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Distribution of Anuran Species in Loboc Watershed of Bohol Island, Philippines

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Abstract - The Philippines is rich in biodiversity and Bohol Island is among the many places in the country requiring attention for conservation efforts. For this reason, a survey o f anurans was conducted in Loboc Watershed, the forest reserve in the island. Different sampling techniques were used. Three transect lines was established and were positioned perpendicular to water bodies parallel to the existing trails. A 10x10 meter quadrat size was established along each transect line. A visual encounter technique was used along each established quadrat and identification was done using a field guide. Fifteen species of anurans were recorded. One species belongs to families Bufonidae (*Bufo marinus*) and Megophryidae (*Megophryis stejnegeri*); two to family Microhylidae (*Kalophrynus pleurostigma* and *Kaluola picta*); six family Ranidae (*Fejervarya cancrivora, Limnonectes leytensis*, *Limnonectes magnus*, *Platymantis guentheri*, *Playmantis corrugatus*, and *Rana grandocula*) and five Rhacophoridae (*Nyctixalus spinosus, Polypedates leucomystax leucomystax, Polypedates leucomystax quadrilineatus, Rhacophorus appendiculatus* and *Rhacoporus pardalis*). The disturbed nature of the area still recorded endemic and threatened species. This suggests that forests and critical habitats in the area need to be protected and conserved.

INTRODUCTION

The Philippine archipelago is one of the most megadiverse countries in the world but is considered as a biodiversity hotspot since high habitat destruction has led to mass extinction of its unique species and biotic wealth. Many of the endemic plant and animal species can be found in rainforests in different regions of the country (Oliver and Heaney 1997). This situation made the government consider many regions of the country as Philippine Conservation Priority Areas to properly manage threatened plants and animals (Ong et al. 2002). One of the priority sites in the country is Bohol (PBCPP 2002). Its natural forests exhibit a high level of diversity of flora and fauna that also makes the island a major center for eco-tourism and biodiversity research.

The Loboc Watershed in Bohol is facing a major landscape change and biodiversity is under threat due to persistent and excessive utilization of natural resources and conversion of forest to agricultural areas. These threats can affect the life of existing species in the area, their interaction and role within the forest.

Anurans, which are a group of amphibians, are used as bio-indicators because of their semi-permeable skin and their dependency on both aquatic and terrestrial environments (White 1999). Thus, any changes in their habitat may effect their distribution and survival in a given area (Warner 1991). Several studies have indicated that the decline of the population of anurans may lead to their extinction.

A survey of anuran species at selected sites of Loboc Watershed was conducted to determine their current status. Assessment of the existence of anuran species in the area would provide information on the effect of anthropogenic disturbance and forest destruction on their populations.

OBJECTIVES OF THE STUDY

The main objective of this study was to survey anuran species in Loboc Watershed, Bohol, Philippines. Specifically, this study was conducted to: identify the anurans present to the lowest taxon; identify the distribution and status of anurans present in the area; and, compare anurans found in forest and agricultural areas.

MATERIALS AND METHODS

Study Area

Two municipalities and their Villages, specifically Bilar (Villages Dagohoy and Roxas) and Sevilla (Villages Magsaysay and Bayawahan) were the study sites selected for this study. They are part of Bohol Island State University-Forest Academic Research Area (BISU-FARA). Elevation varied from 200-400 meters above sea level (masl). The forest reserve is part of the Loboc Watershed Rehabilitation Project site. To ensure that the development in Bohol is sustainable, the Provincial Government and local people formulated an environmental code to protect, manage and develop the natural landscapes and seascapes of the island in a manner that will safeguard the functional capacities of these ecosystems and their sustainable use (RSPL-GMP , 2007). To carry out this goal, the Province promoted the conservation of flora and fauna, geological resources and the beauty of natural landscapes and seascapes and ensures that the river easements, buffer zones and landscape assemblies are also protected.

The BISU-FARA is classified as secondary forest. The degree of slope and contour in the two municipalities are mountainous and undulating to rolling terrain. The vegetation of the area is still considered suitable for anurans, however, there are patches of disturbance observed. In all municipalities surveyed, most forest sampling sites are covered by heterogeneous species of trees with few vines and epiphytes.

Data Collection Procedure

The survey was conducted from August to November 2007. Different sampling techniques were used as specified in the standard method of amphibian monitoring (Heyer et al. 1994). We determined the presence and abundance of anurans within specific habitats in each Village. These are useful for rapid evaluation of amphibian populations in structurally uniform habitats where visibility is good (Crump and Scott 1994). Also, this method is particularly useful on rainy or foggy nights when anurans travel from underground retreats (Halliday 1996).

Transect and Quadrat Method. The established transect line follows the method of Ruedas, et al. (1994) and modified by Brown, et al. (1996). Construction of quadrats along the established transects followed the method of Williams (2004) with some modification basing on the size of the covered area.

There were three transect lines established for each site. Transect lines were positioned perpendicular to water bodies and parallel to the existing trails. The length of transect line was an average of 200 meters or was set depending on size of the covered area. The distance between transect lines was set between 50-100 meters apart depending on the size of the covered area. A 10x10 meter quadrat size was established along each transect line. The distance between each quadrat along the transect was 10 meters. The schematic diagram of transect and quadrat established in different sampling sites is shown in Fig. 1.

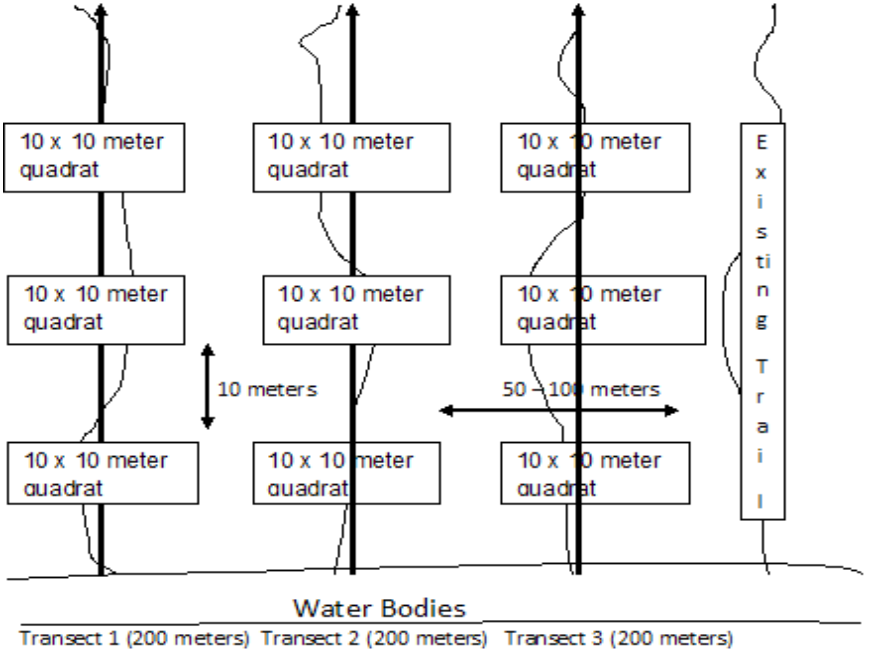

Fig. 1. Theoretical diagram of forest transects with 10x meter quadrats.

Visual Encounter Technique. In the visual encounter technique, the observers walked through a designated quadrat area along a transect line at a prescribed time. Daytime collection was carried out at 8:30 A.M. and evening collection was done at 8:00 P.M. Anurans were searched on the surface and under rocks, logs, trees, the bank of streams, ponds, and springs and other debris within the designated transect areas. All cover objects that were displaced from the area were returned to their original position to avoid disturbing the habitats.

Measurement and Identification. The encountered anurans were collected by hand grabbing and were identified based on their body length and other distinguishing characteristics. Body parts of the anuran, which are vital for identifying the organism, were measured.

The Philippine Amphibian: A Field Guide by Alcala and Brown (1998) and Diesmos, et al. (2004) were used in identifying the anuran species. Those that could not be identified using the field guides, in addition to verification of identified specimens, was done by Arvin Diesmos, herpetologist from the Philippine National Museum.

After identification, the anurans were marked by clipping the toenail. They were then released back to the area where they were caught.

RESULTS AND DISCUSSION

Anuran Species

A total of 15 anuran species were recorded in the four villages of BISU-FARA (Table 1). Of the 15 species, one species was identified under families Bufonidae (Fig. 2) and Megophryidae (Fig. 3); two species under family Microhylidae (Fig.s 4 and 5) ; six species belong to family Ranidae (Figs. 6 to 11) and five species of Rhacophoridae (Fig.s 12 to 16). The total number of species in the BISU-FARA represents at least 15.31% of the 98 presently known anurans in the Philippines (Diesmos et al. 2002).

Table 1. Taxonomic classification of 15 anuran species identified in four selected villages within Loboc Watershed.

Family	Species	Common Name	Village
Bufonidae	*Bufo marinus*	Giant marine toad	4
Megophryidae	*Megophrys stejnegeri*	Mindanao horned toad	4
Microhylidae	*Kalophrynus pleurostigma*	Black-spotted narrowed mouthed frog	2
	Kaloula picta	Slender digit chorus frog	4
Ranidae	*Fejervarya cancrivora*	Asian brackish frog	1, 2
	Limnonectes leytensis	Small disked frog	3
	Limnonectes magnus	Large swamp frog	1, 3, 4
	Platymantis guentheri	Guenther's forest frog	2, 3, 4
	Platymantis corrugates	Roughed backed forest frog	3
	Rana grandocula	Variable backed-frog	1, 2, 3, 4
Rhacophoridae	*Nyctixalus spinosus*	Spine tree frog	3
	Polypedates leucomystax Leucomystax	White-lipped tree frog	2, 4
	Polypedates leucomystax Quadrilineatus	Four-lined tree frog	1, 2, 4
	Rhacophorus appendiculatus	Rough-armed tree frog	3
	Rhacophorus pardalis	Gliding tree frog	1, 4

Villages 1= Bayawahan; 2 = Magsaysay; 3 = Dagohoy; 4 = Roxas

Distribution and Status of Anurans

The list of captured anurans with the total number of individuals per species at all sites is shown in Table 2. The distribution according to Alcala and Brown (1998) and status under IUCN category are also included.

Table 2. Distribution and status of captured anuran in the study areas.

Species	Capture/ Percentage	Status (FARA)	Status (IUCN)	Distribution
Bufo Marinus	8 (3.0%)	Rare	LC	W
Megophryis. Stejnegeri	6 (2.2%)	Rare	VU	W
Kaloula pleurostigma	7 (2.6%)	Rare	LC	W
Kaloula picta	10 (3.7%)	Rare	LC	PE

Fejervara cancrivora	38 (14.1%)	Very Common	LC	W
Limnonectes leytensis	8 (3.0%)	Rare	LC	PE
Limnonectes magnus	24 (8.9%)	Common	NT	W
Platymantis guentheri	37 (13.8%)	Very Common	VU	ME
Platymantis corrugatus	7 (2.6%)	Rare	LC	PE
Rana grandocula	43 (16.0%)	Very Common	LC	PE
Nyctixalus spinosus	6 (2.2%)	Rare	VU	ME
Polypedates Ieucomystax leucomytax	21 (7.8%)	Common	LC	W
Polypedates Ieucomystax quadrilineatus	32 (11.9%)	Very common	LC	W
Rhacophorus appendiculatus	6 (2.2%)	Rare	LC	W
Rhacophorus pardalis	12 (4.5)	Rare	LC	W

*1 – 14 = rare; 15 – 29 = Common; 30-45 = Very common
* LC = Least Concern; VU = Vulnerable; NT = Near Threatened
* W = Widespread; PE = Philippine Endemic; ME = Mindanao Endemic

A total of six species, namely: *Kaloula. picta, Limnonectes leytensis, Platymantis guentheri, Platymantis corrugatus, Rana grandocula, Nyctixalus spinosus* and *Rhacophorus appendiculatus* are Philippine endemics. This represents 8.9% of the 78 presently recorded endemic anurans in the country. There are no known endemic genera of Philippine anurans (Diesmos et al., 2002). Two species, *P. guentheri* and *N. spinosus*, were classified by Alcala and Brown in 1998 as Mindanao endemics. However, in current surveys and studies, these two species were found to be widely distributed in Visayan region in the areas of Bohol, Samar and Leyte (Diesmos et al. 2004 and IUCN, 2006). The presence of land bridges between islands in the Philippines during the geologic past could have assisted organisms in moving and colonizing new habitat within connected islands. The islands of Bohol, Basilan, Leyte, Samar and Mindanao, more or less share the same faunal species and seem to suggest equal amounts of diversification within the anurans (Catibog-Sinha and Heaney 2006, Brown and Guttman 2002).

Of the seven Philippine endemic species, *P. corrugatus*, *N. spinosus* and *R. appendiculatus* showed low percentages of the total number of individuals. This result may tell us that the three species are naturally occurring in low densities as compared to the populations of other non-endemic species.

Based on the IUCN status list, species recorded in BISU-FARA comprises almost 58% of the recorded species and categorized as least concern species. Other species observed, like *M. stejnegeri*, *N. spinosus*, and *P. guentheri* were categorized as vulnerable species and *L. magnus* as near threatened.

According to the IUCN criteria of 2001, *M. stejnegeri*, *N. spinosus* and *P. guentheri* were categorized as vulnerable. Two of these species (*N. spinosus*, and *P. guentheri*) were considered Philippine endemic (Alcala and Brown 1998). The IUCN categorized it as vulnerable species because they were considered to be facing a risk of extinction in the wild. It is also because its distribution is estimated to be less than 20,000 km, and severely fragmented as well as continuously declining in its extent and quality of forest habitat (IUCN 2001 2006, Baillie et al., 2004). This situation was clearly observed in the study area wherein the three species were restricted to some survey sites and their occurrences were limited to a small area where this species was captured. It was also noted in Table 2 that *M. stejnegeri* and *N. spinosus* showed a lower percentage of captured individuals, having only 2.2% of total captures with just six individuals of each species. It seems that the two species may have a high risk of extinction in the study area. On the contrary, *P. guentheri* showed a higher percentage of capture at 13.8% during the survey. This serves as a good indication of recovery of this species. However, there is still a need to monitor the population of this species in the study area.

Moreover, L. *magnus* was categorized as near threatened by IUCN because it is now observed in low numbers within a limited distribution, which can lead to reduction or extinction in the wild. It was categorized as such because this species is probably in significant decline and is experiencing habitat loss throughout much of its range and over-harvesting for food (Baillie et al. 2004). It was observed that *L. magnus* in the survey area showed a high percentage of capture at 8.9% compared with the other species. This could tell us that the species normally occurs in high population densities in the study area.

Anurans in Forest versus Agricultural Areas

The four sampling sites exhibited differences in vegetation. These were divided into primarily forest areas and agricultural areas. Forest vegetation was composed of a large number and variety of plants and trees that create a wide range of canopy cover compared to the agricultural areas. The over story canopy cover is very important in the maintenance of temperature and moisture that is vital for the survival of the anurans and other amphibian species (Knapp et al. 2003). Thus, in the survey the species composition turned out to be different based on the vegetation of the sampling areas (Table 3).

Table 3. Anurans recorded in forest and agricultural areas.

Family	Species in the Forest Sampling Sites	Species in the Agricultural Sampling Sites
Bufonidae		*Bufo marinus*
Megophrydae	*Megophyrys stejnegeri*	
Microhylidae	*Kalophrynus pleurostigma*	*Kaloula picta*
Ranidae	*Limnonectes leytensis*	*Fejervarya cancrivora*
	Limnonectes magnus	
	Platymantis guentheri	
	Platymantis corrugates	
	Rana grandocula	
Rhacophoridae	*Nyctixalus spinosus*	*Polypedates leucomystax*
	Rhacophorus appendiculantus	*Polypedates quadrilineatus*
	Rhacophorus pardalis	

Most of the species captured were restricted to the forest areas. There were ten species from the forest and five species from the agricultural sites. The result suggests that more species inhabit forest landscapes probably because forests provide heterogeneity of habitats that can create the appropriate environmental to support anurans.

The presence of canopy epiphytes, pandan and ferns were good indicators of the presence of anurans, specifically *Platymantis* species. Ferns and pandan serve as habitats of forest frogs since they accumulate

rainwater or moisture from air where some frog species breed (Alcala and Brown, 1998, Heaney and Regalado 1998).

The low number of species in the agricultural areas indicate only few species with lesser number of trees and plants that can provide protection from extreme temperature changes and less water. Thus, anthropogenic disturbance such as conversion of forest to agricultural areas may lead to extinction of some anuran species that are adapted to a forest habitat (Gray et al., 2004).

CONCLUSIONS

Of the 15 species identified, there were four species considered threatened under IUCN. Habitat features were found to be an important factor in determining the presence and distribution of anurans. This includes existence of water bodies and high habitat heterogeneity that play a crucial role as nesting sites for anurans, the importance of wide percentages of forest cover of existing trees, leaf litter, woody debris and rock formation that provide cover and foraging, and help maintain proper temperature and moisture regimes in the area.

Threats in the study areas include slash-and-burn agriculture, small scale logging, conversion of forest into agricultural land, and other reasons including poverty and ignorance of biodiversity. These were sufficient to cause alarm. Nevertheless, despite the disturbed nature of the forest surveyed, there were still endemic and threatened species of anurans. This suggested that forests and critical habitats for frogs in Loboc Watershed need to be protected.

LITERATURE CITED

Alcala, A.C. and W.C. Brown
1998 Philippine amphibians: An illustrated field guide. Bookmark Incorporated, Makati City.

Baillie, J.E.M., C. Hilton-Taylor and S.N. Stuart (eds)
2004 IUCN Red List of threatened species. A Global Species Assessment. IUCN Gland, Switzerland and Cambridge, U.K.

Brown, R.M., J.W. Ferner, R.V. Sison, P.C. Gonzales and R.S. Kennedy
1996 Amphibians and reptiles of the Zambales Mountains, Luzon Island, Republic of the Philippines. Herpetological Natural History 4:1-22.

Brown, R.M. and S.I. Guttman
2002 Phylogenetic systematics of the *Rana signata* Complex of the Philippines and Bornean stream frog: Recognition of Huxley's modification of the Wallace's line at the Oriental – Australian Faunal Zone Interface. Biological Journal of the Linnean Society 76: 393-461.

Catibog-Sinha, C.S. and L. R. Heaney
2006 Philippine biodiversity: principles and practice. Haribon Foundation for the Conservation of Natural Resources, Inc. Quezon City.

Crump, M.L. and N.J. Scott Jr.
1994 Visual encounter surveys in W.R. Heyer, M.A. Donell, R.W. McDiarmid, L.A.C. Hayek and M.S. Foster, eds. Measuring and monitoring biological diversity: Standard method for amphibians. Smithsonian Institute Press, Washington D.C. USA pp 84 – 92.

Diesmos, A.C., R.M. Brown, A.C. Alcala, R.V. Sison, L.E. Afuang, G.V. Gee
2002 Amphibians and reptiles Page 26 in Ong, P.S., L.E. Afuang and R.G. Rosell A. (eds) 2002. Philippine biodiversity strategy and action plan: Final report. PAWB-DENR, Conservation International-Philippines, BCP-University of the Philippines, Foundation for the Philippines Environment. Quezon City.

Diesmos, A.C., R.M. Brown and G.V.A. Gee
2004 Preliminary report on the amphibians and reptiles of Balbalasang-Balbalan National Park. Luzon Island, Philippines, Sylvatrop, the Technical Journal of the Philippine Ecosystem and Natural Resources: 13 (1&2): 63 – 80.

Gray, M. J., L. Smith, R. Brenes
2004 Effects of agricultural cultivation on demographic of southern high plains amphibians. Conservation Biology Vol. 18 No. 5 Pages 1368 – 1377.

Halliday, T. R.
1996 Amphibians in: W. J. Sutherland (eds) Ecological Census technique: Handbook. Handbook, Cambridge University Press, New York.

Heaney, L.H. & J.C. Regalado
1998 Vanishing Treasures of the Philippine Rain Forest. The Field Museum, Chicago, IL. USA

Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, LAC Hayek and M.S. Foster.
1994 Measuring and monitoring biological diversity: Standard method for amphibians. Smithsonian Institute Press, Wasington D.C., U.S.A.

[IUCN] International Union for Conservation of Nature.
2006 Red list of threatened animals. IUCN gland Switzerland

[IUCN] International Union for Conservation of Nature.
2001 Red list categories and criteria: Version 3.1 IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, U.K.

Knapp, S.M., C.A. Haas, D.N. Harpole and R.L. Kirkpatrick.
2003 Initial effects of clearcutting and alternative silviculture practices on terrestrial salamander abundance. Conservation Biology 17: 752 – 762.

Oliver, W.L.R. and L.R. Heaney
1997 Biodiversity and conservation in the Philippines In: Philippine Red Data Book .Wildlife Conservation Society of the Philippines (WCSP) Bookmark Inc. Makati City, 1997.

Ong, P. S., L. E. Afuang, and R. G. Rosell-Ambal
2002 Philippine biodiversity conservation priorities: a second iteration of the National Biodiversity Strategy and Action Plan. Department of Environment and Natural Resources-Protected Areas and Wildlife Bureau, Conservation International Philippine, Biodiversity Conservation Program-University of the Philippines Center for Integrative and Development Studies, and Foundation for the Philippine Environment, Quezon City Philippines,

[PBCPP] Philippine Biodiversity Priority-Setting Program
2002 Philippine biodiversity conservation priorities. A second iteration of the National Biodiversity Strategy and Action Plan: Final Report (Edited by Ong, P.S., L.E. Afuang, R.G. Rosell-Ambal) Quezon City: PAWB-DENR, Conservation International-Philippines, BCP-University of the Philippines, Foundation for the Philippine Environment.

Robinson, J. and F. Bennett
2000 Hunting for sustainability in tropical forest. New York: Columbia University Press.

Ruedas, L. A., J.R. Demboski and R.V. Sison
1994 Morpological and ecological variation in Otopteropus cartilagonodus from luson, Philippines. Proc. Biol. Soc. Washington 107: 1 – 16

Warner, R. F.
1991 "Impacts of environmental degradation on rivers, with some Examples from Hawkesbury - Nepean System," Australian Geographer. 22:1-3

White, A.W.
1999 Frogs as bioindicator in blue mountains Bioindicator Project. NSW National Parks and Wildlife Service.

Williams, L. A.
2004 Amphibian population and community characteristics, habitat relationship, and first-year response to clearcutting in a central Appalachian Industrial Forest. M.S. Thesis, Department of Fisheries and Wildlife Sciences at Virginia Tech., U.S.A.

Species observed in the sampling sites

Fig. 2. *Bufo marinus*
(Giant marine toad)

Fig. 3. *Megophryis stejnegeri*
(Mindanao horned toad)

Fig. 4 *Kalophrynus pleurostigma*
(Black-spotted narrowed mouthed frog)

Fig.s 5. *Kaloula picta*
(Slender digit chorus frog)

Fig. 6. *Fejervarya cancrivora*
(Asian brackish frog)

Fig.s 7. *Limnonectes magnus*
(Small disked frog)

Fig. 8. *Limnonectes leytensis* (Large swamp frog)

Fig. 9. *Platymantis corrugatus* (Rough-backed forest frog)

Fig. 10. *Platymantis guentheri* (Guenther's forest frog)

Fig. 11. *Rana grandocula* (Variable backed-frog)

Fig. 12. *Nyctixalus spinosus* (Spiny tree frog)

Fig. 13. *Polypedates leucomystax Leucomystax* (White-lipped tree frog)

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Fig. 14. *Polypedates leucomystax quadrilineatus*
(Four-lined tree frog)

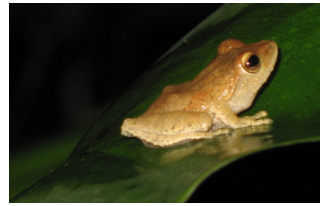

Fig. 15. *Rhacophorus appendiculatus*
(Rough-armed tree frog)

Fig. 16. *Rhacophorus pardalis*
(Gliding tree-frog)