Research Article

Tropical Animals

Species Richness, Abundance, and Conservation Status of Butterflies in Inadan, San Miguel, Surigao del Sur, Philippines

Yazee Shyne C. Tulbo ✉, **Nethan A. Ramos**, **Alleyah Nicolette I. Lina**, **Clinton D. Sequihod**

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Abstract: The butterfly species found in Sitio Inadan, San Miguel, Surigao del Sur, Philippines were surveyed and documented using transect walks, visual observation, and hand net collection. Four transects were established in selected habitat areas, each measuring approximately 3.05 mi. Sampling was conducted from 7:00 AM to 5:00 PM over six consecutive weekends, with one primary observer recording all sightings and captures. A total of 16 species belonging to four families and 14 genera were identified. The family *Nymphalidae* comprised about 56% of the recorded species, followed by *Pieridae*, *Papilionidae*, and *Lycaenidae*. Abundance categories were based on encounter frequency, where species observed once or twice were classified as Very Rare, and those seen more often were categorized as Common or Very Common. Conservation status was verified using the International Union for Conservation of Nature (IUCN) Red List to distinguish global status from local rarity. Although most species are listed as Least Concern, limited sampling suggests possible undersampling of the area.

Introduction

Butterflies (*Order Lepidoptera*) play a crucial ecological role in terrestrial ecosystems, functioning as pollinators, components of food webs, and sensitive bioindicators of environmental quality (1). Their close dependence on vegetation structure, availability of larval host plants, floral resources, and microclimatic conditions makes butterfly communities strongly linked to habitat integrity and overall biodiversity health (2). Consequently, patterns of butterfly species richness and abundance have been widely used to reflect environmental change, land-use dynamics, and ecosystem condition across forested and semi-natural landscapes (3). In the Philippines, a recognized biodiversity hotspot, approximately 915 butterfly species have been recorded, of which more than 350 are endemic, accounting for nearly 10% of the world's endemic butterfly fauna (4). Despite this remarkable richness, comprehensive and site-specific data on butterfly communities remain limited, particularly in forested and semi-natural landscapes outside formally protected areas (5).

The urgency of documenting butterfly diversity is underscored by widespread population declines reported across Southeast Asia, driven primarily by anthropogenic pressures such as deforestation, agricultural expansion, urbanization, and climate variability (6). Numerous studies have consistently shown that habitat fragmentation, loss of floral and larval resources, changes in vegetation structure, and extreme weather events contribute to reductions in species richness and shifts in butterfly community composition (7). Although some generalist species may persist in disturbed environments, habitat specialists are particularly vulnerable to sustained habitat degradation, emphasizing the importance of localized biodiversity assessments (8). In Surigao del Sur, previous research has identified relatively high butterfly diversity in selected lowland forests; however, these studies remain spatially limited and do not adequately represent smaller, less-studied forest patches.

Inadan, a forested area in San Miguel, Surigao del Sur, supports heterogeneous vegetation and provides a suitable habitat for various faunal groups, yet no scientific assessment of butterfly species richness, abundance, and conservation status has been conducted in this area (9). This lack of baseline ecological data constrains informed conservation planning and biodiversity management at the local scale (10). Current approaches to butterfly conservation rely heavily on biodiversity inventories, habitat quality assessments, and long-term monitoring to guide management strategies, but many rural forest ecosystems in the Philippines remain underrepresented in

Figure 1. Location of the study. A. Philippines showing the location of Surigao del sur. B. Sitio Inadan, San Miguel, Surigao del sur. (Photo credits: google earth 2025, and google map 2025).

Figure 2. Shows an actual image of Inadan, highlighting the site where the butterflies were observed, recorded, and collected.

Figure 3. Shows the mapped trail routes within the study area, highlighting the different paths taken during data collection across varying elevations.

such efforts (11). Addressing this gap, the present study provides the first systematic documentation of butterfly species richness, abundance, and conservation status in Inadan, San Miguel, Surigao del Sur. Using transect-based visual encounter surveys and opportunistic sampling with hand nets, this study aims to generate baseline ecological data to support future monitoring, conservation initiatives, and sustainable land-use planning. By contributing localized biodiversity information, the study advances current knowledge on butterfly distribution in Mindanao and highlights the ecological significance of understudied forest habitats.

Methodology

Study Design and Rationale

This study employed a descriptive, field-based ecological survey to document butterfly species richness, relative abundance, and conservation status in an understudied forest landscape in Inadan, San Miguel, Surigao del Sur, Philippines. A cross-sectional sampling design was adopted to generate baseline biodiversity data, consistent with the study objective of providing an initial ecological assessment for an area lacking prior entomological documentation. Butterflies were selected as focal taxa due to their sensitivity to habitat structure, vegetation composition, and microclimatic conditions, making them reliable indicators of ecosystem integrity.

Study Area

Field surveys were conducted in Sitio Inadan, Barangay Magroyong, San Miguel, Surigao del Sur, Mindanao, Philippines, as illustrated in **Figure 1** while the actual condition of the sampling site is presented in **Figure 2**. The area is characterized by secondary forest vegetation interspersed with shrubs, flowering plants, and small-scale agroforestry patches, forming a heterogeneous habitat mosaic. Sampling locations were established along existing forest trails and semi-open areas to capture variation in vegetation structure and resource availability. Geographic coordinates and elevation of each transect were recorded using a handheld Global Positioning System (GPS) unit to ensure spatial accuracy and facilitate reproducibility.

Sampling Design and Criteria

Butterfly sampling was conducted using transect-based visual encounter surveys combined with opportunistic net capture. Surveys were performed once per week over a four-week sampling period during favorable weather conditions (clear to partly cloudy skies, no rainfall, low wind speed) to minimize detectability bias. Observations were carried out between 7:00 AM to 4:00 PM, corresponding to peak butterfly activity periods. The mapped transect routes established within the study area are shown in **Figure 3**. This sampling schedule was designed to maximize detection probability while ensuring consistency in observation effort across sampling days. Weather conditions were monitored prior to each survey to maintain comparable environmental circumstances throughout the study period.

Each transect was surveyed by walking at a constant slow pace, recording all butterflies observed within an approximate 5 m horizontal distance on either side of the transect line. Individuals were included regardless of sex; life stages were recorded when identifiable, although quantitative analyses focused on adult butterflies. Individuals that could not be confidently identified to

species level, either visually or through capture, were excluded from abundance analyses to ensure data reliability.

Materials and Field Techniques

Butterflies were captured using handheld insect nets. Specimens were handled using soft-tipped forceps to minimize physical damage and stress. Captured individuals were temporarily placed in labeled, transparent containers for documentation. Each specimen was photographed in both dorsal and ventral orientations using a high-resolution smartphone camera to support subsequent taxonomic verification.

Specimens selected for preservation were processed following standard entomological procedures, including relaxation, wing spreading using tracing paper, pinning, and air-drying. Preserved specimens were protected from fungal growth and insect damage using naphthalene-based repellents and stored in sealed containers.

Species Identification and Taxonomic Verification

Species identification was conducted using regional field guides and taxonomic keys for Philippine Lepidoptera, supplemented by verified online databases (12). Diagnostic morphological characters, including wing coloration, pattern, venation, size, and antennal structure, were examined. Taxonomic determinations were cross-validated by an experienced entomologist affiliated with the Department of Environment and Natural Resources (DENR), Surigao del Sur, to ensure accuracy and consistency.

Data Analysis

Species richness was calculated as the total number of butterfly species recorded during the sampling period. Relative abundance was assessed using frequency of occurrence and categorized into four qualitative classes, very rare, rare, common, and very common, based on encounter rates across sampling occasions. Conservation status (e. g., vulnerable, endangered) and ecological status (native or endemic) were assigned based on established national and regional conservation references.

Data analysis was primarily descriptive, reflecting the exploratory nature and baseline objective of the study. Inferential statistical analyses were not applied due to the limited temporal scope and absence of prior comparative datasets, an approach appropriate for preliminary biodiversity inventories in data-deficient areas.

Ethical Considerations

Specimen collection was minimized and conducted solely for scientific documentation and taxonomic verification. All field activities complied with local environmental regulations and ethical standards for wildlife research. Permissions to conduct fieldwork were obtained from relevant local authorities and landowners before data collection.

Results and Discussion

Species Composition of Butterflies

There were 16 species of butterflies belonging to four families and 14 genera from Sitio Inadan, Magroyong, San Miguel, Surigao del Sur (**Table 1**). The butterfly species inhabiting the area are fewer than in other places surveyed. Thus, it can be seen quite clearly that the devastation of forests by tree felling is destroying the food and habitat of the butterflies. The *Nymphalidae* family or brush-footed butterflies are the most widely distributed butterfly family throughout Inadan. These low numbers contrast with previous studies (12-14) conducted in the area, which reported a much healthier and more undisturbed forest ecosystem with greater availability of host plants. This underscores the need to conserve this site

Table 1. Checklist of butterflies recorded in Sitio Inadan, San Miguel, Surigao del Sur, Philippines.

Family	Genus	Species	Scientific Name
Lycaenidae	Jamides	*Jamides alecto manilana*	Toxopeus, 1930
Lycaenidae	Zizina	*Zizina otis oriebis*	Fabricius, 1787
Nymphalidae	Athyma	*Athyma ranga*	H. Moore, 1858
Nymphalidae	Euploea	*Euploea tobleri snellerii*	Osada & Hashimoto, 1987
Nymphalidae	Euploea	*Euploea sp.*	-
Nymphalidae	Hypolimnas	*Hypolimnas anomala*	Wallace, 1869
Nymphalidae	Tirumala	*Tirumala limniace*	Cramer, 1775
Nymphalidae	Mycalesis	*Mycalesis janardana micromedex*	Fruhstorfer, 1900
Nymphalidae	Neptis	*Neptis hylas*	Linnaeus, 1758
Nymphalidae	Phaedyma	*Phaedyma columella*	Cramer, 1780
Nymphalidae	Junonia	*Junonia almana*	Linnaeus, 1758
Nymphalidae	Junonia	*Junonia sp.*	-
Nymphalidae	Yoma	*Yoma sp.*	-
Papilionidae	Menelaides	*Menelaides deiphobus rumanzovia*	Eschscholtz, 1821
Papilionidae	Papilio	*Papilio polytes*	Linnaeus, 1758
Pieridae	Eurema	*Eurema sarilata sarilata*	*Semper, 1891*

Table 2. Number of butterfly individuals collected and cumulative species recorded during four sampling days in Sitio Inadan, San Miguel, Surigao del Sur, Philippines.

Sampling Day	Collected	New Species Found	Total species (Cumulative)
Day 1	3	0	1
Day 2	6	0	1
Day 3	4	0	1
Day 4	3	0	1

(15). The sampling accumulation across survey days, including the number of individuals collected and species detected, is summarized in **Table 2.**

The most specious families are *Nymphalidae* (11), *Lycaeenidae* (2), *Papilionidae* (2) and *Pieridae* (1). The *Nymphalidae* family, also known as brush-footed butterflies, is the largest and most ecologically diverse butterfly lineage in the world.

Assessment of Conservation and Ecological Status of Butterflies

A total of 16 butterfly species were recorded in Sitio Inadan, Magroyong, San Miguel, Surigao del Sur, Philippines, and their conservation and ecological classifications are summarized in **Table 3**. In the Eological Status six butterfly species were recorded as Endemic this are the, *J. alecto manilana* Toxopeus, 1930, *E. tobleri snellerii* Osada and Hashimoto, 1987, *H. anomala* Wallance, 1869, *M. janardana micromede* Frushtofer, 1900, *M. deophobus rumanzovia* Eshsholtz, 1821, and *E. sarilata sarilata* Semper, 1891; ten butterfly species were also recorded as Native this are the, *Z. otis oriebs* Fabricus, 1781, *A. ranga* H. Moore, 1858, *Euploea* sp. *T. limniace* Cramer, 1775, *N. hylas* Linnaeus, 1780. *P. columella* Cramer, 1780, *J. almana* Linnaeus, 1978, *Junonia* sp., *Yoma* sp., and *P. polytes* Linnaeus 1758.

In the Conservation Status there were nine butterfly species were recorded as Vulnerable this species are the, *J. alecto, manilana* Toxopeus, 1930, *Euploea* sp., *T. limniae* Cramer, 1775, *N. hylas* Linnaeus, 1758, *P. columella*, 1780, *J. almana* Linnaeus, 1978, *Junonia* sp., *Yoma* sp., and *P. polytes* 1758; six butterfly species were also recorded as Endangered this species are the, *Z. otis oriebs* Fabricu, 1787, *A. ranga* H. Moore 1858, *E. toobbleri snellerii* Osada and Hashimoto, 1987, *H. anomala* Wallace, 1869, *M. janardana micromede* Frushtofer, 1900, *M. deophobus rumanzovia* Eshsccholts, 1821, and *E. sarilata* Semper, 1891.

The IUCN Red List was used to determine the conservation and ecological status of the recorded butterfly species, categorizing them according to their level of extinction risk based on internationally recognized assessment criteria and threat categories.

Frequency of Butterfly Species

The frequency results showed that butterfly occurrence in Sitio Inadan varied among species and families, with members of the family *Nymphalidae* recorded most frequently during the sampling period, as illustrated in **Figure 4** and summarized in **Table 4**. Species such as *J. almana*, *T. limniace*, and *N. hylas* were observed more often compared to other species, indicating that these butterflies are well-adapted to the existing habitat conditions, including the availability of nectar plants and suitable host plants. In contrast, species under *Papilionidae* and *Pieridae* were recorded less frequently, which may suggest limited resources, habitat disturbance, or specific ecological requirements. The higher frequency of certain

Table 3. Assessment of conservation and ecological status of butterflies.

Species Scientific Name	Conservation Status	Ecological Status
Jamides alecto manilana Toxopeus, 1930	Least Concern	Native
Zizina otis oriebs Fabricus, 1787	Least Concern	Native
Athyma ranga H. Moore, 1858	Not assessed	Not assessed
Euploea tobleri snellerii Osada and Hashimoto, 1987	Near threatened	Endemic
Euploea sp.	Not assessed	Not assessed
Hypolinas anomala Wallace, 1869	Least Concern	Endemic
Tirumala limniace Cramer, 1775	Least Concern	Native
Mycalesis janardana micromede Frushtofer, 1900	Least Concern	Native
Neptis hylas Linnaeus, 1758	Not assessed	Not assessed
Phaedyma columella Cramer, 1780	Not assessed	Not assessed
Junonia almana Linnaeus, 1978	Not assessed	Not assessed
Junonia sp.	Not assessed	Not assessed
Yoma sp.	Not assessed	Not assessed
Menelaides deophobus rumanzovia Eshscholtz, 1821	Not assessed	Not assessed
Papilio polytes Linnaeus, 1758	Least concern	Native
Eurema sarilata sarilata Semper, 1891	Not assessed	Not assessed

species reflects their ecological flexibility and tolerance to moderate environmental changes, while the lower frequency of others may indicate sensitivity to habitat alteration. Overall, the variation in butterfly frequency highlights the influence of vegetation structure, food availability, and microclimatic conditions on species distribution in the study area.

Conclusion

Inadan exhibited a medium level of butterfly diversity across four regions, with sixteen species recorded during the sampling period, indicating a moderately structured butterfly community overall within the study area and surrounding habitats. Species richness was low, and several species were observed only once or twice, suggesting a high proportion of locally rare species and uneven distribution across sampling sites. Although many identified butterflies are generally common in the Philippines, their low encounter rate suggests possible habitat pressure or localized environmental constraints influencing species occurrence. Conservation status was verified using the International Union for Conservation of Nature (IUCN) listings to ensure standardized classification and reliable assessment of species vulnerability. The presence of rare and vulnerable species, together with limited encounters, may reflect environmental changes, habitat modification, or human disturbance affecting ecological stability in the area. These findings highlight the importance of continued biodiversity monitoring to better understand temporal changes in butterfly populations and habitat quality. Maintaining suitable vegetation structure and minimizing anthropogenic disturbances may help sustain butterfly diversity and support ecosystem balance. Furthermore, the results provide baseline ecological information that can assist future conservation planning and environmental management initiatives within the locality. Long-term monitoring and community-based conservation efforts are therefore recommended to protect butterfly habitats and promote sustainable biodiversity conservation in Inadan and adjacent areas.

Declaration

Author Information

Yazee Shyne C. Tulbo
*Corresponding author
San Miguel National Comprehensive High School.
Contribution: Conceptualization, Data Curation, Investigation, Methodology, Writing - Original Draft, Writing - Review & Editing.

Nethan A. Ramos
San Miguel National Comprehensive High School.
Contribution: Conceptualization, Data Curation, Investigation, Methodology, Writing - Original Draft, Writing - Review & Editing.

Alleyah Nicolette I. Lina
San Miguel National Comprehensive High School.

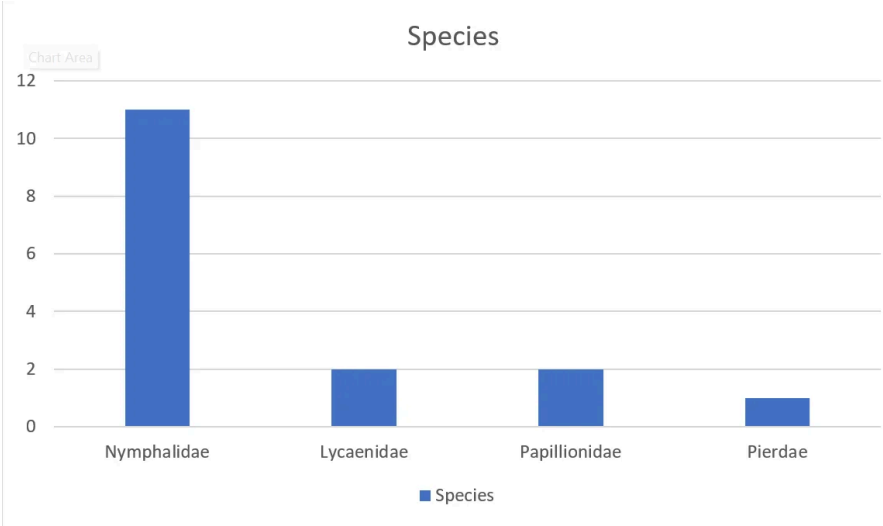

Figure 4. Distribution of butterfly species among families recorded during the survey in Sitio Inadan, San Miguel, Surigao del Sur, Philippines, highlighting the dominance of the family *Nymphalidae* compared with *Lycaenidae*, *Papilionidae*, and *Pieridae*.

Table 4. Butterfly encounter frequency and total individuals recorded across sampling transects in Sitio Inadan, Magroyong, San Miguel, Surigao del Sur, Philippines.

Transect	Visit 1	Visit 2	Visit 3	Visit 4	Total Individuals	Encounter Frequency (%)
T1	1	1	3	2	7	60%
T2	0	1	0	0	1	5%
T3	2	1	0	0	3	15%
T4	0	1	1	2	4	20%

Contribution: Conceptualization, Data Curation, Investigation, Methodology, Writing-Original Draft, Writing-Review & Editing.

Clinton D. Sequihod
San Miguel National Comprehensive High School.
Contribution: Conceptualization, Data Curation, Investigation, Methodology, Writing - Original Draft, Writing - Review & Editing.

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Conflict of Interest
The authors declare no conflicting interest.

Data Availability
All data generated or analyzed during this study are included in this published article.

Ethics Statement
Ethical approval was not required for this study.

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