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Species richness and conservation status of ferns (Pteridophyta) in Barangay New Casul, Mutia, Zamboanga del Norte

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ABSTRACT

This study assessed the species composition, diversity, and conservation status of ferns (Pteridophyta) in Barangay New Casul, Mutia, Zamboanga del Norte. Three 10 × 10-meter quadrats were established across distinct microhabitats, and ferns were identified using morphological and taxonomic references. A total of sixteen fern species from nine families were recorded, representing both terrestrial and epiphytic forms. The families Aspleniaceae and Nephrolepidaceae were the most represented, while Athyriaceae, Dryopteridaceae, Gleicheniaceae, Lygodiaceae, Marattiaceae, Davalliaceae, Polypodiaceae, Psilotaceae, and Pteridaceae occurred less frequently. *Diplazium esculentum*, *Nephrolepis biserrata*, and *Dryopteris australis* were the most dominant and widely distributed species, reflecting their ecological tolerance to moderate habitat disturbance. Three species carried conservation designations: *Drynaria quercifolia* (Vulnerable), *Angiopteris evecta* (Other Threatened Species), and *Lygodium circinnatum* (Economically Important Species). The computed Shannon–Wiener Diversity Index (H′ = 1.23) indicates low species diversity, suggesting that the area is dominated by generalist species adapted to partially disturbed conditions. These findings suggest the importance of small upland habitats in maintaining fern assemblages and highlight the need for localized conservation and habitat restoration initiatives to preserve remaining fern diversity in Mutia and nearby upland ecosystems.

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INTRODUCTION

Ferns are among the oldest vascular plants, characterized by a dominant sporophyte phase and the absence of seeds and flowers. They play essential ecological roles in nutrient cycling, microhabitat formation, soil stabilization, and biodiversity maintenance. Globally, more than 12,000 fern species have been recorded (Hassler, 2004–2021; Qian *et al.*, 2022), many of which thrive in humid tropical regions. In the Philippines, approximately 1,100 species belonging to 154 genera and 34 families have been documented, with 262 species (24%) endemic to the archipelago (Coritico and Amoroso, 2020). This richness highlights the country's importance as a biodiversity hotspot for ferns and lycophytes.

Local research on fern diversity has expanded in recent years but remains concentrated in major protected areas. Amoroso and Aspiras (2011) surveyed the fern flora of Mount Hamiguitan and recorded several endemic and threatened taxa, emphasizing the value of montane habitats for fern conservation. Coritico *et al.* (2017) reported the distribution of threatened ferns in Northern Mindanao, particularly in Mount Kitanglad Range, revealing species' sensitivity to habitat alteration. Similarly, Cudal *et al.* (2021) assessed the fern diversity of Mount Timolan Protected Landscape in Zamboanga del Sur and found that forest integrity strongly affects fern abundance. Perida, Peñaverde, and Barrera (2023) documented roadside fern diversity in Quezon Province, demonstrating that ferns can adapt to disturbed environments but still decline with increased anthropogenic pressure. In addition, Raganas and Ponce (2019) analyzed the composition of ferns in a secondary forest in Cebu and observed that *Diplazium esculentum* and *Nephrolepis biserrata* were dominant species, reflecting resilience in semi-disturbed areas. More recently, Suplido *et al.* (2024) investigated the Pteridophyte diversity of Mount Balatukan, Misamis Oriental, and emphasized the need for long-term monitoring of lowland forest patches.

Despite these efforts, limited studies have examined fern diversity in less-studied local areas such as in barangay New Casul, Mutia, Zamboanga del Norte. This barangay has varied habitats including riverine and secondary forest zones that may harbor unique fern assemblages. However, no formal documentation of fern species in this locality has been conducted. Understanding fern diversity at the local level is vital, as ferns serve as bioindicators of microclimatic and ecological stability (Perida *et al.*, 2023; Cudal *et al.*, 2021; Raganas and Ponce, 2019). Thus, this study seeks to address these gaps by (1) identifying the fern species composition in Barangay New Casul, Mutia, Zamboanga del Norte; (2) assessing the conservation status of identified species using the IUCN and DENR classifications; (3) determining species richness and diversity index. The findings will serve as baseline data for future biodiversity assessments and conservation initiatives within the province. The findings of this study are further aligned with the ZAMPEN CARE Hub framework and provincial environmental management programs, strengthening institutional integration and supporting science-based decision-making for biodiversity conservation in Zamboanga Peninsula.

In the Philippine context, fern conservation is supported by national and local environmental policies, including Republic Act 9147 (Wildlife Resources Conservation and Protection Act) and local government ordinances on biodiversity conservation and forest protection. These policies provide a legal framework for the protection and sustainable utilization of plant resources, including pteridophytes. Conceptually, species richness and diversity are influenced by environmental gradients such as moisture availability, canopy cover, and degree of disturbance. In relatively undisturbed habitats, higher species richness and evenness are expected, whereas disturbed environments tend to be dominated by a few tolerant species.

This study adopts this ecological framework to interpret how habitat conditions in Barangay New Casul shape fern assemblages.

MATERIALS AND METHODS

Entry protocol

Before data collection, the researchers secured a Gratuitous Permit (GP No. IX-2023-19) from the Department of Environment and Natural Resources (DENR) in compliance with Republic Act 9147 (Wildlife Resources Conservation and Protection Act). Ethical clearance was obtained from the Research Ethics Committee of JRMSU. Permission to conduct the study was formally requested and granted by the Barangay Captain of Barangay New Casul, Mutia, Zamboanga del Norte.

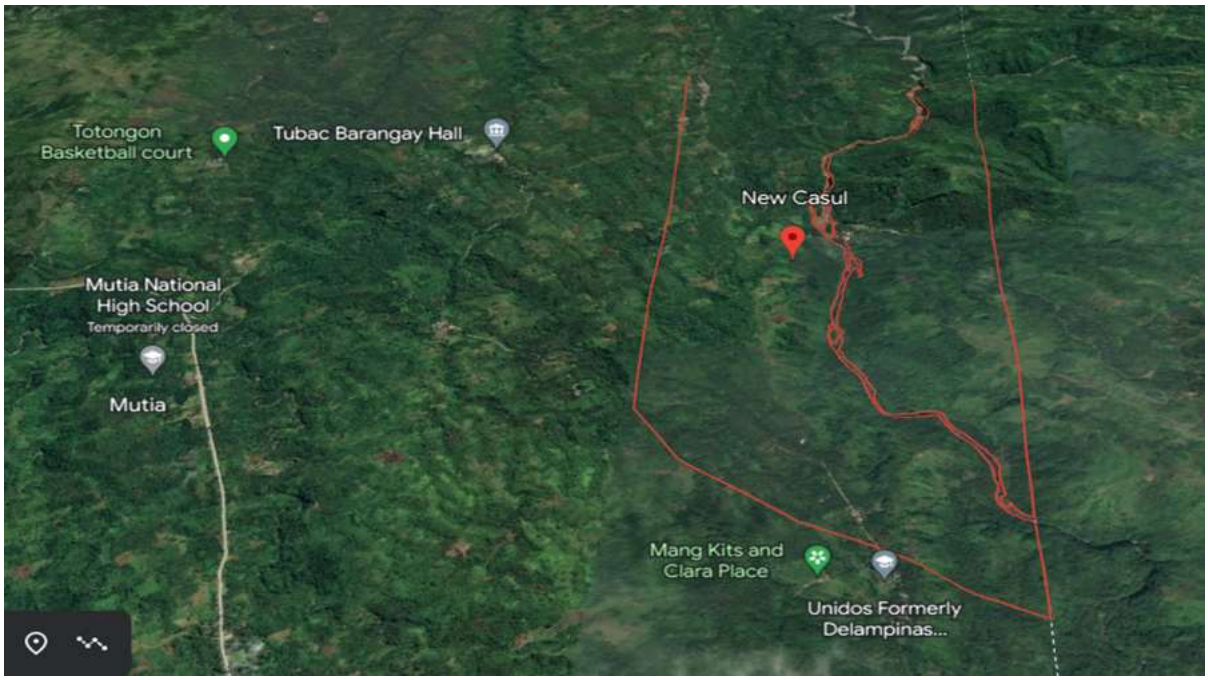

Fig. 1. Map of Barangay New Casul

Sampling site

Barangay New Casul is an upland barangay within the municipality of Mutia in the province of Zamboanga del Norte, Mindanao, Philippines. Geographically, it lies at approximately 8.398° N latitude and 123.548° E longitude, with an estimated elevation of about 325.5 m above sea level. The terrain is predominantly hilly to moderately steep, characteristic of the upland interiors of Mutia. The barangay forms part of the landlocked municipality of Mutia, which has a total area of about 73.58 sq km (7,358 ha) and is bordered by other municipalities within Zamboanga del Norte. The area's humid tropical climate and proximity to riverine and forested habitats provide ideal conditions for fern growth (Fig. 1).

Sampling procedure

Data collection was conducted over three consecutive months across three established sampling sites representing distinct microhabitats. In each site, 10 × 10 m quadrats were systematically established at 200-meter intervals to ensure spatial representation of the study area.

Within each quadrat, all fern species were recorded, photographed, and identified. To complement quadrat sampling, opportunistic sampling was employed outside quadrat boundaries to document rare or less abundant species, which are often underrepresented in fixed plots.

Species identification was carried out using standard taxonomic keys and references, including Co's Digital Flora of the Philippines (Pelser *et al.*, 2016) and relevant fern identification manuals.

To enhance methodological rigor, each sampling site was treated as a replicate representing distinct microhabitat conditions. Although sampling was limited to three plots due to logistical constraints, the design ensured representation of riverine, mid-slope, and open

canopy environments. Species identification was further validated through cross-referencing with published floras and, where possible, comparison with herbarium records and photographic databases to minimize misidentification.

The selection of three sampling plots was constrained by accessibility and terrain limitations; however, each plot was carefully chosen to represent key habitat types within the study area.

This approach ensured ecological representation despite limited sample size. To ensure accuracy of species identification, collected specimens and photographic records were cross-checked with herbarium references and validated through multiple taxonomic sources.

Data analysis

Species richness was determined as the total number of distinct fern species recorded per site.

Species diversity was further assessed using the Shannon–Wiener Diversity Index (H′), which accounts for both species richness and evenness in species distribution. The formula used is:

$H' = -\sum (pi \ln pi)$

Where:

pi = proportion of individuals per species

ln = natural logarithm

$\sum$ = summation across all species

Additionally, similarity indices were computed to compare species composition among sites.

Conservation status of species

Fern's Conservation Status was determined by the Department of Environment and Natural Resources' (DENR, 2017) classifications and the published book of the Philippines Threatened Plants (Fernando *et al.*, 2022), which complies with the International Union for the Conservation of Natures' (IUCN) Standards.

RESULTS AND DISCUSSION

The study recorded sixteen fern species across nine families from the three study sites, reflecting diverse microhabitats that support both terrestrial and epiphytic taxa. The most represented families were Aspleniaceae and Nephrolepidaceae, while the families Athyriaceae, Dryopteridaceae, Gleicheniaceae, Lygodiaceae, Marattiaceae, Davalliaceae, Polypodiaceae, Psilotaceae, and Pteridaceae were represented by one or two species each (Table 1, Fig. 2).

This richness suggests a structurally complex habitat capable of sustaining ferns with varied ecological requirements, similar to findings by Barcelona *et al.* (2019) and Amoroso and Aspiras (2021), who noted that fern diversity is strongly associated with habitat heterogeneity and canopy cover. The combined use of quadrat and opportunistic sampling allowed for a more comprehensive inventory of fern species, particularly those with low abundance or patchy distribution, thereby improving the reliability of species richness estimates.

A notable finding was the widespread occurrence of *Diplazium esculentum* (Athyriaceae) across all sites. This species thrives in moist, shaded environments, especially riparian zones, indicating its adaptability and ecological tolerance (Pelser *et al.*, 2016). Other ferns, such as *Dryopteris australis* and *Nephrolepis biserrata*, were also found in multiple sites, implying a preference for humid and shaded microclimates. Conversely, species recorded from only one site, the *Macrotlepis torresiana*, *Thelypteris limbospema*, and *Thelypteris reticulata* may have narrow ecological amplitudes or specialized habitat preferences, as observed in similar studies on lowland fern assemblages (Tagupa and Villanueva, 2022).

Three of the sixteen species carry recognized conservation designations. *Drynaria quercifolia* is classified as Vulnerable (IUCN, 2023) due to overharvesting for ornamental and medicinal purposes (Amoroso and Coritico, 2018). *Angiopteris evecta* is listed as an Other Threatened Species (DENR, 2017), attributed to habitat degradation and low natural regeneration.

Fig. 2. Some documented pteridophytein Barangay New Casul, Mutia, Zamboanga del Norte
(A) *Asplenium platyneuron* (B) *Decranopteris linearis* (C) *Lygodium circinnatum* (D) *Pityrogramma calomelanos* (E) *Angiopteris evecta* (F) *Microsorum membranifolium* (G) *Drynaria quercifolia* (H) *Pyrrosia piloselloides* (I) *Nephrolepis biserreta* (J) *Diplazium esculentum* (K) Asplenium serratum (L) *Davallia solida* (M) *Thelypteris limbosperma* (N) *Thelypteris reticulata* (O) *Macrothelypteris torresiana* (P) *Dryopteris australis*

Table 1. Species composition and conservation status of ferns

Family	Species	Status	S1	S2	S3
Aspleniaceae	*Asplenium platyneuron*		+		
	Asplenium serratum				+
	Macrothelypteris torresiana			+	
	Thelypteris limbosperma			+	
	Thelypteris reticulata				+
Athyriaceae	*Diplazium esculentum*		+	+	+
Dryopteridaceae	*Dryopteris australis*		+	+	
Gleicheniaceae	*Decranopteris linearis*				+
Lygodiaceae	*Lygodium circinnatum*	EIS			+
Marattiaceae	*Angiopteris evecta*	OTS		+	
Nephrolepidaceae	*Nephrolepis biserreta*		+	+	
	Davallia solida		+		
	Drynaria quercifolia	VU	+		
	Microsorum membranifolium			+	
Psilotaceae	*Pyrrosia piloselloides*				+
Pteridaceae	*Pityrogramma calomelanos*	PNN; EIS			+
Total (Species per site)			177	199	201

Status: CR= Critically Endangered; EN= Endangered; VU= Vulnerable; PES= Philippine Endemic; OTS= Other Threatened Species; PNN= Philippine non- native; Economic Important Species

Lygodium circinnatum and *Pityrogramma calomelanos* are considered Economically Important Species; the former is valued for handicrafts and weaving, while the latter, though non-native, is popular for ornamental use and traditional practices (Racelis *et al.*, 2020).

These findings emphasize the ecological and economic relevance of ferns and highlight the need for sustainable utilization, echoing the call of Santos and Buot (2020) for community-based conservation of non-timber forest products. Species distribution patterns across the three sites revealed differences in ecological conditions. Site 1 supported moisture-loving species such as *Diplazium esculentum*, *Dryopteris australis*, and *Nephrolepis biserrata*, typical of shaded, humid riparian or forest-interior zones. Site 2 also featured shade-tolerant ferns but included *Macrotlepis torresiana* and *Thelypteris limbospema*, indicative of mid-slope or partially open habitats. Site 3 contained light-tolerant and disturbance-resistant species like *Pityrogramma calomelanos* and *Pyrrosia piloselloides*, suggesting secondary growth or open canopy conditions. This gradient aligns with the disturbance–succession model observed by Buot and Villanueva (2021), where fern composition shifts with increasing exposure and human impact.

A total of 577 fern individuals were recorded across the three study sites, resulting in a Shannon–Wiener Diversity Index (H′) of 1.23, which signifies low species diversity (Table 2).

Table 2. Shannon's diversity index of ferns

Total number of individuals	H′ Index
577	1.23 (Low diversity)

According to Magurran (2013), H′ values below 1.5 generally reflect limited ecological heterogeneity and dominance by a few species. This suggests that while ferns are present in considerable numbers, the community is composed mainly of common and tolerant species, with fewer rare or specialized taxa.

The dominance of *Diplazium esculentum*, *Nephrolepis biserrata*, and *Dryopteris australis* species known for their ecological tolerance and ability to thrive in moist but disturbed habitats indicates that the study area may be undergoing environmental pressure or habitat modification (Amoroso and Aspiras, 2021; Buot and Villanueva, 2021). Such conditions tend to favor generalist ferns over shade-dependent or epiphytic types that require intact forest cover and stable microclimates. Dominant fern species such as *Diplazium esculentum* contribute to ecosystem services including soil stabilization, nutrient cycling, and microhabitat provision for invertebrates and microorganisms. These ecological functions are particularly important in upland systems where vegetation plays a critical role in preventing soil erosion and maintaining watershed integrity.

Although the computed Shannon Diversity Index indicates low diversity, variation in species composition among sites suggests differences in microhabitat conditions. While formal statistical comparison (e.g., similarity or evenness indices) was limited, observed patterns indicate that Sites 1 and 2 share more moisture-dependent species, whereas Site 3 supports disturbance-tolerant taxa. This pattern supports the influence of environmental gradients on fern distribution. Future studies may incorporate quantitative similarity indices (e.g., Jaccard or Sørensen Index) to strengthen comparative analysis across sites.

CONCLUSION

The study documented sixteen fern species across three sampling sites in Barangay New Casul, Mutia, Zamboanga del Norte, revealing moderate species richness but low diversity (H′ = 1.23). The dominance of ecologically tolerant species indicates that the area is experiencing moderate environmental disturbance, likely associated with land-use practices such as small-scale agriculture and vegetation clearing. The presence of conservation-relevant species, including *Drynaria quercifolia* (Vulnerable), *Angiopteris evecta* (Other Threatened Species), and *Lygodium circinnatum* (Economically Important Species), highlights the ecological and conservation value of the area. These findings provide baseline data that can support local government units (LGUs) and DENR initiatives in biodiversity conservation, habitat rehabilitation, and

sustainable resource management. These findings highlight the importance of integrating fern conservation into local biodiversity management plans. For local government units (LGUs) and DENR, the results provide a scientific basis for implementing targeted interventions such as habitat rehabilitation, protection of vulnerable species, and sustainable land-use planning. Embedding these strategies into existing environmental programs can enhance ecosystem resilience while supporting community livelihoods.

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