LIZARD DIVERSITY PATTERNS ALONG DISTURBANCE GRADIENTS IN POLILLO ISLAND: IMPLICATIONS FOR EFFECTIVE CONSERVATION

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Abstract
An ecological study of the lizard species in Polillo Island (c. 350-400m elevation) was conducted for a period of two months (July-September, 1999). Drift fences in conjunction with pitfall traps and intensive searching that utilizes a plot as sampling area, constituted the sampling techniques employed in the field. Using these two methods to sampling lizard populations, diversity patterns using standard diversity indices (i.e. Shannon-Weaver Indices) were computed and ecological relationships among the different habitats were determined. A total of 783 individuals belonging to 25 species in four genera were recorded from the island. Four of the 25 species are new island records. Of the four groups of lizards, family Scincidae is the most represented taxon, followed by Gekkonidae, Agamidae and the Varanidae to which the endangered and endemic *Varanus olivaceus* belong. Across disturbance gradients, primary forest harbors the most number of species with a total of 11 followed by the secondary growth with eight species and agro-ecosystem with only five. Species diversity is highest in the primary forest and lowest in the agro-ecosystem. Likewise, endemicity was observed to be highest in the primary and decreases as the species go towards the more disturbed habitats. The trends in the diversity patterns as observed among the lizard fauna on the island largely contributed to the assessment of the existing faunal population. Several conservation measures for the protection and conservation of the species were recommended for the sustainability of the species and their remaining habitats.

Introduction
Made up of more than 7,100 islands and islets, the Philippine Archipelago lies between South China and the Greater Sunda Islands, but zoogeographically it is a fringing archipelago extending northeast from Borneo for nearly a thousand miles (Darlington, 1957). Heaney (1985) divided the entire archipelago into six faunal regions as defined by the extent of the Pleistocene islands – Greater Luzon (this include Luzon island and the adjacent islands of Catanduanes, Marinduque and Polillo), Greater Mindanao, Greater Palawan, Greater Mindoro, Greater Negros-Panay and Greater Sulu. The entire island is home to various floral and faunal assemblages, unique only to the region. At present, more than 1,700 species of vertebrates are found in the Philippines, most of which are island endemics (Dans and Gonzalez, 1998). Among the 224 reptiles that have been recorded from the island, 123 species are lizards, 97 of which are endemic. Gonzalez, 1995).

Although the Philippines is regarded as one of the major centers of biological diversity ("biodiversity") and endemism due to its unique and exceptionally rich biota it is also considered as one of the world's biodiversity "hotspots" for having a markedly high number of threatened plant and animal species. Apparently, this is mainly due to (i) habitat loss as brought about by deforestation and increasing human encroachment on forested areas; and (ii) hunting and illegal poaching of wild animals from the forests. This present predicament has prompted various researchers involved in the study of wildlife species, to dwell on the more pressing issues involved in the understanding of the taxonomic and systematic accounts of most, if not all the entire Philippine faunal population – conservation. It is imperative in any conservation effort to know and identify the different patterns of species distribution as a tool in assessing the existing condition or status of any particular group of organism. Similarly, it is also important to correlate this with the different ecological data that may be obtained or made available in order to recognize salient points that may be equally important in identifying possible threats to the species' survival.

Most of the remaining forests in the country are now basically restricted to a few tracts of mountains and highlands in major protected areas and national parks (Gonzalez, 1997). The Philippine government included these protected areas and national parks as top priority areas for protection. Thus, efforts towards the protection and conservation of wildlife species in these areas are currently in progress. This circumstance further resulted in very minimal attention being given to equally important but smaller islands in the archipelago and Polillo group of islands is among the many places in the Philippines that need immediate attention for conservation efforts. In fact, the paucity of researches done on this island is enough reason to study the fauna of this island. Hence, in an attempt to contribute and help promote future conservation efforts on the island and at the same time provide ecological data on the lizards found on the island, this study aims to accomplish the following:

- (i) to determine the species assemblage of the island under varying disturbance gradients;
- (ii) to identify the different diversity patterns of lizards on the island using standard diversity indices; and
- (iii) to formulate conservation measures as basis for future protection and conservation of the species and their remaining habitat.

History of herpetological studies in Polillo

In retrospect, although there are distributional records of reptiles from Polillo, the history of comprehensive collections on the island is very much limited. In the early 1920s, Edward H. Taylor made noteworthy collections of reptiles from the island and included this among his many Philippine collections. Since then, no attempts have been made to conduct ecological studies on the herpetofauna in the island. The period between 1930 until 1990 marked the "lethargic" years in the study and development of valuable information on the herpetofauna of the island. It was only in 1995 when Ronald I. Crombie of the Smithsonian Institution from Washington, D.C. came on the island that specimens of reptiles were once again collected for purposes of recording and identification. Unfortunately, information generated from such collection is yet unpublished. Nonetheless, based on interviews with some of the local people on the island who were able to work for Crombie during his stay on the island revealed that, he made quite a sizable collection. After Ronald Crombie, no further attempts have been made in conducting surveys or collecting specimens of reptiles from the island.

Description of the study areas

Located some 20-30 kms off the eastern coast of Luzon, the Polillo group of islands ($14^0$50'N, $122^0$5'E) is among the many distinct islands in the Philippines that is biogeographically situated within the Greater Luzon faunal region (Figure 1). Of the many cluster of islands and islets that comprise the entire Polillo group of islands, Polillo, Patnanungan, Jomalig and Palasan are considered as the major islands while others are simply smaller islands and islets that are scattered around the major islands. Of the four major islands, Polillo has the largest area covering 761 km^2 (618 ha), followed by Patnanungan which has an area of 41 km^2 (89.2 ha), Jomalig with 51.7 hectares and Palasan with less than 50 hectares. The entire island of Polillo has a Type II climate characterized by having no or very short dry season followed by a pronounced wet season that runs between the months of November until January. Prevailing wind directions are the Southwest monsoon ("amihan") which starts in May and ends until September followed by the Northeast monsoon ("habagat") which frequents the island between the months of October until April. Every year, crops, properties and even forests were severely damaged and lost due to typhoons.

For the purpose of this study, the researcher focused her study on Polillo, one of the three municipalities of Polillo Island where the Sibulan Watershed is actually part of. Specific sites visited by the researcher are listed and described in detail below. Other sites that had been visited (i.e. Panukulan) was also noted. Sampling sites are plotted on a map (Figure 2). However, these are only approximations of the areas covered and not the exact locations per se.

Site A1, A2 - *Sitio Mahabang-kahoy, Brgy. Pinaglubayan, Sibulan, Polillo Is., Quezon Province*. Covers part of the agro-ecosystem just outside the eastern boundary of the Sibulan Watershed. It is primarily planted with coconuts and small to medium-sized shrubs (Plate 1). Sampling sites for transect counts cover approximately 3 km. that runs through several streams. Transect counts coupled with intensive searching was carried out on this area for eight days while pitfall traps were left operational for 45 days.

Site S1, S2 - *Sitio Mahabang-kahoy, Brgy. Pinaglubayan, Sibulan, Polillo Is., Quezon Province*. Logged over secondary growth with remnants of primary forests located just along the peripheral boundary Sibulan Watershed on the southeastern flank. It is characterized by moderately sloping hills (approx. 15 to 50 degrees) mostly dominated by small to moderately-sized trees (approx. 7 to 12 m) with traces of Red and White Lauan species. Undergrowth is mainly composed of shrubs and saplings of few dipterocarp species. (Refer to Figure 2)

Site P1, P2 - *Sitio Mahabang-kahoy, Brgy. Pinaglubayan, Sibulan, Polillo Is., Quezon Province*. Primary lowland dipterocarp forest located along the central to the northeastern side of the Sibulan Watershed. The dipterocarps and other hardwood species averaging from 15 to 20 m in height dominate canopy plant species. The undergrowth is mainly composed of various medium to moderately tall plant species with several *anibong, pugahan* and *tukyong* species – these are all palms. Species of rattan are also observed. (Refer to Figure 2)

Methods

Collection / sampling methods

A number of field techniques have been described in sampling lizards. These include noosing, hand-grabbing and pit fall traps (Campbell and Christman, 1982; Karns 1986; and Simmons 1987). More recent innovations involve glue boards (Bauer and Sadlier 1992), refuge tubes, baited lizard sticks (Strong et al 1993) and extraction hooks (Bedford et al 1995) as trapping tools. While these techniques and those that are commonly used by herpetologists in standard trapping or collection activities are efficient, many are expensive and require a long period of time to set up. In the Philippines, although there exists other methods of sampling lizards in the field, one of the most popular and more commonly adapted technique is hand-grabbing. For the purpose of this study, the researcher tried to use at least three methodologies - bucket fencing, transect walk combined with hand-grabbing and intensive searching/plot method.

Bucket fencing or **pitfall traps** coupled with wire mesh as fencing material was used as a collection method in this study. A total of four stations, each having 13 buckets arranged in a more or less straight line distanced at 2.5m apart were positioned in strategic places within the agro-forestry and secondary. Buckets were checked three times a day, sometimes more depending on the weather, to minimize casualties or injuries that may be incurred on species of animals trapped inside each bucket. Bucket numbers, type and the total number of lizard species caught in each bucket were noted. Whenever possible, some important body measurements were recorded for purposes of proper identification. All information gathered were then recorded in field data sheets. This bucket fencing method went operational for 45 days.

Transect walk is accomplished by assigning an imaginary transect of definite length and traversing it for at least seven hours a day for eight days per habitat. Whatever species of lizard encountered during such activity was recorded and its frequency noted. Most often than not, transect walk is simultaneously carried out with opportunistic collection through hand-grabbing. After taking down the important body measurements, each individual is released backed into its original habitat. However, in cases when the researcher has to bring it over to the base camp for photo documentation, the animal/s are being released in the nearby agro-forestry to avoid further stress.

Intensive searching on the other hand, is carried out using a plot, approximately 25m X 20m in area and then search the area for possible presence of lizards by inspecting every rock crevices, dead or rotting logs lying within the assigned plot, every tree trunks, leaf axils and even litter falls. Usually, intensive searching is done together with the transect walk. Both the transect walk and the intensive searching techniques were carried out for 24 days, each habitat being examined for eight days. In order to minimize the disturbance level whenever the researcher tries to carry out sampling activities on a specific habitat, each study area is examined on a regular interval – each habitat is not checked or visited everyday for eight consecutive days but rather, each site is frequented either on a two-day interval period.

Aside from the three field techniques used, other methods by which information or data have been derived were: (i) ethnobiological interviews; (ii) presence of fecal materials or droppings ; and (iii) presence of "roosting" sites.

As aforementioned, whenever possible, body measurements were recorded for every individual caught. Using a Tajima calibrated dial caliper and steel rulers, indicated below are some of the biometric parameters that were measured:

1. Weight (wt) -in grams
2. Total Length (TL) -tip of snout to tip of tail
3. Snout-Vent Length (SVL) -tip of snout to tip of tail
4. Axillary to Groin (AxG) -distance between axilla of forelimb to base of hindlimb
5. Hindfoot Length (HF) -base of hindlimb to tip of longest claw
6. Head Length (HdL) -tip of snout to post. edge of ear
7. Head Width (HdW) -widest point near the angle of the jaw
8. Tail depth and width -widest point near the base, just posterior to the basal, ventral swellings
9. 4^{th} toe lamellae -total number of scansors beneath the digits

Measures for patterns of diversity

Using the bucket fencing or pitfall traps and transect counts, the species composition of lizards between disturbance gradients (i.e. agro-forestry, secondary forest, primary forest) around Sibulan Watershed, Polillo Island was analyzed using diversity and equability indices. Although not foolproof, these ecological indices are a means of combining the species richness and evenness of a species community. For the purpose of this study, the Shannon-Wiener indices were used:

$$\text{Diversity Index } H' = -\Sigma p_I \,.\, \ln (p_I)$$

where p_I is the proportion of species i expressed as a proportion of the total number of individuals of all species, **ln** is the natural logarithm, and **Σ** represents the **total p_I . ln (p_I)** for all species.

$$\text{Equability Index } J = H'/H_{max} = \Sigma\, p_I \,.\, \ln (p_I)/\ln (s)$$

where s = number of species.

Care and handling of specimens

Although proper care and handling of animals were observed in the field, it is quite inevitable however that some of the animals may experience stress which have resulted to death. It is only through this that the researcher was compelled to collect specimens.

For the purpose of this study, the researcher used 10% strength formalin (1 part formalin : 9 parts water) as fixative. Formalin is used to preserve the actual morphological state and color of the specimen, and to prepare the tissues for microscopic examination (Pisani, 1973). To reduce discoloration of specimens, formalin may be buffered by mixing 1 tablespoon of baking soda or borax with each part of 10% formalin solution. All specimens were then allowed to remain in fixative for 24 hours. After fixing with 10% formalin, the specimens were then transferred to alcohol (i.e. 50% strength ethanol or isopropyl alcohol). However, prior this, the specimens were soaked in water for 48 hours to prevent alcohol dehydration.

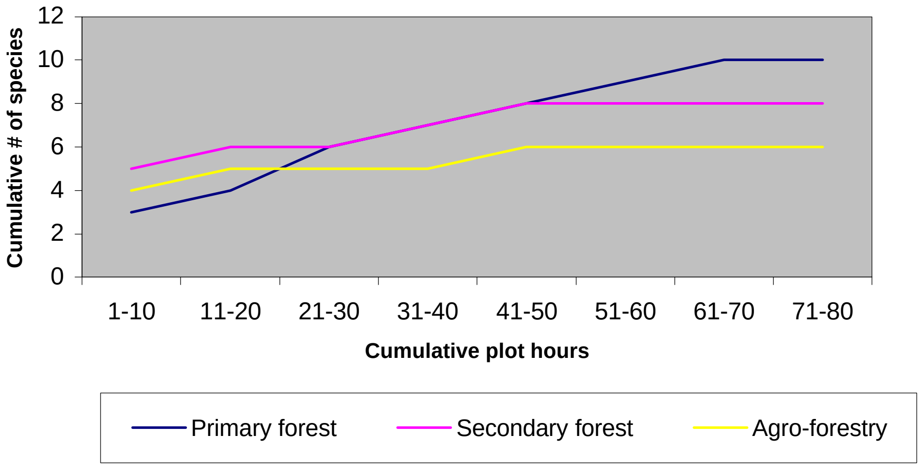
Results and discussion

A total of 25 species of lizards was recorded for both Sibulan and Panukulan Watershed on Polillo Island, although majority was recorded from the former. Table 1 gives a list of all the species accounted during field surveys in a span of two months. Of the 25 recorded species, four are agamids: *Calotes marmoratus sanchezi, Draco spilopterus, Hydrosaurus pustulatus* and *Gonocephalus semperi* (Figures 1,2). An endemic species, the *H. pustulatus* is included as one of the ten species of reptiles on the Red Data List of threatened animals in the Philippines. The White-spotted Anglehead (*G. semperi*) on the other hand, is a new island record. Eight species of geckoes are recorded. Of these, three are regarded as commensal species (*Cosymbotus platyurus, Hemidactylus frenatus* and *Gehyra mutilata*); one island endemic (*Pseudogekko smaragdinus*); and two were unidentified gekkonid species which may possibly be new records for the island. The species of *Lepidodactylus cf. planicaudus* may also prove to be new for the island while the *Cyrtodactylus philippinicus* is a Philippine endemic species. Eleven species belonging to six genera comprise the skink population. It represented almost half of the entire lizard population recorded from the island. *Brachymeles boulengeri boulengeri* is Luzon endemic, being reported only from Luzon, Polillo and Marinduque. Both species of monitor lizards (*Varanus salvator marmoratus* and *Varanus olivacues*) are considered as endemic. The latter, aside from being endemic, is also considered as endangered.

Species composition and diversity patterns along disturbance gradients

Between the three existing habitats that were surveyed, the primary forest yielded the most number of species (11), followed by the secondary forest with only eight species and the agro-ecosystem with five. Table 1 shows the cumulative results on the type of species recorded for both transect count and pitfall traps.

Species effort curve for surveys of lizards using plot method and pitfall traps & bucket fences



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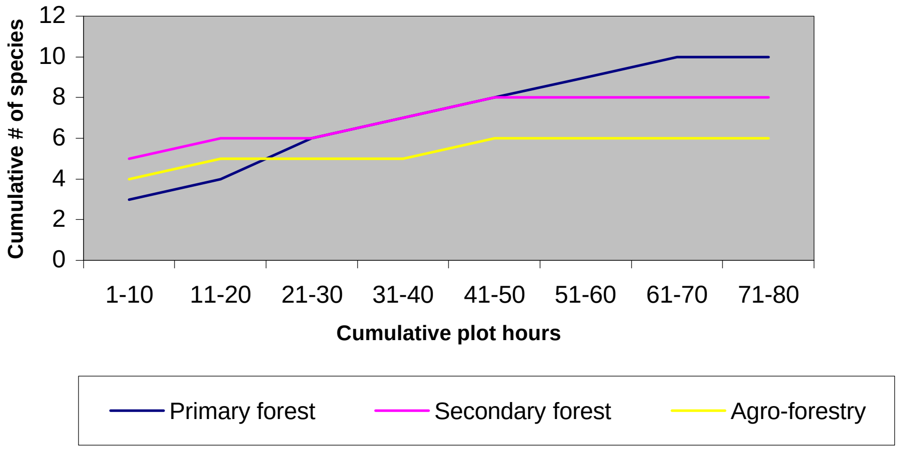

Table 1. Species of lizards recorded from Sibulan Watershed and Panukulan, Polillo Island, Quezon Prov., Philippines (July-September, 1999).

SPECIES	Common Name	Presence			
		Agro	2^o forest	1^o forest	Pitfall/TC
Family Agamidae (4)					
1. Calotes marmoratus sanchezi	Philippine Calotes*	-	x	x	PL
2. Draco spilopterus	Common Flying Lizard*	x	x	x	PL
3. Gonocephalus semperi	White-spotted Anglehead*	-	-	x	O
4. Hydrosaurus pustulatus	Sailfin Water Lizard	x	-	-	PL
Family Gekkonidae (9)					
5. Cyrtodactylus philippinicus	Bent-toed Gecko*	-	-	x	PL
6. Lepidodactylus sp.	-	-	x	-	O
7. Pseudogekko smaragdinus	Green Smooth-scaled Gecko*	-	x	x	PL
8. Pseudogekko sp. A	-	-	-	x	O
9. Pseudogekko sp. B	-	-	x	-	O
10. Cosymbotus platyurus	Flat-bodied House Gecko	x	-	-	O
11. Hemidactylus frenatus	Common House Gecko	x	-	-	O
12. unknown Hemidactylid	-	-	x	-	O
13. Gehyra mutilata	Tender-skinned House Gecko	x	-	-	O
Family Scincidae (11)					
14. Brachymeles bonitae	Stumb-limb Burrowing Skink*	-	x	-	PF
15. Brachymeles b. boulengeri	Boulenger's Burrowing Skink*	-	-	x	PL/PF
16. Lamprolepis smaragdina	Spotted Green Tree Skink	x	x	-	PL
17. Lipinia pulchella	Yellow-striped Slender Tree	-	x	-	O
18. Mabuya multicarinata	Skink*	x	x	x	PL/PF
19. Mabuya multifasciata	Two-striped Mabuya	x	-	-	PL/O
20. Sphenomorphus jagori	Common Mabuya	x	x	x	PL/PF
21. Sphenomorphus cumingi	Jagor's Sphenomorphus	x	x	x	PL/PF
22. Sphenomorphus coxi	Cuming's Sphenomorphus*	-	x	x	PL/PF
23. Sphenomorphus abdictus	Cox's Sphenomorphus*	-	-	x	PL/PF
24. Tropidophorus grayi		-	-	x	PL
	Spiny Waterside Skink				
Family Varanidae (2)					
25. Varanus salvator	Philippine Monitor Lizard* (R,	-	x	x	O
marmoratus	En)	-	x	x	O
26. Varanus olivaceus	Gray's Monitor Lizard* (R, En)				

Note : (x) – confirmed presence
(-) – not observed
(*) – Philippine endemic
(R) – rare ; based on RDB,1997
(En) – endangered; based on RDB,1997
(O) – opportunistic collection or data obtained from other sources
(PL) – plot method
(PF) – Pitfall traps

In the agro-ecosystem, the frequently encountered species are members of Family Scincidae (*Lamprolepis smaragdina, Mabuya multicarinata, Mabuya multifasciata, Sphenomorphus jagori* and *Sphenomorphus cumingi*). Next to the skinks are the geckoes, with four species recorded (*Cosymbotus platyurus, Hemidactylus frenatus, Gehyra mutilata* and a gekkonid sp.). Except for the latter, all three species of geckoes are commensal in nature. They are frequently observed in areas associated with human habitation (i.e. houses and shanties which has been used for drying coconuts). The gekkonid sp. A on the other hand, was caught only once on a jackfruit near very near the base camp. Unfortunately, it escaped before the researcher got the chance to preserve it as voucher specimen (note: a picture was taken though, before it escaped). Only two agamid species were caught and recorded in the agro-ecosystem (*Draco spilopterus* and *Hydrosaurus pustulatus*). *D. spilopterus* is highly associated with coconut plantations (Plate 2). However, based on observations they seem to prefer the taller and mature stocks of coconuts (approx. 12- 20m in height) over that of the younger and smaller ones (usu. less than 10m in height). The *Hydrosaurus pustulatus* or the Sailfin Water Lizard is associated with unpolluted bodies of water (i.e.rivers but very seldom on streams) near secondary growth forests (Plate 3). This particular species is considered as the largest among the agamids in the Philippines, next only to the monitor lizards (Family Varanidae). It is however absent in both the secondary and primary forests.

Species of lizards associated with the secondary growth forest include two agamids (*Calotes marmoratus sanchezi* and *Draco spilopterus*); three gekkonids (*Lepidodactylus cf. planicaudus*, *Pseudogekko smaragdinus* and a *gekkonid sp.*); nine species of skinks (*Brachymeles bonitae, B. b. boulengeri, Lamprolepis smaragdina, Lipinia pulchella, Mabuya multicarinata, Sphenomorphus jagori, S. cumingi, S. coxi* and *S. abdictus*); and two varanids (*Varanus salvator marmoratus* and *V. olivaceus*). All species recorded from the secondary growth forest represented all four families of lizards with the skinks being the most dominant group. Of the two agamid species, *C. marmoratus sanchezi* has been noted by Crombie (1994) to be present only on Polillo but pointed out nonetheless, that this present distribution might be inaccurate because distributional data on *Calotes* species are insufficient and needs further review. Note that it was observed only in the secondary forests and not in the agro-ecosystem or primary forests in Sibulan Watershed. The other agamid species, *Draco spilopterus* was observed on a small to medium-sized tree (approx. 50-60 cm in dbh) over looking a patch of mixed secondary and agro-ecosystem. The endemic *Pseudogekko smaragdinus* is one of the three species of geckoes recorded in the secondary forest and was caught on the leaf axils of a *Pandanus* species found on boundary between the primary and the secondary forest (Plate 4). The other two species of geckoes are *Lepidodactylus cf. planicaudus* and a gekkonid sp. B. Both were only recorded from secondary growths but the former was recorded only from the Sibulan Watershed while the latter was found in Panukulan, the other watershed of Polillo Island, situated on its northern flank. Of the nine recorded species of skinks, the two species of *Brachymeles* (*B. bonitae* and *B. b. boulengeri*) together with the other two species of *Sphenomorphus* (*S. coxi* and *S. abdictus*) are species of lizards which can be found in the secondary but not in the agro-ecosystem while the other five species are simply common to both agro- and secondary growth forests. Not entirely encountered within our transect and pitfall traps, records of the two varanid lizards were basically obtained from ethno-biological interviews and data gathered by one of the members of the expedition team, Daniel Bennett, who is working on monitor lizards at the time this particular study on lizards by the researcher was conducted. For purposes of documentation, the confirmed presence of these two varanid lizards from the island was reported. Another species of skink recorded from the secondary forest is the *Lipinia pulchella.* Fortunately, this skink was accidentally found on a "layasin" tree when the group was just setting camp. For some reasons that may be entirely due to specific habitat or vegetation type, this species was not at all encountered in the Sibulan watershed for the whole duration of the expedition.

Next only to the secondary growth forest in terms of species composition, the primary forest yielded equally substantial number of lizard species with three species specific or found only in this type of habitat and not shared by either agro- or secondary forest. The aforementioned species include *Gonocephalus semperi*, *Cyrtodactylus philippinicus* and *Tropidophorus grayi*. The other ten species are simply shared with the other two habitats except for the two varanid lizards which are not observed in the agro-ecosystem. The agamid lizard, *G. semperi* is a new record for the island. Both Taylor (1922) and Crombie (1994) failed to record this species during the time of their collection on the island.

Assessing the species composition along disturbance gradients, it appears that diversity index value increases as the level of disturbance in each habitat lessens. Table 2 indicates the different values and trends that were observed in the field using the different diversity indices that has been computed. Diversity index for primary forest is 1.4911, followed by the secondary growth with 1.2389 and the agro-ecosystem with only 1.1768. These diversity indices only show that, in the primary forest, more species were recorded and decreased as you go outside the forest towards the more disturbed areas, the agro-ecosystems.

Table 2. Analysis of transect count in the different habitats around Sibulan Watershed, Polillo Island, Quezon Prov., Philippines.

Habitat type	Total no. of ind. Recorded	Total no. of species	Diversity Index (H')	Equability Index (J)
Agro-forestry	248	7	1.1768	.6048
Secondary Forest	271	8	1.2389	.5958
Primary Forest	264	11	1.4911	.6232

In assessing the diversity of a certain habitat, what matters most is the total number of species recorded rather than the total number of individuals encountered. Number of individuals will only give you how often or frequent the species has been observed. Take the case of the secondary forest. Relatively, more individuals were observed while doing sampling activities as compared to the primary forest when less individuals were observed. However, there appears to be more species of lizard that were recorded from the primary than that of the secondary growth. The comparatively higher species diversity in the primary forest, can be attributed to the inherently more available and suitable habitats for lizards compared to the secondary forest. Basically, lizards prefer areas that are characterized by lush and conspicuous looking vegetation that offers enough room for concealing themselves against any predators. Dead forest logs, rock crevices, vines, epiphytes, thick litter fall, humus spiny-edged leaf axils of big *Pandanus* plants, all provide excellent hiding sites for lizards.

The relatively high species diversity for the primary forest may be attributed to the ecotonal relations with agro-ecosystem that borders the forest. Intrusion of species of lizards from the coconut plantations and scrubland, increases the number of species in the primary forest. Colonizing species from non-forested areas may inhabit niches previously vacated by intolerant types. Species diversity in both the secondary and agro-forestry sites is nearly equal. This condition would imply similar ecotonal conditions affecting primary forests can also be observed between secondary and agro-ecosystems.

Based on the evenness indices, data shows that primary forest has the highest equability index (.6232), followed by the agro-ecosystem (.6048) and the secondary forest (.5958). A high equability value implies that there are more individuals equally represented in the species found on each of the other study sites. A low equability index would mean that there are more species found in the site, but with less equally represented species. Perhaps, such values would be indicative of more specialized species being found in habitats with low equability values, and more widespread species are likely to be found on habitats with high equability index.

Bucket fencing vs. Transect walk

Although bucket fencing as a sampling technique for capturing and recording reptiles offer many disadvantages (expensive, difficult to assemble, needs constant checking, moderately destructive because a hole has to be dug out in order to accommodate the buckets), it proved very effective in catching lizards which are not easily captured by hand when walking on transect. Species of *Brachymeles* were trapped inside the buckets. These species of skinks are associated with their burrowing nature. Thus, it would be very difficult to catch them without having to dig into the earth. Furthermore, *Sphenomorphus* species are highly active organisms. You can spot them under heavy forest litter, on holes of dead logs or in rock crevices but seldom are they being caught by hand. They are very agile and easily blend with their surrounding. Using the pitfall traps allow us to capture some of these individuals without any difficulty except when retrieving them from the buckets. Transect counts on the other hand, allows a researcher to explore all possible microhabitats of lizards found within a habitat. It is highly dependent on the ability of the researcher to spot and capture the animal with very minimal amount of stress inflicted on an organism. Area-wise, transect walk is very advantageous for a researcher.

In terms of the total number and kind of species caught in each of these technique, transect walk yielded the most number of species. However, some of the species that were caught in the pitfall traps were not encountered during transect walk and vice-versa. It would be very obvious that upon assessment and comparison, transect counts definitely will yield more species. On the contrary, the researcher thinks that both methods will provide more and valuable amount of data if combined together.

THREATS TO THE LIZARDS AND OTHER WILD FAUNA OF POLILLO ISLAND

By way of carrying out ecological studies, a particular population of organism can be analyzed or assessed. One way of determining how important a study should turn out to be, it must be able to address if not all, some of the pressing issues that may threaten the existing population of that particular group of organism.

Not only lizards, but also all wildlife species, are threatened by environmental factors. Their present population may not be affected by such activities but any future repercussions brought about by such actions can create problems that may threatened their survival. Below is a list of possible threats that may affect the existing population of wild fauna on Polillo Island:

i. Small-scale carabao logging - many of the local people depend on the forest as a source for livelihood. Timber or any forest product is a valuable commodity for them. If this activity remain unregulated by the local government as well as by the people themselves, there would come a time that the forest can no longer sustain the demands by the people for forest products. If left unprotected, the forest will eventually be wiped out. Gone are the trees that provide for them; the pristine, unpolluted and unlimited source of clean water; and even the wild fauna that helps in maintaining "equilibrium".

ii. Encroachment by people into the watershed and other forested areas – continuous and unperturbed encroachment into the forested areas will eventually pose severe repercussions on the following: health, crops and even properties. Without the forests, the areas near the slope of the mountains/hills will experience flooding; farm lands will be flooded which may later affect yield; problems with health and hygiene will increase due to associated diseases brought by development.

These threats can only be abated by (1) Increasing the hectarage or total area covered by the watershed. It is one of the best solution to protect the remaining forested areas. Also, it will allow regeneration of forest species to take place without human interference. Buffer zones may also be considered for this purpose. (2) Encourage the people to practice sustainable use of the forest through careful harvesting of forest products. (3) Form a group that will specifically patrol and check the entire watershed on a regular basis. It would be a great move to involve unemployed but willing to get the job. This job will require hardwork and dedication.

These conservation measures are highly hypothetical but nonetheless, the possibility that some of it might work is something to look forward to. Remember, any conservation effort must be a concerted effort between the concerned party and the stakeholders – the people of the community and the inhabitants of the forest. You can easily talk to them but how about the animals? You just have to know them in order to understand them.

RECOMMENDATIONS

This study was able to generate a list of species of lizards on Polillo Island which can be used as baseline data for further researches on the fauna of the island. However, this data only include information on one island – Polillo and none on the remaining three major islets and satellite island of the entire Polillo group of islands. A lot of data has to be further generated in order to come up with a comprehensive and updated list of all wildlife species on Polillo. The paucity on the ecological studies done on the island should not be looked upon as a hindrance or obstacle in understanding the ecology of these species but rather, it should motivate and encourage future expeditions to be carried out on these group of islands. Below are some of the recommendations that the researcher wishes to convey:

1. To further understand and correlate the species population on this island with the other islands in the Greater-Luzon faunal region, there has to be a comprehensive ecological study between these islands that will employ scientific and standardized methods of sampling.
2. Future studies on lizards and on any other vertebrate group must considered seasonal variations. It is significant to note the underlying biological adaptations of the animal in terms of thermal requirements. It may affect their distributional patterns.
3. The use of several and not just by only one type of sampling method is encouraged by the researcher. Based on this study, it can generate enormous and significant data on the animal's ecology, distribution and behavior.
4. If possible, involve the local people in the conduct of future surveys. It is one way of making them feel that they have a "say" on issues that are happening in their community. Also, it is an excellent means of educating them about the importance of our work and their role in all these.
5. It is very important to also educate the younger generation – teenagers and even those who in the primary level of education. Eventually, all that we are working for will fall into there hands and it is up to them if they would continue working towards conservation.

REFERENCES

Alviola, P.A. and M.M. Ledesma. 1998. Guide to the Families Agamidae, Varanidae and Dibamidae Currently Recognized in the Philippines. A Special Problem in Zoology 145 (Herpetology), UPLB. 47pp. (Unpublished)

Bauer, A. and R. Sadlier. 1992. The use of mouse glue traps to capture lizards. Herpetological Review 23:112-113.

Bedford, G.S. 1995. A method for catching lizards in trees and rock crevices. Herpetological Review 26:21-22

Brown, R.M. et al. 1996. Amphibians and Reptiles of the Zambales Mountains of Luzon Island, Republic of the Philippines. *Herpetological Natural History*. Vol. 4(1): 1-32pp.

Gaston, K, J. 1996. Biodiversity. A Biology of Numbers and Difference. Blackwell Science Ltd., UK. 396 pp.

Gaulke, M. 1994. Notes on the Herpetofauna of Panaon and Samar, East Visayans, Philippines. *Hamadryad*. Vol. 19. pp. 1-10.

Griffin, L. E. 1910. A List of Snakes from the Island of Polillo, P.I. with Description of a New Species. *The Phil. Journal of Science*. Vol V(4): 211-217.

Inger, R. F. 1958. A New Gecko of the Genus *Cyrtodactylus* with a Key to the Species from Borneo and the Philippine Islands. *Sarawak Museum Journal*. pp. 221-264.

King, W. 1962. A New Gekkonid Lizard of the Genus *Cyrtodactylus* from the Philippine Islands. *Fieldiana. Zoology*. Vol. 44(13): 117-119.

Kluge, A. G. 1966. Phylogenetic Relationships of the Gekkonid Lizard Genera *Lepidodactylus* Fitzinger, *Hemiphyllodactylus* Bleeker, and *Pseudogekko* Taylor. *The Phil. Journal of Science*. Pp. 331-352.

__________________ 1991. Checklist of Gekkonid Lizards. *Smithsonian Herpetological Information Service*. No. 85, 35 pp.

Lazell, J. 1992. New Flying Lizards and Predictive Biogeography of Two Asian Archipelagos. Bulletin of Mus. of Comp. Zool., Cambridge, UK. Vol. 152(9): 475-505.

Philippine Red Data Book: Red List of Threatened Animals. Wildlife Conservation Society of the Philippines, Inc., Makati City, Phils. 262 pp.

Pisani, G. R. 1973. A Guide to Preservation Techniques for Amphibians and Reptiles. *Miscellaneous Publications.* Herpetological Circular No. 1, 22 pp.

Rabor, D, S. 1966. A Report on the Zoological Expeditions in the Philippines for the Period 1961-1966. *Silliman Journal*. Vol. XIII(4): 605-616.

Ross, C.A. and P.C. Gonzales. 1992. Amphibians and Reptiles of Catanduanes Island, Philippines. *National Museum Papers (Manila)*. Vol. 2(2): 50-76.

Simmons, J.E. 1987. Herpetological collecting and collections management. SSAR Circular no. 16.

Stejneger, L. 1907. A New Gekkonid Lizard from the Philippine Islands. Proceedings U. S. National Museum, Vol. XXXIII(1576): 545-546.

_________________ 1908. Three New Species of Lizards from the Philippine Islands. Proceedings U.S. National Museum, Vol. XXXIV(1606): 199-204.

_________________ 1908. A New Species of Flying Lizard from the Philippine Islands. Proceedings U.S. National Museum, Vol. XXXIII(1583): 677-679.

_________________ 1910. A New Scincid Lizard from the Philippine Islands. Proceedings U.S. National Museum, Vol 39(1776): 97-98.

Strong, D. 1993. Two new simple methods for catching small, fast lizards. Herpetological Review 24:22-23.

Taylor, E. H. 1915. New Species of Philippine Lizards. The Philippine Journal of Science. Vol. X(2): 89-111.

_______________ 1917. *Brachymeles*, A Genus of Philippine Lizards. The Philippine Journal of Science. Vol XII(5): 267-277.

_______________ 1917. Snakes and Lizards Known from Negros, with Descriptions of New Species and New Subspecies. The Philippine Journal of Science. Vol XII(6): 353-379.

_______________ 1922. The Lizards of the Philippine Islands. Manila Bureau of Printing. Vol. 17: 144-153 pp.

_______________ 1923. Additions to the Herpetological Fauna of the Philippine Islands, III. The Philippine Journal of Science. Vol. 22(5): 515-555.

Appendix 1. Results of the total number of lizards recorded based on pitfall traps and transect counts in Sibulan Watershed, Polillo Is.

SPECIES	Agro-forestry				Secondary forest				Primary forest		
	Pitfall	Plot method			Pitfall	Plot method			Plot method		
	caught	obs	caught	sub-total	caught	obs	caught	sub-total	obs	caught	sub-total
1. *Calotes marmoratus*	-	0	0	0	-	1	1	2	-	-	-
2. *Draco spilopterus*	-	60	13	73	-	9	2	11	-	-	-
3. *Gonocephalus semperi*	-	0	0	0	-	-	-	-	1	1	2
4. *Hydrosaurus pustulatus*	-	19	0	19	-	-	-	-	-	-	-
5. *Cyrtodactylus philippinicus*	-	-	-	-	-	-	-	-	2	1	3
6. *Pseudogekko smaragdinus*	-	-	-	-	-	14	6	20	11	10	21
7. *Brachymeles bonitae*	0	-	-	-	2	-	-	-	-	-	-
8. *Brachymeles boulengeri*	13	-	-	-	29	-	-	-	3	1	4
9. *Lamprolepis smaragdina*	-	1	-	1	-	3	1	4	1	1	2
10. *Mabuya multicarinata*	11	130	4	134	4	151	1	152	72	2	74
11. *Mabuya multifasciata*	-	1	-	1	-	-	-	-	-	-	-
12. *Sphenomorphus jagori*	15	14	2	16	12	58	13	71	102	26	128
13. *Sphenomorphus cumingi*	0	4	0	4	3	10	0	10	3	0	3
14. *Sphenomorphus coxi*	0	-	-	-	1	1	0	1	8	3	11
15. *Sphenomorphus abdictus*	4	-	-	-	3	-	-	-	4	2	6
16. *Tropidophorus grayi*	-	-	-	-	-	-	-	-	6	4	10
TOTAL	**43**			**248**	**54**			**271**			**264**

Appendix 2. Results of the relative abundance and diversity index per habitat based on transect counts.

SPECIES	Agro-forestry			Secondary forest			Primary forest		
	p_i	$p_i(\ln p_i)$	$p_I (ln)$	P_I	$p_i(\ln p_i)$	$p_I (ln)$	p_i	$p_i(\ln p_i)$	$p_I (ln)$
1. *Calotes marmoratus*	0	0	0	.0074	-.0363	-4.9090	0	0	0
2. *Draco spilopterus*	.2944	-.3600	-1.2230	.0406	-.1301	-3.2042	0	0	0
3. *Gonocephalus semperi*	0	0	0	0	0	0	.0076	-.0371	-4.8828
4. *Hydrosaurus pustulatus*	.0766	-.1968	-2.5690	0	0	0	0	0	0
5. *Cyrtodactylus philippinicus*	0	0	0	0	0	0	.0114	-.0510	-4.4773
6. *Pseudogekko smaragdinus*	0	0	0	.0738	-.1924	-2.6064	.0795	-.2012	-2.5314
7. *Brachymeles b. boulengeri*	0	0	0	0	0	0	.0152	-.0637	-4.1897
8. *Lamprolepis smaragdina*	.0040	-.0221	-5.5134	.0148	-.0624	-4.2158	.0076	-.0371	-4.8828
9. *Mabuya multicarinata*	.5403	-.3326	-.6156	.5609	-.3243	-.5782	.2803	-.3565	-1.2719
10. *Mabuya multifasciata*	.0040	-.0221	-5.5134	0	0	0	0	0	0
11. *Sphenomorphus jagori*	.0645	-.1768	-2.7408	.2620	-.3509	-1.3394	.4848	-.3510	-.7239
12. *Sphenomorphus cumingi*	.0161	-.0664	-4.1271	.0369	-.1218	-3.2995	.0114	-.0510	-4.4773
13. *Sphenomorphus coxi*	0	0	0	.0037	-.0207	-5.6021	.0417	-.1325	-3.1781
14. *Sphenomorphus abdictus*	0	0	0	0	0	0	.0227	-.0859	-3.7842
15. *Tropidophorus grayi*	0	0	0	0	0	0	.0379	-.1241	-3.2734
S p_I (ln p_i) =H'			***1.1768***			***1.2389***			***1.4911***