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A Preliminary Study of Herpetofauna and their Microhabitats in Pagatpatan Wetland Center, Caraga Region, Philippines

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ABSTRACT

Estuarine wetlands harbor a unique set of organisms that can tolerate a mixture of saltwater tides diluted with freshwater run-offs from the terrestrial habitats. This study surveyed amphibians and reptiles of the Pagatpatan Wetland Center (PWC), Caraga Region, to account the different species of herptiles. Employing the rapid extensive opportunistic diurnal and nocturnal surveys in all PWC habitats collected a total of 641 individuals belonging to five species of amphibians and 13 species of reptiles. *Limnonectes magnus* was the most abundant amphibian species (n=283, 44.5%), and C*erberus schneiderii* was the most abundant reptile species (n=84, 13.10%). Most of the species (38.89%) utilized terrestrial microhabitats. The tolerance of the amphibians and reptiles recorded in the brackish water environment will add to the habitat range these species could occupy. Species accounts with an emphasis on distinctive characters and morphometrics are provided in this study. Conservation priority should be given to PWC since several habitat fragmentations are observed due to the expansion of agriculture and developments for urbanization.

Keywords: *Amphibians, Estuarine wetland, Microhabitats, Pagatpatan Wetland Center, Reptiles*

1 Introduction

The herpetofauna of the Philippines is currently holding a record of 112 amphibian species (Diesmos et al. 2015) and 361 reptilian species (Uetz et al. 2018). It supports extraordinary high endemism but is also experiencing fast-paced habitat degradation (Myers et al. 2000). More than 50% of the fauna needs an accurate assessment of ecology, distribution, and population trend (Diesmos et al. 2002a). Conservation challenges, especially for Mindanao's herpetological diversity, could be attributed to security-related issues (Ross and Lazell 1990), mountainous terrain (Brown et al. 2001), and remote areas inaccessible to surveys.

One of the least studied habitats is estuarine wetlands. Estuarine wetlands are important habitats for organisms that can tolerate the mixture of salt and freshwater. Pagatpatan Wetland Center (PWC) is an estuarine wetland, predominantly composed of the mangrove ecosystem. The area offers habitat to many wildlife species, both terrestrial and aquatic organisms, especially herpetofauna. Amphibians and reptiles are bio-indicator species because they are highly dependent on their environment for survival (Blaustein and Wake 1995). These organisms provide valuable ecosystem services such as provisioning, regulating, cultural, and supporting services vital for other organisms and most especially humans (Valencia-Aguilar et al. 2013). Therefore, changes in their microhabitats would also reflect the species found in the area.

Over the years, the surrounding waters of PWC, such as the Lower Agusan River and Butuan Bay has become threatened due to increased anthropogenic activities and industrialization. Reports on heavy metal accumulation in several species (Demetillo and Goloran 2017, Elvira et al. 2016, Velasco et al. 2016) were also recorded. Mangrove surveys had been initially conducted in the area, but no studies were done for faunal assessments, most especially on the herpetofaunal diversity of the area.

The study is the first to record the herpetofauna of PWC with notes on their microhabitats. No studies were conducted on herpetofauna in the Philippines' estuarine environments (except by Devan-Song and Brown, 2012 in Subic Bay Area). The data provides additional information on herpetofauna in Mindanao since the majority of available information is dispersed and sporadic. With the several anthropogenic activities happening in PWC, the study's findings will provide insights and essential microhabitat utilization of the herptiles, valuable in conserving the unique ecosystem of the area.

2 Materials and Methods

Description of sampling stations

The study was conducted in Pagatpatan Wetland Center, Barangay Pagatpatan, Butuan City, Agusan del Norte, located between 8°59'43'' North and 125°31'28'' East with an elevation of 5.9 masl to 9.2 masl. Adjacent to the study area lies the lower Agusan river basin and the Butuan Bay, which supports a brackish water environment. The study area is composed of mangrove habitats, grasslands, agricultural lands, and riparian zones (Figure 1). Several residential houses and man-made ponds were also present in the area. The soil substrate ranges from sandy-loamy-muddy. The area was once dominated by the *Sonneratia alba* mangrove, locally known as "pagatpat," hence, the name Pagatpatan. The "Kayam" forest adjacent to the Agusan River also served as one of the sampling sites. An entry protocol was conducted before establishing the sampling sites.

Herpetofaunal surveys and microhabitats

The extensive opportunistic sampling method was utilized in collecting samples across various habitat types (mangrove and mangrove-associated habitats, grasslands, kayam forest, residential areas, and man-made ponds) in the wetland ecosystem. The sampling was conducted between April 2017 and February 2019. The diurnal and nocturnal surveys generally include slow walking through the habitats, checking barks and arboreal habitats, and searching under rotten and fallen logs, leaf litters, and other ground debris. The cruising method was done between 0800 to 1100, 14:00 to 1600, and 1900 to 2000 hours following the method of Supsup et al. (2016) with modification, for 15 days. The man-hour spent passes the required sampling effort for herpetofaunal surveys as cited by de Freitas et al. (2017). Species Accumulation Curve was also computed to determine the adequacy of the sampling effort. Both the Michaelis Menten (MM value =17.77) and Ugland, Gray, Elison (UGE value = 18) species estimators showed that the

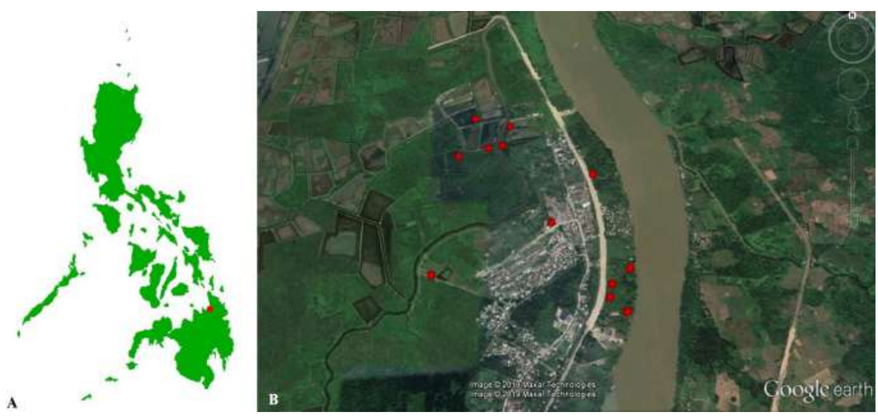

Figure 1. Map of the sampling stations: A. Philippines pointing Butuan City and B. Sampling sites in Pagatpatan Wetland Center, Barangay Pagatpatan, Butuan City, Agusan del Norte, Philippines.

sampling effort was enough. However, Bootstrap analysis (value= 20.69) showed that an additional three species or more will be collected in the area if sampling was extended (Figure 2). Non-metric multidimensional scaling (nMDS) was also done to represent the species abundance relationships in reduced dimensions. The species accumulation curve and nMDS were determined through the software PRIMER ver. 6.

Microhabitats inhabited by amphibians and reptiles were recorded and these include arboreal microhabitat (type I), ground microhabitat (type II), and aquatic microhabitat (type III) (Calo and Nuñeza 2015). The captured specimens were measured for their morphometric measurements including SVL (snout-vent length), TL (total length), HL (head length), HW (head width), TD (tympanum diameter), ED (eye diameter), SL (Snout Length), FL (forelimb length), TL (Tibia length) HLL (Hind limb length), TLL (Tail length) and BW (body weight). The mid-body scale row (MBSR) for snakes was also counted. Significant traits of captured specimens were recorded, and proper photo documentation of all the species encountered was done. After the series of measurements, samples were then released back to the same habitat. The identification of species was made using the available photographic guides and published articles (Diesmos and Brown 2009, and Diesmos et al. 2015). Species identifications were verified by an expert.

3 Results and Discussion

Species Composition, Endemicity and Abundance

A total of 641 individuals were collected and recorded in the sampling sites belonging to 12 families and 18 species (Table 1). Of the 641 individuals, 443 of them were amphibians (69.11%), and 198 individuals were reptiles (30.89%). Five anuran species were recorded belonging to four families: Bufonidae, Dicroglossidae, Microhylidae, and Rhacophoridae. Furthermore, there were 13 species of reptiles (8 lizards, 4 snakes, and 1 species of turtle) belonging to eight families: Agamidae, Colubridae, Gekkonidae, Geoemydidae, Homolopsidae, Natricidae, Phytonidae, and Scincidae. Among the anurans, Dicroglossidae had the most number of species (2), while family Gekkonidae and Scincidae were the most species-rich families for the reptiles, with each having three species.

In terms of conservation status, the Giant Philippine frog, *Limnonectes magnus*, was regarded as a near-threatened species due to its decreasing population trend caused by over-harvesting for food IUCN (2018). Furthermore, two species were in the vulnerable status, which includes the Philippine sailfin lizard, *Hydrosaurus pustulatus*, and the Southeast Asian box turtle, *Cuora amboinensis*. *Gonocephalus interruptus*, and *Cerberus schneiderii* were regarded as data deficient species, and the remaining thirteen species were regarded as Least Concern species of IUCN, 2018. In

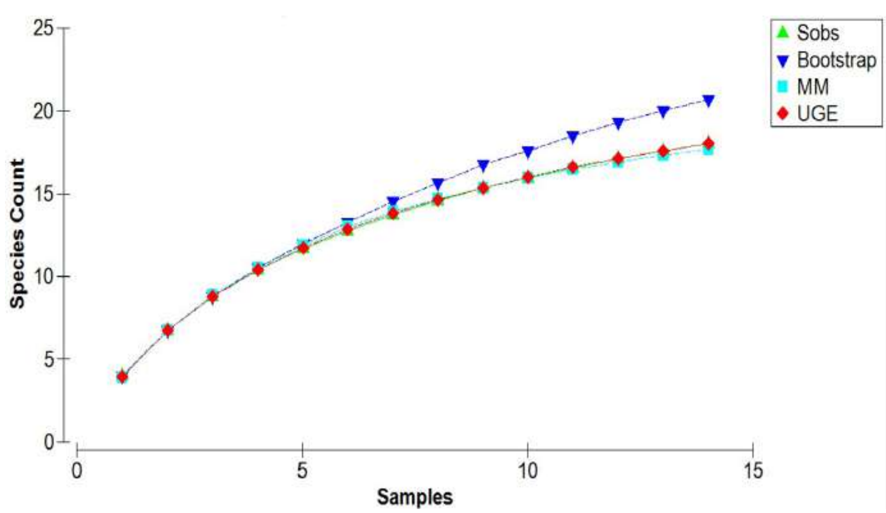

Figure 2. Estimation of species richness using Species Accumulation Curve during the study period.

Table 1. Checklist of amphibians and reptiles with their conservation and distribution status, abundance and relative abundance in Pagatpatan Wetland Center during the study period (April 2017 - February 2019).

Family Name	Species Name	Common Name	Philippine Red List Status	Conservation Status	Distribution Status	Abundance (Relative Abundance, %)
			AMPHIBIANS			
Bufonidae	*Rhinella marina*	Giant toad	OWS	LC ↑	IAS	113 (17.63)
Dicroglossidae	*Fejervarya vittigera*	Luzon wart frog	OWS	LC ↓	PE	23 (3.59%)
	Limnonectes magnus	Giant philippine frog	OTS	NT ↓	PE (ME)	283 (44.15)
Microhylidae	*Kaloula picta*	Painted narrow mouth frog	OWS	LC -	PE	11 (1.72)
Rhacophoridae	*Polypedates leucomystax*	Common tree frog	OWS	LC -	NE	13 (2.03)
			REPTILES			
Agamidae	*Hydrosaurus pustulatus*	Philippine sailfin lizard	OTS	VU ↓	PE	5 (0.78)
	Gonocephalus interruptus	Boulenger forest dragon	OTS	DD ?	PE	4 (0.62)
Colubridae	*Lycodon dumerili*	Dumeril's wolf snake	OWS	LC ↓	PE	1 (0.16)
Gekkonidae	*Cyrtodactylus agusanensis*	Agusan bent-toed gecko	OWS	LC ↓	PE (ME)	1 (0.16)
	Gekko gecko	Tokay gecko	OTS	LC ?	NE	10 (1.56)
	Hemidactylus frenatus	Common house gecko	OWS	LC -	NE	23 (3.59)
Homolopsidae	*Cerberus schneiderii*	Dog-faced water snake	OWS	DD ?	PE	84 (13.10)
Natricidae	*Rhabdophis lineatus*	Zig-zag water-lined snake	OWS	LC ↓	PE	1 (0.16)
Phytonidae	*Malayopython reticulatus*	Reticulated Python	OTS	LC ?	NE	1 (0.16)
Scincidae	*Eutropis multifasciata*	Common Mabuya	OWS	LC -	NE	58 (9.05)
	Lamprolepis smaragdina philippinica	Green tree skink	OWS	LC ?	PE	6 (0.94)
	Pinoyscincus jagori	Jagor's Sphenomorphus	OWS	LC ?	PE	2 (0.31)
	Cuora amboinensis	Southeast Asian box turtle	OTS	VU +	NE	2 (0.31)
					TOTAL	**641**

Legend: Philippine Red List Status = OTS- Other Threatened Taxa, OWS- Other Wildlife Species (DAO2019-09) ; Conservation status = LC- Least Concern, VU- Vulnerable, DD- Data Deficient, NT- Near-Threatened ; Distribution Status = NE- Non Endemic, PE- Philippine Endemic, ME- Mindanao Endemic, IAS- Invasive Alien Species ; Population Trend = ↑- Increasing, ↓- Decreasing, - - Stable, ? – Unknown, + - Unspecified terms of population trend, six species (33.33%) were decreasing, and also six species (33.33%) had an unknown population status (Table 1). This unknown status could lead to the underestimation of these organisms, causing negative impacts on proper conservation actions. Catenazzi et al. (2016) stated that information on population distribution brought about by rapid biological surveys at the species level could provide conservation relevance, most especially for endemic, threatened, and range-restricted species.

Six species under the Other Threatened Species (OTS) category of the Philippine Red List Status were recorded. These include *L. magnus, H. pustulatus, G. interruptus, Gekko gecko, Malayopython reticulatus,* and *C. amboinensis*. Other Threatened Species refers to species in the Philippines that are not critically endangered, endangered, or vulnerable as of the moment but may be moved to a vulnerable category in the near future. All of the remaining species belong to the Other Wildlife Species (OWS) category and are considered non-threatened (Table 1) (DAO 2019-09).

Eleven species (61.11%) were Philippine endemics composed of three anurans (*L. magnus, Fejervarya vittigera*, and *Kaloula picta*), five lizards (*G. interruptus, H. pustulatus, Cyrtodactylus agusanensis, Lamprolepis smaragdina*, and *Pinoyscincus jagori*) and three snakes (*Lycodon dumerili, Cerberus schneiderii*, and *Rhabdophis lineatus*). However, six species were non-endemics (33.33%), and only one species was regarded as invasive (5.56%).

The Mindanao endemic, *L. magnus* was the most abundant species (n=283, 44.15%). The abundance of *L. magnus* is not surprising due to its ability to thrive among various habitats. According to Alcala et al. (2012), this species inhabits a wide-range distribution, from lowland to montane areas. However, the high number of *Rhinella marina*, an invasive, introduced species (n=113, 17.63%), is alarming that endemic species might be experiencing strong competition for food and space. The generalist, omnivore behavior of this species was observed in the diet of *R. marina* samples from Butuan City by Solania et al. 2019.

On the other hand, the Philippine endemic, *C. schneiderii*, was the most abundant reptile species comprising 84 individuals accounting for 13.10% of the total captured species. This water snake was frequently recorded in the brackish water of the agricultural ponds and mangrove habitats, basking in the water during the night surveys. This species is locally abundant in mangroves and mudflats in Southeast Asia (Murphy et al. 2012). In the dry habitats, the common sun skink, *Eutropis multifaciata*, was the most abundant (n=58, 9.05%). During the day, it was recorded basking in the sun while at night, it was seen among leaf litters.

Species Accounts

Amphibia

Family Bufonidae

Rhinella marina (Linnaeus 1758), Figure 3A

It is easy to identify the species because of its large-size, brown coloration, and loud calling mechanism essential for their breeding habits (Brown et al. 2012). The average morphometric measurements of the species are SVL–106 mm, HL–28 mm, HW–34 mm, TD–5 mm, ED–5 mm, FL–41 mm, and BW–3.5 g. The giant toad is a non-native species that was initially introduced to the Philippines during the industrial revolution. Since its introduction, it has spread widely all over the country successfully and can be found throughout low elevation agricultural areas where densities may be particularly high (Siler et al. 2013). This species utilizes ground microhabitats, which coincide with the observation in the Andanan Watershed Forest Reserve (Solania and Gamalinda 2018). In Barangay Pagatpatan, this species was found in almost all types of habitat, from agricultural fields to residential houses; however, the species was most abundant in areas near water.

Family Dicroglossidae

Fejervarya vittigera (Wiegmann 1834), Figure 3B

Fejevarya vittigera is easily identified at a distance by loud “honking” advertisement call and aggregation in massive choruses (Brown et al. 2012). Average morphometrics includes SVL–67 mm, HL–14 mm, HW–18 mm, TD–4 mm, ED–4 mm, FL–16 mm, and BW–2.1 g. The species is widespread throughout the country. It inhabits low elevation aquatic habitats and is often found in streams, drainage ditches, and flooded rice fields and is typically observed in highly disturbed areas

(Sanguila et al. 2016). In PWC, it is commonly found in the aquatic habitats adjacent to various types of trees, such as falcata, mangrove, and banana.

Limnonectes magnus (Stejneger 1910), Figure 3C

The Mindanao fanged frog, locally known as "bak-bak," is commonly collected in the area for sustenance. The average morphometric measurements of the species were as follows: SVL–67 mm, HL–19 mm, HW–23 mm, TD–4 mm, ED–4 mm, FL–19 mm, and BW-2.2 g. The species inhabits undisturbed and disturbed streams and rivers in lower montane and lowland forests (Alcala et al. 2012). It breeds and deposits egg clutches in quiet side pools of forested riverine habitats. The primary possible reason for its declining population is over-exploitation through habitat loss and excessive hunting for meat (Sanguila et al. 2016). In PWC, this species was commonly found in habitats with stagnant and flowing waters.

Family Microhylidae

Kaloula picta (Duméril and Bibron 1841), Figure 3D

The painted narrow-mouth toad has a stouter body appearance probably used to deter predators. The average morphometric measurement includes SVL–42 mm, HL–5 mm, HW–4 mm, TD–1 mm, ED–3 mm, FL–15 mm, and BW–2.0 g. It is commonly encountered in low elevation agricultural areas, riparian habitats in the foothills of mountain systems, and river valleys (Diesmos et al. 2002b). Dense aggregations of the species were also recorded in rice fields and temporary bodies of water in the rainy season (Sanguila et al. 2016). The species were commonly found in areas near water, such as in areas with fishponds and usually moist and muddy areas of PWC.

Family Rhacophoridae

Polypedates leucomystax (Gravenhorst 1829), Figure 3E

Locally known as "baki sa unas," the species persists well in disturbed habitats and agricultural areas. The average morphometrics includes SVL–53 mm, HL–16 mm, HW–018 mm, TD–3 mm, ED–3 mm, FL–18 mm, and BW–2.0 g. In PWC, this species mostly found in areas with a high number of plantations, such as bananas with broad and wide leaves. Solania and Gamalinda (2018) recorded this species also among leaf sheaths in banana and corn plantations.

Family Geoemydidae

Cuora amboinensis (Riche in Daudin 1802), Figure 3F

The turtle's carapace is dark brown to black with yellowish plastron, and it has a webbed foot. The average morphometric measurements include SVL–420 mm, SL–30 mm, HL–100 mm, HW–50 mm, ED–20 mm, TL–50 mm, and BW–150 g. This species is known to wander over long distances but does not seasonally migrate (Schoppe 2008). It is semi-aquatic, inhabiting various natural and man-made wetlands with soft bottoms and slow or no current. This species was listed in CITES Appendix II. The turtle was recorded in the residential area kept as a pet.

Figure 3. Amphibians and reptiles of Pagatpatan Wetland Center: A) *Rhinella marina*, B) *Fejervarya vittigera*, C) *Limnonectes magnus*, D) *Kaloula picta*, E) *Polypedates leucomystax, and* F) *Cuora amboinensis*.

Reptilia

Family Agamidae

Hydrosaurus pustulatus (Eschscholtz 1829), Figure 4A

The species is characterized by having rugose, yellow, and black skin coloration with sharp claws. It has an average morphometric of HW–27 mm, HL–46.20 mm, SL–33.60 mm, ED–12 mm, TD–6 mm, TL–471 mm, HLL–52 mm, and body weight of 280 grams. Specimens of this species were found in the mangrove area and along the riparian zone. It inhibits close mangrove and forest areas and mostly found perching in the trunk of the trees in PWC. They are terrestrial and semi-aquatic species and have been hunted for food.

Gonocephalus interruptus Boulenger 1885, Figure 4B

The Boulenger forest dragon has a pigmented color of yellow and black in its body. It has average morphometrics of HW–20 mm, HL–40 mm, SL–30 mm, ED–10 mm, TD–10 mm, TL–480 mm, HLL– 50 mm, and body weight of 275 grams. It is widely distributed in the Philippine archipelago. The population of *G. interruptus* in Barangay Pagatpatan is decreasing since it is frequently harvested for human consumption. Several habitats for the species were destroyed because of residential expansion and the widening of the road. The species was found near the road having a sundry in the middle of the day.

Family Gekkonidae

Cyrtodactylus agusanensis (Taylor 1915), Figure 4C

The species is characterized by having a brown and greyish color with long claws. Average morphometrics includes HW–11 mm, HL–20 mm, SL–12 mm, ED–5.10 mm, TD–4 mm, TL–170 mm, HLL–22 mm, TL–74 mm, and body weight of 15 grams. Mindanao Island specimens of *C. agusanensis* have been collected in various forest types, from disturbed to undisturbed habitats, usually in the riparian vegetation adjacent to streams (Sanguila et al. 2016). The individuals of Agusan bent-toed gecko were caught in the kayam forest of Barangay Pagatpatan.

Gekko gecko (Linnaeus 1758), Figure 4D

Gecko gecko has a prominent gray and orange coloration, with brown eyes. Average morphometrics includes SVL–160 mm, TL–320 mm, HL–40 mm, HW–35 mm, ED–7 mm, TL– 160 mm, HLL–30 mm, and BW–110 g. Tokay gecko is usually hunted for its usage in traditional medicine. In the Philippines, illegal hunting or trading of this species is punishable under Republic Act 9147 (Wildlife Resources Conservation and Protection Act 2001) (Caillabet 2013). Specimens were collected beneath rocks, rotting logs, and on trees in the kayam forest of PWC. However, several individuals were seen in residential areas.

Hemidactylus frenatus Schlegel in Duméril and Bibron 1836, Figure 4E

The common house gecko has a dirty white skin coloration, which usually camouflages in the wall of houses were it is more adapted. Average morphometrics includes HW–10.20 mm, HL–15 mm, SL–10 mm, ED–2 mm, TL–50 mm, HLL–8 mm, and it weighs 2.5 grams. This nocturnal species is usually found close to electric lights in urban areas (Malkmus et al. 2002). A distribution study of *H. frenatus* was conducted by McKay et al. (2009) showed that some populations of the species persist in vegetation up to 1 km away from anthropogenic structures. All individuals of this species were captured from mangrove-associated vegetation near houses, residential houses, and man-made temporary huts in PWC.

Family Scincidae

Eutropis multifasciata (Kuhl 1820), Figure 4F

It has bronze to orange and brown coloration with patches of black scales. Average morphometrics includes SVL–145 mm, SL–15 mm, HL–26 mm, HW–14 mm, ED–5 mm, HLL–155 mm, TLL–300 mm, and BW–20 g. It is a diurnal species and is mainly terrestrial, inhabiting primary and secondary lowland forests, grasslands, mangroves, and clearings with vegetation. They are agile animals and can move through the leaf litter and forest floor quickly, making them at times difficult to follow or even to see. They seek shelter during inclement weather as well (Nuñeza et al. 2016). Individuals are often found basking on the ground during daytime and shelters on the ground with thick leaf litters, under rotting logs, or in tree holes in PWC.

Lamprolepis smaragdina philippinica (Mertens 1928), Figure 4G

The species is well adapted to any habitat type. Dorsal scales color ranges between green, brown, and sky blue. It has an average morphometric measurement of SVL–195 mm, SL–25 mm, HL–30 mm, HW–18 mm, ED–7 mm, HLL–200 mm, TLL–350 mm, BW–25 g. This skink species are entirely arboreal, and they prefer on trees where they may be seen day after day. They are typically active at least 5 meters from the ground on large tree trunks. The species camouflages the tree making it hard to recognize. The green tree skink was captured in the middle part of the tree hunting for food.

Pinoyscincus jagori (Peters 1864), Figure 4H

The scale color is usually brown, with patches of white and black. Average morphometrics includes SVL–24 mm, SL–15 mm, HL–25 mm, HW–11 mm, ED–7 mm, HLL–111 mm, TLL–195 mm, and BW–10 g. It was recorded in the close forest and among kayam trees in PWC. This species can often be seen basking in the sun during daytime and shelters on the ground beneath the leaf litter, rotting logs, and tree holes.

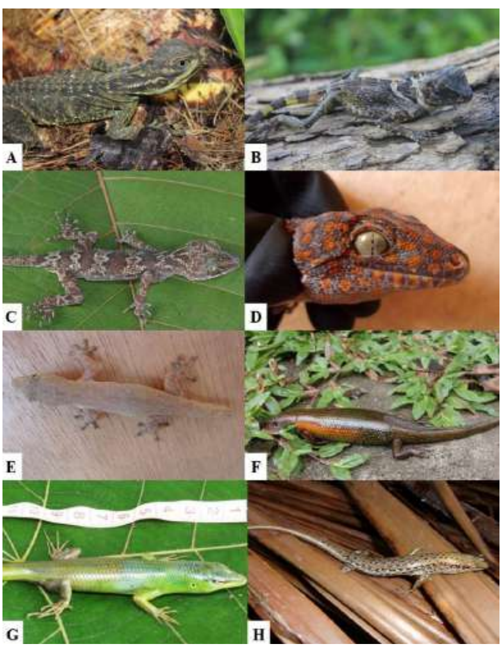

Figure 4. Lizards of Pagatpatan Wetland Center: A) *Hydrosaurus pustulatus*, B) *Gonocephalus interruptus,* C) *Cyrtodactylus agusanensis*, D) *Gekko gecko*, E) *Hemidactylus frenatus*, F) *Eutropis multifasciata*, G) *Lamprolepis smaragdina philippinica*, and H) *Pinoyscincus jagori*.

Family Colubridae

Lycodon dumerili (Boulenger 1893), Figure 5A

Lycodon dumerili has black and white stripe scale coloration. Average morphometrics includes SL–12 mm, HL–20 mm, HW–12 mm, ED–3 mm, HLL– 100 mm, TLL–470 mm, MBSR–24 scales diagonally, and BW–25 g. The species occurs up to 800masl in the terrestrial ecosystem (Diesmos and Delima 2009). The species was frequently found near *Nypa fruiticans* and mangrove habitats in PWC. It is a relatively large snake that may be killed directly on sight by local people.

Family Nitricidae

Rhabdophis lineatus (Peters 1861), Figure 5B

It is black from head to tail and a non-venomous snake. It has average morphometrics of HW–15 mm, HL–19 mm, SL–10 mm, ED–1 mm, TD–18 mm, TL–90 mm, MBSR–26 scales diagonally, and BW–15.5 grams. The water snake is associated with streams and rivers. It was also recorded in forest offcuts and at the forest edge. It was recorded in Barangay Pagatpatan in the swampy areas underneath houses during the night survey.

Family Phytonidae

Malayopython reticulatus (Schneider 1801), Figure 5C

Formerly known as *Python reticulatus*, there was only one specimen recorded with patterns of brown, black, and white scale color with light brown eyes. Morphometrics includes SVL–850 mm, SL–30 mm, HL–40 mm, HW–28 mm, HLL–115 mm, MBSR–60 scales diagonally, TL–950 mm, and BW–150 g. The species is usually associated with aquatic habitats and an excellent swimmer. It is a highly tolerant species and occurs even in urban areas (Stuart et al. 2018). Many individuals of this species are being hunted for their skins (Sanguila et al. 2016). This species was captured near the residential area of the barangay.

Family Homalopsidae

Cerberus schneiderii (Schlegel 1837), Figure 5D

The species is easy to identify due to its small eyes on top of the head close to snout. The head is distinct from the body, with an oblique black stripe at the rear eye margin. Its body coloration is olivegrey above with irregular narrow blackish bars and spots (Devan-Song and Brown 2012). The underside is yellow or white mottled with black. The average morphometric measurements of *C. schneiderii* recorded are SVL–61.6 cm, HL–2.7 cm, HW–1.8 cm, and BW–22.1 g. The dog-faced water snakes are known to be nocturnal, and they feed on small fishes. The species is known to be mildly venomous and are found in estuarine areas, in mangroves and canals in built-up areas (Murphy et al. 2012). Several individuals of the species were recorded in the aquatic swamps and mangrove habitats in PWC.

Figure 5. Snakes of Pagatpatan Wetland Center: A) *Lycodon dumerili*, B) *Rhabdophis lineatus*, C). *Malayopython reticulatus* and D) *Cerberus schneiderii*.

Species Ordination and Microhabitats

The stress value of nMDS of herpetofaunal species composition in PWC was 0.05 (Figure 6), which represents a reliable representation of the dataset in reduced dimensions. It was observed that all of the anurans together with *C. schneiderii* clustered at the right corner of the diagram, indicating that these species have high abundance compared to other species. The breeding and larval development of amphibians largely depend on adequate water levels (Giffen et al. 2009). On the other hand, some reptiles are not that dependent on water because they have thick and hard scales as protective covers from drying air and sun. However, turtles and water snakes are very reliant on wetlands for survival (Wildlife and your Land 2010). The high water level offered by the wetland habitat of PWC might have promoted the abundance of amphibians and water snake in the area.

Species clustered at the left side of the diagram, *R. lineatus*, *M. reticulatus*, and *C. amboinensis* have low abundance, with only one individual per species were recorded. Both *R. lineatus* and *C. amboinensis* are associated with freshwater aquatic habitats. The brackish water environment might have limited the population of these species. However, their presence, even in low numbers, indicates there slight tolerance to this habitat. The *M. reticulatus* are also dependent on water and prey on small to medium mammals. Incidents' attempt to

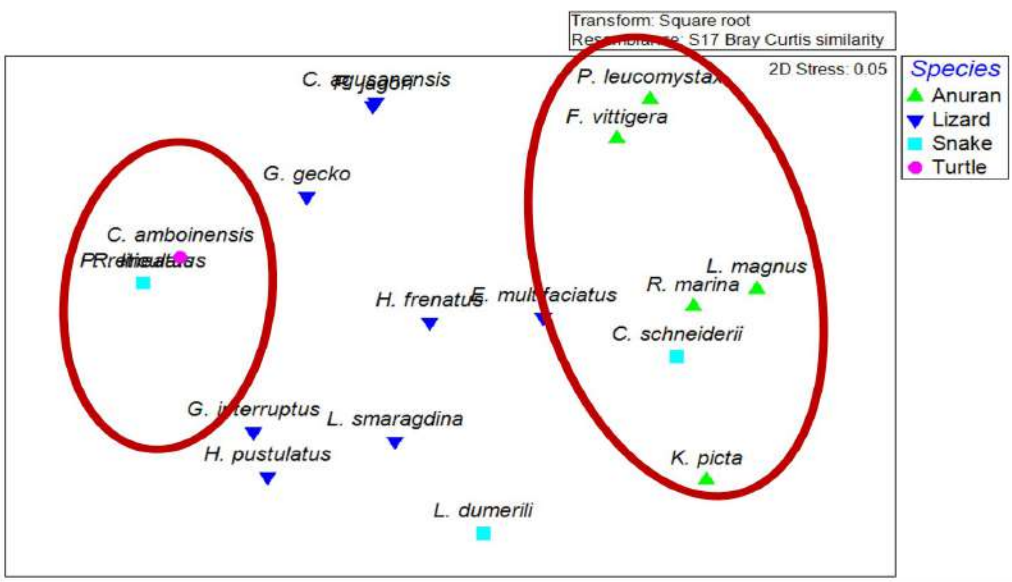

Figure 6. Non-metric multidimensional scaling of herptile species composition in PWC during the study period.

kill and consume humans is also well documented (Reynolds et al. 2014). According to locals in the area, they usually kill or drive this species away because of fear. This stigma might have caused its low abundance in the study site.

All of the lizards together with *L. dumerili* clustered at the median plane of the ordination. These species had a moderate abundance in the area. Most active diurnal lizards regulate internal temperatures such as basking in the sun in cold temperatures or moving in the shade in warmer weather (Shine 2013). This mobility might have caused the encounter rate of reptiles in the area.

In terms of microhabitat utilization, there were seven species (38.89%) that prefer terrestrial microhabitats (*R. marina, G. interruptus, L. dumerili, P. reticulatus, E. multifaciata, L. smaragdina,* and *P. jagori*), two species (11.11%) utilize aquatic microhabitats (*F. vittigera* and *C. schneiderii*), and three species (16.67%) occupy arboreal microhabitats (*P. leucomystax, C. agusanensis,* and *H. frenatus*). The results conformed to the study of Balmores and Nuñeza (2015). It recorded *P. jagori* in the ground microhabitats along sites recently cleared by burning. *R. marina* was solely a terrestrial species (Solania and Gamalinda 2018). The *E. multifasciata* was recorded by Devan-Song and Brown (2012) along beaches edge. Murphy et al. 2012 regarded C. schneiderii as an aquatic inhabitant snake. *P. leucomystax* was also observed in the arboreal microhabitats by Delima et al. (2006).

Only one species (5.56%) utilizing both terrestrial and arboreal microhabitats (*G. gecko*) and four species (22.22%) habituate both aquatic and terrestrial microhabitats (*L. magnus, K. picta, R. lineatus*, and *C. amboinensis*). The study on habitat preference of *G. gecko* revealed that this species prefers perching in mud walls at 2m above the ground (Singh and Chouhury 2016). The *L. magnus* was also seen utilizing both aquatic and ground microhabitats by Solania and Gamalinda (2018). *Rhabdophis. lineatus* was also observed in the aquatic environment by Balmores and Nuñeza (2015).

There were no species observed in both aquatic and arboreal microhabitats. Furthermore, only *H. pustulatus* (5.56%) was observed utilizing all three microhabitats. The use of multiple microhabitats could be an advantage for foraging, refuge, and reproduction of the species (Delima et al. 2006).

The findings showed that the estuarine-associated microhabitats of the area are suitable shelters for many amphibians and reptiles. The tolerance of the amphibians and reptiles recorded in the study towards the brackish water environment will add to the habitat range these species could occupy. Protecting the habitats within PWC would also mean protecting the species utilizing the area.

4 Conclusion and Recommendations

The wetland ecosystem of Barangay Pagatpatan offers a habitat for endemic and vulnerable amphibians and reptiles. The diverse record of herpetofauna is noteworthy since it adds to the habitat range each species can thrive. However, habitat fragmentation and forest degradation can lead to species declines and, eventually, extinction if not given a conservation attention. The various species of amphibians and reptiles in the area could indicate the health of the environment since amphibians and reptiles are indicators of environmental pressures. Hence, regular monitoring of the herpetofauna and other species should be considered in safeguarding the environment. Also, serious evaluation of the community concerning urbanization developments is deemed critical because habitat destruction would increase and alter the distribution and diversity of the herpetofauna and other organisms in the environment.

Statement of Conflict of Interest

The authors declare no conflict of interest.

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