Mega Construction in Panglao Island, Philippines: The Magnitude of the Possible Biodiversity Losses

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Abstract To support the needs of the booming ecotourism of Bohol province, construction of an international airport across four island villages was to commence in the latter part of 2013. The mega structure would reduce into concrete some 233 hectares of natural habitat and displace its dependent fauna in the impact zones. A biodiversity assessment is one of the requirements in securing the Environmental Compliance Certificate (ECC). This study primarily aimed to assess the biodiversity status in the site. Data were gathered through field surveys employing purposive sampling techniques. The global positioning system (GPS) device was used to get the exact location and elevation of the 350 floral plots and faunal sampling stations. Faunal surveys involved mist-netting and light traps. Ecological parameters analyzed included species diversity, dominance and evenness. Floral results yielded a total of 167 species of plants in 136 genera and 41 families in the project site. Out of 167 plant species, 76 were trees species; 28 shrubs; 24 herbs; 18 grasses; 14 vines; 6 sedges and 1 fig species. Threatened species include *Vitex parviflora* and *Diospyros pilosanthera*. Some 51 species of weeds belonging to 42 genera under 16 families were identified. Results showed a total of 26 avifauna species, 4 bats species and 6 anurans. Of the 26 birds, 20 were endemics. The arthropods survey yielded a total of 84 insect species in 14 Orders and 49 families. It was concluded that species diversity of both flora and fauna was moderate to high. There is an urgent need of an enrichment tree planting of indigenous trees in the rest of the island to harbor the fauna that would soon be displaced from the "wipeout zone".

INTRODUCTION

The Philippine Environmental Impact Assessment (EIA) System requires projects to secure an Environmental Compliance Certificate (ECC) prior to its implementation. It involves a comprehensive EIS (Environmental Impact Statement) that would assure the ecological feasibility of the proposed project. Among the information needed are the biodiversity status of the area and the realistic possible impacts of the proposed project to this natural life-support system.

Municipality of Panglao is composed of ten villages where four of these are part of the proposed 233-ha international airport. The proposed airport site has plain to slightly rolling topography and is largely comprised of Maribojoc limestone, the youngest of the limestone units found in the western area of Bohol. All sites have scrubland type of vegetation characterized with low shrubs, mixed with grasses, herbs, and geophytes. The sites were a mixture of pioneer species and remnants of advanced vegetation. The presence of so many stumps and the coppicing growth of trees/shrubs are evident of the massive cutting during the last decade and a half.

What would be the magnitude of the species and ecosystem biodiversity losses that will be affected with the construction and ensuing operation of the new airport? More importantly, what mitigating plans can be proposed to save the remnant species and their habitats?

OBJECTIVES

This study sought to determine the species composition and assess the diversity, dominance and status of flora and fauna of the proposed Bohol Airport Site in Panglao, Bohol which covers the four villages of Bolod, Danao, Lourdes and Tawala; and to recommend several activities to be included in the environmental management plan of the proposed project.

METHODOLOGY

Flora: Purposive (preferential) sampling technique was employed to obtain quantitative information on the structure and composition of terrestrial plants in the project area. Data collected include plant species names, number of individuals and growth habit. Basal diameter, total height, crown diameter, and the plant's current stature were taken in plots established in scrubs and wooded areas

A total of 120 plots (with a dimension 10 m x 10 m each) were established along the proposed runway across the 4 villages. These were laid mostly on dense scrub thickets where varied species of plants are evident. Some plots were also laid in areas with few scattered small trees and shrubs to have a total picture of the whole area. A 1m x 1m subplot was also established within each plot to assess the associated undergrowth plants.

Fig. 1 Sampling plots for higher vegetation   **Fig. 2 Sampling plots for weeds assessment**

Ecological parameters: Species dominance was determined by computing the species importance value (IV). Importance value considers, not only the density per unit area of a certain species of plants like in the usual faunal assessment, but also includes frequency and cover/basal dominance of all species recorded. It is the sum of the relative density, relative frequency and relative dominance combined as one. The IV was derived using the following formulas:

$$Density = \frac{Total\ number\ of\ a\ species}{Total\ area\ sampled} \tag{1}$$

$$Relative\ Density = \frac{Density\ of\ a\ species}{Total\ densities\ of\ all\ species} \times 100 \tag{2}$$

$$Dominance = \frac{Basal\ area\ of\ a\ species}{Total\ area\ sampled} = \frac{Relative\ percent\ cover\ of\ a\ species}{Total\ area\ sampled} \tag{3}$$

$$Relative\ Dominance = \frac{Dominance\ of\ a\ species}{Total\ dominance\ of\ all\ species} \times 100 \tag{4}$$

$$Frequency = \frac{Number\ of\ times\ a\ species\ is\ encountered}{Total\ number\ of\ plots\ established} \times 100 \tag{5}$$

$$Relative\ Frequency = \frac{Frequency\ of\ a\ species}{Total\ of\ frequency} \times 100 \tag{6}$$

$$Importance\ Value\ (IV) = Rel.\ Density + Rel.\ Dominance + Rel.\ Frequency \tag{7}$$

Indices of species diversity and dominance: Diversity indices were also determined using the richness and dominance computation following the formula of Magurran (1988). Richness measures include Shannon diversity index (H') and Evenness index (E). The former assumes that individuals are randomly sampled from an indefinitely large population. It equally considers that all species are represented in the sample. The latter is the ratio of observed diversity to maximum diversity. Dominance measure, on the other hand, weighs towards the abundances of the commonest species rather than providing a measure of species richness. This, in particular, is computed by the Simpson's index (D). Simpson's index gives the probability that any two individuals drawn at random from an infinitely large community may belong to different species. Species diversity (H'), evenness (E) and Simpson's dominance (D) were assessed using the following formulas:

$$Species\ Divesity\ (H') = -\sum pi\ (\ln pi) \tag{8}$$

where: $pi = \frac{IV\ of\ a\ species}{Total\ IVs\ of\ all\ species} = \frac{number\ of\ individuals\ of\ a\ species}{Total\ number\ of\ indiduals\ of\ all\ species}$

$$Evenness\ Index\ (E) = H'/\ln s \tag{9}$$

where: $s = number\ of\ species$

$$Simpson's\ Index\ (D) = \sum pi^2 \tag{10}$$

The species diversity index is the ratio between the number of species or importance values that may be expressed as the number of individuals, biomass productivity and the like. A high index value usually means a large number of rare species – "rare" in the sense that, it is represented by a low number of individuals as opposed to high counts for a few common species.

The index of dominance expresses the degree to which the dominance is concentrated in one, several, or many species (Odum, 1971). This is measured using several factors such as the number of individuals, biomass, productivity and others.

Arthropods: The techniques employed in arthropod assessment were pan and light trapping. Twenty-four (24) pan trapping sites were set for eight hours during the day while four light trapping sites at night in the four areas were laid out.

**Table 1 Ordinal classification of species richness and dominance indices
(adopted from Fernando, et al. 1998)**

Relative Values	Species Diversity	Evenness	Dominance
Very high	3.50 – 4.00	0.75 – 1.00	0.75 – 1.00
High	3.00 – 3.49	0.50 – 0.74	0.50 – 0.74
Moderate	2.50 – 2.99	0.25 – 0.49	0.25 – 0.49
Low	2.00 – 2.49	0.15 – 0.24	0.15 – 0.24
Very low	1.00 – 1.99	0.05 – 0.14	0.05 – 0.14

Agricultural crops: Most farms were given up or abandoned a decade ago when the lands were expropiated for the Project. A few remained and these were just listed and given a a cursory inspection.

RESULTS AND DISCUSSION

Flora

Floral results yielded a total of 167 species of plants belonging to 136 genera under 41 families in the project site. The most represented families were Fabaceae, Poaceae, and Euphorbiaceae with more than 10 species and genera. Out of 167 plant species, 76 were trees species; 28 shrubs; 24 herbs; 18 grasses; 14 vines; 6 sedges and 1 strangling fig species. The shrub-layer contained 90 species of plants under 77 genera and 33 families while the undergrowth had 92 plants, belonging to 78 genera and 31 families. *Threatened* species include *Vitex parviflora* and *Diospyros pilosanthera*. *Buchanania arborescens* was found to be the most common in the shrub layer. This was followed by *Glochidion lutescens* and *Myrsine philippinensis*, all are indicators of a karst environment including *Vitex parviflora*. *Chromolaena odorata* and *Imperata cylindrica* were the common undergrowth species. *Bambusa blumeana* (kawayan-tinik) dominated based on its cumulative basal diameter. *Imperata cylindrica* dominated the undergrowth. The diversity and dominance values in the shrub-layer showed a moderate to high species diversity. Its species dominance was very low. The undergrowth had very high species diversity values and consequently a low species dominance.

The implication of moderate and high species diversity and evenness in the shrub layer of the wooded thickets means that there were many species of plants recorded in the sampling plots. The result of the analysis was expected since all types of plants (trees, shrubs, vines and herbs) were noted as long as the shrub-layer minimum limit of 1 meter in height is met. Many literatures also attested to the fact that early succession forests and scrubs similar with the wooded thickets in the project area definitely have high species diversity and consequently have low species dominance. The wooded thicket undergrowth also had very high species diversity and evenness values and low species dominance value since most of the trees, shrubs and vines had dispersed their seeds which now flourished in the floor in addition to several species of grasses and broadleaves which normally grow under partial shade provided by the canopy of trees.

For the weeds, some 51 species belonging to 42 genera under 16 families were identified. Family *Poaceae* (grass family) was the most represented group. *Chrysopogon aciculatus* (amorseko) was the most dominant weed followed by *Imperata cylindrica*. The mean diversity value for weeds in the entire project site is moderate while evenness was high. On agricultural crops, a total number of 23 agricultural crop species belonging to 21 genera under 19 families were

identified. The major agricultural crop species under cultivation were coconuts and bananas. Coconuts, through copra sales, yielded the most family income among the crops grown. The species diversity of the agricultural crops in the project site was very low due to a few species that dominated in the count.

Fauna

Faunal survey results revealed a total of 26 avifauna species, 4 bats species and 6 anurans. It was very remarkable that out of the 26 birds, 20 were endemics. Distribution status was mostly *Common.* The most commonly bird species observed were *Lonchura jagori* and *Aplonis panayensis.* The *Lanius nasutus* (Long-tailed Shrike) birds made an adaptation to the degraded environment by like building their nests on the ground grasses due to the absence of higher vegetation. The bats were the only conspicuous wildlife mammals in the area. The degraded vegetation and habitat conditions could not support the presence of other mammals like monkeys, tarsiers, civet cats, flying lemurs and squirrels. All the six anuran species identified were under the status of *Least Concern* based on the IUCN status list. Two were endemics. A land crab under family *Gecarcinidae* was encountered during the search for anurans in Barangay Bolod.

Anurans: All the six (6) species caught in the entire study area are under the status of *Least Concern* based on the IUCN status list. However, *Limnonectes leytensis* is one of the two endemic anurans which usually thrive in a good habitat like forests with water bodies. The other endemic species, *Kaloula picta,* is commonly found in cultivated agricultural lands. Although the species had the highest number of capture, still, the figure did not indicate a good population of the sites.

Avifauna: Out of the 26 species identified, it was very remarkable that 20 were endemics which suggest an urgent need for conservation through habitat rehabilitation. The most commonly bird species observed were *Lonchura jagori* and *Aplonis panayensis* which are commonly known to thrive in marginal areas like the scrubby study sites. There were endemics like *Lanius nasutus* (Long-tailed Shrike) species which were also common and had made peculiar adaptations like building their nests on the ground grasses due to the absence of higher vegetation.

Mammals: Only bats were conspicuous in the area. The kind of existing vegetation could not support the presence of other mammals like monkeys, tarsiers, civet cats, flying lemurs and squirrels. Out of the four (4) fruit bat species captured, two were endemics. *Cynopterus brachyotis,* a *Widespread* species and most commonly caught, is believed to mainly roost in or near the study sites. This was evident with the observed "leaf-tent" formation that served as roosting place. There were insect bats in the area but were not captured due to their ability to echolocate and easily evade the mist nets. The bats need higher vegetation for roosting and food source.

Arthropods: The arthropods survey yielded the following data: a total of 84 insect species belonging o 14 Orders and 49 families; 6 arachnids belonging to 1 order (Araneae) and 6 families; and 1 *Diplopod* were positively identified. Identification is still to be made with 17 insects and 3 arachnids. The diversity, evenness and dominance varied with different sites from very low to low. However, for nocturnal arthropods, 3 of the 4 sites had high diversity. The dominant species in all sites were the *Hymenopterous* insects which include the ants, wasps and the bees which mostly useful as pollinators, predators, decomposers, parasites and predators of insect pests.

CONCLUSION

From the results, it was concluded that species diversity was moderate to high in terms of higher vegetation (trees and shrubs), undergrowth and weeds. *Buchanania arborescens* dominated the scrubby layer while *Chromolaena odorata* and *Chrysopogon aciculatus* dominated the weeds. Arthropods' diversity varied from low to very low in the sites. Avifauna or birds dominated the faunal component. Species diversity was low among the birds, anurans and bats, but there was high endemicity among the birds. Of the arthropods dominant species in all sites were the *Hymenopterous* insects which include the ants, wasps and the bees which are important pollinators. Coconuts and bananas dominated the plantation and agricultural crops.

RECOMMENDATIONS

There should be an enrichment planting of high vegetation (trees) and shrubs to cover the inevitable losses of species and species populations during the airport development. Other indigenous tree species endemic to the island should be planted to save the affected faunal species which are in dire need of food sources and roosting places. Dipterocarps which are native to the island-province like narig, white lauan, apitong, yakal, manggachapui, manggasinoro, palosapis and mayapis can be used. These are already known to thrive in open plantations in the island like in the neighboring town of Dauis, as well as tree endemics like bagalunga, dao, kalumpit, bitanghol, aniam-gubat and many others can be used too. For food sources, in addition to the existing shrubs, fruit trees like antipolo, breadfruit (kolo), mangoes, Ficus spp. (balete), manzanitas and others can also be planted. The existing molave and sineguelas should be sustained. A minimum of a 20-m wide tall vegetation (with dense crowns) should be established as noise barrier in the immediate periphery of the airport.

Special conservation sites and/or wildlife sanctuaries maybe established away from the noisiest part of the airport. Furthermore, the people particularly the farmers as well as the technicians of the municipality should be ready to understand and prepare for the massive transfer or swarm of the arthropods to the different routes which may include their farms. Conservation and utilization of the plant species already growing in the area like bignay, molave, pandakaki and more should be considered to make sure that the food and host plants will still be available and accessible to the species. These plant species can be used in the avenue planting along the road network within the Panglao island like "bignay boulevard" , "molave avenue" or pandakaki grove". The municipal local government unit s of Panaglao and Dauis through their respective Municipal Agriculture Office should prepare a pest management plan for the island a year ahead of the New Airport project implementation.

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