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Research

Faunal diversity and habitat associations in Mt. Arayat Protected Landscape, Luzon, Philippines

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Abstract

Mountain ecosystems are vital centers of biodiversity but face increasing threats from human disturbance and habitat change. This study aimed to assess the faunal diversity of the Mt. Arayat Protected Landscape to generate baseline data for conservation management. Seasonal surveys were conducted using a standardized multilevel approach across 36 quadrats on both northern and southern slopes. A total of 2,359 individuals representing rodents, detritivores, amphibians, reptiles, and birds were recorded. Results showed high species richness, evenness, and functional redundancy, with dominant species varying by group. Endemics such as *Apomys cf. iridensis*, *Platymantis mimulus*, and *Dasylophus superciliosus* indicated intact forest microhabitats, while generalists like *Rattus everetti* and *Eutropis multicarinata* reflected adaptability across gradients. Disturbance-tolerant species, including *Rattus tanezumi* and *Hemidactylus frenatus,* signaled anthropogenic influence in forest margins. Functional guilds were well represented, ranging from detritivores that drive decomposition to predators that maintain trophic balance. The low occurrence of canopy-, stream-, and apex-dependent species highlighted vulnerable niches that require focused monitoring. These findings emphasize the importance of protecting interior forests, restoring disturbed zones, and integrating local stewardship to sustain biodiversity and ecosystem functions in Mt. Arayat.

Keywords: biodiversity, community structure, ecosystem resilience, functional role, protected area

Introduction

Mountains function as global hubs of biodiversity, hosting remarkable species diversity and unique species due to their intricate topographical variations, diverse microclimates, and a wide range of habitat gradients (Rahbek et al., 2019; Antonelli et al., 2018). Mountain ecosystems provide critical ecological services, including climate regulation, watershed protection, and carbon sequestration, while harboring approximately 25% of terrestrial biodiversity on only 12% of Earth's land surface (Körner et al., 2017; Spehn et al., 2010). However, mountain ecosystems are experiencing threats and challenges due to climate change, habitat fragmentation, and human disturbances, positioning them as critical conservation priorities across the globe. (Payne et al., 2020; Menéndez-Guerrero et al., 2020).

Biodiversity monitoring in mountain ecosystems needs multi-taxa approaches to capture the full spectrum of ecological relationships and functional diversity (Larigauderie & Mooney, 2010; Cardinale et al., 2012). Various taxonomic groups react differently to changes in the environment and disturbances, with detritivores playing a role in nutrient cycling, vertebrates indicating the quality of habitats, and different taxa sustaining essential trophic relationships. (Barnes et al., 2014; Brehm et al., 2019). Comprehensive faunal assessments that incorporate various functional groups yield crucial foundational data for comprehending ecosystem interactions and guiding conservation efforts. (Gardner et al., 2018).

The Philippine archipelago's mountain ecosystems are especially remarkable due to their significant endemism and species diversity, which stem from a complex geological history and the principles of island biogeography. (Heaney et al., 2016; Brown et al., 2013). The mountainous terrains of Central Luzon, such as the Mt. Arayat Protected Landscape (MAPL), play a vital role as sanctuaries for native species and act as linkages between divided forest ecosystems. (Ong et al., 2020). Although the ecological significance of these areas is acknowledged, thorough assessments of biodiversity across multiple taxa are still scarce in many protected regions of the Philippines, which impedes effective planning and management for conservation. (Diesmos et al., 2020). This study aims to fill the knowledge gap regarding the faunal diversity of MAPL by performing an extensive multi-taxa survey that includes five ecologically significant groups: detritivores, rodents, reptiles, amphibians, and birds. The study seeks to gather foundational information on species composition, patterns of diversity, and the ecological significance of values across various habitat gradients within MAPL. By integrating seasonal sampling and standardized methods, the study offers vital insights for prioritizing conservation efforts and conducting long-term ecological monitoring in one of the most important protected areas of Central Luzon.

Material and methods

Study area and sampling design

The study was conducted in the Mt. Arayat Protected Landscape (MAPL) in Central Luzon (Fig.1). Sampling sites were located on both the northern and southern slopes to capture habitat variation. Each site consisted of six stations with six 20×20 meter quadrats, totaling 36 quadrats and covering 6,400 square meters. Quadrats were spaced at least 20 meters apart, and stations were 100 meters apart to reduce edge effects and ensure independence. This layout follows the standardized biodiversity assessment protocol by Karger et al. (2014).

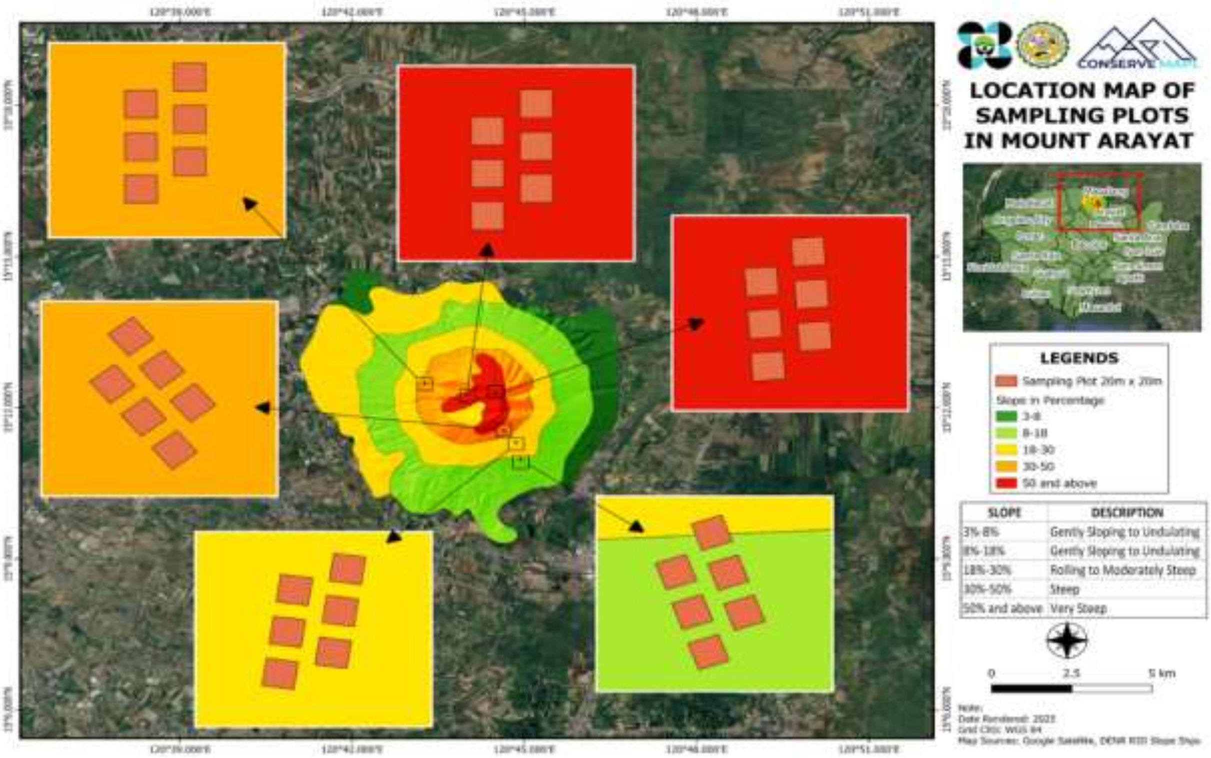

Figure 1. Location Map of Sampling Sites (20m x 20m) in Mt. Arayat Protected Landscape with Overlaid Slope Gradient Zone.

Data collection procedure

Field surveys were conducted during two distinct seasons to account for seasonal variation. Faunal presence within each quadrat was recorded through visual encounter surveys and microhabitat inspections. Leaf litter, decaying logs, and understory vegetation were examined to detect cryptic and moisture-sensitive species.

Table 1. Methods of Collection for each Taxon Group

Taxon Group	Method of Collection	Description / Notes

Rodents	Live Trapping (e.g., Sherman or cage traps)	Baited traps set along transects or grids
Detritivores (Gastropoda, Hexapoda, Malacostraca)	Visual Encounter Surveys and Hand Collection	Active search under logs, litter, and debris; typically conducted during both day and night surveys.
Amphibians	Acoustic Monitoring, Visual Encounter Surveys, and Hand Collection	Night-time surveys during peak activity (e.g., after rain); identification by calls, morphology, and habitat preference.
Birds	Acoustic Monitoring and Visual Encounter Surveys	Early morning point counts and transect walks, identification by calls and plumage. Binoculars and audio recorders used.
Reptiles	Visual Encounter Surveys and Hand Collection	Day and night searches in leaf litter, under logs, and on trees; careful handling protocols applied.

Species identification and preservation

The collected specimens were stored in 100% ethanol. Initial identification was carried out with dichotomous keys, and final taxonomic identification was done by experts at the UPLB Museum of Natural History and the National Museum. No specimens were gathered for species that were initially designated as endangered; instead, photographic data were employed.

Ethical considerations

The study adhered to ethical guidelines for wildlife research. Physical collection was avoided for threatened or listed species. Instead, photographic documentation was employed to confirm species identity. A Gratuitous Permit was obtained from the Department of Environment and Natural Resources (DENR) for wildlife collecting and sampling. Before this, the Protected Area Management Board (PAMB) of Mt. Arayat Protected Landscape issued a Board Resolution as a prerequisite for the Gratuitous Permit. These permissions verified that field operations complied with national biodiversity protection legislation.

Quantitative analysis

Species frequency, density, and dominance were calculated for each group. The Shannon-Wiener Index and Simpson's Index were used to assess species diversity and evenness. Importance Value (IV) was computed as the sum of relative frequency, relative density, and relative dominance to identify ecologically influential species using Microsoft Excel.

Results

Faunal records

A total of 2,359 individual organisms were recorded from 36 quadrats established in the Mt. Arayat Protected Landscape. These individuals represent five major faunal groups: rodents, detritivores, amphibians, birds, and reptiles. The dataset reflects a compositionally rich assemblage (Caro & O'Doherty, 1999), with species ranging from wide-ranging generalists to habitat-restricted endemics. The following subsections present the quantitative results for each taxonomic group, including relative frequency, relative density, relative dominance, and importance values derived from standardized ecological indices.

Rodents

Three rodent species were documented in the MAPL (Table 2). *Rattus everetti* (Figure 2-A) exhibited the highest values across all ecological indices, with a relative frequency of 0.6696, a relative density of 0.0788, and a relative dominance of 0.0022. These values yielded an Importance Value (IV) of 0.7505, indicating that *R. everetti* was the most ecologically significant species in the assemblage.

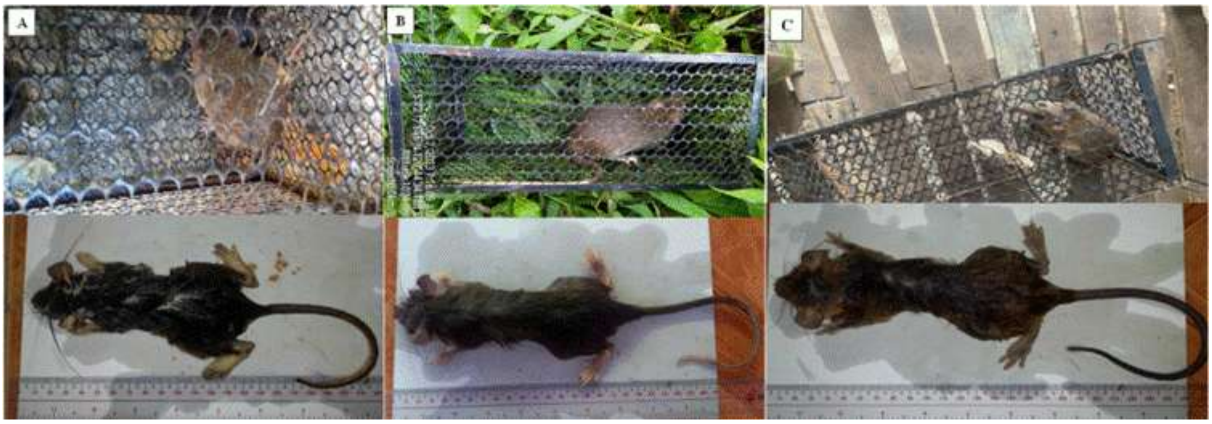

Figure 2. Rodent Species identified from the study site, with representative species illustrated (A. *Apomys cf. iridensis,* B. *Rattus everetti,* C. *Rattus tamezumi*)

Table 2. Relative Frequency, Relative Density, Relative Dominance, and Importance Value of Rodents of Mt. Arayat Protected Landscape

Species	Relative Frequency	Relative Density	Relative Dominance	Importance Value
Rattus tamezumi	0.03938558488	0.03938558487	0.000548266655	0.0793194364
Rattus everetti	0.6695549429	0.07877116976	0.00219306662	0.7505191793

Apomys cf. iridensis	0.03938558488	0.03938558487	0.000548266655	0.0793194364

In comparison, *Rattus tanezumi (*Figure 2-C) and *Apomys cf. iridensis* (Figure 2-B) each showed markedly lower and identical values, with relative frequency (0.0394), relative density (0.0394), and relative dominance (0.0005), resulting in IVs of 0.0793. These low values reflect their limited occurrence and abundance within the sampling quadrats.

Detritivores

A total of 60 detritivore taxa were recorded in the MAPL (Table 3). *Diacamma australe* (Southern Ant) recorded the highest ecological values with a relative frequency of 3.51, a relative density of 3.51, and a relative dominance of 4.34, yielding an IV of 11.35 (Figure 3-S).

Table 3. Relative Frequency, Relative Density, Relative Dominance, and Importance Value of Detritivores Mt. Arayat Protected Landscape

Species	Relative Frequency	Relative Density	Relative Dominance	Importance Value
Camponotus floridanus	2.323749508	2.323749508	1.908516226	6.556015241
Labidura riparia	1.142181961	1.142181961	0.461092257	2.74545618
Camponotus sp.	1.851122489	1.851122489	1.211121041	4.913366019
Oniscus sp.	0.551398188	0.551398188	0.107460264	1.210256641
Polyrhachis sp. (Blue)	1.102796377	1.102796376	0.429841057	2.63543381
Monachoides vicinus	1.929893659	1.929893659	1.316388239	5.176175557
Paralaoma servilis	1.654194565	1.654194565	0.967142379	4.275531509
Polyrhachis sp. (black)	1.811736904	1.811736904	1.160132242	4.78360605
Chrysolina americana	1.378495471	1.378495471	0.671626652	3.428617594
Dorcus rectus	1.45726664	1.45726664	0.750577051	3.665110331
Tenebrio molitor	2.166207168	2.166207168	1.658506631	5.990920967
Gryllus rubens	0.945254037	0.945254037	0.315801593	2.206309667
Oecophylla sp.	0.275699094	0.275699094	0.026865066	0.578263254
Oecophylla smaragdina	1.61480898	1.61480898	0.921636247	4.151254207
Oxychilus cellarius	0.315084679	0.315084679	0.035089066	0.665258424
Alphitobius diaperinus	1.063410792	1.063410792	0.399686391	2.526507975
Armadillidium sp.	0.551398188	0.551398188	0.107460264	1.210256641
Polyrhachis pirata	0.905868452	0.905868452	0.29003306	2.101769965

Diacamma australe	3.505317054	3.505317054	4.342820174	11.35345428
Euborellia annulipes	0.354470264	0.354470264	0.044409599	0.753350127
Subuliodetermes emersoni	1.339109886	1.339109886	0.633796253	3.312016025
Periplaneta fuliginosa	0.905868452	0.905868452	0.29003306	2.101769965
Calopteron reticulatum	0.787711698	0.787711698	0.219306662	1.794730057
Blaptica dubia	3.269003545	3.269003545	3.777008986	10.31501608
Oecophylla longinoda	0.315084679	0.315084679	0.035089066	0.665258424
Lithobius forficatus	0.827097282	0.827097282	0.241785595	1.895980159
Gryllodes sigillatus	0.748326113	0.748326112	0.197924262	1.694576487
Lithobius sp.	0.472627019	0.472627018	0.078950398	1.024204435
Teleogryllus emma	1.69358015	1.69358015	1.013745045	4.400905344
Helix pomatia	1.024025207	1.024025207	0.370628259	2.418678673
Acheta domesticus	1.654194565	1.654194565	0.967142379	4.275531509
Blattella asahinai	0.787711698	0.787711698	0.219306662	1.794730057
Pheidole megacephala	1.339109886	1.339109886	0.633796253	3.312016025
Trichoniscus pusillus	0.472627019	0.472627018	0.078950398	1.024204435
Dinoponera gigantea	0.748326113	0.748326112	0.197924262	1.694576487
Polyrhachis sokolova	1.890508074	1.890508074	1.263206373	5.044222521
Laevicaulis alte	0.15754234	0.15754234	0.008772266	0.323856946
Polyrhachis dives	2.875147696	2.875147696	2.921713004	8.672008396
Brachytrycherus humeralis	0.551398188	0.551398188	0.107460264	1.210256641
Oxychilus alliarius	0.827097282	0.827097282	0.241785595	1.895980159
Lumbricus terrestris	0.275699094	0.275699094	0.026865066	0.578263254
Metapocyrtus sp.	0.039385585	0.039385585	0.000548267	0.079319436
Polyrhachis sp.(yellow)	0.315084679	0.315084679	0.035089066	0.665258424
Odontomachus infandus	0.866482867	0.866482867	0.265361061	1.998326796
Odontoponera transversa	0.472627019	0.472627018	0.078950398	1.024204435
Harpaphe sp.	0.354470264	0.354470264	0.044409599	0.753350127
Haplophthalmus danicus	1.339109886	1.339109886	0.633796253	3.312016025
Blattella germanica	0.551398188	0.551398188	0.107460264	1.210256641
Forficula smyrnensis	0.669554943	0.669554943	0.158449063	1.497558949
Pachycondyla sp.	0.669554943	0.669554943	0.158449063	1.497558949
Blatta orientalis	2.166207168	2.166207168	1.658506631	5.990920967
Camponotus abdominalis	0.669554943	0.669554943	0.158449063	1.497558949
Trochulus hispidus	0.708940528	0.708940528	0.177638396	1.595519452

Macrotermes malaccensis	2.363135093	2.363135093	1.973759958	6.700030143
Archachatina marginata	0.118156755	0.118156755	0.0049344	0.241247909
Nemobius sylvestris	0.905868452	0.905868452	0.29003306	2.101769965
Supella longipalpa	0.748326113	0.748326112	0.197924262	1.694576487
Harmonia axyridis	0.196927924	0.196927924	0.013706666	0.407562515
Geophilus flavus	0.275699094	0.275699094	0.026865066	0.578263254

Blaptica dubia (Dubia Roach) and *Polyrhachis dives* (Weaver Ant) followed with IVs of 10.32 and 8.67, respectively (Fig. 3-X, 3-U). Both species were consistently abundant across sampling sites. Other taxa with relatively high values included *Macrotermes malaccensis* (Malayan Termite), *Camponotus floridanus* (Florida Carpenter Ant) (Fig. 3-A), *Tenebrio molitor* (Yellow Mealworm Beetle) (Fig. 3-K), *Blatta orientalis* (Oriental Cockroach), *Monachoides vicinus* (Land Snail) (Fig. 3-F), and *Polyrhachis sokolova* (Spiny Ant) (Fig. 3-R), with IVs ranging from 5.04 to 6.70. Intermediate contributors included *Teleogryllus emma* (Emma Field Cricket) (Fig.3-AC), *Acheta domesticus* (House Cricket) (Fig. 3-AA), *Oecophylla smaragdina* (Asian Weaver Ant) (Fig. 3-N), *Paralaoma servilis* (Minute Land Snail) (Fig. 3-G), *Chrysolina americana* (Rosemary Beetle) (Fig. 3-I), *Dorcus rectus* (Japanese Stag Beetle) (Fig. 3-J), *Subuliodetermes emersoni* (Termite), and *Pheidole megacephala* (Bigheaded Ant), with IVs between 3.31 and 4.40.

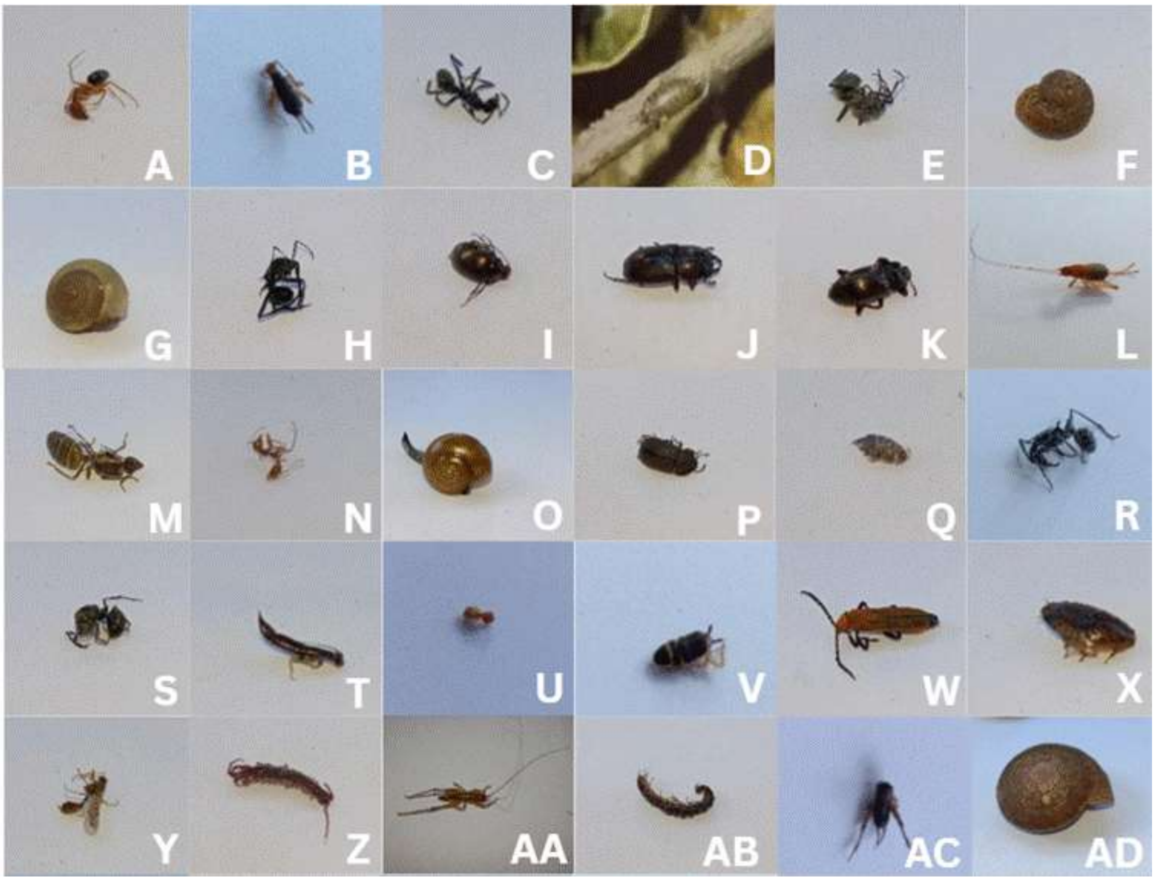

Figure 3. Invertebrate detritivores identified from the study site, with representative species illustrated. (A. *Camponotus floridanus,* B. *Labidura riparia,* C. *Camponotus sp.,* D. *Oniscus sp.,* E. *Polyrhachis sp. (Blue),* F. *Monachoides vicinus,* G. *Paralaoma servilis, H. Polyrhachis sp. (black),* I. *Chrysolina americana,* J. *Dorcus rectus,* K. *Tenebrio molitor,* L. *Gryllus rubens,* M. *Oecophylla sp.,* N. *Oecophylla smaragdina,* O. *Oxychilus cellarius,* P. *Alphitobius diaperinus,* Q. *Armadillidium sp.,* R. *Polyrhachis pirata,* S. *Diacamma australe,* T. *Euborellia annulipes,* U. *Subuliodetermes emersoni,* V. *Periplaneta fuliginosa,* W. *Calopteron reticulatum,* X. *Blaptica dubia,* Y. *Oecophylla longinoda,* Z. *Lithobius forficatus,* AA. *Gryllodes sigillatus,* AB. *Lithobius sp.,* AC. *Teleogryllus emma, and* AD, *Helix pomatia*)

Species with low values (<1.00) included *Metapocyrtus* sp. (Weevil) (Figure 3-Y), *Archachatina marginata* (Giant African Land Snail), *Laevicaulis alte* (Tropical Leatherleaf Slug), and *Harmonia axyridis* (Harlequin Ladybird). These species were detected only infrequently in the quadrats.

Amphibians

Eight amphibian species were recorded in the MAPL as shown in Table 4. *Platymantis mimulus* (Japanese Bullet Frog) (Figure 4-C) had the highest values across all ecological indices, with a relative frequency of 2.13, a relative density of 2.13, and a relative dominance of 1.60. These values give an Importance Value (IV) of 5.85 and identify it as the most ecologically significant amphibian in the assemblage.

Table 4. Relative Frequency, Relative Density, Relative Dominance and Importance Value of Amphibians Mt. Arayat Protected Landscape

Species	Relative Frequency	Relative Density	Relative Dominance	Importance Value
Kaloula kalingensis	0.07877117	0.07877117	0.002193067	0.159735406
Limnonectes Woodworthi	0.236313509	0.236313509	0.0197376	0.492364618
Occidozyga Laevis	0.590783773	0.590783773	0.123359997	1.304927544
Platymantis Corrugatus	0.905868452	0.905868452	0.29003306	2.101769965
Platymantis Dorsalis	0.551398188	0.551398188	0.107460264	1.210256641
				5.852388733
Platymantis Mimulus	2.126821583	2.126821583	1.598745566	
Polypedates leucomystax	0.118156755	0.118156755	0.0049344	0.241247909
Sanguirana luzonensis	0.039385585	0.039385585	0.000548267	0.079319436

Platymantis corrugatus (Rough-Back Forest Frog) (Fig. 4-B) and *Occidozyga laevis* (Common Puddle Frog) showed moderate values. *P. corrugatus* had a relative frequency of 0.91, a relative density of 0.91, and a relative dominance of 0.29, with an IV of 2.10. *O. laevis* had a relative frequency of 0.59, a relative density of 0.59, and a relative dominance of 0.12, with an IV of 1.30.

Figure 4. Amphibian species identified from the study site, with representative species illustrated. (A. *Limnonectes Woodwort, B. Platymantis Corrugatus, C. Platymantis Mimulus, D. Polypedates leucomystax,* and *E. Sanguirana luzonensis*)

Platymantis dorsalis (Dumeril's Wrinkled Ground Frog) recorded lower values with a relative frequency of 0.55, a relative density of 0.55, and a relative dominance of 0.11, giving an IV of 1.21. *Limnonectes woodworthi* (Woodworth's Frog) (Figure 4-A) had a relative frequency of 0.24, a relative density of 0.24, and a relative dominance of 0.02, with an IV of 0.49.

Very low IVs were recorded for *Kaloula kalingensis* (Kalinga Narrowmouth Frog), *Polypedates leucomystax* (Common Tree Frog) (Figure 4-D), and *Sanguirana luzonensis* (Luzon Frog) (Figure 4-E). These species had limited presence in the sampling quadrats.

Birds

Twelve bird species were recorded in the MAPL as shown in Table 5. *Lanius cristatus* (Brown Shrike, Figure 5-D) and *Pericrocotus divaricatus* (Ashy Minivet, Figure 5-A) exhibited the highest ecological values, with Importance Values (IVs) of 39.80 and 39.19, respectively. *L. cristatus* had relative frequency 8.15, relative density 8.15, and relative dominance 23.49, while *P. divaricatus* had relative frequency 8.07, relative density 8.07, and relative dominance 23.04. Together, these species comprised nearly 80% of the total avian IV.

Table 5. Relative Frequency, Relative Density, Relative Dominance and Importance Value of Aves Mt. Arayat Protected Landscape

Species	Relative Frequency	Relative Density	Relative Dominance	Importance Value
Pericrocotus divaricatus	8.0740449	8.074044899	23.04090618	39.18899597
Periparus elegans	0.512012603	0.512012603	0.092657065	1.116682271
Phylloscopus borealis	0.787711698	0.787711698	0.219306662	1.794730057
Muscicapa griseisticta	0.512012603	0.512012603	0.092657065	1.116682271
Lanius cristatus	8.152816069	8.152816069	23.4926779	39.79831004
Haliastur indus	0.07877117	0.07877117	0.002193067	0.159735406
Dasylophus superciliosus	5.277668373	5.277668374	9.844676057	20.4000128
Dicrurus balicassius	3.07207562	3.072075621	3.335654329	9.47980557
Merops philippinus	0.393855849	0.393855849	0.054826665	0.842538363
Geopelia striata	0.15754234	0.15754234	0.008772266	0.323856946
Phapitreron leucotis	0.15754234	0.15754234	0.008772266	0.323856946
Halcyon chloris	0.708940528	0.708940528	0.177638396	1.595519452
Pycnonotus goiavier	0.07877117	0.07877117	0.002193067	0.159735406

Dasylophus superciliosus (Red-Crested Malkoha, Figure 5-F) was the third most dominant species, registering an IV of 20.40, with relative frequency 5.28, relative density 5.28, and relative dominance 9.84. *Dicrurus balicassius* (Balicassiao, Figure 5-G) also recorded a relatively high IV of 9.48, supported by relative frequency 3.07, relative density 3.07, and relative dominance 3.34.

Figure 5. Avifauna species identified from the study site, with representative species illustrated. (A. *Pericrocotus divaricatus*, B. *Periparus elegans*, C. *Phylloscopus borealis*, D. *Lanius cristatus*, E. *Haliastur indus*, F. *Dasylophus superciliosus*, G. *Dicrurus balicassius,* and H. *Merops philippinus*)

Moderate IVs were obtained for *Periparus elegans* (Elegant Tit, Figure 5-B), *Muscicapa griseisticta* (Grey-Streaked Flycatcher), and *Phylloscopus borealis* (Arctic Warbler, Figure 5-C), each ranging between 1.12 and 1.79. These species showed low to moderate frequencies, densities, and dominances. Species with very low IVs (<0.35) included *Haliastur indus* (Brahminy Kite, Figure 5-E), *Geopelia striata* (Zebra Dove), *Pycnonotus goiavier* (Yellow-Vented Bulbul), and *Phapitreron leucotis* (White-Eared Brown Dove). *Merops philippinus* (Blue-Tailed Bee-Eater, Figure 5-H) and *Halcyon chloris* (Collared Kingfisher) recorded slightly higher but still low IVs of 0.84 and 1.60, respectively.

Reptiles

Among the reptiles, thirteen species were recorded in the MAPL (Table 6). *Pinoyscincus jagori* (Jagor's Sphenomorphus, Figure 6-A) exhibited the highest values across the ecological indices, with a relative frequency of 1.02, a relative density of 1.02, and a relative dominance of 0.37. These yielded an Importance Value (IV) of 2.42, identifying it as the most ecologically significant reptile in the assemblage.

Table 6. Relative Frequency, Relative Density, Relative Dominance, and Importance Value of Reptiles Mt. Arayat Protected Landscape

Species	Relative Frequency	Relative Density	Relative Dominance	Importance Value
Eutropis multicarinata	0.393855849	0.393855849	0.054826665	0.842538363
Hemidactylus frenatus	0.551398188	0.551398188	0.107460264	1.210256641
Gecko gekko	0.15754234	0.15754234	0.008772266	0.323856946
Lycodo capucinus	0.07877117	0.07877117	0.002193067	0.159735406
Hemibungarus calligaster	0.039385585	0.039385585	0.000548267	0.079319436
Otosaurus cumingi	0.669554943	0.669554943	0.158449063	1.497558949
Pinoyscincus jagori	1.024025207	1.024025207	0.370628259	2.418678673
Cyrtodactylus Philippinicus	0.15754234	0.15754234	0.008772266	0.323856946
Gekko monarchus	0.039385585	0.039385585	0.000548267	0.079319436
Draco spilopterus	0.07877117	0.07877117	0.002193067	0.159735406
Varanus marmoratus	0.07877117	0.07877117	0.002193067	0.159735406
Malayopython reticulatus	0.039385585	0.039385585	0.000548267	0.079319436
Gekko manorchus	0.039385585	0.039385585	0.000548267	0.079319436

The next most important species were *Otosaurus cumingi* (Luzon Giant Forest Skink, Figure 6-B) and *Hemidactylus frenatus* (Common House Gecko), with IVs of 1.50 and 1.21, respectively. *O. cumingi* showed relative frequency and density of 0.67 and relative dominance of 0.16. *H. frenatus* recorded relative frequency and density of 0.55 and relative dominance of 0.11. *Eutropis multicarinata* (Philippine Mabuya) followed with an IV of 0.84, supported by relative frequency and density of 0.39 and relative dominance of 0.05.

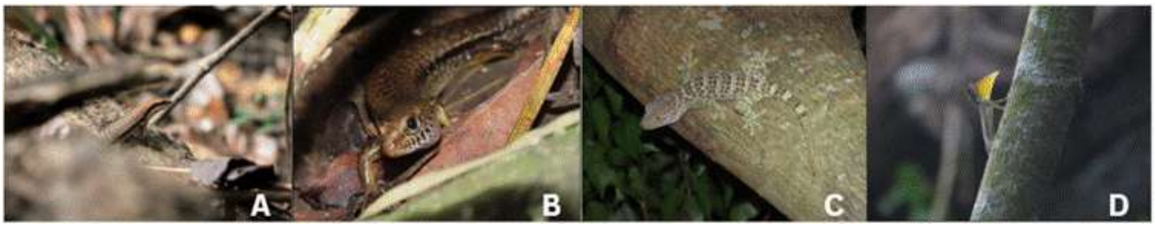

Figure 6. Reptile species identified from the study site, with representative species illustrated. (*A. Pinoyscincus jagori, B. Otosaurus cumingi, C. Gecko gekko, and D. Draco spilopterus)*

Low IVs were recorded for *Cyrtodactylus philippinicus* (Philippine Bent-toed Gecko), *Gecko gekko* (Tokay Gecko, Figure 6-C), and *Draco spilopterus* (Philippine Flying Dragon, Figure 6-D), each ≤ 0.32. Additional species, including *Varanus marmoratus* (Marbled Water Monitor), *Malayopython reticulatus* (Reticulated Python), and *Hemibungarus calligaster* (Barred Coral

Snake) had IVs < 0.16. Other geckos, such as *Gekko monarchus* and *Gekko manorchus* were also detected at very low values (IV = 0.08).

Diversity metrics

The results show clear differences in diversity across groups (Table 7). Detritivores are the most diverse, with a high Shannon index (H' = 3.83), very low Simpson's dominance (D = 0.025), and an Inverse Simpson value of 39.6, indicating many species with even abundances. Amphibians are less diverse (H' = 1.55, D = 0.275, 1/D = 3.64), reflecting lower richness and higher dominance. Reptiles show moderate diversity (H' = 1.99, D = 0.171, 1/D = 5.83), while birds (H' = 1.77, D = 0.217, 1/D = 4.60) are similar but slightly less even. Rodents have the lowest diversity (H' = 0.73, D = 0.620, 1/D = 1.61), dominated by only one or two species. Overall, detritivores contribute strongly to ecosystem stability through high diversity, reptiles and birds show intermediate diversity, while amphibians and rodents are more vulnerable due to low richness and high dominance.

Table 7. Diversity indices of the Fauna of Mt. Arayat Protected Landscape

Group	Shannon	Simpson's Index	Simpson's Diversity Index	Inverse Simpson Index
Detritivores	3.830441813	0.02526849765	0.9747315024	39.57496857
Amphibians	1.545924038	0.2750977836	0.7249022164	3.63507109
Reptiles	1.994450923	0.1714285714	0.8285714286	5.833333333
Aves	1.767036135	0.2173384453	0.7826615547	4.601118769
Rodents	0.7335417488	0.6198830409	0.3801169591	1.613207547

Discussion

Species assemblages

The faunal community of the MAPL is characterized by the dominance of a few species within each taxonomic group, accompanied by a wide range of low-abundance taxa. Rodents exhibited the lowest diversity (H' = 0.73, D = 0.620, 1/D = 1.61), indicating strong dominance by only one or two species. *Rattus everetti* (Philippine Forest Rat) emerged as the most ecologically significant, with high frequency and widespread distribution across sampling sites, consistent with its adaptability to various forest types and elevations (Heaney et al., 2010; Rickart et al., 2011; Balete et al., 2009). In contrast, *Rattus tanezumi* (Tanezumi Rat) and *Apomys cf. iridensis* (Mt. Irid Forest

Mouse) were recorded at low importance values, which reflect restricted occurrence or association with localized conditions (Aplin et al., 2003; Heaney & Regalado, 1998; Balete et al., 2011).

Detritivores, on the other hand, were the most diverse group (H' = 3.83, D = 0.025, 1/D = 39.6), with species distributed more evenly across the assemblage. *Diacamma australe* (Southern Ant) held the highest ecological importance, followed by *Blaptica dubia* (Dubia Roach) and *Polyrhachis dives* (Weaver Ant), underscoring the role of ants and cockroaches in litter processing and trophic regulation (Gobin et al., 2003; Ramsay, 1990; Roisin et al., 2006). Termites, particularly *Macrotermes malaccensis*, also contributed strongly as ecosystem engineers that alter soil structure and accelerate decomposition (Jouquet et al., 2011). Beetles and cockroaches such as *Tenebrio molitor* and *Blatta orientalis* displayed similarly high values which indicates their efficiency as decomposers (Triplehorn & Johnson, 2005). Amphibians showed relatively low diversity (H' = 1.55, D = 0.275, 1/D = 3.64), reflecting uneven distributions. However, *Platymantis mimulus* (Japanese Bullet Frog) dominated the assemblage, supported by high frequency and density. This highlights its specialization in leaf litter and moist understories (Brown et al., 2000; Alcala & Brown, 1998). Moderate contributions were observed from *Platymantis corrugatus* and *Occidozyga laevis*, while species such as *Platymantis dorsalis* and *Limnonectes woodworthi* reflected vertical and hydrological stratification (Diesmos et al., 2005; Brown & Alcala, 1970; Inger, 1954). Rare taxa like *Kaloula kalingensis*, *Polypedates leucomystax*, and *Sanguirana luzonensis* were detected in very low numbers (Diesmos et al., 2004).

Avifaunal exhibited moderate diversity (H' = 1.77, D = 0.217, 1/D = 4.60). The assemblage was skewed toward edge-tolerant and migratory species such as *Lanius cristatus* and *Pericrocotus divaricatus*, which comprised nearly 80% of total avian importance values (Yap et al., 2002; Kennedy et al., 2000). Native forest birds such as *Dasylophus superciliosus* (Red-Crested Malkoha) and *Dicrurus balicassius* (Balicassiao) held secondary importance which indicates the persistence of structurally complex forest habitats (Mallari et al., 2001; Kennedy et al., 2000).

Reptiles displayed moderate diversity (H' = 1.99, D = 0.171, 1/D = 5.83), with assemblages dominated by *Pinoyscincus jagori* (Jagor's Sphenomorphus) and was the most significant species, consistent with its preference for forest litter and damp microhabitats (Brown et al., 1996). *Otosaurus cumingi* (Luzon Giant Forest Skink) and *Hemidactylus frenatus* (Common House Gecko) followed, which indicates transitional forest margins and anthropogenic edges, respectively (Siler et al., 2011; Hoskin, 2011). Rare but ecologically important records included large or secretive taxa such as *Varanus marmoratus* (Marbled Water Monitor), *Malayopython reticulatus* (Reticulated Python), and *Hemibungarus calligaster* (Barred Coral Snake), consistent with their known elusive behavior and low detectability (Sy et al., 2009; Brown & Alcala, 1980;

McGuire & Alcala, 2000; Luiselli, 2006). The community structure of MAPL reflects strong dominance by a limited set of species across groups, balanced by the presence of endemics, specialists, and low-abundance taxa that together indicate both ecological heterogeneity and disturbance influence.

Species responses to habitat quality and disturbance

Patterns in species composition from MAPL illustrate contrasting responses of taxa to habitat quality and disturbance. Endemics reflect forest integrity and microhabitat specialization. The detection of *Apomys* cf. *iridensis* (Mt. Irid Forest Mouse), though limited in abundance, indicates persistence of high-quality microhabitats that support forest-dependent small mammals (Heaney & Regalado, 1998; Balete et al., 2011). Amphibians such as *Platymantis mimulus* (Japanese Bullet Frog) and *Platymantis corrugatus* (Rough-Back Forest Frog) further underscore this pattern, being restricted to litter-rich understory and structurally complex forest zones (Alcala & Brown, 1998; Brown et al., 2000; Diesmos et al., 2005). In the avifauna, *Dasylophus superciliosus* (Red-Crested Malkoha) and *Dicrurus balicassius* (Balicassiao) provide evidence of canopy and subcanopy integrity which reinforce the importance of mature vegetation cover (Mallari et al., 2001).

Generalists thrive across a broader range of environments and often dominate disturbed or transitional habitats. *Rattus everetti* (Philippine Forest Rat), though endemic, is widely distributed across elevations and forest types, exemplifying ecological flexibility that allows persistence even under disturbance (Heaney et al., 2010; Rickart et al., 2011). Among reptiles, *Eutropis multicarinata* (Philippine Mabuya) and *Hemidactylus frenatus* (Common House Gecko) demonstrate tolerance for open and human-influenced habitats (Hoskin, 2011). Birds such as *Lanius cristatus* (Brown Shrike) and *Pericrocotus divaricatus* (Ashy Minivet) exploit semi-open and edge habitats, particularly during migration (Yap et al., 2002; Kennedy et al., 2000).

Disturbance-adapted and synanthropic species serve as ecological indicators of anthropogenic pressure. *Rattus tanezumi* (Tanezumi Rat) reflects localized disturbance and proximity to human settlements or cleared forest margins (Aplin et al., 2003). Among invertebrates, cockroaches including *Blattella asahinai* and *Blattella germanica*, together with ants such as *Polyrhachis dives*, highlight tolerance to edge conditions and modified substrates (Ramsay, 1990; Roisin et al., 2006). The widespread distribution of *Hemidactylus frenatus* further signals invasive potential in buffer zones and settlement areas (Hoskin, 2011). Hence, MAPL's faunal composition demonstrates a community structured by both habitat-restricted endemics and disturbance-tolerant taxa. Endemics serve as indicators of intact habitats, generalists provide ecological stability across gradients, and disturbance-adapted species act as sentinels of human impact. Such assemblages are consistent with observations in other Philippine montane systems, where endemics persist in interior forests and generalists dominate degraded zones (Balete et al., 2009; Rickart et al., 2011; Heaney et al., 2016). This indicates that species' ecological strategies can be used as reliable indicators of habitat quality and disturbance gradients in MAPL.

Habitat associations

The distribution of species across MAPL also reflects clear patterns of habitat preference and microhabitat specificity. Several taxa point to well–preserved litter and understory conditions. The dominance of *Platymantis mimulus* (Japanese Bullet Frog) and *Pinoyscincus jagori* (Jagor's Sphenomorphus), both litter and forest–floor specialists, suggests that the forest retains suitable microclimatic conditions—specifically leaf litter depth and moisture—that support these endemic, leaf-litter-associated species (Alcala & Brown, 1998; Brown et al., 1996; Brown et al., 2000).

Aquatic and semi-aquatic habitats appear to be represented as well. The occurrence of *Occidozyga laevis* (Common Puddle Frog), *Limnonectes woodworthi* (Woodworth's Frog), and other stream-associated amphibians suggest that MAPL retains hydrological variability, including stagnant water bodies and mid-elevation streams (Inger, 1954; Brown & Alcala, 1970).

Vertical or arboreal niches also show representation but appear under-sampled in ground-based surveys. The limited detection of *Draco spilopterus* (Philippine Flying Dragon) and *Cyrtodactylus philippinicus* (Philippine Bent-toed Gecko) implies they inhabit canopy and rocky microhabitats less accessible to standard survey methods (Brown & Alcala, 1980; McGuire & Alcala, 2000).

Avian patterns further differentiate habitat zones. Migratory, edge-favoring species such as *Lanius cristatus* (Brown Shrike) and *Pericrocotus divaricatus* (Ashy Minivet) dominate semi-open areas, indicating open or disturbed zones that are suitable during non-breeding periods (Yap et al., 2002; Kennedy et al., 2000). In contrast, forest interior–dependent species such as *Dasylophus superciliosus* (Red-Crested Malkoha) and *Dicrurus balicassius* (Balicassiao) reflect the persistence of structurally complex canopy and subcanopy vegetation (Mallari et al., 2001).

Detritivore guilds span habitat heterogeneity within the forest floor. The predominance of ants (*Diacamma australe*, *Polyrhachis* spp.), cockroaches (*Blaptica dubia*, *Blatta orientalis*), and termites (*Macrotermes malaccensis*) indicates active organic matter processing in areas with litter deposition and soil complexity (Gobin et al., 2003; Ramsay, 1990; Roisin et al., 2006; Jouquet et al., 2011). The assemblage suggests that MAPL maintains a heterogeneous mosaic of forest microhabitats—litter, moisture gradients, hydrological features, and vertical structure—that support both forest specialists and habitat-generalist taxa. These associations underscore the importance of conserving multi-strata and hydrologically variable habitats to maintain ecological diversity across taxa.

Functional roles

The fauna documented in the MAPL fulfils complementary ecological roles that sustain key processes across trophic levels. Detritivores dominated by *Diacamma australe* (Southern Ant), *Blaptica dubia* (Dubia Roach), *Polyrhachis dives* (Weaver Ant), and *Macrotermes malaccensis* (Malayan Termite) drive decomposition and nutrient cycling. Ants and cockroaches process organic litter, termites engineer soil through mound construction and lignocellulose breakdown, while beetles such as *Tenebrio molitor* (Yellow Mealworm Beetle) contribute to rapid turnover of decaying organic matter (Gobin et al., 2003; Ramsay, 1990; Roisin et al., 2006; Jouquet et al., 2011; Triplehorn & Johnson, 2005). These activities maintain soil fertility and influence vegetation dynamics, echoing findings that detritivore diversity underpins ecosystem resilience in tropical forests (Basset et al., 2012). Amphibians serve as mid-trophic regulators. Species such as *Platymantis mimulus* (Japanese Bullet Frog) and *Platymantis corrugatus* (Rough-Back Forest Frog) consume large numbers of invertebrates in the forest floor and understory, linking primary consumers to higher predators (Brown et al., 2000; Diesmos et al., 2005). Semi-aquatic species like *Occidozyga laevis* (Common Puddle Frog) extend this role to aquatic and riparian systems, regulating insect larvae and small aquatic invertebrates (Inger, 1954). The amphibian guild thus contributes to both terrestrial and aquatic food web stability, consistent with global evidence of amphibians' roles in pest suppression and nutrient transfer between habitats (Whiles et al., 2006). Rodents play diverse roles as both consumers and prey. *Rattus everetti* (Philippine Forest Rat) functions as a seed predator and disperser, shaping understory vegetation, while also serving as a prey base for avian and reptilian predators (Heaney et al., 2010; Rickart et al., 2011; Balete et al., 2009). The occurrence of *Apomys cf. iridensis* (Mt. Irid Forest Mouse) highlights the role of forest-restricted endemics in maintaining seed dispersal pathways, whereas *Rattus tanezumi* (Tanezumi Rat) signals potential trophic disruption through crop and seed predation in disturbed areas (Aplin et al., 2003). These roles illustrate both stabilizing and destabilizing influences of rodents in forest ecosystems.

Bird assemblages span insectivory, frugivory, predation, and flock leadership. Migratory insectivores such as *Lanius cristatus* (Brown Shrike) and *Pericrocotus divaricatus* (Ashy Minivet) exploit seasonal insect abundance in semi-open zones (Yap et al., 2002; Kennedy et al., 2000). Native forest birds like *Dasylophus superciliosus* (Red-Crested Malkoha) function as canopy insectivores, while *Dicrurus balicassius* (Balicassiao) not only predate insects but also act as a mixed-species flock leader and predator deterrent, shaping community interactions (Mallari et al., 2001). Raptors such as *Haliastur indus* (Brahminy Kite) occupy apex roles, maintaining top-down regulation despite low abundances. These functional guilds collectively indicate trophic layering and habitat partitioning across MAPL's avifauna.

Reptiles further reinforce trophic diversity. Skinks such as *Pinoyscincus jagori* (Jagor's Sphenomorphus), *Otosaurus cumingi* (Luzon Giant Forest Skink), and *Eutropis multicarinata* (Philippine Mabuya) act as mesopredators of insects and small invertebrates, while geckos and agamids such as *Hemidactylus frenatus* (Common House Gecko) and *Draco spilopterus* (Philippine Flying Dragon) extend predatory roles into arboreal microhabitats (Brown & Alcala, 1980; McGuire & Alcala, 2000; Hoskin, 2011). Larger reptiles including *Varanus marmoratus* (Marbled Water Monitor) and *Malayopython reticulatus* (Reticulated Python) occupy higher trophic levels as apex or mid-level predators (Sy et al., 2009). The persistence of these species, albeit in low densities, suggests intact food web architecture critical for ecological regulation (Luiselli, 2006). Taken together, the MAPL fauna demonstrate strong functional redundancy, where multiple species fulfill overlapping ecological roles. This redundancy promotes resilience by buffering ecosystem processes against species loss, a feature widely emphasized in tropical biodiversity research (Mori et al., 2013). The presence of detritivores, insectivores, frugivores, seed dispersers, and apex predators illustrates a functionally complete faunal assemblage that underpins ecosystem stability.

Conservation implications and future directions

The species assemblages documented in MAPL have direct implications for conservation management. The dominance of habitat generalists such as *Rattus everetti* (Philippine Forest Rat) and *Hemidactylus frenatus* (Common House Gecko) highlights the adaptive capacity of some taxa to persist under disturbance but also signals increasing ecological homogenization that could marginalize habitat specialists (Heaney et al., 2010; Rickart et al., 2011; Hoskin, 2011). Conversely, the persistence of forest-dependent endemics like *Apomys cf. iridensis* (Mt. Irid Forest Mouse), *Platymantis mimulus* (Japanese Bullet Frog), and *Dasylophus superciliosus* (Red-Crested Malkoha) underscores the importance of intact understory, litter, and canopy habitats that remain within MAPL (Alcala & Brown, 1998; Brown et al., 2000; Mallari et al., 2001). These species function as indicators of habitat quality and should be prioritized in monitoring schemes.

The relatively low representation of stream- and canopy-dependent specialists such as *Sanguirana luzonensis* (Luzon Frog) and *Draco spilopterus* (Philippine Flying Dragon) may reflect under-sampling of vertical and aquatic habitats but also suggests that these guilds are especially vulnerable to habitat degradation. Protecting riparian zones and maintaining vertical structural complexity should therefore be considered in future management plans (Brown & Alcala, 1980; McGuire & Alcala, 2000).

The prevalence of disturbance-tolerant or synanthropic species such as *Rattus tanezumi* (Tanezumi Rat), *Polyrhachis dives* (Weaver Ant), and *Blattella germanica* (German Cockroach) illustrates ongoing anthropogenic influence at forest margins. These taxa provide useful early-warning indicators for habitat disturbance and should be incorporated into long-term ecological monitoring (Aplin et al., 2003; Ramsay, 1990; Roisin et al., 2006).

MAPL's faunal composition demonstrates strong functional diversity across trophic roles, from detritivores driving decomposition to apex predators such as *Varanus marmoratus* (Marbled Water Monitor) maintaining top-down regulation. Maintaining this diversity ensures functional redundancy, which increases ecosystem resilience to environmental change (Mori et al., 2013). Conservation planning should thus move beyond species counts to include the protection of ecological functions and redundancy.

Given the mix of generalists, endemics, and disturbance indicators, MAPL exemplifies a transitional system balancing intact forest interiors with disturbed margins. Strengthening protection in interior zones, restoring degraded edges, and maintaining habitat mosaics will be essential to conserving both species and their ecological roles. These findings align with broader studies of Philippine montane landscapes, where habitat conservation is critical to sustaining endemic-rich but disturbance-sensitive communities (Heaney et al., 2016; Balete et al., 2009).

The findings from the study also highlight both the strengths of current biodiversity persistence and the challenges posed by disturbance and habitat modification. Future research should prioritize long-term monitoring of key indicator taxa, such as *Apomys cf. iridensis* (Mt. Irid Forest Mouse), *Platymantis mimulus* (Japanese Bullet Frog), and *Dasylophus superciliosus* (Red-Crested Malkoha), to track changes in forest integrity over time. Establishing standardized protocols for repeated surveys will allow detection of population trends and early signals of ecological decline (Heaney et al., 2016).

Expanding survey coverage to vertical strata and aquatic habitats is also necessary. Limited detection of canopy- and stream-dependent species indicates potential under-sampling of these niches. Incorporating canopy fogging, acoustic monitoring, and nocturnal surveys will provide a more complete picture of MAPL's biodiversity (Basset et al., 2012).

Integrating functional ecology into conservation assessment offers another pathway. Measuring ecosystem services linked to detritivores, amphibians, birds, and reptiles—such as decomposition, pest control, seed dispersal, and prey regulation—will allow managers to safeguard not only species richness but also ecosystem processes (Mori et al., 2013; Whiles et al., 2006).

Finally, future management should consider socio-ecological integration. Engaging surrounding communities in participatory biodiversity monitoring and habitat restoration can enhance stewardship, reduce disturbance, and secure the long-term resilience of MAPL. Linking ecological outcomes to community-based conservation programs will be critical in ensuring that biodiversity protection translates into sustainable benefits for local stakeholders.

Conclusion

The faunal assemblage of Mt. Arayat Protected Landscape (MAPL) reflects both ecological resilience and sensitivity. Endemics such as *Apomys cf. iridensis* (Mt. Irid Forest Mouse), *Platymantis mimulus* (Japanese Bullet Frog), and *Dasylophus superciliosus* (Red-Crested Malkoha) indicate the persistence of intact habitats, while generalists like *Rattus everetti* (Philippine Forest Rat) and *Eutropis multicarinata* (Philippine Mabuya) sustain ecological stability across gradients. Disturbance-tolerant taxa including *Rattus tanezumi* (Tanezumi Rat) and *Hemidactylus frenatus* (Common House Gecko) signal anthropogenic influence, consistent with patterns observed in other Philippine montane systems where endemics persist in interiors and generalists dominate degraded zones (Aplin et al., 2003; Heaney et al., 2010; Rickart et al., 2011; Hoskin, 2011; Balete et al., 2009; Heaney et al., 2016).

Diversity metrics demonstrate high richness, evenness, and functional redundancy, with detritivores, amphibians, reptiles, birds, and rodents contributing to decomposition, trophic regulation, seed dispersal, and prey dynamics (Mori et al., 2013; Whiles et al., 2006). However, the low representation of canopy-, stream-, and apex-dependent species such as *Sanguirana luzonensis* (Luzon Frog), *Draco spilopterus* (Philippine Flying Dragon), and *Varanus marmoratus* (Marbled Water Monitor) underscores the need for enhanced monitoring in vertical and aquatic habitats (Brown & Alcala, 1980; McGuire & Alcala, 2000; Sy et al., 2009; Basset et al., 2012). Conservation priorities should therefore combine protection of forest interiors, restoration of disturbed margins, and community-based stewardship to secure both biodiversity and ecosystem resilience in MAPL.

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