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Assessment of the Diversity of Animals in Mt. Tapulao, Palauig, Zambales

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The study was conducted in order to assess the current diversity of animals in Mt. Tapulao, Palauig, Zambales. This study was concerned with the identification, determination of the conservation status, endemism, and population trend of fauna present in the area. The state of the wildlife and the sources of its decline, as well as the sources of the levels of impacts of environmental problems/degradation of forest ecosystem, were also determined. The study areas were chosen through the establishment of five stations with varying elevational gradients. Various capture methods were used to record the different vertebrate species in the area where 32 species of animals were observed. Results revealed that the birds obtained a moderate diversity index of 2.65 while mammals, reptiles, and amphibians acquired a very low diversity indices of 1.61, 1.03 and 0.56, respectively. Mt. Tapulao showed high endemism of wildlife of which 52% were Philippine endemic and 39% were native. Assessment on the status of each animal species disclosed that most of the wildlife in the study area were in the least concern category (75%) but indicated a decreasing population trend (43%). Three species were under the vulnerable category and two were considered as near threatened according to IUCN Red List of Threatened species. Moreover, DAO 2019-09 (Updated National List of Threatened Philippine Fauna and their Categories) considered four of the assessed animals as vulnerable, two of whom were listed as endangered. Mt. Tapulao's forest ecosystem was much affected by human activities. Wildlife hunting still occurred mainly as a source of food and income in the area. It was determined that road construction, wildlife hunting, soil erosion/silt runoff, and tourism areas/recreational areas were the sources of major threats to the forest ecosystem, while mining, solid waste, ecotourism and quarrying had moderate impacts on the degradation of Mt. Tapulao.

Keywords: Mt. Tapulao, biodiversity assessment, environmental degradation, forest ecosystem

INTRODUCTION

The complex geological history of the Philippines has resulted in an extraordinary wealth of biodiversity which ranks the country as one of the highest in the concentration of terrestrial vertebrate life on earth (Ambal et al., 2012). The country is considered as one of the 17 megadiversity countries, as it possesses 70 to 80 percent of the global biodiversity. The country harbors more than 1,000 terrestrial wildlife species (576 birds, 172 terrestrial mammals, 101 amphibians and 258 reptiles) almost half (49%) of which are unique to this country (Balatibat, 2008). However, having the highest rates of tropical forest loss, declining from 70% down to 18% cover in the last 100 years, the forest ecosystems of the Philippines are considered as the eighth most vulnerable forest ecoregions in the world (Turner, Tamblyn, Dray, Maunder, & Raines 2003). Approximately 60% of endemic Philippine flora are now extinct, while around 128 endemic wildlife species are under various threat categories. These resources are continuously under pressure due to loss and destruction of their habitat, over-exploitation, environmental pollution, and the recent global climate change (Ong et al., 2002).

Zambales Mountain Range is identified as an Important Bird and Biodiversity Area, sub-center of mammalian diversity, and a Key Biodiversity Area (BirdLife International, 2019; UNDP-GEF, 2015; UNDP-GEF, 2012). The terrestrial KBAs are identified based on the presence of globally threatened and/or restricted-range species of freshwater fish, amphibians, reptiles, birds, mammals, and congregatory species of birds. These areas are priority sites for conservation (Ambal et al., 2012). Important Bird and Biodiversity Areas are identified as globally important sites for the conservation of bird species. They are the sites needed to ensure the survival of viable populations of most of the world's bird species (UNEP-WCMC, 2014).

Moreover, Zambales Mountain Range has been considered a high priority conservation area (Mallari, Tabaranza, & Crosby 2001). It has also been known as a sub-center of mammalian diversity on Luzon Island due to high endemism of mammalian species in the area and the discovery of two species of *Apomys* and one species of *Rhynchomys* that are endemic to the area. However, the province of Zambales has been categorized as an Important Bird Area because of the presence of several of the threatened and restricted-range species of the Luzon Endemic Bird Area (Balete, Heaney,

Veluz, & Rickart, Eric, 2009; Birdlife International, 2019). Mt. Tapulao has been declared as a Key Biodiversity Area (KBA) due to species richness and diversity in terms of flora and fauna, with 304 species of plants and 142 species of animals recorded (NewCAPP, 2013).

An inventory and assessment of the fauna of Mount Tapulao were conducted last 2012. Seven elevational gradients across different major forest types were surveyed. The sampling stations were located along the western slope of Mount Tapulao facing the China Sea. A total of 142 wildlife species were recorded during the survey. These included nine amphibians, 19 reptiles, 28 mammals and 86 birds. Among these species, 55% were endemic to the country, 17 species of which were endemic to Luzon Island and another two species were found only in Mount Tapulao and nowhere else in the world.

This study aimed to determine the diversity of animals present in Mt. Tapulao's forest ecosystem. It specifically determined the ecological parameters, conservation status, endemism, population trend, and the ecological and economic importance of the wildlife such as mammals, birds, reptiles, and amphibians in the area. The state of the wildlife, the bases of their decline, and the sources of the levels of impacts of environmental problems/degradation of forest ecosystem were also identified.

MATERIALS AND METHODS

Study Area

Zambales Mountain Range is situated on the west-central area of Luzon, located by the South China Sea on the west and north, the Central Plains on the east, and Subic Bay and Mt. Natib complex on the southeast. Mt. Tapulao, with 2037 m, has the highest peak on the Zambales Mountain and has an approximate total area of more than 17,000 hectares spread through the municipalities of Palauig, Iba, and Masinloc in Zambales, and small parts of Mayantoc, Tarlac (Department of Environment and Natural Resources Region 3, 2019).

The study of Ong et al., (2012) has defined Mt. Tapulao to include five different forest types: tropical semi-evergreen rainforest, tropical lowland evergreen rainforest, tropical lower montane rainforest including pine forest,

tropical upper rainforest, and tropical sub-alpine forest. These forest types serve as a habitat preference by different type of species.

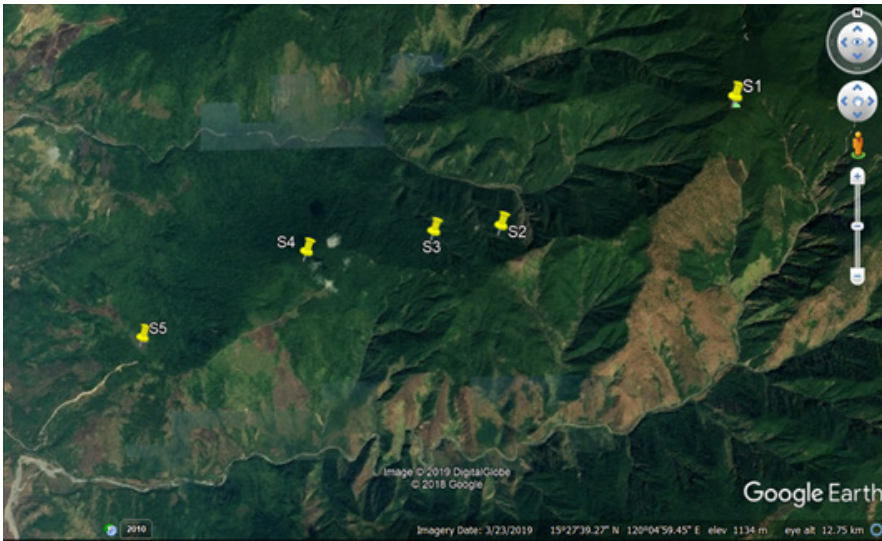


Figure 1. The study site with the designated sampling stations
(Source: Google Earth Pro)

Selection of Sampling Areas

Mainly located within the Municipality of Palauig, five stations within the western slope of Mt. Tapulao were established and were set as the sampling points. This portion of the slope was chosen since it was the only accessible area within Mt. Tapulao and because the windward portion of the mountain facing China Sea brings high precipitation and humidity. The sampling sites were established from different elevations (1910 m, 1360 m, 957 m, 618 m, and 456 m). The designations of the sampling stations ensured that the different types of niches were included (Alberto, 2005).

The stations were characterized by the presence of young trees with thick forest canopy and limited sunlight that reaches the ground. The surface ground was totally covered with dried leaves. These areas had rocky and clayey terrain with elevation that ranged from 400-1900 meters above sea level. A small stream was present near Station 4. Abundant tree species in the area were *Sterculia* sp. and *Ficus* sp., which are both fruiting trees, while understory plants such as Mountain Nibong Palm, Fishtail Palm, and rattan

were also present in all the stations. The survey was conducted during the dry season of February 11 to 22, 2020. However, heavy rain occurred during the sampling at Stations 1 and 2. Temperature in the area during the conduct of the study ranged from 9 to 11 ° C.

Collection, Identification, and Documentation of Animal Species

To assess the fauna present in the study area, the activity focused on the following groups of animals: mammals, birds, amphibians, and reptiles. The survey was conducted during the dry season on February 11 to 22, 2020. The animals present in each station were surveyed and recorded. Appropriate collection method for specific vertebrate group were used. Collection was conducted through the establishment of mist nets for volant mammals and birds (two mist nets per station for both bats and birds and set for two days per stations), improvised traps for reptiles and amphibians, and hand-picking for some mammals and amphibians. The traps and mist nets were set-up in their respective stations in the afternoon and were obtained the following morning. For birds, the mist nets were set-up about 6 am to 6 pm, while the net-days for birds and bats were placed from 6 pm to 6 am of the same day. Potential microhabitats (e.g., ground holes, tree holes and buttresses, fallen logs, runways along grass or forest litter) were searched for and noted. After all needed information were gathered, the captured animals were then released. The animals were also monitored through sightings, photographs, recorded sounds, and traces. The study was restricted to the available species that were caught during the season or period of the study. General observations through ocular sightings and sound recordings of birds were also done to survey other areas on Mt. Tapulao that were not covered by the stations.

Additional data gathered included the ecological and economic uses of the animals recorded. The conservation status of each species was determined based on the International Union for Conservation of Nature (IUCN) Red List Categories and DAO 2019-09 (Updated National List of Threatened Philippine Fauna and their Categories). Species endemism and their population trend were also determined.

Quantitative Descriptions of Animals

Quantitative descriptions such as total number of individual species, frequency, relative frequency, density, relative density, dominance, relative dominance, importance value index, Shannon's diversity index, and percentage occurrence were determined. The formulas were adapted from Smith and Smith (1998, as cited by Alberto, 2005).

Sources and Level of Impacts of Environmental Degradation of Mt. Tapulao

In order to obtain information regarding Mt. Tapulao, focus group discussions (FGD) and key informant interviews (KII) were conducted. The FGDs and KIIs with semi-structured questionnaires were used to gather additional information on the the community's utilization of the resources provided by Mt. Tapulao, specifically the mountain's socio-economic influence on the community. These methods also aided in identifying problems that affected the wildlife status in the area and the possible sources of the wildlife's decline. To confirm the results from the KII and FGDs, firsthand information on the present environmental degradation were also generated through observation and documentation.

To assess the present condition of the forest ecosystem, and the sources and level of impacts on environmental degradation, a checklist adapted from Alberto (2005) was utilized to generate secondary data. To determine the present condition of the forest ecosystem, the checklist was rated using the values 1-4 by seven evaluators from DENR, researchers, and LGUs that were familiar with Mt. Tapulao. Four levels of impact in each source of environmental degradation were identified. A value was assigned to each level. Then, the level of impact was estimated based on the percentage of impact or damage in the study area. To determine the mean of the respondents' answers, the sum of the answers for each level was divided by the total number of respondents. To interpret the scores, a scale measuring the level of impact of the environmental degradation on the ecosystem was used. Firsthand information from the respondents and from the checklist were compared and consolidated.

RESULTS AND DISCUSSION

Assessment of Fauna in Mt. Tapulao, Palauig, Zambales

A total of 32 wildlife species present in the forest ecosystem of Mt. Tapulao were identified and evaluated. Among these species, eight belonged to Class Mammalia, 18 were under the Class Aves, four were from Class Reptilia and two were from Class Amphibia. Results revealed that among the mammals, *Rattus everetti* (Philippine Forest Rat) had the highest importance value index which was 46.7%. This indicates that this mammalian species was the most common among the 32 observed species of wildlife in the forest ecosystem of Mt. Tapulao. In the Class Aves, *Turdus merula* (Eurasian Blackbird) got the highest IVI at 33.69%, while among the amphibians, *Limnonectes parvus* (Philippine Small-disked Frog) obtained the highest IVI at 7.60%. Both *Cyrtodactylus philippinus* (Philippine Bent-toed Gecko) and *Eutropis multifasciata* (Common Sun Skink) garnered the highest importance value index (7.53%) on the reptile category (Table 1).

There were no major threats to *Rattus everetti* population, for this had been found to be competitively superior to the introduced *Rattus* species. *Rattus everetti* is endemic to the Philippines as it is widespread throughout its range. It is also presumed to have a large population and a tolerance for a wide range of habitats. Moreover, *Rattus everetti* is most common in primary and disturbed lowland, montane, and mossy forests, according to Heaney, Alviola, Duya, Tabao, Gonzalez, and Balet (2016). Meanwhile, *Turdus merula* inhabits a very wide range of habitats, from forests to grassy areas. This species can be sedentary, partially migratory, and fully migratory, depending mainly on latitude (BirdLife International, 2016). *Limnonectes parvus* is endemic in the Philippines. It inhabits undisturbed and disturbed streams and rivers in lower montane and lowland forests. It can also be found in swamps, seeps, and wide, slow-moving streams (IUCN SSC Amphibian Specialist Group, 2018). *Cyrtodactylus philippinus* is also endemic to the Philippines and has been recorded from a wide variety of microhabitats. This species seems to congregate in suitable habitats close to rivers and streams (Brown, Gaulke, & Rico, 2009). Moreover, *Eutropis multifasciata* species is native in the Philippines and dwells in primary and secondary forests and open areas. It is often found on open forest floors, forest edges, stream-beds, and other degraded areas. This species

is also found around human settlements (Chakma, 2015).

Previous studies in the area recorded a total of 142 wildlife species which included nine amphibians, 19 reptiles, 28 mammals, and 86 Birds (Ong et al., 2012). The lower number of recorded species in this current study is attributed to fact that the sampling period was on a dry season. This means that the low temperature in the area during the conduct of the study was also an influencing factor.

Table 1

Number of Individuals, Relative Frequency, Relative Density, Relative Dominance and Importance Value Index of Animals in Mt. Tapulao

Common Name	Scientific Name	No. of Individuals	Relative Frequency	Relative Density	Relative Dominance	Importance Value Index
MAMMALS						
Lesser Dog-faced Fruit Bat	<i>Cynopterus brachyotis</i>	1	2.33	1.124	0.000	3.449
Greater Musky Fruit Bat	<i>Ptenochirus jagori</i>	2	2.33	2.247	0.633	5.206
Mt. Tapulao Forest Mouse	<i>Apomys brownorum</i>	1	2.33	1.124	0.000	3.449
Tapulao Shrew-Rat	<i>Rhynchomys tapulao</i>	1	2.33	1.124	0.000	3.449
Philippine Forest Rat	<i>Rattus everetti</i>	10	6.98	11.24	28.490	46.70
Asian Civet Cat	<i>Paradoxurus hermaphroditus</i>	5	11.60	5.618	6.330	23.580
Philippine Warty Pig	<i>Sus philippensis</i>	2	2.33	2.247	0.633	5.206
Philippine Brown Deer	<i>Rusa marianna</i>	1	2.33	1.124	0.000	3.449
BIRDS						
Philippine Cuckoo Dove	<i>Macropygia phasianella</i>	1	2.33	1.124	0.000	3.449
Eurasian Blackbird	<i>Turdus merula</i>	8	6.98	8.989	17.720	33.690
Philippine Eagle-Owl	<i>Bubo philippensis</i>	3	4.65	3.371	1.899	9.921
Brahminy Kite	<i>Haliastur indus</i>	1	2.33	1.124	0.000	3.449
Luzon Tarictic Hornbill	<i>Penelopides manillae</i>	4	2.33	4.494	3.798	10.620
Lesser Coucal	<i>Centropus bengalensis</i>	1	2.33	1.124	0.000	3.449
White-eared Brown Dove	<i>Phapitreron leucotis</i>	2	2.33	2.247	0.633	5.206
Red Jungle Fowl	<i>Gallus gallus</i>	1	2.33	1.124	0.000	3.449

White-breasted Wood Swallow	<i>Artamus leucorhynchus</i>	3	2.33	3.371	1.899	7.595
Tri-colored Munia	<i>Lonchura leucogastra</i>	1	2.33	1.124	0.000	3.449
Pacific Swallow	<i>Hirundo tahitica</i>	7	2.33	7.865	13.29	23.480
Eurasian Tree Sparrow	<i>Passer montanus</i>	2	2.33	2.247	0.633	5.206
Grey-backed Tailorbird	<i>Orthotomus derbianus</i>	3	2.33	1.124	1.899	7.595
Philippine Bulbul	<i>Hypsipetes philippinus</i>	6	2.33	6.742	9.495	18.56
Luzon Scops Owl	<i>Otus longicornis</i>	3	2.33	6.742	1.899	7.595
Buff-spotted Flameback	<i>Chrysocolaptes lucidus</i>	4	2.33	3.371	3.798	10.620
Brush cuckoo	<i>Cacomantis variolosus</i>	3	2.33	4.494	1.899	7.595
Buff-spotted Flameback	<i>Chrysocolaptes lucidus</i>	4	2.33	4.494	3.798	7.595
Pipit	<i>Unidentified</i>	3	2.33	3.371	1.899	7.595

REPTILES

Philippine Bent-toed Gecko	<i>Cyrtodactylus philippinicus</i>	2	4.65	2.27	0.633	7.531
Tokay Gecko	<i>Gekko gekko</i>	1	2.33	1.14	0.000	3.449
Yellow-headed Water Monitor	<i>Varanus marmoratus</i>	1	2.33	1.14	0.000	3.449
Common Sun Skink	<i>Eutropis multifasciata</i>	2	4.65	2.27	0.633	7.531

AMPHIBIANS

Philippine Small-disked Frog	<i>Limnonectes parvus</i>	3	2.33	3.41	1.899	7.595
Luzon Fanged-frog	<i>Limnonectes macrocephalus</i>	1	2.33	1.14	0.000	3.449
Total		89	100	100	100	300

Diversity Indices of the Fauna Present in the Forest Ecosystem of Mt. Tapulao, Palauig, Zambales

The animal diversity assessment revealed that the birds had a moderate diversity index of 2.65, while mammals, reptiles, and amphibians had very low diversity indices of 1.61, 1.03 and 0.56 respectively. This is different from the study of Ong et al., conducted in 2012 which showed a high number of recorded and diverse species.

The very low diversity of herpetofauna and mammalian species is attributed to the anthropogenic factors that were present in the area such

as wildlife hunting and the recent development of tourism that might have driven away the animals to other parts of Mt. Tapulao and of the mountain chain. Tourism had various negative effects on animal populations, behaviors, and welfare. It is well-noted that activities associated with tourism may have led to the disruption of activities, direct killing or injury, and habitat alternation (Green & Higginbottom, 2001). Meanwhile, the bird's moderate diversity may have been caused by the rich vegetation and habitat structure in the forest ecosystem.

Among the five stations, Station 2 had the highest percentage occurrence of animals in the area at 54.54%, while Station 5 had the least occurrence as there were no animals recorded in the area. Station 2 was located at 1360 masl. and mostly consisted of young trees with undergrowth plants. This area had a thick forest canopy with limited sunlight that reached the ground. The surface ground was totally covered with dried leaves. According to Bertuzzo et al., (2016) and Malonza (2015), biodiversity typically peaks at mid-altitudes due to different factors such as low temperatures at high elevations and the human disturbance further down. The lowest number of species was discerned from Station 5 because this station was the nearest to the community and was thus prone to human disturbances. Moreover, it had the least elevation at 456 masl. Fewer trees and anthropogenic disturbances such as logged trees were more commonly observed in this area compared to other stations. In comparison to the previous study of Ong et al. (2012), species richness of birds, bats, amphibians, and reptiles was the highest ranging from 600m to 896m in the tropical lowland and evergreen rainforest, while species richness of small mammals, such as rodents, increased with elevation.

Table 2

Diversity Indices of Four Major Vertebrates in Mt. Tapulao, Palauig, Zambales

Class	No. Of individuals	Diversity index	Interpretation
Birds	33	2.67	Moderate
Mammals	22	1.61	Very Low
Reptiles	6	1.37	Very Low
Amphibians	4	0.56	Very Low

Conservation Status and Endemism of the Animal Species Present in the Forest Ecosystem of Mt. Tapulao

An assessment of the status of each species as shown in Table 3 revealed that most of the wildlife in the study area were in the least concern category (75%) of IUCN. This indicates that wildlife in this area was still widespread and abundant. However, a decreasing population trend was also observed mostly with the assessed wildlife (43%). This indicates that proper conservation and management must be in order (Figure 2). This is in line with the statement of the locals about the recently observed decline in majority of the recorded animals that, reportedly, were rarely or no longer seen anymore in the area.

Two mammalian species and one bird (*Sus philippinensis*, *Rusa marianna* and *Bubo philippinensis*) were found to be in the vulnerable category based on IUCN. These species were therefore facing a high risk of extinction in the wild. *Limnonectes macrocephalus* (Luzon Fanged Frog) and *Otus longicornis* (Luzon Scops Owl) appeared to be under the Near Threatened category of IUCN. Based on DAO 2019-09, *R. marianna*, and *B. philippinensis* were under the endangered category, while ***Rhynchomys tapulao***, ***S. philippinensis***, ***Penelopides manillae***, and *Otus longicornis* were considered as vulnerable. Thus, these species were under threat from adverse factors throughout their range. The following are categorized as Other Threatened Species (OTS): *Apoyms brownorum*, *Gekko gekko*, *Varanus marmoratus*, and *Limnonectes macrocephalus*. OTS were also under threat from the adverse factors throughout their range and were likely to move to the Vulnerable category in the near future. The habitat of these endangered, threatened, vulnerable, and other threatened species must be given high priority in terms of protection and conservation.

It was observed that out of the identified wildlife, 52% (16 species) were found only in the Philippines, 39% or 10 species were native, only two species (6%) were under the introduced category, and only one was an unknown endemism in the country. Among the endemic species observed in this study, 10 wildlife species were found within the Philippine archipelago. Four of them were restricted to Luzon Island, and two species were present only in Mt. Tapulao alone and nowhere else in the world (Figure 3). A total of 142 wildlife species were recorded during the survey. Among these, 55% were

endemic to the country, 17 species of which were endemic to Luzon Island, and another two species (Mt. Tapulao Forest Mouse and Tapulao Shrew-Rat) were found only in Mount Tapulao and nowhere else in the world.

Table 3

Summary of Assessed Wildlife Present in Mt. Tapulao and their Conservation Status, Endemism and Population Trend

Common Name	Scientific Name	IUCN	DAO 2019-09	Endemism	Pop. Trend
MAMMALS					
Lesser Dog-faced Fruit Bat	<i>Cynopterus brachyotis</i>	LC	Not listed	Native	Unknown
Greater Musky Fruit Bat	<i>Ptenochirus jagori</i>	LC	Not listed	Philippine endemic	Stable
Tapulao Forest Mouse	<i>Apodymys brownorum</i>	DD	Not listed	Site endemic	Unknown
Tapulao shrew rat	<i>Rhynchomys tapulao</i>	DD	Not listed	Site endemic	Unknown
Philippine Deer	<i>Rusa marianna</i>	VU	VU	Philippine endemic	Decreasing
Philippine Warty Pig	<i>Sus philippinensis</i>	VU	VU	Philippine endemic	Decreasing
Common Palm Civet	<i>Paradoxurus hermaphroditus</i>	LC	Not listed	Unknown	Decreasing
BIRDS					
Philippine Cuckoo-dove	<i>Macropygia tenuirostris</i>	LC	Not listed	Native	Stable
Eurasian Blackbird	<i>Turdus merula</i>	LC	Not listed	Introduced	Increasing
Philippine Eagle-Owl	<i>Bubo philippensis</i>	VU	VU	Philippine endemic	Decreasing
Brahimny Kite	<i>Haliastur indus</i>	LC	EN	Native	Decreasing
Luzon Hornbill	<i>Penelopides manillae</i>	LC	Not listed	Luzon endemic	Decreasing
Lesser Coucal	<i>Centropus bengalensis</i>	LC	Not listed	Native	Decreasing
White-eared Brown Dove	<i>Phapitreron leucotis</i>	LC	Not listed	Philippine endemic	Stable
Red Junglefowl	<i>Gallus gallus</i>	LC	Not listed	Native	Decreasing
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	LC	Not listed	Native	Stable
White-bellied munia	<i>Lonchura leucogastra</i>	LC	Not listed	Native	Stable
Pacific Swallow	<i>Hirundo tahitica</i>	LC	Not listed	Native	Unknown

Eurasian Tree Sparrow	<i>Passer montanus</i>	LC	Not listed	Introduced	Decreasing
Grey-backed Tailorbird	<i>Orthotomus derbianus</i>	LC	Not listed	Luzon endemic	Stable
Luzon Island Scops-Owl	<i>Otus longicornis</i>	NT	EN	Luzon endemic	Decreasing
Brush Cuckoo	<i>Cacomantis variolosu</i>	LC	Not listed	Native	Stable
Philippine Bulbul	<i>Hypsipetes philippinus</i>	LC	Not listed	Philippine Endemic	Stable
Buff-spotted Flameback	<i>Chrysocolaptes lucidus</i>	LC	Not listed	Native	Decreasing
REPTILES					
Tokay Gecko	<i>Gekko gekko</i>	LC	Not listed	Native	Unknown
Bent-toed Gecko	<i>Cryodactylus philippinensis</i>	LC	Not listed	Philippine Endemic	Stable
Philippine water monitor	<i>Varanus marmoratus</i>	LC	VU	Philippine endemic	Stable
Common Sun Skink	<i>Eutropos multifasciata</i>	LC	N/A	Native	Stable
AMPHIBIANS					
Philippine Small-disked frog	<i>Limnonectes parvus</i>	LC	Not listed	Philippine endemic	Decreasing
Luzon Fanged-frog	<i>Limnonectes macrocephalus</i>	NT	Not listed	Philippine endemic	Decreasing

***Note:** LC=Least Concern, NT=Near Threatened, VU=Vulnerable, EN=Endangered, DD=Data Deficient

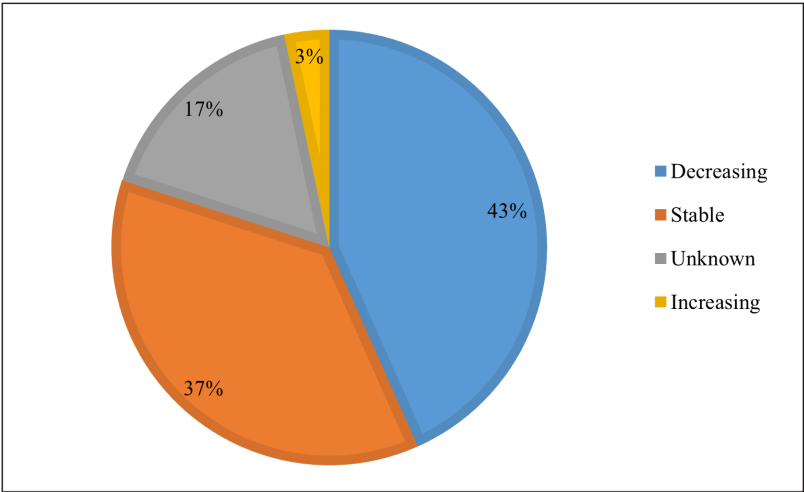


Figure 2. Population trend of the observed animal species present in Mt. Tapulao

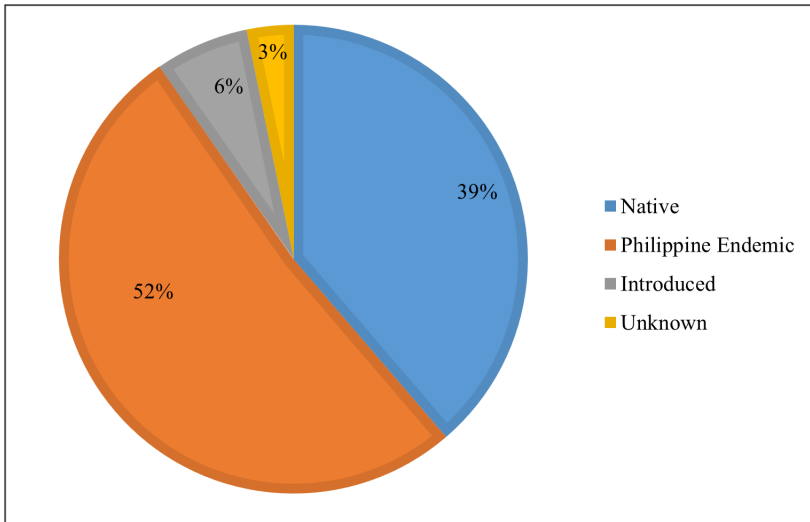


Figure 3. The endemism composition of wildlife species assessed in Mt. Tapulao

Ecological and Economic Importance of the Present Fauna in Mt. Tapulao

The ecological roles of the fauna, as defined by numerous studies, mostly consisted in biological control of insects (18 species) and seed dispersal (13 species). Other wildlife played their role in the ecosystem through predation (4 species), pollination (4 species), serving as bio-indicator (2 species), decomposition (1 species), parasite hosting (1 species), and habitat protection (1 species). Most of the animals assessed were economically important. They were an important source of food (18 species) and were raised as pets and used in trade (16 species). Some birds were targets for sports hunting (4 species) and served as natural pest control (2 species). Other animals were utilized in the practice of religious beliefs (2 species), medicine (1 species), and ecotourism (1 species). Two animals still had unknown economic importance (Alberto, 2015; Severson, 2002; Tanalgo & Tabora, 2015; Scheffers et al., 2012; BirdLife International, 2016; BirdLife International, 2017; Salibad & Nuñez, 2014). The high number of seed dispersers may have been one of the main attributions to the rich vegetation in the area. It was well-noted from the study of Corlette (2016) that animals had a great role in the forest and its processes, for they were responsible for most pollination, seed dispersal, and herbivory. Animals were also found to have a major contribution to decomposition and

nutrient cycling. Carnivores also have had an influence on these processes through their impacts on their prey, thereby balancing the ecosystem.

Table 4
Ecological and Economic Significance of Animals Present in Mt. Tapulao

Ecological Importance	Number
Biological control of insects	18
Seed dispersers	13
Predation	4
Pollination	4
Bio-indicator	2
Decomposition	1
Parasite host	1
Habitat protection	1
Total	44
Economic Importance	Number
Source of food	18
Pet and trade	16
Sports hunting	4
Pest control	2
Religious belief	2
Medicine	1
Ecotourism	1
Unknown	42
Total	44

State of Wildlife and Sources of its Decline

Focus group discussions (FGDs) and key informant interviews were conducted in the community. Specifically, the FGDs and interviews involved mountain guides, members of ATIP, and representatives from the local government units and people’s organization in order to gather first-hand information on the current threats on the biodiversity in the area, environmental issues present in Mt. Tapulao, and the causes of these concerns.

Mt. Tapulao has a rich wildlife. Locals of Sitio Dampay, the nearest community to Mt. Tapulao, had observed different types of wildlife in

the area. Having a total of 142 species of amphibians, reptiles, birds, and mammals, Mt. Tapulao was well-note in the study of Ong et al., (2012) for its diverse wildlife. It had also been known that mountain habitats sustained a high proportion of Philippine species (Peh et al., 2011; Mallari, Tabaranza, & Crosby, 2001). Moreover, the locals of Sitio Dampay also noted that they did not perceive a decline in wildlife in Mt. Tapulao.

Assessment on the Environmental Problems and Sources of Degradation in Mt. Tapulao

The forest of Mt. Tapulao was continuously threatened by human activities. It was discerned that road construction, wildlife hunting, soil erosion/silt runoff, and tourism area/ recreational area posed major threats to the forest ecosystem. Meanwhile, mining, solid waste, ecotourism, and quarrying had moderate impacts on the degradation of Mt. Tapulao. Illegal logging, fires, charcoal making, shift cultivation/kaingin, and firewood collection had small impacts, albeit should not be overlooked (Table 4).

Activities related to road construction had led to cutting of trees and clearing of the vegetations along the constructed pathways. Wildlife hunting also occurred in the area as a source of income. This economic benefit of wildlife must be carefully weighed against its impacts on wildlife populations (Fa & Brown, 2009) as unregulated hunting can severely affect wildlife populations, particularly in the tropics (Scheffers et al., 2012). As observed by the locals, a good number of wild animal species were rarely seen or were no longer visible in the area. The locals were aware that poaching of these animals as a source of food and income, raising them as pets, and using them for medicinal purposes had caused the decline in the population of these animals. Wild animals were captured not only for local food consumption but were also mostly sold for their meat or were used in pet trade for additional income. The species that were most affect by hunting were warty pigs and deer. The locals also emphasized that the main reason for wildlife hunting was the need to generate income. Wildlife hunting was still rampant and it was driven by both direct consumption and sale as some people of Palauig would still buy warty pigs and deer meat for consumption. Indeed, hunting plays a pivotal role in many cultures and communities. In many less-developed regions, hunting for bushmeat provides people with

relatively inexpensive food and some income (Brashares et al., 2004). It was noted by Corlett (2011) that hunting is a major threat to vertebrates in both intact and logged forests.

Furthermore, the aforementioned activities such as mining, kaingin, illegal logging, and the establishment of trails were deemed as the possible reasons for the incidents of soil erosions. Locals also reported that the increasing human population in the area was also an influencing factor. Numerous participants noted that wild animals had been recently more detached from their original habitat due to human activities that had caused disruption in the natural environment and the recent establishment of tourism in the area. These activities had led to the constriction of wildlife habitats and consequently to the migration of certain species to other parts of Mt. Tapulao or of the mountain range. It was observed during the study that the animals, specially the birds, tended to transfer locations when they detected the presence of people. In many developing countries, tourism is widely acknowledged as a means of stimulating local economic development (Geneletti & Dawa, 2009). However, if not given enough attention and preclusion, tourism can lead to the depletion of resources that may consequently bring about changes in the ecosystem and in the local community.

Table 5

Sources and Level of Impacts of Anthropogenic Activities in Mt. Tapulao's Forest Ecosystem

Sources of Environmental Degradation	Computed Value	Interpretation
Road construction	3.99	Major Impact
Wildlife hunting	3.62	Major Impact
Soil erosion/silt runoff	3.54	Major Impact
Tourism Area/Recreational Area	3.37	Major Impact
Mining	3.12	Moderate Impact
Solid Waste	2.86	Moderate Impact
Ecotourism	2.80	Moderate Impact
Quarrying	2.53	Moderate Impact
Illegal logging	2.25	Small Impact

Fires	2.16	Small Impact
Charcoal making	2.14	Small Impact
Shift cultivation/Kaingin	2.12	Small Impact
Firewood collection	1.99	Small Impact

CONCLUSION

There is a moderate diversity of birds and very low diversity of mammals, reptiles, and amphibians in the forest ecosystem of Mt. Tapulao. Among the assessed wildlife in the area, *Rattus everetti* showed to be the most significant. Two mammalian species and one bird species showed to be in the vulnerable category according to IUCN, while one amphibian and one bird species were considered as near-threatened.

According to DAO 2019-09, two species were considered as endangered, four were vulnerable, and four were OTS. A decreasing population trend was observed from the 43% of the assessed wildlife in Mt. Tapulao, and more than half of them (52%) were endemic in the country. The ecological roles of the fauna observed in Mt. Tapulao were mostly in the form of biological control of insects and seed dispersal. The fauna were also economically important as source of food and as pets. They were also used in trade. Furthermore, the area was constantly threatened by human activities like road construction, and wildlife hunting for consumption and income generation. Moreover, soil erosion/silt runoff, and tourism also threatened the area. These threats must not be ignored. Mt. Tapulao as a Key Biodiversity Area can help the government and stakeholders prioritize conservation actions and devise geographically specific strategies that protect individual species and safeguard representative habitats in Zambales which is dubbed as a sub-center of mammalian diversity in the Luzon Island and as an Important Bird Area. Zambales is considered as a high priority conservation area (UNDP-GEF, 2012).

RECOMMENDATIONS

In the light of the findings of this research, the following recommendations are given:

1. conduct wildlife diversity assessment on different periods of the year

- such as the wet season;
2. carry out assessment and monitoring of wildlife in other parts of Mt. Tapulao and Zambales Mountain Range; and
 3. perform DNA analysis on animals present in the area for accurate and proper identification of species.

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