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REVIEW ARTICLE

A review on lepidopteran studies in Mizoram: Overview, present status, hurdles and prospects, along with a compiled checklist of moths

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Abstract

The Indo-Burma biodiversity hotspot, one of 36 globally recognized hotspots, spanning seven countries across five northeastern Indian states. Though ecologically important, the Indian side of this hotspot is under-explored, particularly concerning insect diversity. The present work deals with the state of Mizoram, where there is more than 84 % forest cover and a conducive tropical climate which support a rich insect fauna. The aim was to collate and assess the available records of Lepidoptera diversity in Mizoram, understand the gaps in knowledge and emphasize the region's contribution to India's general insect biodiversity. Historical literature, museum records and recent surveys from 1890 to 2023 were reviewed. Findings indicate that over 250 species of Lepidoptera have been reported from Mizoram, with 103 being first records and 18 as new species described. Interestingly, the Northeast states of India which induding Mizoram has nearly 32.92 % of India's documented Lepidoptera species in an area that only covers around 8 % of the country's land. New ant and beetle species have been found along with butterflies and moths. Nonetheless, much of the state does not remain unexplored due to past insurgencies, rugged terrain and inaccessibility. The results highlight the need for detailed biodiversity documentation in northeastern India and suggest that Mizoram has significant potential for entomological discoveries in the future. The analysis concludes that extensive and systematic surveys are necessary to determine the true insect diversity of under-represented hotspot regions and to yield meaningful benefits for conservation and biogeographical research.

Keywords: biodiversity; checklist; conservation; history; lepidoptera; Mizoram

Introduction

“Biological diversity must be treated more seriously as a global resource, to be indexed, used and above all preserved” is the opening line of the book ‘Biodiversity' by E.O. Wilson, published in 1988. Since Wilson echoed the importance of biodiversity and its conservation, “biodiversity” has been a topic of utmost importance. Despite this diversity of organisms on Earth, innumerable concerns have been raised over the very existence of living organisms. Primarily, humans have accelerated the extinction rate, which is now approximately 0.01-0.1 % per year, resulting in the loss of about, about roughly 8700-87000 species per year. Therefore, immediate action is required to address this problem by implementing conservation programs in ecologically rich areas. The places on Earth with high levels of species richness are categorized as “biodiversity hotspots” to earmark the high level of ecological value. The term "biodiversity hotspot" was first coined by Norman Myers in 1988 where he elucidated them as “Areas that comprise less than 3.5 % of remaining primary forests which harbour over 34,000 endemic plant species (27 % of all plant species in tropical forests and 13 % of all plant species worldwide)” while also identifying 10 hotspots in his initial work (1). Later, the Critical Ecosystem Partnership Fund (CEPF) defined them as “areas on Earth that house a minimum of 1,500 species of vascular plants, known as "endemic" species and have experienced the loss of at least 70 % of their primary native vegetation (2) also these places house more than 43 % of the world’s birds, mammals, reptiles and amphibian species, it can be remarked that insects species count is largely ignored in the given definitions even though these hotspots do contain a larger species count of insects.

India is a geographically and culturally rich country, occupying an area of approximately 3.29 million km^2 and it is the seventh-largest country in the world. Of the globally identified 36 biodiversity hotspots, India is home to four namely the Western Ghats, Indo-Burman region, Sundaland and Himalayas (Fig. 1). Out of these hotspots, the Sundaland

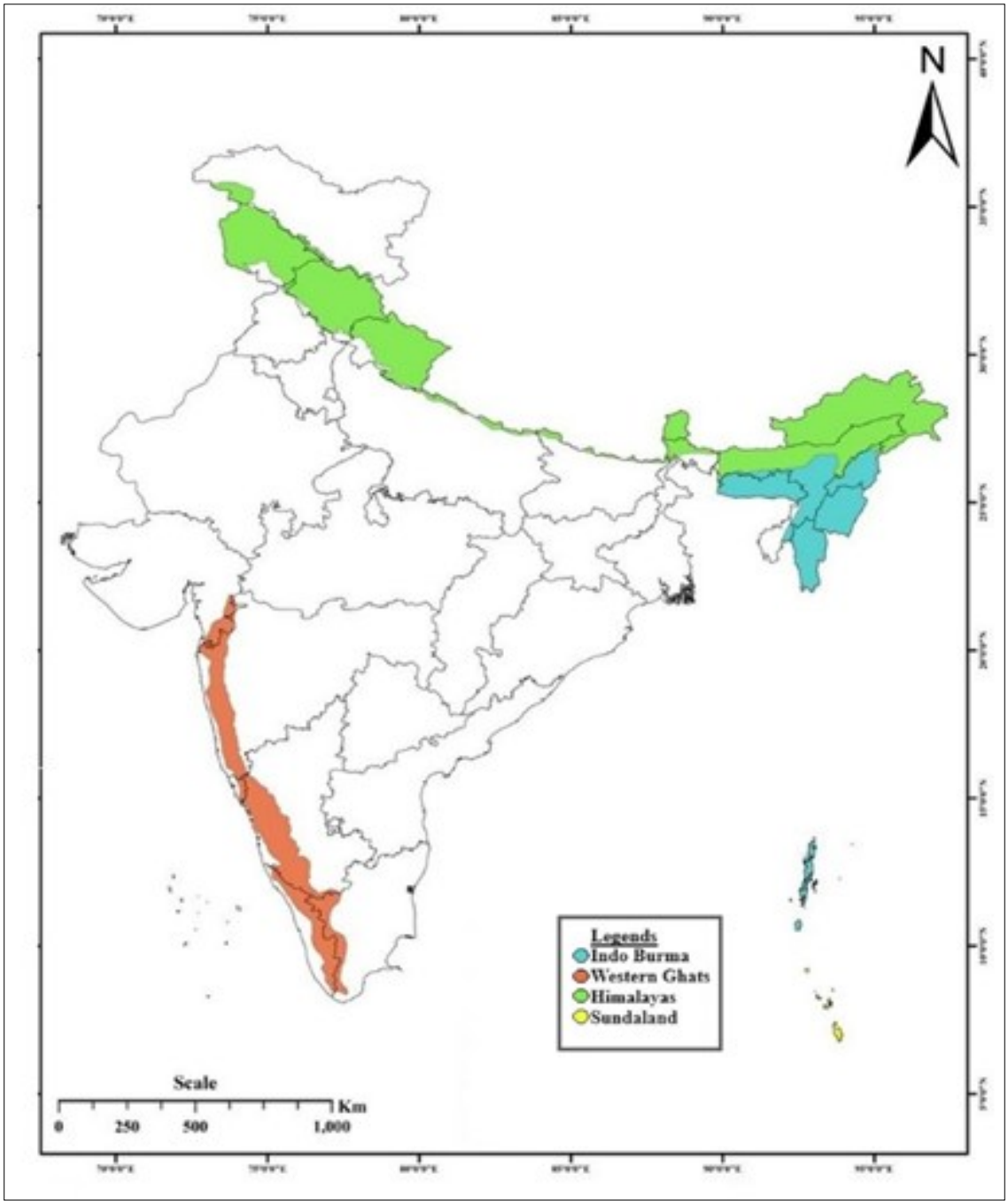


Fig. 1. Biodiversity hotspots of India.

and the Indo-Burman regions are essentially understudied mainly due to geographical, logistical and political reasons. These regions contain a large number of insect species, with estimates of 6000 or more in the Western Ghats (3), 13883 for the Indo-Burman region (4) and 24684 for the Himalayas (5). However, no published estimates are available for the Sundalands. The Indo-Burma region harbours 25.40 % of the insect diversity in the hotspots, which is high given its underexplored status, especially on the Indian side, comprising five states: Meghalaya, Nagaland, Manipur, Mizoram and Tripura.

Materials and Methods

A comprehensive search was done on the Thomson Reuters Web of Science database (WoS) using relevant keywords (Mizoram, Lushai hills, Northeast India, lepidoptera, Moths, butterfly, biodiversity, Indo-Burma**,** checklist) in different combinations, the search was repeated in Google scholar on a date range of 1890-2023 which yielded a total of 213 articles. Historical publications from the colonial era was obtained from the Biodiversity Heritage Library (BHL). Several news articles and web pages of the concerned study topic and area were also downloaded. Consequently a checklist of Moths from Mizoram was constructed as there was no comprehensive species list available. The names of the moths were updated to check for synonyms and duplicates.

The Indo-Burma hotspot

The Indo-Burma hotspot (Fig. 2) lies in 7 countries, namely India, Myanmar (Burma), Thailand, Laos, Cambodia, Vietnam and Southern China and is geographically located at 19°N-27° 30'N and 93°E-95°E. This area is formed by the subduction between the Indian and Burma microplates in Myanmar (6). It contains an estimated 2.3 % of the total endemic plants and 1.9 % of the total vertebrate species (7).

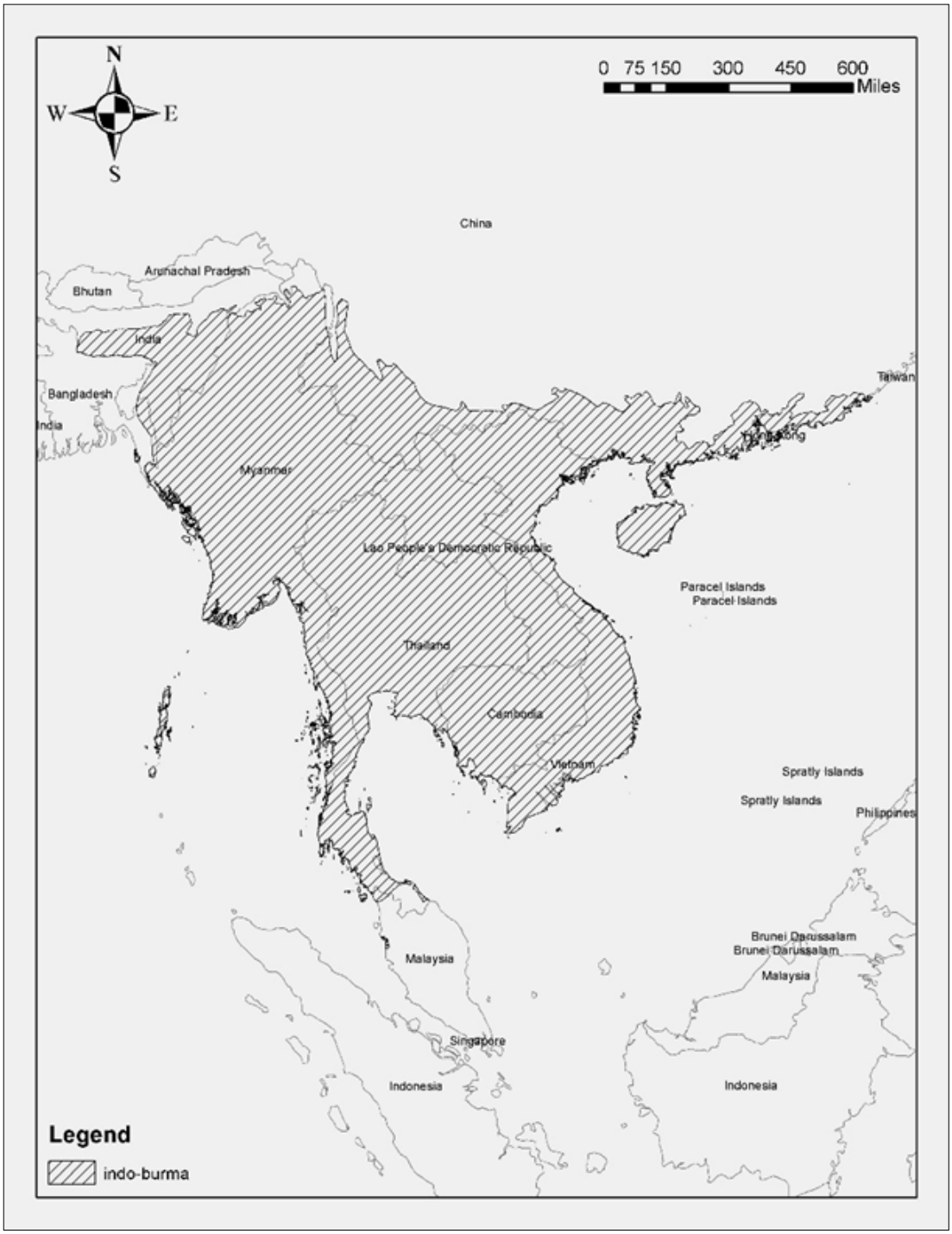


Fig. 2. Map of Indo-Burma biodiversity hotspot.

The North-East region of India, comprising eight states, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, which have long been recognized as a biodiversity hotspot within the larger Indo-Burma biodiversity region. Despite this, the North Eastern States of India were omitted from a main ecosystem profile published by CEPF (8). These areas have historically lain in or near international borders, characterized by unstable political conditions that hinder accessibility, even for researchers. However, there has been an improving appreciation for these states, particularly within the Lepidopterist community in India. This positive change is partly attributed to advancements in various modes of transportation and the gradual resolution of long-standing political dilemmas. During the colonial era, researchers such as G.F. Hampson, E.C. Cotes and Col. C. Swinhoe made significant strides in documenting the lepidopteran diversity of this region. However, only a few subsequent works have been undertaken after the publication of series like The Fauna of British India and Moths of India. The Zoological Survey of India released the state series, a collection of research papers published in the 2000s to document the area's fauna further, significantly enhancing our understanding of the biodiversity in these regions. However, large portions of this land remain unexplored, heightening the allure of discovering unique flora and fauna.

Lepidoptera studies in North East India

There has been a fair number of investigations into the order of lepidopterans in North-East India. Hampson in 1892, 1894, 1895, 1896, 1906, 1908, 1910, 1911, 1912 and1930, Moore and Swinhoe in 1892, 1892-1896, 1901-1903, 1903-1905, 1906, 1910-1911 and 1911-1912, Bingham in1905, 1907 and Talbot in 1939

and 1947 played a pioneering role in lepidopteran study in India with their book 'The Fauna of British India including Ceylon and Burma and recorded numerous species from the northeast. Previous researchers added more species of knowledge on lepidopterans in Noth Eastern India and increased the already expansive 'Fauna of British India' series (9). Studies were also made on the the specimen collected from India stored in the British Natural History Museum (10). An inventory of moths from Assam (11), which is the first species catalogue dedicated to a northeast Indian state. Recent decades have seen an interest in lepidopteran taxonomy and ecology in the remote northeast states, evident in the works of various researchers (12-27). There have also been several state-specific studies, specifically from various states of northeast India (28-35), with all the authors either working independently or in collaboration. John Heppner has conservatively estimated a total of approximately 255000 insect species, with around 157,424 species described to date (36) and in India, approximately 12,345 species have been described (37). Regionally, the tropical evergreen forests of the eastern Himalayas and hills in Meghalaya, Sikkim, Manipur, Arunachal Pradesh, Nagaland, Mizoram and Tripura have the highest insect species diversity, which is followed by the Western Ghats, then the western Himalaya and Andaman and Nicobar Islands with the third highest insect biodiversity (38). Around 3,265 moth species have been observed in the North–Eastern states of India with Meghalaya having the highest number of species (2247) and Mizoram ranking 6th with 463 species (39) the number was reduced to 410 species after correction of duplicates and construction of a comprehensive checklist in this paper (Fig. 3). Approximately 800 butterfly species are observed in Northeast India with 174 species observed in Mizoram (Fig. 4) (40). Notably, the Northeast region accounts for approximately 32.92 % of the total lepidopterans recorded in the country, despite covering only 8 % of the country's total area.

Mizoram: History, climate and geography

The history of Mizoram started with the migration of various ethnic Chin groups from the Chin State of Burma. The ancestors of the present-day Mizo people lacked a written language until the influence of the British (41). They were identified anthropologically as part of the Tibeto-Burman ethnic group. The earliest documented records of Mizoram date back to the 1850s, when British military officers encountered raids in the Chittagong Hill Tracts. The British administration, due to persistent tribal conflicts resulting in casualties, undertook military expeditions in 1871 and 1889, ultimately annexing the entire Lushai Hills (42). Mizoram attained the status of a Union Territory in 1972 (Fig. 5a) following an accord with the moderate faction of the Mizo National Front (MNF). Later, on February 20, 1987, after signing the Mizoram Peace Accord, the Union Territory was conferred the status of a full-fledged state, solidifying its political identity

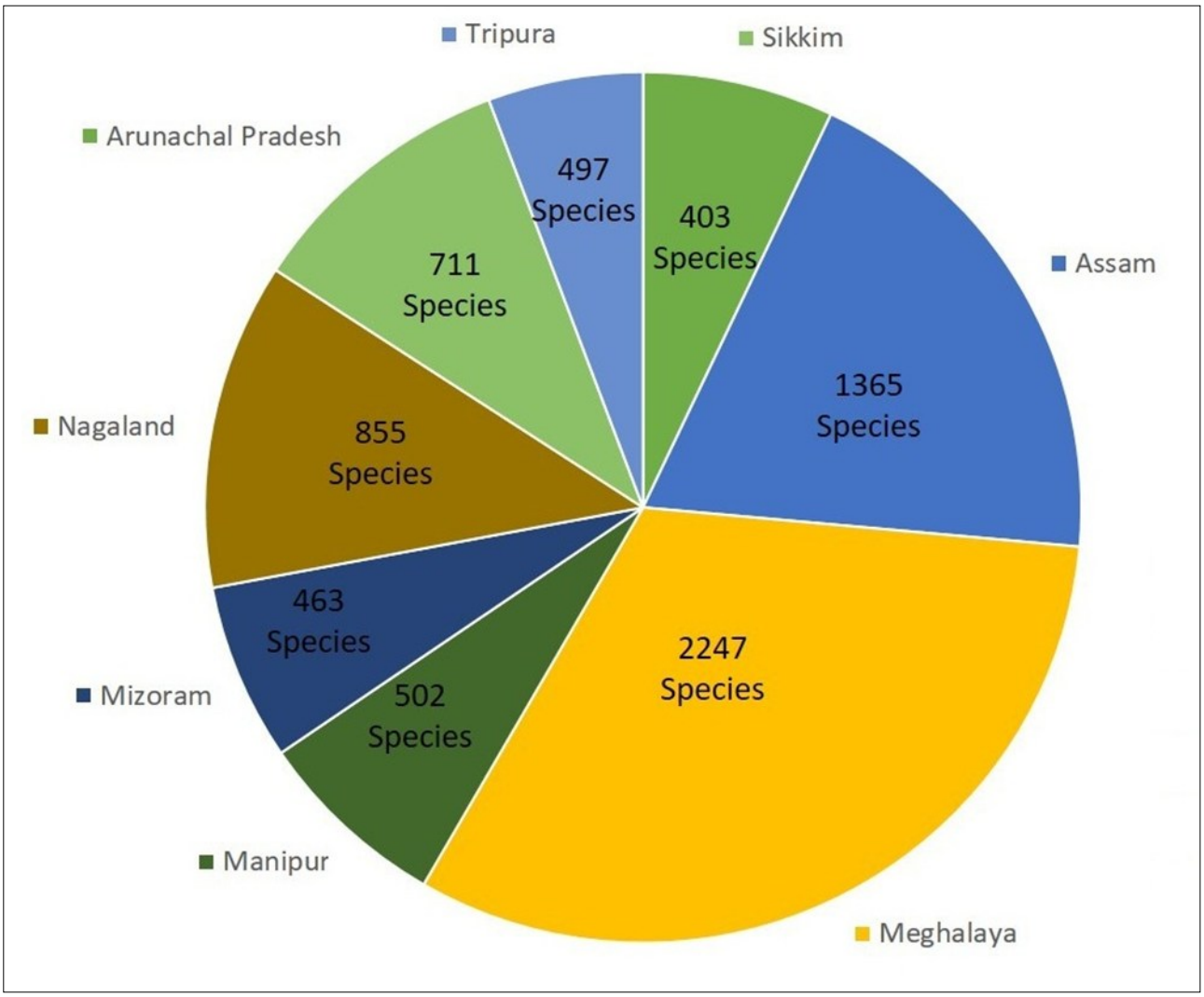


Fig. 3. Number of moth species in the different states of the North-East region.

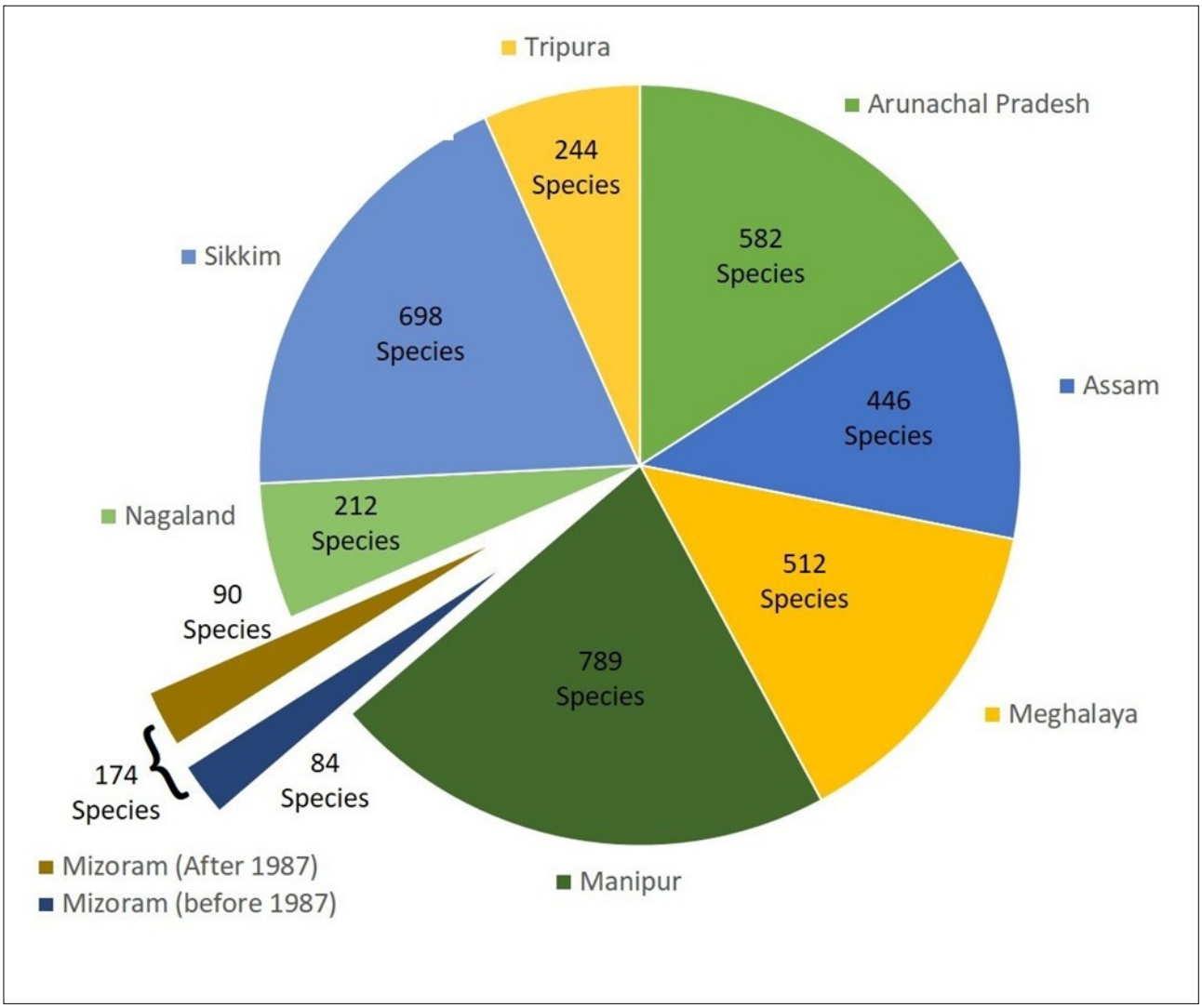


Fig. 4. Number of butterfly species in the different states of the Northeast region.

within India. Before the arrival of Welsh Christian missionaries in the early 1890s, the land's inhabitants predominantly followed animism as their spiritual belief (43) and practice Jhum farming as their primary means of subsistence. Even after converting to Christianity, the traditional way of life was rooted in the forest as the primary provider. Villagers continued to forage the forests for sustenance and trade, reflecting the enduring significance of the forest within the community. Mizoram (Fig. 5b), situated as the easternmost state in India, remains relatively unknown to many of the inhabitants due to the inherent challenges in accessibility. This unique land is a melting pot of diverse tribes. It is India's second least populated state, boasting a population density of 52 persons per square km, a notable contrast to the national average of 434.60 persons per square km (44). Mizoram also has the highest forest coverage in India, 84.53 % of its total land area of which open occupying more than 50 % (Fig. 6) (45).

Geographically, the terrain mainly comprises undulating hills, with an average elevation of 450 meters above sea level (msl). The higher peaks in the land reach around 2000 m above msl. These rugged hill ranges dominate 97 % of the topography, interspersed with valleys and occasional plain areas. It shares international borders with Myanmar to the east and Bangladesh to the west; the state is demarcated by the Tiau and Chhimtuipui rivers on the Myanmar border, while the Khawthlangtuipui River, along with its tributaries Kawrpui, Tuichawng, Phairuang, Kau and De, marks its western boundaries, which are shared with Tripura and Bangladesh. Mizoram shares national boundaries with Assam, Tripura and Manipur.

The annual rainfall ranges between 2100 mm and 3500 mm and the annual temperature during winter is 11 °C to 24 °C and in summer, between 18 °C and 29.44 °C. The temperature range is suitable for insect development, typically around 25-32 °C. Mizoram also has a high relative humidity, with an annual average of 76 % (46). The state also has two national parks, seven wildlife sanctuaries and one tiger reserve, which covers 9.48 % (1,997.75 km^2) of the state's total area (Fig. 7).

Studies of Insect Diversity in Mizoram

Despite the adaptability of insects to diverse environments, species richness significantly increases in forested landscapes, underscoring the critical role of these protected areas in supporting biodiversity. Although the explorative studies of the Mizoram areas are few and far between, especially the focus on entomology, there have been several new species of arthropods discovered since the 2010s in the state are two new species of ants of the genus Myrmecina, that is *M. bawai* and *M. reticulata* (47), a lepidopteran *Salassa mizorama* (48) and three species of beetles of the genus Maladera that is *M. alloservitrita*, *M. kolasibensis* and *M. mizoramensis* (49) along with these several insect species such as *Athyma whitei* (Lepidoptera: Nymphalidae: Limenitidinae), *Callogaeana festva* (Insecta:

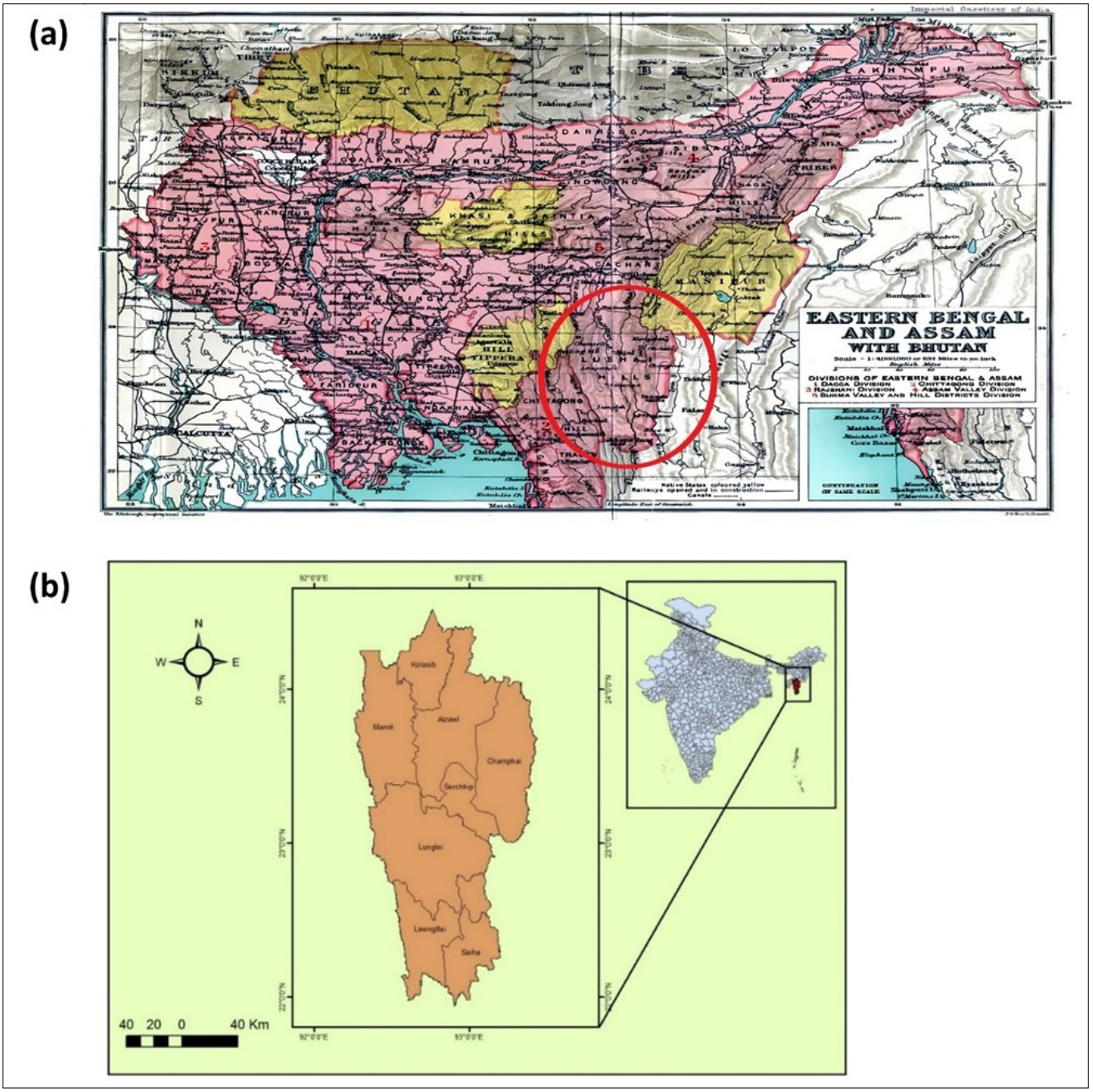


Fig. 5. (a). Map of Eastern Bengal and Assam with Bhutan highlighting the Lushai Hills (95); (b). Map of Mizoram and it location within India.

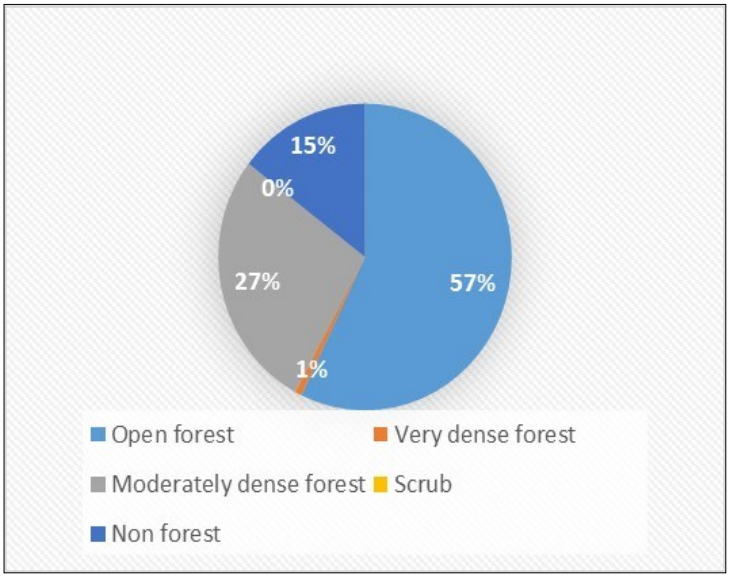
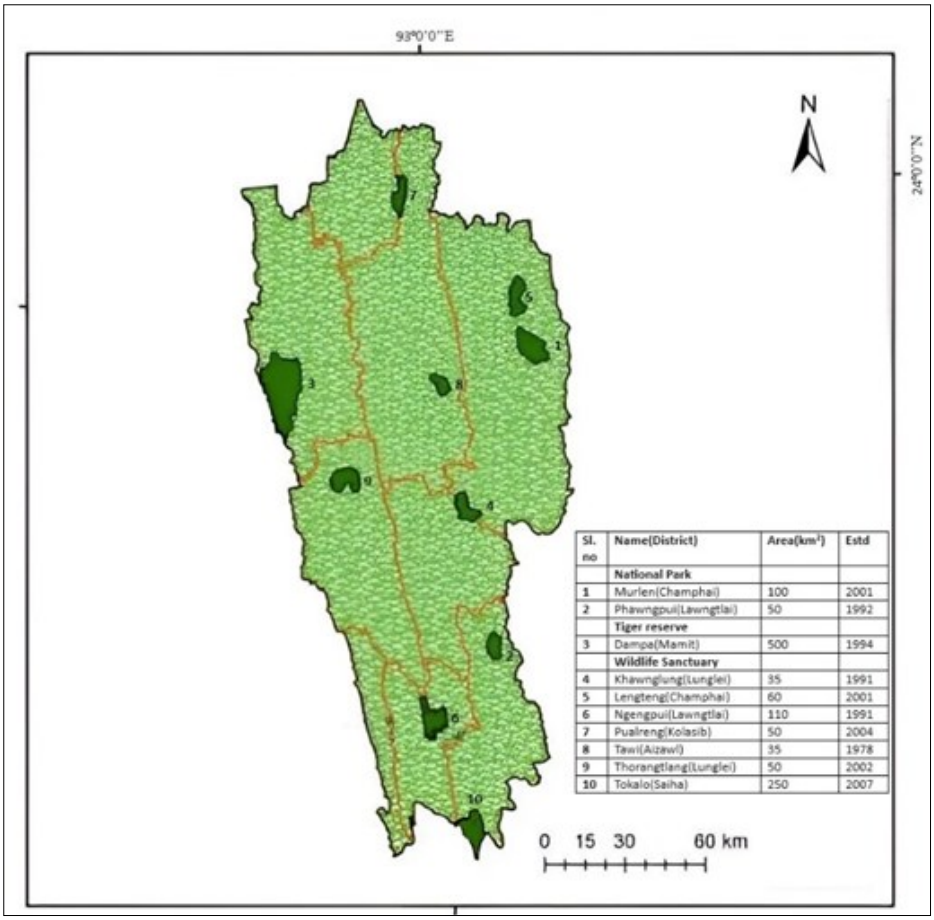


Fig. 6. Breakup of forest cover of Mizoram.



Sl. no	Name(District)	Area(km²)	Estd
	National Park		
1	Murlen(Champhai)	100	2001
2	Phawngpui(Lawngtlai)	50	1992
	Tiger reserve		
3	Dampa(Mamit)	500	1994
	Wildlife Sanctuary		
4	Khawnglung(Lunglei)	35	1991
5	Lengteng(Champhai)	60	2001
6	Ngengpui(Lawngtlai)	110	1991
7	Pualreng(Kolasib)	50	2004
8	Tawi(Aizawl)	35	1978
9	Thorangtlang(Lunglei)	50	2002
10	Tokalo(Saiha)	250	2007

Fig. 7. Wildlife reserves and their location in Mizoram.

Cicadidae), *Protanilla gengma* Hymenoptera: Formicidae: Leptanillinae), *Rosalia formosa* (Insecta: Coleoptera: Cerambycidae) (47, 50-52) whose distribution has been expanded to include Mizoram.

Lepidoptera studies in Mizoram

The exploration of Lepidoptera in Mizoram (erstwhile Lushai Hills) (Fig. 5a) dates back to 1890 when Lionel de Niceville initiated studies on this subject. He published a significant article titled "List of Chin-Lushai Butterflies" (53), which examines the specimens collected by Lieutenant D. Thompson and Mr. F. E. Dempster of the Telegraph Department during an expedition by the 28th Pponeers in the winters of 1889-1890 aimed at subjugating the Mizo tribes (53). This undertaking was prompted by a series of unsuccessful attempts to bring the tribes under control, as they were consistently raiding the tea plantations in Cachar (54). Lionel de Niceville meticulously examined the collected samples. His study categorized the lepidopterans into five families and documented 85 distinct species. Niceville's pioneering work laid the foundation for lepidopteran studies in Mizoram, setting the stage for subsequent research in this rich and diverse region. The following publications like 'The Fauna of British India, including Ceylon and Burma' did not mention specimens found in Mizoram, as the Lushai hills were a part of Assam and the locations were specified only at a state level. Due to this, the specific cataloguing of Lepidoptera in Mizoram is incomplete. Forty-eight species from 8 families from the Lushai hills were added in the book '*Lepidoptera Indica*' by Moore and Swinhoe and then by Bingham and Talbot in their publication of the '*Fauna of British India*' added four more species in the turn of the century along with four more species catalogued in '*Bibliographia lepidopterologica*' by Junk, then, after the independence of the country in 1947 the specimens collected from India and stored in the British Museum of Natural History leading to further cataloguing of 3 species by Evans, after thus the study of lepidoptera in Mizoram suffered a long hiatus of almost 50 years which as broken in 1994 with one species catalogued by Bridges in 1994. From 2000 to 2010, there was a resurgence in the studies with five publications that contained a description of 159 species of lepidoptera and in 14 families with 103 first reports (55-59), then in 2011-2020, there was a total of 106 species from 25 families catalogued from the state along with 18 new species (Fig. 8) the available decade wise publication in the area is also shown in Fig. 9 (12-15, 25, 48, 50, 60-79). In the most recent decade, from 2021 onwards, there have been five accessible publications with six new reports for the country (39, 80-84). These were then used to construct a checklist of 410 species of moths (Supp. Table 1) and on analysis of the constructed moth checklist, there are 11 superfamilies and 22 families of moths found in Mizoram, it was found that the family Noctuidae had the highest amount of subfamilies (13 subfamilies) and erebidae had the highest amount of individual species (169 species) with the second highest amount of subfamilies (10 subfamilies) (Table 1).

Protected and endemic Lepidoptera in Mizoram

Based on the provisions of the Wildlife (Protection) Act, 1972 (85), four butterfly species recorded from Mizoram were assessed for their conservation status and formally identified as endangered. Of these, two species are currently listed under Schedule II, which offers a higher degree of legal protection due to their

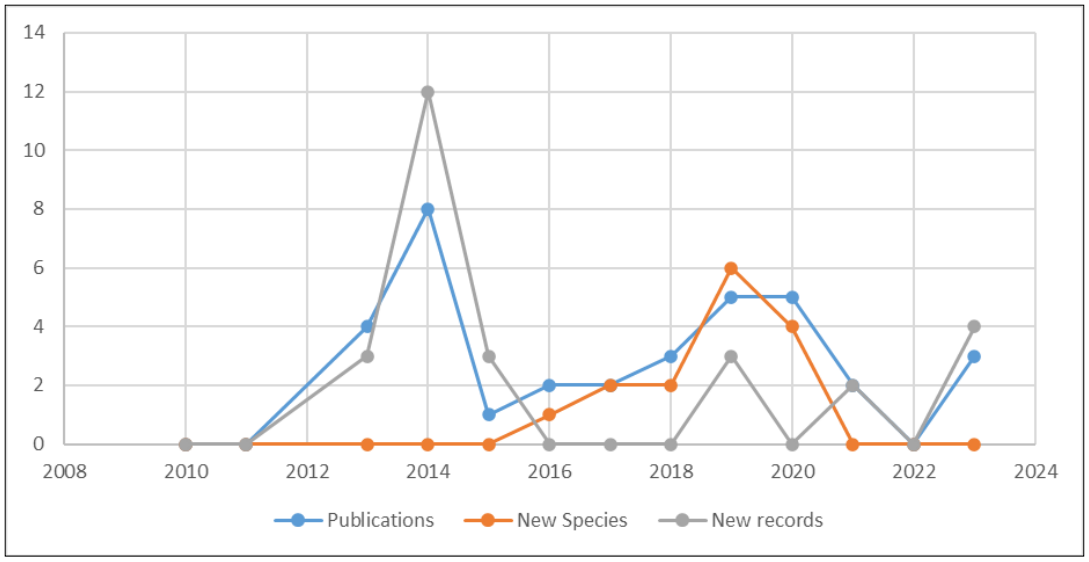


Fig. 8. Lepidopteran biodiversity publication from Mizoram from 2010-2023 with their relevant findings.

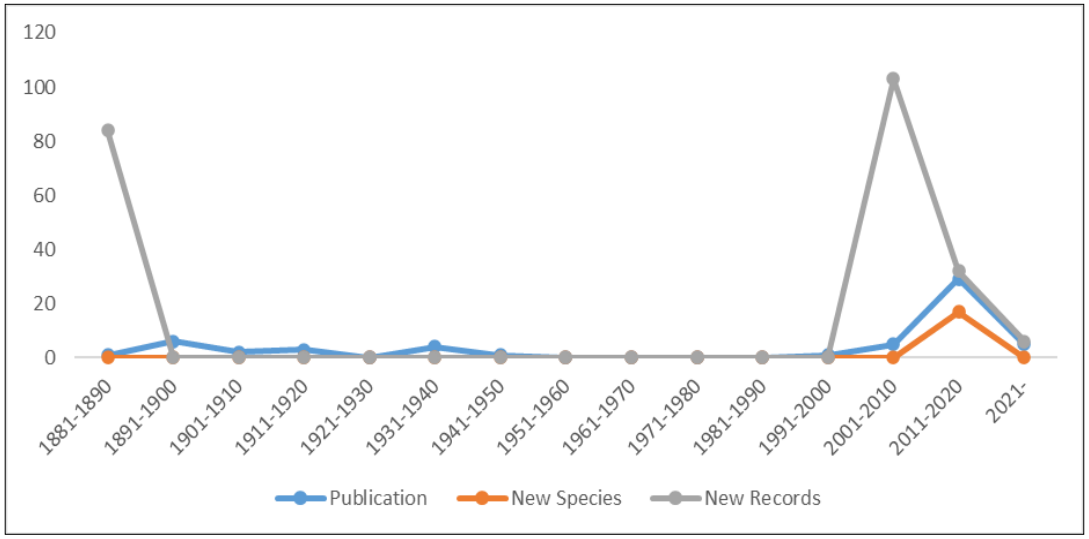


Fig. 9. Decade wise lepidopteran biodiversity publication from Mizoram from 1881 onwards with their relevant findings.

Table 1. Clades, superfamily, family and number of Moths species recorded in Mizoram

Clade	Superfamily	Family	Subfamily	Species
Apoditrysia	Gelechioidea	Elachistidae	1	1
		Oecophoridae	1	1
	Zygaenoidea	Limacodidae	1	4
Ditrysia	Tineoidea	Tineidae	1	1
	Yponomeutoidea	Attevidae	1	1
		Plutellidae	1	1
Macroheterocera	Bombycoidea	Bombicae	1	3
		Eupterotidae	1	2
		Saturniidae	2	22
		Sphingidae	3	34
	Drepanoidea	Drepanidae	3	10
	Geometroidea	Geometridae	4	71
		Uraniidae	2	4
	Lasiocampoidea	Lasiocampidae	1	5
Obtectomera	Noctuoidea	Erebidae	9	129
		Euteliidae	1	8
		Noctuidae	10	33
		Nolidae	2	7
		Notodontidae	8	10
	Hyblaeoidea	Hyblaeidae	1	2
	Pyraloidea	Crambidae	5	23
		Pyralidae	2	10

threatened status, while the remaining two species fall under Schedule IV, indicating their inclusion in the list of protected fauna with moderate protection status (Table 2). Furthermore, a comprehensive review of previously documented moth specimens from the region revealed that 22 species exhibit endemism to Mizoram (Table 3). Further studies and ground monitoring will be required to expand upon the collected information from published literature.

Economically important lepidopterans of Mizoram

There are almost 28 lepidopteran pest which cause economic losses to various agricultural and horticultural crops in Mizoram (Table 4). More than 50 % of Mizoram's population is involved in farming, however it contributes only around 5 % of the GDP (86). The major pest outbreak in recent times are rice leaf folder in rice and fall army worm in maize. Although figures of yield loss are not known, it was severe enough to induce the local government to distribute pesticides and disseminate knowledge to the farmers about control practices of the pest. In terms of economically beneficial insects, silkworm has been a growing industry with almost 5054 farmers participating over 5293 ha of land (87).

Status of insect DNA barcoding

There have been microscopic studies done in molecular taxonomy in the area, despite the advent of next-generation sequencing (NGS) and Sanger's sequencing methods. India has seen a positive trend in using DNA barcodes, leading to the steady growth of Indian origin Barcodes in repositories such as the Barcode of Life Data System (BOLD). India is ranked seventh in reported barcodes, with 13152 sequences (88). The seven states of the North-East again have a very low number of recorded barcodes. According to BOLD, only five barcodes belonging to different species are reported from Mizoram and among these, only one is from the order Lepidoptera (*Salassa mizorama*: Saturniidae). This excludes the five other publications about lepidopteran DNA barcoding, which do not possess a BIN number (74, 89-91).

Challenges of Lepidopteran studies in Mizoram and their possible solutions

The study of lepidopterans in Mizoram is a subject of interest to a few people for various reasons. Accessing the state primarily relies on roads along National Highway 54 or flights from Lengpui airport. Both transportation modes frequently face delays and weather-related issues (92). Regarding roads, the intrastate roadways are also prone to landslides and are poorly maintained, which further hampers the ease of travel to survey locations. The pervasive landslides further impede intra-state mobility, given the challenging road conditions. Currently, the railway network only extends to the Mizoram-Assam border at Bairabi, requiring a transversal of an additional 127 km of winding, often poorly maintained roads plagued by landslides. This limits the exploration of the state's forested areas, as researchers are predominantly from other parts of the nation; they also face language barriers with local guides who typically speak little to no English. Moreover, there is a noticeable lack of interest among the educated youth of the state in pursuing studies related to diversity and taxonomic research of insects. The Mizoram University is the only large scholastic body that offers a research opportunity, but other study topics are

Table 2. Protected Lepidopterans found in Mizoram

Sl. No	Scientific Name	Family	Protected under
1	*Lampides boeticus* Linnaeus, 1767	Lycaenidae	Schedule II, Indian Wildlife (Protection) Act, 1972
2	*Neptis soma soma* Moore, 1858	Nymphalidae	Schedule II, Indian Wildlife (Protection) Act, 1972
3	*Euploea mulciber mulciber* Cramer, 1777	Nymphalidae	Schedule IV, Indian Wildlife (Protection) Act, 1972
4	*Pelopidas sinensis* Mabille, 1877	Hesperiidae	Schedule IV, Indian Wildlife (Protection) Act, 1972

Table 3. Moths endemic to Mizoram in India

Sl. No	Species	Family	Source
1	*Microlithosia champhaiensis* Singh & Kirti, 2016	Erebidae	39
2	*Miltochrista falcihumilis* Singh & Kirti, 2016	Erebidae	39
3	*Miltochrista pseudolutara* Singh & Kirti, 2016	Erebidae	39
4	*Neoduma kaungtungensis* Daniel, 1951	Erebidae	39
5	*Neoeugoa humerana* Walker, 1863	Erebidae	39
6	*Teuloma microoblitterans* N. Singh, Kirti and Datta, 2019	Erebidae	76
7	*Diomea fasciata* Leech, 1900	Erebidae	16
8	*Belciades sugii* Kononenko, 1997	Noctuidae	15
9	*Ischyja hagenii* Snellen, 1885	Erebidae	16
10	*Ophisma pallescens* Walker, 1864	Erebidae	16
11	*Serrodes caesia* Warren, 1915	Erebidae	16
12	*Simplicia bimarginata* Walker, 1864	Erebidae	16
13	*Biston mediolata* Jiang, Xue and Han, 2011	Geometridae	70
14	*Borbacha punctipardaria* Holloway, 1982	Geometridae	70
15	*Luxiaria amasa* Butler, 1878	Geometridae	39
16	*Luxiaria subrasata* Walker, 1861	Geometridae	39
17	*Orothalassodes leucospilota* Moore, 1887	Geometridae	56
18	*Ariola triangulifera* Warren, 1912	Nolidae	39
19	*Asinduma exscripta* Walker, 1863	Nolidae	39
20	*Allata violaceus* Schintlmeister, 1997	Notodontidae	39
21	*Locastra mizo* Ranjan, N. Singh & Kirti, 2022	Pyralidae	93
22	*Salassa mesosa tonkiniana* Le Moult, 1933	Saturniidae	39

Table 4. Economically important lepidopteran pest found in Mizoram

Sl. No	Lepidopteran Pest	Scientific Name	Crops Affected
1.	Skipper	*Erionota thrax*	Banana, Ginger, Turmeric
2.	Leaf roller	*Sylepta derogata*	Bhendi
3.	Shoot and fruit borer	*Leucinodes orbonalis*	Brinjal
4.	Citrus leaf miner	*Phyllocnistis citrella*	Citrus
5.	Citrus butterfly	*Papilio demoleus*	Citrus
6.	Diamond back moth	*Plutella xylostella*	Cole crops
7.	Cabbage semilooper	*Trichoplusia ni*	Cole crops
8.	Head borer	*Hellula undalis*	Cole crops
9.	Rhizome borer / Stem borer	*Palpita haematichroa (implied)*	Ginger, Turmeric
10.	Fruit sucking moth	*Eudocima spp*	Guava
11.	Leaf folder	*Omiodes indicata*	Lab-lab, Soybean
12.	Semilooper	*Chrysodeixis spp*	Lab-lab, Soybean, Beans, Cole crops
13.	Cob borer	*Stenachroia elongella*	Maize
14.	Stem borer (Maize)	*Chilo partellus*	Maize
15.	Fall army worm	*Spodoptera frugiperda*	Maize
16.	Maize webworm	*Marasmia trapezalis*	Maize
17.	Leaf webber	*Orthaga euadrusalis, Herpetogramma bipunctalis*	Mango, Brinjal
18.	Black hairy caterpillar	*Spilosoma obliqua*	Ragi
19.	Pod borer	*Helicoverpa armigera (implied)*	Red gram, Cowpea, Lab-lab, Lentil, Tomato, Bhendi
20.	Yellow stem borer	*Scirpophaga incertulas*	Rice
21.	Striped rice borer	*Chilo suppressalis*	Rice
22.	Rice leaf folders	*Cnaphalocrocis medinalis, Marasmia patnalis,Marasmia ruralis*	Rice
23.	Rice skipper	*Pelopidas mathias*	Rice
24.	Swarming caterpillar	*Spodoptera mauritia*	Rice
25.	White stem borer	*Scirpophaga innotata*	Rice
26.	Mythimna armyworm	*Mythimna separata*	Rice, Maize, Groundnut, Soybean
27.	Pink borer	*Sesamia inferens*	Rice, Maize, Ragi
28.	Fruit borer	*Helicoverpa armigera*	Tomato, Bhendi

favoured again due to job prospects. Although the government of Mizoram has made commendable efforts to conserve its forests and natural resources, a shortage of an experienced workforce hampers the documentation of flora and fauna in these areas. Even in historical scientific literature, such as the Fauna of British India, Ceylon and Burma Series, the blurred delineation of borders before 1972, when the state was not yet established, makes it difficult to authenticate reports unless they are designated explicitly about the Lushai Hills region. Therefore, the total species count of Lepidoptera and almost all animal and plant species in Mizoram may be questioned. Another issue is the lack of funding for biodiversity and taxonomy studies, a widely recognized problem in science. As the study of biodiversity and taxonomy in an area is a precursor to conservation, the lack of information may significantly hamper conservation efforts in these areas.

The way forward from the listed impediments is to train more local taxonomists with better funding who can actively collaborate with experienced taxonomists from the mainland. The government and academic institutions must also play a part, as research in this field requires funding and specialized tools. The suggested solution can be promoted by inciting Mizoram as a favourable destination and using its inherent enormous biodiversity as its main attraction; this will incentivize the general public, the government and other organizations to take action in the exploration and conservation of Mizoram and other areas of the Northeast region as a whole, as these areas are a sorely under-explored region in terms of natural flora and fauna and diverse ecosystems.

Future prospects

The field has witnessed a consistent increase in researchers, as evidenced by a steady rise in publications. However, much work remains to be done. Efforts are underway to address transportation challenges by constructing a new railway station at Sairang, near the capital, with the aim of alleviating travel-related issues and financial burdens. The North-East region of India is widely recognized as a biodiversity hotspot and to fully capitalize on this wealth, fostering a community of resident specialists is essential. Rather than relying on visiting experts with limited time for research in a distant state, having local expertise is paramount. The government can play a pivotal role by actively promoting eco-tourism and showcasing the state's natural fauna and flora. This has the potential to generate revenue and raise awareness for conservation efforts. Increasing awareness among the residents is crucial. Educational initiatives and campaigns can bridge this gap, ensuring that the region's people recognize and appreciate the ecological significance of their surroundings. By actively involving and informing the local community, we can harness their support and contribute to the sustainable conservation of the region's unique biodiversity.

Conclusion

The study of taxonomy as a whole was once at the forefront of the study of natural history, but the subject is now facing a decline due to its lack of job prospects, regardless, there is still a dearth of taxonomical studies in many parts of the world which were previously difficult to access, Mizoram being a prime example. This study aims to establish a starting platform to future studies in the subject and as a reference to field scientist about the general standing of Lepidoptera studies within Mizoram.

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Authors' contributions

All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by MH. The first draft of the manuscript was written by MH, CN, SRP, SGP, KR, BV and DN and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

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