

One Small Step for Toad, One Giant Leap for Frogkind: An Updated Checklist and Microhabitat Preference of Anurans in Mt. Sumagaya, Misamis Oriental, Philippines

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Abstract

Amphibians thrive in a wide variety of habitats and are determined by factors like metamorphic life cycle, reproductive activity and modes. The primary objective of the study is to provide baseline information in reviewing the biogeographic range of included species and provide information regarding the microhabitat preferences of amphibians in Mt. Sumagaya Range. Opportunistic sampling was conducted to record anurans which took place during the day (0900–1400 hours) and at night (1900–2300 hours) using standard illuminating device along the established Biodiversity Monitoring Sites (BMS) trail, streams, and rivers. A total of 19 anuran species were observed, providing 12 additional species records in the study site where eight (32%) species were only observed in arboreal microhabitat and the five (20%) species solely preferred aquatic microhabitat types. Invasive species such as *Rhinella marina* and *Kaloula pulchra* were recorded during the survey. Given the high level of endemism in Misamis Oriental, the presence of these invasive alien species highlights the urgent need to strengthen conservation and protection efforts in the region.

Keywords: Arboreal, Conservation, Endemism, Habitats, Invasive

1. Introduction

Amphibians thrive in a wide range of habitats, from relatively undisturbed forested areas to environments influenced by human activity, such as water puddles, roadside ditches, canals near residences, and rice fields [1, 2]. Various studies support that amphibian species exhibit specific habitat preferences, some are found in pristine, forested environments such as undisturbed and clean forest streams, while others are commonly observed in areas near human settlements or communities [3, 4, 5, 6].

The high variability in amphibian microhabitat preferences is largely attributed to their metamorphic life cycle. Most species begin as aquatic larvae and later develop limbs and lungs as they transition into terrestrial adults. However, some species bypass the larval stage entirely, developing directly from eggs laid on land. Despite these differences, nearly all amphibians are highly dependent on moist environments,

and most still require freshwater habitats for breeding [1]. Terrestrial species were primarily observed on the moist forest floor, often concealed beneath leaf litter, rotting logs, or at the base of tree buttresses. Species favoring aquatic microhabitats were typically found clinging to rocks in fast-flowing forest streams or perched on twigs overhanging forest rivers. Arboreal species, meanwhile, occupied branches, leaves, and leaf axils of understory trees [6, 7].

Another factor that contributes to amphibian microhabitat diversification is their reproductive activity [8] and modes [9]. Most species that occupy their specific microhabitats tend to do their reproductive activity such as calling, resting, or in amplexus and deposit their eggs using their distinct reproductive modes (7, 9, 10), such as aquatic developing species like most ranid species where they deposit eggs directly in water and have an aquatic development stage. With rhacophorid and platymantine frogs being completely independent of standing water and have evolved specialized reproductive strategies. Platymantines lay terrestrial eggs that undergo direct development, while rhacophorids produce foam nests for their eggs [7, 8, 9, 10] The new data gathered provide baseline information in reviewing the biogeographic range of included species, assess the microhabitat preference, the similarity of species composition between microhabitat types, and the conservation of the province's biodiversity.

2. Materials and Methods

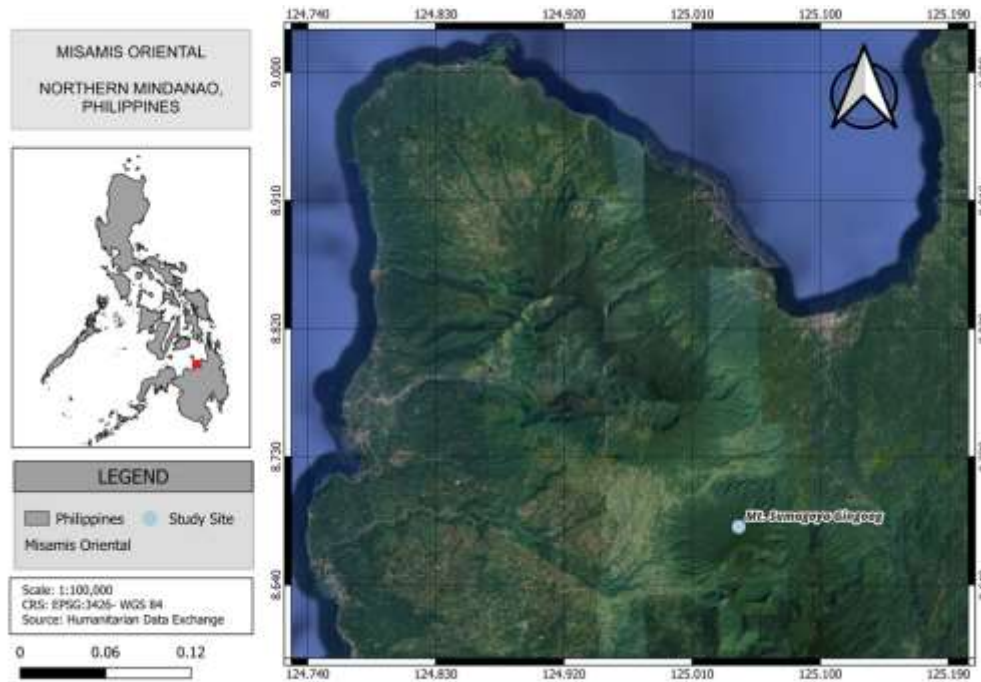
Ethical Consideration

In accordance with DENR-DA-PCSD Administrative Order No. 01 Series of 2004, a gratuitous permit was acquired to facilitate the sampling activity. Before samplings was conducted courtesy calls were arranged, and orientations were provided before the reconnaissance survey. Following this, a field orientation was conducted by the Bantay Lasang, including rituals and prayers as integral components of the activity before the collection commenced.

Sampling Site

The province of Misamis Oriental, located in Northern Mindanao, Philippines, features a diverse landscape that includes coastal plains, limestone formations, and mountain ranges. A significant portion of its land area is classified as forestland. The province is bordered by two major bays, Macajalar Bay and Gingoog Bay, and is traversed by numerous rivers originating from the highlands of neighboring Bukidnon. Covering an area of approximately 3,544 km², Misamis Oriental is divided into 24 municipalities, which includes Balingoan and the city of Gingoog. The study site, Mt. Sumagaya falls under the territory of Gingoog City (Figure 1). Anuran inventories were done for potential new records in the selected areas of Misamis Oriental.

Figure 1. Map of Misamis Oriental, Northern Mindanao Philippines showing the coordinates for Mt. Sumagaya Range. The insets show the Map of the Philippines.



The Mt. Sumagaya Range in Misamis Oriental features a topographically diverse and elevated landscape that supports a range of forest types across various sampling sites. The forest structure includes emergent and canopy trees, predominantly from the genera *Shorea* and *Lithocarpus* (locally known as “ulayan”), with tree heights ranging from 11 to 26 meters. The understory is typically composed of palms and tree ferns, while the ground layer is dominated by ferns, sedges, and grasses. The forest floor consists primarily of clay soil, overlaid by a layer of leaf litter approximately 3 to 10 cm thick, contributing to the area’s organic matter accumulation and microhabitat diversity.

Table 1. Study sites of Mt. Sumagaya with corresponding elevation and vegetation type.

Site	Municipality	Locality	Elevation (masl)	GPS Coordinates	Forest type
Mt. Sumagaya	Gingoog	Barangay Lunotan	870-1250	8°40'51"N, 125°2'34"E	Montane

The site's proximity to the Gingoog River and several adjacent streams (ranging from 20 to 280 meters) contributes to persistently high relative humidity levels, recorded between 84% and 90%. This, in combination with the dense forest canopy, facilitates extensive moss colonization on exposed substrates such as logs, rocks, and tree trunks. Additionally, the elevated topography induces a cool and moist microclimate, with fog frequently observed during early morning and late afternoon to evening hours. These environmental factors collectively establish a highly humid, shaded habitat favorable for the persistence of moisture-dependent plant and animal species.

Sampling Method

Opportunistic sampling was conducted to record anurans present in the selected study sites. Surveys took place during the day (0900–1400 hours) and at night (1900–2300 hours), aligning with the peak activity periods when most anurans emerge to call and advertise. Anurans were collected using a standard scoop net to prevent injury and reduce the chances of escape. Each specimen was then placed in a cloth sample bag for storage. Habitats and microhabitats such as tree holes, burrows, decaying logs, tree buttresses, tree foliage, leaf litter, and isolated pools were specifically targeted for the study (Figure 2). Morphological measurements such as snout-vent length (SVL), head width (HW), head length (HL), tympanum width (TW), Internarial width (InW), tympanum diameter (TD), Interorbital width (IoW), tibia length (TL), and toe length (TL) were taken using a vernier caliper. Nocturnal sampling was facilitated using commercially available flashlights and headlamps. The researcher was accompanied by local guides and forest guards assigned by the office managing the protected area, ensuring safety and assistance through their familiarity with established trails, river systems, and known anuran habitats. Among the three study sites, Mt. Sumagaya, the second site, is the only location that is not designated as a Protected Area. Sampling efforts at the study sites were scheduled based on the availability of Department of Environment and Natural Resources (DENR) personnel, as well as the safety clearance and permission granted by the Indigenous Peoples (IPs) and the overseeing Infantry Battalion. As a result, the number of sampling days varied across sites and was not uniform. Mt. Sumagaya was sampled for 7 days, with a total of 63 person-hours from April 22–28, 2024.

Photographic guides by Alcalá & Brown (1998) and Plaza & Sanguila (2015) and other available published materials were used as reference for identification. Species identification was verified by Dr. Rafe Brown of University of Kansas, an expert in herpetology. Species nomenclature follows the Amphibian Species of the World Online Reference [11]. Specimens that were readily identified in the field were marked and promptly released back into their habitat. Voucher specimens were kept in the Museum of Natural Sciences, College of Natural Sciences, College of Science and Mathematics, MSU-Iligan Institute of Technology, Iligan City. The distribution and conservation status of each species were checked using 2024 IUCN Red list of Threatened Species and other published references.

Figure 2. Examples of habitats assessed in Misamis Oriental. A: Gingoog river located in Mt. Sumagaya. B: Mixed dipterocarp montane forest at 870-1250 masl of Mt. Sumagaya, with presence of anthropogenic disturbances.



Microhabitat Classification

The microhabitat of each amphibian species was noted upon observation. Its characterization was based on the following broad categories Ates & Delima (2008).

Type I – Arboreal microhabitats referring to those from the ground (5-10m) including branches and stems of plants, leaves and leaf axils.

Type II – Ground microhabitats referring to microhabitats directly off the ground (0-5m), or on rotting logs and tree buttresses.

Type III – Aquatic microhabitat includes streams, rivers, and creeks as well as standing bodies of water.

Statistical Analysis

Rstudio Version 2024.12.0+467 software was used for analyzing the data on the distribution of anuran species per site with respect to their microhabitat preference. Bray-Curtis cluster analysis was utilized to identify the similarity of the microhabitat types. QGIS (Geographic Information Systems) Map version 3.40.4. created map presentations. This computer software integrates geographic and descriptive data to support map production, enabling more accessible and effective spatial analysis.

3. Results and Discussion

The anuran survey conducted in a total of 19 species belonging to seven families, namely: Bufonidae, Ceratobatrachidae, Dicroglossidae, Megophryidae, Microhylidae, and Megophryidae, and 15 genera of anurans from Mt. Sumagaya Range, Misamis Oriental. 12 species are new records in the montane forest of Mt. Sumagaya, namely; *Ansonia muelleri*, *Pelophryne brevipes*, *Rhinella marina*, *Limnonectes parvus*, *L. lumadorum*, *P. stejnegeri*, *C. fusca*, *Sanguirana mearnsi*, *S. natator*, *Philautus acutirostris*, *Philautus poecilus*, and *Philautus worcesteri*. An updated checklist on the anurans of Mt. Sumagaya Range, Misamis Oriental, Mindanao, Philippines is provided in Table 2. Accounts for each species recorded in this study were also included with notes on their natural history and distribution.

Table 2. Species composition of anurans in Mt. Sumagaya Range. Published reports of species are marked by ✓ are shown in columns, including our data during the field survey.

ANURANS	Mt. Sumagaya Sanguila et. al., 2016	This Study
Bufonidae		
<i>Ansonia muelleri</i> (Boulenger, 1887)*★		2
<i>Pelophryne brevipes</i> (Peters, 1857)* ★		2
<i>Rhinella marina</i> (Linnaeus, 1758)+ ★		2
Ceratobatrachidae		
<i>Platymantis corrugatus</i> (Duméril, 1853)*	✓	2
Dicroglossidae		
<i>Limnonectes leytensis</i> (Boetger, 1893)*	✓	2
<i>Limnonectes magnus</i> (Stejneger, 1910)*	✓	2
<i>Limnonectes parvus</i> (Taylor, 1920)* ★		2
<i>Occidozyga laevis</i> (Günther, 1858)*	✓	2
Megophryidae		

<i>Leptobrachium lumadorum</i> (Brown et al., 2010)* ★		2
<i>Pelobatrachus stejnegeri</i> (Taylor, 1920)* ★		2
<i>Microhylidae</i>		
<i>Chaperina fusca</i> (Mocquard, 1892)		2
<i>Ranidae</i>		
<i>Hylarana grandocula</i> (Taylor, 1920)*	✓	2
<i>Sanguirana mearnsi</i> (Stejneger, 1905)* ★		2
<i>Staurois natator</i> (Günther, 1858)* ★		2
<i>Rhacophoridae</i>		
<i>Philautus acutirostris</i> (Peters, 1867)* ★		2
<i>Philautus poecilus</i> (Brown & Alcala, 1994)* ★		2
<i>Philautus worcesteri</i> (Stejneger, 1905)* ★		2
<i>Polypedates leucomystax</i> (Gravenhorst, 1829)+	✓	2
<i>Rhacophorus pardalis</i> (Günther, 1858)	✓	2

Legend: * endemic species; + introduced species; ★ new records).

Species Account

Family Bufonidae

Ansonia muelleri (Boulenger, 1887) (Fig. 3). The Mindanao slender toad is the most abundant species that was commonly found from 1250-1300 masl in the montane riparian environments of Mt. Sumagaya, mostly in the splash zones of fast-flowing rivers. This species is widespread across most major mountains of Mindanao, mainly in the central and western Mindanao and Dinagat island [11, 12, 13]. It was frequently observed near the splash zones of near rapid or fast-flowing rivers, this behavior could be linked to its highly specific torrent-dwelling larval habitat requirements, as this species is also limited to montane habitats with high gradient stream flow [6].

Pelophryne brevipes (Peters, 1867). The Zamboanga Flathead Toad were documented from 1250-1300 masl and was observed perched on the leaves of understory trees in Mt. Sumagaya. The distribution of this species was previously considered disjunct, spanning across the Philippine islands of Mindanao and Basilan [11], as well as the Malay Peninsula, Sumatra, Mentawai, and Natuna islands [13]. However, a recent phylogenetic study determined that the populations from the Malay Peninsula and Sumatra represent a separate species, now identified as *Pelophryne ingeri*, and confines *Pelophryne brevipes* to Mindanao, and is now considered to be a Philippine endemic [14, 15].

Figure 3. *Ansonia muelleri* found perched on a leaf in mid elevation stream of Mt.



Rhinella marina (Linnaeus, 1758). The South American Cane Toad were commonly documented from 1250-1400 masl in Mt. Sumagaya and was observed near human settlements, particularly in bodies of water where they were found calling to attract mates. The population in the Philippines may have originally been introduced to the Philippines via four pathway categories: intentional 'release' for biological control and hunting in the wild; 'escape' from farms; 'contamination' of agricultural commodities, fish stocks, and ornamental plants/nursery materials; and 'stowaway' on container/bulk or as hitchhikers on ships/boats [16], and is widely distributed in Alabat, Bohol, Calayan, Catanduanes, Cebu, Cocomo, Dinagat, Gigantes Norte, Leyte, Lubang, Luzon, Marinduque, Masbate, Mindanao, Mindoro, Negros, Palawan, Panay, Polillo, Romblon Island Group, Sicogon, Samar, Ticao, Verde [13].

Family Ceratobatrachidae

Platymantis corrugatus (Dumeril, 1853). Despite the widespread population of the Philippine Wrinkled Ground Frog in the Mindanao PAIC, only one specimen was documented 1250 masl and was observed on the forest edge of Mt. Lumot. This is a frequently observed species because of its widespread presence across the Mindanao PAIC, and is common throughout the main islands from Luzon to Mindanao, namely; Bohol, Cagraray, Camiguin Sur, Camotes Island Group, Catanduanes, Cebu, Dinagat, Leyte, Luzon, Mindanao, Mindoro, Negros, Panay, Polillo, Ponson, Poro, Rapu-Rapu, Samar, Sicogon, Siquijor, while being absent in Palawan [11, 13]. The *Platymantis corrugatus* population in Mindanao differs both morphologically and acoustically from the lineages found in Luzon and the Visayas PAIC. Additionally, the Mindanao population exhibits distinct behavior, as they typically call from open areas and continue calling throughout the evening [6, 15].

Family Dicroglossidae

Limnonectes leytensis (Boetger, 1893) (Fig. 4). Several individual of the Leyte Wart Frog were heard and seen calling while perched on rocks and tree branches near water. Some were also spotted higher up in trees, far from any water sources. This is a common species found in aquatic environments like swamps and marshes, as well as along small streams. It is widely distributed across the Philippine islands south of Mindoro and Luzon and is absent in Palawan, Mindanao, Visayan, and Romblon PAICs and can be easily identified by its small size, rough skin, and a "V" shape mark on the scapular region [6, 11, 13, 15].

Limnonectes magnus (Stejneger, 1910) (Fig. 5). The individuals of Mindanao Fanged Frog were documented 450-1360 masl and was observed calling while perched on rocks or under leaf cover near bodies of water, the researcher's personal observations confirm that this species is harvested by locals for consumption, or under the belief that it helps alleviate fatigue. This is a commonly distributed species throughout the Mindanao faunal region [11, 13], primarily found in both aquatic and terrestrial microhabitats. It has been documented on rocks and in rivers and streams within dipterocarp forests [17].

Figure 4. *Limnonectes leytensis* found near the stream of Mt. Sumagaya.



Figure 5. *Limnonectes magnus* found near the stream of Mt. Sumagaya.



Limnonectes parvus (Taylor, 1920) (Fig. 6). A single individual of the Philippine Guardian Frog was observed 1250 masl in the agricultural area along the forest edge of Mt. Lumot. This species is commonly encountered in undisturbed streams in lowland and lower montane forests and locally abundant species in central, southern, and western Mindanao [11, 13]. However, it is absent in most northeastern Mindanao localities and has not been recorded on Bohol, Leyte, Dinagat, Siargao, or Samar [6].

Occidozyga laevis (Günther, 1858) (Fig. 7). Several individuals of the Common Puddle Frog were documented 870-1250 masl and was encountered calling in shallow, muddy streams and wallows of water buffalos in disturbed areas near human civilizations. As its name suggests, inhabits aquatic microhabitats, particularly shallow, slow-moving streams, small pools of water in disturbed areas, and flooded rice fields at lower elevations, to cascading mountain streams in montane environments and is common throughout the Philippines [6, 11, 13].

Figure 6. *Limnonectes parvus* found on the forest edge of Mt. Sumagaya.



Figure 7. *Occidozyga laevis* observed in a small stream on mixed agriculture forest of Mt. Sumagaya.



Family Megophryidae

Leptobrachium lumadorum (Brown et al., 2010) (Fig. 8). Individuals of the Mindanao Litter Frog were documented 450-1400 masl and was encountered near the stream or exposed on the trail used by locals in agricultural areas on the way to the sampling site. This recently described species is widely distributed in Mindanao and Basilan but is absent from Leyte, Samar, and Bohol, and the smaller islands associated with Mindanao [11, 13, 18]. It occupies both aquatic and terrestrial microhabitats and thrives in a variety of environments, as long as some vegetation remains [6].

Figure 8. *Leptobrachium lumadorum* observed hidden under vegetation near a stream in Mt. Sumagaya.



Pelobatrachus stejnegeri (Taylor, 1920) (Fig. 9). Individuals of the Mindanao Horned Frog were documented 450-1930 masl and was mostly observed calling during and after rainfall, often hidden under fallen tree branches, rocks, and boulders near the stream. This species is endemic to the Mindanao faunal region [11, 13], with recorded occurrences in various montane areas of the island, including Mt. Sinaka, Mt. Hamiguitan [4], Mt. Pasian [19], Mt. Malindang [20], and Siargao Island (*unpublished data of Diesmos, A. C., as cited by Plaza & Sanguila, 2015*).

Figure 9. *Pelobatrachus stejnegeri* found perched on a rock near a stream in Mt. Sumagaya.



Family Microhylidae

Chaperina fusca (Mocquard, 1892). Individuals of the Saffron-bellied Frog were documented 450-870 masl and was observed calling from the tops of water-filled bamboo tree hollows. Some were also seen inside the hollows alongside tadpoles, indicating potential parental care. This is a non-endemic species that has a broad geographic range, though it is only locally observed in the Mindanao, Basilan, Palawan, and Sulu archipelago [11, 13]. It is also found in Peninsular Malaysia, Thailand, and central Borneo, utilizing both arboreal and terrestrial microhabitats, mostly observed among rotting leaves, moss and on ground fern [6, 7].

Family Ranidae

Hylarana grandocula (Taylor, 1920) (Fig. 10). Individuals of the Big-eyed Frog were documented 450-1300 masl and was commonly found sitting on rocks, on low branches, and even on tree branches 5m above the ground near the stream. This is a widely distributed and commonly encountered species, often found in high abundance across Basilan, Biliran, Bohol, Camiguin Sur, Dinagat, Leyte, Mindanao, and Samar [21]. It is found in disturbed habitats and occurs across a wide range of elevations throughout Mindanao, males typically form choruses around pools in streams and rivers, calling when water levels are relatively low, with females being observed far away from the water, perching on low branches of understory trees, and occasionally aggregating in shallow caves formed by overhanging stream banks [6]. *Sanguirana mearnsi* (Stejneger, 1905) (Fig. 11). Individuals of the Cabilian Frog, were documented 1230-1300 masl and was observed calling while perched on low branches and streamside vegetation in streams near human habitation or agricultural areas. One specimen was found atop a tree, 7-9 meters above the ground, several meters away from any visible streams or bodies of water. This is an endemic species of the Philippines that are locally found in Samar, Leyte, and the eastern part of Mindanao island [11, 13]. Formerly classified as a subspecies of “*Rana everetti*,” is now recognized as a distinct species. Initially proposed based on morphometric data, this classification is now supported by genetic evidence [22]. They are exceedingly common and locally abundant when reproductively active in riparian habitats and usually perches in streamside vegetation, on steep banks, or large boulders, with some individuals observed as high as 4-5m in riverbank trees [6].

Figure 10. *Hylarana grandocula* perched on a tree near a stream in Mt. Sumagaya.



Figure 11. *Sanguirana mearnsi* observed perched on a rock near a stream in Mt. Sumagaya.



Staurois natator (Günther, 1858). Individuals of the Mindanao Splash Frog were documented 450-1300 masl and was often found resting on rocks or perched on low branches and vegetation near fast-flowing streams, small waterfalls, or at the water's edge. This is now considered a species exclusively found in the Mindanao PAIC [11, 13], following recent genetic evidence that suggests the Palawan populations of *Staurois natator* are distinct, thereby limiting the species' distribution to the Mindanao faunal region [23]. This species is typically found in clear, rocky, and fast-flowing streams within tropical rainforests. It is often observed near streams, resting on rocks, boulders, and stream banks, or perched on vegetation along or near the water's edge [6].

Family Rhacophoridae

Philautus acutirostris (Peters, 1867) (Fig. 13). Specimens of the Philippine Bubble-nest Frog were observed 870-1300 masl perched on the leaves of understory trees or hidden under dead banana leaves, some individuals were found on the forest floor on the forest edge. This is a species found in Jolo, Basilan, and Mindanao particularly in Mt. Apo, Mt. Sinaka and Mt. Hamiguitan and Mt. Malindang (Brown *et. al.*, 1998; Ates & Delima, 2008; Stuart *et. al.*, 2008; Nuñez *et. al.*, 2010; Frost, 2024)[4, 12, 20, 24]. It is a prominent, locally abundant, and frequently recorded montane forest frog, commonly found perched on small leaves, including the undersides of leaves 0.3–1.0 meters above the forest floor, which constitutes its preferred microhabitat [6].

Figure 12. *Staurois natator* observed near a stream in Mt. Sumagaya.



Figure 13. *Philautus acutirostris* observed perched on a bird's nest on Mt. Sumagaya.



Philautus poecilius (Brown & Alcala, 1994) (Fig. 14). A single individual of the Mottled Tree Frog was found 870 masl in the disturbed agricultural area at the edge of Mt. Lumot. This is a species known from the mountains of eastern, north-western, and central Mindanao Island, particularly in Mt. Lumot, Mt. Malindang, and Mt. Sinaka [4, 11, 12, 17, 20]. It is commonly found on arboreal microhabitats, where it is perched in bird's nest ferns and leaf axils of *Pandanus* three to six meters high on mossy forest [7].

Figure 14. *Philautus poecilius* observed perched on a leaf of an understory plant on Mt. Sumagaya.



Philautus worcesteri (Stejneger, 1905). A single specimen of the Mindanao Bubble-nest Frog was found 870 masl perched on an understory tree on the forest edge of Mt. Lumot. This species is found in various montane regions of Mindanao in Agusan del Norte, Davao, Misamis Occidental, and Zamboanga del Norte provinces (Stuart *et. al.*, 2008; Diesmos *et. al.*, 2015; Frost, 2024) [11, 12, 13]. It is mostly found on arboreal microhabitats in lower montane and lowland forests, and has also been found in slightly disturbed habitats on the forest edge, where it calls to attract mates [6, 12].

Polypedates leucomystax (Gravenhorst, 1829) (Fig. 15). Individuals of the Common Tree Frog were documented 450-1300 masl and are mostly found near human habitation, perched on trees or cut bamboo used as fences in agricultural areas. This is a widely distributed introduced species across the Philippines, thriving in disturbed habitats and commonly found in agricultural areas [6, 13]. It is primarily found in

both arboreal and terrestrial microhabitats, often seen perched on leaves or branches of trees, ground ferns, vine leaves, and decaying leaves near riverbeds in cultivated areas, as well as in secondary and logged dipterocarp forests [7].

Figure 15. *Polypedates leucomystax* observed perched on a banana trunk on Mt. Sumagaya.



Rhacophorus pardalis (Günther, 1858). Specimens of the Gliding Tree Frog were documented 1170 masl and was encountered sitting on a rock near a stream. This species is known to be widespread in the Philippines [11, 13, 25]. It is mostly found in arboreal microhabitats, often seen perched among leaves, leaves of trees and shrubs and pocket ferns and on rocks near river [7].

Figure 16. *Rhacophorus pardalis* found perched on a rock near a stream on Mt. Sumagaya.



Table 2. Species composition of anurans in Mt. Sumagaya Range. Published reports of species are marked by ✓ are shown in columns, including our data during the field survey.

ANURANS	Mt. Sumagaya Sanguila <i>et. al.</i> , 2016	This Study
Bufonidae		
<i>Ansonia muelleri</i> (Boulenger, 1887)*★		✓
<i>Pelophryne brevipes</i> (Peters, 1857)* ★		✓
<i>Rhinella marina</i> (Linnaeus, 1758)+ ★		✓
Ceratobatrachidae		
<i>Platymantis corrugatus</i> (Duméril, 1853)*	✓	✓
Dicroglossidae		
<i>Limnonectes leytensis</i> (Boetger, 1893)*	✓	✓
<i>Limnonectes magnus</i> (Stejneger, 1910)*	✓	✓
<i>Limnonectes parvus</i> (Taylor, 1920)* ★		✓
<i>Occidozyga laevis</i> (Günther, 1858)*	✓	✓
Megophryidae		
<i>Leptobrachium lumadorum</i> (Brown <i>et al.</i> , 2010)* ★		✓
<i>Pelobatrachus stejnegeri</i> (Taylor, 1920)* ★		✓
Microhylidae		
<i>Chaperina fusca</i> (Mocquard, 1892)		✓
Ranidae		
<i>Hylarana grandocula</i> (Taylor, 1920)*	✓	✓
<i>Sanguirana mearnsi</i> (Stejneger, 1905)* ★		✓
<i>Staurois natator</i> (Günther, 1858)* ★		✓
Rhacophoridae		
<i>Philautus acutirostris</i> (Peters, 1867)* ★		✓
<i>Philautus poecilus</i> (Brown & Alcalá, 1994)* ★		✓
<i>Philautus worcesteri</i> (Stejneger, 1905)* ★		✓
<i>Polypedates leucomystax</i> (Gravenhorst, 1829)+	✓	✓
<i>Rhacophorus pardalis</i> (Günther, 1858)	✓	✓

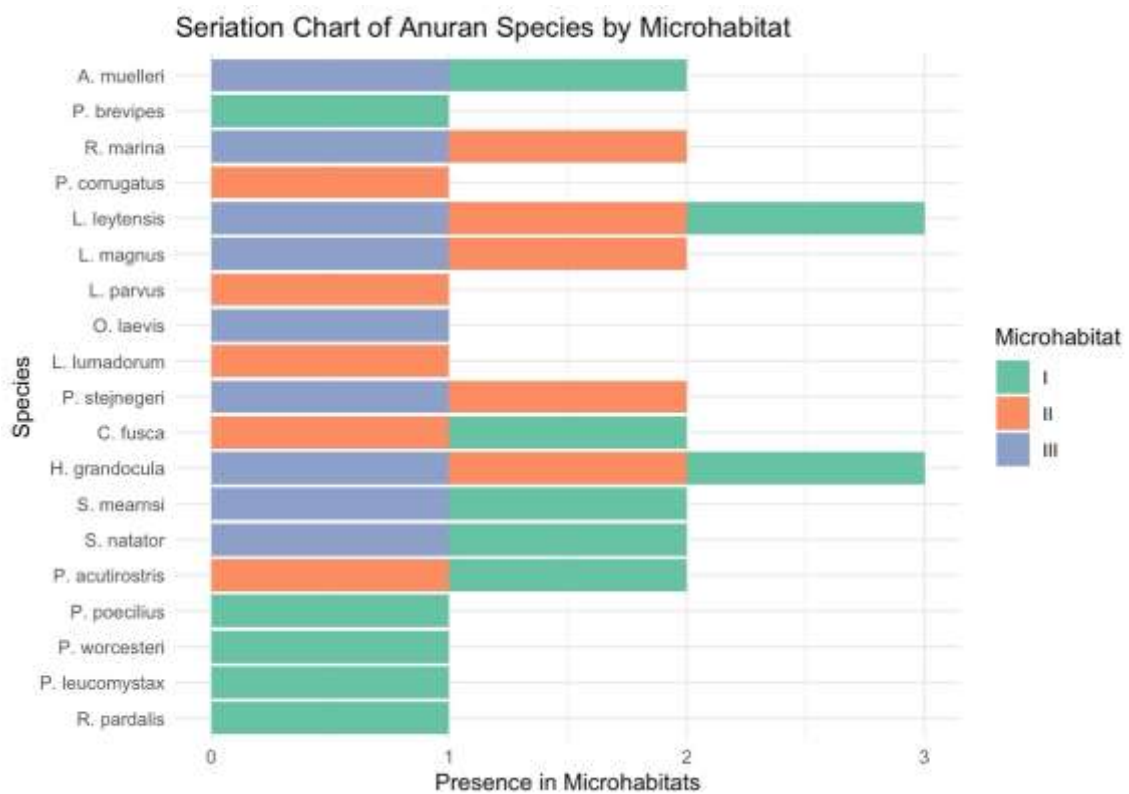
Legend: * endemic species; + introduced species; ★ new records).

Microhabitat Preferences

Three types of anuran microhabitats were characterized and used in this study as referenced from Ates & Delima (2008). Anuran microhabitat preferences of the species encountered in the area are shown in Figure 3. Among the 19 species of anurans documented in this study, five (26.32%) species were only observed in type I (arboreal) microhabitat, and three (15.79%) species only observed in type II (ground) microhabitat, and one (5.26%) species only observed in type III (aquatic) microhabitat. This indicates that majority of the species encountered in Mt. Sumagaya Range are arboreal species. The most abundant

anuran species that were found in a specific microhabitat type were arboreal-dwelling anurans, which were found elevated from the ground such as branches, stems of plants, leaves and leaf axils which were usually 5-10m above ground [4]. Observed species were *P. brevipes*, *P. poecilius*, *P. worcesteri*, *P. leucomystax*, and *R. pardalis*. The second observed anuran species that exclusively dwell in a particular microhabitat were ground-dwelling species which thrive directly on the ground, on rotting logs and tree buttresses [6, 7, 18]. Anuran species such as *P. corrugatus*, *L. parvus*, and *L. lumadorum* were found in this type of microhabitat. The least observed anuran species that only dwell in a particular microhabitat were aquatic or water-dwelling species, aquatic anurans are species that spend most of their lives in or near water, including environments like streams, rivers, creeks, and standing water bodies [2]. The only solely aquatic species encountered during the sampling was *O. laevis*.

Figure 17. Seriation chart of anuran microhabitat distribution in Misamis Oriental, Philippines.

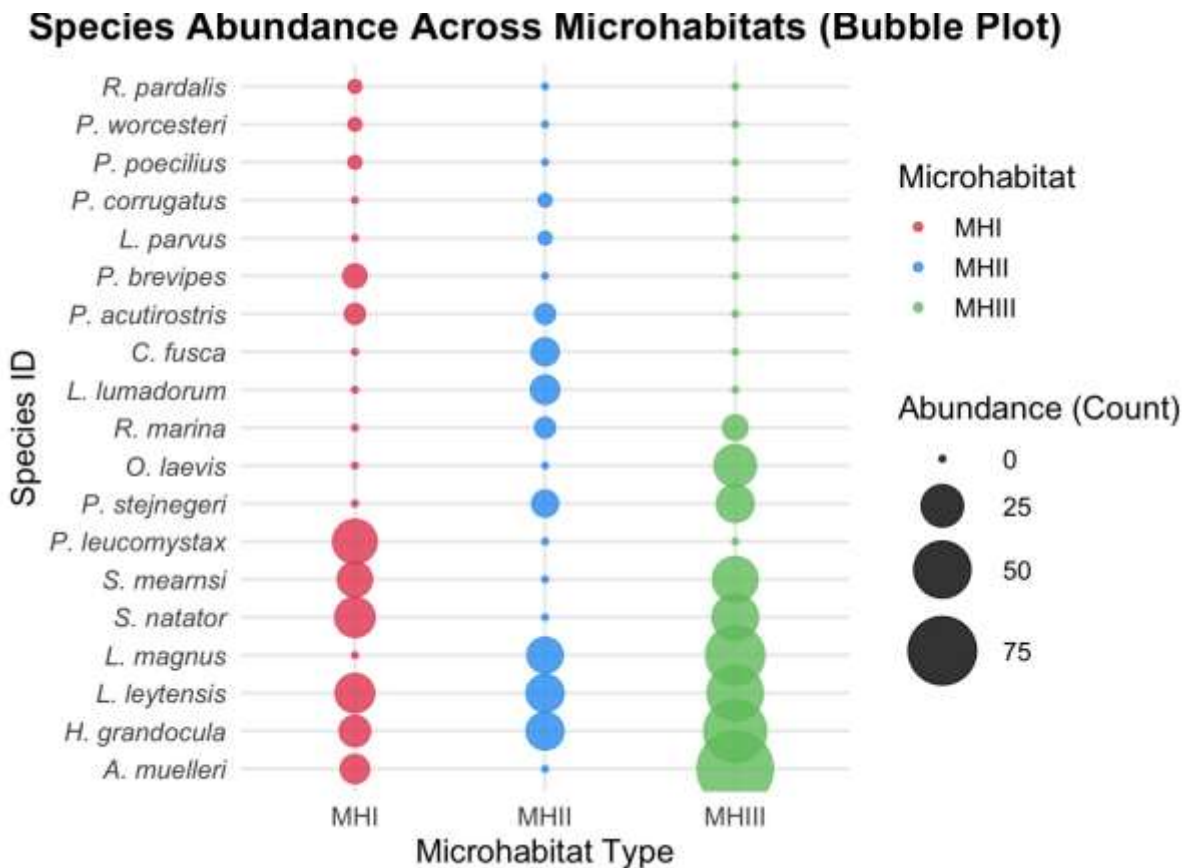


These observations show that the anuran species that were encountered tend to diverge near streams, rivers and standing bodies of water. The high species richness in Mt. Sumagaya supports the statement that intermediate elevations tend to support more anurans due to more suitable habitats [9, 26, 27, 28, 29]. There were also some species that were observed in the different microhabitat types. Anuran species such as *C. fusca* and *P. acutirostris* were observed on both the type I (arboreal) and type II (ground) microhabitat types. While anuran species such as *A. muelleri*, *S. mearnsi*, and *S. natator* were observed on both the type I (arboreal) and type III (aquatic) microhabitat types which agree with the findings of Plaza & Sanguila (2015). Anuran species such as *R. marina*, *L. magnus*, and *P. stejnegeri*, on the other hand were found on both the type II (ground) and type III (aquatic) microhabitat types as also reported by Plaza & Sanguila (2015) and Venturina et. al. (2023). While two anurans species were found on the three

different microhabitat types, namely, *L. leytensis* and *H. grandocula* which reflects to the findings of Plaza & Sanguila (2015).

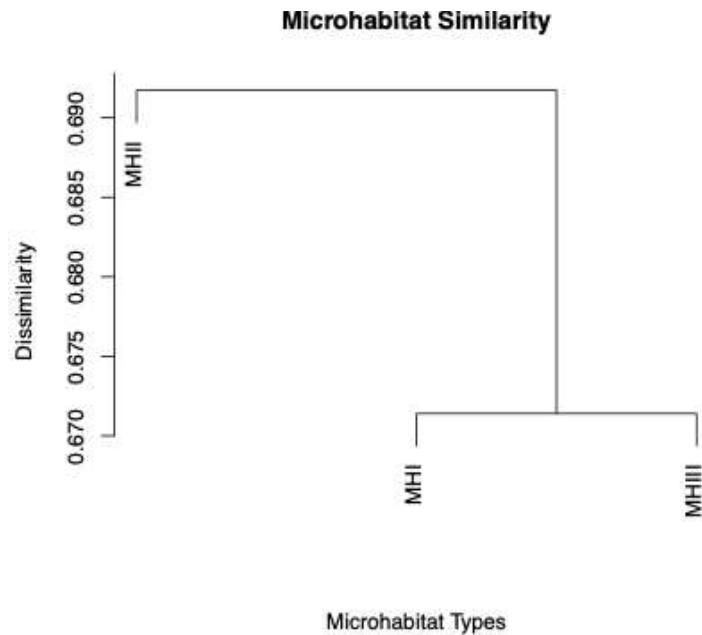
Scatter plot on the distribution of the anuran species in the different microhabitat types per sampling location in Mt. Sumagaya, Misamis Oriental is shown in Fig. 4. Despite being mixed-agricultural forest, Mt. Sumagaya Range had a high number of species. Presence of terrestrial species like the *P. corrugatus* and *L. parvus* this could be due to their tolerance to anthropogenic disturbances and habitat preference of vegetation cover, such as rotting leaves and moss. The presence of arboreal species which include *P. poecilius* and *R. pardalis* together with *P. worcesteri* that utilizes both the microhabitat types is explained by the presence of short understory agricultural plants these species are mostly encountered were only observed in site II, this could be due to their tolerance to anthropogenic disturbances ([6, 7].

Figure 18. Scatter plot of anuran microhabitat distribution in Misamis Oriental, Philippines.



Bray-Curtis index of similarity for the three microhabitats revealed types I and III to be the most similar with regards to their species composition (BC=0.673) which was followed by type II (BC=711). The relationship between these sites is shown in Fig. 19.

Figure 19. Dendrogram showing the similarity of microhabitat based on presence and absence of anuran species.



Type I (arboreal) and Type III (aquatic) microhabitats were shared by *A. muelleri*, *S. mearnsi*, and *S. natator*. These species utilize these habitats for breeding, calling and oviposition site (Plaza & Sanguila, 2015; Sanguila, *et. al.* 2016). *A. muelleri*, can be observed in splash zones near rapids or waterfalls, where it deposits its eggs due to its highly specific torrent-dwelling habitat requirements (Sanguila, *et. al.* 2016). *S. mearnsi*, a species that is common and abundant in riparian habitats was observed usually perched in streamside vegetation several meters from the water, where it can be heard vocalizing to attract mates (Sanguila, *et. al.* 2016). *S. natator* was typically found in clear, small rocky streams and large rivers with boulders, situated in primary and secondary forests on hilly terrain. Adults rest on vegetation overhanging streams or on rocks along the riverbanks. It breeds in the water, where it lays its eggs and undergoes larval development [7].

Type II (terrestrial) microhabitat, being the most dissimilar had four anuran species that were not encountered on other microhabitat types, namely, *P. corrugatus*, *P. cf. dorsalis*, *P. guentheri*, *L. parvus*, and *L. lumadorum*. These terrestrial anurans prefer this microhabitat for cover or to call either exposed on the forest floor or under the cover of vegetation [6, 7].

This study provides essential baseline data on anuran diversity in Misamis Oriental, documenting 19 anuran species were observed, providing 12 additional species records. The findings expand the known biogeographic range of several species and highlight the province’s rich anuran fauna. Most species showed preference for arboreal and terrestrial microhabitats, while aquatic habitats hosted fewer specialists. Species composition analysis revealed greater similarity between arboreal and aquatic microhabitats, with terrestrial types being most distinct. These results underline the importance of protecting diverse microhabitats and elevational zones to support both endemic and disturbance-tolerant species, contributing valuable insight for local biodiversity conservation efforts.

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