Final Report:
Biodiversity Assessment in Southern Leyte

Submitted by

Fauna & Flora International

c/o The International Institute of Rural Reconstruction

Y.C. James Yen Centre

Silang, Cavite

4118 Philippines

(www.fauna-flora.org)

Submitted to

New Conservation Areas of the Philippines Project (NewCAPP)

Protected Areas and Wildlife Bureau

Department of Environment and Natural Resources

2nd Floor, Biodiversity Division, North Avenue

Quezon City

(www.pawb.gov.ph)

and

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Climate Change Office

Department of Environment and Natural Resources

2nd Floor, FASPO Building, Visayas Avenue

Quezon City

(www.giz.de/philippines)

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- Barangay San Juan
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Executive Summary

The project “Climate-relevant Modernisation of the National Forest Policy and Piloting of REDD Measures in the Philippines”, funded under the International Climate Protection Initiative of the German Federal Ministry for the Environment (BMU), supports the country’s efforts towards forest and climate protection and the development of appropriate policy and instruments. The project is implemented by GIZ with the Department of Environment and Natural Resources (DENR) as the main partner, in cooperation with local government units (LGUs) and a wide range of stakeholders, in line with the National REDD-plus Strategy (NRPS).

The project aims at an improved forest policy and the development of incentives for forest protection and rehabilitation, reduction of greenhouses gases (GHG), conservation of biodiversity, and building of capacities towards this end. It focuses on forest policy reforms and REDD+ pilot activities in and around selected protected areas.

In discussions with DENR, Leyte Island has been selected as a site for piloting REDD+ measures with Barangays in five Municipalities of Southern Leyte Province as a pilot project area. Municipalities included are Silago, Sogod, Bontoc, Tomas Opus and Maasin.

This technical report comprises the results of the biodiversity assessment conducted by Fauna and Flora International in a Key Biodiversity Area in Southern Leyte covering six (6) municipalities (Silago, Hinunangan, Sogod, Maasin, Tomas Opus and Malitbog). The study was aimed at generating practical information and key species-habitat information to inform management planning. The following activities were conducted: a) identified and compared habitat types based on natural and land-use stratification, b) determined anthropogenic factors influencing overstorey and understorey vegetation, c) identified the patterns of fauna–habitat associations, d) listed species baseline for future protected area management plans and monitoring programmes, e) provided a guide for the design and implementation of management interventions for specific species’ survival within and across their range in Southern Leyte; and, f) modelled of species responses and/or communities to various land cover-uses.

The study that spanned slightly over one month, from 08 November to 15 December, 2012, recorded a total of 229 flora species in 65 families, with 31 Philippine endemics, 10 IUCN-critically endangered species which are mostly Dipterocarp species and 20 IUCN-vulnerable species. While, the terrestrial vertebrates accounted in the survey totalled to 212 species (Birds: 112 species , Mammals: 36 species, Herpetofauna: 64 species). Of the 112 species of birds, forty-one (41) are endemic to the Philippines and fourteen (14) are endemic to the Visayas and the Greater Mindanao faunal region. Among the forty-one endemic (41) species, eleven (11) are in the IUCN threatened category. A total of 36 species of mammals belonging to 15 families were recorded, 17 species (47%) are Philippine endemics of which eight (8) are restricted only to the Mindanao faunal region. Threatened mammalian species recorded in the survey, include the Golden capped fruit bat *Acerodon jubatus,* endangered (EN), *Sus barbatus mindanensis* vulnerable (VU), the Large flying fox *Pteropus vampyrus,* the Philippine forest horshoe bat (*Rhinolophus inops)* and the Philippine tarsier (*Tarsius syrichta)* which are all endemic in the Philippines. Likewise, there are a total of 69 species of terrestrial amphibians and reptiles recorded across the four (4) localities. Of the 69 herpetofaunal species, 25 species are frogs belonging to seven (7) families in which two of these were possitively identified as new species; 23 species are lizards belonging to five (5) families; 20 species of snakes and one (1) species of

terrestrial turtle. The general pattern of the species accumulation curves of the vertebrates found during the survey showed to approach the asymptote. It also showed that the combination of anthropogenic and natural factors played a major role on species distribution and diversity. Consequently, highly disturbed areas resulted in low diversity.

Results of the faunal habitat association indicated the general preference of southern Leyte's fauna to forest and riverine habitats. Whereas, with the plant communities surveyed, through the canonical correspondence analyis (CCA) using 18 habitat parameters (e.g. tree counts, biomass values, increasing bamboo, herb coverage, etc.) indicated that with increasing disturbance, vectors of increasing understory, ground and bamboo coverage, as well as higher incidences of fallen trees can be observed. Similarly, through the CCA, trees associated with humans were grouped and found in areas with increasing bamboo cover and herbaceous cover, whilst, species known to be associated with high quality forest seem to favor areas with less disturbance. Whilst with birds and small non-volant mammals, CCA also confirmed trends found on trees and the general pattern of diversity of the species, which increases as it approach less disturb, high biomass and more pristine habitats. An occupancy modelling on 21 species of birds showed that the detection probability (*p*) were less than one (1), which are influenced by environmental covariates such as tree girth (dbh), presene of palms (palm), densities of saplings (sap), coverage of rattan clumps (rat), extent of grass cover (grass) and or the combinations of these co-variates.

The simple modeling exercise demonstrated how science reinforce to positively guide management in protected areas or REDD+ demonstration sites. Habitat associations of trigger species and occupancy modelling can predict impacts of habitat change on species, and can be reduced by addressing the pressures appropriately, taking into consideration tolerance levels. Conduct of baseline studies on fauna and flora provides a better discernment in designing appropriate monitoring protocols. Remote sensing analysis has been demonstrated in this exercise to be useful particularly in large spatial scales, however it can only generate useful information at a certain level or resolution, stimulating the need to conduct ground-truthing which could further validate existing data and analyse historical trend of a site's land-use.

Conflicting land tenurial instruments between private individuals and government in areas visited has also been seen to hamper the implementation of conservation projects, which can be resolved through the intrevention of the local government unit. Ground-truthed areas during the assessment revealed a different description of the site in comparsion with the existing data particularly on maps. The rainy weather condition also hampered the conduct of the survey, causing a reduced mobility and visibility in the field.

Identified threats to biodiversity include, widespread illegal collection of wildlife, conflciting land tenurial issues and improper wildlife collection (e.g. bat collection in caves in maasin). However, these threats can be addressed by having proper land use classification with strict implementation of policy and reforms that strengthens sustainable conservation initiatives through increased capacitation of stakeholders.

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Acronyms and abbreviations

AIC	Akaike's Information Criterion
ASG	Advance Second Growth Forest
CCA	Canonical Correspondence Analysis
CVT	Cultivated
DBH	Diameter at Breast Height
DENR	Department of Environment and Natural Resources
EBA	Endemic Bird Area
EDNSTPAP	Expanding and Diversifying the National System of Terrestrial Protected Areas in the Philippines Project
ESG	Early Second Growth Forest
FAO	Food and Agriculture Organization of the United Nations
FFI	Fauna and Flora International
FMB	Forest Management Bureau
FRA	Forest Resources Assessment
GEF	Global Environment Facility
GBH	Girth at Breast Height
GIZ	Gesellschaft fUr Internationale Zusammenarbeit
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
MRV	Monitoring, Reporting and Verification
MVSP	Multivariate Statistical Package
NewCAPP	New Conservation Areas in the Philippines Project
OG	Old Growth Forest
PAWB	Protected Areas Wildlife Bureau
PAO	Proportion Area Occupied
REDD-Plus	Reduction Emission Deforestation and Degradation
UNDP	United Nations Development Program

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I. INTRODUCTION

Conservation Importance

The Philippines has diverse and unique biodiversity that exhibits an extraordinary high level of endemism and undisputedly one of the richest and most important in the world (Mallari 2001, 2009; Catibog-Sinha & Heaney 2006; WCSP 1997). History reveals that the numerous islands that make up the country have been isolated for thousands of years from mainland Asia, leading to the evolution of exceptional and diverse flora and fauna that can be found nowhere else on earth (Esselstyn *et al*., 2004 & Heaney *et al.*, 2005). Present tally also accounts that there are more than 20,000 endemic species of plants and animals that have been identified in the Philippines, making it one of the world's 17 mega-diverse countries that collectively characterizes two-thirds of the earth's biological diversity (KBA,2007).

As recognized by Wallace, floristic and fauna affinities of the Philippines is largely oriental in character but the archipelago lack many of the oriental representative species (except in Palawan) and contained significant Australian floral components which is best represented in the eastern region of Mindanao. Meanwhile, other islands like Negros and Panay, share faunal species that are surprisingly different from those on other adjacent Visayan Islands of Leyte and Samar, whose fauna are more similar to those of Mindanao. In addition, Masbate's fauna are also more related to Negros and Panay's fauna than they are to the more proximal Luzon.These patterns were observed in many vertebrates including birds (Peterson et al. 2000), amphibians (Evans *et al.,* 2003), mammals (Heaney and Regalado 1998; Steppan et al 2003; Roberts 2006; Esselstyn and Brown, 2009), reptiles (McGuire & Heang, 2001), and fishes (Carpenter and Springer, 2005).

The geographic location and biogeography of the Philippines renders its diverse flora and fauna, but in less than a century, the country's rapid rate of deforestation is possibly one of the greatest threats to biodiversity(Pulhin *etal*. 2006). Current estimates indicate that less than 20 percentof the Philippines' forest cover still remains (Posa *et al*. 2008), of which only six percent is the original forest (Conservation International – Philippines 2006). The country has already been regarded as the "hottest of the biodiversity hot spots in the world" for having high biodiversity that are undergoing high level of threat (Myers *et al*. 2000). Furthermore, the IUCN in 2004 identified 491 Philippine species as globally threatened. Aside from the picturesque landscape it posses, various species also thrive amongst these ecosystems hence the continuous degradation and fragmentation of the remaining forests in the country leads to occurrences of displacement and eventual endangerment of such diverse species. According to the latest listing of IUCN, 38.78 percent (223 out of the 575 plant species) and 18.38 percent (482 out of the 2,622 faunal species) are classified as critically endangered, endangered and vulnerable (IUCN, 2011). This problem on deforestation is the primary reason for our country to be a priority for biodiversity conservation (Mallari *et al*. 2001).

Historical Background of Project

GIZ REDD+ Project and PNRPS-Biodiversity MRV Development

During the American regime, the once lush and forested areas were converted to commercial logging areas with only 19 million hectares of forest remaining (Moya and Malayang, 2004). Decrease of forest cover continued over the period of 1970-1980 and was pegged at 6.46 million hectares (Chokkalingam et al., 2006 and FAO 1989). More recent forest surveys (FMB, 2007) would indicate an increase in forest cover by 7.17 million hectares and credits may be attributed to reforestation and forest management efforts of the government and private sector. However, these efforts must still be strengthened and made sustainable in such a way that biodiversity and community needs are well addressed amidst the issue of climate change.

The international community agrees that one way to address climate change is through the implementation of a REDD-Plus mechanism. This new approach does not only take into account reduction of emission but also considers the various co-benefits that the community can have while participating in the said strategy. In the country, pilot sites have already been identified and preparatory activities were conducted as support for the national REDD-Plus strategy. The GIZ funded project "Climate-relevant Modernisation of Forest Policy and Piloting of REDD"have started their efforts towards REDD-Plus implementation since 2009 in Southern Leyte covering the municipalities of Maasin, Sogod, Silago, Tomas Opus and Bontoc. Part of these preparatory activities includes the assessment of the baseline conditions in the areas in terms of biodiversity and an eventual recommendation of biodiversity monitoring scheme to be adopted at the national level. These activities are in line with the prescribed framework plan of the PNRPS, which considers the importance of social and biological diversity as co-benefits aside from the carbon credits that may be generated from the REDD-Plus mechanism.

UNDP-GEF NewCAP Project Implemented by DENR-PAWB

Protection and conservation efforts have been long implemented in various sites in the country, however, with consistent threats besetting the natural resources, more recent conservation programs are needed at hand. Specifically, one of these conservation programs is the UNDP-GEF funded project entitles Expanding and Diversifying the National System of Terrestrial Protected Areas in the Philippines Project (a.k.a New Conservation Areas in the Philippines Project, NewCAPP). NewCAPP aims to expand and strengthen the terrestrial protected area system in the Philippines by developing new conservation models and building capacity for effective management of the system, supported by improved systemic and institutional capacities. It is being implemented in 12 pilot sites across the country including Mt. Nacolod in Southern Leyte. NewCAPP seeks to establish an inter LGU alliance to establish Mt. Nacolod as a conservation area under an LGU governance regime based on its biodiversity significance, which has been validated by the Biodiversity Assessment.

One of the identified sites of this project is Mt. Nacolod in Southern Leyte, which consequently, is part of the Greater Mindanao biogeographic zone and Eastern Visayas Endemic Bird Area (EBA). In addition, there have been sightings and recordings of the critically endangered Philippine Eagle and other threatened species in this area, hence studies on their current and projected population density within the area is deemed necessary in order to efficiently implement the above-mentioned project.

Biodiversity assessment conducted in the area will further identify and validate the existing data of Mt. Nacolod. Results of the study will also be essential identifying the kind of management activities and biodiversity monitoring scheme that needs to be prioritized for a more sustainable project implementation.

Objectives and scope

Philippine biodiversity is evidently rich, unique, and prominent worldwide. Yet, the capacity to conduct biodiversity studies is low, prompting to a critical lack of quantitative information on abundances and association of impacts of environmental changes on them (Mallari *et al.*,2011).The primary goal of this project is the conservation of the forest and biodiversity in identified areas of Southern Leyte, including Mt. Nacolod Key Biodiversity Area (KBA). The overall objective is to generate practical knowledge and strategic species-habitat information that will be used in drafting management options by conducting information dissemination and monitoring. This will be achieved by the delivery of the following immediate objectives, particularly:

1. To identify and compare the habitat characteristics of the different habitat types/strata vis-à-vis management zones within the framework of natural variation in vegetation and past land uses, and to determine the influence of humanuseontheforestoverstorey and understorey characteristics of vegetation in Southern Leyte;

2. To identify the natural and anthropogenic factors that influence faunal richness and abundance of floral diversity in the different management zones in Southern Leyte, and to provide a robust species baseline for the design of a conservation area management plan and future monitoring programmes;

3. To identify patterns of fauna–habitat associations that will provide guidance for the design and implementation of managementinterventionsforparticular species' survival within Southern Leyte and across their range; and,

4. To model the responses of wildlife species and/or communities to different land cover and land uses in Southern Leytein order to provide guidance to management planners that shall balance the legislated obligations to biodiversity conservation with the principles of equitable access and benefit-sharing by all relevant stakeholders in the Philippines and elsewhere.

Study sites

Biodiversity Assessments in Southern Leyte

The province of Southern Leyte, which lies in the central part of the Philippine Islands, is part of the Greater Mindanao biogeographic region, as well as the Mindanao and Eastern Visayas Endemic Bird Area (EBA). Several threatened and restricted-range bird species occurring within this EBA, including the critically endangered Philippine Eagle, have been recorded in Southern Leyte, and are likely to occur in its remaining forests. One of two Key Biodiversity Areas (KBA) identified on Mt. Nacolod KBA in Leyte Island, is partly situated in Southern Leyte Province, which highlights the conservation importance of remaining critical habitats for biodiversity.

According to BirdLife International (2011) as shown in Table 1, there is clearly a need for survey work to determine the importance of the remaining forests within the EBA as part of the network of sites required for the conservation of the Philippine Eagle. Surveys are required to investigate whether it supports significant populations of threatened and restricted-range birds and other biodiversity. The following table shows a brief list of threatened bird species found in Southern Leyte, and present knowledge of their population estimates.

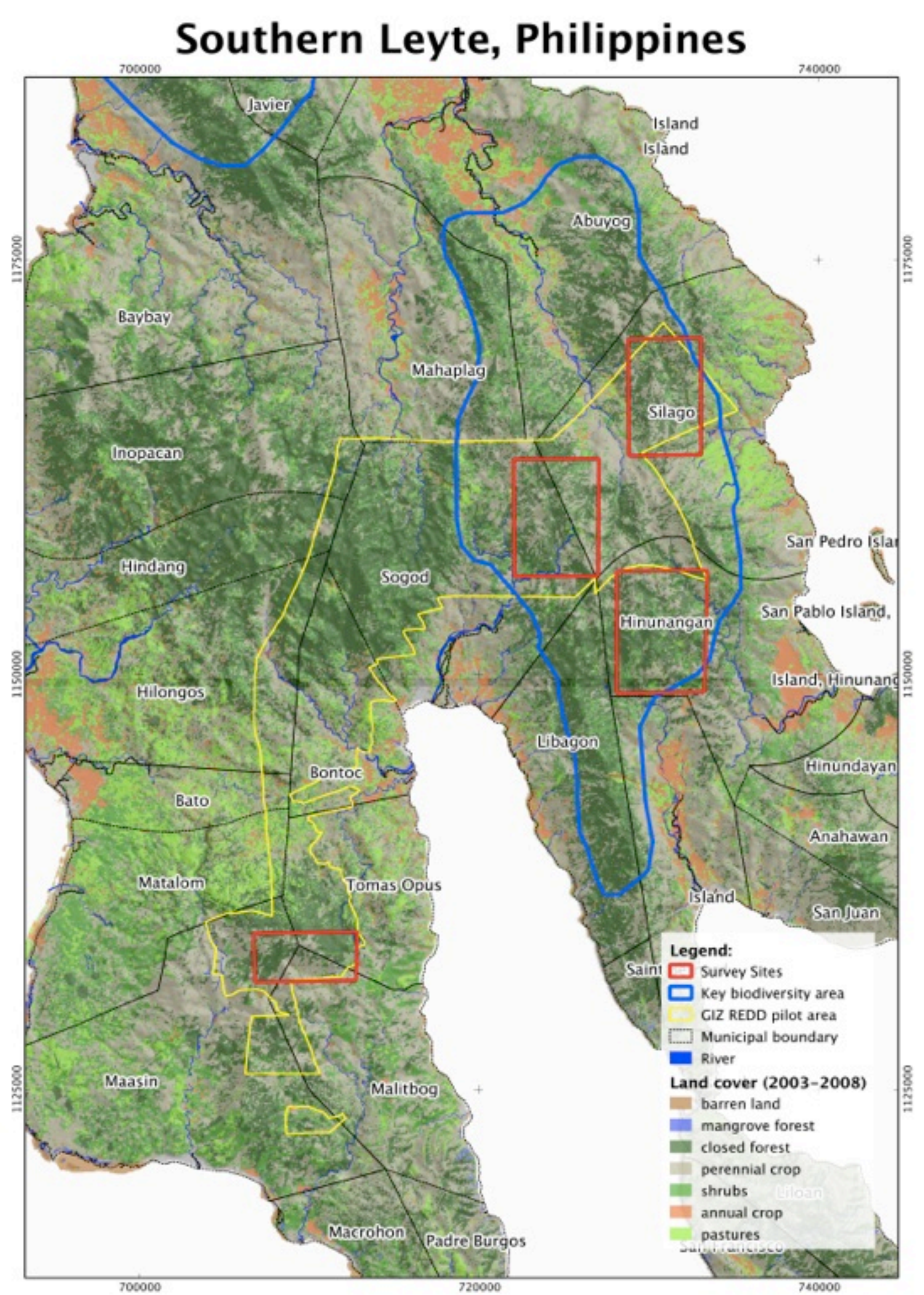
Table 1. List of trigger bird species

Species	Period	Population estimate
Philippine Eagle (*Pithecophaga jefferyi)*	2001	present [units unknown]
Mindanao Bleeding-heart (*Gallicolumba crinigera)*	2001	present [units unknown]
Philippine Eagle-owl (*Bubo philippensi)*	2001	present [units unknown]
Philippine Dwarf-kingfisher (*Ceyx melanurus)*	2001	present [units unknown]
Silvery Kingfisher (*Alcedo argentata)*	2001	present [units unknown]
Visayan Broadbill (*Eurylaimus samarensis)*	2001	present [units unknown]

Source: BirdLife International, 2001

The proposed biodiversity assessments in Southern Leyte were in support of on-going forest management and conservation initiatives, particularly: 1) the UNDP-GEF-funded New Conservation Areas of the Philippines Project (NewCAPP) implemented by DENR-PAWB and its local partners; and 2) the pilot activities on Reducing Emissions from Deforestation and Forest Degradation (REDD+), particularly the “Climate-relevant Modernization of Forest Policy and Piloting of REDD” project implemented by GIZ and its local partners. The assessment focused onthe following municipalities: for the NewCAPP project–Sogod, Silago, andHinunangan; for the GIZ REDD+ project – Sogod, Silago, Bontoc, Tomas Opus, and Maasin. (Note: Sogod and Silago are common areas of both projects).

Figure 1. Study site map showing the coverage of Nacolod area , New-CAPP and GIZ REDD-Plus, and the Biodiversity assessment area



II. METHODOLOGIES

The baseline study was conducted from November 07 to December 16, 2011 both fauna and flora species in four localities in southern Leyte where Mt. Nacolod is also situated (N 10° 27.00', 125° 5.00'E). Mt Nacolod is a Key Biodiversity Area (KBA) and declared as forest reserve with total land area of 14000 hectares. The vegetation is mainly composed of regenerating second to old growth forest and patches of cultivated area in forest edges.

Habitat surveys and mapping

Habitat surveys were conducted using transects routes, established for bird census along the four (4) sites in Southern Leyte. Along each transect route, assessment and classification of habitat every 50 meter section were done. The conventions used for these broad habitats were classified as follows: old growth forest (OG), advanced second growth (ASG), early second growth (ESG), cultivated (CVT). The classification of the habitat was based on the dominance of mature trees (OG), the different stages of succession following logging (ASG and ESG), and various degree of cultivation (CVT) (Mallari, 2010). Cultivation is defined as areas with active or recently abandoned farmland including grasslands, brushlands, agricultural plots, and small orchards with fruit trees less than (≤) four meters tall. Early second growth forests are areas of newly regenerating forest (less than (<) 20 years old) dominated by saplings and other small to medium sized trees. Advanced second growth forests are 20–40 years old, which have a less dense understorey and are dominated by medium to large trees. Old growth (i.e., primary forest or forest greater than (>) 40 years old) forests are dominated by large to very large trees and have a less complex understorey compared with early second growth and advanced second growth.

For the detailed habitat measurements, habitat variables recorded at each 250 meters section of the transect. This includes the estimated cover of bamboo; presence of rocks, estimated canopy cover (percentage cover), number of trees at mid-storey and understorey as well as presence of groundwater. Selection of the five nearest trees (between 80 and 320 girth breast height (gbh)) within 10 meter radius. The trees selected were identified and measured (tree height in meters, canopy height, diameter at breast height, height of first branch) using measuring tape for tree size and a clinometer for tree heights. Other variables recorded were evidence of scarring (indicating natural disturbances during early stages of growth), presence of termite mounds, fruiting and flowering trees. Variable Circular plot method was used with radius of 20 meter for measuring the main structure of the forest and reduced to 10 meters for other habitat parameters such as trees with below 30 centimeters dbh. At each sampling point the following physical and structural habitat variables were sampled:

1. position and altitude using a global positioning system receiver;
2. gradient using a clinometer;
3. diameter at breast height (DBH) of the five nearest trees, with each tree then assigned to a size class (80–160 centimeters GBH or > 160 centimeters GBH)
4. percentage ground cover of leaf litter and herbaceous plants (vegetation less than (<) one meter height) in four (4) one meter by one meter quadrats positioned randomly in each quarter;
5. number of rattan clumps and small trees greater than (>) two (2) meters tall and with 10–80 centimeters

The habitat sampling results were then merged with the remote-sensed data. Sample Forest Resource Assessment (FRA) cluster plots from the Region 8 field team, together with additional plots indicating habitat type from the FFI Biodiversity field team were used to analyze spectral responses from specific features to represent pixels of dipterocarp forest (old growth trees/forest), coconut, secondary forest (including 2nd growth and reforestation areas), plantations, agriculture or crops, bare soil, and built-up area (including houses and roads).

There are a total of 24 plots on the 3 transects of FFI from the biodiversity survey but unfortunately, only 11 plots were only able to be considered as the other 13 are either cloud covered or shadowed. These 11 plots were comprised of old growth forest (karst), early second growth forest, reforestation areas, mahogany plantation and abaca plantation. Samples of other land covers were from the sample FRA plots and other easily identifiable area in the image (i.e. built up features).

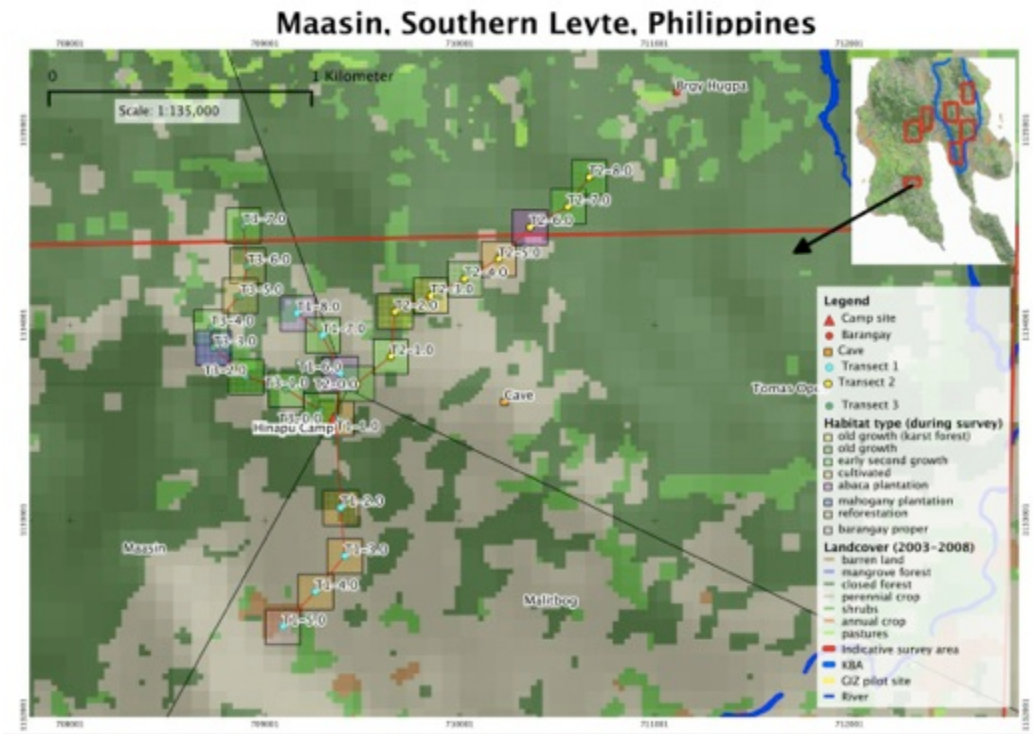


Fig. 2 Maasin Southern Leyte with FFI's transect from the biodiversity assessment

The requirement to detect heterogeneity in the forest environment at the level to map different habitat types needs a resolution finer than the 50 meter offered by the ALOS PALSAR mosaic as it can be overly generalized. Having the availability of the high resolution Worldview-2 image allowed us to explore the extraction of other cover types present that may not be readily understandable in coarser resolution image data.

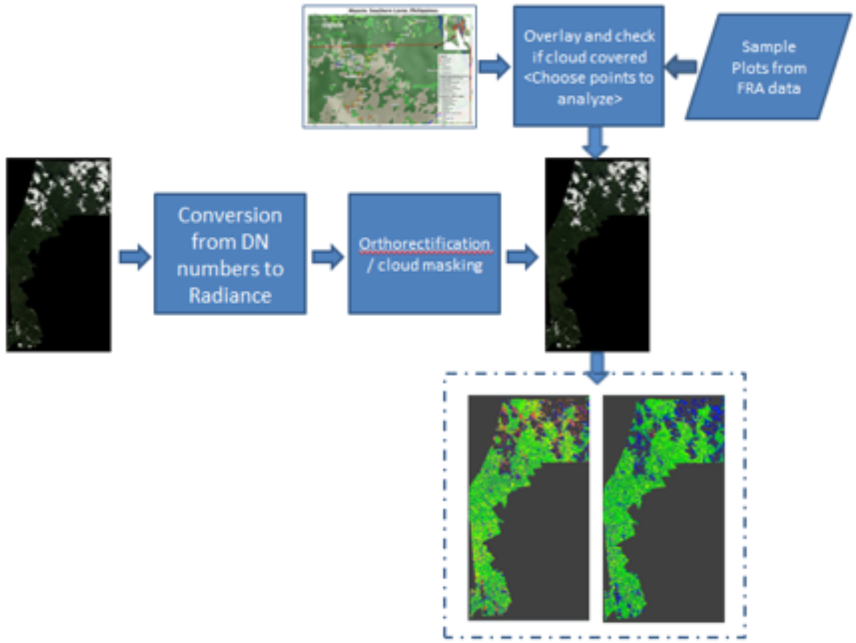


Fig. 3 Processing Flow Chart

Bird surveys

Methods used in study generally followed the variable width transect method (VWTM) (Mallari, 2009; Alldredge *et al*., 2007; Watson, 2004; Raman, 2003) and variable circular plot method (VCPM) used by recent survey in Palawan by Mallari (2009) and Marsden and Lee (2008) in Mindoro. Transect routes were surveyed for birds using a combination of transect and point count methods employing the distance sampling method. Each transect sampling effort comprised a minimum of two (2) kilometers transect walked beginning at dawn, when bird activity is highest. For the point count method, birds were surveyed at points situated every 250 meters along transects. These combinations of transect and point count was repeated the following day in reverse order to minimize bias (Mallari, 2009).

Fourteen (14) transect lines from the four study sites were established covering the following six (6) municipalities of Nacolod: Silago, Sogod, Hinunangan, Maasin, Tomas Opus and Malitbog. There is an accumulated total survey effort of 55 kilometers of transects including the reverse route while spending a total of 154 hours doing the combination of transect and point count for the four (4) study sites in Southern Leyte.

Mammals

Direct observation, ethno-survey and capture techniques such as mist-netting and live-trapping were used in determining species occurrence. Indirect evidences of species presence such as feces/scats or foot prints, bite marks, etc. were noted during the survey.

Mammals trapping followed the standardized method of (Heaney *et.al* 1999; Rickart *et. al* 1993) were the traps and mistnets are set for three (3) nights and three (3) days in each sampling site in a particular area. Traps and mistnets were also set adjacent to birds transects. Eighty percent (80%) of the snap traps were set on the ground along gradient within the study plots having 5-10 meters spacing whilst the 20 percent were placed on tree branches above five (5) meters to catch arboreal species of non-volant mammals. Baits used include roasted coconuts coated with peanut butter and live baits such as earthworms. Live traps were re-set and change its bait daily during afternoon and checked in the morning. Mist nets with a total length of 15-20 meters were set on the ground (80%) and sky nets (20%) were placed near tree canopies. These nets will be employed daily excluding rainy days, to avoid unnecessary animal deaths. The nets shall be closed in the morning to avoid birds but will be opened beginning at dusk (for insectivores) and through the night. Nets were checked and serviced (caught animals removed and kept for identification and biometrics) every hour until before midnight. Pitfalls were also set on the ground along with live traps to catch for other non-volant mammals.

Reptiles and amphibians

A combination of methods were used to sample reptiles and amphibians, transect and microhabitat samplings.

Transect sampling. This method was used to generate information on species assemblages and richness of the study areas. Two types of sampling efforts were executed, sampling in a given (1) habitat type (primary, secondary forest, montane, and riverine habitat), and (2) across a gradient of habitat types and elevations (the existing human trails serve as transect lines from the base up to the summit of the mountain). Transects were traversed intensively; thereby recording all individuals on the main path.

Microhabitat sampling. Specific microhabitats were searched intensively for any occupying species. Sampling was conducted ranging from 5 to 30 minutes. The microhabitats that were sampled include tree hole, barks, tree buttresses, forest floor, palm, and aroid leaf axils, epiphytes, tree ferns, aerial ferns, puddles, lotic and lentic bodies of water (Diesmos, 1998).

Sampling methods were conducted during daylight between 0800-1100H and 1300-1600H while night surveys conducted between 1800-2300H. Frogs, froglets, tadpoles, and lizards were collected by hand or with the use of hand nets and dip nets. Snake hooks or sticks were used to capture snakes. Only experienced handlers were allowed to handle snakes. Transect sampling was also established along birds transects, but some transects were set depending on habitat types like riverine and gradient. Established transect lines for herps has a total length of 110 meters with 10 stations. Ground dwelling and arboreal species of reptiles and aphibians were also noted during the survey.

Data Analysis

Non-parametric statistics were used to determine the species accumulation and diversity across four (4) habitat types using Estimate S v. 8.20 (Colwell, 2009). The species accumulation or known as Mao Tau (Sobs) was estimated from sample-based refraction. Bird species observed in four (4) localities were pooled per habitat type. While for mammals, species recorded in each locality were also pooled. Randomizations of samples were done 999 times without replacement in each dataset (birds, mammals and herps species diversity was represented by Shannon Wiener index (H') (Beck & Schwanghart, 2010; Chao & Shen, 2003).

To determine the microhabitat associatio s, a total of 21 species of birds were selected randomly acr ss four (4) localities. The species detection (presence/abse ce) from 14 transects and nine (9) repeated surveys were used in analysis including the five (5) covariates representing different strata, overstorey (mean tree dbh), understorey (percentage cover of palms, sapling and rattans) and ground (percentage cover of grass). Program PRESENCE v 3.1 was used to generate species occupancy (ψ) and detection probability (p) (Hines, 2006). Naïve occupancy estimate and proportion area occupied (PAO) were calculated using single-season analysis and one group model. Detection probability (p) was also calculated using single-season analysis with custom model and run it on different covariates having 28 combinations to obtain also the most parsimonious model through Akaike's Information Criterion (AIC) value. Measure of accuracy of detection probability estimates was done through bootstrapping technique.Fitnessofmodelwasassessedusing AIC weight (ω).

Fourteen (14) key tree species were selected based on their importance values. The formulas used were a modification of the point-centered quarter method (Cottam & Curtis, 1956). For each tree, the basal area (based on the individual girths), the distance from the sampling point, and the frequency of each species in the transect lines were used to derive the importance percentages. Calculations were done for each transect line, after which the top five species per transect were selected. The presence of each species on the top five lists was then tallied, and the fourteen with the highest frequency values, or importance value scores, were chosen. In order to assess the interplay of habitat and disturbance variables to the key tree species, tree community ordination was done by Canonical Correspondence Analysis (CCA). For the species data sheet, the presence of 14 trees was tabulated against the 13 transects (herein referred to as cases), while for the environmental data sheet, the 18 habitat parameters were tabulated against the cases. The results of the analysis were displayed in a biplot that shows the species represented as points and the habitat variables as vectors.

Table 2. Codes used to represent the habitat variables for analysis

CODE	VARIABLE
MeanAltitude	Mean altitude per transect
MeanGradient	Mean gradient per transect
SumTrees320	Sum of trees per transect that amount to more than 320 cm dbh
SumTrees160320	Sum of trees per transect that are between 160 to 320 cm dbh
SumTrees80160	Sum of trees per transect that are between 80 to 160 cm dbh
SumTrees4080	Sum of trees per transect that are between 40 to 80 cm dbh
SumTrees2040	Sum of trees per transect that are between 20 to 40 cm dbh
SumTrees1020	Sum of trees per transect that are between 10 to 20 cm dbh
SumTrees10	Sum of trees less than 10 cm dbh
SumPalms	Sum of counted palm trees per transect
SumRattan	Sum of counted rattan palms per transect
MeanHerbCov	Mean percent coverage of herbs per site
MeanBambCov	Mean percent coverage of bamboo per site
MeanRockCov	Mean percent coverage of rock per site
MeanCanopyCov	Mean canopy coverage per site
MeanMidstoreyCov	Mean midstorey coverage per site
MeanGroundCov	Mean percent coverage of litter per site
SumFallenTrees	Sum of counted fallen tree trunks with more than 160cm dbh

III. RESULTS AND ANALYSIS

Flora Diversity Structure and Composition

A total of 14 transect routes, measuring two (2) kilometers each, were establshed in four (4) study sites covering six (6) municipalities (Silago, Hinunangan, Sogod, Maasin, Tomas Opus and Malitbog) in Southern Leyte. Each transect were located across different types of habitat with 41 points marked with 50 meters distance interval to get the broad habitat types. A detailed habitat assessment in nine (9) points with 250 meters intervals. In total, there are 126 plots of detailed habitat and 564 broad habitat assessed covering an area of 27.5 kilometers. The proportion of sampling plots using broad habitat classification (Table 5) in the study site shows that ASG has the highest percentage in terms of cover with 41.49 percent (232 out of 564) followed by OG with 23.76 percent (136 out of 564), CVT with 17.55 percent (99 out of 564) and ESG with the lowest percentage cover of 17.20 percent (97 out of 564).

The result suggests that the forest habitat on the study areas are in an active state of recovery and regeneration with some remnants of pristine habitats. It is believed that this state of recovery may be linked with the ca.3 decades of communist insurgency in Southern Leyte which may have resulted to the evacuation and out-migration of people from the communities in the forest areas and abandonment of their farmlands allowing the forest to regenerate and the abandoned farmlands to follow and recolonised.

Floristic Composition of the Four Sites

Floristic richness was well reflected and evident from the number of species found from the study area. A total of 65 families and 229 species of flora were identified, in which 31 (13.53 percent) were known endemic to the Philippines. Moreover, there was also the presence of threatened species with the following statistics: 20 out of the 229 (8.73 percent) species were classified as vulnerable species (based from IUCN listing) and 10 out the 229 (4.37 percent) species were classified as critically endangered (Refer to Table 2).

Table 3. Threatened species discovered in the study areas

Family Name	Scientific Name	Common Name	Kinds	Extent (Occurrence)	IUCN
Alangiaceae	*Alangium longiflorum* Merr.	Apitan	Tree		VU
Anacardiaceae	*Mangifera altissima* Blco.	Pahutan	Tree		VU
Anacardiaceae	*Mangifera monandra* Merr.		Tree		VU
Apocynaceae	*Kibatalia merrilliana*		Tree	Endemic	VU
Apocynaceae	*Kibatalia puberula*		Tree	Endemic	EN
Arauacariaceae	*Agathis philippinensis*	Almaciga	Tree	Endemic	VU
Cannabaceae	*Celtic philippinensis*	Magabuyo	Tree	Endemic	VU
Combretaceae	*Terminalia nitens* Presl.	Sakèt	Tree		VU
Dilleniaceae	*Dillenia megalantha* Merr.	Katmon	Tree		VU
Dilleniaceae	*Dillenia philippinensis* Rolfe	Katmon	Tree	Endemic	VU
Dipterocarpaceae	*Dipterocarpus validus* (Blume)	Hagakhak	Tree		CR
Dipterocarpaceae	*Hopea acuminata* Merrill	Manggachapui	Tree	Endemic	CR
Dipterocarpaceae	*Hopea quisumbingiana* Gutierrez	Quisumbing/Gisok (Subyang)	Tree	Endemic	CR
Dipterocarpaceae	*Parashorea malaanonan* (Blanco)	Bagtikan	Tree		CR
Dipterocarpaceae	*Shorea almon*	Almon	Tree		CR
Dipterocarpaceae	*Shorea astylosa* Foxworthy	Yakal	Tree	Endemic	CR
Dipterocarpaceae	*Shorea negrosensis*	Red-lauan	Tree	Endemic	CR
Dipterocarpaceae	*Shorea palosapis syn squamata*	Mayapis	Tree	Endemic	CR
Dipterocarpaceae	*Shorea/Pentacme contorta*	White-lauan	Tree	Endemic	CR
Dipterocarpaceae	*Shorea polysperma*	Tangile	Tree	Endemic	CR
Euphorbiaceae	*Macaranga bicolor*	Hamindang	Small tree	Endemic	VU
Euphorbiaceae	*Macaranga grandifolia*(Blcol.) Merr.	Takip-asim	Tree	Endemic	VU
Fabaceae	*Afzelia rhomboidea* (Blanco) Vidal	Tindalo/Balayong	Tree		VU
Fabaceae	*Pterocarpus indicus* Willd.	Narra	Tree	Endemic	VU
Lauraceae	*Cinnamomum mercadoi* Vid.	Kalingag	Small tree		VU
Myristicaceae	*Myristica philippensis* Lamarck	Duguan	Tree	Endemic	VU
Myrtaceae	*Syzygium aqueum*	Makupa/Water apple	Tree		VU
Myrtaceae	*Tristania decorticata*	Malabayabas	Tree		VU
Sapotaceae	*Palaquium philippense* (Perr.) C. B. Rob.	Nato	Tree	Endemic	VU
Lamiaceae	*Vitex parviflora* Jussieu	Molave	Tree		VU

Comparison of Forest Cover among the Four (4) Sites

The corresponding canopy cover of trees would likely indicate the kind of trees dominant in that area. Larger trees in a tropical environment would have also corresponding large canopy cover, on the other hand co-dominant, midstory and understory species would have smaller canopy cover as indicative of early stages of tree growth.

The relative forest cover of the four (4) study sites namely: Sogod, Silago, Hinunangan and Maasin City (covering municipalities of Tomas Opus and Malitbog) were analyzed by taking the average forest cover of the established plots per transect and per study site. Based from this analysis, results would indicate that from among the four study (4) sites, the forests of Sogod had the highest forest cover followed by Silago, Hinunangan and lastly by Maasin City (based from the canopy, midstorey and understory values). This trend coincides with the fact that Maasin City study site, which also covers the municipalities of Tomas Opus and Malitbog, is an urban area hence there is a higher possibility of disturbance and lower vegetation cover.

Previous data from the dominant forest cover coincides with the results from the comparison of habitat types. Assessment of the habitat types were done by counting the frequency of plots where the various habitat types occurred for all the transects established in each site. The general trend is that the four (4) sites were classified as secondary forest (early and advanced growth). This generalization was reflected from the values generated from the midstorey forest cover percentage that is indicative of a secondary forest and the frequency of plots classified under the ASG and ESG classifications.

Frequency of Species from the various dbh class from the Four (4) Sites

Consistent with the results from the previous analysis (indicating active regeneration), the number of species from each dbh also follows the general trend that most of the species belong to the lower range of dbh class (e.g. >20 <40, >10 <20 and <10 centimeters). The values below were generated from accounting the number of trees that belong to each dbh class. The average for each transect and ultimately from each site were also computed.

Results show that there were very few number of trees having greater than (>) 320 gbh and greater than (>) 160 less than (<) 320 gbh (from all the sites), meaning most of the areas within the study sites are considered as secondary forests since larger gbh class is a characteristic of old growth forests. From among the four (4) sites, Silago had the highest number of trees classified under the smaller range of dbh, namely; greater than (>) 40 less than (<) 20 (214 individuals), greater than (>) 10 less than (<) 20 (629 individuals) and less than (<) 10 with 1711 individuals of trees. Silago is then followed by Maasin, Hinunangan and lastly Sogod (See Table 6).

Table 4. Mean of forest strata cover of four study sites

Sites	Forest Strata Cover (%)		
	Canopy	Midstorey	Understorey
Silago	42	54.8	47
Hinunangan	33.33	48.67	39.67
Sogod	53.33	55.5	52.67
Maasin	27.67	44.33	38.33

Table 5. Comparison of Broad Habitat Type in every 50 meter distance along the established transect line

AREA	Habitat			
	CVT	ESG	ASG	OG
Hinunangan	22	38	61	2
Maasin	58	47	2	11
Silago	11	1	143	50
Sogod	8	11	26	73
Total	99	97	232	136

Note: Silago has five (5) sampling transect while the other three (3) sites have three (3) sampling transects

Table 6. Frequency of tree GBH ranges of four (4) sites

Sites	Diameter Class (cm)						
	>320	>160 <320	>80 <160	>40 <80	>20 <40	>10 <20	<10
Silago	3	16	137	184	214	629	1711
Hinunangan	0	2	56	79	82	166	495
Sogod	3	13	40	53	61	107	314
Maasin	0	8	67	107	147	180	619

Note: Silago has five (5) sampling transect while the other three (3) sites have three (3) sampling transects

Habitat Mapping

Data from the FFI biodiversity team was buffered to a 25 meter radius and overlayed on the orthorectified 2-meter multispectral image. On the zoom window is approximately a 50-meter by 50-meter plot aims to simulate the square plot that the team used in the field to perform the biodiversity assessment. All results in this discussion will account for a descriptive analysis of the visual interpretation of the two classified images just to make a general assessment and recommendation for further statistical analysis. Here is a sample template that we will use as reference for the discussion.

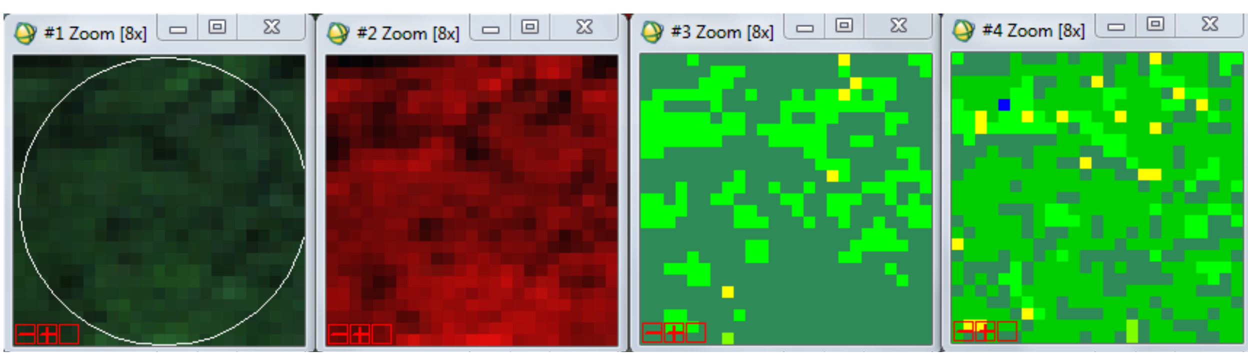


Fig. 4 Sample Template. (L-R): (display #1) Band5-3-2 (true color composite); (display #2) Band7-5-2 (false color composite – for vegetation detection); (display #3) Classificationresult(#classes); (display #4) Classification result (# classes)

(Display#3) Class Colors **(Display #4) Class Colors**

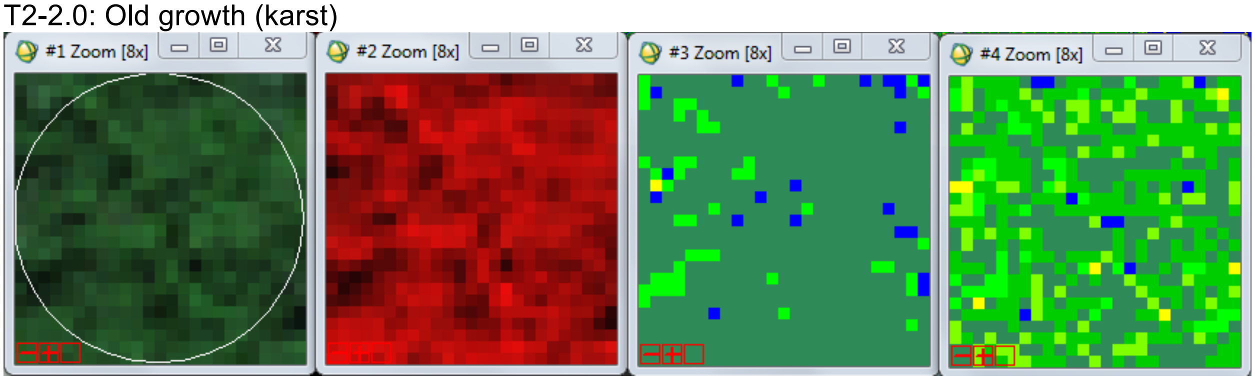
- Built-up (Roads and Houses)
- Coconut
- Forest
- Bare soil
- Crops
- Other vegetation

- Built-up (Roads and Houses)
- Coconut
- Forest (Old growth)
- Second growth (early second growthand reforestation)
- Bare soil
- Crops
- Plantation (Mahogany and Abaca)

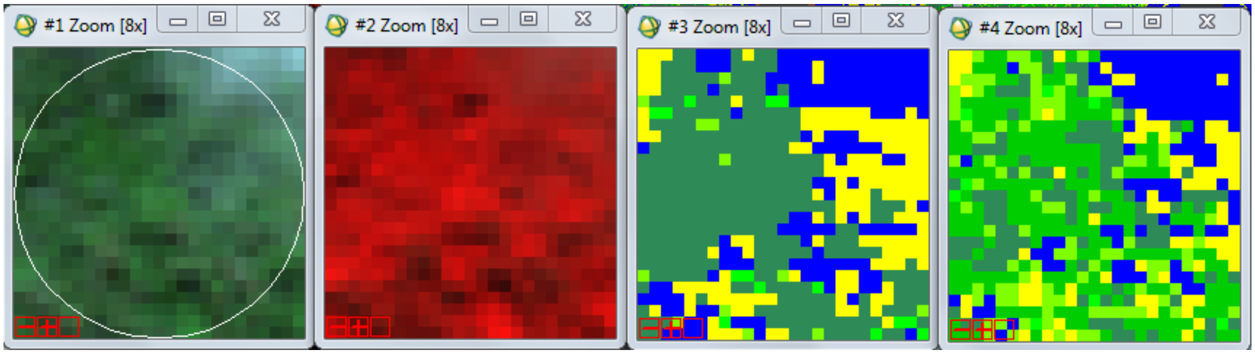
Dipterocarp and Old growth

Most of the clusters flagged as forest/dipterocarp/old growth are partially cloud covered, which can be demonstrated from the resulting classification images we see in this section, indicated by the blue colored pixels. On the initial classification shown in display #3, we can see that forest pixels are easily seen since they tend to clump up together, indicating homogeneity. However, when we added additional classes in the training areas such as the secondary forest and the plantation, the area has displayed a more textured environment compared to the initial assessment; though the result still retained forest pixels, especially for T2-2.0 indicative of a “forest class” cover.

T2-2.0: Old growth (karst)



Since this was tagged as an old growth forest over a karst environment, we would expect
T2-3.0: Old growth (karst)

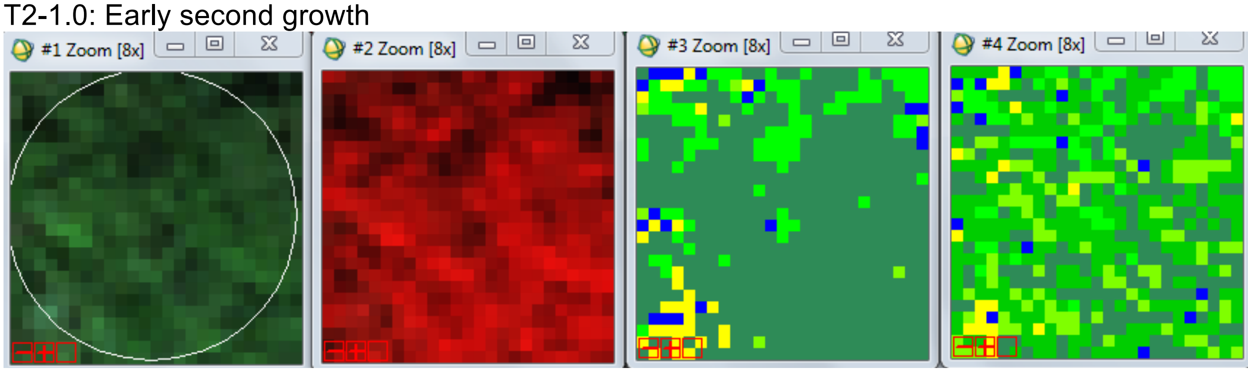


Unfortunate for this area, it is partially cloud covered. The forest pixels from the initial classified result have been greatly reduced. On this account, we can't be sure yet if this was because of the actual cover may not have been old growth or the data was diluted becauseof the haze from thenear presenceofthe cloud suchthatmost ofthe pixels were converted to secondary forest class indisplay #4.

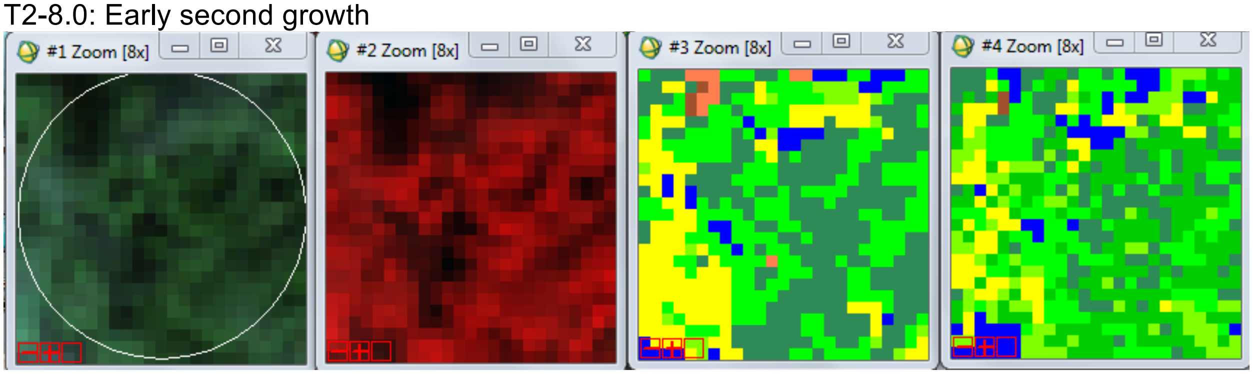
Secondary Forest: (Early second growth and Reforestation)

We see here that initially, these areas were classified under the forest class as seen in display #3. Later on, during one of the discussions on habitat assessment, the need to further subdivide the forest class into subclasses was brought up and seemed promising for further analysis in future studies, that can go hand in hand in developing a forest land cover map for monitoring.

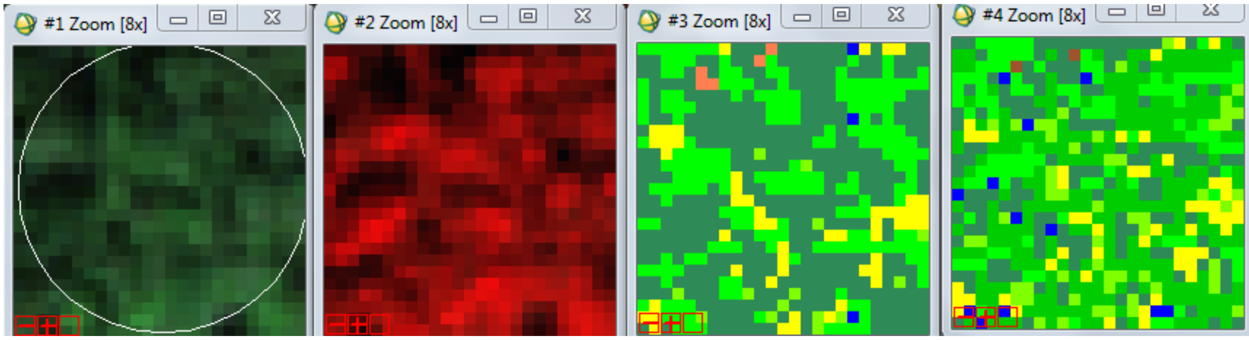
T2-1.0: Early second growth



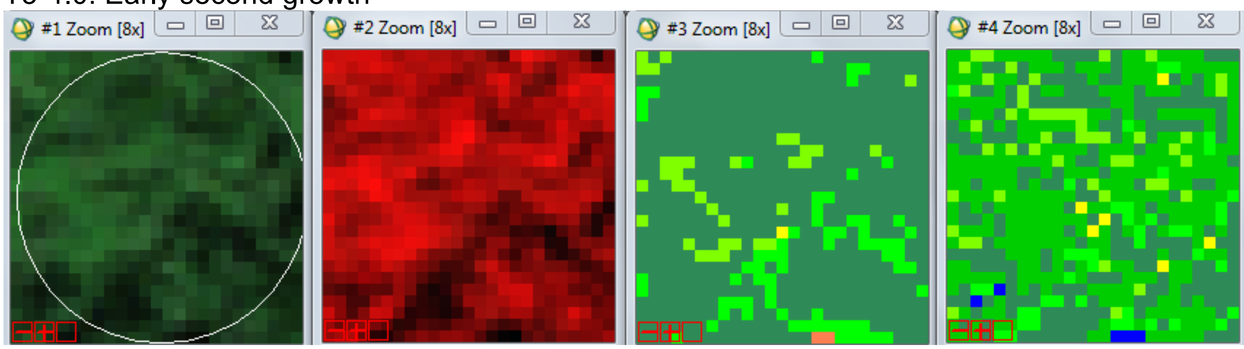
T2-8.0: Early second growth



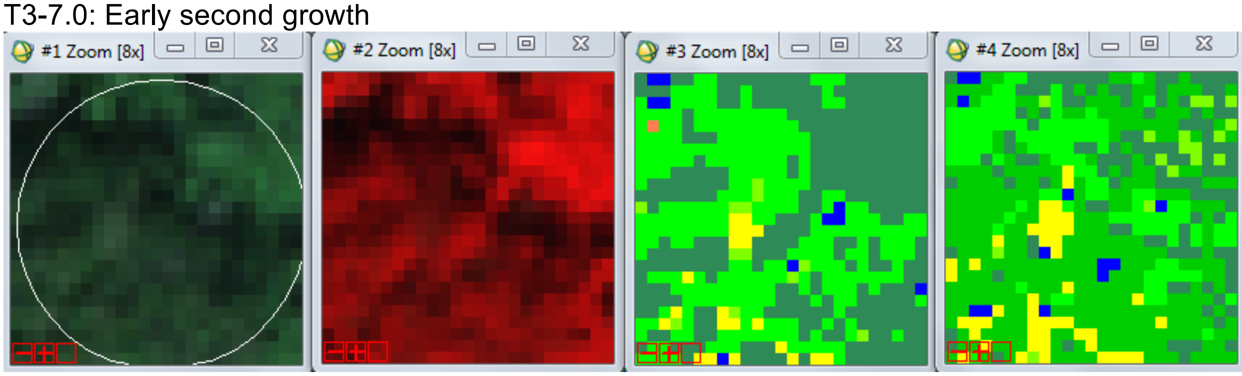
T3-1.0: Early second growth



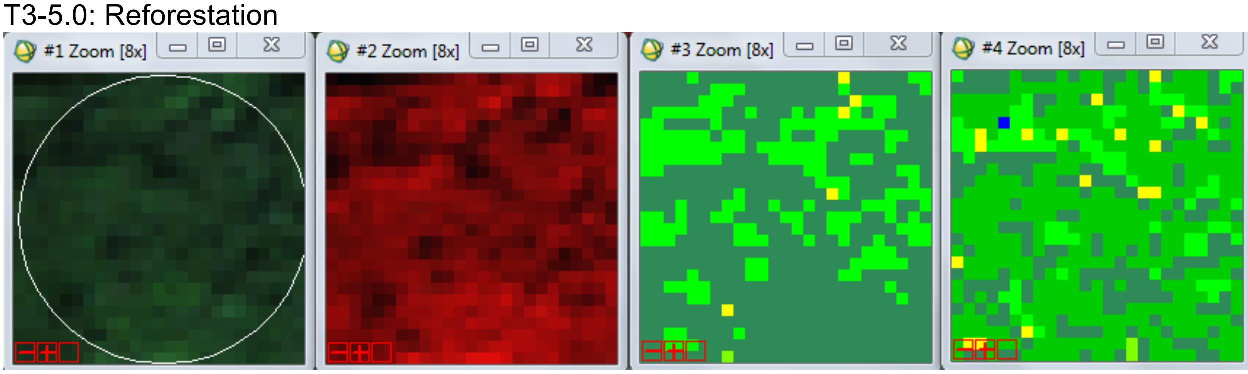
T3-4.0: Early second growth



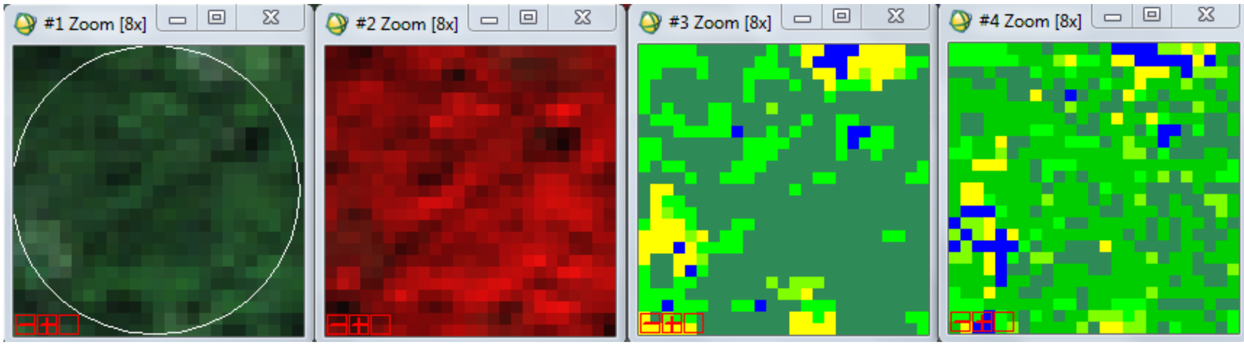
T3-7.0: Early second growth



T3-5.0: Reforestation

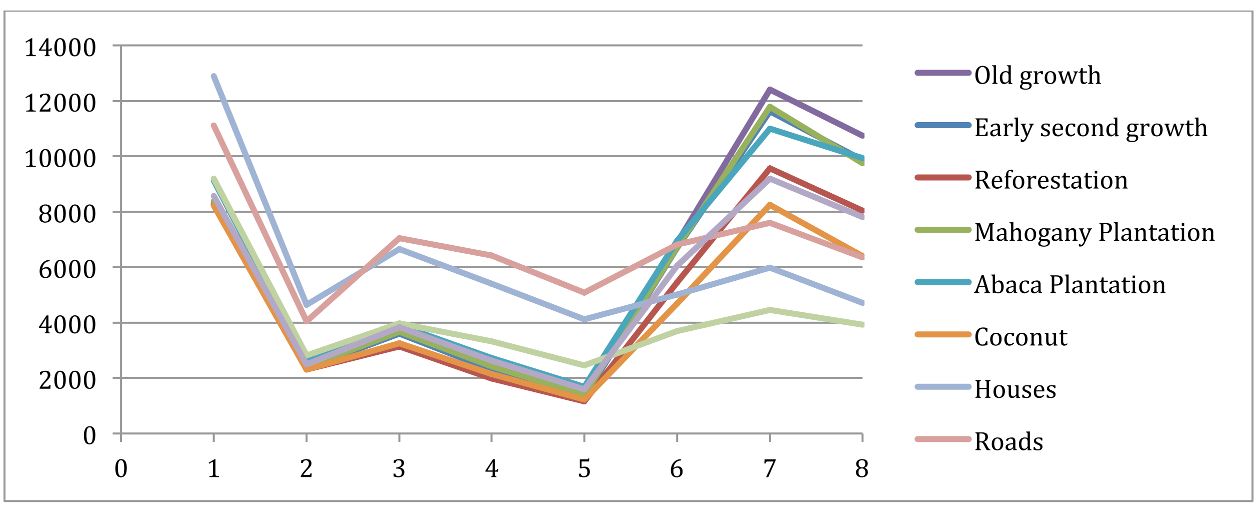


T3-6.0: Reforesetation



From the comparisons of displays #3 and #4, we can observe that the forest class has been broken down to 3 subclasses namely, secondary forest class, plantation class, and coconut class. However, the reforestation area is rather not readily separable from the secondary forest class. This may come from the understanding that reforested areas likely transition to a secondary forest in about 3-5 years with trees having comparable species present that's why when spectral signatures are extracted, we can see that it becomes very similar, therefore hard to separate. It was also unfortunate that there's no plot representative of advanced second growth forest in which we could have also compared with respect to the other forest subclasses.

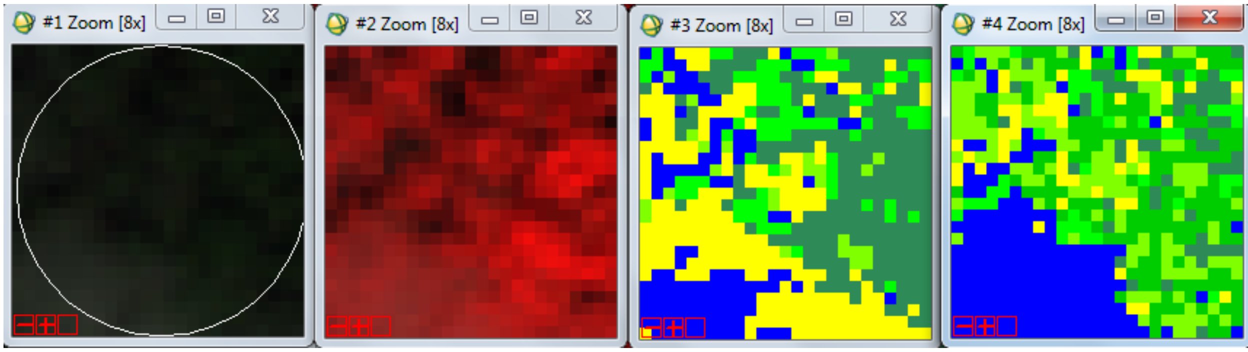
Fig. 5 Spectral responses from the early second growth, reforestation, mahogany plantation (Radiance VS Bands)



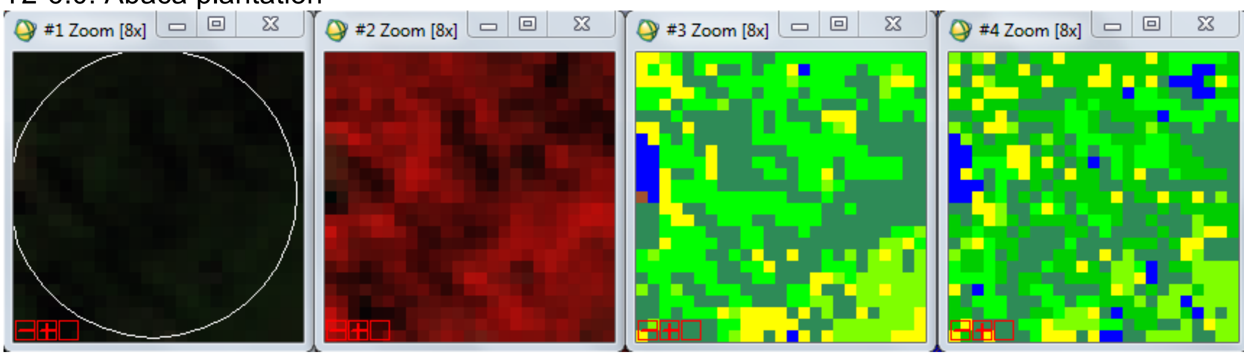
Plantations: (Mahogany/Abaca)

Initially, both Mahogany and Abaca were separate classifications, but in the class color assignment, I've color coded them the same to make the identification of plantation areasbecomemoregeneralized. In the classificationresults, we can see that the areas are a mixture of plantation, secondary forest, coconuts, and crops.

T3-3.0: Mahogany plantation



T2-6.0: Abaca plantation



Key Tree Species

In identifying Key Tree Species (Table 7), the importance values of each tree in a transect was computed to determine the top five (5) most important trees. With the identified top five tree species per transect, the top 14 tree species from all of the transects were identified.

Table 7. Key tree species in a Southern Leyte Dipterocarp forest based on importance values.

Species name	Common or local name	Family	Importance value score (out of 13 transects)	Code used for ordination
Shorea negrosensis	red lauan	Dipterocarpaceae	10	SNGR
Calophyllum blancoi	bitangol; bitaog	Calophyllaceae	7	CBNC
Shorea contorta	white lauan	Dipterocarpaceae	5	SCTR
Syzygium calubcob	kalubkob	Myrtaceae	4	SYCB
Artocarpus ovatus	anubing; hindang	Moraceae	4	AOVT
Ficus balete	balete	Moraceae	3	FBLT

Shorea seminis		Dipterocarpaceae	3	SSMN
Hopea quisumbingiana		Dipterocarpaceae	2	HQSB
Syzygium hutchinsonii	malatambis	Myrtaceae	2	SYHT
Swietenia microphylla	mahogany	Meliaceae	2	SWMR
Lithocarpus ovalis	ulayan; uwayan	Fagaceae	1	LTOV
Myristica philippensis	duguan	Myristicaceae	1	MYPH
Oroxylum indicum		Bignoniaceae	1	OXID
Erythrina subumbrans	rarang; December tree	Fabaceae	1	ERSB

Note:

Importance Value: is an overall estimate of the influence of importance of a plant or a tree species in a community.

Species Code for Ordination: The general format used for processing the data gathered under ordination analysis was taken from the first letter of the genus a nd first three letters of the specific epithet of the tree species (e.g. *Shorea negrosensis*, the code was SNEG).

The Dipterocarpaceae members *Shorea negrosensis, S. contorta, S. seminis,* and *Hopea quisumbingiana* are familiar lowland dipterocarp species, with known occurrences in Samar and Leyte (Margraf and Milan 1996; Pelser, Barcelona and Nickrent 2011). From the study sites, *Shorea negrosensis* and *Shorea contorta* were commonly found in advanced secondary growth forest and old growth forests. *Syzygium calubcob* and *S. hutchinsonii* of the Myrtaceae family are also lowland forest inhabitants (Pelser, Barcelona, & Nickrent, 2011) together with *Calophyllum blancoi* of Calophyllaceae, *Myristica philippensis* of Myristicaceae, and *Lithocarpus ovalis* of Fagaceae (Schade, et al., 1987). *Artocarpus ovatus* and *Ficus balete* of the Moraceae family were also found to be common in the lowland in lowland dipterocarp forests (LaFrankie, 2010). The presence of these tree species were also evident in the early and advanced secondary growth forest.

Erythrina subumbrans of the Fabaceae family belongs to a genus of fast-growing species that are usually found on secondary forests (LaFrankie, 2010). *Oroxylum indicum* of Bignoniaceae is known to be a short-lived, nomadic tree that is not found in mature forests, but always in gaps and in secondary thickets. Nonetheless it is still a lowland forest inhabitant found in the Philippine islands (Pelser, Barcelona, & Nickrent, 2011). *Swietenia macrophylla* is not a native of the Philippines, but introduced during the Commonwealth era. It is still being planted in the country as a reforestation species because of its fast growth (LaFrankie, 2010).

Among the species found in the survey are four Dipterocarpaceae members that are Critically Endangered based on the IUCN Red List (2012). These species *are Hopea quisumbingiana, Shorea negrosensis, Shorea seminis*, and *Shorea contorta*. MoreoverTwo of the species as Vulnerable: *Myristica philippensis* of Myristicaceae and *Swietenia macrophylla* of Meliaceae.

Vegetative history

The plant families of the observed important species in the areas surveyed are comprised of Dipterocarpaceae, Moraceae, Myrtaceae, Fagaceae, Bignoniaceae, Meliaceae, Myristicaceae, Calophyllaceae, and Fabaceae, with Dipterocarpaceae having the most members at 4 out of 14. Both Moraceae and Myrtaceae have 2 species each, while the rest have 1 entry. Based on a previous vegetative analysis done by Schade *et al.* (1987), as presented on Margraf and Milan (1996), Dipterocarpaceae is the most frequent plant family on the islands of Samar and Leyte, followed by Myrtaceae and Fagaceae. This is in coherence with the data we obtained, implying the continuing ecological relevance of these families in the area.

The Schade et al. (1987) study also enumerated the most frequent tree species in the old growth forests of Samar and Leyte. *Shorea negrosensis* ranked second on their list; while on our survey it ranked first. It strongly suggests the sustained ecological importance of this species for the region. Other species similar to both lists *Calophyllum blancoi*, which ranked 14th, *Lithocarpus ovalis*, which ranked 10th, and *Myristica philippensis*, which placed 12th on the Schade et al. list. On our survey, these species placed 2nd, 11th and 12th, respectively.

Fauna

A total of 212 species of terrestrial vertebrates were recorded during the survey Birds constitute half of the fauna in Southern Leyte with 112 species, the rest are herpetofauna with 64 species and mammals with a total of 36 species of which 17 are endemic to Philippines.

Birds

A total of 112 species of birds belonging to 42 families were recorded based from transect walk, mistnetting and general observation on the four (4) study site in Southern Leyte. Fifty-five (55) of these 112 species are endemics , of which forty-one (41) are endemic to the Philippines and fourteen (14) are endemic to Visayas and Greater Mindanao faunal region. Among the forty-one endemic (41) species, eleven (11) are in the IUCN threatened category list, like the Pink-bellied Imperial Pigeon (*Ducula poliocephala*), Philippine Needletail (*Mearnsia picina*), Rufous Hornbill (*Buceros hydrocorax),* Pygmy Babbler (*Stachyris plateni*), and Yellow-breasted Tailorbird (*Orthotomus samarensis*) (found only in Bohol, Samar & Leyte), are listed as Near-threatend (NT); the Silvery Kingfisher (*Alcedo argentata*), Philippine Dwarf-Kingfisher (*Ceyx melanurus*), Rufous-lored Kingfisher (*Todirhamphus winchelli*), Visayan Wattled Broadbill (*Eurylaimus samarensis*), Steere's Pitta (*Pitta steerii*) listed as Vulnerable (VU); and Tarictic Hornbill (*Penelopides panini*) listed as Endangered (EN). Two (2) species Brown Tit-Babbler (*Macronous striaticep*), Miniature Tit-Babbler (*Micromacronus leytensis*) are both endemic to greater Mindanao faunal region and in Data Deficient (DD) list.

Twenty-four (24) bird species (see Table 8) were selected from the 102 species (see Annex 2) recorded in the transect survey. These 24 focal species were selected because they include: (1) lowland forest specialists which also represents other species that are dependent on this type of forest; (2) understorey species believed to be sensitive to changes in habitat quality; (3) restricted-range species or endemics which are deemed by virtue of their small ranges to be more prone to extinction; (4) globally threatened and near-threatened species. Detection of birds from the two (2) visits to the transect point were pooled to calculate encounter rates (expressed as individuals per point transect+standard error).

Table 8. Residency, endemism, mirgratory, conservation status (IUCN: EN= endangered, VU= vulnerable, NT= near threatened, LC= least concern) and habitat preferences of 24 species across the sites

Species	Ranges	Conservation status	Principal habitat (Kennedy et.al. 2000)
Alcedo argentata	E	**VU**	Lowland forest,along creek or river
Bolbopsittacus lunulatus	E	LC	Lowland forest, forest and forest edge
Buceros hydrocorax	E	**NT**	Lowland forest, forest
Centropus melanops	E	LC	Lowland forest, forest, midstorey
Centropus viridis	E	LC	Wide ranges, understorey
Dicrurus hottentottus	R	LC	Below 1,500 masl
Ducula poliocephala	E	**NT**	Below 1,500 masl
Gallus gallus	R	LC	Lowland forest up to 2000masl, ground
Harpactes ardens	E	LC	Lowland, forest and second growth, midstorey
Irena cyanogaster	E	LC	Below 1500 masl, canopy, midstorey
Ixos everetti	E	LC	Below 1000 masl, forest edge
Ixos philippinus	E	LC	below 2000 masl, all types of forest
Loriculus philippensis	E	LC	Lowland up to montane, all forest types
Macronous striaticeps	E	LC	Below 1500 masl, understorey
Pachycephala philippinensis	E	LC	All forest level, understorey and midstorey
Parus elegans	E	LC	All forest level, canopy
Penelopides panini	E	**EN**	Forest and forest edge, up to 1500 masl
Pernis ptilorhynchus	M		Near forest below 1500 masl
Phapitreron amethystina	E	LC	Forest and forest edge, up to 2000 masl
Phapitreron leucotis	E	LC	Early second growth to montane up to 1600
Prioniturus discurus	E	**VU**	Forest and forest edge near cultivation up to 1500
Ptilinopus occipitalis	E	LC	forest and forest edge, middle and upper canopy
Ptilocichla mindanensis	E	LC	lowland and mid montane up to 1400, near on on ground
Todiramphus winchelli	E	**VU**	Forest and forest edge, perch on canopy also come to ground

Birds species accumulation and diversity

A total of 101 species of birds were recorded on the transect surveys. Based on the survey, there were species observed across different habitat types and localities. However, through the Mao Tau Species Accumulation Curve Analysis a maximum of five (5) species may have been overlooked during the survey as indicated by the maximum standard error which is 5 (see table 9.; standard deviations of observed species richness). The species that were overlooked maybe attributed to the inclemental weather experienced during the survey. From a sampling effort of 143 points across all habitat types, the advance second growth in Silago had the highest number of species observed (56) followed by the early second growth in Maasin (51). Whilst, the least number of species recorded were in early second growth (2) and old growth (8) forests in Silago and Hinunangan, respectively (See Table 9). The possible reason for this observation pattern in Southern Leyte may possibly be due to disproportionality of available old growth forests with early and second growth forests.

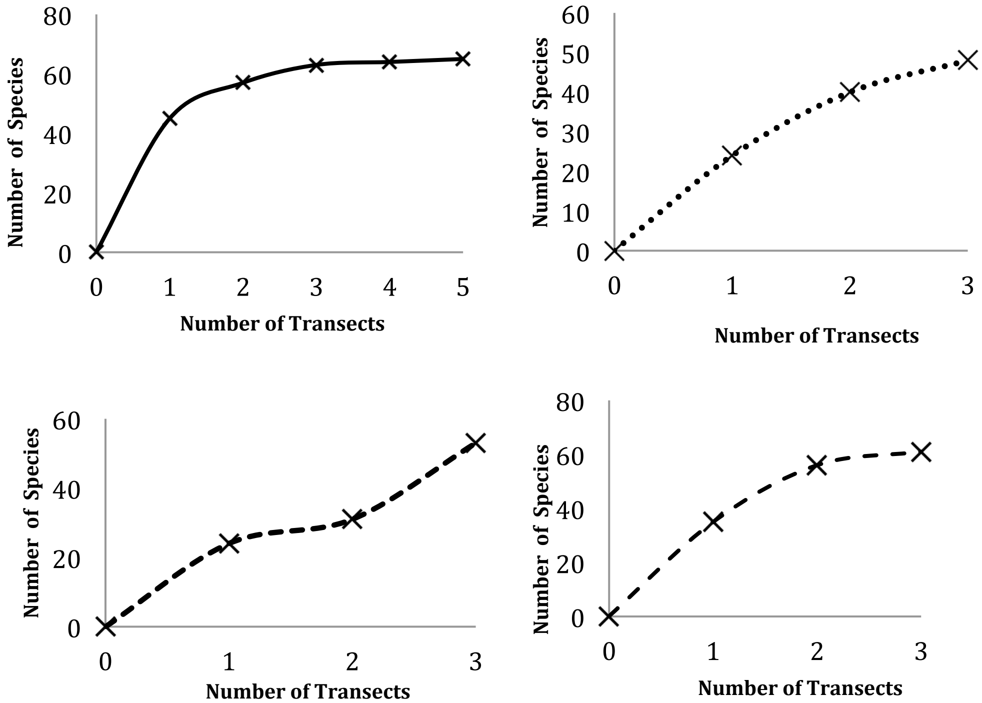
Species diversity (H') across all habitat types follows the pattern of species observation in all localities. In general, highest diversity values were in early and advance second growth except for Silago. This may be an artifact of sampling (only 1 point falling in ESG). Cultivated areas in Hinunangan and Maasin also showed high values of diversity index as well as in old growth forests in Silago and Sogod. Lowest diversity was obtained on the early second and old growth forests in Silago and Hinunangan. Overall, advance second growth in Silago has the highest diversity value (H'=3.58) which may be attributed to the sampling effort on ASG in Silago.

The effort of the sampling was measuredthrough species accumulation curve per transect effort in the every study sites (see Figure 6). Silago area has 5 transects where the curve is about to approach the asymptote. In Hininungan area, the curve was not reach the desired curve and similar to Maasin area. Whilst Sogod area has increasing proportion when transect 3 was incorporated, which the transect was position toward high elevation thus the sample has increasing species accumulation as shown in Figure 6.

Table 9. Bird's community measures of species accumulation (Mao Tau) and diversity (H') in four habitat types (CVT=Cultivated; ESG= Early second growth; ASG= Advance second growth; OGF=Old growth forest) across four localities in southern Leyte. Shown also is the corresponding total number of points of sampling effort in each habitat type.

	Habitat	Survey efforts (number of points)	Species observed (Mao Tau)± SD	Species Diversity (H')
Silago	CVT	11	17 ± 4	2.59
Silago	ESG	1	2 ± 0	0.69
Silago	ASG	143	56 ± 5	3.58
Silago	OG	50	36 ± 5	3.15
Hinunangan	CVT	22	27 ± 4	3.06
Hinunangan	ESG	38	36 ± 4	3.31
Hinunangan	ASG	61	36 ± 5	3.22
Hinunangan	OG	2	8 ± 3	1.98
Sogod	CVT	8	11 ± 3	2.37
Sogod	ESG	11	14 ± 4	2.58
Sogod	ASG	26	24 ± 5	2.83
Sogod	OG	73	41 ± 5	3.38
Maasin	CVT	58	41 ± 5	3.31
Maasin	ESG	47	51 ± 5	3.27
Maasin	ASG	2	11 ± 3	2.35
Maasin	OGF	11	23 ± 4	2.9

Figure 6. Species Accumulation Curve per site sampling. Solid line=Silago site, Round dot= Hinunangan site, Square dot=Sogod site and Dash=Maasin site.



Mammals

A total of 36 species of mammals belonging to 15 families were recorded on the four (4) sampled localities (Silago, Hinunangan and Sogod and Maasin) of which 13 species are non-volant mammals (*Crocidura beatus, Tarsiussyrichta, Macacafascicularis, Exilisciurus concinnus, Sundasciurus samarensis, Apomys sp., Batomys salomonseni, Bullimus bagobus, Rattuseveretti, Rattustanezumi, Paradoxurus hermaphrodites, Vivera tangalunga, Susbarbatus mindanensis*) and 22 are volant (*Myotis muricola, Cynocephalus volans, Acerodon jubatus, Cynopterus brachyotis, Eonycteris spelaea, Haplonycteris fischeri, Harpyionycteris whiteheadi, Macroglossus minimus, Megaerops wetmorei, Ptenochirus jagori, Ptenochirus minor, Pteropus hypomelanus, Pteropus vampyrus, Rousettus amplexicaudatus, Emballonura alecto, Megaderma spasma, Hipposideros ater, Hipposideros bicolor, Rhinolophus arcuatus, Rhinolophus inops, Rhinolophus philippinensis, Rhinolophus subrufus*). Of the total species of mammals recorded, 17 species (47%) are Philippine endemics of which eight (8) are restricted only to the Mindanao faunal region *i.e*. the Philippine pygmy squirrel (*Exilisciurus concinnus)*; Mindanao batomys (*Batomys salomonseni)*; Mindanao ballimus (*Bullimus bagobus)*; and the Samar squirrel (*Sundasciurus samarensis)* which is restricted only in Samar and Leyte Islands and the unidentified *Apomys sp.* Theothervolant mammals recorded were the Philippine flying lemur (*Cynocephalus volans)* and Lesser musky fruit bat (*Ptenochirus minor*).

Table 9. Identified species of mammala from the four study sites

Family Name	Scientific Name	Common Name	Extent	IUCN Status
	Crocidura beatus	Mindanao Shrew		LC
Tarsiidae	*Tarsius syrichta*	Philippine Tarsier	Endemic	NT
Cercopithecidae	*Macaca fascicularis*	Crab-eating Macaque		LC
Sciuridae	*Exilisciurus concinnus*	Philippine Pygmy Squirrel)	Endemic	LC
Sciuridae	*Sundasciurus samarensis*	Samar Squirrel	Endemic	LC
	Apomys sp.			
Muridae	*Batomys salomonseni*	Mindanao Batomys	Endemic	LC
Muridae	*Bullimus bagobus*	Mindanao Bullimus	Endemic	LC
Muridae	*Rattus everetti*	Philippine Forest Rat	Endemic	LC
Muridae	*Rattus tanezum*			
	Paradoxurus hermaphroditus			
	Vivera tangalunga			
	Susbarbatus mindanensis			
Vespertilionidae	*Myotis muricola*	Nepalese Whiskered Myotis		LC
Cynocephalidae	*Cynocephalus volans*	Philippine Flying Lemur	Endemic	LC
Pteropodidae	*Acerodon jubatus*	Golden-capped Fruit Bat	Endemic	EN
Pteropodidae	*Cynopterus brachyotis*	Lesser Dog-faced Fruit Bat		LC
Pteropodidae	*Eonycteris spelaea*	Dawn Bat		LC
Pteropodidae	*Haplonycteris fischeri*	Philippine Pygmy Fruit Bat	Endemic	LC
Pteropodidae	*Harpyionycteris whiteheadi*	Harpy Fruit Bat	Endemic	LC
Pteropodidae	*Macroglossus minimus*	Dagger-toothed Long-nosed Fruit Bat		LC
Pteropodidae	*Megaerops wetmorei*	White-collared Fruit Bat		VU
Pteropodidae	*Ptenochirus jagori*	Greater Musky Fruit Ba	Endemic	LC
Pteropodidae	*Ptenochirus minor*	Lesser Musky Fruit Bat	Endemic	LC
Pteropodidae	*Pteropus hypomelanus*	Island Flying Fox		LC
Pteropodidae	*Pteropus vampyrus*	Large Flying-fox		NT
Pteropodidae	*Rousettus amplexicaudatus*	Geoffroy's Rousette		LC
Emballonuridae	*Emballonura alecto*	Small Asian Sheath-tailed Bat		LC
Megadermatidae	*Megaderma spasma*	Lesser False Vampire		LC
Hipposideridae	*Hipposideros ater*	Dusky Leaf-nosed Bat		LC
Hipposideridae	*Hipposideros bicolor*	Bicolored Leaf-nosed Bat		LC
Rhinolophidae	*Rhinolophus arcuatus*	Arcuate Horseshoe Bat		LC
Rhinolophidae	*Rhinolophus inops*	Philippine Forest Horseshoe Bat		LC
Rhinolophidae	*Rhinolophus philippinensis*	Large-eared Horseshoe Bat		LC
Rhinolophidae	*Rhinolophus subrufus*	Small Rufous Horseshoe Bat	Endemic	DD

IUCN Status Categories: EX (Extinct), EW (Extinct in the Wild), CR (Critically Endangered), EN (Endangered), VU (Vulnerable), NR (Near Threatened), LC (Least Concern), DD (Data Deficient) and NE (Not Evaluated)

Based on the IUCN 2011 red list of threatened species, the Golden capped fruit bat (*Acerodon jubatu),* an endemic species in the Philippines, is listed as endangered (EN) of which two (2) individuals were recorded in the survey site in Sogod. Another species, *Sus barbatus mindanensis* is listed as vulnerable (VU) due to the decreasing population trend. Some species are listed as near threatened, such as, the Large flying fox (*Pteropus vampyrus),* Philippine forest horshoe bat (*Rhinolophusinop) s*and the Philippine tarsier (*Tarsius syrichta)* which are all endemic in the Philippines.

Of the total 218 individuals recorded on the four (4) study areas, 63 individuals (29 %) were recorded in Sogod area and 59 (27%) were recorded from Hinunangan. The Philippine Forest rat (*Rattus everetti)* has the highest number of individuals recorded for the non-volant mammals while the Lesser musky fruit bat (*Ptenochirus minor)* for volant mammals. The presence of other mammals like the Common palm civet were also observed during the study. *Paradoxurus hermaphrodites* and the *Susbarbatus mindanensis*, a sub-species of the Philippine warty pig restricted in Mindanao faunal region were also observed. There are two (2) notable species of primates that were also recorded during the survey, the Crab-eating macaque (*Macaca fascicularis)* and Philippine tarsier (*Tarsius syrichta*)~~.~~

The population of non-volant mammals is mainly dominated by Muridae family (*Apomys sp., Botomys solomonseni, Bullimus bagobus, Rattus everetti, R. tanezumi*), while the volant mammals is dominated by Pteropodidae species (*Acerodon jubatus, Cynopterus brachyotis, Econycteris spelea, Haplonycteris fischeri*). The population of non-volant mammals is mainly dominated by Muridae family (*Apomys sp., Botomys solomonseni, Ballimus bagobus, Rattus everetti, R. tanezumi*), while the volant mammals is dominated by Pteropodidae species (*Acerodon jubatus, Cynopterus brachyotis, Econycteris spelea, Haplonycteris fischeri etc*.).

Mammals species accumulation and diversity

Across four (4) localities, 2,953 traps and 199 nets have yielded eight (8) species of small non-volant and 22 species of volant mammals, respectively (See Table 10). There were three (3) non-volant species belonging to three (3) families (*Paradoxurus hermaphrodites, Vivera tangalunga, Sus barbatus mindanensis*) were observed and not captured. *Tarsius syrichta* in Silago was captured by net and hand in Hinunangan. While bones of *Macaca fascicularis were* obtained from abandoned local traps in Silago and Sogod.

Species variability of non-volant mammals across sites was not significant. The sufficiency of sampling established with this survey as asymptotes were reached across the sampling regimes (Fig. 7). The results suggest that a maximum of 2 species may have been missed during the survey. The species accumulation (Mao Tau) indicates that highest observation of non-volant mammals is high in Sogod (5±1.37) and least in Silago and Maasin.

Species diversity of captured mammals follows the pattern of species observations in localities. For non-volant, diversity values was high in Sogod with five (5) species recorded and the lowest diversity was in Silago with only nine (9) individuals captured belonging to three (3) species (*Apomys sp., R. everetti and C. beatus*). It is also interesting to note that Sogod has the highest elevation (957 meters) among the three (3) localities. It only indicates that diversity of small mammals occurs in high elevations. Volant mammals diversity was high in Maasin (H'=2.29) and lowest in Silago (H'=1.52). The highdiversityofvolant mammals in Maasinmightbe attributedtonumerous cavesrecorded in the surveysites wherebatsusuallyroost.

Table 10. Mammals' community measuresofspecies accumulation and diversity. Shown also are the corresponding number of traps or surveyefforts undertaken.

Locality	Survey effort (number of traps)	Species observed (Mau Tau) ±Standard error	Species diversity (Shannon H' mean)
Non-volant Mammals			
Hinunangan	599	4 ± 1	1.26
Maasin	252	3 ± 1	0.99
Silago	923	3 ± 1	0.96
Sogod	1179	5 ± 1.	3.16
Volant Mammals			
Hinunangan	35	10 ± 2	1.73
Maasin	30	12 ± 2	2.29
Silago	57	10 ± 2	1.52
Sogod	80	11 ± 2	2.12

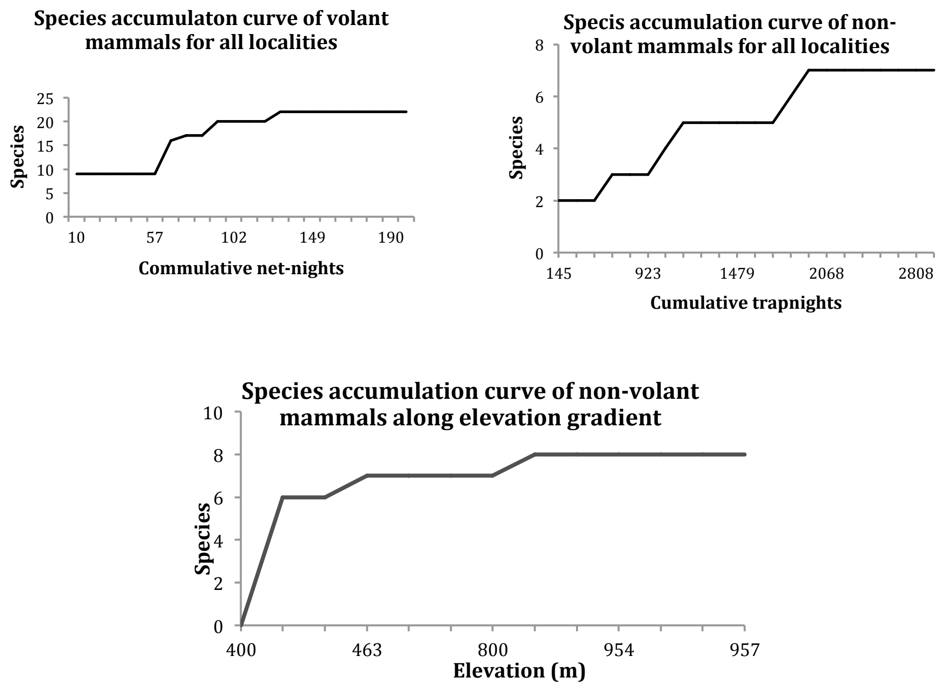


Figure 7. Species accumulation curve of non-volant and volant mammal's across all survey sites in Southern Leyte.

Amphibians and Reptiles

Although biological expeditions have been conducted on Leyte since the 1800s, very few have centered on the amphibians and reptiles of the island. The most recent and extensive herpetofaunal study was conducted by researchers from the Visayan State College of Agriculture in collaboration with European institutions, during the 1980s to early 1990s. Except for a few rapid assessment studies, virtually there are no herpetofaunal studies that have ever been undertaken.

The mountain ranges of Nacolod and Cabalian in Southern Leyte Province are among the last forested areas on the island. These areas are also among the least studied in terms of biodiversity. The forests of southern Leyte Province are home to at least 90 species of amphibians and reptiles or about 25 percent of the total species known in the Philippines. Of the 90 species, over 50 percent are found only in the Philippines and at least four (4) species are restricted to this region. Herpetologists believe that more new species of amphibians and reptiles will be discovered in the forests of Leyte after intensive and extensive field studies have been conducted on the area.

Meanwhile, the result of the biodiversity assessment conducted in the area shows that there are a total of 69 species of terrestrial amphibians and reptiles recorded across the four (4) localities. Of these 69 species, 25 species are frogs belonging to seven (7) families, 23 species of lizards belonging to five (5) families, 20 species of snakes and one (1) species of turtle.

Table 11. Herpetofaunal composition found in the four study sites.

Family Name	Scientific Name	Common Name	Kinds	Extent	IUCN Status
Bufonidae	*Pelophryni lighti*		frogs	Endemic	VU
Ceratobatrachidae	*Platymantis bayani*		frogs		
Ceratobatrachidae	*Platymantis corrugatus*		frogs	Endemic	LC
Ceratobatrachidae	*Platymantis guentheri*		frogs	Endemic	VU
Ceratobatrachidae	*Platymantis rabori*		frogs	Endemic	VU
	Platymantis sp.		frogs		
	Platymantis sp,		frogs		
Dicroglossidae	*Limnonectes leytensis*	(Small Disked Frog	frogs	Endemic	LC
Dicroglossidae	*Limnonectes magnus*	Giant Philippine Frog	frogs		NT
Dicroglossidae	*Occidozyga laevis*	Yellow Bellied Puddle Frog	frogs		LC
Dicroglossidae	*Fejervarya cancrivora*	Asian Brackish Frog	frogs		LC
Dicroglossidae	*Fejervarya vittigera*		frogs	Endemic	LC
Megophryidae	*Megophrys stejnegeri*	Southeast Asian Horned Toad	frogs	Endemic	VU
Microhylidae	*Kalophrynus pleurostigma*		frogs		LC
	Kaloula sp.		frogs		
Ranidae	*Hylarana grandocula*		frogs	Endemic	LC
Ranidae	*Sanguirana albotuberculata*		frogs		
Ranidae	*Staurois natator*		frogs		LC
Rhacophoridae	*Nyctixalus spinosus*		frogs	Endemic	VU
Rhacophoridae	*Philautus leitensis*		frogs	Endemic	VU
Rhacophoridae	*Polypedates leucomystax*	White-lipped Tree Frog	frogs		LC
Rhacophoridae	*Rhacophorus appendiculatus*	Southeast Asian Tree Frog	frogs		LC
Rhacophoridae	*Rhacophorus bimaculatus*		frogs	Endemic	VU
Rhacophoridae	*Rhacophorus pardalis*		frogs		LC
	Bronchocoela cristatella	Green crested lizard	lizard		
Agamidae	*Draco cyanopterus*		lizard	Endemic	LC
Agamidae	*Draco mindanensis*		lizard	Endemic	VU
Agamidae	*Gonocephalus semperi*	Mindoro Forest Dragon	lizard	Endemic	DD

Agamidae	*Hydrosaurus pustulatus*	Soa-soa Water Lizard	lizard	Endemic	VU
	Cyrtodactylus gubaot		lizard	Endemic	
Gekkonidae	*Hemidactylus frenatus*	Common House Gecko	lizard		LC
Gekkonidae	*Pseudogekko compressicorpus*	Cylindrical-bodied Smooth-scaled Gecko	lizard	Endemic	LC
	Brachymeles orientalis	Southern Burrowing Skink	lizard		
	Brachymeles paeforum	PAEF Slender Skink	lizard	Endemic	
	Brachymeles cf. talinis		lizard		
	Brachymeles sp		lizard		
	Eutropis multicarinata multicarinata		lizard		
	Otosaurus cumingii		lizard		
	Parvoscincus steerei		lizard		
	Pinoyscincus coxi coxi	Cox's Sphenomorphus	lizard		
	Pinoyscincus jagori	agor's Sphenomorphus	lizard		
	Pinoyscincus mindanensis	Mindanao Sphenomorphus	lizard		
Scincidae	*Sphenomorphus acutus*	Pointed-headed Sphenomorphus	lizard	Endemic	LC
Scincidae	*Sphenomorphus fasciatus*	Banded Sphenomorphus	lizard	Endemic	LC
Scincidae	*Sphenomorphus variegatus*		lizard		
Varanidae	*Varanus cumingi*		lizard	Endemic	LC
	Python reticulatus		snakes		
	Ahaetulla prasina preocularis		snakes		
Pareatidae	*Aplopeltura boa*	Blunthead Slug Snake	snakes		LC
	Boiga cynodon	Dog-toothed Cat Snake	snakes		LC
Calamariidae	*Calamaria lumbricoidea*	Variable Reed Snake	snakes		LC
	Coelognathus erythrura		snakes		
	Cyclocorus nuchalis taylori		snakes		
	Dendrelaphis caudolineatus		snakes		
	Lycodon aulicus		snakes		
	Lycodon ferroni		snakes		DD
Colubridae	*Oligodon modestum*	Spotted-bellied Short-headed Snake	snakes	Endemic	VU
	Oxyrhabdium modestum		snakes		
Lamprophiidae	*Psammodynastes pulverulentus*		snakes		
	Rhabdophis auriculata auriculata		snakes		
Natricidae	*Tropidonophis dendrophiops*	Spotted Water Snake	snakes	Endemic	LC
Natricidae	*Tropidonophis negrosensis*		snakes	Endemic	VU
Elapidae	*Naja samarensis*	Samar Cobra	snakes	Endemic	LC
	Typhlops sp.		snakes		
Viperidae	*Trimeresurus flavomaculatus*	Philippine Pit Viper	snakes	Endemic	LC
	Tropidolaemus wagleri	Wagler's Keeled Green Pit Viper	snakes		LC
Geoemydidae	*Cuora amboinensis*	Southeast Asian Box Turtle	turtle		VU

The population of frog species across four (4) localities is mainly dominated by families of Ceratobatrachidae and Rhacophoridae. While for lizards and snakes species, it is dominated by Scinicidae and Colubridae, respectively. There are two (2) recorded species of lizards that were known to be endemic on the island, the *Cyrtodactylus gubaot* and *Brachymeles paeforum*. There are also at least five (5) species with new distribution records on Leyte (3 *Platymantis sp*., 1 *Kaloula sp.* and 1 *Brachymeles sp*.) and at least three new species of frogs and lizards (2 *Platymantis* and 1 *Brachymeles*) that were discovered on the recent surveys.

Reptiles and Amphibians species accumulation and diveristy

To obtain the diversity results and to compare the diversity of the four (4) sites, a non-parametric statistical analysis such as Mau Tao and Shannon (H') was used (see Table 11). The results shows that Sogod area is the most diverse among the other areas which obtained a value of 41 ± 3.84 species observed (H'=3.27), followed by Silago with 30 ± 3.99 species (H'=3.0), Hinunangan with 23 ± 3.84 species and Maasin with the lowest among the four (4) areas with 17 ± 3.53. The results of the diversity of the species were also affected by the sampling effort per site (as shown in the table below) where Maasin was considered as under sampled compared with the rest. However, maximum number of species (± 3.5) suggests that the survey may have only missed 4 species.Therefore this low species richness in Maasin is not only brought aboutbythe low sampling effort but also by the available habitats where transect lines were positioned. We noted that Maasin had more degraded habitats than the rest of the 4 sites. This is consistent with the findings in other sites in the Philippines where species richness and faunal abundance declined in the forest fragments (Diesmos, 2008). Hence, the expansion of the area such as elevational gradient also changes the area's diversity. Silago had the most numberof sampling effort but its elevational expansion is lower than 750 meters above sea level compared with Sogod area has 950 meters above sea level area characterized by good forest above.

Table 11. Herpetofauna community measures of species accumulation (Mao Tau) and diversity (H') across four localities in southern Leyte. Shown also corresponding numberoftransect

Survey area	Survey Effort (Number of transects)	Species Observed (Mau Tao) ± Standard Deviation	Shannon Species Diversity H'
Maasin	3	17 ± 3.5	2.74
Hinunangan	11	23 ± 3.8	2.87
Silago	19	30 ± 3.9	3
Sogod	10	41 ± 3.8	3.27

Faunal Habitat Association:

Birds: Broad Habitat Association

Habitat association based on (Table 12) indicate that four (4) species of birds are found to have narrow niche width or special habitat requirement. For example, the Silvery Kingfisher, commonly found on rocks and along banks of forest streams, was recorded only on an advanced second growth (ASG), the Oriental Honey Buzzard was found only in cultivated area (CVT), Red Jungle fowl was found in advanced second growth (ASG), Silvery Kingfisher also in advanced second growth (ASG) and the Amethyst Brown-Dove seen only in old growth (OG). But in the case of the Red Junglefowl which is known to be found in almost all types of habitat, from forest edge, early second growth to old growth (OG), was only recorded in advanced second growth (ASG) forest. This may be due to hunting pressure from forest edge to early second growth (ESG) as evinced by the snare traps that the team have found.

There are also ten (10) species that has broad habitat requirements and can adapt to broad range of habitat types such as the Rufous Hornbill - usually found only in forest areas- which was also recorded in a cultivated area (CVT). This suggests a great deal of fragmentation of forest habitats in Southern Leyte. The Philippine Coucal is known to inhabit a variety of habitats from grassland to forest. The rest of the species: Hair-crested Drongo, Pink-bellied Imperial Pigeon, Yellowish Bulbul, Philippine Bulbul, Brown-tit Babbler, Elegant Tit, Visayan Tarictic, White-eared Brown Dove and Streaked Ground-Babbler were also found to have a broad habitat range because they were observed in the four (4) habitat types as the Rufous Hornbill.

Table 12. Bird-habitat association

SPECIES	CVT	ESG	ASG	OG
Silvery Kingfisher			X	
Guaiabero	X	X		X
Rufous Hornbill	X	X	X	X
Black-faced Coucal		X	X	X
Philippine Coucal	X	X	X	X
Hair-crested Drongo	X	X	X	X
Pink-bellied Imperial Pigeon	X	X	X	X
Red-Jungle fowl			X	
Rufous –lored Kingfisher	X		X	
Philippine Trogon		X	X	X
Philippine Fairy - Bluebird		X	X	X
Yellowish Bulbul	X	X	X	X
Philippine Bulbul	X	X	X	X
Colasisi	X		X	X
Brown-Tit Babbler	X	X	X	X
Elegant Tit	X	X	X	X
Yellow-bellied Whistler			X	X
Visayan Tarictic	X	X	X	X
Oriental Honey Buzzard	X			
Amethyst Brown-Dove				X
White-eared Brown-Dove	X	X	X	X
Blue-crowned Racquet-tail	X		X	X
Yellow-breasted Fruit-Dove			X	X
Streaked Ground-Babbler	X	X	X	X

Mammal: Broad Habitat Association

As shown on Table 13, three (3) mammal species have narrow habitat preferences (*C. volans, B. cf. solomonseni, R. tanezumi*). *C. volans* was found only in ASG while *Batomys cf. solmomseni* was present only in old growth forest and was only captured at elevation above 900 masl. *Rattus tanezum,* species known as commensal or invasive and has been widely introduced throughout the Philippines (Heaney et al. 1998; Musser and Carleton 2005; Larry Heaney pers. comm.), was found encroaching in early ESG. Four (4) species (*Crocidura sp*., *Macaca fascicularis*, *Sundasciurus sp*. and *Apomys sp*) occupied both advance second growth and old growth forest. These species preferred a much pristine habitat. *M. fascicularis* was observed to be moving farther to the forest of which might indicate hunting pressure on the area. There are also two (2) species (*Bullimus bagobus* and *rattus everetti*) that occupied and can tolerate all forest type.

Table 13. The broad habitat and presence (as mark "x") of the Non-volant mammals

Species	ESG	ASG	OG
Crocidurabeatus		x	x
Cynocephalus volans		x	
Macaca fascicularis		x	x
Sundasciurus samarensis		x	x
Apomis sp.		x	x
Batomys solomonseni			x
Bullimus bagobus	x	x	x
Rattus everetti	x	x	x
Rattus tanezumi	x		

Ordination: Species-Habitat Modelling

Plant Community Ordination

The Canonical Correspondence Analyses (CCA) of the tree surveys at 18 habitat parameters in 13 cases produced two canonical axes. The first canonical axis (eigenvalue = 0.777) accounts for 1.00 species-environment correlation, with a cumulative constrained percentage of 33.558%. This vertical axis, as shown in Figure 1, appears to be an axis of biomass. Variables found on the left-hand side, including all tree counts and forest cover vectors, indicate forests with increasing biomass values. Those on the right-hand side comprise vectors of increasing bamboo and herb coverage, and are thus consistent with the scenario of a low-biomass forest.

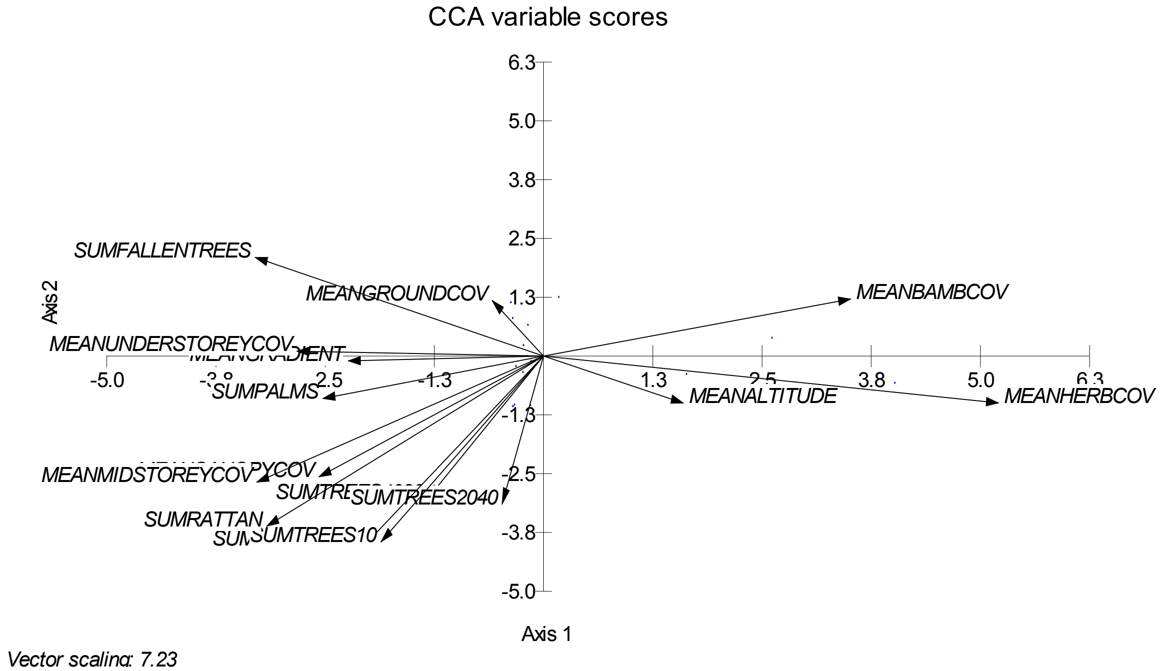


Figure 8. Canonical correspondence analysis (CCA) biplot of 18 habitat parameters on the two canonical axes using Multivariate Statistical Package.

The second canonical axis (eigenvalue = 0.421) accounts for 1.00 species-environment correlation, with a cumulative constrained percentage of 51.768%. It appears to be an axis of increasing disturbance, evidenced by vectors on the lower portion that describe variables of increasing canopy and midstorey covers. Higher tree counts are also found here. These are consistent with forests of higher quality.

On the other hand, vectors of increasing understory, ground and bamboo coverage, as well as higher incidences of observed fallen trees, are seen on the upper portion of the second axis. These appear to be indications of greater disturbance, and therefore lesser quality of the forest.

In addition to this, the position of the vector for mean altitude implies that as one moves up the elevation grid, forest seems to be thinner. The vector for gradient suggests increased biomass in steeper areas. Both vectors do not lie far from the disturbance axis, which may indicate a balance in forest quality.

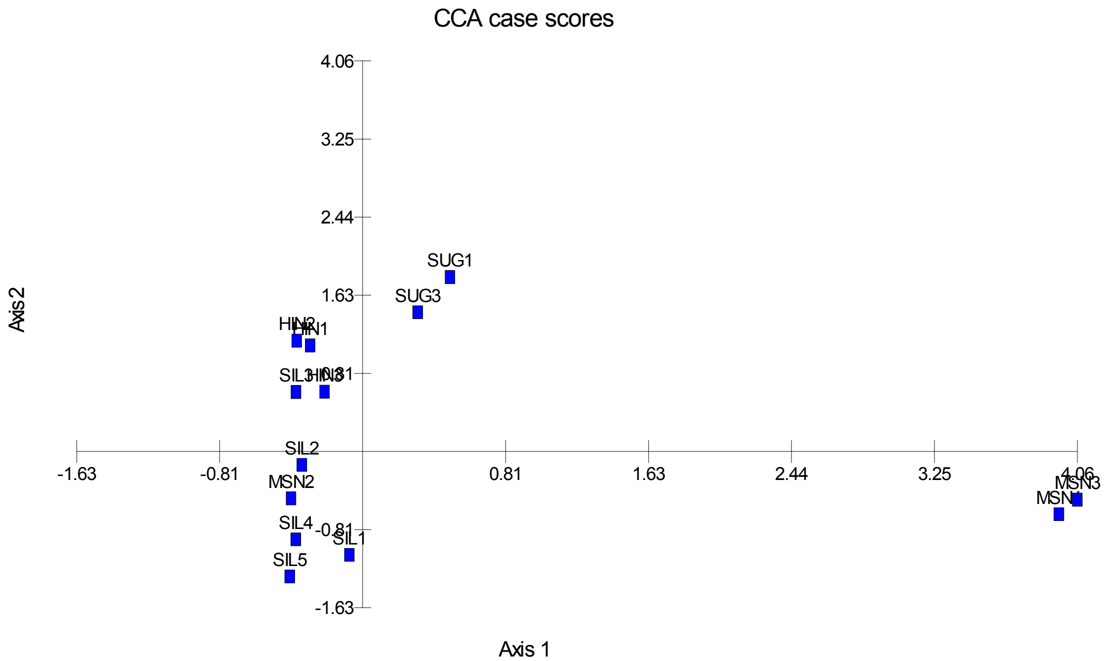


Figure 9. Ordination of the 13 cases on the two canonical axes using Multivariate Statistical Package. (SUG = Sugod; MSN = Maasin; HIN = Hinunangan; SIL=Silago)

The position of the sites on the axes (Figure 9) may imply the condition of the forests that were sampled. The centroids for Silago 1, 2, 4 and 5 are positioned on the areas of fewer disturbances and increasing biomass, which may suggest that these are more mature forests. Silago 3 is found together with the centroids for all the Hinunangan sites on the upper left side of the biplot. This position may indicate an intermediately disturbed forest, with the vector for increasing fallen trees pointing towards this portion. For Sugod, the centroids' presence in the upper right corner suggests lesser biomass and an even higher disturbance. Maasin centroids 1 and 3 are plotted on the extreme right of the axis for biomass, proving even if there is not much disturbance, the trees are thinnest amongst all areas sampled. Interesting to note though, that the Maasin 2 centroid is plotted together with the majority of the Silago centroids, which might indicate a more mature condition.

The formed axes also divided the species centroids (See Figure 10). The vertical Axis 1 grouped together familiar lowland dipterocarp forest species on the left-hand side, separating it from widely distributed and known reforested species on the right. Species on the left-hand side include *Shorea negrosensis, Shorea seminis, Shorea contorta, Syzygium hutchinsonii, Syzygium calubcub, Calophyllum blancoi, Lithocarpus ovalis, Hopea quisumbingiana, Myristica philippensis*, and *Oroxylum indicum*. Those on the right-hand side are *Artocarpus ovatus, Ficus balete, Erythrina subumbrans*, and *Swietenia macrophylla*.

From the horizontal Axis 2, a clearer grouping can be made of the left-hand side centroids. Those placed further below (*Shorea contorta, Oroxylum indicum*, and *Myristica philippensis*) are dipterocarp species that may prefer conditions of less disturbance, rather than the species which lie near or further above the axis.

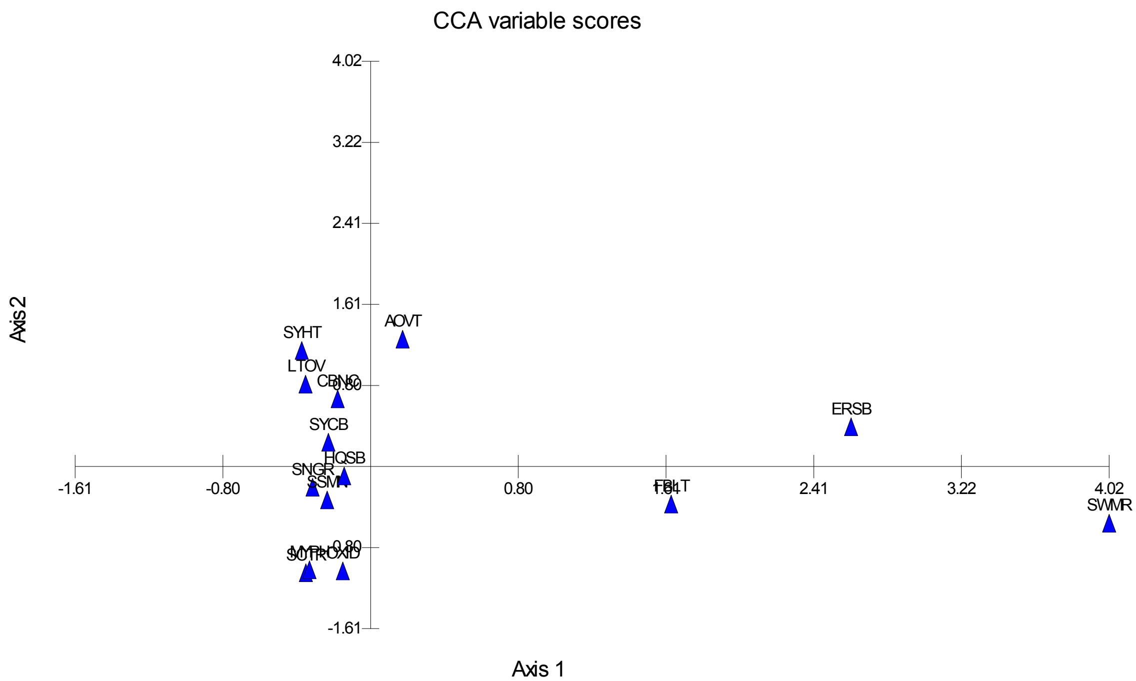


Figure 10. Ordination of the 14 tree species on the two canonical axes using Multivariate Statistical Package. Codes used are listed in Table 2.

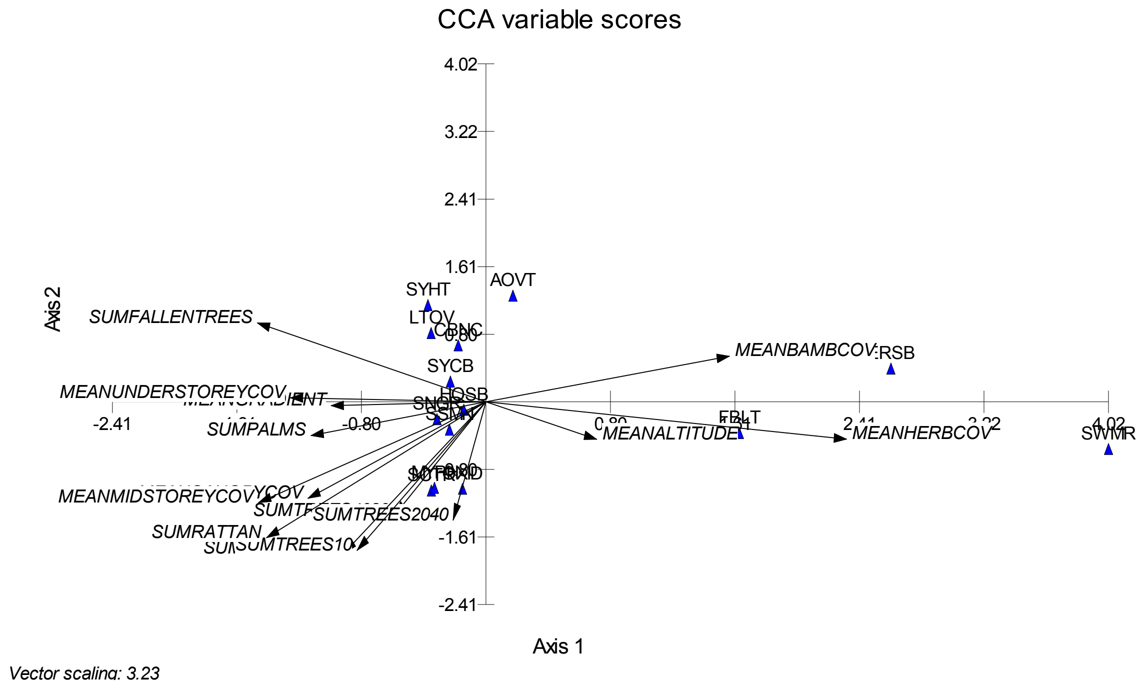


Figure 11. Canonical correspondence analysis (CCA) biplot of 18 habitat parameters and 14 tree species on the two canonical axes using Multivariate Statistical Package. Codes for habitat parameters and species centroids are listed in Tables 2 and 7, respectively.

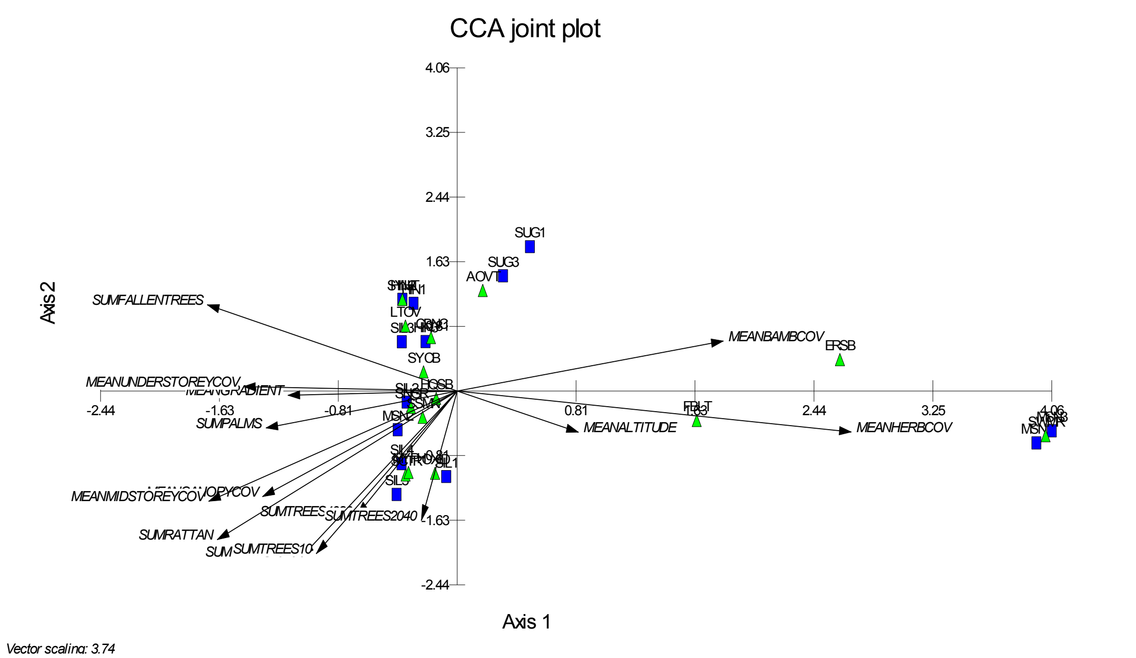


Figure 12. Canonical correspondence analysis (CCA) biplot of 18 habitat parameters, 14 tree species, and 13 cases on the two canonical axes using Multivariate Statistical Package. Codes for habitat parameters and species centroids are listed in Tables 2 and 7, respectively.

A superimposition of the habitat parameter vectors and species centroids is presented in Figure 4. From this, the habitat preferences of the key tree species can be observed. Those on the left-hand side of the vertical axis are species that prefer higher biomass, more mature forests, while those on the right are leaning towards thinner stands. More specifically, the centroid for *Swietenia macrophylla* leans towards high herb coverage, and is found near the Maasin 1 and 3 centroids (Figure 12). That of *Erythrina subumbrans* seem to prefer higher bamboo cover areas, while *Ficus balete* is suggested to be associated with higher altitude areas (Figure 11).

Bird Community Ordination

Canonical corespondence analysis (CCA) of the bird survey was based on 14 transect lines with 123 points or observation stations. Axis 1 (Figure 10) the vectors position in the left-hand side are the variables indicating evidence of pristine habitat with vectors associated with increasing dominance of large trees and canopy cover percentage, tree height, tree dbh. The vectors for habitat variables position in the right-hand side of the axis are influence the proximity to the open areas(i.e. habitat near cultivation and more disturbed area) as evidence of grass and increasing ground cover. This is an axis of decreasing forest quality. The second canonical axis, the vector on upper portion are variables associated with forest characteristics proximate to the less pristine habitat (i.e. increasing proportion of second generation forest type as evidenced with the increasing understorey parameters) whilst the vector in the lower portion have variables associated with forest interior (e.g. increasing number proportion to tree height, increasing dbh, canopy cover, tree and other height with less understorey biomass). This axis is a decreasing habitat quality as result proportion of the disturbances and habitat alteration.

The centroid of 12 bird species (figure 4) in axis 1 (*Prioniturus discurus, Loriculus philippinensis, Ixos everetti, Dicrurus hottentottus, Pachycephala philippinensis, Ducula poliocephala, Phapitreron amethystine, Centropus melanops, Penelopides panini, Buceros hydrocorax, Ptilinopus occipitalis, Todirhamphus winchelli*) were projected on the left-hand side, indicating preference of mature forest habitat as indication of increasing tree DBH, canopy crown, and height and other forest quality indications. One species (*Alcedo argentata*) is outlier. Whilst the centroid of ten (10) species (*Gallus galus, Harpactes ardens, Macronous striaticeps, Parus elegans, Irena cyanogaster, Phapitreron leucotis, Ixos philippinus, Bolbopsitattacus lunulatus, Centropus viridis, Pernis ptilorhynchus*) were projected on the right-hand side, indicating the preference of habitat are much proportion to disturbances as indication of increasing ground cover,grass, ferns and herbs. The second canonical axis (axis 2) the centroid of nine (9) species (*H. ardens, P. elegans, M. striaticeps, P. discurus, P. mindanensis, I. everetti, D. hottentottus, I. cyanogaster, P. leucotis*) were projected at the upper portion of the axis indicating the preferences of actively generating forest as evince by increasing understorey habitat variables. Whilst the centroid of the species at the lower portion preferred the more forest quality. The centroid of three species (*Phachycephala philippinensis, Ixos philippinus, Phapitreron leucotis*) were at neither the extremity nor at the center of the axis. There are four (4) species (*G. gallus, P. occipitalis, T. winchelli, P ptilorhynchus*) are outliers.

Figure 13. Ordination of 20 habitat variables on the two canonical axes from Multivariate Statistical Package (MVSP)

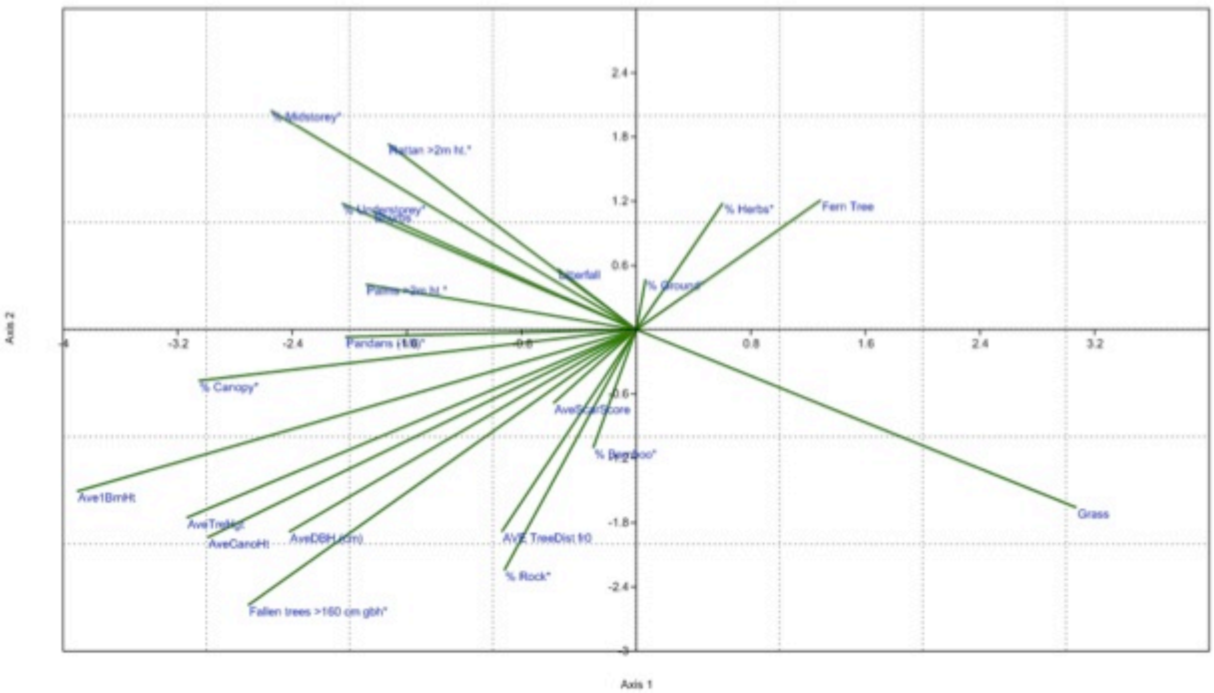


Figure 14. Ordination of 24 selected species on the two canonical axes from Multivariate Statistical Package (MVSP)

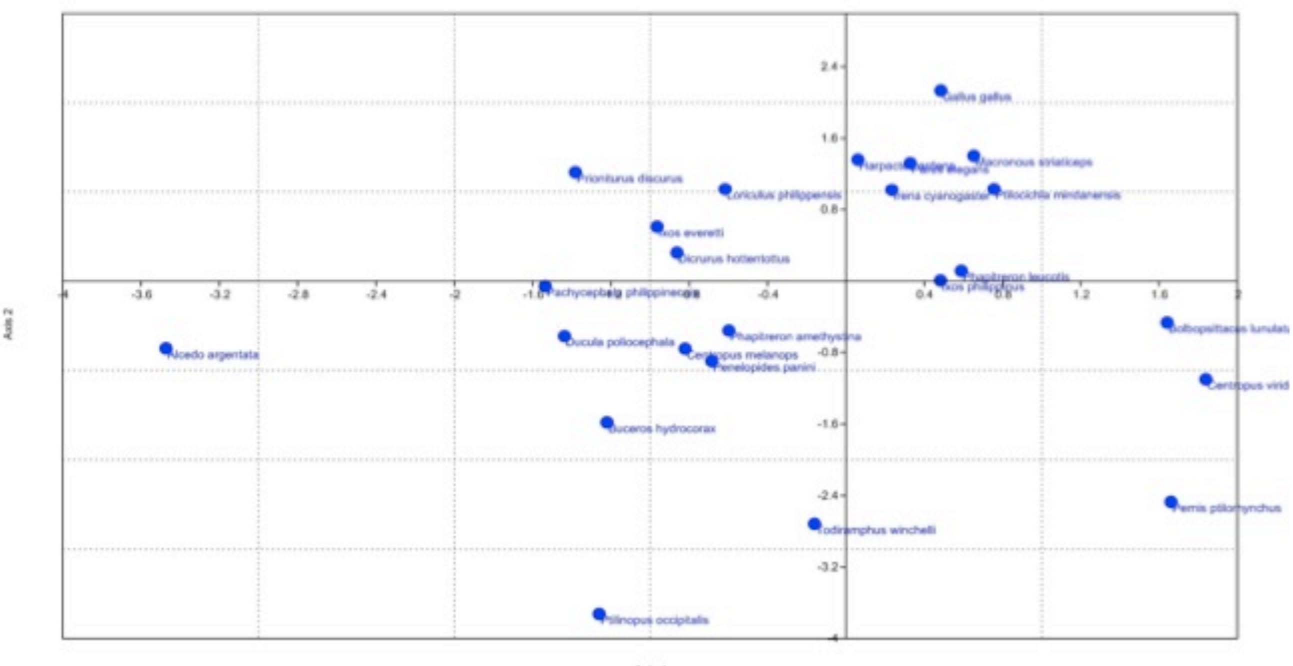
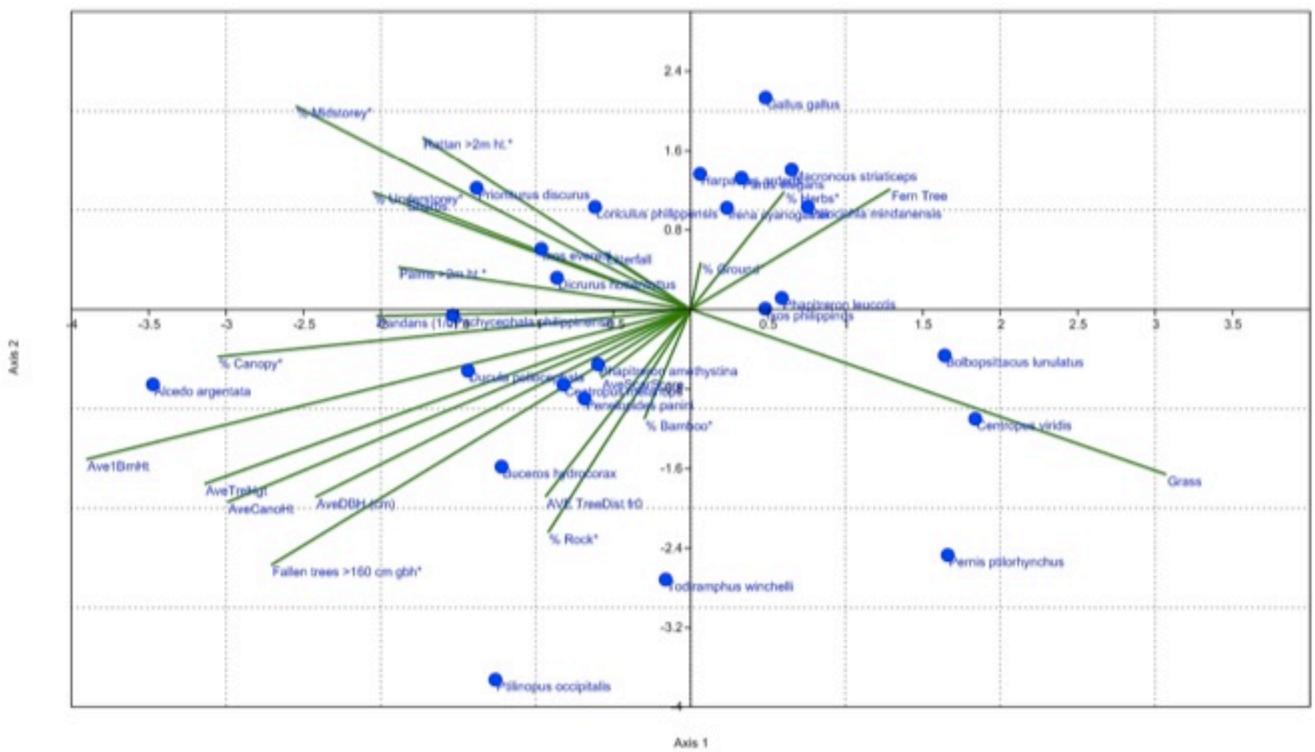


Figure 15. Canonical Correspondence Analysis (CCA) biplot of 24 species and 20 habitat variables on



Non-volant Small Mammals Community ordination

Canonical correspondence analysis (CCA) of nine (9) non-volant mammal species surveys covering 13 sampling points and 19 habitat variables. Axis 1, the vectors position on the left-hand side are variables of generating habitat as evidence to the presence of ground cover, understorey, grass, pandan and bamboo. The vector for the habitat variables on the right-hand side of the axis are the variables with more defined forest quality as evidence by increassing dominant big trees, tree height, with canopy cover. These indicate that this canonical axis is an axis of increasing forest quality. The second cononical axis, the vector on the upper portion are variables associated with less prestine habitat as indication of the presence of actively generating forest habitat. Whilst the vector on the lower portion are variable with increasing habitat complexity as indication of more mature habitat as evidence of increasing tree canopy cover, height and DBH. These indicate that this canonical axis is an axis of decreasing habitat quality.

The centroid of five (5) mammalians species in axis 1 (*Rattus everetti, Crocidura sp., Batomys cf. salomonseni, Macaca fascicularis, apomys sp.*) were projected in the left-hand side indicating the presence of understorey or increasing ground cover, whilst the centroid of another two (2) species (*Sundasciurus sp, Rattus tanezumi*) were projected at the right-hand side, indicating a more complex forest structure. The centroid of one (1) species of mammal (*Bullimus* *bagobus*) were at niether extremity of this axis nor at the center. The centroid of species in axis 2 (*Rattus tanezumi, Crocidura sp.*) were projected at upper portion indicating that their preffered proportion is less complex forest (i.e. Early second growth or degraded forest type), whilst the centroid of most of the species in axis 2 were projected in the middle of the lower part of the axis indicating much more complex habitat structure of the forest. The centroid of three (3) species (*Batomys cf. solomonseni, Bullimus bagobus, sundasciurus sp*) were at neither the extremity nor at the center of the axis.

Figure 16. Canonical Correspondence Analysis showing the Ordination of 19 habitat variables of two cannonical axes from Multivariate Statistical Package (MVSP)

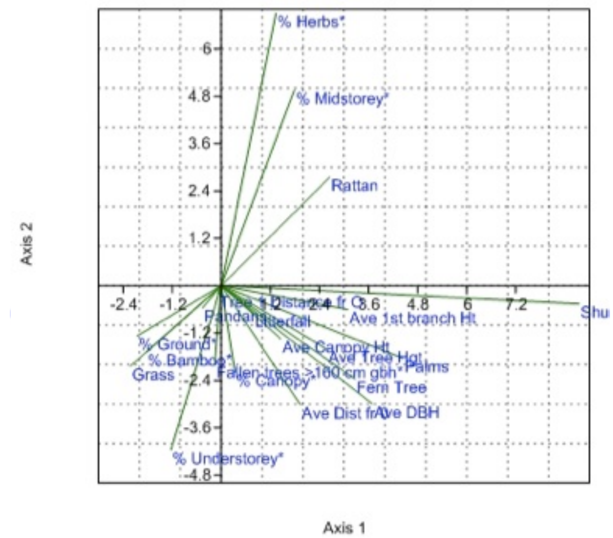


Figure 17. Mammals centroid from Multivariate Statistical Package (MVSP)

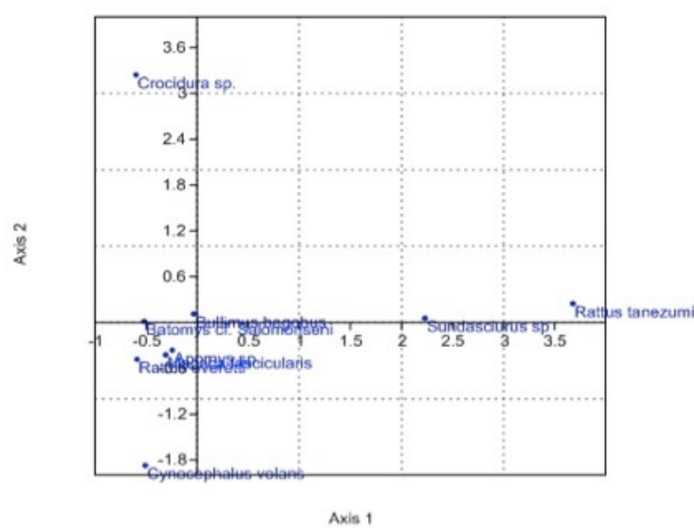
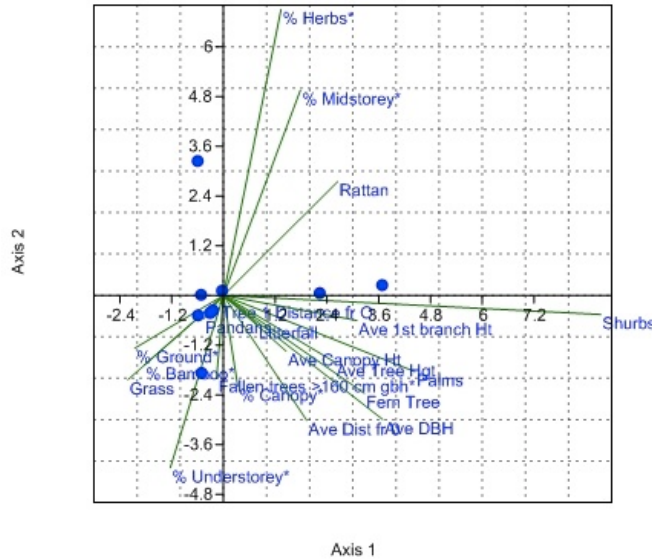


Figure 18. Mammals Biplot fromMultivariate Statistical Package (MVSP)



Habitat associations of individual species, occupancy estimation and modelling

Birds occupancy

The results of the model selection for detection probability (*p*) are summarized in Table 14. The detection probabilities of all species are not greater than one (1) which support the theory developed situation by McKenzie *et. al.* (2002) where species detection probability is less than one (1) and where it varies among species or habitats. Twenty-one (21) species (*Alcedo argentata, Bolbopsittacus lunulatus, Galus galus, Centropus melanops, Centropus viridis, Irena cyanogaster, Loriculus philippensis, Parus elegans Pernis ptilorhynchus, Phapitreron amethystine, Buceros hydrocorax, Irena cyanogaster, Ixos everetti, Macronous striaticeps, Dicrurus hottentottus, Penelopides Panini, Phapitreron leucotis, Phapitreron amethystina, Ixos philippinus, Prioniturus discurus, Ptilocichla mindanensis*) showed that the detection probability (*p*) were influenced by environmental covariates such as tree girth (dbh), presene of palms (palm), densities of saplings (sap), coverage of rattan clumps (rat), extent of grass cover (grass) and the combinations of these.

By including the detection probability, the occupancy estimates (ψ) or PAO of most species were higher than the naïve occupancy estimates (ψ). Nine (9) species (IUCN Endangered *Penelopides Panini, Phapitreron leucotis, Ixos philippinus, Dicrurus hottentottus,* IUCN Near-Threatened *Buceros hydrocorax, Irena cyanogaster, Ixos everetti, Macronous striaticeps* and *Pachycephala philippinensis*) showed an occupancy of above 50 percent whilst eleven other species showed an occupancy below 50 percent. includes two (2) IUCN Vulnerable species (*Prioniturus discurus* and *Alcedo argentata*) and one (1) IUCN Near-Threatened (*Ducula poliocephala*). The best-fitting models with the lowest AIC value (most pasimonious model) are listed in Table 15. For example, the occupancy of *Ixos philippinus, a very greagarious and* *common species,* (93%) is influenced by dbh; *Bolbopsittacus lunulatus* (29%)and *Centropus viridis* (43%) by the combination of *dbh+palm* and so on.

Table 14. Summary of the results of occupancy estimstes (ψ) and detection probability (p) using PRESENCE 3.1 Softwares showing each species best-fitting model, Naive Occupancy (ψ) detection probability (p)with standard error and proportion area occupancy (ψ) with standard error.

Species	Detection model	Naïve Occupancy(ψ)	p±SE	PAO±SE
Alcedo argentata	*ψ(dbh+rat)*	0.07	0.11±0.10	0.07±0.96
Bolbopsittacus lunulatus	*ψ(dbh+palm)*	0.28	0.32±0.08	0.29±0.12
Buceros hydrocorax	*ψ(dbh+palm+grass)*	0.50	0.10±0.28	0.66±0.22
Centropus melanops	*ψ(dbh+palm+grass)*	0.28	0.17±0.37	0.30±0.13
Centropus viridis	*ψ(dbh+palm)*	0.42	0.36±0.06	0.43±0.13
Dicrurus hottentottus	*ψ(rat)*	0.64	0.25±0.05	0.67±0.13
Ducula poliocephala	*ψ(palm+sap+rat+grass)*	0.35	0.12±0.29	0.47±0.20
Gallus gallus	*ψ(dbh+sap)*	0.07	0.03±0.03	0.07±0.96
Irena cyanogaster	*ψ(palm)*	0.50	0.14±0.05	0.65±0.21
Ixos everetti	*ψ(dbh+palm+sap+rat+grass)*	0.57	0.27±0.79	0.60±0.14
Ixos philippinus	*ψ(dbh)*	0.93	0.42±0.04	0.93±0.07
Loriculus philippensis	*ψ(palm+rat)*	0.29	0.23±0.08	0.30±0.13
Macronous striaticeps	*ψ(dbh+palm+grass)*	0.57	0.20±0.61	0.63±0.15
Pachycephala philippinensis	*ψ(dbh+rat)*	0.29	0.09±0.18	0.64±0.52
Parus elegans	*ψ(palm)*	0.29	0.22±0.08	0.31±0.13
Penelopides panini	*ψ(Palm+rat+grass)*	0.71	0.16±0.04	0.99±0.25
Pernis ptilorhynchus	*ψ(dbh+sap)*	0.07	0.04±0.04	0.07±0.96
Phapitreron amethystina	*ψ(dbh+palm+sap)*	0.07	0.22±0.22	0.07±0.07
Phapitreron leucotis	*ψ(sap)*	0.79	0.17±0.05	0.93±0.16
Prioniturus discurus	*ψ(sap+rat)*	0.29	0.11±0.25	0.35±0.17
Ptilocichla mindanensis	*ψ(dbh+sap+rat)*	0.14	0.33±0.44	0.15±0.09

Table 15. Species and covariates best fitting model using PRESENCE 3.1 score by Akaike's Information Criterion (AIC). As the AIC lowering to the most parsimonious while the AIC weigth increasing. The covariates are label as follows: dbh=Average breast height diameter of all five largest tree presence in the area, palm=mean percentage of palm >2 meters, sap=average number of sappling within 10 meters radius plot, rat=average number of rattan >2 meter height within 20 meter radius plot, and grass=mean of grass percentage in the plot

Species	Model	AIC	ω	K	-2log
Alcedo argentata	*ψ(dbh+rat)*	12.28	0.14	3	6.28
Buceros hydrocorax	*ψ(dbh+palm+grass)*	69.56	0.68	4	61.56
Bolbopsittacus lunulatus	*ψ(dbh+palm)*	59.90	0.14	3	53.90
Centropus melanops	*ψ(dbh+palm+grass)*	50.12	0.55	4	42.12
Centropus viridis	*ψ(dbh+palm)*	90.95	0.10	3	84.95
Dicrurus hottentottus	*ψ(rat)*	114.36	0.27	10	94.36
Ducula poliocephala	*ψ(palm+sap+rat+grass)*	57.96	0.22	5	47.96
Galus galus	*ψ(dbh+sap)*	14.55	0.07	3	8.55
Irena cyanogaster	*ψ(palm)*	79.67	0.13	2	75.67
Ixos everetti	*ψ(dbh+palm+sap+rat+grass)*	106.75	0.25	6	94.75
Ixos philippinus	*ψ(dbh)*	175.49	0.13	2	171.49
Loriculus philippensis	*ψ(palm+rat)*	59.01	0.12	3	53.01
Macronous striaticeps	*ψ(dbh+palm+grass)*	98.07	0.49	4	90.07
Pachycephala philippinensis	*ψ(dbh+rat)*	39.32	0.12	3	33.32
Parus elegans	*ψ(palm)*	60.33	0.10	2	56.33
Penelopides Panini	*ψ(Palm+rat+grass)*	95.58	0.24	4	87.58
Pernis ptilorhynchus	*ψ(dbh+sap)*	14.55	0.07	3	8.55
Phapitreron amethystina	*ψ(dbh+palm+sap)*	17.53	0.12	4	9.53
Phapitreron leucotis	*ψ(sap)*	117.48	0.12	2	113.48
Prioniturus discurus	*ψ(sap+rat)*	49.95	0.17	3	43.95
Ptilocichla mindanensis	*ψ(dbh+sap+rat)*	30.91	0.21	4	22.91

IV. DISCUSSIONS

Determinants of species distribution and diversity

The combinations of natural and anthropogenic factors are considered to have significant influence on species distributions and diversity (Mallari 2009), such as, climate, geographic ranges and vegetation types (Cueto & Casenave, 1999). The pattern of increase in habitat heterogeneity on the structure and composition of vegetation become complex if the niche diversity and species diversity increases (Gingold *et al*., 2010; McClain & Barry, 2010; Tews *et. al*., 2004; Cramer & Willig, 2002). Although, for small non-volant mammals it is known that elevational gradient in tropical regions also have greater effects on species richness and diversity (Heaney 2001; Rickart, 1993). As shown in Figure 7, the result of the surveys confirmed that the species accumulation in different elevation have reached the asymptote. In the case of the four (4) localities, Silago has the highest diversity of non-volant mammals (Table 10) wherein it also has the highest elevation (945 meters). For birds, reptiles and amphibians, diversity and richness was high in early and advance second growth habitats. Diversity and richness of flora species on the four (4) localities were defined by proximity of the area to the communities where it is therefore prone for resource extraction (Mallari, 2009). As also shown in the result, the geographic range also defines the species endemism across the four (4) localities. In fact, many species recorded are known to be endemic in Mindanao faunal region and some are restricted only on the island. The increase of species endemism on the island was also contributed to species diversity. There are also anthropogenic disturbances observed on the area such as the small patches of "Kaingin" in Silago and the illegal hunting of wildlife in Sogod and Silago. Meanwhile, conversion of land use to abaca, banana and mahogany plantations were observed on the localities of Maasin and Hinunangan. These disturbances have influenced the diversity of species in the surveyed localities where the lowest diversity was observed in cultivated areas.

Fauna-Habitat Association

In general, terrestrial fauna are dependent on the forest and riverine habitats (streams, rivers surrounded by forest), thus, requiring forest-dominated habitats for their existence. Interestingly, data from recent ecological studies shows that even disturbed original forests such as secondary forest or second growth vegetation, mixed with artificial or man-made forest (i.e., reforestations) still harbor considerable diverse and endemic species. It appears that some species could tolerate some degree of disturbance provided that the original vegetation is protected and left out to regenerate.

Buffer zones surrounding disturbed original vegetation are very important management strategies. In the Philippines, it has been a tradition to establish at least one (1) kilometer of buffer zone around a protected core. Unfortunately, concrete data on the proper delineation of buffer zones based on biological data (e.g., What is the proper area and size?) based on Philippine vertebrate species is non-existent. In general, it is suggested that the largest possible area of original vegetation (forest) and the largest possible area of buffer zone should be delineated as protected and management areas.

Occupancy

Birds are vocally distinctive in most species; therefore the team assumed that the detection probabilities were constant. Presence or absence surveys for species are commonly used in a wide variety of ecological applications. However, in all such applications an observed species absence (or more correctly, the non-detection of the species) does not imply that the species is genuinely absent from a sampling location. Frequently, a species can be present at an area but go undetected due to random chance. Such "false absences" lead to incorrect inferences if the imperfect detection of the species is not accounted for (MacKenzie,2005).New classes of models, called occupancy models,were developed to solve the problems created by imperfect detectability (MacKenzie *et al.*2002, 2003, 2004). In the recent years, site occupancy modeling has become increasingly useful to ecologists because the only data requirements are based on the detection or non-detection of a species over several sampling occasions (Linkie *et. al.*, 2007; MacKenzie et al., 2002; Weller, 2008).MacKenzie *et al., (*2002) describe a method that allows for unbiased estimation of the proportion of area occupied by a species in a single season, in scenarios where the species cannot always be detected with certainty. The occupancy model selection accounted with survey effort is influenced by habitat covariates.

Management Options

Option 1: Secure remaining forest area in Silago, Hinunangan and Sogod through protected area proclamation, but with scheme of sustainable management of resources.

Securing the remaining forest in the 3 localities will definitely have positive impact on biodiversity. We proposed that these areas are high priority for conservation and there is a need to proclaim this as protected area, but the proposed type of protected area will not be as conventional. Because many communities in these areas are dependent on forest natural products and in order to have an effective management of protected area, sufficient budget is needed. Putting economic value in protected area is quite essential to support the management of natural resources and sustain the community's basic needs. Therefore, this will be the first model of protected area in the Philippines where it allows sustainable extraction of resources. Having said this, strategic and sustainable management of our forest will simultaneously secure biodiversity and basic needs of the people.

Option 2: Expand forest area in Tomas Opus, Malitbog and Maasin by increasing reforestation activities and minimize the expansion of agricultural plantations.

Tomas Opus has the smallest forest fragment where based on the computed value it has a total of 4, 352.22 hectares of forest followed by Malitbog and Maasin. Expansion of forest in these 3 localities might be very expensive and requires extra effort, but this option is also important due to many species based on the model (Annex 9) will be affected by the decrease in forest. Numerous caves that serve as roosting sites for bats were also recorded in these areas and other import species of mammals were observed. Based on the model (Annex 11), avoiding 10% decrease of forest in Tomas Opus and at least 40-50 % in Malitbog and Maasin will have positive impact on biodiversity otherwise it will affect the species with large area of occupancy. Therefore, reduction or minimizing agricultural expansion will benefit both biodiversity and REDD+ initiatives. Avoiding forest degradation and increase of reforestation activities will enhance carbon stock.

Option 3: Designate permanent or shifting plot for agricultural activities and provide alternative livelihoods.

Defining permanent plots for agricultural activities will avoid forest degradation and reduce pressures on biodiversity. Our model (Annex 10) suggests that forest dependent species are highly vulnerable to fragmentation. Although, generalist species of birds, such as, C. viridis, P. elegans and G. gallus are likely benefiting from cultivated areas, but most of them are least concern compared to vulnerable species that are endangered and endemic. Creating permanent plots may seem contradictory especially when it comes soil nutrient cycle, thus shifting plots is another option. Establishment of shifting plots may allow soil to regain its nutrients and regenerate vegetation.

Providing alternative livelihoods will also reduce the impacts of degradation on biodiversity by diverting the community's practices (e.g. hunting) and interest.

V. IMPLICATIONS FOR MANAGEMENT PLANNING

The simple modeling exercise demonstrates how science can positively drive management in protected areas or REDD+ demonstration sites. In effect, the habitat associations of trigger species coupled with the occupancy (how much of the habitat each species uses) predicted impacts of habitat change on species can confidently be mitigated by a appropriately addressing the pressures on the species in relation to its level of tolerance; or revision of the management zoning of the incepient protected area. This would place the conservation of advanced secondary and old growth forest at the heart of the new management plan: any negative impacts on these areas risk compromising the protected area's ability to meet its mandated obligations to maintain its biodiversityvalues.Therefore,there areissues related to tenure or userights that have an impact on these key habitats,theseshouldbe reviewedandappropriate agreements be made.

It is important to recognise one feature shared by many of the priority-based evaluations for global conservation is that these areas are already in a marked state of degradation. Thus for example, 34 global hotspots have already lost c.80% of their primary vegetation (CI 2009). Even areas that receive higher degrees of protection status are highly vulnerable to threats outside the protected area boundaries, thus emphasising the need for realism and practicality, combined with solid scientific evidence, in any measures to minimise the impact of land use on biodiversity (Novacek & Cleland 2001). In the Philippines, there is a long history of traditional land tenure in most of the key areas for biodiversity conservation that are not yet legally declared. The process of establishing these sites as protected areas, includes imposition of protective legislation through management zones to prevent further degradation by controlling access by people resulting in conflicts because these zones are perceived to disenfranchise and marginalise many indigenous peoples, landowners, local farmers and residents (Bryant 2000; Dressler 2006). As a result, resolution of these conflicts become the major preoccupation of protected areas management. This, coupled with low technical capacity in protected areas' staff to measure conservation success, means conservation targets set in management planning become confined to result indicators that fail to monitor the response of biodiversity to management prescriptions. Thus management achievements are accounted for by the number of timber poachers apprehended or the number of wildlife/forest wardens deputised, not by monitoring the population increases or shrinkage of occupancy of/in threatened species or the expansion of areas of regeneration and rehabilitation. Clearly, approaches are needed improve the ability of protected area managers to set measurable conservation targets and monitor conservation success (Eken et al. 2004; Myers 2003b; Rodrigues et al. 2004b) whilst minimising social costs by promoting transparency, facilitating communications and fully involving all stakeholders (Brotherton 1996; De Lopez 2001; Hovardas & Poirazidis 2007; Severino 2000; Usongo & Nkanje 2004; Weladji & Tchamba 2003; White et al. 2002).

Habitat loss and fragmentation are two of the most pressing problems in wildlife management and biodiversity conservation (Shafer 1990) in developing countries (Anderson et al. 2007; Barbier 1993; Brook et al. 2003; Brooks et al. 1997a). In the Philippines, it was reported that at least 70% of the natural habitats had disappeared in the last 30 years and the remaining intact habitats are largely fragmented (Myers 2003a; Myers et al. 2000). The commonly used figures are based on land cover analysis of the Philippines stating that 97% of the country's lowland old growth has been lost (WRI/IUCN/UNEP/UNDP 1994), with annualchange in forest coverof −157,400 hectares or −2.1% /year (Tan 2000) owing to logging and conversion of forest to production and industrial areas, agriculture and residential areas (Kummer 1992a, b; Myers et al. 2000; Posa et al. 2008). Monitoring and forecasting theeffects of these habitat alterations on agreed biodiversity indicators, e.g. biodiversity intactness index etc., are currently lacking in many protected areas (Butchart et al. 2006a; Hess et al. 2006; Mace & Baillie 2007; Scholes & Biggs 2005), especially in the Philippines (Danielsen et al. 2005b; Dinerstein & Wikramanayake 1993). A number of monitoring methodologies such as remote-sensed 'change detection' protocols (Goosem 2007; Jeanjean & Achard 1997; Kintz et al. 2006; Knick & Rotenberry 2000; McDonald2003)provide useful information for protected areas to developmitigating measures. However, often thereis a lag between management decisions and the scales and speed at which these changes happen and are detected (Brook et al. 2003; Brooks et al. 1999; Ernoult et al. 2006; Myers 2003b). By the time these results have been handed over to protected area managers, large tracts of key habitats may have been cleared and a number of species displaced or extirpated. Tools are therefore needed to guide protected area manager in making sound management decisions as well as providing measures of change to serve as 'early warning signals' that trigger adaptive management.

Regional conservation plans are increasingly used to plan and protect biodiversity at large spatial scales, however, the means of quantitatively evaluating their effectiveness are rarely specified. Multiple-species approaches, particularly those which employ site-occupancy estimation, have been proposed as robust and efficient alternatives for assessing the status of wildlife populations over large spatial scales, but the implemented examples are few (Weller, 2008). Integration of occupancy modeling to BMS will improve the protocol as it would rectify the biases of imperfect detection cause by observers biases, influenced by environmental covariates and temporal changes (Mallari, 2009).

Baselining the current flora and fauna composition of a certain place provides better insight on how to design appropriate monitoring protocols. This inventory takes into account the species and ecosystem that need to be effectively prioritized through management measures based on the result of the study. One useful tool to obtain baseline data for the said study is to conduct ground truthing. Ground truthing is a tool in validating existing data and in analyzing historical trend of the study site. Though with the use of new technology, digital images of the site can now be obtained using satellite images. But the remote-sensed data or image can only provide useful information at a certain resolution prompting a need for ground truthing of which on the other hand provide more accurate and current data of the site.

Issues and Challenges in the Field

There have also been issues and challenges encountered by the team during the field activities of which are worth mentioning. The first and most important would have been the existing conflicting tenural instruments. The different tenurial claims of private individuals and government on the project area can hamper implementation of the project. In addition, ground truthing validation also resulted to a different land use description. Thus, it was highly recommended by the team that the issues regarding conflicting tenural instrument and land use description shall be settled with the assistance of the local government unit (LGU) prior to the project implemention. Lastly, weather condition especially the rain have been a factor in reduced mobility and visibility during the field survey.

Realities on the ground: The threats to biodiversity

Illegal collection and poaching of wildlife is rampant on the project site. There have been personal sightings of the team that wildlife were used as pets and food for personal comsumption and for sale on the market. Hunting of birds species such as doves and pigeon including *Varanus* and *Hydrocephalus*, threatened species such as *T. lucionensis* and *B. hydrocorax* are indeed unrestrained on the area. Another observation on the site was even on early age, some children were already practicing hunting of wildlife. These scenarios reflect the very poor knowledge in conservation on the said area. The need for an Information, Education and Communication (IEC) campaign regarding the importance of biodiversity should be taken into consideration. Aside from the IEC campaign, alternative livelihood should also be promoted on the area so the people will not result in wildlife trading.

Forest conversion to agriculture land is also one threat to the loss of biodiversity of the project site since most of the forest areas are now being used for planting crops for food and construction supplies. As observed, there are newly opened forest area on the project site that were converted into coconut and banana plantation. These land convertions lead to the degredation of forest cover and in turn affects the wildlife inhabiting the forest areas.

The conflicting land tenurialship as previously mentioned have a major effect on the land classification and conservation efforts of the LGU. According to the Defending the Gains of Tenurial Reforms Report, the complexities of implementation on the many laws on access to land require joint coordination of the different agencies of the government. It was also mentioned on the report that the mixed responsibilities resulted not only in backlogs but also contradicting implementation.
Thus, the need for this issue to be resolved prior to the implementation of the project is crucial for the project's success. In addition, other problems like hunting pressure on certain species and land conversion can be alleviated if tenurialinstruments are clear to the people.

Habitat are always prone to destruction during improper wildlife collections (i.e caves in Maasin). But it was ensured by the team that sampling protocols have been observed during the survey so as not to disturb habitat and species. Accessibilty of the area is a factor for conservation effort. If the area is far from human settlements, it is more likely to be prestine and preserved.

The identified issues and threats to biodiversity can be addressed by proper land use classification aided by strict implementation of policy and reforms that would strengthen sustainable conservation efforts though capability building of the stakeholders.

1. Data provides better insight on how to design monitoring protocols.
2. Remotely-sensed data or image can only give us useful information at a certain resolution (for management planning). Therefore, there is still a need for ground-thruthing.
3. Never under estimate a patch of forest.
4. Hunting pressure on certain species and land conversion can be alleviated if tenurial instruments are clear to the people.

VI. SUMMARY AND CONCLUSIONS

Key species with narrow niche width (low occupancy, very specific habitat requirements). These species include the Silvery Kingfisher *A. Argentata*, Rufous –lored Kingfisher *T. Winchelli*, Red jungle fowl *G. Gallus* (reduced niche width due to hunting pressure), Yellow-breasted Fruit-Dove *D. Poliocephala* , Mindanao shrew *Crocidura beatus, Philippine flying-lemur Cynocephalus volans,* Samar Squirrel *Sundasciurus samarensis, Apomys sp. and* Mindanao Batomys *Batomys solomonseni.*

Importance of intermediate habitats (riparian ecosystems). In management planning regimes, these are almost automatically designated as buffer zones! But clearly, this is where we find the highest species diversity and highest densities of key species.

Overstorey habitat characteristics influence the avifauna, heavily. understorey/undergrowth influence the distribution/abundance of non volant fauna (frogs, mammals).

Biodiversity surveys and species ordination were performed on three areas of the Southern Leyte lowland rainforest. It was found that Dipterocarpaceae, which historically dominates these lands, still registered as the most important family, with four important species identified belonging to this taxon. Shorea negrosensis (red lauan) was identified as the most important species.

Ordination of the species vis-à-vis the habitat parameters created two axes: one of increasing biomass and another of increasing disturbance. Based on these, regions on the biplots were identified: a region of thicker, less disturbed forest, and an area of thick yet disturbed forest. The locations of the species centroids in these areas then suggest their habitat preference. This contributes to knowledge than can be applied by forest managers during restoration activities.

Baseline studies on the current flora and fauna of a certain place provides better guidance in designing suitable monitoring system.

Remote-sensing data analysis demonstrated to be useful in generating information of an area but only at a certain resolution. However, ground truthing has been proven to be a more essential tool in terms of validating existing information of an area. Likewise,the results of the ground-truthing actvitiy in this study resulted to a different description of the surveyed area.

Conflicting tenurial instruments hindered the implementation of the project due to conflicting land classification, claims and responsibilities of the parties. However, it can be resolved through the local government unit (LGU) intervention.

Activities observed in the survey that threatens biodiversity included wildlife collection, forest conversion to agricultural uses and house construction. Poor knowledge on wildlife is has also been seen to be a contributory threat on the biodiversity of Southern Leyte.

The identified issues and threats on the biodiversity of Southern Leyte can be addressed by having proper land use classification coupled with a strict implementation of policy and reforms and the conduct of a comprehensive capacity building efforts to sustain conservation initiatives.

ANNEXES:

Annex 1.Species list of mammals in Silago, Hinunangan, Sogod and Maasin Southern, Leyte

Family	Scientific Name	Common Name	IUCN 2011	Silago	Hinunangan	Sogod	Maasin
Soricidae	*Crocidurabeatus*	Mindanao shrew	LC	X	X	X	
Cynocephalidae	*Cynocephalus volans*	Philippine flying lemur	LC			X	
Pteropodidae	*Acerodonjubatus*	Golden-capped fruit bat	EN			X	
	Cynopterusbrachyotis	Lesser dog-faced fruit bat	LC		X	X	X
	Eonycterisspelaea	Dawn bat	LC	X	X	X	X
	Haplonycterisfischeri	Philippine pygmy fruit bat	LC	X	X	X	X
	Harpyionycteriswhiteheadi	Harpy fruit bat	LC	X	X		
	Macroglossusminimus	Dagger-toothed Long-nosed Fruit Bat	LC	X	X	X	X
	Megaeropswetmorei	White-collared Fruit Bat			X		
	Ptenochirusjagori	Greater Musky Fruit Bat	LC	X	X	X	X
	Ptenochirus minor	Lesser Musky Fruit Bat	LC	X	X	X	X
-	*Pteropushypomelanus*	Island Flying fox	LC			X	
-	*Pteropusvampyrus*	Large flying-fox	NT			X	
	Rousettusamplexicaudatus	Geoffroy'sRousette	LC	X	X	X	X
Emballonidae	*Emballonuraalecto*	Small Asian Sheath-tailed Bat, Philippine Sheath-tailed Bat					X
Megadermatidae	*Megadermaspasma*	Lesse false vampire	LC				X
Hipposididae	*Hipposiderosater*	Dusky Leaf-nosed Bat, Bi-coloured Leaf-nosed Bat, Dusky Roundleaf Bat		X			
	Hipposideros bicolor	Bicolored Leaf-nosed Bat		X			
Rhinolophidae	*Rhinolophusarcuatus*	Arcuate Horseshoe Bat	LC	X			
	Rhinolophusinops	Philippine Forest Horseshoe Bat	NT		X		X
	Rhinolophusphilippinensis	Philippine Forest Horseshoe Bat					X
	Rhinolophussubrufus	Small Rufous Horseshoe Bat		X			X
Vespertilionidae	*Myotismuricola*	Nepalese Whiskered Myotis	LC	X			
Tarsiidae	*Tarsiussyrichta*	Philippine tarsier	NT	X	X	X*	X*
Cercopithecidae	*Macacafascicularis*	Crab-eating Macaque	LC	X	X*	X	X*
Sciuridae	*Exilisciurusconcinnus*	Philippine Pygmy Squirrel	LC				
	Sundasciurussamarensis	Samar Squirrel	LC	X*	X*	X*	
Muridae	*Apomys sp.*			X	X	X	
	Batomyssalomonseni	Mindanao Batomys	LC			X	
	Bullimusbagobus	Mindanao Bullimus	LC		X	X	X
	Rattuseveretti	Philippine Forest Rat	LC	X	X	X	X
	Rattustanezumi	Oriental House Rat	LC		X		X
Viveridae	*Paradoxurushermaphroditus*	Common Palm Civet	LC	X*	X*	X*	X*
	Viveratangalunga	Malay Civet tangalunga					
Suidae	*Susbarbatusmindanensis*		VU	X*	X*	X*	
Cervidae	*Cervusmariannus*	Philippine Brown Deer	VU				

Note: X species present in the area, but not captured.*

Annex 2. List of birds recorded in during the survey in southern Leyte on November to December 2011

COMMON NAME	SCIENTIFIC NAME	LOCAL NAME	Range	IUCN Conservation Status 2011
ARDEIDAE				
Black-crowned Night−Heron	*Nycticorax nycticorax*		M	LC
ACCIPITRIDAE				
Oriental Honeybuzzard	*Pernis ptilorhynchus*		R	
Barred Honeybuzzard	*Peris celebensis*		R	
Brahminy kite	*Haliastur indus*	*Banog*	R	LC
Philippine Serpent−Eagle	*Spilornis holospilus*		R	LC
Philippine Hawk-Eagle	***Splzaetus philippinensis***	***Banog***	**E**	
FALCONIDAE				
Philippine Falconet	***Microhierax erythrogenys***		**E**	**LC**
PHASIANIDAE				
Red Junglefowl	*Gallus gallus*	*manok-ihalas*	R	LC
RALLIDAE				
Barred Rail	*Gallirallus torquatus*	*kee-jaw*	R	LC
Slaty-legged Crake	*Rallina eurizonoides*		R	LC
Plain Bush−hen	***Amaurornis olivaceus***	***tik-ling***	**E**	**LC**
COLUMBIDAE				
White-eared Brown-Dove	***Phapitreron leucotis***		**E**	
Amethyst Brown−Dove	***Phapitreron amethystina***		**E**	**LC**
Yellow-breasted Fruit−Dove	***Ptilinopus occipitalis***		**E**	**LC**
Black-chinned Fruit−Dove	***Ptilinopus leclancheri***	***punay***	**E**	**LC**
Pink-bellied Imperial−Pigeon	***Ducula poliocephala***	***antulihaw***	**E**	**NT**
Green Imperial−Pigeon	*Ducula aenea*		R	LC
Metallic Pigeon	*Columba vitiensis*			
Philippine Cuckoo−Dove	***Macropygia tenuirostris***		**R**	**LC**
Island Collared−Dove	*Streptopelia bitorquata*		R	LC
Common Emerald−Dove	*Chalcophaps indica*		R	LC
Mindanao Bleeding-Heart	***Gallicolumba criniger***		**E**	
PSITTACIDAE				
Guaiabero	***Bolbopsittacus lunulatus***		**E**	
Blue-naped parrot	***Tanygnathus lucionensis***	***periko***	**E**	
Blue-backed Parrot	*Tanygnathus sumatranus*		R	
Blue-crowned Racquet-tail	***Prioniturus discurus***	***managing***	**E**	
Colasisi	***Loriculus philippensis***	***kusi***	**E**	
CUCULIDAE				
Hodgson's Hawk-Cuckoo	*Cuculus fugax*		R	
Drongo Cuckoo	*Surniculus lugubris*		R	LC
Philippine Coucal	***Centropus viridis***	***kookook***	**E**	**LC**
Black-faced Coucal	***Centropus melanops***	***kookook sa lasang***	**E**	**LC**
STRIGIDAE				
Philippine Scops-Owl	***Otus megalotis***		**E**	**LC**
Philippine Hawk−Owl	***Ninox philippensis***		**E**	**LC**
PODARGIDAE				
Philippine Frogmouth	***Batrachostomus septimus***		**E**	**LC**
CAPRIMULGIDAE				
Great Eared Nightjar	*Eurostopodus macrotis*		R	LC
Philippine Nightjar	*Caprimulgus manillensis*		R	LC
APODIDAE				
Glossy Swiftlet	*Collocalia esculenta*		R	LC
Pygmy Swiftet	***Collocalia troglodytes***		**E**	**LC**
Philippine Needletail	***Mearnsia picina***		**E**	**NT**
HEMIPROCNIDAE				
Whiskered Treeswift	*Hemiprocne comata*		R	LC
TROGONIDAE				
Philippine Trogon	***Harpactes ardens***		**E**	**LC**
CORACIIDAE				
Dollarbird	*Eurystomus orientalis*	*bawud*	R	LC
ALCEDINIIDAE				
Silvery Kingfisher	***Alcedo argentata***		**E**	**VU**
Philippine Dwarf-Kingfisher	***Ceyx melanurus***		**E**	**VU**

Annex 2. List of birds recorded in during the survey in southern Leyte on November to December 2011

COMMON NAME	SCIENTIFIC NAME	LOCAL NAME	Range	IUCN Conservation Status 2011
White-throated Kingfisher	*Halcyon smyrnensis*	*tikaraw*	R	LC
Rufous-lored Kingfisher	***Todirhamphus winchelli***	***tikaraw***	**E**	**VU**
White-collared Kingfisher	*Todirhamphus chloris*	*tikaraw*	R	LC
MEROPIDAE				
Blue-throated Bee−eater	*Merops viridis*		R	LC
Blue-tailed Bee−eater	*Merops philippinus*		R	LC
BUCEROTIDAE				
Tarictic Hornbill	***Penelopides panini***	***tawas***	**E**	**EN**
Rufous Hornbill	***Buceros hydrocorax***	***kalaw***	**E**	**NT**
CAPITONIDAE				
Coppersmith Barbet	*Megalaima haemacephala*		R	LC
PICIDAE				
Philippine Pygmy Woodpecker	***Dendrocopos maculatus***	***batok***	**E**	**LC**
Sooty Woodpecker	***Mulleripicus funebris***	***batok***	**E**	**LC**
White-bellied Woodpecker	*Dryocopus javensis*	*batok*	R	LC
Greater Flameback	*Chrysocolaptes lucidus*	*batok*	R	LC
EURYLAIMIDAE				
Visayan Wattled Broadbill	***Eurylaimus samarensis***		**E**	**VU**
PITTIDAE				
Hooded Pitta	*Pitta sordida*		R	LC
Steere's Pitta	***Pitta steerii***		**E**	**VU**
HIRUNDINIDAE				
Pacific Swallow	*Hirundo tahitica*		R	LC
CAMPEPHAGIDAE				
Bar-bellied Cuckoo-shrike	*Coracina striata*			
Black-bibbed Cuckoo-shrike	*Coracina mindanensis*			
Pied Triller	*Lalage nigra*		R	LC
PYCNONOTIDAE				
Yellow-vented Bulbul	*Pynonotus goiavier*		R	
Yellow-wattled Bulbul	***Pynonotus urostictus***		**E**	
Philippine Bulbul	***Ixos philippinus***	***tagbida***	**E**	
Yellowish Bulbul	***Ixos everetti***		**E**	**LC**
DICRURIDAE				
Spangled Drongo	*Dicrurus hottentottus*		R	LC
ORIOLIDAE				
Philippine Oriole	***Oriolus steerii***		**E**	**LC**
Black-naped Oriole	*Oriolus chinensis*	*orion*	R	LC
Philippine Fairy-Bluebird	*Irena cyanogaster*			
CORVIDAE				
Large-billed Crow	*Corvus macrorhynchos*		R	LC
PARIDAE				
Elegan Tit	***Parus elegans***		**E**	**LC**
SITTIDAE				
Velvet-fronted Nuthatch	*Sitta frontalis*		R	LC
Sulphur-billed Nuthatch	*Sitta oenochlamys*			
RHABDORNITHIDAE				
Stripe-headed Rhabdornis	***Rhabdornis mysticalis***		**E**	
TIMALIIDAE				
Streaked Ground-Babbler	***Ptilocichla mindanensis***		**E**	**LC**
Pygmy Babbler	***Stachyris plateni***		**E**	**NT**
Brown Tit-Babbler	***Macronus striaticeps***		**E**	**DD**
Miniature Tit−Babbler	***Micromacronus leytensis***		**E**	**DD**
SYLVIIDAE				
Philippine Leaf−Warbler	***Phylloscopus olivaceus***		**E**	**LC**
Philippine Tailorbird	***Orthotomus castaneiceps***		**E**	**LC**
Yellow-breasted Tailorbird	***Orthotomus samarensis***		**R**	**NT**
MUSCICAPIDAE				
Grey-streaked Flycatcher	*Muscicapa griseisticta*		M	LC
Mangrove Blue Flycatcher	*Rhinomyias ruficauda*		R	LC
Citrine Canary-Flycatcher	*Culicicapa helianthea*		R	LC
Blue-headed Fantail	*Rhipidura cyaniceps*		E	
PACHYCEPHALIDAE				
Yellow-Bellied Whistler	***Pachycephala philippinensis***		**E**	**LC**
MOTACILLIDAE				

Annex 2. List of birds recorded in during the survey in southern Leyte on November to December 2011

COMMON NAME	**SCIENTIFIC NAME**	**LOCAL NAME**	**Range**	**IUCN Conservation Status 2011**
Grey Wagtail	*Motacilla cinerea*		M	LC
Yellow Wagtail	*Motacilla flava*		M	LC
ARTAMIDAE				
LANIIDAE				
Brown Shrike	*Lanius cristatus*		M	LC
STURNIDAE				
Asian Glossy Starling	*Aplonis panayensis*		R	LC
Coleto	***Sarcops calvus***		**E**	**LC**
NECTARINIIDAE				
Plain-throated Sunbird	*Anthreptes malacensis*		R	LC
Olive-backed Sunbird	*Cinnyris jugularis*		R	LC
Purple-throatd sunbird	*Leptocoma sperata*		R	LC
Metallic-winged Sunbird	***Aethopyga pulcherrima***		**E**	**LC**
Lovely Sunbird	***Aethopyga shelleyi***		**E**	**LC**
Naked-faced Spiderhunter	***Arachnothera clarae***		**E**	**LC**
Little Spiderhunter	*Arachnothera longirostra*		R	LC
DICAEIDAE				
Olive-backed Flowerpecker	***Prionochilus olivaceus***		**E**	**LC**
Bicolored Flowerpecker	***Dicaeum bicolor***		**E**	**LC**
Red-keeled Flowerpecker	***Dicaeum australe***		**E**	**LC**
Buzzing Flowerpecker	***Dicaeum hypoleucum***		**E**	**LC**
Orange-bellied Flowerpecker	*Dicaeum trigonostigma*		R	LC
Pygmy Flowerpecker	***Dicaeum pygmaeum***		**E**	**LC**
ZOSTEROPIDAE				
Everette's White-eye	*Zosterops everetti*		R	LC
ESTRILDIDAE				
White-bellied Munia	*Lonchura leucogastra*		R	LC

*** bold= endemic**

Annex 3. List of Amphibians and Reptiles with conservation status and site location.

Family	**Scientific Name**	**Common Name**	**IUCN 2011 Status**	**Silago**	**Hinunangan**	**Sogod**	**Maasin**
	Frogs						
Bufonidae	*Pelophryni lighti*					X	
Ceratobatrachidae	***Platymantis bayani***	Limestone-forest frog					
	Platymantis corrugatus	Rough-Backed Forest Frog	LC	X	X	X	
	Platymantis guentheri	Guenther's Forest Frog		X	X	X	X
	Platymantis rabori	Rabor's Forest Frog	VU			X	
	Platymantis sp. A (new species)		DD				X
	Platymantis sp. B (new species)		DD			X	
	Platymantis sp. C		DD			X	
Dicroglossidae	*Limnonectes leytensis*	Small Disked Frog	LC	X			
	Limnonectes magnus	Giant Philippine Frog	NT	X	X	X	
	Occidozyga laevis	Common Puddle Frog	LC	X	X	X	
	Fejervarya cancrivora	Crab-eating Frog	LC				
	Fejervarya vittigera		LC		X		X
Megophryidae	*Megophrys stejnegeri*	Mindanao horned frog	VU	X	X	X	
Microhylidae	*Kalophrynus pleurostigma*	Black-spotted Sticky Frog	LC	X	X		X

Annex 3. List of Amphibians and Reptiles with conservation status and site location.

Family	Scientific Name	Common Name	IUCN 2011 Status	Silago	Hinunangan	Sogod	Maasin
	Kaloula sp.			X	X	X	
Ranidae	***Hylarana grandocula***		LC				
	Sanguirana albotuberculata		DD				
	Staurois natator	Black-spotted Rock Frog	LC	X		X	
Rhacophoridae	*Nyctixalus spinosus*	spiny tree frog	VU			X	
	Philautus leitensis	Leyte Tree Frog	VU	X	X	X	X
	Polypedates leucomystax	White-lipped tree frog	LC				X
	Rhacophorus appendiculatus	Southeast Asian Tree Frog	LC	X	X		X
	Rhacophorus bimaculatus	Tree Frog	VU		X	X	
	Rhacophorus pardalis	Tree Frog	LC	X		X	
	Turtles						
Geoemydidae	*Cuora amboinensis*	Southeats Asian Box Turtle	VU				X
	Lizards						
Agamidae	*Bronchocoela cristatella*	Green Crested Lizard				X	X
	Draco cyanopterus				X		
	Draco mindanensis	Mindanao Flying Lizard	VU		X		
	Gonocephalus semperi	Mindanao Forest Dragon	DD	X	X	X	
	Hydrosaurus pustulatus	Sailfin Water Lizard	VU				
Gekkonidae	*Cyrtodactylus gubaot**						
	Hemidactylus frenatus	Common House Gecko	LC			X	
	Pseudogekko compressicorpus	Cylindrical-bodied Smooth-scaled Gecko	LC	X			X
Scincidae	***Brachymeles orientalis***	Southern Burrowing Skink					
	Brachymeles paeforum*						
	Brachymeles* cf. *talinis	Duméril's Short-legged Skink	LC				
	***Brachymeles* sp. (possible new species)**						
	Eutropis multicarinata multicarinata			X		X	
	Otosaurus cumingii	Cuming's Sphenomorphus			X		
	Parvoscincus steerei	Steere's Sphenomorphus				X	
	Pinoyscincus coxi coxi	Cox's Sphenomorphus				X	X
	Pinoyscincus jagori	Jago's Sphenomorphus		X	X	X	X
	Pinoyscincus mindanensis	Mindanao Sphenomorphus		X			
	Sphenomorphus acutus	Pointed-headed Sphenomorphus	LC	X			
	Sphenomorphus fasciatus	Banded Sphenomorphus	LC			X	X
	Sphenomorphus variegatus			X	X	X	
Varanidae	*Varanus cumingi*	Mindanao Water Monitor	LC			X	
	Snakes						
Boidae	*Python reticulatus*	Reticulated python				X	
Colubridae	*Ahaetulla prasina preocularis*	Gunther's whip snake,	LC			X	X
	Aplopeltura boa	Blunt-headed Slug Snake	LC				X

Annex 3. List of Amphibians and Reptiles with conservation status and site location.

Family	Scientific Name	Common Name	IUCN 2011 Status	Silago	Hinunangan	Sogod	Maasin
	Boiga cynodon	Dog Toothed Cat Snake		X			
	Calamaria lumbricoidea	Variable Reed Snake	LC				X
	Coelognathus erythrura	Reddish Rat Snake				X	
	Cyclocorus nuchalis taylori	Southern Triangle-spotted Snake	LC				
	Dendrelaphis caudolineatus	Striped Bronzeback					X
	Lycodon aulicus	Common Wolfsnake				X	
	Lycodon ferroni		DD			X	
	Oligodon modestum	Luzon Kukri Snake	VU	X	X	X	
	Oxyrhabdium modestum	Philippine Shrub Snake		X	X	X	
	Psammodynastes pulverulentus	Common Mock Viper		X		X	
	Rhabdophis auriculata auriculata	White-lined Water Snake	LC				
	Tropidonophis dendrophiops	Spotted Water Snake	LC	X			
	Tropidonophis negrosensis		VU			X	
Elapidae	*Naja samarensis*	Samar Cobra,	LC	X			
Typhopidae	*Typhlops* sp.	Blind Snake			X		
Viperidae	*Trimeresurus flavomaculatus*	Philippine pitviper	LC	X			
	Tropidolaemus wagleri	Wagler's pit viper			X		

Annex 4. Floristic Composition of Samar-Leyte Island

Family Name	Scientific Name	Common Name	Extent of Occurrence	IUCN Status
Achariaceae	*Pangium edule* Reinwardt	Pangi		
	Trichadenia zeylanica			
Adoxaceae	*Samcubus javanica*			
Alangiaceae	*Alangium longiflorum* Merr.	Apitan		V
	Alangium meyeri			
Anacardiaceae	*Dracontomelon dao* (Blco) Merr. & Rolfe	Dao		
	Koordersiodendron pinnatum (Blco) Merr.	Amugis		
	Mangifera altissima Blco.	Pahutan		V
	Mangifera monandra Merr.			V
	Rhus taitensis Guill.			
Annonaceae	*Cananga odorata* (Lamk.) Hook.	Ilang-ialng		
	Cyatocalex pruniferus			
	Dysymanchalon closiflorum			
	Goniothalamus elmeri Merr.			
	Polyanthea lateriflora			
Apocynaceae	*Alstonia macrophylla* Wall. ex. G. Don	Batino		LR
	Alstonia scholaris (L.) R. Br.	Dita		
	Kibatalia merrilliana		Endemic	V
	Kibatalia puberula		Endemic	E
	Tabernaemontana pandacaqui Poir.	Kampupot		
	Voacanga globosa (Blco.) Merr.	Bayag-usa		
Araliaceae	*Osmoxylon trilobatum* (Merr.)			
	Polyscias nodosa (Bl.) Seem.	Malapapaya		
	Scheftera sp			
Arecaceae	*Areca sp.*			
	Caryota rumphiana	Takipan		
	Livistona rotundifolia	Anahaw		

Annex 4. Floristic Composition of Samar-Leyte Island

Family Name	Scientific Name	Common Name	Extent of Occurrence	IUCN Status
	Oncospermum horridum	Anibong		
	Orania decipiens		Endemic	
		Sagisi		
	Pinanga insignis Becc.	Sarauag	Endemic	
	Pinanga maculata Porté ex Lem.	Molted abiki	Endemic	
	Calamus sp.	Ilhiun (Rattan)		
	Calamus sp.	Amerikan (Rattan)		
	Calamus sp.	Tambunganga (rattan)		
	Calamus sp.	Sahaan (Rattan)		
Aspleniaceae	*Asplenium nidus* L.	Pakpak-lawin		
	Asplenium tenerum Forst.			
Arauacariaceae	*Agathis philippinensis*	Almaciga	Endemic	V
Bignoniaceae	*Oroxylum indicum* (L.) Vent.	Tui		
	Spatthodea companulata	African tulip		
Boraginaceae	*Cordia dichotoma*			
Burseraceae	*Canarium asperum* Benth.	Pagsahingin		
	Dacryodes rostrata Lamarck	Kembayau		LC
Cannabaceae	*Celtic philippinensis*	Magabuyo	Endemic	V
	Gironniera celtidifolia Gaudich.			
	Parasponia rugosa			
	Trema orientalis (L.) Bl.	Anabiong		
Casuarinaceae	*Casuarina nodiflora syn rumphiana* Miq.	Mountain agoho		
Chloranthaceae	*Sarcandra glabra* (Thunb.) Nakai			
Calophyllaceae	*Calophyllum blancoi* Pl. & Tr.	Bitangol		
	Calophyllum soulattri Burm. f.	Bintanggor		LC
	Calophyllum macrocarpum			
Clusiaceae	*Garcinia rubra* Merrill	Kamandiis		R
	Garcinia bentami	Bunog		
	Garcinia binucao			
Combretaceae	*Terminalia nitens* Presl.	Sakèt		V
	Terminalia foetidissima	Talisay gubat		
Cyatheaceae	*Cyathea negrosiana Christ.*			R
	Cyathea moluccana			
	Cyathea contaminans			
Cunoniaceae	*Weinmannia camiguinensis*			
Dilleniaceae	*Dillenia indica*	Katmon		
	Dillenia megalantha Merr.	Katmon		V
	Dillenia philippinensis Rolfe	Katmon	Endemic	V
Dipterocarpaceae	*Dipterocarpus validus* (Blume)	Hagakhak		CE
	Hopea acuminata Merrill	Manggachapui	Endemic	CE
	Hopea quisumbingiana Gutierrez	Quisumbing Gisok (Subyang)	Endemic	CE
	Parashorea malaanonan (Blanco)	Bagtikan		CE
	Shorea almon	Almon		CE
	Shorea astylosa Foxworthy	Yakal	Endemic	CE
	Shorea negrosensis	Red-lauan	Endemic	CE
	Shorea palosapis syn squamata	Mayapis	Endemic	CE
	Shorea/Pentacme contorta	White-lauan	Endemic	CE
	Shorea polysperma	Tangile	Endemic	CE
	Shorea seminis	Malayakal (Uwayan)		
		Red uwayan		
		White uwayan		
		Uwayan kule		
Ebenaceae	*Diospyros blancoi A. DC.*	Mabolo		
	Diospyros pilosanthera Blco.	Bulong-eta		
	Diospyros pyrrhocarpa Miq.	Anang		
Euphorbiaceae	*Antidesma nitidum* Tul.			
	Blumeodendron subrotundifolium			
	Havea brasiliensis	Para-rubber		
	Homalanthus macradenius	Banti (small leaf)		
	Homalanthus sp1	Banti (small and rounded leaf)		
	Homalanthus sp2	Banti (big and rounded leaf)		
	Macaranga bicolor	Hamindang	Endemic	V
	Macaranga grandifolia(Blcol.) Merr.	Takip-asim	Endemic	V
	Macaranga hispida (Bl.) Muell.-Arg.			
	Macaranga tanarius (L.) Muell.-Arg.	Binunga		

Annex 4. Floristic Composition of Samar-Leyte Island

Family Name	Scientific Name	Common Name	Extent of Occurrence	IUCN Status
	Macaranga gigantifolia	Binunga (Big leaf)		
	Mallotus mollisimus			
	Mallotus philippensis (Lam.) Muell.-Arg.		Endemic	
	Melanolepis multiglandulosa (Reinw.)	Alim		
	Mallotus cumingii (Muell.-Arg.)	Apanang	Endemic	
	Phyllanthus leytensis Elm.		Endemic	
	Securinega flexousa Mueller	Anislag		
Fabaceae	*Acacia auriculiformes*	Auri		
	Afzelia rhomboidea (Blanco) Vidal	Tindalo/Balayong		V
	Archidendron clypearia (Jack) I.C. Nielsen	Unaki		
	Bauhinia integrifolia Roxb.	Agpoi/Orchid tree		
	Bauhinia sp	Vine		
	Cynometra bipinnata			
		Matang-hipon		
	Erythrina subumbrans (Hassk.) Merr.	Rarang/Anii		
	Glericidia sipium	Kakawati		
	Leucaena leocucephala	Ipil-ipil		
	Pterocarpus indicus Willd.	Narra	Endemic	V
	Parkea speciosa	Kupang		
	Saraca sp.(Narrow and opposite leaves)			
	Saraca sp.Narrow and decossotes leaves)			
	Senna alata	Palomaria		
	Wallaceodendron celebicum Koord	Banuyo		
Fagaceae	*Lithocarpus buddii* (Merr.) A. Camus	Babaisakan	Endemic	
Gentianaceae	*Fagraea auriculata* Jack			
	Fagraea racemosa Jack ex Wall.	Marikaba		
Gesneriaceae	*Cyrtandra oblongata*			
Gnetaceae	*Gnetum gnemon L. var. gnemon*	Bago		LC
Hernandiaceae	*Illigera luzoniensis* (Presl) Merr.	Binat, Kuripatong	Endemic	
Hydrangeaceae	*Ditchroa febrifuga*			
Lauraceae	*Actinodaphne pruinosa*	Puso-puso		
	Cinnamomum mercadoi Vid.	Kalingag		V
	Litsea leytensis Merr.	Batikulin	Endemic	
Malvaceae	*Cieba pentandra*	Kapok		
(Sterculiaceae)	*Colona sp*			
	Commersonia bartramia			
	Durio sp.	Durian		
	Hibiscus tiliaceus			
	Kleinhovia hospida L.	Tan-ag		
	Pterospermum celebicum Miq.	Bayok-bayukan		
	Pterospermum diversifolium Bl.	Bayok		
Marattiaceae	*Angiopteris evecta* (Forst.) Hoffm.			
	Marattia pellucida Presl.			
Melastomataceae	*Astronia candolleana*			
	Medinilla cumingii			
	Medinilla magnifica			
	Melastoma malabathricum	Amumusing		
	Melostoma sp. (hairy)			
	Ptenandra hirta			
Meliaceae	*Aphanamixis polystachia* (Wall.) R.N. Parker	Kangko		
	Chisocheton pentandrum (Blancoi)	Katong-matsing		
	Dysoxylum arborescens (Blume) Miq.	Kalimutain		
	Sandoricum koetjape	Santol		
	Sandoricum sp	Santol-gubat		
	Swietenia micropylla	Mahugany		
	Toona calantas Merr. & Rolfe	Kalantas	Endemic	DD
Moraceae	*Artocarpus blancoi (Elm.)* Merr.	Antipolo		
	Artocarpus heterophylla	Nangka		
	Artocarpus nitidus			
	Ficus alstisimma	Tangisang layogan		
	Ficus balete Merr.	Balete		
	Ficus benjamina L.	Weeping Fig		
	Ficus botryocarpa Miq.	Basikong		
	Ficus fistulosa Reinw. ex Bl.			
	Ficus minahassae Miq	Hagimit		

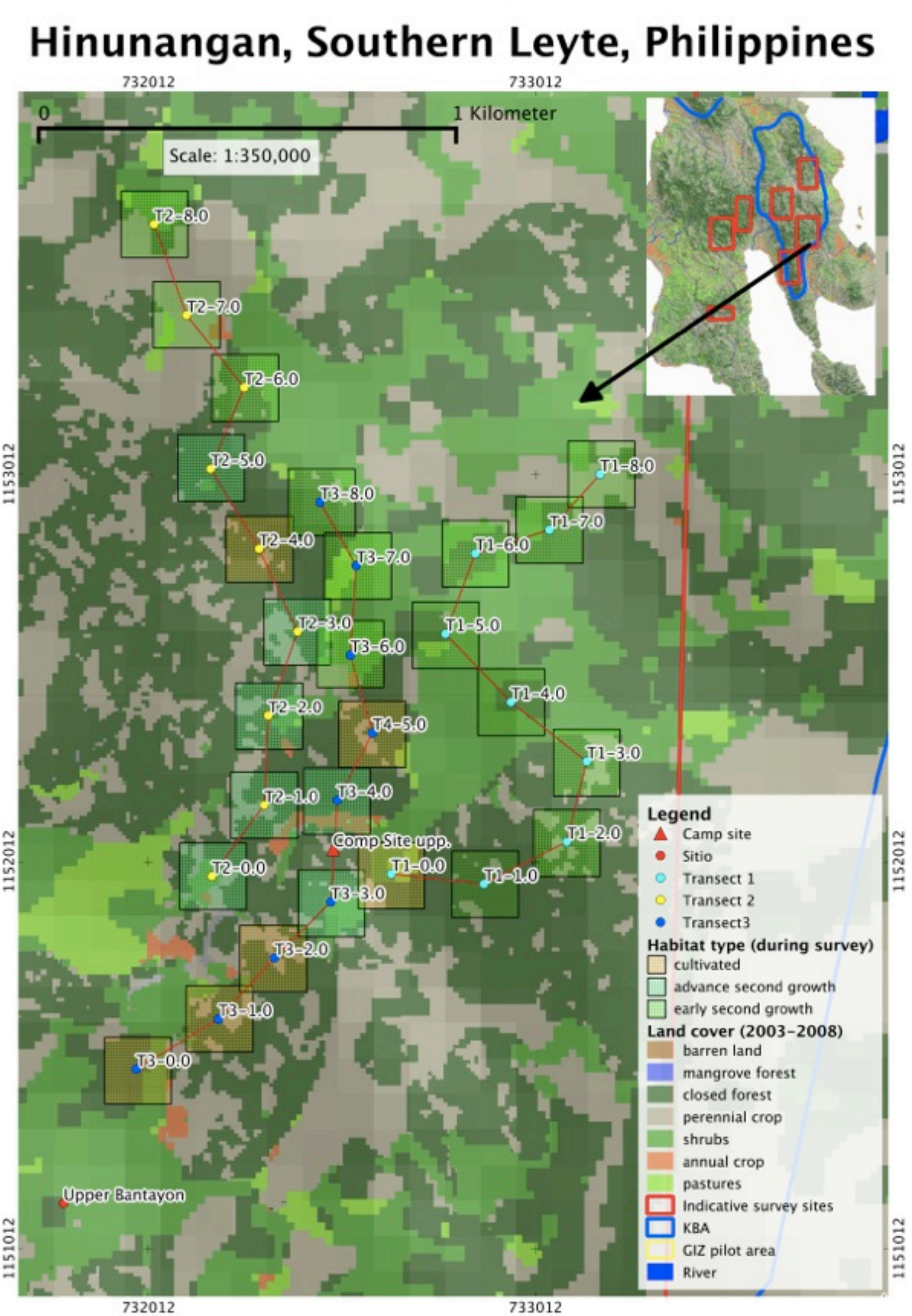
Annex 4. Floristic Composition of Samar-Leyte Island

Family Name	Scientific Name	Common Name	Extent of Occurrence	IUCN Status
	Ficus odorata (Blco.) Merr.	Pakiling	Endemic	
	Ficus nota	Tebeg		
	Ficus septica	Hawili		
	Ficus ulmifolia	Is-is	Endemic	V
	Ficus variegata	Tangisang bayawak		
Myristicaceae	*Myristica philippensis* Lamarck	Duguan	Endemic	V
Myrsinaceae	*Ardisia squamulosa* Presl	Tagpo	Endemic	
	Ardisiapyramidalis			
	Discocalyx lnearifolia.			
	Loheria classifolia			
Myrtaceae	*Melaleuca cajaputi*			
	Syzygium aqueum	Makupa/Water apple		V
	Syzygium calobkob	Sagimsim		
	Syzygium curranii	Curran Lipoti		
	Syzygium samarangense			
	Tristania decorticata	Malabayabas		V
	Tristaniopsis whiteana	Tiga		
Pandanaceae	*Pandanus (Big)*			
	Pandanus (Small)			
	Pandanus (Climber)			
Phyllanthaceae	*Antidesma bunius*			
	Aporusa			
Piperaceae	*Piper adduncum*			
Poaceae	*Imperata cylindrica*	Kogon		
Polygalaceae	*Polygala venenosa* Juss. ex Poir.			
Polypodiaceae	*Drynaria quercifolia L. (J. Sm)*	Oak-left fern		
Proteaceae	*Helicia velutina*			
Pteridaceae	*Pteris spp*			
	Pneumatopteris laevis			
	pleiocnemia irregularis			
Rhamnaceae	*Ziziphus angustifolius* (Miq.)			
Rosaceae	*Prunus arborea* (Bl.) Kalkm. var. arborea			
	Prunus grisea (Bl,) Kalkm. var. grisea	Lago		LC
	Rubus fraxinifolius Poiret	Pinit/wild strawberry		
Rubiaceae	*Coffea sp.*	Kape		
	Ixora sp.			
	Lasianthus cf. obliquinerva Merr.			
	*Mussaenda philippica*Elm.	Kahoy dalaga		
	Nauclea officinalis	Bangkal		
	Neonauclea formicaria (Elm.) Merr.			
	Praravinia cf. mindanensis (Elm.) Brem.			
	*Psychotria pallidifolia*Merr.			
	Timonius arboreus Merr.			
Rutaceae	*Lunasia amara* Blco.			
	Micromelum compressum (Blco.) Merr.	Piris		
Sapindaceae	*Acer laurinum*	Baliag		
	Allophyllus cobbe (L.) Raeuschel	Tit berry		
	Brucea mollis			
	Nepheliumlappaceum	Rambutan		
	Nephelium sp	Ituman		
	Pometia pinnata Forst.	Malugai		
Sapotaceae	*Palaquium philippense* (Perr.) C. B. Rob.	Nato	Endemic	V
Schizaeaceae	*Lygodium auriculatum* (Willd.) Alst. et Holtt.			
	Lygodium circinatum (Burm.) Sw.	Nito		
Solanaceae	*Solanum anisophyllum* Elm.			
	Solanum ferox L.	Tarambulo/Tarong-tarong		
Taccaceae	*Tacca palmata* Bl.	Payung-payong		
Taenitidaceae	*Taenitis blechnoides* (Willd.) Sw.			
Tectariaceae	*Pleocnemia irregularis* (Presl) Holttum			
Tetramelaceae	*Octomeles sumatrana* Miq.	Binuang		LC
Thelypteridaceae	*Pneumatopteris laevi*s (Mett.) Holttum		Endemic	
Urticaceae	*Dendrocnide meyeniana*	Lipa		
	Leucosyke capitellata (Poir.) Wedd.	Alagasi		
Lamiaceae	*Clerodendrum interiudium*			
	Gmelina arborea	Yemane		

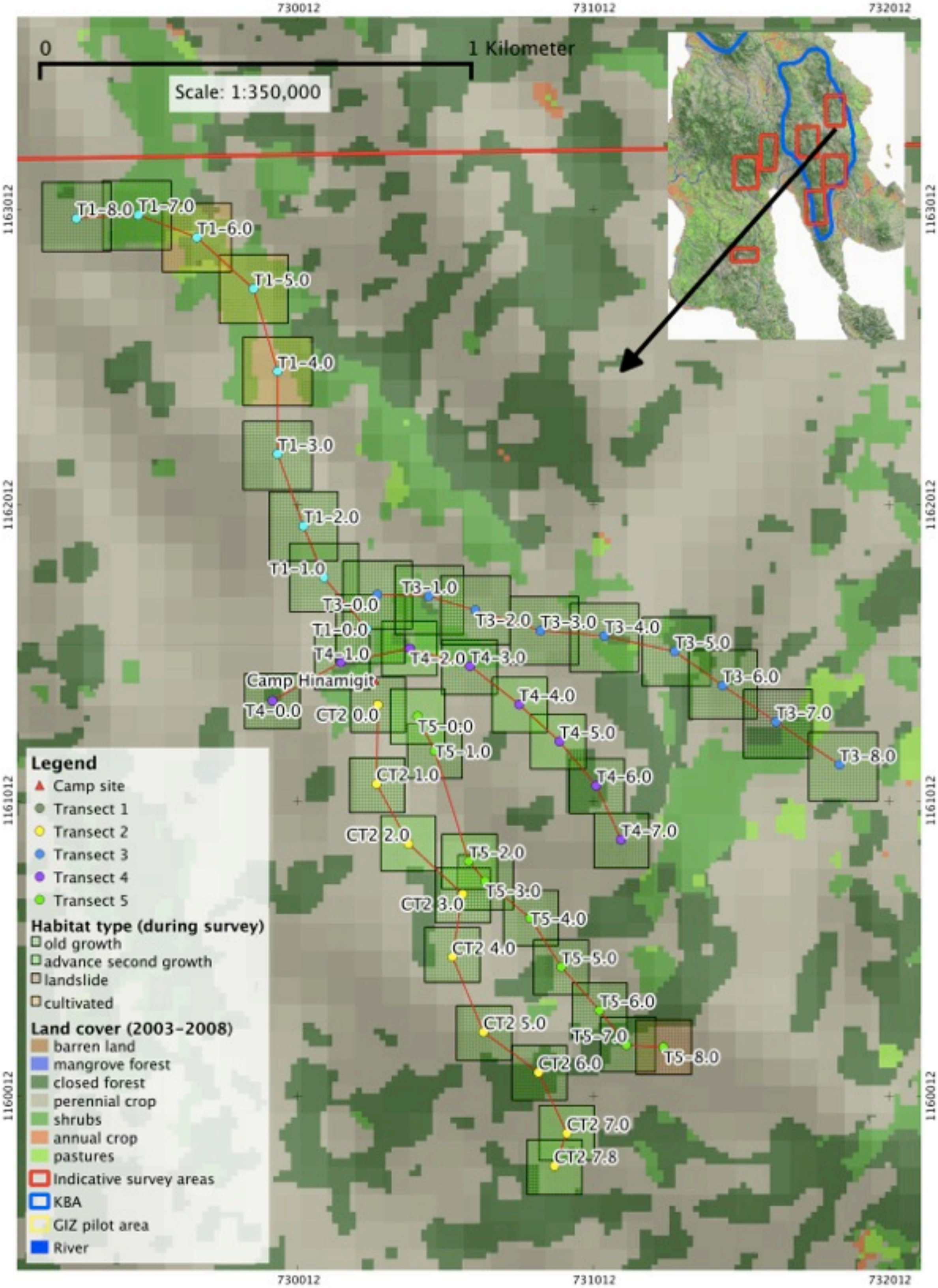
Annex 4. Floristic Composition of Samar-Leyte Island

Family Name	Scientific Name	Common Name	Extent of Occurrence	IUCN Status
	Lantana camara			
	Premna odorata Blco.	Kantutay		
	Vitex parviflora Jussieu	Molave		V
	Vitex quinata			
Anonymous	*Nepenthes sp1*	Pitcher plant		
	Nepenthes sp2	Pitcher plant (Medium)		
	Nepenthes sp3	Pitcher plant (Big)		
	Dicranopteris linearis			
	Dicranopteris linearis-Big			
		Bukawi (Running bamboo)		
		Balikaw (Running bamboo)		
		Hagonoy		
		Triskantos (Grass)		
	Begonia fucsioides	Begonia small leaf		
	Begonia sp	Begonia big leaf		
		Banag (Vine)		
	Musa textilis	Abaca		
		Tagbak		
	Angeospteris evicta			
	Pteris vittata			
	Segnilla sp			
	Nephrolepis biserrata	Pako-pako		

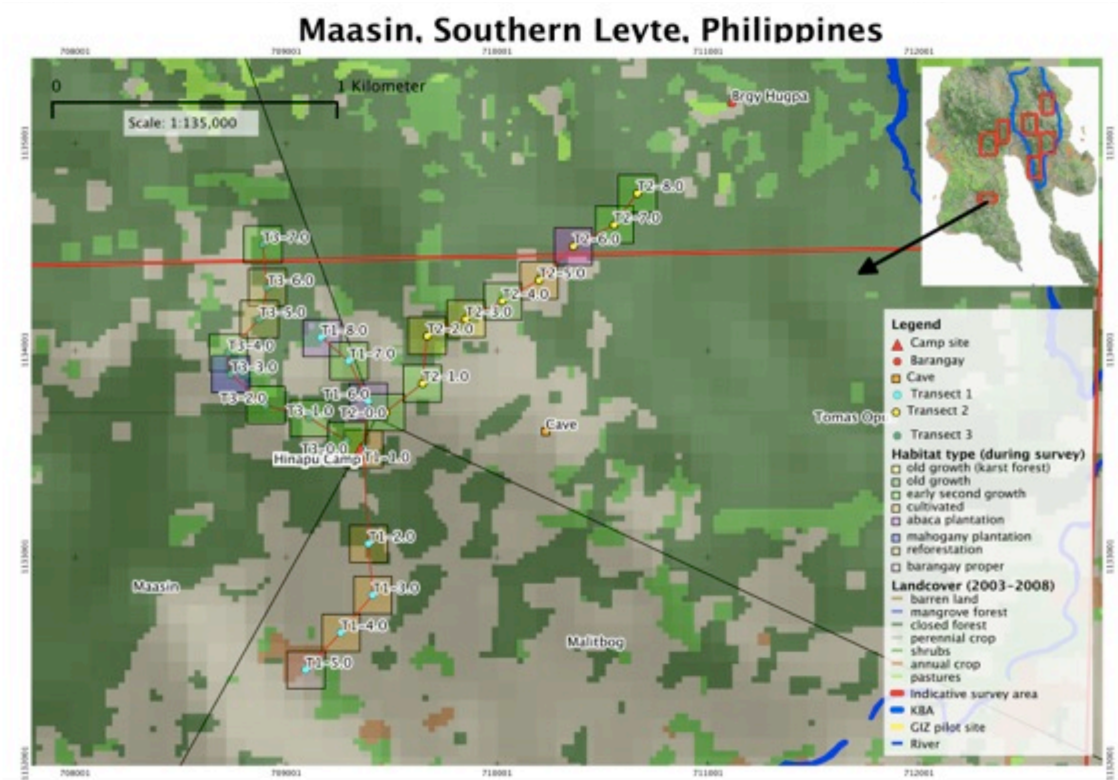
Annex 5. Survey Transects in Four Localities



Silago, Southern Leyte, Philippines




Sogod, Southern Leyte, Philippines
1 Kilometer
Scale: 1:135,000
Sogod
Silago
Inner Falls
View Bats Roost
Camp Sogod SJ
Hinunangan
Libagon
Legend
Camp site
Observed areas
Transect 1
Transect 2
Transect 3
Habitat type (during survey)
old growth
early second growth
cultivated
Land cover (2003-2008)
barren land
mangrove forest
closed forest
perennial crop
shrubs
annual crop
pastures
Indicative survey areas
KBA
GIZ pilot area
River


Maasin, Southern Leyte, Philippines
1 Kilometer
Scale: 1:135,000
Brgy Hugpa
Cave
Hinapu Camp
Maasin
Malitbog
Legend
Camp site
Barangay
Cave
Transect 1
Transect 2
Transect 3
Habitat type (during survey)
old growth (karst forest)
old growth
early second growth
cultivated
abaca plantation
mahogany plantation
reforestation
barangay proper
Landcover (2003-2008)
barren land
mangrove forest
closed forest
perennial crop
shrubs
annual crop
pastures
Indicative survey area
KBA
GIZ pilot site
River

Annex 6. Animals and plants used by communities in Southern Leyte.

Species	Local Name	Use, significance and othern information
Mammals		
Flying Foxes: Golden-crowned flying fox *Acerodon jubatus* Large flying fox *Pteropus vampyrus* *Pteropus hypomelanus*	Kabug/paniki	Food, sold for cash (P30.00/piece)
Cynocephalus volans	Kagwang	
Long-tailed macaque *Macaca fascicularis*	unggoy	Food, sold for cash; ~P150-P200/kilo
Common palm civet *Paradoxurus hermaphroditus*	milo	For food
Malay civet *Viverra tangalunga*	milo	For food
Philippine warty pig *Sus barbatus mindanensis*	Baboy ihalas	For barter or sold to buy rice. ~P190.00/kilo * Fresh tracks were still observed in municipalities of Silago, Sogod and Hinunangan during the survey.
Philippine brown deer *Cervus mariannus*	Usa	For food. Last time they observed deer in Upper Bantawon in 1970
Birds		
Red-jungle fowl *Gallus gallus*	Manok ihalas	Pet, food
Colasisi	kusi	As pet,
Doves and pigeons	Punay, manatad, alimoken	Food, sold for cash. Most of the time as pet. Found in cages in several houses in the barangays near the forests.
Amphibians		
frogs		food
Reptiles		
Reticulated pythons *Python reticulatus*	bitin	food
Water Monitor lizards *Varanus*	Hawo/halo	Food, no observation were made in the area maybe due to excesive hunting
Sailfin Lizard		Food, pet
Plants		
Dipterocarp tress		selectively logged, for boat-making (Silago)

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