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A Study on Butterfly Diversity in Port Moresby in Papua New Guinea

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Abstract

This study investigates butterfly diversity across three distinct habitats—Adventure Park, IBS University campus, and Pacific Adventist University—over a four-month period from April to July 2019. Field surveys were conducted three times weekly using random walk-through observations and photographic documentation for species identification. Diversity was quantified using the Simpson Index of Diversity, revealing the highest diversity at Pacific Adventist University (0.47), followed by IBS University (0.42) and Adventure Park (0.38). A total of 233 butterflies were recorded, with the Nymphalidae family emerging as the most dominant across all sites. Species were categorized by abundance: four were abundant, two common, eight less common, and seven occasional. Habitat complexity—including gardens, orchards, and agroforestry—was found to influence species richness. The findings align with previous studies and underscore the ecological importance of butterfly diversity in the region. The study advocates for further research and conservation efforts, including the development of butterfly parks.

Keywords: Diversity, Butterfly, IBS University, Conservation

1. INTRODUCTION

Papua New Guinea is an beautiful country in the southwestern Pacific, known for its rich cultural diversity and stunning natural landscapes. It inhabits the eastern half

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of the island of New Guinea and includes numerous smaller islands. (Ronald et al.,1991) Papua New Guinea has a total land area of 452,860 square kilometers (174,850 square miles) As of 2025, its population is estimated to be around 10.8 million people. (Saunders,1993) The country ranks 90th in the world by population, with a relatively low population density of 24 people per square kilometer. (United Nations,2024) Papua New Guinea is home to incredibly diverse cultural traditions. The Sing-sing is a traditional congregation in Papua New Guinea where tribes showcase their distinct cultures through dance, music, and elaborate decorations. These events serve as a way for communities to celebrate their heritage and share traditions. (Chenoweth,2000)

Papua New Guinea: A Biodiversity Treasure Worth Protecting

Papua New Guinea is a biodiversity hotspot, home to an incredible variety of flora and fauna. Its dense rainforests, coastal mangroves, and mountainous regions support over 4,624 vertebrate species, including the iconic birds of paradise, cassowaries, and the elusive New Guinea singing dog. The country's plant life is equally diverse, with mangroves, orchids, and towering rainforest trees dominating the landscape. Many species found here are endemic, meaning they exist nowhere else in the world. The region's biodiversity is shaped by its unique geological history, with species originating from both Australia and Asia due to past land connections. However, conservation efforts are crucial as deforestation, habitat loss, and climate change threaten many of these species. Protecting Papua New Guinea's natural environment is essential for maintaining its ecological balance and preserving its rich cultural heritage.

Study Area: Port Moresby

Port Moresby in Papua New Guinea is home to a remarkable diversity of butterflies, including some of the world's largest and most vibrant species. Among them, the Queen Alexandra's Birdwing stands out as the largest butterfly on Earth, with a wingspan reaching up to 30 cm. The country's tropical rainforests and varied landscapes provide an ideal habitat for numerous butterfly species, including the Paradise Birdwing, Banana Skipper, and Fat Tiger. Conservation efforts, such as butterfly ranching, help protect these delicate creatures while promoting sustainable livelihoods for local communities. However, habitat destruction and climate change pose significant threats to their survival, making conservation initiatives crucial for preserving Papua New Guinea's rich biodiversity.

irrelevant data attributes, enhancing classification accuracy, interpretability, and robustness in medical diagnostics. The system seeks to address challenges associated with nois The ultimate goal is to deliver a reliable, reproducible, and adaptive CAD prediction framework that aligns with real-world healthcare needs, particularly in regions with

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Estimated populations butterflies of Port Moresby (Papua New Guinea)

Common Name	Scientific Name	Wingspan	Estimated Population	Notable Features
Queen Alexandra's Birdwing	*Ornithoptera alexandrae*	Up to 30 cm	Fewer than 1,000	Largest butterfly in the world
Paradise Birdwing	*Ornithoptera paradisea*	12-15 cm	Several thousand	Bright green and yellow wings
Banana Skipper	*Erionota thrax*	5-7 cm	Widespread	Fast-flying, brown wings
Fat Tiger	*Parantica rotundata*	8-10 cm	Unknown	Black and yellow patterns

Source: Petrasanek and Vojtech Novotny,Demography and Mobility of Three Common Understory Butterfly Species from Tropical Rainforest of Papua New Guinea Volume 57, Population Ecology publication, 2015, Pp 445-455

Table 1: Checklist of the species of butterfly recorded in the study area

Family	Common Name	Scientific Name	Habitat/Notes	Individual Number of Butterflies
Papilionidae	New Guinea Birdwing	*Ornithoptera priamus*	Common in lowland forests and gardens	10
Papilionidae	Goliath Birdwing	*Ornithoptera goliath*	Found in nearby forested hills, very large species	5

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Nymphalidae	Blue Tiger	*Tirumala hamata*	Migratory, often seen near coastlines and open areas	63
Nymphalidae	Cruiser	*Vindula arsinoe*	Bright orange, common in forest edges and parks	15
Nymphalidae	Cruiser	*Vindula arsinoe*	Bright orange, common in forest edges and parks	6
Nymphalidae	Danaid Eggfly	*Hypolimnas misippus*	Mimics the Plain Tiger; females vary in pattern; found in open areas	14
Nymphalidae	Common Palmfly	*Elymnias hypermnestra*	Prefers shaded areas; mimics other butterfly species	16
Nymphalidae	Fat Tiger	*Parantica rotundata*	Slow-flying; often seen near coastal vegetation	12
Nymphalidae	Lesser Wanderer	*Danaus petilia*	Related to the Monarch; found in open and disturbed habitats	13
Lycaenidae	Small Jewel	*Hypochrysops spp.*	Iridescent, found in forest margins	7
Lycaenidae	Philiris spp.	*Philiris spp.*	Tiny, metallic blue, often near host plants	11

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Lycaenidae	Amethyst Jewel	*Hypochrysops elgneri*	Brilliant iridescent wings; forest margins and gardens	9
Hesperiidae	Grass Skipper	*Taractrocera spp.*	Fast-flying, common in grassy clearings	20
Pieridae	Lemon Migrant	*Catopsilia pomona*	Seen fluttering in groups, especially after rain	13
Pieridae	Common Albatross	*Appias paulina*	White with black tips, active in sunny areas	21

Source: Primary data

Butterflies and Plants: A Co-evolutionary Journey"

Butterflies and plants have evolved together in a fascinating process known as coevolution. This means that changes in one group—like butterflies—have influenced adaptations in the other—like flowering plants. Over millions of years, butterflies developed specialized traits, such as their proboscis, a long, tube-like mouthpart perfect for sipping nectar. In response, plants evolved brightly colored

flowers and sweet nectar to attract butterflies, ensuring pollination. The coevolution of butterflies and plants is a fascinating example of how species evolve in response to one another. Butterflies rely on plants for food and reproduction, while plants benefit from butterfly pollination. Over time, plants have developed chemical defenses to deter herbivores, and butterflies have evolved mechanisms to counteract these defenses, allowing them to continue feeding on specific plants. This reciprocal adaptation has led to the diversification of both butterflies and plants, shaping ecosystems worldwide. Butterflies and plants have been engaged in a fascinating evolutionary dance for millions of years, shaping each other's survival strategies

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in a beautiful display of mutual adaptation. This Co-evolutionary relationship is driven by pollination, predation, and defence mechanisms.

Plants have evolved colourful, nectar-rich flowers to attract butterflies, ensuring efficient pollination. In turn, butterflies have developed specialized proboscises to extract nectar, favouring plants that provide the best resources. Some plants, like milkweed, have even evolved toxic chemicals that caterpillars of certain butterfly species can tolerate—giving them an edge against predators.

On the other side of this relationship, butterflies have adapted their life cycles and behaviours to specific plants. Many species lay their eggs exclusively on certain host plants, ensuring their caterpillars have the right food upon hatching. Monarch butterflies, for example, rely entirely on milkweed, and their larvae absorb its toxins, making them unpalatable to predators.

This delicate balance of attraction, survival, and defences showcases the interconnectedness of life and the evolutionary pressures that shape biodiversity

The Role of Pollinators in Plant Fertilization

Fertilization in flowers is a vital process that ensures plant reproduction by transferring pollen from the male part (anther) to the female part (stigma). This transfer is

often facilitated by pollinators like butterflies, which feed on nectar and inadvertently carry pollen between flowers. As butterflies move from one bloom to another, pollen adheres to their bodies and brushes onto the stigma of new flowers, enabling fertilization and seed formation. In addition to nectar consumption, some species, such as the Heliconius butterflies, supplement their diet by collecting pollen, which provides essential nutrients like amino acids. This interaction not only benefits plant diversity and ecosystem stability but also ensures the survival of pollinators by providing them with a nutritious food source. more effective in handling diverse classification tasks.

This paper systematically explores the integration of ABC with Naive Bayes to enhance classification accuracy. The discussion begins with the initialization of feature subsets, followed by the evaluation of fitness functions that guide the selection process. The iterative optimization strategy of ABC is then examined, detailing how it refines feature selection. This section concludes with an analysis of performance improvements, highlighting how the optimized NB model achieves higher accuracy, lower feature redundancy, and improved computational efficiency.

Hereditary Variation in Plant Species

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Butterflies play a vital role in pollination, contributing to genetic diversity among plant species. As they move from flower to flower collecting nectar, they inadvertently transfer pollen, facilitating cross-pollination, which strengthens ecosystems and enhances plant adaptability.

Some butterfly species migrate over long distances, spreading pollen across widely separated plant populations. This process helps maintain biodiversity and supports the survival of various plant species in changing environmental conditions. While butterflies may not be as efficient as bees in pollination, their preference for brightly coloured flowers with strong scents ensures they contribute significantly to plant reproduction

Measuring Ecosystem Health: Vital Environmental Indicators

Butterflies and moths, belonging to the order Lepidoptera, are widely recognized as biological indicators of environmental health (Rosenberg et al., 1986; New et al., 1995; Beccaloni et al., 1995; Oostermeijer et al., 1998). Their well-defined taxonomy, life history, and physiological tolerances make them valuable for ecological assessments. Key factors such as habitat conditions, temperature, and light requirements have been extensively studied (Warren, 1985; Thomas & Harrison, 1992). Research by Bowman has demonstrated correlations between Lepidoptera populations and environmental changes. According to Dobson (2012), 72% of butterfly and moth species have declined in the past decade, underscoring their role as early warning indicators for broader biodiversity loss. Some species are highly sensitive to even minor disturbances in natural forests, making them excellent markers of habitat integrity (Kearney, 2015). As one of the most closely watched insect groups worldwide, butterflies provide essential insights into ecosystem stability.

Give Food to Other Organisms

Butterflies play a vital role in ecosystems by serving as a food source for various organisms, including birds, reptiles, and amphibians. Their caterpillars, in particular, provide nourishment to creatures like scorpions and ants, while certain flies and wasps lay their eggs inside caterpillars, using them as a parasitic food source (Kearney, 2015). A decline in butterfly populations can lead to broader consequences, affecting birds, mice, and other wildlife that depend on them

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for sustenance, potentially resulting in the collapse of entire ecosystems.

Beyond their role in the food chain, butterflies contribute to pollination, helping plants reproduce and sustain biodiversity. Many plant species rely on butterflies for pollination, ensuring the survival of forests, meadows, and agricultural crops. Their presence also serves as an indicator of environmental health, as butterfly populations respond quickly to changes in climate, habitat destruction, and pollution. Stephen Dickie highlights this interdependence, explaining that birds time their breeding season based on caterpillar abundance. If butterfly and caterpillar numbers decline, there will be a shortage of food for developing chicks, which could negatively impact bird populations (Dobson, 2012).

Butterflies and Their Predators

Some butterfly larvae can act as natural predators of harmful insects. For instance, hoverfly larvae (Syrphidae) are known predators, particularly of aphids, which makes them useful in biological pest control (Sommaggio, 1999). Similarly, certain caterpillar species, such as the Harvester Butterfly (Feniseca tarquinius), consume aphids instead of plants, further supporting their role in integrated pest management.

Identification of the species of butterfly

The photographs of butterflies were used for the identification of the species of butterfly. Colour patterns, sizes and shapes as well as their designs were considered in identification of the species of butterfly with the help of entomologist expert and relevant available literature as well as photographs described by (Sunil et al., 2016) and (Kumar et al., 2016).

Statistical Analysis of Data

Identified species of butterfly observed in the study area were analysed by using Simpson index of diversity formula adopted by (Sunil et al., 2016) and (Ashok, 2017). The Simpson index of diversity

The field surveys on butterflies were carried out in the study area three times a week for the period of four months from April to July 2019. Butterflies were accessed in the study area from 9am to 11am in the morning by random observations during walking through the three selected sites based on habitats present in the study area. In the field, photographs of the butterflies were taken with the aid of camera for the identification purpose based on (Dey et al., 2017).

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$$\text{Where: } (D) = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

1- D = Simpson Index of Diversity
Σ = sum of (Total)
n = the number of individuals of each different species
N = the total number of individuals of all the species

Fig. 1: Number of the species of butterfly in a family wise composition in the study area.

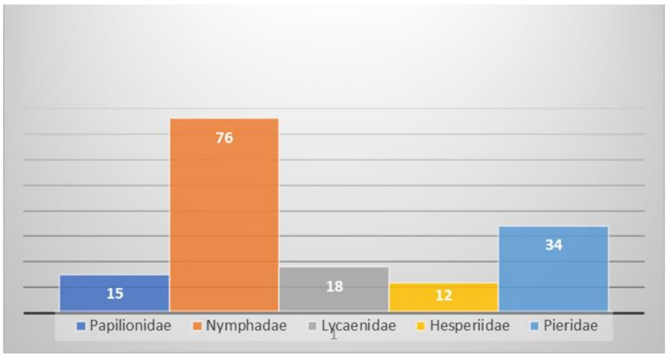
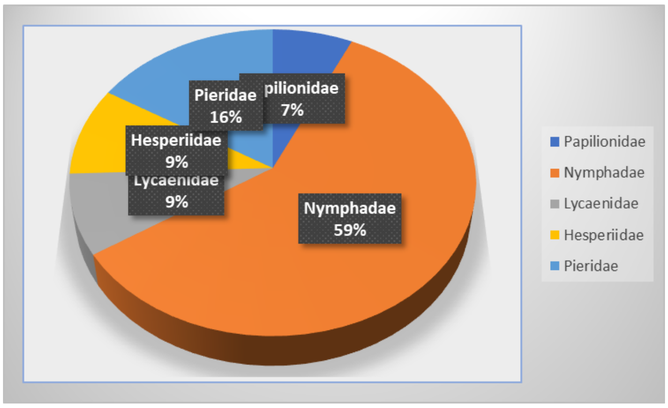


Fig. 2: Family wise percentage composition of the species of butterfly in the study area.



Diversity of the species of butterfly in the study area

The diversity of the species of butterfly observed in the study area is presented in (Table 1). The result showed that the highest number of butterflies and Simpson index of diversity was observed in Adventure Park (87 and 0.38) followed by IBSUniversity campus and Pacific Adventist University sites showing (73 and 0.42) and (73 and 0.47) respectively.

Table 3: Number of butterflies and Simpson Index of Diversity in the study area,

S.No	Study Area	Number of butterflies	Simpson Index of Diversity
1	Adventure Park	73	0.38
2	IBSUniversity	49	0.42
3	Pacific Adventist University	87	0.47

Discussion Checklist of the species of butterfly Based on family wise composition of checklist of the species of butterfly observed in the study area, Papilionidae family was the lowest number and percentage of the species of butterfly among the other families, which may be due to adaptation and habitat preference of the species. This finding agrees with that of koneri and Nangoy (2019) who observed the status of Sangihe Island butterflies and recorded maximum number of the species of butterfly from Nymphalidae family constituted with53.81%, followed by Papilionidae of 22.67%, Pieridae with 15.57%, Lycaenidae having 7.31% and Hesperidae with only 0.64% in the study area.

Nymphalidae family was described as the highest in the study area. Also this finding is in close agreement with the findings of Charn (2015) who listed 54 species of butterfly belong to 7 families from the forest strip of Punjab. Nymphalidae family indicated as dominant during the study period with the highest number of the species of butterfly. In addition,the result is supported by Bubesh et al. (2012) who observed 50 species of butterfly belong to 5 families. Nymphalidae and Lycaenidae families were the highest number of the species of butterfly in the study area. The result of this study conceded with the findings of Sayeswara (2018) who was recorded higher percentage of the species of butterfly from Nymphalidae family with 44.4%, followed by Papilionidae of 22.2%, Lycaenidae having 8.33% and Hesperidae was the least percentage of the species of butterfly in the study area. A Similar studies reported by Singh and Chib (2014) on a preliminary checklist of butterflies that recorded 125 species of butterfly from 78 genera belong to 5 families

Another relevant studies reported by Saurav et al. (2017) who was found that the Lycaenidae family having the maximum percentage of the species of butterfly with 34.9%, followed by Nymphalidae of 28.3%, Hesperidae 19.81%, Pieridae 9.43%, Papilionidae 6.6% and Riodinidae 0.94% respectively. This finding agrees with that of koneri and Nangoy (2019) who observed the status of Sangihe Island butterflies and recorded maximum number of the species of butterfly from Nymphalidae family constituted with 53.81%, followed by Papilionidae of 22.67%, Pieridae with 15.57%, Lycaenidae having 7.31% and Hesperidae with only 0.64% in the study area. Further, the results are in strong agreement with Sethyet al.(2014) who also reported that Nymphalidae represent the dominant family in the study area with 42.5%, followed by Papilionidae of 21.2%, Lycaenidae 15.1%, Pieridae 14.1% and Hesperidae with 7.1%. Diversity of the species of butterfly The greatest Simpson index of diversity was observed in company bagh site (0.8) among the other sites, indicating that the study area is more diverse of the species of butterfly. However, the maximum number individual of butterflies recorded may lead to the greatest diversity of the species of butterfly in the study area. Previous studies reported by Ashok (2017) who was recorded high diversity of the species of butterfly from five habitats of Jhansi. Narayan bagh was the highest diversity (0.7440) and the lowest diversity was observed from Jhansi Gwalior (0.6916) in the study area. In addition Savarimuthuet al. (2012) also stated that the maximum Simpson index of diversity was observed in the month of April from river bank (0.9743) followed by crop area (0.9819) then forest area (0.9661) during the study period.
Among the species of butterfly observed in the study area, 4 of them were abundantly (Danaus chrysippus, Danaus genutia,

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Catopsilia pomona, Acreae violae) and 2 species were common (Eurema andersoni, Chilades pandava) while 8 number of the species of butterfly were less common (Euploea core, Tirumala limniace, Eurema hecabe, Delias eucharis, Appias albino, Graphium doson, Zizeeria karsandra, Papilio demoleus). 7 numbers of the species of butterfly was found occasionally in the study area (Pseudozizeeria maha, Hypolimnas misippus, Venessa cynthia, Anaphaeis aurota, Phalanta phalantha, Neptis hylas, Papilio polytes) as shown in (Appendix 4, 5 & 6).

The vegetation and habitat types in the study area might be reason for the above common occurrences of the species of butterfly. Each and every site had various habitats pattern. In addition to that, the sites were found with gardens, orchards, farmland, landscape and agroforestry/forest nursery area etc. The results are in accordance with the findings of Kanagaraj and Kathirvely (2018) who recorded and categorized various species of butterfly as very common (6), common (28), less common (16) and rare (2) respectively. Also similar observation was made by Bora and Meitei (2014) who find out diversity of butterflies in Assam University campus and observed very common (20), common (34), uncommon (29), rare (9) and very rare (4) of the species of butterfly in the study area.

Conclusion:

Based on the results obtained from the study on butterfly diversity in the study area, Nymphalidae family was found maximum in number and percentage of the species of butterfly among all the families. Also Adventure Park was found highest among the other sites in terms of individual number of butterflies and Simpson index of diversity. Therefore, it is concluded that the study area is rich in butterfly diversity and further research could be conducted to obtain details and documentation on butterfly diversity for the conservation and butterfly parks

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