 140; Van Gasse, 2013.
Remarks: Not recorded during the study.

Sinthusa Moore, 1884
241. *Sinthusa chandrana* (Moore, 1882)
Published records: Tytler, 1915b: 139; Varshney & Smetacek, 2015: 121.
Remarks: Not recorded during the study.
242. *Sinthusa virgo* (Elwes, 1887)
Published records: Tytler, 1915b:139; Varshney & Smetacek, 2015: 122.
Remarks: Not recorded during the study.
243. *Sinthusa nasaka amba* (Kirby,1878) *
Published records: Tytler, 1915b: 139; Varshney & Smetacek, 2015: 121.
Sighting locality: 20, 70, 41.

Bindahara Moore, [1881]
244. *Bindahara phocides phocides* (Fabricius, 1793) *
Published records: Tytler, 1915b: 142; Varshney & Smetacek, 2015: 122.
Sighting locality: 4, 30, 68.

Rapala Moore, [1881]
245. *Rapala buxaria* De Nicéville, 1889
Published records: Tytler, 1915b: 137; Varshney & Smetacek, 2015: 122.
Remarks: Not recorded during the study.
246. *Rapala damona* Swinhoe, 1890
Published records: Varshney & Smetacek, 2015: 122.
Remarks: Not recorded during the study.
247. *Rapala iarbus iarbus* (Fabricius, 1787) *
Published records: Varshney & Smetacek, 2015: 123.
Sighting locality: 68.
248. *Rapala manea* (Hewitson, 1863) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 123.
Sighting locality: 32.
249. *Rapala nissa ranta* Swinhoe, 1897 *
Published records: Varshney & Smetacek, 2015: 123.
Sighting locality: 4, 59, 68.
250. *Rapala pheretima petosiris* (Hewitson,1863) *
Published records: Tytler, 1915b: 137; Varshney & Smetacek, 2015: 123.
Sighting locality: 23.
251. *Rapala refulgens* de Nicéville, 1891
Published records: Tytler, 1915b: 138; Van Gasse, 2013.
Remarks: Not recorded during the study.
252. *Rapala rectivitta* (Moore, 1879) *#
Sighting locality: 60, 78.
253. *Rapala rubida* Tytler, 1926
Published records: Tytler, 1915b: 138; Van Gasse, 2013; Varshney & Smetacek, 2015: 124.
Remarks: Not recorded during the study.

254. *Rapala rosacea* De Nicéville, 1889
Published records: Tytler, 1915b: 137.
Remarks: Not recorded during the study.
255. *Rapala suffusa suffusa* Moore, 1878
Published records: Tytler, 1915b: 137.
Remarks: Not recorded during the study.
256. *Rapala scintilla* de Niceville, 1890 *
Published records: Tytler, 1915b: 137.
Sighting locality: 7.
257. *Rapala tara* de Niceville, [1889] *
Published records: Tytler, 1915b: 137; Van Gasse, 2013.
Sighting locality: 32, 39.
258. *Rapala varuna gebenia* Fruhstorfer,1914 *
Published records: Varshney & Smetacek, 2015: 124.
Sighting locality: 19, 60, 72.

Artipe Boisduval, 1870
259. *Artipe eryx* (Linnaeus, 1771)
Published records: Tytler, 1915b: 142; Varshney & Smetacek, 2015: 121.
Remarks: Not recorded during the study.

Tribe Eumaeini Doubleday, 1874

Strymon Huebner, 1818
260. *Strymon mackwoodi* (Evans, 1914)
Published records: Evans, 1914: 302; Van Gasse, 2013; Varshney & Smetacek, 2015: 125.
Remarks: Not recorded during the study.

Subfamily Lycaeninae Leach, 1815

Heliophorus Geyer, 1832
261. *Heliophorus androcles androcles* (Westwood, 1851)
Published records: Van Gasse, 2013.
Remarks: Not recorded during the study.
262. *Heliophorus brahma brahma* (Moore, [1858]) *
Published records: Varshney & Smetacek, 2015: 93.
Sighting locality: 12, 20, 74, 54.
263. *Heliophorus epicles* (Godart, [1824]) *
Published records: Singh *et al*., 2011.
Sighting locality: 4, 14, 65, 19, 20, 29, 72, 71, 48, 55, 78.
264. *Heliophorus kohimensis* (Tytler, 1912) *#
Sighting locality: 4, 74, 52.
265. *Heliophorus moorei tytleri* Riley, 1929 *
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 93.
Sighting locality: 4, 23, 60, 72.
266. *Heliophorus tamu* (Kollar, [1844]) *#
Sighting locality: 55, 77, 78.

Subfamily Polyommatinae Swainson, 1827

Tribe Lycaenesthini Toxopeus, 1929

Anthene Doubleday, 1847

267. *Anthene emolus emolus* (Godart, 1824) *
Published records: Varshney & Smetacek, 2015: 126.
Sighting locality: 76.

268. *Anthene lycaenina lycambes* (Hewitson, 1878) *
Published records: Varshney & Smetacek, 2015: 126.
Remarks: Not recorded during the study.

Tribe Niphandini Eliot, 1973

Niphanda Moore, [1875]

269. *Niphanda cymbia cymbia* de Nicéville, [1884]
Published records: Tytler, 1915b: 122; Van Gasse, 2013; Varshney & Smetacek, 2015: 126.
Remarks: Not recorded during the study.

Tribe Polyommatini Swainson, 1827

Una de Niceville, 1890

270. *Una usta usta* (Distant, 1886) *
Published records: Tytler, 1915b: 120.
Sighting locality: 14, 53, 62, 70, 74.

Orthomiella de Niceville, 1890

271. *Orthomiella rantaizana rovorea* (Fruhstorfer, 1918)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 127.
Remarks: Not recorded during the study.

272. *Orthomiella pontis pontis* (Elwes, 1887) *
Published records: Tytler, 1915b: 122.
Sighting locality: 58, 60, 64, 77.

Petrelaea Toxopeus, 1929

273. *Petrelea dana* (de Niceville, [1884]) *
Published records: Varshney & Smetacek, 2015: 127.
Sighting locality: 20, 21, 68.

Nacaduba Moore, [1881]

274. *Nacaduba beroe gythion* Fruhstorfer, 1916
Published records: Varshney & Smetacek, 2015: 127.
Remarks: Not recorded during the study.

275. *Nacaduba kurava euplea* Fruhstorfer, 1916 *
Published records: Varshney & Smetacek, 2015: 128.
Sighting locality: 72.

276. *Nacaduba pactolus continentalis* Fruhstorfer, 1916
Published records: Varshney & Smetacek, 2015: 128.
Remarks: Not recorded during the study.

Prosotas Druce, 1891

277. *Prosotas aluta coelestis* (WoodMason & de Niceville, [1887]) *
Published records: Varshney & Smetacek, 2015: 129.
Sighting locality: 4, 27, 60, 72.

278. *Prosotas bhutea* (de Niceville, [1884]) *
Published records: Tytler, 1915b: 122.
Sighting locality: 2, 4, 19, 22, 26, 32, 68.

279. *Prosotas dubiosa indica* (Evans, [1925]) *
Published records: Varshney & Smetacek, 2015: 129.
Sighting locality: 2, 4, 19, 32, 60, 72.

280. *Prosotas nora nora* (C. Felder, 1860) *
Published records: Varshney & Smetacek, 2015: 129.
Sighting locality: 4, 21, 76.

281. *Prosotas noreia hampsonii* (de Nicéville, 1885)
Published records: Varshney & Smetacek, 2015: 130.
Remarks: Not recorded during the study.

282. *Prosotas pia marginata* Tite, 1963
Published records: Varshney & Smetacek, 2015: 130.
Remarks: Not recorded during the study.

283. *Prosotas lutea sivoka* (Evans, 1910) *
Published records: Varshney & Smetacek, 2015: 129.
Sighting locality: 19, 77.

Ionolyce Toxopeus, 1829

284. *Ionolyce helicon merguiana* (Moore, 1884) *
Published records: Varshney & Smetacek, 2015: 130.
Sighting locality: 70, 76.

Caleta Fruhstorfer, 1922

285. *Caleta decidia decidia* (Hewitson, 1876) *
Published records: Varshney & Smetacek, 2015: 131.
Sighting locality: 70, 77.

286. *Caleta elna noliteia* (Fruhstorfer, 1918) *
Published records: Varshney & Smetacek, 2015: 131.
Sighting locality: 4, 60, 72

287. *Caleta roxus roxana* (de Niceville,1897) *
Published records: Tytler, 1915b: 122; Van Gasse, 2013; Varshney & Smetacek, 2015: 131.
Sighting locality: 39.

Discolampa Toxopeus, 1929

288. *Discolampa ethion ethion* (Westwood, 1851) *
Published records: Varshney & Smetacek, 2015: 131.
Sighting locality: 59.

Jamides Huebner, [1819]

289. *Jamides alecto alocina* Swinhoe, 1915*
Published records: Varshney & Smetacek, 2015: 132.
Sighting locality: 27, 32.

290. *Jamides bochus bochus* (Stoll, [1882]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 132.
Sighting locality: 53, 68.

291. *Jamides caeruleus* (Druce, 1873) *#

Sighting locality: 70, 71.

292. *Jamides celeno aelianus* (Fabricius, 1783) *
Published records: Varshney & Smetacek, 2015: 132.
Sighting locality: 32, 72.

293. *Jamides elpis croculana* (Fruhstorfer, 1915) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 133.
Sighting locality: 2, 4, 60, 64, 77, 78.

294. *Jamides pura pura* (Moore,1886) *
Published records: Varshney & Smetacek, 2015: 133.
Sighting locality: 2, 4, 19, 27, 32, 60, 77.

Catochrysops Boisduval, 1832

295. *Catochrysops panormus exiguus* (Distant, 1886) *
Published records: Varshney & Smetacek, 2015: 133.
Sighting locality: 4, 22, 60, 77, 79.

296. *Catochrysops strabo strabo* (Fabricius, 1793) *
Published records: Varshney & Smetacek, 2015: 133.
Sighting locality: 2, 4, 19, 20, 27, 58, 63, 72.

Lampides Huebner, [1819]

297. *Lampides boeticus* (Linnaeus, 1767) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 133.
Sighting locality: 4, 21, 51, 58, 60, 64,

Leptotes Scudder, 1876

298. *Leptotes plinius* (Fabricius, 1793) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 134.
Sighting locality: 4, 60, 76.

Castalius Huebner, [1819]

299. *Castalius rosimon rosimon* (Fabricius, 1775) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 134.
Sighting locality: 68.

Tarucus Moore, [1881]

300. *Tarucus venosus* Moore,1882 *#
Sighting locality: 72, 71, 77.

301. *Tarucus ananda* (de Niceville, [1884]) *
Published records: Varshney & Smetacek, 2015: 134.
Sighting locality: 59, 70.

302. *Tarucus waterstradti dharta* Bethune–Baker, 1918 *
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 134.
Sighting locality: 67.

Zizeeria Chapman, 1910

303. *Zizeeria karsandra* (Moore, 1865) *
Published records: Varshney & Smetacek, 2015: 135.
Sighting locality: 19, 69, 77.

Pseudozizeeria Beuret, 1955

304. *Pseudozizeeria maha maha* (Kollar, [1844]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 135.
Sighting locality: 2, 4, 32, 68.

Zizina Chapman 1910

305. *Zizina otis sangra* (Moore, [1866]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 135.
Sighting locality: 2, 4, 32, 60, 63, 76.

Zizula Chapman, 1910

306. *Zizula hylax* (Fabricius, 1775) *
Published records: Varshney & Smetacek, 2015: 135.
Sighting locality: 65, 27, 49.

Everes Huebner, [1819]

307. *Everes argiades diporides* Chapman, 1909 *
Published records: Tytler, 1915b: 122; Van Gasse, 2013; Varshney & Smetacek, 2015: 136.
Sighting locality: 2, 4, 68.

308. *Everes huegelii dipora* (Moore, 1865) *#
Sighting locality: 23.

309. *Everes lacturnus assamica* Tytler, 1915 *
Published records: Tytler, 1915b: 122; Varshney & Smetacek, 2015: 136.
Sighting locality: 4, 68.

Tongeia Tutt, [1908]

310. *Tongeia kala* (de Nicéville, 1890)
Published records: Tytler, 1915b: 123; Van Gasse, 2013; Varshney & Smetacek, 2015: 137.
Remarks: Not recorded during the study.

Talicada Moore, [1881]

311. *Talicada nyseus nyseus* (Guerin-Meneville, 1843) *#
Sighting locality: 32, 63.

Pithecops Horsfield, [1828]

312. *Pithecops fulgens fulgens* Doherty, 1889
Published records: Tytler, 1915b: 120; Van Gasse, 2013; Varshney & Smetacek, 2015: 138.
Remarks: Not recorded during the study.

313. *Pithecops corvus corvus* Fruhstorfer, 1919 *
Published records: Varshney & Smetacek, 2015:138.
Sighting locality: 63, 77.

Euchrysops Butler, 1900

314. *Euchrysops cnejus* (Fabricius, 1798) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 142.
Sighting locality: 9, 19, 21.

Neopithecops Distant, 1884

315. *Neopithecops zalmora zalmora* (Butler, [1870]) *
Published records: Varshney & Smetacek, 2015: 138.
Sighting locality: 32, 68.

Megisba Moore, [1881]

316. *Megisba malaya* (Horsfield, [1828]) *
Published records: Varshney & Smetacek, 2015: 139.
Sighting locality: 3, 68.

Celastrina Tutt, 1906

317. *Celastrina argiolus iynteana* (de Niceville, 1884) *
Published records: Varshney & Smetacek, 2015: 139.
Sighting locality: 77, 78, 79.

318. *Celastrina hugelii oreoides* (Evans 1925) *
Published records: Varshney & Smetacek, 2015: 139.
Sighting locality: 20, 77.

319. *Celastrina lavendularis limbata* (Moore, 1879) *
Published records: Varshney & Smetacek, 2015: 140.
Sighting locality: 77.

Notarthrinus Chapman, 1908

320. *Notarthrinus binghami* Chapman, 1908
Published records: Tytler, 1915b: 121; Van Gasse, 2013; Varshney & Smetacek, 2015: 140.
Remarks: Not recorded during the study.

Acytolepis Toxopeus, 1927

321. *Acytolepis puspa gisca* (Fruhstorfer, 1910) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 141.
Sighting locality: 19, 71.

Monodontides Toxopeus, 1927

322. *Monodontides musina musinoides* (Swinhoe, 1910) *
Published records: Tytler, 1915b: 120; Van Gasse, 2013; Varshney & Smetacek, 2015: 142.
Sighting locality: 60, 77, 78.

Udara Toxopeus, 1928

323. *Udara albocaerulea albocaerulea* (Moore, 1879) *
Published records: Varshney & Smetacek, 2015: 142.
Sighting locality: 4, 7, 60, 64, 80.

324. *Udara dilecta dilecta* (Moore, 1879) *
Published records: Varshney & Smetacek, 2015: 142.
Sighting locality: 4, 7, 68.

325. *Udara placidula howarthi* (Cantlie & Norman, 1960)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 142.
Remarks: Not recorded during the study.

Phengaris Doherty, 1891

326. *Phengaris atroguttata* (Oberthür, 1876)
Published records: Tytler, 1915b: 122.
Remarks: Not recorded during the study.

Chilades Moore, 1881

327. *Chilades lajus lajus* (Stoll, [1780]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 143.
Sighting locality: 19, 25, 32.

Luthrodes Druce, 1895

328. *Luthrodes pandava* (Horsfield, [1829]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 143.
Sighting locality: 2, 4, 68.

Freyeria Courvoisier, 1920

329. *Freyeria putli* (Kollar, [1844])
Published records: Varshney & Smetacek, 2015: 143.
Remarks: Not recorded during the study.

330. *Freyeria trochylus* (Freyer, 1845)
Published records: Varshney & Smetacek, 2015: 143.
Remarks: Not recorded during the study.

Callenya Eliot & Kawazoé, 1983

331. *Callenya melaena melaena* (Doherty, 1889) *
Published records: Tytler, 1915b: 121; Van Gasse, 2013; Varshney & Smetacek, 2015:141.
Sighting locality: 59, 72.

Lestranicus Eliot and Kawazoe, 1983

332. *Lestranicus transpectus* (Moore, 1879) *#
Sighting locality: 1, 2, 60, 77.

Celatoxia Eliot and Kawazoe, 1983

333. *Celatoxia marginata marginata* (de Niceville, 1884) *
Published records: Varshney & Smetacek, 2015: 140.
Sighting locality: 37, 46.

Family Nymphalidae Rafinesque, 1815

Subfamily Libytheinae Boisduval, 1833

Libythea Fabricius, 1807

334. *Libythea myrrha sanguinalis* Fruhstorfer,1898 *
Published records: Varshney & Smetacek, 2015: 223.
Sighting locality: 4, 32.

Subfamily Danainae Boisduval, 1833

Tribe Danaini Boisduval, 1833

Parantica Moore, [1880]

335. *Parantica aglea melanoides* Moore,1883 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 150.
Sighting locality: 4, 68.

336. *Parantica melaneus plataniston* (Fruhstofer,1910) *
Published records: Butler, 1885; Talbot, 1947: 44; Varshney & Smetacek, 2015: 150.
Sighting locality: 30, 76.

337. *Parantica sita sita* (Kollar, [1844]) *
Published records: Varshney & Smetacek, 2015: 150.
Sighting locality: 4, 22, 37, 71, 68.

Tirumala Moore, [1880]

338. *Tirumala limniace exotica* (Gmelin, 1790) *
Published records: Talbot, 1947: 31; Singh *et al*., 2011; Varshney & Smetacek, 2015: 151.
Sighting locality: 22, 27, 80.

339. *Tirumala septentrionis septentrionis* (Butler, 1874) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 151.
Sighting locality: 29, 71.

Danaus Kluk, 1780
340. *Danaus chrysippus chrysippus* (Linnaeus, 1758) *
Published records: Talbot, 1947: 20; Singh *et al*., 2011; Varshney & Smetacek, 2015: 149.
Sighting locality: 2, 22, 47, 59, 60, 77.
341. *Danaus genutia genutia* (Cramer, [1779]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 149.
Sighting locality: 2, 23, 32, 55, 59, 63, 77.

Euploea Fabricius, 1807
342. *Euploea mulciber mulciber* (Cramer, [1777]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015
Sighting locality: 55, 80.
343. *Euploea core godartii* Lucas, 1853 *
Published records: Talbot, 1947: 70; Singh *et al*., 2011; Van Gasse, 2013; Varshney & Smetacek, 2015: 152.
Sighting locality: 4, 70, 55, 68.
344. *Euploea algea deione* Westwood, 1848
Published records: Tytler, 1939: 243; Talbot, 1947: 75.
Remarks: Not recorded during the study.
345. *Euploea radamanthus radamanthus* (Fabricius, 1793) *#
Sighting locality: 20, 63, 76.
346. *Euploea doubledayi* C. & R. Felder, [1865]
Published records: Varshney & Smetacek, 2015: 152.
Remarks: Not recorded during the study.
347. *Euploea sylvester* (Fabricius, 1793)
Published records: Varshney & Smetacek, 2015: 153.
Remarks: Not recorded during the study.
348. *Euploea klugii* Moore, [1858]
Published records: Moore, 1890: 117; Varshney & Smetacek, 2015: 153.
Remarks: Not recorded during the study.

Subfamily Charaxinae Guenée, 1865

Tribe Charaxini Guenee, 1865

Charaxes Ochsenheimer, 1816
349. *Charaxes aristogiton* C. & R. Felder, [1867]
Published records: Varshney & Smetacek, 2015: 156.
Remarks: Not recorded during the study.
350. *Charaxes athamas athamas* (Drury, [1773]) *
Published records: Butler, 1885; Smiles, 1982: 166–167; Gupta, 2004: 568; Varshney & Smetacek, 2015: 155.
Sighting locality: 20, 22, 32.
351. *Charaxes arja* (C. & R. Felder, [1867]) *
Published records: Smiles, 1982: 176–177; Gupta, 2004: 569; Varshney & Smetacek, 2015: 155.
Sighting locality: 4, 71, 60, 80.
352. *Charaxes bernardus hierax* C. & R. Felder, [1867] *

Published records: Gupta, 2004: 568; Singh *et al*., 2011; Varshney & Smetacek, 2015: 157.
Sighting locality: 72.

353. *Charaxes delphis delphis* (Doubleday, 1843) *
Published records: Smiles, 1982; 190–191; Gupta, 2004: 569; Varshney & Smetacek, 2015: 155.
Sighting locality: 32.

354. *Charaxes dolon magniplaga* (Fruhstorfer, 1904)
Published records: Smiles, 1982: 209; Gupta, 2004: 569; Varshney & Smetacek, 2015: 155.
Sighting locality: 7.

355. *Charaxes eudamippus eudamippus* (Doubleday, 1843)
Published records: Tytler, 1940:109; Smiles, 1982: 199–200; Gupta, 2004: 569.
Remarks: Not recorded during the study.

356. *Charaxes moori sandakana* (Fruhstorfer, 1895) *
Published records: Varshney & Smetacek, 2015: 155.
Sighting locality: 37.

357. *Charaxes kahruba* (Moore, [1895]) *
Published records: Varshney & Smetacek, 2015: 157.
Sighting locality: 60, 72.

358. *Charaxes marmax marmax* Westwood, 1847 *
Published records: Varshney & Smetacek, 2015: 157.
Sighting locality: 68.

359. *Charaxes schreiber* (Godart, [1824])
Published records: Varshney & Smetacek, 2015: 156.
Remarks: Not recorded during the study.

360. *Charaxes solon* (Fabricius, 1793)
Published records: Varshney & Smetacek, 2015: 157.
Remarks: Not recorded during the study.

Tribe Prothoini Roepke, 1938

Prothoe Hübner, [1824]

361. *Prothoe franck regalis* Butler, 1885
Published records: Butler, 1885; Moore, 1899: 126; Bingham, 1905: 382; Gupta, 2004: 567; Varshney & Smetacek, 2015: 154.
Remarks: Not recorded during the study.

Subfamily Satyrinae Boisduval, 1833

Tribe Amathusiini Moore, 1894

Faunis Hübner, [1819]

362. *Faunis canens arcesilas* Stichel, 1933*
Published records: Varshney & Smetacek, 2015: 158.
Sighting locality: 60, 76.

Aemona Hewitson, 1868

363. *Aemona amathusia amathusia* (Hewitson, 1867) *
Published records: Tytler, 1939: 250; Talbot, 1947: 413; Gupta, 2004: 542; Varshney & Smetacek, 2015: 158.
Sighting locality: 60, 63, 64, 76, 77, 79.

Enispe Doubleday, [1848]

364. *Enispe intermedia intermedia* Rothschild, 1916
Published records: Tytler, 1914; Van Gasse, 2013; Varshney & Smetacek, 2015: 160.
Remarks: Not recorded during the study.

365. *Enispe euthymius euthymius* (Doubleday, 1845) *
Published records: Tytler, 1914; Talbot, 1947: 460; Gupta, 2004: 545; Varshney & Smetacek, 2015: 160.
Sighting locality: 17, 20, 77, 79.

366. *Enispe cycnus* Westwood, [1851]
Published records: Varshney & Smetacek, 2015: 160.
Remarks: Not recorded during the study.

Discophora Boisduval, [1836]

367. *Discophora sondaica zal* Westwood, 1851 *
Published records: Gupta, 2004: 545; Varshney & Smetacek, 2015: 159.
Sighting locality: 77.

368. *Discophora deo deo* de Nicéville, 1898
Published records: Tytler, 1939: 252; Evans, 1932; Talbot, 1947: 451; Gupta, 2004: 545; Van Gasse, 2013; Varshney & Smetacek, 2015: 159.
Remarks: Not recorded during the study.

369. *Discophora timora* Westwood, [1850]
Published records: Varshney & Smetacek, 2015: 159.
Remarks: Not recorded during the study.

Amathuxidia Staudinger, [1887]

370. *Amathuxidia amythaon* (Doubleday, 1847)
Published records: Varshney & Smetacek, 2015: 158.
Remarks: Not recorded during the study.

Thaumantis Hübner, [1826]

371. *Thaumantis diores diores* Doubleday, 1845 *
Published records: Butler, 1885; Talbot, 1947: 427; Gupta, 2004: 544; Varshney & Smetacek, 2015: 159.
Sighting locality: 2, 4, 26, 27, 32, 68.

Thauria Moore, 1894

372. *Thauria aliris amplifascia* Rothschild, 1916
Published records: Talbot, 1947: 431; Gupta, 2004: 544; Varshney & Smetacek, 2015: 159.
Remarks: Not recorded during the study.

373. *Thauria lathyi* (Fruhstorfer, 1902)
Published records: Tytler, 1914; Evans, 1932; Gupta, 2004: 544; Van Gasse, 2013; Varshney & Smetacek, 2015: 159.
Remarks: Not recorded during the study.

Stichophthalma C. and R. Felder, 1862

374. *Stichophthalma camadeva nagaensis* Rothschild, 1916 *
Published records: Moore, 1883: 203; Talbot, 1947: 420; Gupta, 2004: 543; Van Gasse, 2013; Varshney & Smetacek, 2015: 158.
Sighting locality: 77.

375. *Stichophthalma sparta tytleri* Rothschild, 1918
Published records: Moore, 1883: 218; Bingham, 1905: 193; Tytler, 1914; Talbot, 1947: 422; Gupta, 2004: 543; Van Gasse, 2013; Varshney & Smetacek, 2015: 158.
Remarks: Not recorded during the study.

376. *Stichophthalma nourmahal nourmahal* (Westwood, 1851)

Published records: Tytler, 1914; Gupta, 2004: 543; Varshney & Smetacek, 2015: 158.
Remarks: Not recorded during the study.

Tribe Elymniini Herrich–Schaeffer, 1864

Elymnias Huebner, 1818

377. *Elymnias hypermnestra undularis* (Drury,1773) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 161.
Sighting locality: 77, 78.

378. *Elymnias malelas malelas* (Hewitson,1863) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 161.
Sighting locality: 22, 30, 32, 68.

379. *Elymnias vasudeva deva* (Moore, 1893) *
Published records: Varshney & Smetacek, 2015: 162.
Sighting locality: 4, 60, 80.

380. *Elymnias nesaea* (Linnaeus, 1764)
Published records: Varshney & Smetacek, 2015: 161.
Remarks: Not recorded during the study.

381. *Elymnias patna* (Westwood, [1851])
Published records: Varshney & Smetacek, 2015: 161.
Remarks: Not recorded during the study.

382. *Elymnias penanga chelensis* de Nicéville, 1890
Published records: Talbot, 1947: 399; Van Gasse, 2013; Varshney & Smetacek, 2015.
Remarks: Not recorded during the study.

383. *Elymnias peali* Wood–Mason, 1883
Published records: Talbot, 1947: 392; Varshney & Smetacek, 2015: 161.
Remarks: Not recorded during the study.

Tribe Melanitini Reuter, 1896

Cyllogenes Butler, 1868

384. *Cyllogenes janetae fascialata* Smiles, 1973
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 163.
Remarks: Not recorded during the study.

Melanitis Fabricius, 1807

385. *Melanitis leda leda* (Linnaeus, 1758) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 162.
Sighting locality:4, 17, 19, 20, 21, 71, 60, 64, 80.

386. *Melanitis phedima bela* Moore, 1857 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 163.
Sighting locality: 2, 4, 32, 47, 60, 64, 77.

387. *Melanitis zitenius zitenius* (Herbst, 1796) *
Published records: Talbot, 1947: 374; Singh *et al*., 2011; Varshney & Smetacek, 2015: 163.
Sighting locality: 2, 4, 32.

Tribe Zetherini Reuter, 1896

Penthema Doubleday, [1848]

388. *Penthema lisarda lisarda* (Doubleday, 1845)

Published records: Tytler, 1940: 111; Gupta, 2004: 546; Varshney & Smetacek, 2015: 162.
Remarks: Not recorded during the study.

Ethope Moore, [1866]

389. *Ethope himachala* (Moore, 1857) *
Published records: Varshney & Smetacek, 2015: 162.
Sighting locality: 2, 4, 60, 72.

Neorina Westwood, [1850]

390. *Neorina hilda* Westwood, [1851]
Published records: Varshney & Smetacek, 2015: 162.
Remarks: Not recorded during the study.

391. *Neorina patria* Leech, 1891
Published records: Varshney & Smetacek, 2015: 162.
Remarks: Not recorded during the study.

Tribe Satyrini Boisduval, 1833

Orinoma Gray, 1846

392. *Orinoma damaris* Gray, 1846
Published records: Varshney & Smetacek, 2015: 171.
Remarks: Not recorded during the study.

Rhaphicera Butler, 1867

393. *Rhaphicera satricus kabrua* Tytler, 1939
Published records: Talbot, 1947: 249; Van Gasse, 2013; Varshney & Smetacek, 2015: 171.
Remarks: Not recorded during the study.

Lethe Hübner, [1819]

394. *Lethe bhairava* (Moore, [1858])
Published records: Varshney & Smetacek, 2015: 164.
Remarks: Not recorded during the study.

395. *Lethe chandica chandica* (Moore, [1858]) *
Published records: Moore, 1890: 247; Singh *et al*., 2011; Varshney & Smetacek, 2015: 164.
Sighting locality: 32.

396. *Lethe confusa confusa* Aurivillius,1898 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 164.
Sighting locality: 4, 20, 63, 78.

397. *Lethe distans* Butler, 1870 *#
Sighting locality: 4, 72.

398. *Lethe dura gammiei* (Moore, [1892]) *#
Sighting locality: 80.

399. *Lethe europa niladana* Fruhstorfer, 1911 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 165.
Sighting locality: 2, 4, 68.

400. *Lethe gemina gafuri* (Tytler, 1914)
Published records: Tytler, 1914: 218.
Remarks: Not recorded during the study.

401. *Lethe goalpara kabruensis* Tytler, 1939
Published records: Tytler, 1939: 246; Talbot, 1947: 186; Van Gasse, 2013; Varshney & Smetacek, 2015: 165.

Remarks: Not recorded during the study.

402. *Lethe hyrania dinarbas* (Hewitson, 1863) *
Published records: Varshney & Smetacek, 2015: 166.
Sighting locality: 68.
Remarks: The species *hyrania* (Kollar, 1844) was resuscitated and synonymized with *Lethe insana* (Lang & Lamas, 2016).

403. *Lethe kabrua* (Tytler, 1914)
Published records: Tytler, 1914: 222; Talbot, 1947: 182; Varshney & Smetacek, 2015: 166.
Remarks: Not recorded during the study.

404. *Lethe kansa* (Moore, [1858])
Published records: Moore, 1890: 241; Bingham, 1905: 92; Varshney & Smetacek, 2015: 166.
Remarks: Not recorded during the study.

405. *Lethe kanjupkula* Tytler, 1914 *
Published records: Tytler, 1914: 220; Talbot, 1947: 177; Van Gasse, 2013; Varshney & Smetacek, 2015: 166.
Sighting locality: 51, 60.

406. *Lethe latiaris latiaris* (Hewitson, 1862) *#
Sighting locality: 74, 77.

407. *Lethe mekara zuchara* Fruhstorfer, 1911*
Published records: Varshney & Smetacek, 2015: 167.
Sighting locality: 60, 80.

408. *Lethe naga naga* Doherty, 1889
Published records: Tytler, 1914: 219; Talbot, 1947: 214; Varshney & Smetacek, 2015: 167.
Remarks: Not recorded during the study.

409. *Lethe nicetas* (Hewitson, 1863)
Published records: Tytler, 1914: 222; Talbot, 1947: 179.
Remarks: Not recorded during the study.

410. *Lethe rohria rohria* Frbricius, 1787 *
Published records: Varshney & Smetacek, 2015: 168.
Sighting locality: 72, 53, 68.

411. *Lethe satyavati* de Nicéville, 1881
Published records: Tytler, 1914: 220; Talbot, 1947: 210; Van Gasse, 2013; Varshney & Smetacek, 2015: 168.
Remarks: Not recorded during the study.

412. *Lethe scanda* (Moore, 1857) *
Published records: Varshney & Smetacek, 2015:168.
Sighting locality: 41.

413. *Lethe serbonis naganum* Tytler, 1914
Published records: Tytler, 1914: 219; Talbot, 1947: 221; Varshney & Smetacek, 2015: 168.
Remarks: Not recorded during the study.

414. *Lethe siderea* Marshall, 1881 *
Published records: Tytler, 1914: 220; Talbot, 1947: 171; Van Gasse, 2013.
Sighting locality: 71, 74, 60, 72.

415. *Lethe sidonis* (Hewitson, 1863) *
Published records: Talbot, 1947: 172; Varshney & Smetacek, 2015: 168.
Sighting locality: 68.

416. *Lethe sinorix sinorix* (Hewitson, 1863) *
Published records: Varshney & Smetacek, 2015: 168.
Sighting locality: 2, 32.

417. *Lethe sura* (Doubleday, [1849]) *#
Sighting locality: 4, 68.

418. *Lethe tristigmata* Elwes, 1887

Published records: Talbot, 1947: 181; Van Gasse, 2013.
Remarks: Not recorded during the study.

419. *Lethe verma sintica* Fruhstrofer, 1911 *
Published records: Talbot, 1947: 230; Singh *et al*., 2011; Varshney & Smetacek, 2015: 169.
Sighting locality: 77.

420. *Lethe vindhya* (C. & R. Felder, 1859)
Published records: Varshney & Smetacek, 2015: 169.
Remarks: Not recorded during the study.

421. *Lethe visrava* (Moore, [1866]) *
Published records: Tytler, 1914: 222; Talbot, 1947: 170; Van Gasse, 2013.
Sighting locality: 68.

Neope Moore, [1866]

422. *Neope armandii khasiana* Moore, 1881 *
Published records: Tytler, 1914: 222; Talbot, 1947: 234; Van Gasse, 2013; Varshney & Smetacek, 2015: 169.
Sighting locality: 64, 80.

423. *Neope bhadra* (Moore, 1857) *
Published records: Varshney & Smetacek, 2015: 170.
Sighting locality: 31.

424. *Neope pulaha* (Moore, [1858]) *#
Sighting locality: 4, 19, 30, 32.

425. *Neope pulahina* (Evans, 1923) *
Published records: Talbot, 1947: 234; Van Gasse, 2013; Varshney & Smetacek, 2015: 170.
Sighting locality: 80, 64, 76.

426. *Neope yama yama* (Moore, [1858]) *#
Sighting locality: 80.

Telinga Moore, 1880

427. *Telinga malsara* (Moore, 1857) *
Published records: Moore, 1890: 205; Talbot, 1947: 157; Varshney & Smetacek, 2015: 171.
Sighting locality: 60, 77.

Mycalesis Huebner, 1818

428. *Mycalesis anaxias aemate* Fruhstorfer, 1911 *
Published records: Talbot, 1947: 119; Varshney & Smetacek, 2015: 172.
Sighting locality: 53, 68.

429. *Mycalesis adamsoni* (Watson, 1897)
Published records: Tytler, 1914: 223; Talbot, 1947: 118; Van Gasse, 2013; Varshney & Smetacek, 2015: 172.
Remarks: Not recorded during the study.

430. *Mycalesis evansii* Tytler, 1914
Published records: Tytler, 1914: 224; Talbot, 1947: 146; Varshney & Smetacek, 2015: 172.
Remarks: Not recorded during the study.

431. *Mycalesis francisca albofasciata* (Tytler, 1914) *
Published records: Tytler, 1914: 224; Van Gasse, 2013; Varshney & Smetacek, 2015: 172.
Sighting locality: 4, 68.

432. *Mycalesis gotama charaka* Moore, [1857] *
Published records: Varshney & Smetacek, 2015: 173.
Sighting locality: 41.

433. *Mycalesis lepcha kohimensis* Tytler, 1914
Published records: Tytler, 1914: 226; Talbot, 1947: 161; Van Gasse, 2013; Varshney & Smetacek,

2015: 173.
Remarks: Not recorded during the study.

434. *Mycalesis malsarida* Butler, 1868
Published records: Varshney & Smetacek, 2015: 173.
Remarks: Not recorded during the study.

435. *Mycalesis misenus* de Nicéville, 1889
Published records: Tytler, 1914: 225; Talbot, 1947: 156.
Remarks: Not recorded during the study.

436. *Mycalesis mnasicles perna* Fruhstorfer, 1906
Published records: Tytler, 1914: 226; Talbot, 1947: 151; Van Gasse, 2013; Varshney & Smetacek, 2015: 174.
Remarks: Not recorded during the study.

437. *Mycalesis mystes* de Nicéville, 1891
Published records: Tytler, 1914: 227; Talbot, 1947: 149; Varshney & Smetacek, 2015: 174.
Remarks: Not recorded during the study.

438. *Mycalesis intermedia* (Moore, [1892]) *#
Published records: Evans, 1920.
Sighting locality: 4, 68.

439. *Mycalesis mestra mestra* Hewitson, 1862 *
Published records: Varshney & Smetacek, 2015: 174.
Sighting locality: 4, 27, 60, 71.

440. *Mycalesis mineus mineus* (Linnaeus, 1758) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 174.
Sighting locality: 1, 76.

441. *Mycalesis perseus blasius* (Fabricius, 1798) *
Published records: Moore, 1890: 174; Singh *et al*., 2011; Varshney & Smetacek, 2015: 175.
Sighting locality: 2, 4, 17, 19, 30, 32, 60, 71.

442. *Mycalesis suaveolens sebonga* Tytler, 1926
Published records: Tytler, 1926: 259; Talbot, 1947: 152; Varshney & Smetacek, 2015: 175.
Remarks: Not recorded during the study.

443. *Mycalesis visala visala* Moore, [1855] *
Published records: Varshney & Smetacek, 2015: 176.
Sighting locality: 2, 4, 17, 32, 68.

Erites Westwood, [1851]

444. *Erites falcipennis falcipennis* Wood Mason & de Niceville, 1883
Published records: Varshney & Smetacek, 2015: 176.
Remarks: Not recorded during the study.

Orsotriaena Wallengren, 1858

445. *Orsotriaena medus medus* (Fabricius, 1775) *
Published records: Varshney & Smetacek, 2015: 176.
Sighting locality: 64, 79.

Zipaetis Hewitson, 1863

446. *Zipaetis scylax* Hewitson, 1863 *#
Sighting locality: 60, 77.

Ragadia Westwood, [1851]

447. *Ragadia crisilda crito* de Niceville, 1890 *
Published records: Talbot, 1947: 356; Varshney & Smetacek, 2015: 177.
Sighting locality: 77.

Aulocera Butler, 1867

448. *Aulocera loha japroa* Tytler, 1939
Published records: Tytler, 1939: 247; Van Gasse, 2013.
Remarks: Not recorded during the study.

Ypthima Huebner, 1818

449. *Ypthima asterope* (Klug, 1832) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 180.
Sighting locality: 1, 11, 20, 32, 53, 69.

450. *Ypthima affectata* Elwes & Edwards, 1893
Published records: Varshney & Smetacek, 2015: 180.
Remarks: Not recorded during the study.

451. *Ypthima atra* Cantlie & Norman, 1959
Published records: Uemura & Monastyrskii, 2004: 21; Van Gasse, 2013; Varshney & Smetacek, 2015: 181.
Remarks: Not recorded during the study.

452. *Ypthima baldus baldus* (Fabricius, 1775) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 181.
Sighting locality: 21, 77, 78, 80.

453. *Ypthima dohertyi khasia* Eliot, 1967
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 181.
Remarks: Not recorded during the study.

454. *Ypthima huebneri huebneri* Kirby, 1871 *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 182.
Sighting locality: 21, 77, 78.

455. *Ypthima lisandra* (Cramer, [1780])
Published records: Varshney & Smetacek, 2015: 182.
Remarks: Not recorded during the study.

456. *Ypthima methora* Hewitson, 1865
Published records: Bingham, 1905: 136; Varshney & Smetacek, 2015: 183.
Remarks: Not recorded during the study.

457. *Ypthima nareda* (Kollar, [1844]) *
Published records: Butler, 1885: 302.
Sighting locality: 68.

458. *Ypthima newara newara* Moore,1875 *
Published records: Butler, 1885: 302; Wood–Mason & de Niceville, 1887: 351.
Sighting locality: 4, 68.

459. *Ypthima norma burmana* Evans 1923
Published records: Varshney & Smetacek, 2015: 183.
Remarks: Not recorded during the study.

460. *Ypthima persimilis* Elwes & Edwards, 1893
Published records: Talbot, 1947: 342; Uemura & Monastyrskii, 2004: 21; Van Gasse, 2013; Varshney & Smetacek, 2015: 183.
Remarks: Not recorded during the study.

461. *Ypthima philomela* (Linnaeus, 1763)
Published records: Varshney & Smetacek, 2015: 183.
Remarks: Not recorded during the study.

462. *Ypthima sakra austeni* Moore, 1893 *
Published records: Talbot, 1947: 344; Varshney & Smetacek, 2015: 183.
Sighting locality: 20, 30, 32, 53, 72.

463. *Ypthima savara savara* Grose Smith, 1887 *
Published records: Talbot, 1947: 340; Van Gasse, 2013; Varshney & Smetacek, 2015: 184.

Sighting locality: 72, 77.

464. *Ypthima similis similis* Elwes & Edwards, 1893 *
Published records: Varshney & Smetacek, 2015: 184.
Sighting locality: 72, 63, 77, 78.

465. *Ypthima watsoni* (Moore, [1893])
Published records: Talbot, 1947: 323; Uemura & Monastyrskii, 2004: 40; Van Gasse, 2013; Varshney & Smetacek, 2015: 184.
Remarks: Not recorded during the study.

Callerebia Butler, 1867

466. *Callerebia orixa* Moore,1872 *
Published records: Moore, 1883: 96–97; Tytler, 1939: 247
Sighting locality: 78, 80.

467. *Callerebia suroia* Tytler, 1914 *
Published records: Tytler, 1914: 218–219; Tytler, 1939: 247; Talbot, 1947: 312; Van Gasse, 2013; Varshney & Smetacek, 2015: 178; Irungbam *et al.,* 2017a.
Sighting locality: 77, 78.

Subfamily Calinaginae Moore, 1895

Calinaga Moore, 1857

468. *Calinaga buddha brahma* Butler, 1885 *
Published records: Moore, 1901: 47–48; Bingham, 1905: 466; Varshney & Smetacek, 2015: 154.
Sighting locality: 77, 80.

Subfamily Heliconiinae Swainson, 1822

Tribe Acraeini Boisduval, 1833

Acraea Fabricius, 1807

469. *Acraea issoria issoria* (Huebner,1819) *
Published records: Gupta, 2004; Varshney & Smetacek, 2015: 222.
Sighting locality: 2, 4, 20, 32, 68.

470. *Acraea violae* (Fabricius, 1793) *
Published records: Gupta, 2004; Varshney & Smetacek, 2015: 222.
Sighting locality: 80.

Cethosia Fabricius, 1807

471. *Cethosia biblis tisamena* Fruhstorfer,1912 *
Published records: Gupta, 2004; Varshney & Smetacek, 2015: 222.
Sighting locality: 1, 4, 12, 13, 20, 22, 33, 69, 46.

472. *Cethosia cyane cyane* (Drury, [1773]) *
Published records: Moore, 1899: 177–179; Gupta, 2004; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 222.
Sighting locality: 22, 71, 46.

Tribe Argynnini Swainson, 1833

Argynnis Fabricius, 1807

473. *Argynnis hyperbius hyperbius* (Linnaeus, 1763) *

Published records: Butler, 1885; Gupta, 2004; Singh *et al*., 2011; Varshney & Smetacek, 2015: 206.
Sighting locality: 4, 51, 68.

474. *Argynnis childreni childreni* Gray,1831 *
Published records: Moore, 1899: 228–230; Gupta, 2004; Van Gasse, 2013.
Sighting locality: 63, 72.

Tribe *Vagrantini* Pinratana & Eliot, 1996

Phalanta Horsfield, [1829]

475. *Phalanta alcippe* (Stoll, [1782])
Published records: Varshney & Smetacek, 2015: 208.
Remarks: Not recorded during the study.

476. *Phalanta phalantha phalantha* (Drury, [1773]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 208.
Sighting locality: 63, 72.

Vindula Hemming, 1934

477. *Vindula erota erota* (Fabricius, 1793) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 209.
Sighting locality: 4, 21, 60, 76.

Cirrochroa Doubleday, [1847]

478. *Cirrochroa aoris aoris* Doubleday, [1847] *
Published records: Tytler, 1915a: 511; Varshney & Smetacek, 2015: 209.
Sighting locality: 68.

479. *Cirrochroa tyche mithila* Moore, 1872 *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 209.
Sighting locality: 39.

Algia Herrich Schaeffer, 1864

480. *Algia fasciata* (C. & R. Felder, 1860) *#
Sighting locality: 51, 63.

Cupha Billberg, 1820

481. *Cupha erymanthis lotis* (Sulzer, 1776) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 208.
Sighting locality: 2, 4, 20, 21, 32, 60, 63, 72.

Vagrans Hemming, 1934

482. *Vagrans egista sinha* (Kollar, [1844]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 209.
Sighting locality: 21, 51, 52, 68.

Subfamily Limenitidinae Behr, 1864

Tribe Parthenini Reuter, 1896

Parthenos Huebner, [1819]

483. *Parthenos sylla gambrisius* (Fabricius, 1787) *
Published records: Bingham, 1905; 288; Gupta, 2004: 559; Varshney & Smetacek, 2015: 200.
Sighting locality: 79.

Tribe Cymothoini Dhungel & Wahlberg, 2018

Bhagadatta Moore, [1898]

484. *Bhagadatta austenia purpurascens* Tytler, 1915 *
Published records: Tytler, 1915a: 508; Gupta, 2004: 559; Varshney & Smetacek, 2015: 199.
Sighting locality: 2, 4, 32, 68.

Tribe Adoliadini Doubleday, 1845

Euthalia Huebner, [1819]

485. *Euthalia aconthea garuda* (Moore, [1858]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 201.
Sighting locality: 4, 32, 71, 60, 76.
486. *Euthalia alpheda* (Godart, [1824])
Published records: Varshney & Smetacek, 2015: 202.
Remarks: Not recorded during the study.
487. *Euthalia anosia anosia* (Moore, [1858]) *
Published records: Varshney & Smetacek, 2015: 202.
Sighting locality: 2, 4, 32, 60, 72.
488. *Euthalia durga splendens* (Tytler, 1915) *
Published records: Tytler, 1915a: 505; Gupta, 2004: 562; Yokochi, 2012: 11; Varshney & Smetacek, 2015: 202.
Sighting locality: 10, 72, 68.
489. *Euthalia evelina derma* (Kollar, 1848) *
Published records: Varshney & Smetacek, 2015: 202.
Sighting locality: 3, 14, 23, 35, 53, 69.
490. *Euthalia franciae* (Gray, 1846) *
Published records: Varshney & Smetacek, 2015: 203.
Sighting locality: 10, 29, 46.
491. *Euthalia japroa* Tytler, 1915
Published records: Tytler, 1915a: 507.
Remarks: Not recorded during the study.
492. *Euthalia jama jama* (Felder, 1932)
Published records: Gupta, 2004: 561.
Remarks: Not recorded during the study.
493. *Euthalia lubentina lubentina* (Cramer, [1777]) *
Published records: Varshney & Smetacek, 2015: 203.
Sighting locality:71.
494. *Euthalia monina kesava* (Moore, 1859) *
Published records: Varshney & Smetacek, 2015: 204.
Sighting locality: 4, 26, 32, 72.
495. *Euthalia nara nara* (Moore, 1859) *
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 204.
Sighting locality: 2, 4, 21, 68.
496. *Euthalia narayana* Grose–Smith & Kirby, 1891
Published records: Tytler, 1940: 115.
Remarks: Not recorded during the study.
497. *Euthalia phemius phemius* (Doubleday, [1848]) *
Published records: Varshney & Smetacek, 2015: 204.
Sighting locality: 4, 72, 71, 60, 72.
498. *Euthalia sahadeva nadaka* Fruhstorfer, 1913 *

Published records: Tytler, 1915a: 506; Tytler, 1940: 115; Van Gasse, 2013.
Sighting locality: 4, 71, 51, 58, 79.

499. *Euthalia iva* Moore, [1858]
Published records: Moore, 1896: 134–135; Tytler, 1915a: 507; Van Gasse, 2013.
Remarks: Not recorded during the study.

500. *Euthalia taooana* Moore, 1879
Published records: Tytler, 1915a: 507; Van Gasse, 2013.
Remarks: Not recorded during the study.

501. *Euthalia curvifascia curvifascia* (Tytler, 1915)
Published records: Tytler, 1915a: 505; Van Gasse, 2013; Varshney & Smetacek, 2015: 202.
Remarks: Not recorded during the study.

502. *Euthalia lengba* Tytler, 1940
Published records: Tytler, 1940; Varshney & Smetacek, 2015: 203.
Remarks: Not recorded during the study.

503. *Euthalia teuta teuta* (Doubleday, [1848])
Published records: Butler, 1885; Moore, 1896: 60–63; Tytler, 1915; Varshney & Smetacek, 2015: 204.
Remarks: Not recorded during the study.

Tanaecia Butler, [1869]

504. *Tanaecia jahnu* (Moore, [1858])
Published records: Varshney & Smetacek, 2015: 201.
Remarks: Not recorded during the study.

505. *Tanaecia julii appiades* (Ménétriés, 1857) *
Published records: Tytler, 1915a: 507; Van Gasse, 2013; Evans, 1932; Gupta, 2004: 560.
Sighting locality: 2, 4, 32, 51, 58, 68.

506. *Tanaecia lepidea lepidea* (Butler, 1868)
Published records: Gupta, 2004: 561; Varshney & Smetacek, 2015: 200.
Remarks: Not recorded during the study.

507. *Tanaecia cocytus cocytus* (Hewitson, 1876)
Published records: Tytler, 1915a: 507; Gupta, 2004: 561; Van Gasse, 2013; Varshney & Smetacek, 2015: 200.
Remarks: Not recorded during the study.

508. *Tanaecia telchinia telchinia* (Menetries, 1857) *
Published records: Varshney & Smetacek, 2015: 201.
Sighting locality: 21, 22, 26, 27, 74, 76.

Neurosigma Butler, [1869]

509. *Neurosigma siva* (Westwood, [1850])
Published records: Varshney & Smetacek, 2015: 200.
Remarks: Not recorded during the study.

Lexias Boisduval, 1832

510. *Lexias cyanipardus* (Butler, [1869])
Published records: Varshney & Smetacek, 2015: 205.
Remarks: Not recorded during the study.

511. *Lexias pardalis jadeitina* (Fruhstorfer, 1913) *
Published records: Tytler, 1915; Gupta, 2004: 562; Van Gasse, 2013; Varshney & Smetacek, 2015: 205.
Sighting locality: 2, 4, 17, 74, 68.

512. *Lexias dirtea khasiana* (Swinhoe, 1890)
Published records: Butler, 1885; Tytler, 1915a: 505; Gupta, 2004: 561; Van Gasse, 2013; Varshney & Smetacek, 2015: 205.
Remarks: Not recorded during the study.

Abrota Moore, 1857

513. *Abrota ganga* Moore, 1857
Published records: Tytler, 1915a: 505.
Remarks: Not recorded during the study.

Tribe Limenitidini Behr, 1864

Moduza Moore, [1881]

514. *Moduza procris procris* (Cramer, [1777]) *
Published records: Butler, 1885; Moore 1896: 161–163; Gupta, 2004: 556; Varshney & Smetacek, 2015: 198.
Sighting locality: 68.

Athyma Westwood, 1850

515. *Athyma asura asura* Moore, [1858] *
Published records: Varshney & Smetacek, 2015: 196.
Sighting locality: 4, 21, 60, 63, 72.

516. *Athyma cama cama* Moore, [1858] *
Published records: Butler, 1885; Moore, 1896: 200–202; Gupta, 2004: 558; Varshney & Smetacek, 2015: 196.
Sighting locality: 4, 71, 60, 76.

517. *Athyma daraxa daraxa* (Doubleday, [1848]) *
Published records: Gupta, 2004: 559; Varshney & Smetacek, 2015: 199.
Sighting locality: 48.

518. *Athyma kanwa phorkys* (Fruhstorfer, 1913) *
Published records: Varshney & Smetacek, 2015: 196.
Sighting locality: 4, 27, 66.

519. *Athyma larymna siamensis* Fruhstorfer,1906
Published records: Tytler, 1915a: 508; Gupta, 2004: 558; Van Gasse, 2013; Varshney & Smetacek, 2015: 196.
Remarks: Not recorded during the study.

520. *Athyma nefte inara* (Westwood, 1850) *
Published records: Gupta, 2004: 557; Varshney & Smetacek, 2015: 196.
Sighting locality: 2, 4, 32, 72, 53, 60, 78.

521. *Athyma opalina* (Kollar, [1844]) *#
Sighting locality: 60, 77.

522. *Athyma perius perius* (Linnaeus, 1758) *
Published records: Gupta, 2004: 558; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 196.
Sighting locality: 30, 32.

523. *Athyma pravara acutipennis* Fruhstorfer, 1906 *
Published records: Varshney & Smetacek, 2015: 197.
Sighting locality: 32, 62.

524. *Athyma ranga ranga* Moore, [1858] *
Published records: Varshney & Smetacek, 2015: 197.
Sighting locality: 4, 68.

525. *Athyma selenophora selenophora* (Kollar, [1844]) *
Published records: Moore, 1896: 202–204; Gupta, 2004: 557; Varshney & Smetacek, 2015: 197.
Sighting locality: 59, 60, 71.

526. *Athyma whitei* (Tytler, 1940) *
Published records: Tytler, 1940: 117; Gupta, 2004: 557; Varshney & Smetacek, 2015: 197.
Sighting locality: 2, 27, 68.

527. *Athyma zulema* (Doubleday, [1848])
Published records: Varshney & Smetacek, 2015: 199.
Remarks: Not recorded during the study.

Parasarpa Moore, 1898
528. *Parasarpa dudu dudu* (Doubleday, [1848]) *
Published records: Varshney & Smetacek, 2015: 199.
Sighting locality: 4, 53, 68.
529. *Parasarpa zayla* (Doubleday, [1848]) *
Published records: Gupta, 2004: 559; Varshney & Smetacek, 2015: 199.
Sighting locality: 2, 4, 32, 68.

Auzakia Moore, [1898]
530. *Auzakia danava danava* (Moore, [1858]) *
Published records: Varshney & Smetacek, 2015: 199.
Sighting locality: 4, 68.

Tribe *Neptini* Newman, 1870

Lebadea Felder, 1861
531. *Lebadea martha ismene* (Doubleday, [1848]) *
Published records: Gupta, 2004: 560; Van Gasse, 2013; Varshney & Smetacek, 2015: 199.
Sighting locality: 51, 77.

Lasippa Moore, 1898
532. *Lasippa viraja* (Moore, 1872)
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 194.
Remarks: Not recorded during the study.

Pantoporia Huebner, [1819]
533. *Pantoporia hordonia hordonia* (Stoll, [1784]) *
Published records: Butler, 1885; Varshney & Smetacek, 2015: 194.
Sighting locality: 60, 72.
534. *Pantoporia sandaca davidsoni* Eliot, 1969 *
Published records: Varshney & Smetacek, 2015:194.
Sighting locality: 4, 60, 77.
535. *Pantoporia paraka paraka* (Butler, 1879) *#
Sighting locality: 68.

Neptis Fabricius, 1807
536. *Neptis ananta ochracea* Evans 1924 *
Published records: Evans, 1924; Eliot, 1969; Gupta, 2004: 555; Varshney & Smetacek, 2015: 189.
Sighting locality: 7, 77.
537. *Neptis clinia susruta* Moore, 1872 *
Published records: Varshney & Smetacek, 2015:190.
Sighting locality: 7, 19, 22, 28.
538. *Neptis cartica cartica* Moore, 1872
Published records: Tytler, 1940: 118; Varshney & Smetacek, 2015:190.
Remarks: Not recorded during the study.
539. *Neptis cydippe kirbariensis* Tytler, 1915
Published records: Tytler, 1915a: 508.
Remarks: Not recorded during the study.

540. *Neptis harita* Moore, [1875]
Published records: Varshney & Smetacek, 2015: 190.
Remarks: Not recorded during the study.
541. *Neptis hylas kamarupa* Moore, [1875] *
Published records: Evans, 1932; Gupta, 2004: 555; Singh *et al.,* 2011; Varshney & Smetacek, 2015:190.
Sighting locality: 19, 27, 69, 78.
542. *Neptis jumbah jumbah* Moore, [1858] *
Published records: Varshney & Smetacek, 2015:191.
Sighting locality: 77.
543. *Neptis magadha* C. & R. Felder, [1867]
Published records: Varshney & Smetacek, 2015:191.
Remarks: Not recorded during the study.
544. *Neptis miah miah* Moore, 1857 *
Published records: Gupta, 2004: 556; Varshney & Smetacek, 2015: 191.
Sighting locality: 80.
545. *Neptis nata adipala* Moore, 1872 *
Published records: Varshney & Smetacek, 2015:192.
Sighting locality: 19, 76, 80.
546. *Neptis namba namba* Tytler, 1915
Published records: Tytler, 1915a: 510; Gupta, 2004: 556; Van Gasse, 2013; Varshney & Smetacek, 2015: 192.
Remarks: Not recorded during the study.
547. *Neptis narayana nana* de Nicéville, 1888
Published records: Varshney & Smetacek, 2015: 192.
Remarks: Not recorded during the study.
548. *Neptis nemorum phesimensis* Tytler, 1915
Published records: Tytler, 1915a: 508.
Remarks: Not recorded during the study.
549. *Neptis nashona* Swinhoe, 1896
Published records: Varshney & Smetacek, 2015: 192.
Remarks: Not recorded during the study.
550. *Neptis pseudovikasi* (Moore, 1899)
Published records: Varshney & Smetacek, 2015: 193.
Remarks: Not recorded during the study.
551. *Neptis radha* Moore, [1858]
Published records: Varshney & Smetacek, 2015: 193.
Remarks: Not recorded during the study.
552. *Neptis sankara* (Kollar, [1844])
Published records: Varshney & Smetacek, 2015: 193.
Remarks: Not recorded during the study.
553. *Neptis sappho astola* Moore,1872 *
Published records: Gupta, 2004: 555; Varshney & Smetacek, 2015: 193.
Sighting locality: 1, 4, 19, 31, 36.
554. *Neptis soma soma* Moore, 1858 *
Published records: Varshney & Smetacek, 2015: 193.
Sighting locality: 19, 36, 74.
555. *Neptis zaida manipuriensis* Tytler, 1926
Published records: Tytler, 1926; Gupta, 2004: 555; Van Gasse, 2013; Varshney & Smetacek, 2015: 194.
Remarks: Not recorded during the study.

Phaedyma Felder, 1861
556. *Phaedyma columella ophiana* (Moore, 1872) *

Published records: Varshney & Smetacek, 2015: 194.
Sighting locality: 76, 78.

Subfamily Pseudergolinae Jordan, 1898

Pseudergolis C. & R. Felder, [1867]

557. *Pseudergolis wedah wedah* (Kollar, 1848) *
Published records: Gupta, 2004: 554; Varshney & Smetacek, 2015: 215.
Sighting locality: 46, 59, 63, 78.

Dichorragia Butler, [1869]

558. *Dichorragia nesimachus nesimachus* (Doyere, 1840) *
Published records: Varshney & Smetacek, 2015: 215.
Sighting locality: 35, 46, 78.

Stibochiona Butler, [1869]

559. *Stibochiona nicea nicea* (Gray, 1846) *
Published records: Gupta, 2004: 564; Varshney & Smetacek, 2015: 215.
Sighting locality: 19, 20, 22, 32, 35.

Subfamily Biblidinae Boisduval, 1833

Tribe Biblidini Boisduval, 1833

Ariadne Horsfield, [1829]

560. *Ariadne araidna pallidior* (Fruhstorfer, 1899) *
Published records: Varshney & Smetacek, 2015: 210.
Sighting locality: 62, 63, 77.

561. *Ariadne merione tapestrina* (Moore, 1884) *
Published records: Moore, 1901: 20–22; Singh *et al*., 2011; Varshney & Smetacek, 2015: 210.
Sighting locality: 62, 63, 77.

Subfamily Apaturinae Boisduval, 1840

Mimathyma Moore, [1896]

562. *Mimathyma ambica ambica* (Kollar, [1844]) *
Published records: Varshney & Smetacek, 2015.
Sighting locality: 72.

563. *Mimathyma chevana* (Moore, [1866])
Published records: Gupta, 2004: 566; Varshney & Smetacek, 2015.
Remarks: Not recorded during the study.

Chitoria Moore, 1896

564. *Chitoria sordida sordida* (Moore, [1866]) *
Published records: Tytler, 1915a: 502; Gupta, 2004: 566; Van Gasse, 2013; Varshney & Smetacek, 2015: 211.
Sighting locality: 34, 77.

565. *Chitoria ulupi florenciae* (Tytler, 1911)
Published records: Tytler, 1915a: 503; Gupta, 2004: 566; Varshney & Smetacek, 2015: 211.
Remarks: Not recorded during the study.

Dilipa Moore, 1857

566. *Dilipa morgiana* (Westwood, [1850]) *

Published records: Moore, 1896: 12–13; Van Gasse, 2013; Varshney & Smetacek, 2015: 212.

Sighting locality: 4, 60, 72.

Eulaceura Butler, [1872]

567. *Eulaceura manipurensis* (Tytler, 1915)

Published records: Tytler, 1915a: 503.

Remarks: Not recorded during the study.

Rohana Moore, [1880]

568. *Rohana parvata* (Moore, [1858])

Published records: Varshney & Smetacek, 2015: 211.

Remarks: Not recorded during the study.

569. *Rohana parisatis parisatis* (Westwood, 1850) *

Published records: Gupta, 2004: 565; Varshney & Smetacek, 2015: 211.

Sighting locality: 72.

Euripus Doubleday, 1848

570. *Euripus consimilis* (Westwood, [1851])

Published records: Varshney & Smetacek, 2015: 213.

Remarks: Not recorded during the study.

571. *Euripus nyctelius nyctelius* (Doubleday, 1845) *

Published records: Butler, 1885; Varshney & Smetacek, 2015: 213.

Sighting locality: 27, 58, 71.

Helcyra Felder, 1860

572. *Helcyra hemina* Hewitson, 1864

Published records: Varshney & Smetacek, 2015: 212.

Remarks: Not recorded during the study.

Herona Doubleday, [1848]

573. *Herona marathus marathus* Doubleday, [1848] *

Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015.

Sighting locality: 22, 77.

Hestina Westwood, 1850

574. *Hestina persimilis persimilis* (Westwood, [1850]) *

Published records: Varshney & Smetacek, 2015:213.

Sighting locality: 59.

Hestinalis Bryk, 1938

575. *Hestinalis nama nama* (Doubleday, 1844) *

Published records: Gupta, 2004: 566; Varshney & Smetacek, 2015: 214.

Sighting locality: 59.

Sephisa Moore, 1882

576. *Sephisa chandra* (Moore, [1858])

Published records: Gupta, 2004: 566; Varshney & Smetacek, 2015: 212.

Remarks: Not recorded during the study.

Subfamily Cyrestinae Guenée, 1865

Cyrestis Boisduval, 1832

577. *Cyrestis cocles cocles* (Fabricius,1787) *
Published records: Varshney & Smetacek, 2015: 214.
Sighting locality: 63, 77.

578. *Cyrestis thyodamas thyodamas* Boisduval, 1846 *
Published records: Varshney & Smetacek, 2015: 214.
Sighting locality: 51, 63, 77.

Chersonesia Distant, 1883

579. *Chersonesia intermedia intermedia* Martin, 1895 *
Published records: Varshney & Smetacek, 2015.
Sighting locality: 63, 77.

580. *Chersonesia rahrioides* Moore, [1899] *
Published records: Tytler, 1915a: 510; Gupta, 2004: 553; Van Gasse, 2013.
Sighting locality: 63, 77.

581. *Chersonesia risa risa* (Doubleday, 1848) *
Published records: Gupta, 2004: 553; Varshney & Smetacek, 2015.
Sighting locality: 63, 70, 77.

Subfamily Nymphalinae Rafinesque, 1815

Tribe *Incertae sedis*

Doleschallia Felder, 1860

582. *Doleschallia bisaltide indica* Moore,1899 *
Published records: Varshney & Smetacek, 2015: 221.
Sighting locality: 2, 4, 68.

Rhinopalpa C. and R. Felder, 1860

583. *Rhinopalpa polynice birmana* Fruhstorfer, 1898 *
Published records: Varshney & Smetacek, 2015: 221.
Sighting locality: 72.

Tribe Nymphalini Rafinesque, 1815

Araschnia Hübner, [1819]

584. *Araschnia prorsoides dohertyi* (Moore, [1899]) *
Published records: Moore, 1899: 108–110; Bingham, 1905: 375; Evans, 1932; Gupta, 2004: 549; Van Gasse, 2013; Varshney & Smetacek, 2015: 217.
Sighting locality: 70, 71, 77, 78.

Symbrenthia Huebner, [1819]

585. *Symbrenthia brabira doni* Tytler, 1940
Published records: Tytler, 1940: 119; Varshney & Smetacek, 2015: 216.
Remarks: Not recorded during the study.

586. *Symbrenthia hypselis cotanda* Moore, [1874] *
Published records: Gupta, 2004; Varshney & Smetacek, 2015: 217.
Sighting locality: 2, 4, 68.

587. *Symbrenthia lilaea khasiana* Moore, [1874] *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 217.
Sighting locality: 2, 60, 30.
588. *Symbrenthia niphanda* Moore, 1872
Published records: Varshney & Smetacek, 2015: 217.
Remarks: Not recorded during the study.
589. *Symbrenthia silana* de Nicéville, 1885
Published records: Tytler, 1915a: 511; Gupta, 2004; Van Gasse, 2013; Varshney & Smetacek, 2015: 217.
Remarks: Not recorded during the study.

Vanessa Fabricius, 1807
590. *Vanessa cardui* (Linnaeus, 1758) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 2, 4, 9, 32, 60, 72.
591. *Vanessa indica indica* (Herbst, 1794) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 2, 4, 17, 19, 22, 60, 72.

Aglais Dalman, 1816
592. *Aglais caschmirensis aesis* Fruhstorfer, 1912 *
Published records: Irungbam *et al.,* 2017b.
Sighting locality: 1, 3, 4, 8, 10, 19, 20, 68.

Kaniska Moore, 1899
593. *Kaniska canace canace* (Linnaeus, 1763) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 218.
Sighting locality: 4, 60, 78.

Tribe Junoniini Reuter,1896

Junonia Huebner, [1819]
594. *Junonia almana almana* (Linnaeus, 1758) *
Published records: Gupta, 2004: 552; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 4, 22, 60, 80.
595. *Junonia atlites* (Linnaeus, 1763) *
Published records: Gupta, 2004: 551; Singh *et al*., 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 7, 22, 60, 72.
596. *Junonia hierta magna* (Evans, 1926) *
Published records: Gupta, 2004: 551; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 4, 53, 60, 79.
597. *Junonia iphita iphita* (Cramer, [1779]) *
Published records: Gupta, 2004: 551; Singh *et al*., 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 4, 20, 21, 68.
598. *Junonia lemonias lemonias* (Linnaeus, 1758) *
Published records: Gupta, 2004: 552; Singh *et al*., 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 2, 4, 17, 32, 68.
599. *Junonia orithya ocyale* Huebner, [1819] *
Published records: Gupta, 2004: 551; Singh *et al*., 2011; Varshney & Smetacek, 2015: 219.
Sighting locality: 60, 76, 77, 78.

Hypolimnas Huebner, [1819]

600. *Hypolimnas bolina jacintha* (Drury,1773) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 220.
Sighting locality: 48.

601. *Hypolimnas misippus* (Linnaeus, 1764) *
Published records: Gupta, 2004:550; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 220.
Sighting locality: 4, 25, 53, 79.

Tribe Kallimini Doherty, 1886

Kallima Doubleday, [1849]

602. *Kallima knyvetti* de Niceville, 1886 *#
Sighting locality: 60, 78.

603. *Kallima inachus inachus* (Boisduval,1846) *
Published records: Varshney & Smetacek, 2015: 221.
Sighting locality: 2, 4, 21, 32, 60, 64, 76.

Family Hesperiidae Latreille, 1809

Subfamily Coeliadinae Evans, 1937

Badamia Moore, [1881]

604. *Badamia exclamationis* (Fabricius, 1775) *
Published records: Varshney & Smetacek, 2015: 23.
Sighting locality: 1, 20,

Bibasis Moore, [1881]

605. *Bibasis mahintha* (Moore, 1875) *
Published records: Tytler, 1915b: 155; Evans, 1949: 52; Chiba, 2009: 15–16; Van Gasse, 2013; Varshney & Smetacek, 2015:23.
Sighting locality: 1, 2, 4, 26, 32, 68.

606. *Bibasis sena sena* (Moore, 1865) *
Published records: Chiba, 2019: 14; Varshney & Smetacek, 2015: 23.
Sighting locality: 1, 2, 3, 4, 17, 19, 20, 21, 26, 32, 68.

Burara Swinhoe, 1893

607. *Burara etelka* (Hewitson, 1867)
Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 23.
Remarks: Not recorded during the study.

608. *Burara gomata gomata* (Moore, [1866]) *
Published records: Varshney & Smetacek, 2015: 23.
Sighting locality: 1, 2, 4, 19, 20, 26, 27, 32, 71, 68.

609. *Burara harisa harisa* (Moore, [1866])
Published records: Tytler, 1915b: 155; Varshney & Smetacek, 2015: 24.
Remarks: Not recorded during the study.

610. *Burara jaina jaina* (Moore, [1866]) *
Published records: Chiba, 2009: 9; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 24.
Sighting locality: 1, 2, 4, 17, 21, 22, 32, 68.

611. *Burara oedipodea belesis* (Mabille, 1876) *
Published records: Varshney & Smetacek, 2015: 24.
Sighting locality: 1, 2, 4, 5, 19, 20, 21, 22, 30, 32, 60, 71.

Hasora Moore, [1881]

612. *Hasora anura anura* de Niceville, 1889 *
Published records: Tytler, 1915b: 155; Evans, 1949: 58; Chiba, 2009: 22; Van Gasse, 2013; Varshney & Smetacek, 2015: 24.
Sighting locality: 1, 2, 4, 17, 20, 73, 77, 78, 79.

613. *Hasora badra badra* (Moore, [1858])
Published records: Tytler, 1915b: 155; Varshney & Smetacek, 2015: 25.
Remarks: Not recorded during the study.

614. *Hasora chromus chromus* (Cramer, [1780]) *
Published records: Chiba, 2009: 24; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 25.
Sighting locality: 1, 2, 4, 32.

615. *Hasora danda* Evans, 1949
Published records: Evans, 1949: 58; Van Gasse, 2013; Varshney & Smetacek, 2015: 25.
Remarks: Not recorded during the study.

616. *Hasora schoenherr gaspa* Evans, 1949
Published records: Tytler, 1915b: 155; Chiba, 2009: 27; Van Gasse, 2013; Varshney & Smetacek, 2015:25.
Remarks: Not recorded during the study.

617. *Hasora taminatus bhavara* Fruhstorfer, 1911 *
Published records: Chiba, 2009: 25; Varshney & Smetacek, 2015: 25.
Sighting locality: 1, 2, 3, 17, 19, 20, 21, 32, 71, 60, 64, 76.

618. *Hasora vitta indica* Evans, 1932 *
Published records: Chiba, 2009: 30; Varshney & Smetacek, 2015: 26.
Sighting locality: 1, 19, 60, 64, 77.

Choaspes Moore, [1881]

619. *Choaspes benjamini japonicus* Murray, 1875*
Published records: Chiba, 2009: 40; Varshney & Smetacek, 2015: 26.
Sighting locality: 1, 2, 4, 19, 32, 60,71.

620. *Choaspes furcatus* Evans, 1932
Published records: Varshney & Smetacek, 2015: 26.
Remarks: Not recorded during the study.

621. *Choaspes stigmatus* Evans, 1932
Published records: Evans, 1949:73; Varshney & Smetacek, 2015: 26.
Remarks: Not recorded during the study.

622. *Choaspes xanthopogon xanthopogon* (Kollar, 1844)
Published records: Evans, 1949: 73; Chiba, 2009: 41; Varshney & Smetacek, 2015: 26.
Remarks: Not recorded during the study.

Subfamily Eudaminae Mabille, 1877

Lobocla Moore, 1884

623. *Lobocla liliana liliana* (Atkinson, 1871) *
Published records: Varshney & Smetacek, 2015: 27.
Sighting locality: 20, 70, 43.

Subfamily Pyrginae Burmeister, 1878

Tribe Tagiadini Mabille, 1878

Capila Moore, [1866]

624. *Capila phanaeus lalita* (Doherty, 1888)
Published records: Tytler, 1915b: 143; Evans, 1949: 85; Van Gasse, 2013; Varshney & Smetacek, 2015: 28.
Remarks: Not recorded during the study.
625. *Capila pieridoides pieridoides* (Moore, 1878)
Published records: Evans, 1949: 87; Van Gasse, 2013; Varshney & Smetacek, 2015: 28.
Remarks: Not recorded during the study.
626. *Capila zennara* (Moore, 1866])
Published records: Tytler, 1915b: 143; Evans, 1949: 87; Van Gasse, 2013; Varshney & Smetacek, 2015: 28.
Remarks: Not recorded during the study.

Odina Mabille, 1891
627. *Odina decoratus* (Hewitson, 1867)
Published records: Tytler, 1915b: 149.
Remarks: Not recorded during the study.

Darpa Moore, [1866]
628. *Darpa striata minta* Evans, 1949
Published records: Evans, 1949:110; Van Gasse, 2013; Varshney & Smetacek, 2015: 28.
Remarks: Not recorded during the study.
629. *Darpa hanria* Moore, [1866]
Published records: Tytler, 1915b: 149.
Remarks: Not recorded during the study.
630. *Darpa pteria dealbata* Distant, 1886
Published records: Tytler, 1915b: 147; Van Gasse, 2013.
Remarks: Not recorded during the study.

Tapena Moore, [1881]
631. *Tapena thwaitesi minuscula* Elwes & Edwards, 1897
Published records: Tytler, 1915b:146; Evans, 1949: 109; Van Gasse, 2013; Varshney & Smetacek, 2015: 28.
Remarks: Not recorded during the study.

Coladenia Moore, [1881]
632. *Coladenia agni* (de Nicéville, [1884])
Published records: Tytler, 1915b: 146; Varshney & Smetacek, 2015: 29.
Remarks: Not recorded during the study.
633. *Coladenia agnioides* Elwes & Edwards, 1897
Published records: Tytler, 1915b: 146; Evans, 1949: 116; Van Gasse, 2013; Varshney & Smetacek, 2015: 29.
Remarks: Not recorded during the study.
634. *Coladenia buchananii* (de Nicéville, 1889)
Published records: Tytler, 1915b:146.
Remarks: Not recorded during the study.
635. *Coladenia indrani uposathra* Fruhstorfer, 1911 *
Published records: Tytler, 1915b: 146; Evans, 1949:115; Singh *et al*., 2011; Van Gasse, 2013; Varshney & Smetacek, 2015: 29; Soibam *et al*., 2016.
Sighting locality: 2, 53, 70.
636. *Coladenia laxmi landa* Evans, 1949
Published records: Evans, 1949: 117; Van Gasse, 2013; Varshney & Smetacek, 2015: 29.
Remarks: Not recorded during the study.

Satarupa Moore, [1866]

637. *Satarupa gopala* Moore, [1866]
Published records: Varshney & Smetacek, 2015: 29.
Remarks: Not recorded during the study.

638. *Satarupa zulla* Tytler, 1915
Published records: Varshney & Smetacek, 2015: 30.
Remarks: Not recorded during the study.

Seseria Matsumura, 1919

639. *Seseria dohertyi dohertyi* Watson, 1893
Published records: Evans, 1932; Evans 1949: 124; Van Gasse, 2013.
Remarks: Not recorded during the study.

640. *Seseria sambara sambara* (Moore, [1866])
Published records: Tytler, 1915b: 148; Evans, 1932; Evans, 1949: 124; Van Gasse, 2013.
Remarks: Not recorded during the study.

Chamunda Evans, 1949

641. *Chamunda chamunda* (Moore, [1866])
Published records: Tytler, 1915b: 145; Varshney & Smetacek, 2015: 30.
Remarks: Not recorded during the study.

Gerosis Mabille, 1903

642. *Gerosis bhagava bhagava* (Moore, [1866]) *
Published records: Tytler, 1915b: 148; Evans, 1949: 132; Van Gasse, 2013; Varshney & Smetacek, 2015: 30.
Sighting locality: 72, 71,

643. *Gerosis phisara phisara* (Moore, 1884) *
Published records: Tytler, 1915b: 146; Varshney & Smetacek, 2015: 30.
Sighting locality: 4, 68.

644. *Gerosis sinica narada* (Moore,1884)
Published records: Tytler, 1915b: 148; Varshney & Smetacek, 2015: 30.
Remarks: Not recorded during the study.

Tagiades Huebner, [1819]

645. *Tagiades gana athos* Ploetz, 1884 *
Published records: Tytler, 1915b: 147; Varshney & Smetacek, 2015: 31.
Sighting locality: 4, 20, 37, 68.

646. *Tagiades cohaerens* Mabille, 1914
Published records: Varshney & Smetacek, 2015: 31.
Remarks: Not recorded during the study.

647. *Tagiades parra* Fruhstorfer, 1910
Published records: Varshney & Smetacek, 2015: 31.
Remarks: Not recorded during the study.

648. *Tagiades japetus ravi* (Moore, [1866]) *
Published records: Tytler, 1915b: 147; Varshney & Smetacek, 2015: 31.
Sighting locality: 2, 4, 22, ,30, 32, 37, 71, 68.

649. *Tagiades vajuna* Fruhstorfer, 1910 *
Published records: Tytler, 1915b: 147; Varshney & Smetacek, 2015: 32.
Sighting locality: 2, 4, 60, 72.

650. *Tagiades menaka* (Moore, [1866])
Published records: Tytler, 1915b: 147; Varshney & Smetacek, 2015: 32.
Remarks: Not recorded during the study.

Mooreana Evans 1926

651. *Mooreana trichoneura pralaya* (Moore, [1866]) *
Published records: Tytler, 1915b: 147; Varshney & Smetacek, 2015: 33.
Sighting locality: 2, 4, 31.

Ctenoptilum de Nicéville, 1890

652. *Ctenoptilum vasava* (Moore, [1866])
Published records: Tytler, 1915b: 145; Varshney & Smetacek, 2015: 33.
Remarks: Not recorded during the study.

653. *Ctenoptilum multiguttata* de Nicéville, 1890
Published records: Tytler, 1915b: 145; Evans, 1949:157; Van Gasse, 2013; Varshney & Smetacek, 2015: 33.
Remarks: Not recorded during the study.

Odontoptilum de Niceville, 1890

654. *Odontoptilum angulatum angulatum* (C. & R. Felder, 1862) *
Published records: Varshney & Smetacek, 2015: 33.
Sighting locality: 72.

Caprona Wallengren, 1857

655. *Caporona agama agama* (Moore, [1858]) *
Published records: Tytler, 1915b: 146; Evans, 1949: 162; Van Gasse, 2013; Varshney & Smetacek, 2015: 33.
Sighting locality: 4, 11, 20, 68.

656. *Caprona alida alida* de Niceville, 1891
Published records: Tytler, 1915b: 146; Evans, 1949: 164; Van Gasse, 2013; Varshney & Smetacek, 2015: 33.
Remarks: Not recorded during the study.

Tribe Celaenorrhini Swinhoe, 1912

Celaenorrhinus Huebner, [1819]

657. *Celaenorrhinus asmara* (Butler, 1877) *#
Sighting locality: 59, 77, 80.

658. *Celaenorrhinus aspersa* Leech, 1891
Published records: Varshney & Smetacek, 2015: 34.
Remarks: Not recorded during the study.

659. *Celaenorrhinus aurivittatus aurivittatus* (Moore, 1878) *
Published records: Tytler, 1915b: 145.
Sighting locality: 4, 10, 68.

660. *Celaenorrhinus dhanada affinis* Elwes & Edwards, 1897
Published records: Tytler, 1915b: 145; Varshney & Smetacek, 2015: 35.
Remarks: Not recorded during the study.

661. *Celaenorrhinus leucocera* (Kollar, [1844]) *
Published records: Tytler, 1915b: 145; Varshney & Smetacek, 2015: 35.
Sighting locality: 4, 20, 60, 78.

662. *Celaenorrhinus maculicornis* Elwes & Edwards, 1897 *#
Published records: Tytler, 1915b: 145; Varshney & Smetacek, 2015: 35.
Sighting locality: 59, 60.

663. *Celaenorrhinus morena* Evans, 1949
Published records: Evans, 1949: 97; Van Gasse, 2013; Varshney & Smetacek, 2015: 35.
Remarks: Not recorded during the study.

664. *Celaenorrhinus nigricans* (de Nicéville, 1885)
Published records: Tytler, 1915b: 145; Varshney & Smetacek, 2015: 36.
Remarks: Not recorded during the study.
665. *Celaenorrhinus patula* de Niceville, 1889 *
Published records: Tytler, 1915b: 145; Evans, 1949: 98; Van Gasse, 2013; Varshney & Smetacek, 2015: 36.
Sighting locality: 4, 23, 60, 76.
666. *Celaenorrhinus plagifera* de Nicéville, 1889
Published records: Varshney & Smetacek, 2015.
Remarks: Not recorded during the study.
667. *Celaenorrhinus putra* (Moore, [1866])
Published records: Varshney & Smetacek, 2015: 36.
Remarks: Not recorded during the study.
668. *Celaenorrhinus pulomaya pulomaya* (Moore, 1865)
Published records: Evans, 1949: 96; Varshney & Smetacek, 2015: 36.
Remarks: Not recorded during the study.
669. *Celaenorrhinus pyrrha* de Nicéville,1889
Published records: Tytler, 1915b: 144; Varshney & Smetacek, 2015: 36.
Remarks: Not recorded during the study.
670. *Celaenorrhinus ratna tytleri* Evans, 1926
Published records: Evans, 1932; Van Gasse, 2013; Varshney & Smetacek, 2015: 36.
Remarks: Not recorded during the study.
671. *Celaenorrhinus sumitra* (Moore, [1866])
Published records: Tytler, 1915b: 145; Evans, 1949: 97; Van Gasse, 2013; Varshney & Smetacek, 2015: 37.
Remarks: Not recorded during the study.
672. *Celaenorrhinus zea* Swinhoe, 1909
Published records: Varshney & Smetacek, 2015: 37.
Remarks: Not recorded during the study.

Pseudocoladenia Shirozu & Saigusa, 1962
673. *Pseudocoladenia dan fatih* (Kollar, [1844]) *
Published records: Tytler, 1915b: 146; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 37.
Sighting locality: 20, 64, 80.
674. *Pseudocoladenia festa* (Evans, 1949) *
Published records: Evans, 1949: 113; Van Gasse, 2013; Varshney & Smetacek, 2015: 37.
Sighting locality: 69, 64, 77.
675. *Pseudocoladenia fatua* (Evans, 1949)
Published records: Evans, 1949: 113; Van Gasse, 2013; Varshney & Smetacek, 2015: 37.
Remarks: Not recorded during the study.

Sarangesa Moore, [1881]
676. *Sarangesa dasahara dasahara* (Moore, [1866]) *
Published records: Singh *et al*., 2011; Varshney & Smetacek, 2015: 38.
Sighting locality: 20, 53, 63.

Tribe Carcharodini Verity, 1940

Spialia Swinhoe, [1912]
677. *Spialia galba* (Fabricius, 1793) *
Published records: Singh *et al*., 2011.
Sighting locality: 20, 69, 74, 76.

Subfamily Hesperiinae Latreille, 1809

Tribe Aeromachini Tutt, 1906

Baracus Moore, [1881]

678. *Baracus vittatus septentrionum* Wood–Mason & de Nicéville, 1887
Published records: Tytler, 1915b: 149.
Remarks: Not recorded during the study.

Ampittia Moore, [1881]

679. *Ampittia dioscorides dioscorides* (Fabricius, 1793) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 41.
Sighting locality: 1, 2, 19, 20, 32, 70, 73, 59, 68.

680. *Ampittia maroides* de Niceville, 1896 * [Figure 56–57, 91]
Published records: Tytler, 1915b: 150; Evans, 1949: 240; Van Gasse, 2013; Varshney & Smetacek, 2015: 41.
Sighting locality: 19, 20, 32, 70, 42.

681. *Ampittia maro* (Fabricius, 1798)
Published records: Tytler, 1915b: 150.
Remarks: Not recorded during the study.

682. *Ampittia subvittatus* (Moore, 1878) *
Published records: Varshney & Smetacek, 2015: 40.
Sighting locality: 4, 20, 30, 64, 77, 80.
Remarks: Based on the phylogenetic analyses and morphological characteristics, *Ampittia* Moore, [1881] and *Ochus* de Nicéville, 1894 were merged into one and herewith subsumed under *Ampittia* Moore, [1881] (Huang *et al.,* 2019).

Aeromachus de Niceville, 1890

683. *Aeromachus dubius impha* Evans, 1949
Published records: Evans, 1949: 244; Van Gasse, 2013; Varshney & Smetacek, 2015: 41.
Remarks: Not recorded during the study.

684. *Aeromachus kali* de Nicéville, 1885 *
Published records: Tytler, 1915b: 151; Varshney & Smetacek, 2015: 41.
Sighting locality: 19, 20, 32.

685. *Aeromachus jhora creta* Evans, 1949 * [Figure 58–59, 80]
Published records: Tytler, 1915b: 151; Singh *et al*., 2011; Varshney & Smetacek, 2015: 41.
Sighting locality: 19, 20, 32, 70, 42.

686. *Aeromachus stigmatus obsoletus* (Moore, 1878) *
Published records: Tytler, 1915b: 150; Evans, 1949: 242; Van Gasse, 2013; Varshney & Smetacek, 2015: 42.
Sighting locality: 1, 2, 19, 20, 32, 70, 42.

Astictopterus C. & R. Felder, 1860

687. *Astictopterus jama olivascens* Moore, 1878 * [Figures 60–61, 81]
Published records: Tytler, 1915b: 149; Varshney & Smetacek, 2015: 46.
Sighting locality: 20, 28.

Ancistroides Butler, 1874

688. *Ancistroides nigrita diocles* (Moore, [1866]) *
Published records: Tytler, 1915b: 152, Varshney & Smetacek, 2015: 46.
Sighting locality: 1, 20, 75, 57, 71.

Sebastonyma Watson, 1893

689. *Sebastonyma dolopia* (Hewitson, 1868)

Published records: Tytler, 1915b: 150; Varshney & Smetacek, 2015: 42.

Remarks: Not recorded during the study.

Sovia Evans, 1949

690. *Sovia malta* Evans, 1949

Published records: Evans, 1949: 247; Van Gasse, 2013; Varshney & Smetacek, 2015: 42.

Remarks: Not recorded during the study.

691. *Sovia lucasii magna* (Evans, 1932)

Published records: Evans, 1949: 247; Van Gasse, 2013; Varshney & Smetacek, 2015: 42.

Remarks: Not recorded during the study.

692. *Sovia grahami* (Evans, 1926)

Published records: Van Gasse, 2013; Varshney & Smetacek, 2015:42.

Remarks: Not recorded during the study.

693. *Sovia separata* Moore, 1882

Published records: Tytler, 1915b: 154.

Remarks: Not recorded during the study.

Pedesta Hemming, 1934

694. *Pedesta panda* Evans, 1937

Published records: Evans, 1949: 249; Van Gasse, 2013; Varshney & Smetacek, 2015: 43.

Remarks: Not recorded during the study.

695. *Pedesta pandita* (de Niceville, 1885)

Published records: Tytler, 1915b: 151; Van Gasse, 2013.

Remarks: Not recorded during the study.

696. *Pedesta masuriensis* Moore, 1878

Published records: Varshney & Smetacek, 2015: 43.

Remarks: Not recorded during the study.

697. *Pedesta hyrie* (de Niceville, 1891) *

Published records: Evans, 1949: 253; Van Gasse, 2013; Varshney & Smetacek, 2015: 43.

Sighting locality: 76, 78.

Remarks: The species *hyrie* is transferred to *Pedesta* Hemming, 1934 from *Thoressa* Swinhoe, [1913] based on the genitalia character and phylogenetic analysis results (Huang *et al.,* 2019).

698. *Pedesta fusca fusca* (Elwes, [1893])

Published records: Tytler, 1915b:154; Evans, 1949:256; Van Gasse, 2013; Varshney & Smetacek, 2015:43.

Remarks: Not recorded during the study. The species *fusca* is transferred to *Pedesta* Hemming, 1934 from *Thoressa* Swinhoe, [1913] based on the genitalia character and phylogenetic analysis results (Huang *et al.*, 2019).

Thoressa Swinhoe, [1913]

699. *Thoressa masoni* (Moore, 1878)

Published records: Evans, 1949: 252; Van Gasse, 2013; Varshney & Smetacek, 2015: 43.

Remarks: Not recorded during the study.

700. *Thoressa cerata* (Hewitson, 1876) *

Published records: Tytler, 1915b: 153.

Sighting locality: 61, 70.

Halpe Moore, 1878

701. *Halpe arcuata* Evans, 1937 *

Published records: Varshney & Smetacek, 2015: 44.

Sighting locality: 1, 2, 19, 20, 32.

702. *Halpe burmana* Swinhoe, [1913]
Published records: Tytler, 1915b: 154.
Remarks: Not recorded during the study.

703. *Halpe kumara* de Nicéville, 1885
Published records: Tytler, 1915b: 154; Evans, 1949: 259; Van Gasse, 2013; Varshney & Smetacek, 2015: 45.
Remarks: Not recorded during the study.

704. *Halpe knyvetti* Elwes & Edwards, 1897
Published records: Tytler, 1915b: 153.
Remarks: Not recorded during the study.

705. *Halpe hauxwelli* Evans, 1937
Published records: Evans, 1949: 261; Van Gasse, 2013; Varshney & Smetacek, 2015: 44.
Remarks: Not recorded during the study.

706. *Halpe homolea aucma* Swinhoe, 1893 *
Published records: Tytler, 1915b: 154; Evans, 1949: 262; Van Gasse, 2013; Varshney & Smetacek, 2015: 44.
Sighting locality: 61, 70.

707. *Halpe porus* (Mabille, [1877])
Published records: Varshney & Smetacek, 2015: 45.
Remarks: Not recorded during the study.

708. *Halpe sikkima* Moore, 1882
Published records: Tytler, 1915b:154; Evans, 1949: 260; Van Gasse, 2013; Varshney & Smetacek, 2015: 45.
Remarks: Not recorded during the study.

709. *Halpe wantona* Swinhoe, 1893
Published records: Evans, 1949: 267; Varshney & Smetacek, 2015: 45.
Remarks: Not recorded during the study.

710. *Halpe zema* Hewitson, 1877 *
Published records: Tytler, 1915b: 153; Varshney & Smetacek, 2015: 45.
Sighting locality: 61, 70.

711. *Halpe zola zola* Evans, 1937
Published records: Evans, 1949: 258; Van Gasse, 2013; Varshney & Smetacek, 2015: 45.
Remarks: Not recorded during the study.

Pithauria Moore, 1878

712. *Pithauria stramineipennis stramineipennis* Wood–Mason & de Niceville, [1887] *
Published records: Tytler, 1915b: 153; Varshney & Smetacek, 2015: 46.
Sighting locality: 51, 67.

713. *Pithauria murdava* (Moore, [1866])
Published records: Tytler, 1915b:153.
Remarks: Not recorded during the study.

714. *Pithauria marsena* (Hewitson, [1866])
Published records: Tytler, 1915b: 153; Evans, 1949: 26; Van Gasse, 2013; Varshney & Smetacek, 2015: 46.
Remarks: Not recorded during the study.

Arnetta Watson, 1893

715. *Arnetta atkinsoni* (Moore, 1878) *
Published records: Tytler, 1915b: 151, Van Gasse, 2013.
Sighting locality: 20, 61, 70.

Incerta sedis

Apostictopterus Leech, [1893]

716. *Apostictopterus fuliginosus curiosa* (Swinhoe, 1917)
Published records: Evans, 1949: 233; Van Gasse, 2013; Varshney & Smetacek, 2015: 46.
Remarks: Not recorded during the study.

Iambrix Watson, 1893

717. *Iambrix salsala salsala* (Moore, [1866]) * [Figure 62–63, 82]
Published records: Varshney & Smetacek, 2015:47.
Sighting locality: 1, 3, 9, 10, 65, 20, 75, 57, 71.

Koruthaialos Watson, 1893

718. *Koruthaialos rubecula cachara* Evans, 1949
Published records: Tytler, 1915b:149; Evans, 1949: 274; Van Gasse, 2013; Varshney & Smetacek, 2015: 48.
Remarks: Not recorded during the study.

719. *Koruthaialos sindu monda* Evans, 1949
Published records: Evans, 1949: 277; Van Gasse, 2013; Varshney & Smetacek, 2015: 48.
Remarks: Not recorded during the study.

720. *Koruthaialos butleri* (de Nicéville, [1884])
Published records: Tytler, 1915b: 149; Varshney & Smetacek, 2015: 48.
Remarks: Not recorded during the study.

Psolos Staudinger, 1889

721. *Psolos fuligo subfasciatus* (Moore, 1878) *
Published records: Tytler, 1915b: 149; Van Gasse, 2013.
Sighting locality: 65, 20, 75, 57, 71.

Notocrypta de Niceville, 1889

722. *Notocrypta curvifascia curvifascia* (C. & R. Felder, 1862) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 48.
Sighting locality: 1, 3, 9, 10, 65, 20, 75, 57, 71.

723. *Notocrypta feisthamelii alysos* (Moore, [1866]) *
Published records: Varshney & Smetacek, 2015: 49.
Sighting locality: 1, 10, 65, 20, 75, 57, 71.

724. *Notocrypta paralysos* (Wood–Mason & de Nicéville, 1881)
Published records: Varshney & Smetacek, 2015: 49.
Remarks: Not recorded during the study.

Udaspes Moore, [1881]

725. *Udaspes folus* (Cramer, [1775]) *
Published records: Singh *et al.,* 2011; Varshney & Smetacek, 2015: 49.
Sighting locality: 1, 3, 9, 10, 65, 20, 75, 57, 63, 80.

Scobura Elwes & Edwards, 1897

726. *Scobura cephala* Hewitson, 1876
Published records: Tytler, 1915b: 151.
Remarks: Not recorded during the study.

727. *Scobura phiditia* (Hewitson, [1866])
Published records: Tytler, 1915b: 151.

Remarks: Not recorded during the study.

728. *Scobura tytleri* (Evans, 1914)
Published records: Evans, 1914: 303; Tytler, 1915b: 150; Evans, 1932; Evans, 1949: 293; Varshney & Smetacek, 2015: 50.
Remarks: Not recorded during the study.

729. *Scobura cephaloides* (de Nicéville, [1889])
Published records: Tytler, 1915b:152; Evans, 1949: 294; Van Gasse, 2013.
Remarks: Not recorded during the study.

730. *Scobura woolletti woolletti* (Riley, 1923)
Published records: Evans, 1949: 293; Van Gasse, 2013; Varshney & Smetacek, 2015: 50.
Remarks: Not recorded during the study.

Suada de Nicéville, 1895

731. *Suada swerga* de Nicéville, 1883
Published records: Varshney & Smetacek, 2015: 50.
Remarks: Not recorded during the study.

Suastus Moore, [1881]

732. *Suastus gremius gremius* (Fabricius, 1798) * [Figures 64–65, 93]
Published records: Tytler, 1915b:149; Varshney & Smetacek, 2015: 50.
Sighting locality: 57, 71, 75.

733. *Suastus minuta* (Moore, 1877)
Published records: Tytler, 1915b: 150.
Remarks: Not recorded during the study.

Cupitha Moore, 1884

734. *Cupitha purreea* (Moore, 1877) *
Published records: Tytler, 1915b: 153; Varshney & Smetacek, 2015: 51.
Sighting locality: 1, 3, 9, 10, 65, 20, 52.

Zographetus Watson, 1893

735. *Zographetus satwa* (de Nicéville, [1884])
Published records: Tytler, 1915b: 151; Varshney & Smetacek, 2015: 51.
Remarks: Not recorded during the study.

736. *Zographetus ogygia* (Hewitson, [1866])
Published records: Tytler, 1915b: 151; Varshney & Smetacek, 2015: 51
Remarks: Not recorded during the study.

Hyarotis Moore, [1881]

737. *Hyarotis microstictum* Wood–Mason & de Nicéville, 1887
Published records: Tytler, 1915b: 151.
Remarks: Not recorded during the study.

738. *Hyarotis adrastus praba* (Moore, [1866]) *#
Sighting locality: 68.

Plastingia Butler, 1870

739. *Plastingia naga* de Nicéville, 1883
Published records: Tytler, 1915b: 152.
Remarks: Not recorded during the study.

Salanoemia Eliot in Corbet & Pendlebury, 1978

740. *Salanoemia tavoyana titei* Cantlie & Norman, 1960

Published records: Van Gasse, 2013; Varshney & Smetacek, 2015: 52.
Remarks: Not recorded during the study.

741. *Salanoemia noemi* (de Nicéville,1897)
Published records: Tytler, 1915b: 152; Van Gasse, 2013.
Remarks: Not recorded during the study.

Pyroneura Eliot in Corbet & Pendlebury, 1978

742. *Pyroneura margherita margherita* (Doherty, 1889)
Published records: Evans, 1949: 315; Van Gasse, 2013; Varshney & Smetacek, 2015: 52.
Remarks: Not recorded during the study.

Gangara Moore, [1881]

743. *Gangara thyrsis thyrsis* (Fabricius, 1775) *
Published records: Tytler, 1915b: 152; Varshney & Smetacek, 2015: 53.
Sighting locality: 57, 71.

Erionota Mabille, 1878

744. *Erionota torus* Evans, 1941 *#
Sighting locality: 27, 30, 32.

Matapa Moore, [1881]

745. *Matapa aria* (Moore, [1866]) *
Published records: Tytler, 1915b: 152; Singh *et al.,* 2011; Varshney & Smetacek, 2015: 54.
Sighting locality: 60, 72.

746. *Matapa purpurascens* Elwes & Edwards, 1897
Published records: Tytler, 1915b: 152.
Remarks: Not recorded during the study.

747. *Matapa sasivarna* Moore, 1865
Published records: Tytler, 1915b: 152.
Remarks: Not recorded during the study.

Pudicitia de Nicéville, 1895

748. *Pudicitia pholus* de Nicéville, 1889
Published records: Tytler, 1915b:152.
Remarks: Not recorded during the study.

Pirdana Distant, 1886

749. *Pirdana hyela rudolphii* Elwes & de Nicéville, [1887]
Published records: Tytler, 1915b:152.
Remarks: Not recorded during the study.

Tribe Baorini Doherty, 1886

Parnara Moore [1,881]

750. *Parnara guttatus mangala* (Moore, [1866]) *
Published records: Majumdar, 2004: 521.
Sighting locality: 19, 68.

751. *Parnara ganga* Evans, 1937
Published records: Evans, 1949: 434; Van Gasse, 2013; Varshney & Smetacek, 2015: 56.
Remarks: Not recorded during the study.

Pseudoborbo Lee, 1966

752. *Pseudoborbo bevani* (Moore, 1878) * [Figures 66–67, 83]
Published records: Varshney & Smetacek, 2015: 56.
Sighting locality: 60, 64, 77.

Borbo Evans, 1949
753. *Borbo cinnara cinnara* (Wallace, 1866) *
Published records: Evans, 1949: 437; Van Gasse, 2013; Varshney & Smetacek, 2015: 56.
Sighting locality: 60, 64, 77.

Pelopidas Walker, 1870
754. *Pelopidas assamensis* (de Niceville, 1882) * [Figures 68–69, 84]
Published records: Varshney & Smetacek, 2015: 56.
Sighting locality: 22, 23.
755. *Pelopidas agna agna* (Moore, [1866]) * [Figures 70–71, 83, 85, 92]
Published records: Varshney & Smetacek, 2015: 56.
Sighting locality: 22, 23, 35, 39.
756. *Pelopidas conjuncta conjuncta* (Herrich–Schaffer, 1869) *
Published records: Varshney & Smetacek, 2015.
Sighting locality: 5, 9, 20, 22, 23, 35, 70, 47, 53, 71.
757. *Pelopidas mathias mathias* (Fabricius, 1798) *
Published records: Singh *et al.*, 2011; Varshney & Smetacek, 2015: 57.
Sighting locality: 4, 48.
758. *Pelopidas sinensis* (Mabille, 1877) *
Published records: Singh *et al.*, 2011.
Sighting locality: 5, 9, 20, 22, 24.
759. *Pelopidas subochracea subochracea* (Moore, 1878) *
Published records: Evans, 1949: 441; Van Gasse, 2013; Varshney & Smetacek, 2015: 57.
Sighting locality: 35, 70, 47, 53, 71.
760. *Pelopidas thrax masta* Evans, 1949
Published records: Evans, 1949: 440; Van Gasse, 2013; Varshney & Smetacek, 2015: 57.
Remarks: Not recorded during the study.

Polytremis Mabille, 1904
761. *Polytremis lubricans lubricans* Herrich–Schäffer, 1869 *
Published records: Varshney & Smetacek, 2015: 58.
Sighting locality: 19, 20, 39.
762. *Polytremis minuta* (Evans, 1926)
Published records: Evans, 1949: 447; Varshney & Smetacek, 2015: 58.
Remarks: Not recorded during the study.

Zenonoida Fan & Chiba, 2016
763. *Zenonoida discreta discreta* (Elwes & Edwards, 1897) *
Published records: Tytler, 1915b: 155; Majumdar, 2004: 521; Varshney & Smetacek, 2015: 57.
Sighting locality: 19, 20, 39.
Remarks: The species is transferred to Zenonoida Fan & Chiba, 2016 from Polytremis Mabille, 1904 based on the male genitalia structure (Fan *et al.*, 2016).
764. *Zenonoida eltola eltola* (Hewitson, 1869) *
Published records: Varshney & Smetacek, 2015: 58.
Sighting locality: 70, 41.
Remarks: The species is transferred to Zenonoida Fan & Chiba, 2016 from Polytremis Mabille, 1904 based on the male genitalia structure (Fan *et al.*, 2016).

Baoris Moore, [1881]

765. *Baoris farri farri* (Moore, 1878) *
Published records: Tytler, 1915b: 155; Varshney & Smetacek, 2015: 58.
Sighting locality: 4, 40, 60.
766. *Baoris pagana* de Nicéville, 1887
Published records: Varshney & Smetacek, 2015: 58.
Remarks: Not recorded during the study.
767. *Baoris penicillata chapmani* (Evans, 1937) *# [Figures 52–53, 86]
Sighting locality: 59, 63, 72.

Caltoris Swinhoe, 1893
768. *Caltoris aurociliata* (Elwes & Edwards,1897)
Published records: Evans, 1949: 451; Van Gasse, 2013; Tytler, 1915b: 155; Varshney & Smetacek, 2015: 59.
Remarks: Not recorded during the study.
769. *Caltoris cahira austeni* Moore, 1883
Published records: Evans, 1949:452; Van Gasse, 2013; Varshney & Smetacek, 2015:59.
Remarks: Not recorded during the study.
770. *Caltoris kumara* (Moore, 1878)
Published records: Varshney & Smetacek, 2015: 59.
Remarks: Not recorded during the study.
771. *Caltoris plebeia* (de Nicéville, 1887)
Published records: Varshney & Smetacek, 2015: 60.
Remarks: Not recorded during the study.
772. *Caltoris philippina* (Herrich–Schäffer, 1869)
Published records: Varshney & Smetacek, 2015: 60.
Remarks: Not recorded during the study.
773. *Caltoris sirius sirius* (Evans, 1926)
Published records: Evans, 1949: 451; Van Gasse, 2013; Varshney & Smetacek, 2015: 60.
Remarks: Not recorded during the study.
774. *Caltoris tulsi tulsi* (de Nicéville, [1884])
Published records: Tytler, 1915b: 155; Varshney & Smetacek, 2015: 60.
Remarks: Not recorded during the study.

Iton de Nicéville, 1895
775. *Iton semamora* Moore, 1865
Published records: Tytler, 1915b: 154; Varshney & Smetacek, 2015: 60.
Remarks: Not recorded during the study.

Tribe Taractrocerini Voss, 1952

Taractocera Butler, [1870]
776. *Taractocera danna* (Moore, 1865)
Published records: Varshney & Smetacek, 2015: 61.
Remarks: Not recorded during the study.
777. *Taractocera maevius* (Fabricius, 1793)
Published records: Varshney & Smetacek, 2015: 61.
Remarks: Not recorded during the study.
778. *Taractocera ceramas atropunctata* Watson, 1896
Published records: Tytler, 1915b: 150; Evans, 1949: 359; Van Gasse, 2013; Varshney & Smetacek, 2015: 60.
Remarks: Not recorded during the study.

Oriens Evans, 1932

779. *Oriens goloides* (Moore, [1881]) *
Published records: Varshney & Smetacek, 2015: 61.
Sighting locality: 19, 20, 62, 76.

780. *Oriens gola* (Moore, 1877)
Published records: Tytler, 1915b: 153; Varshney & Smetacek, 2015: 61.
Remarks: Not recorded during the study.

Potanthus Scudder, 1872

781. *Potanthus confucius dushta* (Fruhstorfer, 1911) *
Published records: Varshney & Smetacek, 2015: 62.
Sighting locality: 27, 68.

782. *Potanthus mara* Evans, 1932
Published records: Varshney & Smetacek, 2015: 62.
Remarks: Not recorded during the study.

783. *Potanthus mingo ajax* (Evans, 1932) * [Figures 54–55, 87]
Sighting locality: 19, 20, 70, 59,

784. *Potanthus palnia* (Evans, 1914)
Published records: Varshney & Smetacek, 2015: 63.
Remarks: Not recorded during the study.

785. *Potanthus pallidus* (Evans, 1932)
Published records: Varshney & Smetacek, 2015: 63.
Remarks: Not recorded during the study.

786. *Potanthus pavo* (Fruhstorfer, 1911)
Published records: Varshney & Smetacek, 2015: 63.
Remarks: Not recorded during the study.

787. *Potanthus pseudomaesa cleo* (Evans, 1932) * [Figures 74–75, 88]
Published records: Singh *et al.*, 2011; Varshney & Smetacek, 2015: 63.
Sighting locality: 19, 20, 59, 68.

788. *Potanthus rectifasciata* (Elwes & Edwards, 1897) *
Published records: Varshney & Smetacek, 2015: 63.
Sighting locality: 20, 59, 68.

789. *Potanthus sita* (Evans, 1932)
Published records: Varshney & Smetacek, 2015:63.
Remarks: Not recorded during the study.

790. *Potanthus trachala tytleri* (Evans, 1914) * [Figures 76–77, 89]
Published records: Tytler, 1915b: 153; Evans, 1949: 376.
Sighting locality: 19, 20, 70, 59, 68.

Telicota Moore, [1881]

791. *Telicota augias* (Linnaeus, 1763) *
Published records: Varshney & Smetacek, 2015: 64.
Sighting locality: 59, 68.

792. *Telicota bambusae* (Moore, 1878) * [Figures 78–79, 90]
Published records: Majumdar, 2004: 520; Singh *et al.*, 2011; Varshney & Smetacek, 2015: 64.
Sighting locality: 20, 59, 68.

793. *Telicota colon stinga* Evans, 1949 *
Published records: Varshney & Smetacek, 2015: 64.
Remarks: Not recorded during the study.

794. *Telicota linna linna* Evans, 1949 *
Published records: Varshney & Smetacek 201: 64.

Sighting locality: 59, 68.

Cephrenes Waterhouse & Lyell, 1914

795. *Cephrenes acalle* Höpffer, 1874 *

Published records: Tytler, 1915b:153; Varshney & Smetacek, 2015: 67.

Sighting locality: 59, 68.

Tribe Hesperiini Latreille, 1809

Ochlodes Scudder, 1872

796. *Ochlodes brahma* Moore, 1878 *

Published records: Varshney & Smetacek, 2015: 66.

Sighting locality: 20, 59, 60, 77, 80.

797. *Ochlodes subhyalina* (Bremer & Grey, 1853)

Published records: Varshney & Smetacek, 2015: 66.

Remarks: Not recorded during the study.

798. *Ochlodes siva* Moore, 1878

Published records: Tytler, 1915b: 153; Varshney & Smetacek, 2015: 66.

Remarks: Not recorded during the study.

Appendix II. List of the butterflies recorded from Manipur which are legally protected in India under IWPA (1972).

Schedule I

Papilionidae

1. *Byasa crassipes* (Oberthur, 1893)
2. *Papilio clytia clytia* Linnaeus, 1758

Lycaenidae

3. *Amblopala avidiena avidiena* (Hewitson, 1877)
4. *Chliaria othona othona* (Hewitson, 1865)
5. *Deudorix epijarbus amatius* Fruhstorfer, 1912
6. *Castalius rosimon rosimon* (Fabricius, 1775)

Nymphalidae

7. *Callerebia annada* (Moore, [1858])
8. *Neptis jumbah jumbah* Moore, [1858]
9. *Phaedyma columella ophiana* (Moore, 1872)
10. *Athyma zulema* (Doubleday, [1848])
11. *Cynitia telchinia telchinia* (Menetries, 1857)
12. *Euthalia durga splendens* (Tytler, 1915)
13. *Algia fasciata* (C. & R. Felder, 1860)
14. *Dilipa morgiana* (Westwood, [1850])
15. *Lethe distans* Butler, 1870
16. *Lethe dura gammiei* (Moore, [1892])

Schedule II

Papilionidae

17. *Papilio slateri slateri* Hewitson, 1859

18. *Byasa latreillei kabrua* (Tytler, 1915)
19. *Teinopalpus imperialis imperialis* Hope, 1843
20. *Bhutanitis lidderdalii lidderdalii* Atkinson, 1873

Pieridae

21. *Appias albina darada* (C & R Felder, [1865])
22. *Appias indra indra* (Moore, 1857)
23. *Cepora nadina nadina* (Lucas, 1852)
24. *Cepora nerissa phryne* (Fabricius, 1775)
25. *Pareronia avatar avatar* (Moore, [1858])

Riodinidae

26. *Dodona adonira naga* Tytler, 1940
27. *Dodona diploea diploea* Hewitson, 1865

Lycaenidae

28. *Poritia hewitsoni hewitsoini* Moore, [1866]
29. *Cigaritis lohita himalayanus* (Moore, 1884)
30. *Cigaritis nipalicus* (Moore, 1884)
31. *Apporasa atkinsoni* (Hewitson, 1869)
32. *Zinaspa todara* (Moore, [1884])
33. *Catapaecilma elegans* (Druce, 1873
34. *Cheritrella truncipennis* de Niceville, 1887
35. *Pratapa deva lila* Moore, 1884
36. *Suasa lisides* (Hewitson,1863)
37. *Sinthusa nasaka amba* (Kirby,1878)
38. *Bindahara phocides phocides* (Fabricius, 1793)
39. *Rapala scintilla* de Niceville, 1890
40. *Rapala varuna gebenia* Fruhstorfer,1914
41. *Una usta usta* (Distant, 1886)
42. *Caleta roxus roxana* (de Niceville,1897)
43. *Lampides boeticus* (Linnaeus, 1767)
44. *Megisba malaya* (Horsfield, [1828])
45. *Callenya melaena melaena* (Doherty, 1889)

Nymphalidae

46. *Polyura delphis delphis* (Doubleday, 1843)
47. *Charaxes kahruba* (Moore, [1895])
48. *Charaxes marmax marmax* Westwood, 1847
49. *Aemona amathusia amathusia* (Hewitson, 1867)
50. *Elymnias vasudeva deva* (Moore, 1893)
51. *Melanitis zitenius zitenius* (Herbst, 1796)
52. *Lethe scanda* (Moore, 1857)
53. *Lethe siderea* Marshall, 1881
54. *Lethe sinorix sinorix* (Hewitson, 1863)
55. *Lethe latiaris latiaris* (Hewitson, 1862)
56. *Neope pulaha* (Moore, [1858])
57. *Neope yama yama* (Moore, [1858])
58. *Mycalesis mestra mestra* Hewitson, 1862
59. *Ragadia crisilda crito* de Niceville, 1890
60. *Callerebia suroia* Tytler, 1914
61. *Neptis soma soma* Moore, 1858

62. *Athyma ranga ranga* Moore, [1858]
63. *Parasarpa dudu dudu* (Doubleday, [1848])
64. *Auzakia danava danava* (Moore, [1858])
65. *Bhagadatta austenia purpurascens* Tytler, 1915
66. *Parthenos sylvia gambrisius* (Fabricius, 1787)
67. *Cynitia lepidea lepidea* (Butler, 1868)
68. *Euthalia anosia anosia* (Moore, [1858])
69. *Euthalia evelina derma* (Kollar, 1848)
70. *Euthalia franciae* (Gray, 1846)
71. *Euthalia nara nara* (Moore, 1859)
72. *Lexias dirtea dirtea* (Fabricius, 1793)
73. *Chitoria sordida sordida* (Moore, [1866])
74. *Euripus nyctelius nyctelius* (Doubleday, 1845)
75. *Hestina persimilis persimilis* (Westwood, [1850])
76. *Cyrestis cocles cocles* (Fabricius,1787)
77. *Chersonesia rahrioides* Moore, [1899]
78. *Hypolimnas misippus* (Linnaeus, 1764)
79. *Rhinopalpa polynice birmana* Fruhstorfer, 1898

Hesperiidae

80. *Bibasis sena sena* (Moore, 1865)
81. *Halpe homolea aucma* Swinhoe, 1893

Schedule IV

Pieridae

82. *Appias libythea olferna* Swinhoe, 1890
83. *Appias galba* (Wallace, 1867)

Family Nymphalidae

84. *Euploea mulciber mulciber* (Cramer, [1777])
85. *Euthalia lubentina lubentina* (Cramer, [1777])

Hesperiidae

86. *Hasora vitta indica* Evans, 1932
87. *Hyarotis adrastus praba* (Moore, [1866])
88. *Pelopidas assamensis* (de Niceville, 1882)
89. *Pelopidas sinensis* (Mabille, 1877)
90. *Baoris farri farri* (Moore, 1878)

SUMMARY OF THE RESULTS

&

CONCLUSION

Photo taken during the butterfly survey conducted at Lokchao Wildlife Sanctuary, Moreh, Manipur, India @HHuidrom

SUMMARY OF THE RESULTS

The aim of the thesis was to explore shapes of the biodiversity patterns followed by Lepidoptera on the elevational gradient of Shirui Hill, Manipur and to understand the faunistic composition of Lepidoptera community in the generally understudied biodiversity rich region of North east Indian state of Manipur.

The first two chapters focused on the understanding the overall shapes of the pattern followed by the different taxa in the Himalayan elevational gradients. In **Chapter I,** we analysed the shapes from 64 research articles dealing with 90 elevational gradients covering both plants and animals, and tested the hypothesis that unimodal gradients, explicable by the geometric mid-domain effect, prevail in the mountains, whereas decreasing or increasing gradients result from studying only short sections of entire elevational ranges. Multivariate canonical correspondence analysis was used to relate gradient shapes to their elevation ranges, geography positions, and taxa studied. Across taxa, most of the Himalayan elevational gradients display a unimodal shape, with a peak of diversity situated at ca 2,500 m a.s.l. for plants, and 2,200 m a.s.l. for animals. The gradient shapes were attributable to three intercorrelated predictors: vertical range, maximum elevation, and mean elevation of the gradients. Studies covering sufficiently broad elevational range returned unimodal gradients. This also revealed that surveys covering substantial parts of the elevational range of the mountains resulted in unimodal elevational gradients, whereas declining or increasing species richness gradients resulted from incomplete elevation range sampling.

In **Chapter II**, we investigated the shapes of diversity pattern of moths along the elevation gradient of Shirui Hill in Manipur, NE India. We also investigated the assemblages, species richness and abundance of moths in the study area. Moths were sampled at five different elevations between 1,930 to 2,835 m a.s.l. for four years. We have shown that the species diversity (Shannon diversity and entropy), and marginally also the number of species, were significantly related to the elevational gradient.

These measures followed a hump-shaped (unimodal) pattern with a peak close to 2,036 m, then declined strongly to upper elevations. We observed that the low-elevation areas harbour majority of the moth species found in the Shirui Hill, only three families were found throughout the entire elevation gradient. The species turnover and Jaccard index of dissimilarity were high in upper and lower elevations indicating different moth communities, which mix in the middle part of the gradient, likely resulting in accumulated species diversity. When studying elevational gradients, we recommend to look into species level, as species-poor sites, such as the highest elevations, may contain species of conservation concern. We also provided a preliminary checklist of identified moths collected from the study area.

In **Chapters III to VIII**, we emphasised on the faunal surveys of the Shirui Hill. Manipur's Lepidoptera diversity is not well known. There is no definite number of moths and butterflies reported from Manipur so far. Thus, it was an urgent need to undertake a study to document the complete fauna of Lepidoptera to understand its species diversity and composition of Manipur.

Chapter III deals on the discovery of a new Notodontidae species *Euhampsonia rubricata* from high elevations on Shirui Hill. The species is also known from neighbouring Myanmar, but its biology is still unknown. **Chapter IV** also emphasised on the discovery of two species Limacodidae *Caissa kashungii* sp. n. and *Squamosa wungchanngamii* sp. n. from Shirui Hill, Manipur. Paratypes are known from Arunachal Pradesh, India and Myanmar. This chapter also reports *Cania (Paracania) robusta* Hering, 1931 and *Rhamnosa (Rhamnosa) convergens* Hering, 1931 as new to India from Manipur.

In **Chapter V**, we investigated the diversity of Lasiocampidae (Lappet moths) which are an important forest pest in many countries including India. Throughout India, 54 species are known to be present but in north east part of India the family is poorly studied. In the present study we recorded 35 species, of which 17 species are reported for the first time from Manipur. The 5 species viz. *Euthrix improvisa, Eteinopla narcissus,*

Kunugia burmensis, *Kunugia xichangensis*, and *Arguda viettei* are new addition to known Indian Lasiocampidae fauna. Similarly, **Chapter VI**, deals on the diversity of Sphingidae (Hawk moths) of Manipur. The checklist comprises 36 species under 19 genera with 29 new records to Manipur. Of which, two species viz. *Sphinx oberthueri* (Rothschild and Jordan, 1903) and *Theretra tibetiana* Vaglia and Haxaire, 2010 are new records to India. **Chapter VII** deals on the diversity of Notodontidae (Prominent moths) fauna in the Shirui Hill. Notodontids cause noticeable defoliation of their hosts plants and cause serious harm to many forest and fruit trees. In the present survey, 47 species under 32 genera were recorded. 34 species were recorded for the first time from Manipur, of which, 9 species viz. *Besaia argentilinea* Cai, 1982, *B. isis* Schintlemeister, 1997, *B. juncturina* Kiriakoff, 1959, *Phalera albocalceolata* (Bryk, 1950), *Benbowia callista* Schintlmeister, 1997, *Syntypistis wunna* (Schintlmeister, 1997), *Rachiades lichenicolor* (Oberthur, 1911), *Ginshachia phoebe phoebe* Schintlmeister, 1989, and *Periphalera melanius* Schintlmeister, 1997 are new addition to the Notodontidae fauna of India.

Thus, **Chapter V to VII**, reports 81 new records of moths from Manipur of which, 16 are new addition to the Indian moth fauna. Such a records of many species from a particular locality shows the rich diversity of Lepidoptera fauna of the region. This indicates that the region is understudied and neglected for such a long time, even though the diversity of the region is very rich.

Chapter VIII deals on the review and inventory of rich butterfly diversity of Manipur including the Shirui Hill. The butterfly fauna of Manipur is poorly known too, and a few sporadic studies were carried out decades ago. In this study, we surveyed 80 localities including revisiting of 12 historical localities in the hills and valleys from Manipur, India. Butterflies were regularly sampled between 2010 and 2019. In the present checklist, we have included both previously published and recently recorded species: 798 species belong to six families, of which 446 species was recorded during the present surveys. Eight species were rediscovered

during the study: *Byasa latreillei kabrua, Papilio machaon suroia, Lamproptera meges indistincta, Bhutanitis lidderdalii lidderdalii, Lethe kangjupkula, Una usta usta, Arhopala hellenore hellenore and Celaenorrhinus munda maculicornis*. Thirty–two species were new records to Manipur; *Miletus mallus* was a new record for India. Ninety species are legally protected in schedules (I, II & IV) of Indian (Wildlife) Protection Act, 1972. Among the recorded species there are many which are of conservation importance.

CONCLUSION

This thesis consists of several studies on ecological and taxonomical aspects of Lepidoptera community of the Shirui Hill, in the biodiversity rich understudied region of Northeast India. Studying these ecological gradients offered the opportunity to reveal the rich and unique diversity of Lepidoptera. From the elevational gradient studies, we found out that Lepidoptera community in the Shirui Hill prefers mainly the lower and mid elevations between ca. 1,930 to 2,036 (see Chapter II). We documented how insufficient was the knowledge on the local Lepidoptera in Manipur. During the study, we have found high amount of new local and country records (see Chapter II, V, VI, VII, & VIII) as well as species new to science (see Chapter III & IV). And still, we expect many taxonomic novelties to be described from Shirui Hill as well as from the other parts of Manipur (India). Our future action will be 1) to initiate more studies on the inventory of Lepidoptera fauna in all the parts of Manipur, 2) to identify the high priority area of the Lepidoptera in Manipur and 3) to take up measures to initiate for conservation of the unique biodiversity.

Author’s Curriculum vitae

Author and his supervisor, RNDr ZF Fric, during the survey of butterflies at Langol Reserve Forest at Imphal West, Manipur, India @HHuidrom

CURRICULUM VITAE

Jatishwor Singh Irungbam

1. Department of Zoology, Faculty of Science, University of South Bohemia in České Budějovice, Czech Republic
2. Institute of Entomology, Biology Centre, CAS, Ceske Budejovice, Czech Republic

Address: Krcinova, 1112/34, Ceske Budejovice 5, 37005, Czech Republic
Phone: +420 723 770 279
e-mail: jatishwor.irungbam@gmail.com
ORCID ID: 0000-0003-0911-9721
Researcher ID: D-5331-2018

Nationality: Indian
Born: Imphal, India, April 01, 1983
Languages: Manipuri (native), Hindi, English

Education

January 2016 – present: PhD. In Entomology. Faculty of Science, University of South Bohemia in Ceske Budejovice, Czech Republic. Thesis: *Lepidoptera of Shirui National Park (Shirui Hills), Manipur, India: its formation and determinants.*

2005 – 2007: **M.Sc. (Entomology)**, Ahmednagar College, Ahmednagar (Affiliated to Savitribai Phule Pune University, Pune, India).

2002 – 2005: **B.Sc.** (Zoology & Biotechnology), Ahmednagar College, Ahmednagar (Affiliated to Savitribai Phule Pune University, Pune, India).

Work Experience

2016 – present: PhD. Student, Institute of Entomology, Biology Centre, Czech Academy of Science, Ceske Budejovice, Czech Republic.

2019 (November/December): Lab Technician, Laboratory of Helminthology, Institute of Parasitology, Biology Centre, Czech Academy of Science, Ceske Budejovice, Czech Republic.

2009 – 2015: Contractual Teacher (Subject Biology) under Ministry of Education, Royal Government of Bhutan.

Internship/s

March to May 2020

KTHM College, Nashik, India, Supervisor: Dr. Sachin A Gurule.

Field experience

1. Lepidoptera surveys in the Himalayas:

Moths' surveys and trapping using light traps in the Himalayas (Bhutan) (2010 – 2015).

Surveys of butterflies to identify the areas of conservation interst in Tsirang, Bhutan (2012 – 2015).

2. Lepidoptera surveys in the NE India:

Leadership in field surveys and collection of Lepidoptera in the Indo-Malayan region (Manipur, India) (2010 – now).

Collection of moths using light traps for the studies of moth assemblage in the Shirui hill (Manipur, India) (2016 – now).

Current research interest

Biodiversity, ecology, biogeography, Molecular taxonomy of Himalayan moths and butterflies.

Phylogenetics and phylogeography of Oriental butterflies.

Publications with impact factor (IF)

As of December 2021: 97 citations in Google Scholar.

Irungbam, J.S., Laishram, R.M., Huidrom, H., Soibam, B.S., Ngangom, A., & Fric, Z.F. **(2020):** An inventory of the butterflies of Manipur, India (Insecta: Lepidoptera). Zootaxa 4882 (1): 001–091. **(IF. 0.955)**

Schintlmeister, A. & **Irungbam, J.S. (2019)** *Euhampsonia rubricata* spec. nov., a new moth species from north eastern India and western Myanmar (Lepidoptera: Notodontidae). *Zootaxa*, 4560(1): 195–200. **(IF. 0.955)**

Fric, Z.F., Besta, L., Hula, V., Vrba, P., Irungbam, M., **Irungbam**, **J.,** Ignatev, N. & Maresova, J. **(2019).** New Record of the butterfly *Euchrysops cnejus* (Fabricius) from Oman, with notes about phylogeographic patterns of *E. cnejus* and *E. osiris* (Hopffer) (Lepidoptera: Lycaenidae), *Zoology in the Middle East*. 65(3): 236-244. **(IF. 0.580)**

Publications with non-impact factor (IF)

Irungbam, J.S. (2021). Record of *Stueningeria nepalensis* Lehmann, 2019 (Insecta: Metarbelidae) in Bhutan. *Bionotes*, 23(2&3): 54-56.

Irungbam, J.S. & Fric, Z.F. **(2021)** A preliminary checklist of the family Sphingidae (Lepidoptera: Bombycoidea) recorded from Shirui hills, Manipur, India. *Records of the Zoological Survey of India*, 121(1):173-194.

Irungbam, J.S., Huidrom, H. & Fric, Z.F. **(2021)** Sighting of Chinese Hairstreak *Amblopala avidiena avidiena* (Hewitson, 1877) (Lycaenidae: Theclinae) from Shirui Hills: a new record for Manipur, India. *Journal of Bombay Natural History Society*, 3pp.

Irungbam, J.S., Gurule, S.A. & Fric, Z.F. **(2020)** Lappet moths (Lepidoptera: Lasiocampidae) of Manipur, north east India: an updated checklist. *Journal of Insect Biodiversity*, 019(2): 024–043.

Irungbam, J.S., Huidrom, H. & Elangbam, P. **(2020)**. Addition of the butterfly Appias galba (Wallace, 1867) to the fauna of Manipur, India. *Bionotes*, 22(3): 112-113.

Laghude, R., Khobragade, B. & **Irungbam J.S. (2019).** Species diversity of butterflies in moderately disturbed forests and along forest edges – a case study of Karjat, dist. Ahmednagar, Maharashtra, India. *Uttar Pradesh Journal of Zoology*, 40(4): 214–221.

Irungbam, J.S., & Irungbam, M. **(2019).** Contributions to the knowledge of moths of Bombycoidea Latreille, 1802 (Lepidoptera: Heterocera) of Bhutan with new records. *Journal of Threatened Taxa*, 11(8): 14022-14050.

Irungbam, J.S. & Norbu L. **(2019).** A New Country Record of *Langia zenzeroides zenzeroides* Moore, 1872 (Sphingidae: Smerinthinae) from Bhutan. *Journal of the Bombay Natural History Society*, p. 22-24.

Jamtsho, K. & **Irungbam, J.S. (2019)** White-streaked Hawkmoth: report on the range extension of *Clanidopsis exusta* (Butler, 1875) from Bhutan. Bugs R All #170. In: *Zoo's Print*, 34(3): 19-23.

Irungbam, J.S. & Irungbam, M.J. **(2018)** Two moth species of Lasiocampidae (Lepidoptera: Lasiocampoidea) recorded for the first time in Bhutan. *Journal of Threatened Taxa*, 10(11):12598-12601. DOI:10.11609/jott.3297.10.11.12598-12601

Irungbam, J.S. & Irungbam, M.J. **(2018)** An Updated Checklist of Butterflies (Lepidoptera: Rhopalocera) from Tsirang district, Bhutan. *Species*. 19, 55-67.

Irungbam, J.S., Huidrom, H. & B.S. Soibam **(2017):** A century later the Manipur Argus *Callerebia suroia* Tytler, 1914 (Lepidoptera: Nymphalidae: Satyrinae) recorded in its type locality in Manipur, India. *Journal of Threatened Taxa* 9(2): 9866–9869.

Irungbam, J.S., Huidrom, H. & Soibam, B.S. **(2017):** Range extension of the Indian Tortoiseshell *Aglais caschmirensis aesis* Fruhstorfer, 1912 (Lepidoptera: Nymphalidae) into the hills of Manipur, India. *Journal of Threatened Taxa* 9(10): 10860–10864.

Irungbam, J.S., Chib, M.S. & Solovyev, A.V. **(2017):** Moths of the family Limacodidae Duponchel, 1845 (Lepidoptera: Zygaenoidea) from Bhutan with six new generic and 12 new species records. *Journal of Threatened Taxa* 9(2): 9795–9813.

Soibam, B.S., Huidrom, H. & **Irungbam, J.S. (2016):** A century later: Tricolored Pied Flat *Coladenia indrani uposathra* Fruhstorfer, 1911 (Hesperiidae: Pyrginae) and Crenulate Oakblue *Apporasa atkinsoni* Hewitson, 1869 (Lycaenidae: Theclinae) reported from Manipur, India. *Journal of Threatened Taxa* 8(7): 9030–9033.

Irungbam, J.S., Chib, M.S. & Wangdi, K. **(2016):** Taxonomic review of the superfamily Pyraloidea in Bhutan (Lepidoptera). *Journal of Asia-Pacific Biodiversity* 9 (3): 355-382.

Irungbam, J.S., Chib, M.S. & Fric, Z.F. **(2016):** Notes on the occurrence of *Chitoria sordida sordida* (Moore, 1866) (Nymphalidae: Apaturinae) in Tsirang District, Bhutan. *Journal of Threatened Taxa* 8(5): 8814–8817.

Irungbam, J.S. (2016): Some comments on the 'Moist temperate forest butterflies of western Bhutan'. *Journal of Threatened Taxa* 8(5): 8846–8847.

Irungbam, J.S. & Chib, M.S. **(2015):** Checklist of Butterflies of Bhutan. *Journal of the Bhutan Ecological Society* 1(2): 22-58.

Vaidya, A., Huidrom, H. & **Irungbam, J.S. (2015):** An addition to the known range of *Marumba irata* Joicey & Kaye, 1917 (Lepidoptera: Sphingidae) in northeastern India. *Journal of Threatened Taxa* 7(11): 7831–7832

Singh I.J. (2015): A new range record of *Comostola hauensteini* Smetacek, 2004 (Lepidoptera: Geometridae: Geometrinae) from Bhutan. *Journal of Threatened Taxa* 7(6): 7302–7304.

Rushbrooke, M., Jangid, A.K., Alwis, C., Barve, V., Chowdhury, S., **Irungbam, J.S.,** Jayasinghe, H.D., Kehimar, I., Khanal, B., Kunte, K., Lo, P., Moonen, J., Rajapakshe, S.S., Shrestha, B.R. & Tiple, A.D. (2019). *Pachliopta aristolochiae*. The IUCN Red List of Threatened Species 2019: e.T121971639A122602131.

Fernando, E., Jangid, A.K., Chowdhury, S., **Irungbam, J.S.,** Kehimar, I., Khanal, B., Kunte, K., Lo, P., Moonen, J. & Shrestha, B.R. (2019). *Atrophaneura aidoneus*. The IUCN Red List of Threatened Species 2019: e.T121971545A122602116.

Fernando, E., Jangid, A.K., Chowdhury, S., **Irungbam, J.S.,** Kehimar, I., Khanal, B., Kunte, K.,Lo, P., Moonen, J. & Shrestha, B.R. (2019). *Atrophaneura varuna*. The IUCN Red List of Threatened Species 2019: e.T121974980A122602301.

Fernando, E., Jangid, A.K., **Irungbam, J.S.,** Kehimar, I., Khanal, B., Kunte, K., Lo, P., Moonen,J., Qureshi, A.A. & Shrestha, B.R. (2019). *Byasa dasarada*. The IUCN Red List of Threatened Species 2019: e.T121971963A122602151.

Fernando, E., Jangid, A.K., **Irungbam, J.S.,** Kehimar, I., Kunte, K. & Lo, P. (2019). *Bhutanitis lidderdalii*. The IUCN Red List of Threatened Species 2019: e.T121975380A122602321.

Irungbam J.S. (2014): *Checklist on Swallowtail Butterflies (Papilionidae) of Bhutan*. Submitted to National Biodiversity Centre, Serbithang, Bhutan.

Irungbam J.S. (2014): *Species catalogue of Rare and Threatened Butterflies and Moths of Bhutan*. Submitted to National Biodiversity Centre, Serbithang, Bhutan.

Singh I.J. (2014). Butterfly Diversity of Dzamling Norzoed Community Forest, Tsirang, Bhutan – A Preliminary Study. *SAARC Forestry Journal* 3: 38-46.

Singh I.J. & Chib, M.S. **(2014).** A preliminary checklist of butterflies (Lepidoptera: Rhophalocera) of Mendrelgang, Tsirang District, Bhutan. *Journal of Threatened Taxa* 6(5): 5755-5768.

Singh I.J. & Kitching, I.J. **(2014):** A first record of *Clanis hyperion* Cadiou & Kitching, 1990 (Lepidoptera: Sphingidae) in Bhutan, and a preliminary checklist of the hawkmoths of Mendrelgang, Bhutan. *Journal of Threatened Taxa* 6(1):5386-5388.

Singh I.J. & Gogoi, M.J. **(2013).** A New Range Record for the Bath White *Pontia daplidice* Linnaeus 1758 (Lepidoptera: Pieridae) for North East India. *Bionotes* 15(2): 59-60.

Manuscripts submitted or in preparation

Irungbam, J.S., A.B. Sucháčková, M. Konvička & Fric, Z.F. Do shapes of altitudinal species richness gradients depend on the vertical range studied? The case of the Himalayas. (Manuscript)

Irungbam, J.S., A.B. Sucháčková, M. Konvička & Fric, Z.F. Altitudinal distribution pattern of moths (Insecta: Lepidoptera) in Shirui National Park, Manipur, India. (Manuscript)

Irungbam, J.S., Schintlmeister, A. & Fric, Z.F. Lesser known and new Notodontidae Stephens, 1829 (Lepidoptera: Noctuoidea) moths from Manipur, India. (Manuscript)

Irungbam, J.S., Jalil A., Navneet S. & Solovyev, A.V. Two new species and three new record species of family Limacodidae from northeast India (Lepidoptera: Zygaenoidea). (Submitted)

International conferences

Irungbam J.S., H. Huidrom & Z.F. Fric (2019). The Butterfly diversity of Manipur, NE India. In 6th Asian Lepidoptera Conservation Symposium, 17th - 21st September 2019, Kolkata, India, 23 pp. (*Talk*)

Irungbam J.S., M.J. Irungbam & Z.F. Fric (2018). Moths diversity (Lepidoptera: Heterocera) in the different altitudes of the Shirui National Park, Manipur, NE India. In 5th Asian Lepidoptera Conservation Symposium, 13th – 15th December 2018, Hong Kong, SAR China 2018, 14 pp. (*Talk*)

Irungbam J.S. (2017): *Monitoring and Conservation initiative of Butterflies and People's perception towards Butterfly Conservation in Manipur, India*. In British Ecological Society (Eds) 2017: Ecology Across Borders, Annual Meeting 2017. 11th -14th December 2017, ICC, Ghent, Belgium. 67 pp. (Poster)

Irungbam J.S. (2017): *The Moths of Shirui Hills, Manipur, NE India.* In Šašić M., Rota J., Mihoci I. (Eds.) 2017: Book of abstracts of the 20th European Congress of Lepidopterology. 24th - 30th April 2017, Podgora, Croatia. Croatian Natural History Museum, Zagreb. 97 pp. (Poster)

Irungbam J.S. (2016): *Butterflies and Moths of Bhutan: Current state of Knowledge*. In Dutch Butterfly Conservation (Eds.) 2016: Book of abstracts of the International Symposium on Future 4 Butterflies in Europe, 31st March to 2nd April 2016, Wageningen, the Netherlands, 103 pp. (Poster)

Online Talks/Seminars

September 2021: Topic: "Entomology: Entomological research, Current Perspectives, Opportunities & Future Scope" during Online Lecture Series of KTHM College, Nashik, India. Theme: Zoological Research: Current Perspectives, Opportunities & Future Scope.

October 2021: Topic: DNA Barcoding – as a tool for taxonomy during Webinar Series of Dada Patil Mahavidyalaya, Ahmednagar, India. Theme: Recent Trends in Zoology.

---

e-mail address: jatishwor.irungbam@gmail.com

The cover picture of *Bhutanitis lidderdalii* Atkinson, 1873 (Bhutan Glory) is used with the permission of Harmenn Huidrom

Lepidoptera of Manipur, India: its formation and determinants

Ph.D. Thesis Series, 2022, No. 01.

Printed in the Czech Republic by Typodesign
Edition of 15 copies

University of South Bohemia in České Budějovice
Faculty of Science
Branišovská 1760
CZ-37005 České Budějovice, Czech Republic

Phone: +420 387 776 201
www.prf.jcu.cz, e-mail: sekret-fpr@prf.jcu.cz