Biodiversity baseline assessment in the REDD-Plus pilot and key biodiversity area in Mt. Nacolod, Southern Leyte

Final technical report

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of

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in collaboration with

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NewCAPP

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Acronyms and abbreviations

AIC	Akaike's Information Criterion
ALOS PALSAR	Advanced Land Observing Satellite Phased Array L-band Synthetic Aperture Radar
ASG	Advance second growth forest
BACI	Before/after-control/intervention
BMS	Biodiversity Monitoring System
CCA	Canonical correspondence analysis
CENRO	City Environment and Natural Resources Officer
CVT	Cultivated
DBH	Diameter at breast height
DENR	Department of Environment and Natural Resources
EORC	Earth Observation Research Center
EQR	Equirectangular projection
ESG	Early second growth forest
FFI	Fauna & Flora International
FMB	Forest Management Bureau
FPE	Foundation for the Philippine Environment
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HCVA	High conservation value area
HH	Images resulting from horizontally polarized radio waves
HV	Images resuting from vertically polarized radio waves with received radiation restricted horizontally polarized waves
JAXA	Japan Aerospace Exploration Agency
LGU	Local government unit
NGO	Non-government organization
MRV	Measurement, reporting and verification
NewCAPP	New Conservation Areas in the Philippines Project
OG	Old growth forest
PAWB	Protected Areas and Wildlife Bureau
PENRO	Provincial Environment and Natural Resources Officer
PNRPS	Philippine National REDD-Plus Strategy
REDD-Plus	Reducing Emissions from Deforestation and Forest Degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks
SRTM DEM	Shuttle Radar Topographic Mission 90-meter Digital Elevation Model
UNDP	United Nations Development Programme
UP-DGE	University of the Philippines-Department of Geodetic Engineering
USAID	United States Agency for International Development
UTM	Universal Transverse Mercator
WGS	World Geodetic System

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- GIZ
- National Museum of the Philippines
- Local government of Abuyog
- Local government unit of Hinunangan
- Local government unit of Libagon
- Local government unit of Maasin
- Local government unit of Mahaplag
- Local government unit of St. Bernard
- Local government unit of Silago
- Local government unit of Sogod
- Local government unit of Tomas Oppus
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This effort was supported by DENR Region VIII Office, the Provincial Government of Southern Leyte and Local Government Units of Sogod, Silago, St. Bernard, Libagon, Hinunangan, Maasin, Tomas Oppus and Mahaplag.

Executive summary

This Report is a consolidation of the 2011 Wet Season Biodiversity Assessment and the follow-up Dry Season Biodiversity Assessment conducted in May and June 2013 of the Mt. Nacolod Key Biodiversity Area and selected REDD-Plus pilot areas. With the seasonal variation taken care of, this consolidated Report of both assessments provides a clear picture of the biodiversity situation of Southern Leyte in particular and Leyte Island in general. Though habitats have been degraded, Leyte Island is still rich in biodiversity. It is imperative to contain the hotspots which have been identified and reverse the further loss of biodiversity. With a solid scientific basis, the Report recommends the revision of the old KBAs and instead establish new High Conservation Value Areas (HCVA). The results of the surveys also serve as the baseline to monitor the co-benefits of REDD-Plus particularly the impact of the REDD-Plus measures on biodiversity.

The two (2) assessments were implemented by the Fauna & Flora International (FFI) Philippines in collaboration with the Provincial Government of Southern Leyte and the Department of Environment and Natural Resources, based on a commission by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH under the BMU-funded "Climate-relevant Modernization of the National Forest Policy and Piloting of REDD Measures in the Philippines" Project, with co-financing by the UNDP-GEF-funded New Conservation Areas of the Philippines Project (NewCAPP) and the Foundation for the Philippine Environment (FPE).

State (results of biodiversity baseline assessments)

Mt. Nacolod is covered by almost 14,000 ha of forest and is categorized as a Very High priority KBA due to its high biodiversity value and extreme socio-economic pressure on species and habitat (Ong et al., 2002).

More than half (54%) of Southern Leyte is still covered with forest (88,812 ha out of 163,271 ha) and constitutes 12.5% of the total land area of Leyte Island (88,812 ha out of 709,699 ha).

In terms of species richness, more than 350 species of trees, 133 birds, 27 amphibians, 57 reptiles and 40 mammals were recorded for Southern Leyte during the 2011 and 2013 assessments.

New island records include eight species of birds, one of which is the endemic and threatened Little Slaty Flycatcher (*Ficedula basilanicai*); three volant mammals (*Pipistrellus tenuis*, *Tylonycteris robustula* and *Murina suilla*); and two amphibians (*Philautus poecilus* and *P. surdus*).
Two species of frogs of the genus Platymantis were discovered and described (in press), and the endemic Cebu Cinnamon (*Cinnammomum cebuense*) was recorded in at least two sites in Southern Leyte. The latter was previously known only to occur in the island of Cebu.

Pressure (threats and results of habitat change analysis)

Threats on the ground

- Illegal collection and poaching of wildlife
- Conversion of forests for upland agriculture

Between 2007 and 2010

A. Island-wide
   - The pristine forest decreased by 15% (41,060 ha)
   - The degraded forest increased by 57% (55,637 ha)
   - The non-forest areas increased by 18% (48,232 ha)

B. Southern Leyte Province
   - 20% (17,938 ha) of the pristine forest was lost
   - The degraded forest increased by 3% (503 ha)
   - The non-forest areas increased by 31% (17,369 ha)

Response (recommendations)

- Revision of the old Key Biodiversity Areas (KBAs) based on the nine (9) High Conservation Value Areas (HCVAs) for Leyte Island that were identified for the 23 trigger species of trees, birds and frogs. Four (4) of these HCVAs are found in Southern Leyte
- Expansion of protected areas to cover suitable habitats of key biodiversity in the island
- HCVAs 2, 3, 5 and 8 should be subjected to REDD-Plus
- Portions of HCVAs 6 and 7 should become restoration or reforestation sites as there is minor overlap with the hot spots
- Use of Biodiversity Monitoring System for Protected Areas of the DENR-PAWB as monitoring protocol for focal species sensitive to forest degradation and species tolerant to land use change
- Implementation of comprehensive biodiversity inventories for MRV following the before/after-control/intervention (BACI) approach, using the methodologies used in this study and the contents of this report for the before section of the approach

Introduction 1



The project "Climate-relevant Modernization 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, Nature Conservation and Nuclear Safety (BMU), was implemented in the period from October 2009 until December 2013. It supported the Philippines' efforts toward forest and climate protection, and the development of appropriate policies and instruments. The project was implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH with the Department for 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 Philippine National REDD-Plus Strategy (PNRPS).

The project aimed at an improved forest policy and the development of incentives for forest protection and rehabilitation, reduction of greenhouse gases (GHG), conservation of biodiversity and building of capacities toward this end. It focused on forest policy reforms and Reducing Emissions from Deforestation and Forest Degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD-Plus) pilot activities in and around selected protected areas. Leyte Island was selected as the site for piloting REDD-Plus measures, with barangays in five municipalities of Southern Leyte Province as pilot project areas.

The project elaborated the development of a sub-national system for measuring, reporting and verification (MRV) under the PNRPS, which includes the monitoring of biological diversity.

In November 2012, GIZ and DENR started the implementation of a new REDD-Plus project, "National REDD-Plus System Philippines," to support the implementation of the PNRPS. The project is funded under the International Climate Protection Initiative of the BMU and aims to create a national framework for reducing greenhouse gas emissions from deforestation and forest degradation, based on recognized ecological and social safeguards. The integration of biodiversity aspects into a REDD-Plus MRV system also forms part of the project.

The elaboration of the MRV system, supported under both DENR-GIZ REDD-Plus projects, includes monitoring of co-benefits of REDD-Plus, including the impact of REDD-Plus measures on biological diversity. For this purpose, a biodiversity baseline survey was conducted from November to December 2011 in the pilot area of Southern Leyte Province, including the municipalities of Silago, Sogod, Bontoc, Tomas Oppus and Maasin City. The pilot area is adjacent and partly overlaps with the Mt. Nacolod area, one of the key biodiversity areas (KBA) covered by the UNDP/GEF-financed New Conservation Areas in the Philippines Project (NewCAPP) implemented by the DENR Protected Areas and Wildlife Bureau (PAWB) that has started its activities at the end of 2010. The biodiversity baseline survey was implemented by Fauna & Flora International (FFI) Philippines jointly for both project areas in a co-financing approach.

Although the Wet Season Biodiversity Assessment had already been completed in 2011, collaborating institutional partners such as the DENR field offices, Provincial Government of Southern Leyte, GIZ, NewCAPP-PAWB and the Foundation for the Philippine Environment (FPE), working under the "Up-Scaling Forest Restoration Effort in Key Biodiversity Areas" funded by the United States Agency for International Development in the Mt. Nacolod KBA, discussed and agreed that a survey during the dry season is imperative in order to account for possible temporal variations in the faunal and floral assemblages and interactions in Mt. Nacolod – a critical step in identifying and implementing realistic conservation targets in a key biodiversity area that include species indicators for REDD-Plus MRV on biodiversity or for protected area establishment.

This Report is a consolidation of the 2011 Wet Season Biodiversity Assessment and the follow-up Dry Season Biodiversity Assessment conducted in May and June 2013 of the Mt. Nacolod Key Biodiversity Area and selected municipalities of the DENR-GIZ REDD-Plus pilot area of Southern Leyte.

1.1 Participation of organizations

Through three foreign-assisted projects (listed below), the biodiversity assessments in Southern Leyte were conducted by FFI. This is in close coordination with the two bureaus of the DENR, which are implementing forest resources management and biodiversity conservation in the country: the Forest Management Bureau (FMB) and the Protected Areas and Wildlife Bureau (PAWB); as well as the DENR Field Offices, local government units (LGUs) and select civil society organizations in Southern Leyte:

1. The "Climate-relevant Modernization of the National Forest Policy and Piloting of REDD Measures in the Philippines" funded under the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and implemented jointly by the DENR-FMB and the German Development Cooperation-GIZ.

2. The "Expanding and Diversifying the National System of Terrestrial Protected Areas of the Philippines," also known as the New Conservation Areas of the Philippines Project (NewCAPP) (2011), funded by the United Nations Development Programme's Global Environment Facility (UNDP-GEF). This project is implemented by the DENR-PAWB.

3. The "Up-Scaling Forest Restoration Effort in Key Biodiversity Areas," funded by the United States Agency for International Development (USAID) through the FPE (2013).

1.2 Objectives and scope of the study

The study's long-term goal is to secure the survival of key threatened species in the Mt. Nacolod KBA (Important Bird Area Code: PH078). The first step in accomplishing this is to establish ecological baselines. Thus, the main objective of this study is to gather baseline information that can then be used by management authorities and decision-makers to create and enforce appropriate and effective conservation and management interventions for the Mt. Nacolod KBAs and the DENR-GIZ REDD-Plus pilot area.

1.2.1 Specific objectives

To meet the long-term goal, the following specific objectives will be conducted to establish the ecological baseline as basis for conservation planning:

1. Conduct dry season faunal and habitat assessment surveys, indicating the species richness, diversity and conservation significance/status, and list of threatened and economically important species of flora and fauna or potential keystone/indicator species.
2. Assess the status of forest ecosystem, habitat and vegetation types in the area, as well as identify opportunities, in addition to current and potential threats to the biodiversity in the KBA in parallel with the 2011 wet season biodiversity assessment survey.
3. Identify and analyze changes in the biophysical components of Southern Leyte.
4. Recommend appropriate biodiversity management options suitable for the area and, in the process, assist the LGUs covering Mt. Nacolod and REDD-Plus pilot area in identifying local conservation areas in the KBA and REDD-Plus pilot area and their integration into the REDD-Plus approach with biodiversity conservation as a co-benefit.
5. Integrate the dry season assessment and wet season survey results in a REDD-Plus MRV system and recommend an appropriate biodiversity monitoring protocol under the Philippine National REDD Plus Strategy (PNRPS) implementation.
6. Identify information gaps for biodiversity and resource assessments.

1.3 Project beneficiaries

The main beneficiaries of this initiative are the LGUs (municipal and barangay), local offices of the DENR in Region 8, local community organizations and local conservation non-governmental organizations (NGOs) working in Southern Leyte within the REDD-Plus pilot site and Mt. Nacolod KBA, specifically those working in areas with known populations of key and threatened species in Mt. Nacolod.

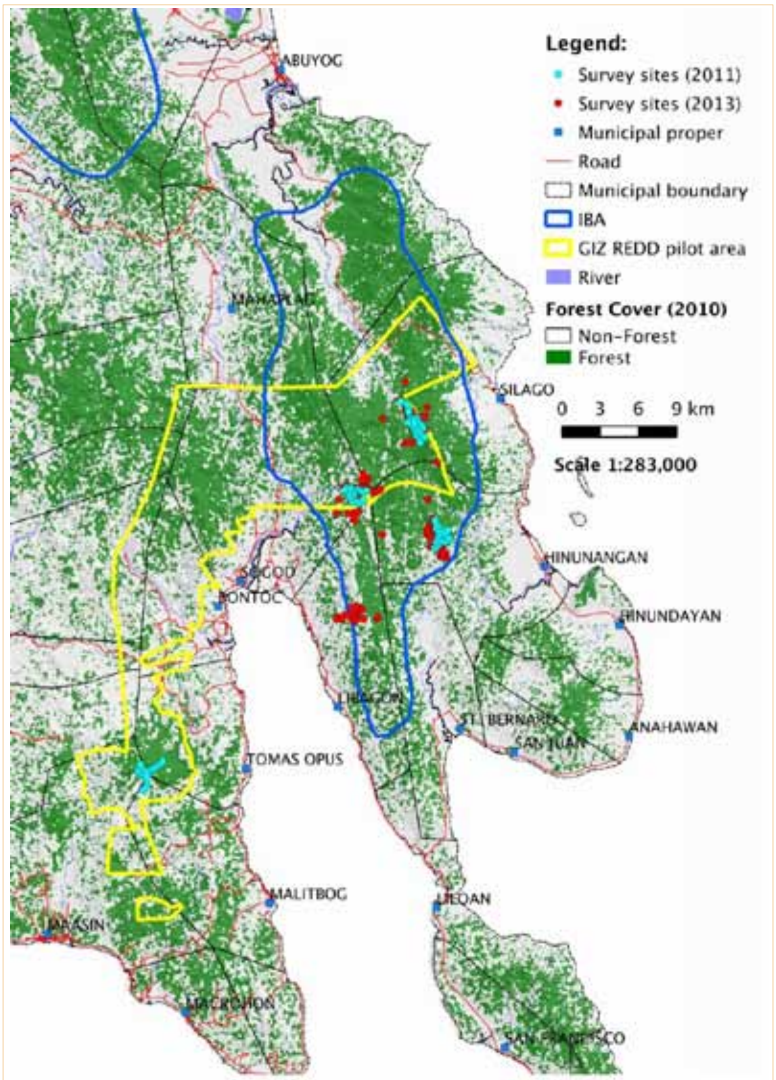


Figure 1. Surveyed sites in Southern Leyte

The ecological surveys and project activities that were conducted with the designated staff and personnel of the above-mentioned institutions and communities will likewise benefit in terms of an increase in skills and knowledge on assessment and monitoring of various species and their habitats. This could later translate into employment opportunities and/or higher compensation. In this regard, a study was conducted under the project to establish a socio-economic baseline study in REDD-Plus project sites in Southern Leyte (GIZ, 2012).

1.4 Project site description

The forest block in Mt. Nacolod KBA of Southern Leyte is bound by seven municipalities: Mahaplag, Sogod, Silago, Abuyog, Hinunangan, St. Bernard and Libagon. Its highest peak reaches 1,007 m above sea level (masl) with a flat to rugged terrain. Two major watershed reserves have been established in Mt. Nacolod KBA: the Buac Watershed Reserve and the Hinabian-Lawigan Watershed Reservation.

1.5 How this report is presented

This report is inspired by the Pressure-State-Response (PSR) Model developed by the Organisation for Economic Co-Operation and Development (OECD). Chapter 3 (State) reports the results of the biodiversity baseline assessments done in Southern Leyte, including Mt. Nacolod. It describes habitat characterization, species present and their relationship with each other. Chapter 4 (Pressure) reports the results of the habitat change analysis done in the same area. It describes the changes that happened between 2007 and 2010. Finally, Chapter 5 (Response) provides a list of FFI's recommendations based on the assessments/analyses written in Chapters 3 and 4.

2 Methods

A combination of field assessment techniques was employed during the wet season (November to December 2011) and the dry season (May to June 2013; Silago: May 20–31; Hinunangan: June 1–8; Sogod: June 9–21; and Libagon: June 22–July 1) to assess faunal/floral diversity and abundance, species–habitat associations, species occupancy, habitat characterization and change detection. Figure 2 shows the flowchart that summarizes the methods employed. A detailed description of the methods used per taxa including tools, data processing and analysis, species distribution modelling and geomatics analysis can be found in Appendix 1.

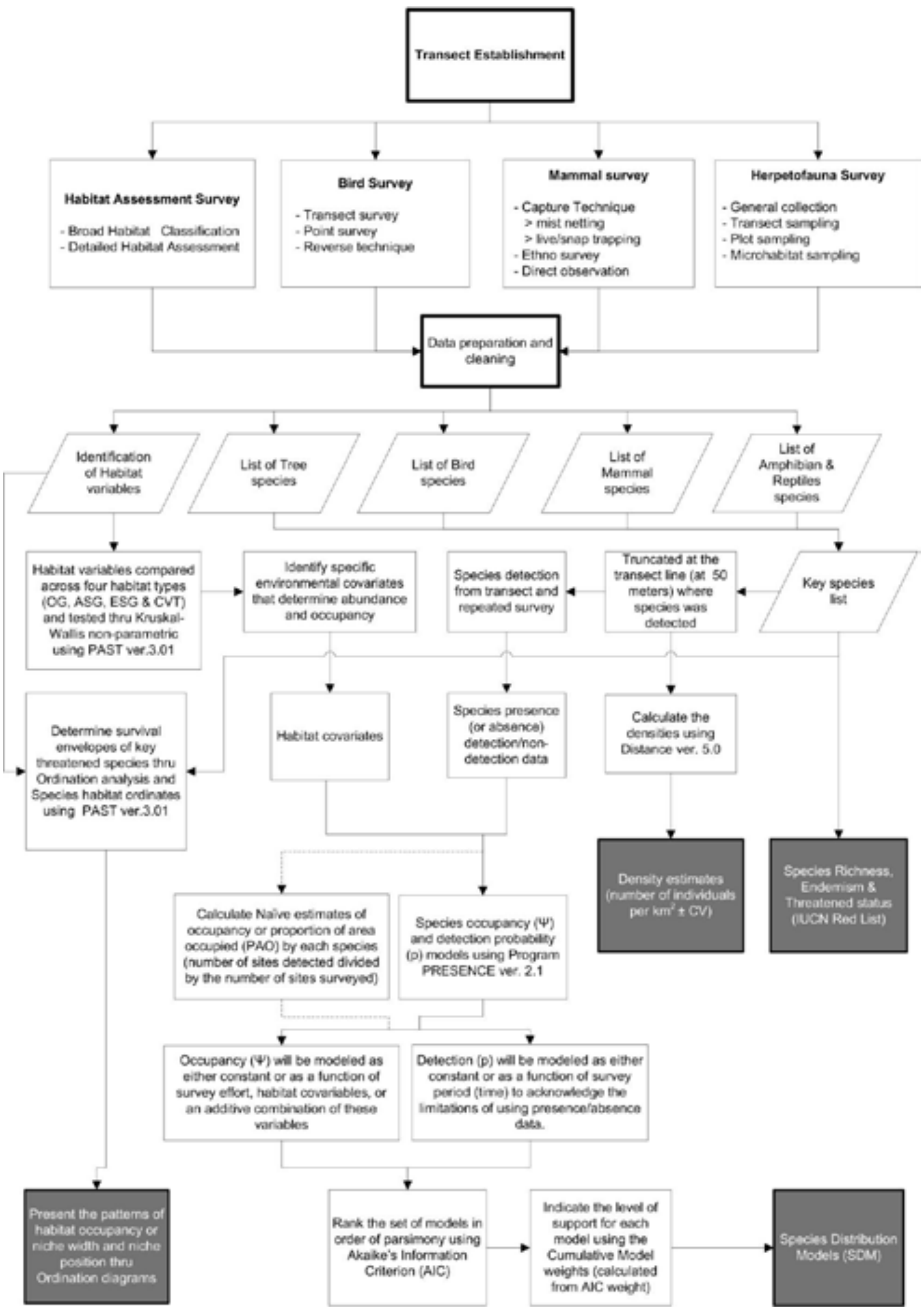


Figure 2. Processing chain for biodiversity assessment data analysis

State: Results of biodiversity baseline assessments

3

3.1 Habitat characterization of Southern Leyte

3.1.1 Key findings

- The result of our analyses of the forest cover extracted from the 2010 25-meter Advanced Land Observing Satellite Phased Array L-band Synthetic Aperture Radar (ALOS PALSAR) mosaic image shows the following computed area covers for the whole Leyte Island: pristine forest (233,770 ha); degraded forest (152,868 ha); and non-forest areas (323,062 ha).
- The forest cover in Southern Leyte province constitutes 12.5% (88,812 ha out of 709,699 ha) of the total land area of the island of Leyte.
- More than half (54%) of Southern Leyte province is covered with forest (163,271 ha)

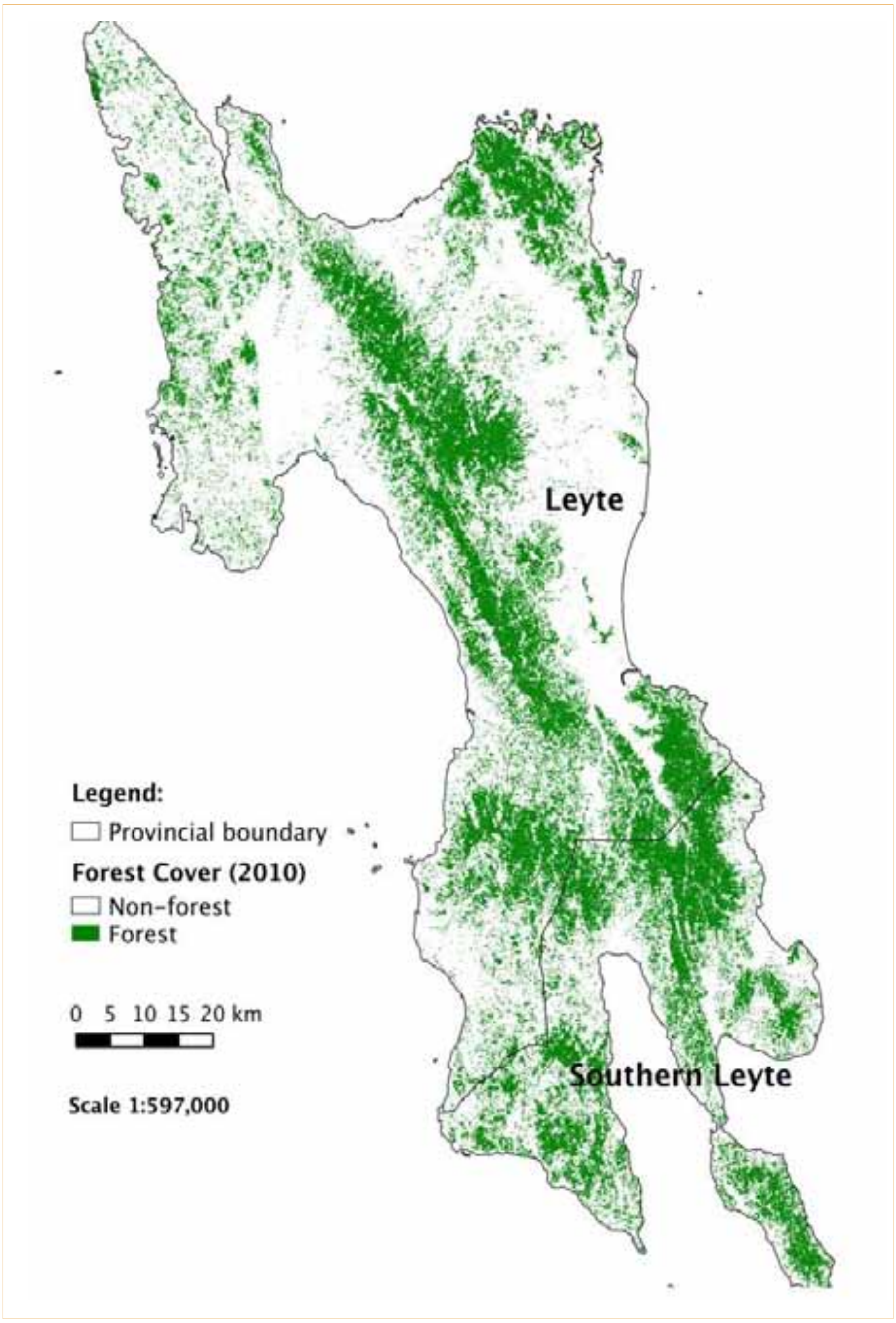
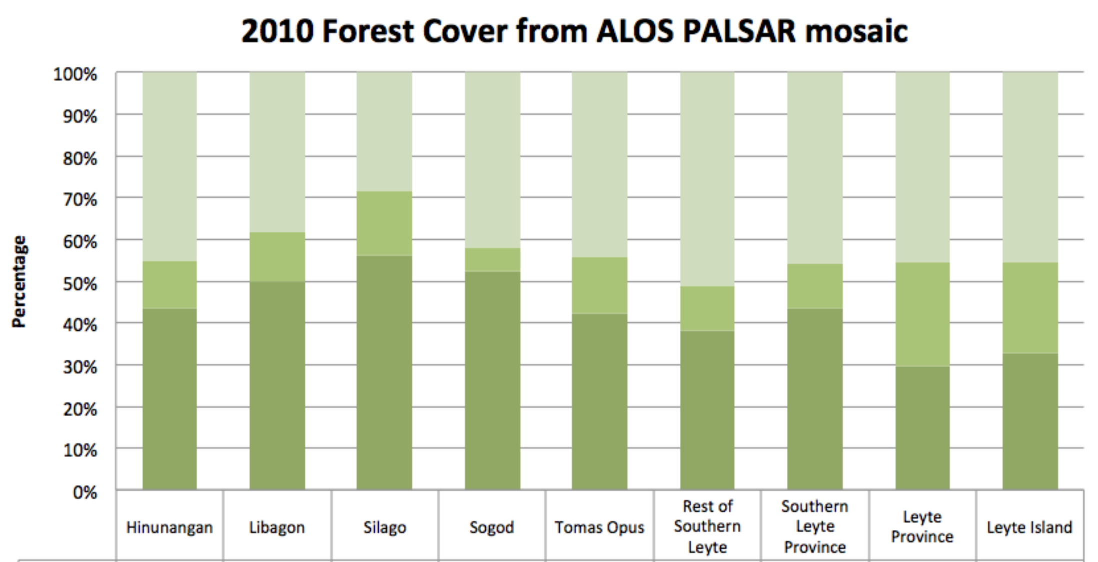


Figure 3. Forest cover interpretation of 2010 ALOS PALSAR mosaic image

Pristine forest refers to old growth and advanced secondary growth forests. Degraded forest refers to early secondary growth forests.



	Hinunangan	Libagon	Silago	Sogod	Tomas Opus	Rest of Southern Leyte	Southern Leyte Province	Leyte Province	Leyte Island
NF/Open	6,036.06	3,740.69	5,509.50	8,750.75	3,849.81	46,572.06	74,458.88	248,603.19	323,062.06
Degraded	1,512.94	1,172.19	3,046.00	1,204.25	1,187.50	9,661.44	17,784.31	135,083.19	152,867.50
Pristine	5,845.50	4,873.94	10,939.81	10,894.56	3,674.19	34,800.00	71,028.00	162,742.13	233,770.13

Figure 4. Forest habitat types (in hectares) in the different municipalities of Southern Leyte Province

The graph suggests that in general, Southern Leyte's forest condition is relatively good. Three sites (Silago, Sogod and Libagon) have relatively moderate to good (>50 % pristine forest) forest cover, whereas two sites (Hinunangan and Tomas Oppus) have 30–45% pristine forest.

3.2 Species richness, endemism and threatened species

3.2.1 Key findings

1. More than half of the known plant species in Leyte Island have been recorded in Southern Leyte. New island records include species in Appendix 3.
2. More than half (133 out of 182) of the known species of birds have been recorded. Eight new island records include the endemic and threatened (Vu, IUCN Red List 2013) Little Slaty Flycatcher, *Ficedula basilanica* (see Appendix 4).
3. Almost all of the known mammal species have been recorded. New island records include three species of volant mammals, Least Pipistrelle *Pipistrellus tenuis*, Greater Bamboo Bat *Tylonycteris robustula* and the Lesser Tube-nosed Bat *Murina suilla* (see Appendix 5).
4. The survey has brought the total known species of herps to 77 reptiles and 34 amphibians including 2 new island records: *Philautus poecilus* and *P. surdus*.
5. One of the highlights of the surveys is the discovery of the *Cinnammomum cebuense* (Cebu Cinnamon) that has been previously recorded in Cebu Island only, and two new species of frogs of the genus *Platymantis* were discovered and described.

Table 1. Species richness, endemism and threatened species recorded in Leyte Island

Taxa	Secondary data	2011	2013	Total
Plants	600+ including epiphytes*	250+	360+	354
Birds	163 **	106 (45/8)	134 (49/10)	182 (54/10)
Mammals	46 ***	35 (18/3)	44 (16/3)	58 (20/3)
Reptiles	60 (excluding sea turtles)	36 (10/4)	19 (5/1)	77 (14/4)
Amphibians	26 ****	24 (8/7)	19 (7/6)	34 (8/7)

Values in bracket denote the following notation: (endemic species / threatened species).
* UNDP, 2007 (Samar National Park Report).
** Kennedy et al., 2000
*** Heaney et al., 1998
**** Denzer et al., 1994

3.3 Species-habitat relationships

3.3.1 Key findings

Table 2. Summary table of the results of the ordination analysis (Canonical Correspondence Analysis) performed using PAST v3.1

	Forest dependent	Degraded forest	Interface of forest and non-forest (outliers)	Non-forest
Plants	*Shorea astylosa* *Dipterocarpus grandiflorus* *Shorea almon* *Ardisia squamulosa* *Dipterocarpus palosapis* *Palaquim luzoniense* *Cinnammomum cebuense* *Parashorea malaanonan*	*Hopea pagata* *Hopea malibato* *Dipterocarpus alatus* *Shorea assamica*	*Cinnammomum iners* *Mangifera monandra* *Artocarpus treculianus* *Shorea virescens* *Macaranga bicolor* *Shorea luzonicum* *Shorea polyspermum* *Brackenridgea palustris* *Tectona grandis* *Sapium luzonicum*	*Canarium luzonicum* *Diplodiscus paniculatus* *Cinnammomum mercadoi* *Shorea negrosensis* *Hopea philippinensis* *Neolitsea vidalii* *Shorea seminis* *Dillenia philippinensis* *Canarium luzonicum* *Afzelia rhomboidea* *Pouteria villamilii*
Birds	*Culicicapa helianthea* *Centropus melanops* *Rhinomyias ruficauda* *Alcedo argentata* *Ducula poliocephala* *Pachycephala philippinensis*	*Dicrurus hottentottus* *Phapitreron amethystina* *Chalcophaps indica* *Oriolus steeri* *Irena cyanogaster* *Macropygia tenuirostris* *Ixos everetti* *Tanygnathus lucionensis* *Prioniturus discurus* *Harpactes ardens*	*Penelopides panini* *Macronus striaticeps* *Centropus viridis* *Ptilocichla mindanensis* *Ixos philipinus* *Galicolumba crinigera* *Zosterops everetti* *Parus elegans* *Gallus gallus* *Micromacronous leytensis* *Columba vitiensis* *Eurystomus orientalis*	*Buceros hydrocorax* *Ptilinopus occipitalis* *Phapitreron leucotis* *Hypothymis azurea* *Oriolus chinensis* *Centropus viridis*
Amphibians	*Pelophryne lighti* *Limnonectes leytensis* *Sanguirana albuturcelata* *Rhacophorus pardalis* *Occidozyga laevis* *Megophrys stejnegeri*	*Rhacophorus bimaculatus* *Philautus leitensis* *Platymantis* sp. *B*	*Rana erythraea* *Limnonectes magnus* *Nyctixalus spinosus* *Philautus poecilus* *Platymantis* sp. *D*	*Platymantis green* *Philautus surdus* *Platymantis guentheri* *Platymantis corrugatus* *Oreophryne anulata* *Platymantis dorsalis*
Reptiles	*Rhabdophis auriculata* *Cymodynastes psammodynastes* *Brachymeles paeforum*	*Boiga dendrophilia* *Rhabdophis lineatus* *Pseuddogekko compressicorpus* *Oligodon modestum* *Gonocephalus interruptus* *Cyrtodactylus gubaot*	*Eutropis indeprensa* *Brachymeles orientalis* *Dendrelaphis caudolineatus*	*Lepidodactylus herrei* *Brachymeles samad* *Hemidactylus frenatus* *Ahaetulla prasina* *Pinoyscincus jagori* *Tropidolaemus philippinensis* *Trimeresurus flavomaculatus*
Mammals	*Ptenochirus jagori* *Apomys* cf. *littoralis* *Crocidura* sp. *Tarsius syrichta* (outlier)	*Rhinolophus subrufus* *Hipposideros obscurus* *Pipistrellus tenuis* *Kerivoula hardwickii* *Cynopterus brachyotis* *Rattus tanezumi*	*Haplonycteris fischeri* *Macroglossus minimus* *Tylonycteris robustula* *Megaderma spasma* *Murina suilla* *Hipposideros bicolor*	*Rousettus amplexicaudatus* *Harpyionycteris whiteheadi* *Eonycteris spelaea* *Rattus tanezumi* *Bullimus bagobus*

Shown are species niche position (habitat preferences) and niche width (levels of tolerance) across landscapes. Tolerance level shown here is based on a disturbance gradient (pristine forest -> degraded -> non-forest).

Note:

1. Species under "forest dependent" are species that are intolerant to forest degradation.
2. Species under "degraded forest" are species that can tolerate forest degradation.

Species under the "interface of forest and non-forest" are species that have no specific habitat preferences and are therefore generalists. Some are even outliers.

3.4 Species abundance and species occupancy

3.4.1 Key findings

Flora (trees)

- 62% (24 of 39 species of flora) has an occupancy value of 1–10%, whereas 38% (15 out of 39 species) has an occupancy value of 20–50%.
- Most of these plant species are categorized as CR (Critically Endangered) or VU (Vulnerable) based on the IUCN Red List (2013).
- Species having higher space requirements (higher occupancy value) are more sensitive to landscape-wide changes in land use. However, this is just one critical factor affecting its vulnerability. As shown above, although 62% have low occupancy values and therefore should survive well even if the forest area grows smaller, majority of the plants recorded in Southern Leyte are threatened species.

Birds

- This is the first ever study that has generated population estimates for key species in Southern Leyte (see Table 4).
- This result provides baseline information of the population of key species in Southern Leyte especially for species that have not yet been assessed or quantified.

Amphibians

- The naive occupancy estimates revealed that 67% (14 out of 21 amphibian species) occupy at least 10% (with occupancy rate of 0.02–0.10) of the area. The remaining seven species have occupancy rates of 11–17% (3 species), 25–27% (2 species) and 33–56% (2 species). At least two trigger species have an occupancy of 60%, which suggests that these species are very vulnerable to contraction of their preferred habitats.

Reptiles

- Based on Table 6, all reptiles modeled had an occupancy rate of less than 30%, suggesting that this group does not respond to landscape-wide interventions.

Mammals

- The following non-volant species Rattus tanezumi, Tarsius syrichta, Crocidura sp. and Bullimus bagobus have less than 50% naïve occupancy.
- The species Rattus everetti and Apomys cf. littoralis, both endemic forest rats belonging to family Muridae, occupies above 50%.
- Volant species, Eonycteris spelaea, Hipposideros bicolor, H. obscurus, Kerivoula hardwickii, Hapyionycteris whiteheadi, Megaderma spasma, Murina suilla, Rhinolophus subrufus and Tylonycteris robustula, have a naive occupancy value of less than 10%, whereas the species Pipistrellus tenuis, Rousettus amplexicaudatus and Macroglossus minimus have greater than 10% but lower than 50% naive occupancy.
- Other species having an occupancy value above 50% include Ptenochirus jagori, Haplonycteris fischeri and Cynopterus brachyotis.

Table 3. Summary of species occupancy modeling of 39 tree species

Species	Naïve occupancy (ψ)	Species	Naïve occupancy (ψ)
Dillenia philippinensis	0.45	*Ficus ulmifolia*	0.05
Neolitsea vidalii	0.43	*Dipterocarpus grandiflorus*	0.05
Shorea palosapis	0.4	*Pouteria villamilii*	0.05
Shorea almon	0.36	*Securinega flexuosa*	0.05
Shorea polysperma	0.34	*Shorea astylosa*	0.03
Shorea negrosensis	0.33	*Tectona grandis*	0.03
Shorea contorta	0.25	*Aglaia leptantha*	0.03
Brackenridgea palustris	0.24	*Sapium luzonicum*	0.03
Mangifera monandra	0.21	*Canarium ovatum*	0.02
Hopea malibato	0.19	*Afzelia rhomboidea*	0.01
Cinnamommum cebuense	0.18	*Dipterocarpus alatus*	0.01
Shorea seminis	0.16	*Hopea philippinensis*	0.01
Shorea assamica	0.14	*Shorea virescens*	0.01
Hopea plagata	0.12	*Agathis philippinensis*	0.01
Ardisia squamulosa	0.12	*Artocarpus treculianus*	0.01
Parashorea malaanonan	0.1	*Diplodiscus paniculatus*	0.01
Palaquium luzoniense	0.09	*Hopea acuminata*	0.01
Macaranga bicolor	0.08	*Macaranga caudifolia*	0.01
Cinnamommum iners	0.07	*Shorea cummingiana*	0.01
Cinnammomum mercadoi	0.05		

Table 4. Population estimates of key bird species present in the study sites and their global population estimates based on BirdLife International Factsheets

Species	Density/ha	Population estimate in Southern Leyte	Global estimates (BirdLife)
Ixos philippinus	3.787	336,331	NE
Ixos everetti	1.194	106,042	NE
Phapitreron leucotis	0.567	50,356	NE
Phapitreron amethystina	0.218	19,361	NE
Irena cyanogaster	0.384	34,104	NE
Dicrurus hottentottus	0.708	62,879	NE
Macronous striaticeps	3.483	309,332	NE
Ptilinopus occipitalis	0.217	19,272	NE
Buceros hydrocorax	0.154	13,677	NE
Oriolus steerii	0.071	6,306	NE
Prioniturus discurus	0.239	21,226	NE
Harpactes ardens	0.052	4,618	NE
Macropygia tenuirostris	0.105	9,325	NE
Penelopides panini	0.406	36,058	1200*
Ptilinopus leclancheri	0.178	15,809	NE
Centropus melanops	0.06	5,329	NE
Ptilocichla mindanensis	0	0	NE
Oriolus chinensis	0.262	23,269	NE
Tanygnathus lucionensis	0.03	2,664	1500-7000*
Centropus viridis	0.134	11,901	NE
Chalcophaps indica	0.01	888	NE
Culicicapa helianthea	0.249	22,114	NE
Hypothymis azurea	0.329	29,219	NE
Parus elegans	0.59	52,399	NE
Rhinomyias ruficauda	0.212	18,828	NE
Loriculus philippensis	0.232	20,604	NE
Columba vitiensis	0.004	355	NE
Gallus gallus	0.073	6,483	NE
Zosterops everetti	0.589	52,310	NE
Ducula aenea	0.019	1,687	NE
Ducula poliocephala	0.038	3,375	NE
Pachycephala philippinensis	0.568	50,445	NE
Gallicolumba criniger	0.068	6,039	1000-2499*

An asterisk (*) indicates the estimated number of mature individuals, whereas "NE" means no estimates.

Table 5. Species occupancy and appropriate detection models for amphibian species

Species	Naive occupancy (ψ)	p ± SE	Detection model
Philautus poecilius	0.56	0.75±13.20	ψ AveTreeDBH
Platymantis guentheri	0.33	0.58±19.79	ψCanopy + Ground + AveTreeDBH + Altitude
Platymantis corrugatus	0.27	0.52±22.27	ψRattan + Canopy + Ground + AveTreeDBH
Philautus leitensis	0.25	0.50±22.97	ψRattan + Ground + Altitude
Megophrys stejnegeri	0.17	0.42±19.62	ψRattan + Canopy + Ground + AveTreeDBH + Altitude
Occidozyga laevis	0.13	0.36±17.25	ψCanopy + Ground + AveTreeDBH
Platymantis dorsalis	0.11	0.33±16.42	ψCanopy + AveTreeDBH + Altitude
Philautus surdus	0.1	0.31±15.55	ψGround + Altitude
Platymantis green	0.1	0.31±15.55	ψRattan + Ground + Altitude
Platymantis singit	0.1	0.31±15.55	ψRattan + Canopy + Altitude
Limnonectes magnus	0.1	0.31±15.55	ψRattan + Canopy + Altitude
Limnonectes leytensis	0.08	0.28±14.64	ψCanopy + Ground + Altitude
Oreophryne anulata	0.06	0.25±5.74	ψCanopy + AveTreeDBH
Rhacophorus bimaculatus	0.06	0.26±5.74	ψRattan + Ground + Altitude
Nyctixalus spinosus	0.03	0.18±5.65	ψRattan + Ground + AveTreeDBH + Altitude
Rhacophorus pardalis	0.03	0.18±5.65	ψCanopy + Ground
Rana erythraea	0.03	0.18±5.65	ψGround + Altitude
Pelophryne lighti	0.02	0.13±9.92	ψRattan + Canopy
Platymantis ground	0.02	0.13±9.92	ψAveTreeDBH + Altitude
Platymantis yellow	0.02	0.13±9.92	ψAveTreeDBH + Altitude
Sanguirana alboturcelata	0.02	0.13±9.92	ψRattan + Ground + AveTreeDBH

Note: Species highlighted in red are threatened species based on IUCN Red List (2013) category.

Table 6. Species occupancy and appropriate detection models for reptilian species

Species	Naive occupancy (ψ)	p ± SE	Detection model
Pinoyscincus jagori	0.26	0.51±27.69	ψRattan + Ground + AveTreeDBH + Altitude
Cyrtodactylus gubaot	0.24	0.49±27.67	ψRattan + Canopy + Ground + AveTreeDBH
Brachymeles samad	0.19	0.44±24.95	ψRattan + Canopy + Ground + Altitude
Eutropis indeprensa	0.14	0.38±7.09	ψGround + AveTreeDBH
Oxyrhabdium modestum	0.14	0.38±7.09	ψRattan + Canopy + Ground + AveTreeDBH
Brachymeles orientalis	0.12	0.35±20.63	ψGround + AveTreeDBH + Altitude
Gonocephalus interruptus	0.1	0.31±19.05	ψRattan + Canopy + Ground +Altitude
Boiga dendrophilia	0.07	0.27±17.35	ψRattan + Ground + Altitude
Brachymeles paeforum	0.07	0.27±17.35	ψCanopy + Ground
Rhabdophis lineatus	0.07	0.27±17.35	ψGround + AveTreeDBH
Dendrelaphis caudolineatus	0.05	0.22±15.44	ψRattan + Ground + Altitude
Pseudogekko compressicorpus	0.05	0.22±15.44	ψCanopy + Altitude
Calamaria lumbricoidea	0.02	0.15±13.09	ψCanopy + Ground + AveTreeDBH
Cymodynastes psammodynastes	0.02	0.15±13.09	ψRattan + Altitude
Ahaetulla prasina	0.02	0.15±13.09	ψRattan
Hemidactylus frenatus	0.02	0.15±13.09	ψRattan + Ground + Altitude
Lepidodactylus herrei	0.02	0.15±13.09	ψCanopy + Ground
Rhabdophis auriculata	0.02	0.15±13.09	ψAveTreeDBH + Altitude
Trimeresurus flavomaculatus	0.02	0.15±13.09	ψRattan + Ground + AveTreeDBH

Table 7. Summary of occupancy modeling and appropriate detection models for non-volant and volant mammals

Species	Naive occupancy (ψ)	Detection model
Cynopterus brachyotis	0.92	ψCanopy
Haplonycteris fischeri	0.82	ψRattan
Rattus everetti	0.68	ψCanopy
Ptenochirus jagori	0.64	ψRattan + Saplings
Apomys cf. *littoralis*	0.63	ψRattan + Ground + Saplings
Macroglossus minimus	0.45	ψRattan + Ground
Bullimus bagobus	0.42	ψRattan + Ground
Rousettus amplexicaudatus	0.27	ψRattan
Crocidura sp.	0.21	ψCanopy + Ground + Saplings
Pipistrellus tenuis	0.19	ψCanopy + Altitude
Tarsius syrichta	0.16	ψCanopy
Rattus tanezumi	0.11	ψRattan + Canopy + AveTreeDBH + Saplings
Eonycteris spelaea	0.09	ψRattan + Canopy + AveTreeDBH
Hipposideros bicolor	0.09	ψRattan + Canopy + AveTreeDBH
Hipposideros obscurus	0.09	ψRattan + Canopy + AveTreeDBH
Kerivoula hardwickii	0.09	ψCanopy + Altitude
Hapyionycteris whiteheadi	0.09	ψRattan + Canopy + AveTreeDBH
Megaderma spasma	0.09	ψRattan + Canopy + AveTreeDBH
Murina suilla	0.09	ψAltitude + Saplings
Rhinolophus subrufus	0.09	ψCanopy + Altitude
Tylonycteris robustula	0.09	ψCanopy + Altitude

Pressure: Threats and results of habitat change analysis

4

This section shows threats to biodiversity, as well as the forest cover loss and forest quality decline in the entire Leyte Island and Southern Leyte Province for the period 2007–2010.

4.1 Threats on the ground

4.1.1 Key findings

- Unlawful collection and poaching of wildlife is widespread in the project site. In particular, there is uncontrolled hunting of birds species (such as pigeons, doves, as well as the threatened species Tanygnathus lucionensis or Blue Naped Parrot, and Buceros hydrocorax or Rufous Hornbill) and monitor lizards. Wildlife is being poached to become pets or food for personal pleasure, or for sale on the market. This confirms the result of the REDD Project's Socio-economic Baseline Survey. (see Appendices 14 and 15 for the list of economically valuable flora and fauna).
- The understanding of the value of conservation in the area is poor. The study found that it is normal for children to start hunting of wildlife at an early age.
- The unclear land tenure situation (open access and unsecured tenure) resulted in unsustainably managed or unprotected forest areas. Without Forest Land Use Planning, there is no proper allocation and the LGU responsibilities are unclear. Insecure tenure discourages the planting of trees, thereby exacerbating the problem of deforestation and forest degradation. Clarifying land tenure can minimize the conversion of forests into agriculture areas.
- Forest areas are now being used for planting food crops as well as for gathering fuelwood and construction materials. In fact, there are newly opened forest areas in the project site that were converted into abaca and coconut plantations. These land conversions not only degrade the forest, but also negatively affect the wildlife inhabiting the forest areas.

4.2 Results of habitat change analysis

4.2.1 Key findings

Between 2007 and 2010:

Island-wide

- There was a decrease of 15% (41,060 ha) of pristine forest from 2007 to 2010.[1] There was a 57% (55,637 ha) increase of degraded forests.
- There was an 18% (48,232 ha) increase in non-forests.

Southern Leyte Province

- Southern Leyte province lost 20% (17,938 ha) of its pristine forest between 2007-2010.[2]
- There was an increase of 3% (503 ha) of degraded forest.
- There was an increase of 31% (17,369 ha) of non-forest.

1 Percentage of the combined pristine forest area found in the Island of Leyte recorded in 2007 that was converted to degraded/non-forest area by 2010 (based on change the detection analysis of 6 ALOS PALSAR 25-meter tiles). It is not a percentage of the total land area of Leyte Island converted to degraded/non-forest.

2 Percentage of combined pristine forest area found in Southern Leyte Province recorded in 2007 that was converted to degraded/non-forest area by 2010 (based on change the detection analysis of 6 ALOS PALSAR 25-meter tiles). It is not a percentage of the total land area of Southern Leyte Province converted to degraded/non-forest.

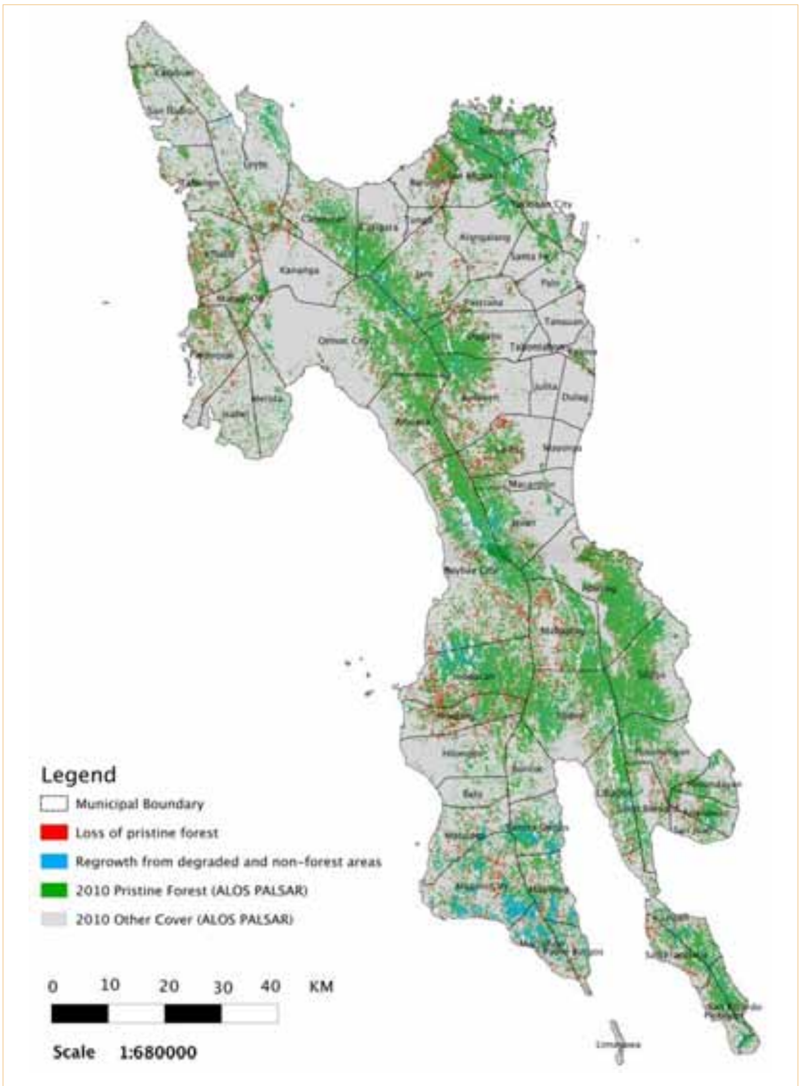


Figure 5. 2007–2010 change detection of forest cover

Table 8. Pixel-based change detection of Leyte Island using 2007 and 2010 ALOS-PALSAR mosaic images

Site	Pristine			Degraded			Non-forest/open		
	2007	2010	Net change	2007	2010	Net change	2007	2010	Net change
Hinunangan	7,657.25	5,845.50	↓1,811.75	1,735.31	1,512.94	↓222.38	4,005.38	6,036.06	↑2,030.69
Libagon	5,927.63	4,873.94	↓1,053.69	1,253.94	1,172.19	↓81.75	2,639.56	3,740.69	↑1,101.13
Silago	12,451.50	10,939.81	↓1,511.69	1,400.06	3,046.00	↑1,645.94	5,648.56	5,509.50	↓ 139.06
Sogod	12,730.38	10,894.56	↓1,835.81	1,690.19	1,204.25	↓485.94	6,446.50	8,750.75	↑ 2,304.25
Tomas Oppus	4,367.00	3,674.19	↓692.81	1,181.44	1,187.50	↑6.06	3,163.38	3,849.81	↑ 686.44
Rest of Southern Leyte	45,832.38	34,800.00	↓11,032.38	10,020.69	9,661.44	↓359.25	35,186.56	46,572.06	↑ 11,385.50
Southern Leyte	88,966.13	71,028.00	↓17,938.13	17,281.63	17,784.31	↑502.69	57,089.94	74,458.88	↑17,368.94
Leyte	185,864.38	233,770.13	↑47,905.75	79,949.00	135,083.19	↑55,134.19	279,540.19	248,603.19	↓30,937.00
Leyte Island	274,830.50	233,770.13	↓41,060.38	97,230.63	152,867.50	↑55,636.88	274,830.50	323,062.06	↑48,231.56

Change detection analysis refers to the tracking of conversion in the pixel classification generated from the processing of radar backscatter using a categorical reference derived in time 1 to a changed or unchanged category in time 2.

Response: Recommendations

5

This section enumerates the proposed conservation interventions based on the results of the biodiversity baseline assessments (State) and the habitat change analysis (Pressure).

This section deals with High Conservation Value Areas (HCVAs). These areas are biologically important sites due to the presence of endemic and threatened species (trigger species). HCVAs are non-negotiable sites because any major habitat change in these areas will almost certainly lead to species extinction. Thus, these places should be top priority in biodiversity conservation (whether through species or landscape approach).

Proposed HCVAs outside the Southern Leyte Province were deduced by extrapolating data from similar habitat types and environmental conditions where trigger species in Southern Leyte were recorded.

5.1 Identifying HCVAs of various groups of species in Southern Leyte

5.1.1 HCVAs for key tree species

Nine HCVAs for 12 key species of trees were identified using Species Distribution Modelling throughout Leyte Island. These sites are in the municipalities of Capoocan, Jaro, Ormoc City, Dagami, Burauen, Albuera, La Paz, Baybay, MacArthur, Abuyog, Mahaplag, Inupacan, Hindang, Sogod, Bontoc, Silago, Hinunangan, Sogod, Libagon, Anahawan, and San Francisco.

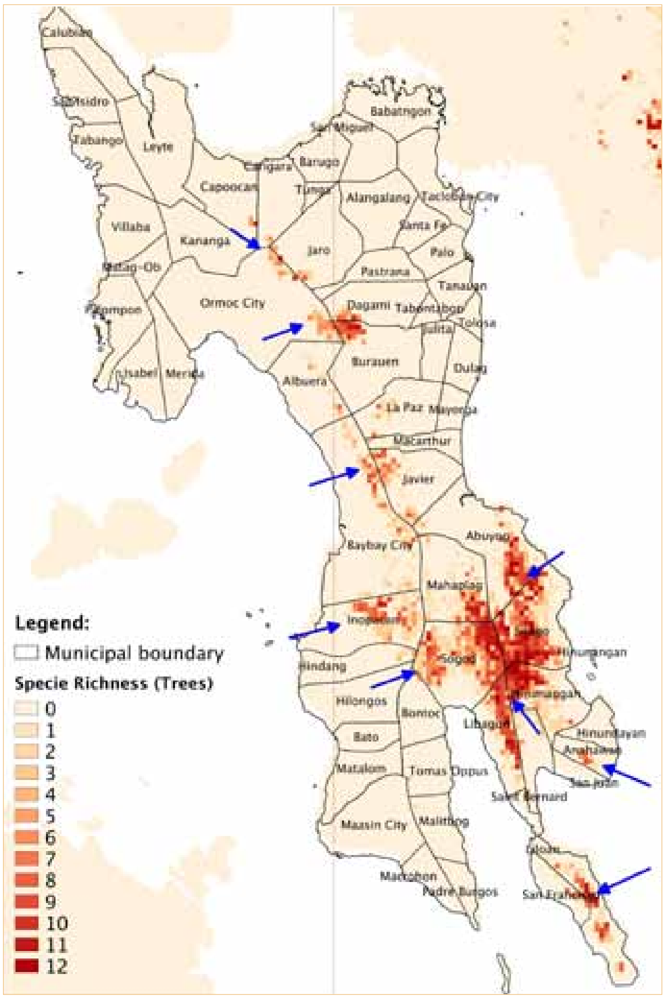


Figure 6. Results of the Species Distribution Model using Maxent for the following tree species: Almon (258), Apitong (11), Bagtikan (36), Cebu Cinnamon (34), Malayakal (31), Mayapis (253), Red Lauan (153), Tangile (137), White Lauan (92), Yakal (6), Yakal Kaliot (135), and Yakal Sapiongan (89)

Shown are extents of the tree HCVAs across the landscape.

5.1.2 HCVAs for birds

Nine HCVAs were identified for five trigger species of birds (Tanygnathus lucionensis, Buceros hydrocorax, Gallicolumba crinigera, Penelopides panini and Prioniturus discurus) in Leyte Island. These sites are in the municipalities of Capoocan, Jaro, Upper Ormoc City, Dagami, Albuera, La Paz, MacArthur, Javier, Baybay City, Mahaplag, Inopacan, Abuyog, Sogod, Silago, Hinunangan, Anahawan, Liloan and San Francisco.

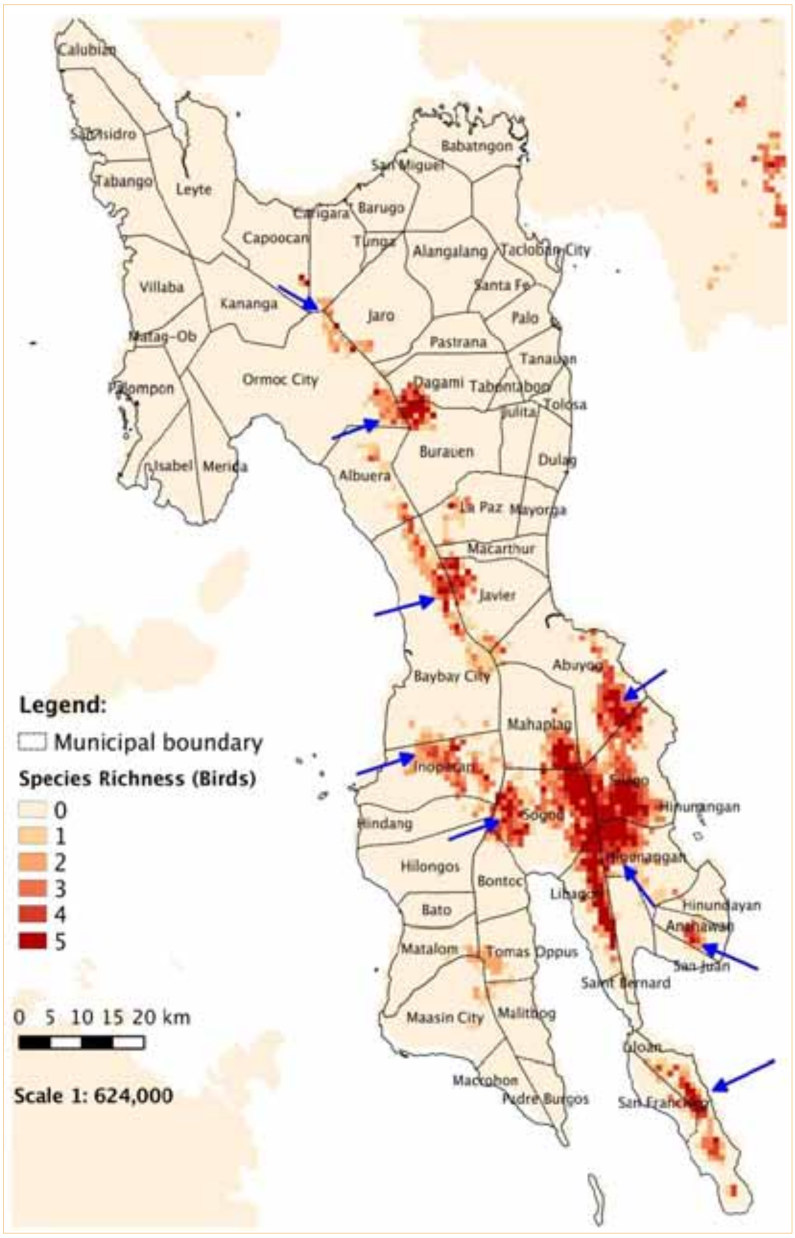


Figure 7. Results of the Species Distribution Model using Maxent for the following bird species: Tanygnathus lucionensis (30), Buceros hydrocorax (130), Gallicolumba crinigera (5), Penelopides panini (100), and Prioniturus discurus (59)
Shown are extents of the bird HCVAs across the landscape.

5.1.3 HCVAs for frogs

Six HCVAs were identified for six trigger species of frogs (Megophrys stejnegeri, Philautus leitensis, Platymantis green, Platymantis guentheri, Platymantis rabori, and Rhacophorus bimaculatus). These sites cover the municipalities of Capoocan, Jaro, Ormoc City, Dagami, Burauen, Baybay City, Javier, Inopacan, Mahaplag, Sogod, Abuyog, Silago, Libagon, Hinunangan, Anahawan, San Francisco, and Liloan.

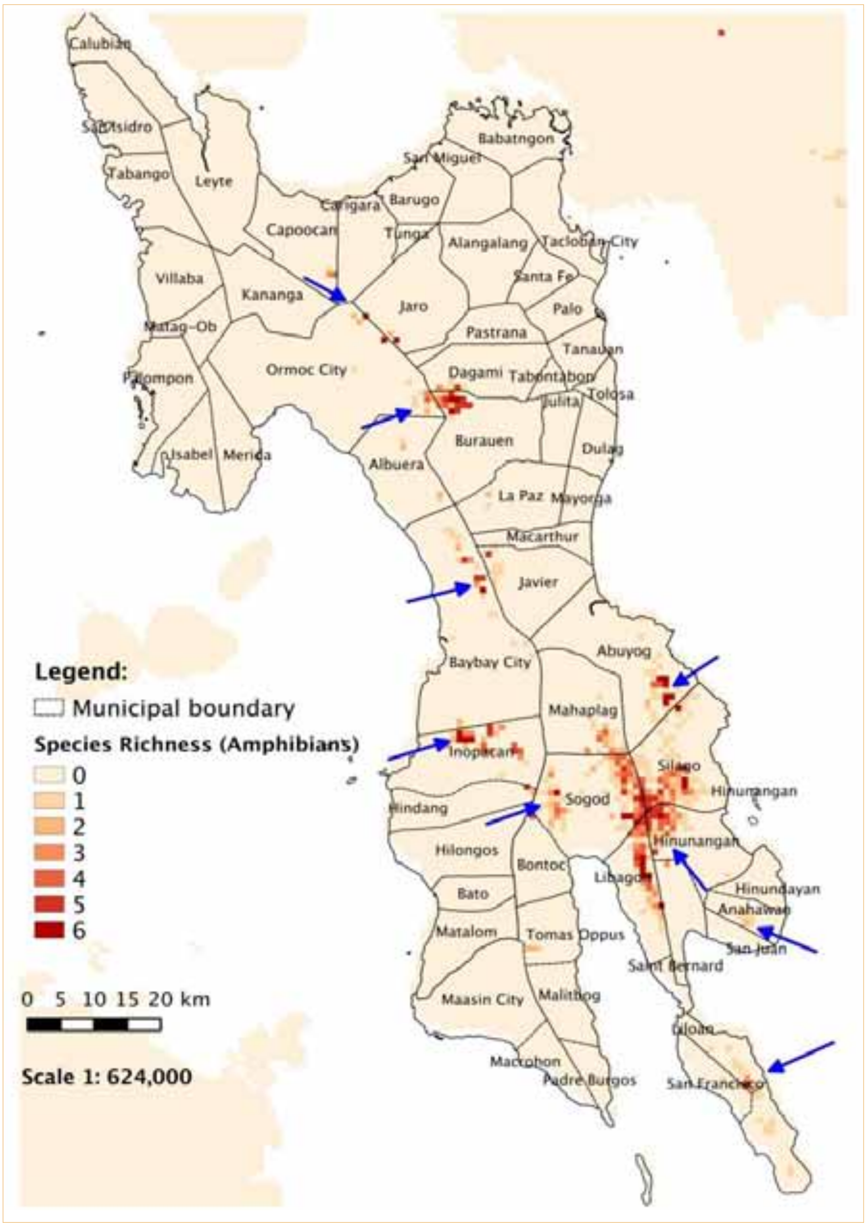


Figure 8. Results of the Species Distribution Model using Maxent for the following amphibians: Megophrys stejnegeri (20), Philautus leitensis (45), Platymantis green (22), Platymantis guentheri (46), Platymantis rabori (13), and Rhacophorus bimaculatus (15) Shown are extents of the frog HCVA across the landscape.

5.1.4 HCVAs for 23 trigger species (trees, birds and frogs)

- Combining all 23 trigger species of trees, birds and frogs, nine HCVAs were identified.
- Revision of the old KBA is recommended. The following HCVAs are proposed:
  - HCVA No.1 Ormoc-Jaro
  - HCVA No. 2 Burauen-Dagami
  - HCVA No. 3 Baybay-Javier
  - HCVA No. 4 Inopacan
  - HCVA No. 5 Sogod
  - HCVA No. 6 Abuyog
  - HCVA No. 7 Mt. Nacolod
  - HCVA No. 8 Anahawan
  - HCVA No. 9 Liloan-San Francisco
- The Mt. Nacolod HCVA is the largest in coverage and has the most number of species overlaps.

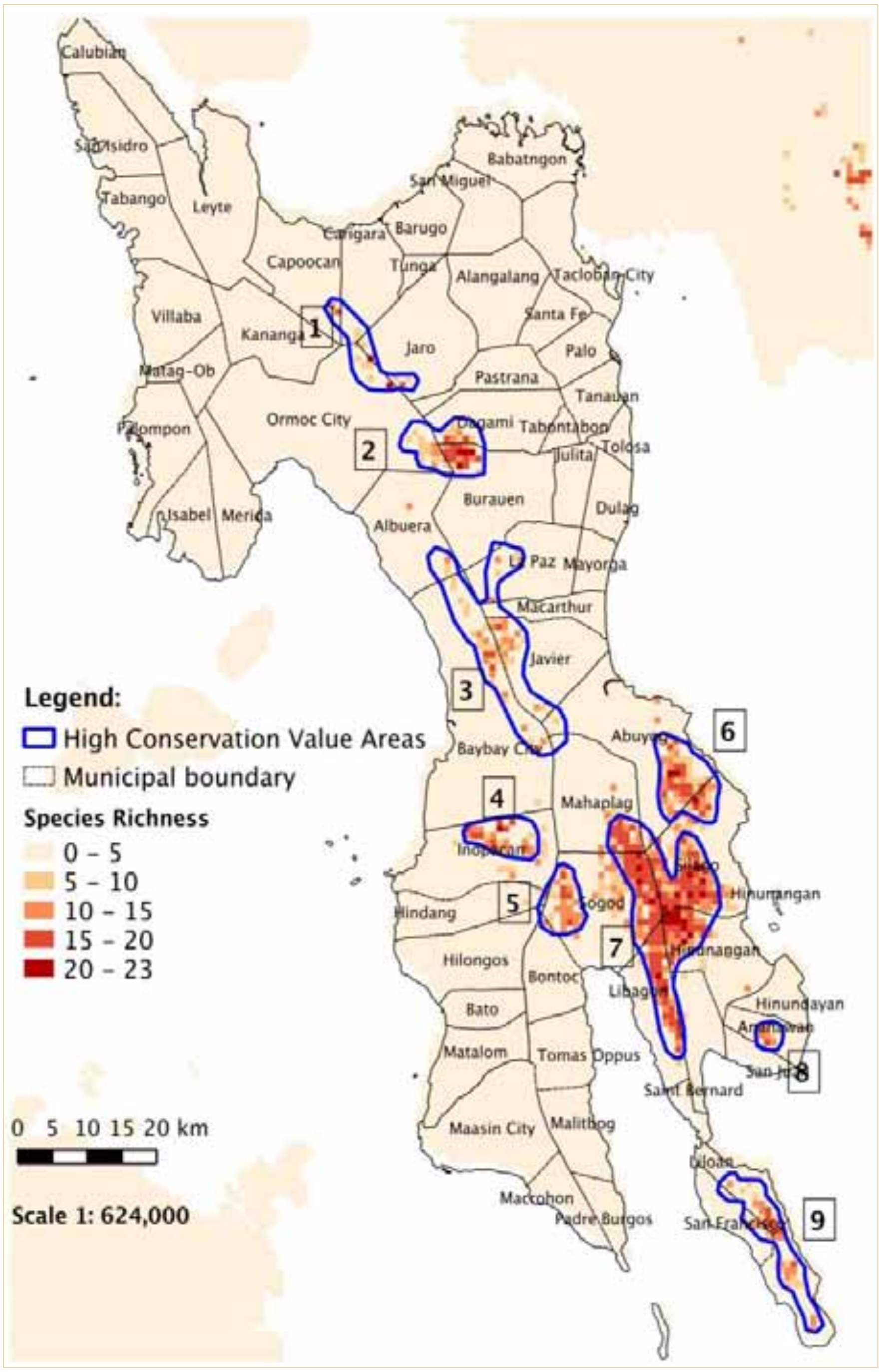


Figure 9. Results of the Species Distribution Model using Maxent for 23 trigger species (12 trees, 5 birds and 6 amphibians) in Leyte Island

Shown are extents of the HCVAs across the landscape. Varying color intensity on the map indicates areas of maximum overlaps for all taxa modeled and areas shaded in light brown are potential buffer zones or restoration sites. HCVAs: (1) Ormoc-Jaro; (2) Burauen-Dagami; (3) Baybay-Javier; (4) Inopacan; (5) Sogod (Southern Leyte); (6) Abuyog; (7) Mt. Nacolod (Southern Leyte); (8) Anahawan (Southern Leyte); and (9) Liloan-San Francisco (Southern Leyte).

5.2 Identifying gaps in protected areas and conservation sites

5.2.1 Key findings

- There are gaps in the existing protected area i.e. existing protected area is rather small compared to what is required.
- There is a need to expand the current protected areas coverage based on the extent of suitable habitats required by key biodiversity in the island.

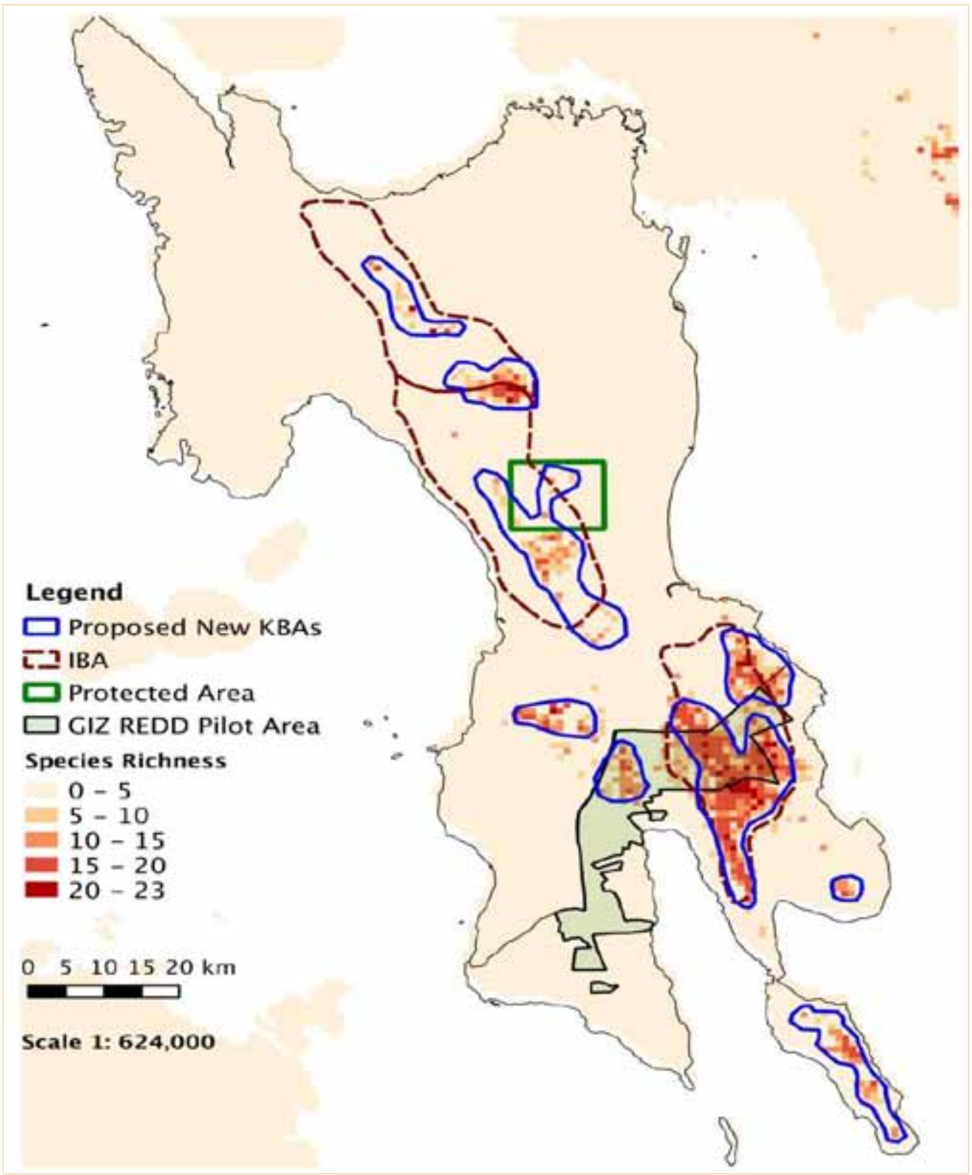


Figure 10. Gap analysis of conservation designation and protection in Leyte Island
Shown are the current coverage of official country Protected Areas (DENR) and Important Bird Areas (Mallari et al., 2001) and our proposed KBA based on the amalgamation of the various HCVAs identified previously.

5.3 Identifying conservation hot spots

5.3.1 Key findings

- Nine areas subjected to various land use change activities were identified through change detection analysis.
- These hot spots or areas with severe to medium deforestation are found in the following areas: Leyte Province (Tunga, Barugo, San Miguel, Leyte, Villaba, Tabango, Mata-ob, Albuera, Burauen, La Paz, Baybay, Inopacan, Hindang, Hilongos and Mahaplag) and Southern Leyte Province (Silago, Sogod, Maasin, Hinunangan, St. Bernard, San Juan, Hinundayan, and Anahawan).

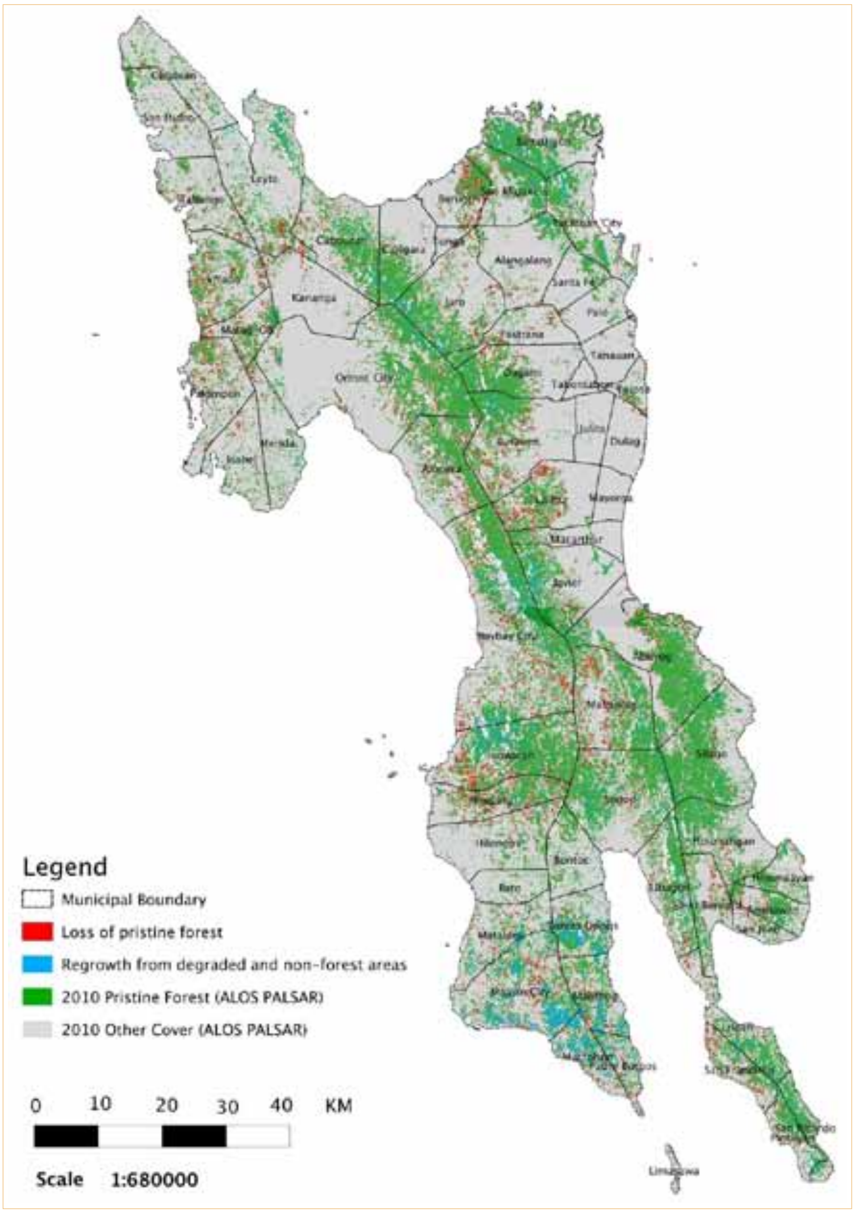


Figure 11. Results of the 2007–2010 change detection analysis in Leyte Island
Shown are extents of the hot spots or areas with medium to severe change (forest to non-forest and degraded to non-forest areas).

5.4 Identifying key biodiversity areas

5.4.1 Key findings

The conservation actions need to be matched with each HCVA i.e. HCVAs suffering from extreme deforestation and degradation are proposed to be subjected to REDD-Plus and areas in the brown or buffer zones are proposed to become restoration or reforestation sites (HS A - Villaba-Matag-ob, HS B - Barugo-Tunga, and HS H - Maasin City).

- The proposed KBAs overlapping with a hot spot are:
  - o HCVA 2 – Burauen-Dagami
  - o HCVA 3 – Baybay-Javier
  - o HCVA 5 – Sogod
  - o HCVA 8 – Anahawan

These HCVAs are threatened with massive forest degradation, and another hot spot is also creeping in from the south of HCVA 3 from the north of Mahaplag.

- The proposed KBAs that appear to be relatively safe due to the absence of overlapping hot spots are:
  - o HCVA 6 – Abuyog
  - o HCVA 7 - Mt. Nacolod

However, HCVA No. 7 (Mt. Nacolod) is threatened with a creeping hot spot coming from the north, in Mahaplag and another from the south coming from HS I - St. Bernard.

- The proposed KBAs that do not overlap with any hot spots are:
  - o HCVA 1 - Jaro-Ormoc
  - o HCVA 4 - Inopacan
  - o HCVA 6 - Abuyog
  - o HCVA 9 - Liloan-San Franciso KBA

This suggests that these areas are under low to moderate threat of land use change. Based on the change detection analysis, it is very close to hot spots of land use change.

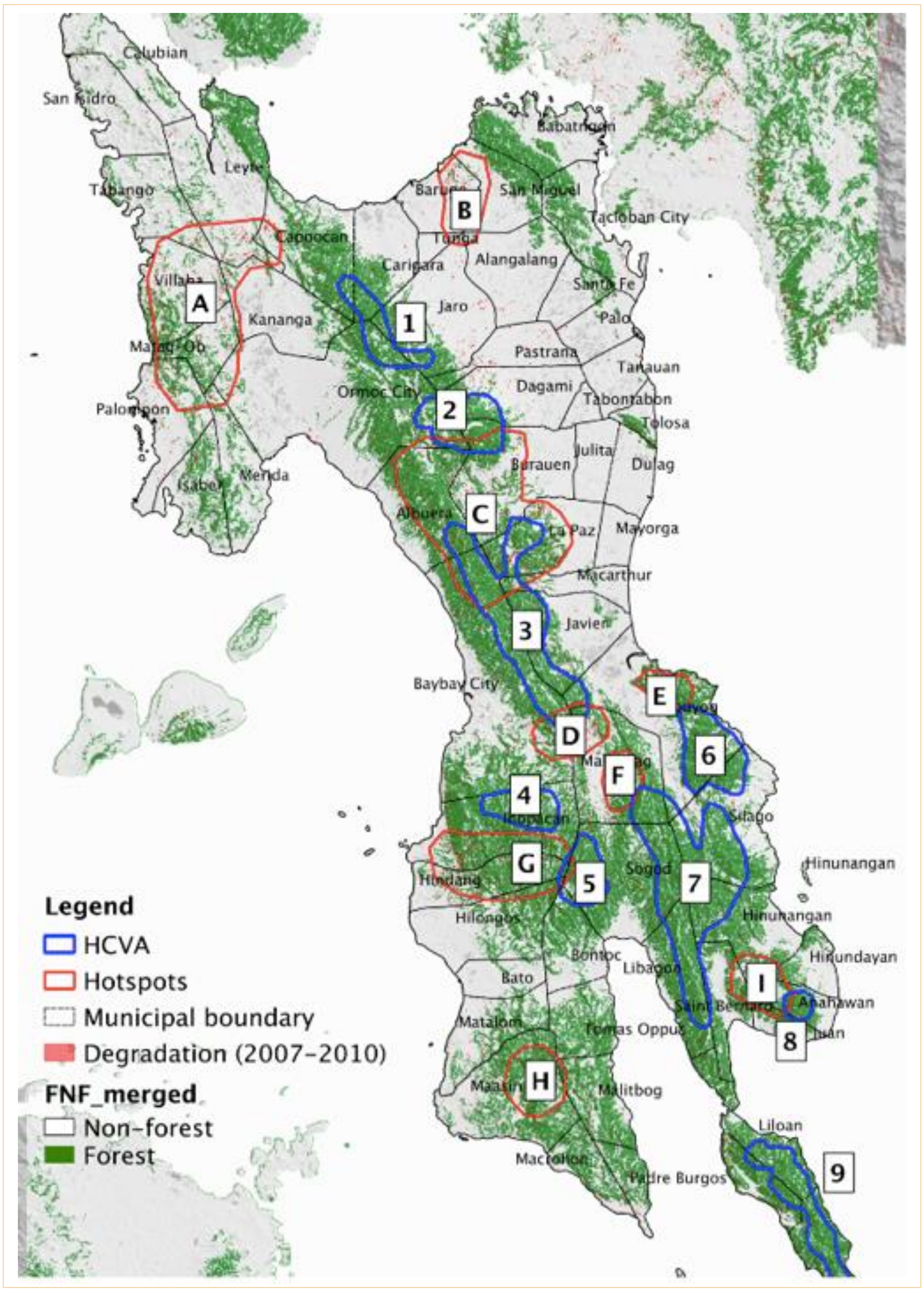


Figure 12. HCVAs and hot spots found in Leyte Island

HCVAs: (1) Ormoc-Jaro; (2) Burauen-Dagami; (3) Baybay-Javier; (4) Inopacan; (5) Sogod (Southern Leyte); (6) Abuyog; (7) Mt. Nacolod (Southern Leyte); (8) Anahawan (Southern Leyte); and (9) Liloan-San Francisco (Southern Leyte). Hot spots: (A) Villaba-Matag-Ob; (B) Barugo-Tunga; (C) Albuera-Burauen-La Paz; (D) Baybay City-Mahaplag; (E) Abuyog; (F) Mahaplag; (G) Hindang; (H) Maasin City; and (I) St. Bernard.

5.5 Proposed monitoring protocol

To monitor the trends of forest ecosystem biodiversity in Southern Leyte (even with consideration of the REDD-Plus eligible activities i.e. reduced deforestation, reduced forest degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks [UNFCCC, 2010]), the general recommendation is the application of the biodiversity monitoring system (BMS) established by the DENR-PAWB in 2001 (NORDECO and DENR, 2001). The BMS is a community-based and participatory "change-detection" protocol that is based on presence–absence of species (Mallari 2009). The manual on BMS explicitly outlines all aspects of the monitoring: from the formation and organization of the monitoring team, budget creation, data collection (including frequency of data collection), and data processing, to data analysis and interpretation.

The BMS is comparable to a recently published paper on monitoring REDD-Plus impacts on biodiversity, the "Participatory Biodiversity Monitoring: Considerations for National REDD+ Programmes" by Mant et al. (2013), which promotes having a participatory biodiversity monitoring (PBM). This paper outlines the various defining characteristics and aspirations of a PBM that encompass the following:

(a) costs and sustainability
(b) scale
(c) data quality
(d) identification of causal factors of changes/trends in biodiversity
(e) community incentives
(f) considerations on biogeography
(d) the varying expectations from the community level up to the national level

However, there are recommended adjustments on the BMS that have to be made based on new information on the species (updated ecological data of the species), new technologies (remote sensing and spatial analysis), as well as the use of new software applications to generate the needed information (PAST, CCA, Distance). Particularly on the monitoring of species, the BMS suggests monitoring species that are large and conspicuous (e.g. Rufous hornbill, jungle fowls, pigeons, warty pigs, macaques). In contrast, the results of this study show that what should be monitored are species that have been identified to be sensitive and intolerant to forest degradation as well as those tolerant to land use change (forest to non-forest) (see Table 9).

The integration of the BMS in the National REDD-Plus MRV scheme to monitor impacts on biodiversity is not far-fetched. There have been ongoing proposals and discussions on integrating BMS and the national forest inventory for REDD-Plus MRV. To date, there is no cleat-cut integration process of these two components. It is a major gap that needs to be addressed as the national REDD-Plus MRV is being established. Moreover, the "Conceptual Approach to REDD+ MRV in the Philppines" also proposed that the forest inventory, forest fragmentation analysis, and a before/after-control intervention approach on biodiversity inventory are data sources that can be used to determine impacts of REDD-Plus eligible activities on biodiversity (Seifert-Granzin, 2013).

Table 9. List of species that are sensitive/intolerant to forest degradation/loss and species that are tolerant of various degrees of land use changes

Taxa	Species that are sensitive and intolerant to forest degradation/loss. These species are good indicators of excellent forest quality.	Species that are tolerant of various degrees of land use changes. These species are good indicators of habitat/forest degradation.
 Flora	*Shorea astylosa* *Shorea almon* *Dipterocarpus grandiflorus* *Dipterocarpus palosapis* *Parashorea malaanonan* *Ardisia squamulosa* *Palaquim luzoniense* *Cinnammomum cebuense*	*Hopea pagata* *Hopea malibato* *Dipterocarpus alatus* *Shorea assamica*
 Birds	*Culicicapa helianthea* *Centropus melanops* *Rhinomyias ruficauda* *Alcedo argentata* *Ducula poliocephala* *Pachycephala philippinensis*	*Dicrurus hottentotus* *Phapitreron amethystine* *Chalcophaps indica* *Oriolus steeri* *Irena cyanogaster* *Macropygia tenuirostris* *Ixos everetti* *Tanygnathus lucionensis* *Prioniturus discurus* *Harpactes ardens*
 Amphibians	*Pelophryne lighti* *Limnonectes leytensis* *Sanguirana albuturcelata* *Rhacophorus pardalis* *Megophrys stejnegeri*	*Rhacophoorus bimaculatus* *Philautus leitensis* *Platymantis* sp. *A*
 Reptiles	*Rhabdophis auriculata* *Cymodynastes psammodynastes* *Brachymeles paeforum*	*Boiga dendrophilia* *Rhabdophis lineatus* *Pseudogekko compressicorpus* *Oligodon modestum* *Gonocephalus interruptus* *Cyrtodactylus gubaot*
 Mammals	*Ptenochirus jagori* *Apomys* cf. *littoralis*	*Rhinolophus subrufus* *Hipposideros obscurus* *Pipistrellus tenuis* *Kerivoula hardwickii* *Cynopterus brachyotis* *Rattus tanezumi*

6 Summary and conclusions

6.1 State (results of biodiversity baseline assessments)

6.1.1 Key findings

Habitat characterization

- Leyte Island: pristine forest (233,770 ha); degraded forest (152,083 ha); and non-forest areas (323,062 ha).
- Forest cover in Southern Leyte Province constitutes 12% of the total land area of the island of Leyte.
- Southern Leyte Province is covered with forest ca. 54% (88,812 ha).
- Southern Leyte's forest is relatively in good condition, having three sites (Silago, Sogod, and Libagon) with relatively moderate to good forest cover (>50% pristine forest), whereas two sites (Hinunangan and Tomas Oppus) have 30–45% pristine forest.

Species richness, endemism and threatened species

- More than half of the known plant species in Leyte Island have been recorded in Southern Leyte.
- More than half (134 out of 182) of the known species of birds have been recorded, 54 of which are endemic and 10 are threatened.
- Almost all of the known mammal species have been recorded. New island records include three species of volant mammals (Pipistrellus tenuis, Tylonycteris robustula and Murina suilla).
- The survey has brought the total known species of reptiles from 60 (Denzer et al., 1994) to 77 (21 endemic, 5 threatened) and brought the total amphibian species from 26 (Denzer et al., 1994) to 34 (8 endemic and 7 threatened).
- Cinnammomum cebuense (Cebu Cinnamon) that has been previously recorded only in Cebu Island and two new species of frogs of the genus Platymantis were discovered and described.

6.2 Pressure (threats and results of habitat change analysis

Threats on the ground

- Illegal collection and poaching of wildlife is rampant on the project site
- Poor knowledge in conservation in the project site
- Forest conversion to agriculture land
- The conflicting land tenurialship

Habitat change analysis

1. Island-wide

- There was a decrease of 15% (41,060 ha) of pristine forest from 2007 to 2010.
- There was a 57% (55,637 ha) increase of degraded forests.
- There was an 18% (48,232 ha) increase in non-forests.

2. Southern Leyte Province

- Southern Leyte Province lost 20% (17,938 ha) of its pristine forest between 2007 and 2010.
- A further increase of 3% (503 ha) of degraded forest.
- There is an increase of 31% (17,369 ha) of non-forest.

6.3 Response (recommendations)

Proposed additional KBAs were identified for the conservation of various groups of species in Southern Leyte: nine for flora, nine for birds and six for amphibians. Each of the proposed KBAs is considered as non-negotiable sites vis-à-vis areas that contain the most suitable habitats for specific species to survive.

Based on the species distribution model (SDM) results for all taxa analyzed, potential buffer zones surrounding each KBA were also identified. These areas are depicted in Appendix 1 as areas shaded in brown.

One of the gaps identified for the existing protected areas system in Southern Leyte is the current size or the extent of coverage of the KBA, which is rather small compared to what is really required by the different species to survive and be conserved. Thus, a network of KBAs that puts into account the extent of suitable habitats required by key biodiversity in Leyte Island was identified.

Immediate action is required to address the drivers of deforestation and forest degradation in municipalities with moderate to severe degradation. These municipalities include Silago, Sogod, Hinunangan, St. Bernard, San Juan, Hinundayan, Anahawan, and Maasin.

The BMS of the DENR-PAWB is recommended as the monitoring protocol. However, we recommend the following focal species to be used: species sensitive and intolerant to forest degradation/loss and species tolerant to land use changes (see Table 9). In addition, the forest inventory, forest fragmentation analysis, and BACI approach on biodiversity inventory will be used to determine impacts of REDD-Plus eligible activities on biodiversity.

Glossary

Akaike's Information Criterion (AIC) – Measure of relative quality of a statistical model. It is used to choose the best species abundance and occupancy models for the study.

Aroid – A plant belonging to the family Araceae. These plants have a modified leaf that protects the spadix where the flowers are located. Famous Arum plants include Anthuriums.

Biodiversity – The variety and variability among living organisms and the ecological complexes in which they occur.

Canonical Correspondence Analysis (CCA) – A multivariate statistical method used to explain the relationships between biological assemblages of species and their environment.

Critically Endangered (CR) – An IUCN threat category stating that there is an extremely high possibility of the taxon's extinction in the wild because all available data meets criteria A to E for Critically Endangered. (Please see section V of the "IUCN Red List Categories and Criteria" at http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf for a detailed explanation of criteria A to E for Critically Endangered.)

Data Deficient (DD) – An IUCN category stating that there is insufficient information to make an assessment of the possibility of extinction based on the available data for distribution and/or population status of the taxon.

Degraded Forest – Forests or grasslands that have been overused or poorly managed, and are likely to have reduced biomass densities.

Endangered (EN) – An IUCN threat category stating that there is a very high possibility of the taxon's extinction in the wild because the best available data meets any of the criteria A to E for Endangered. It is one step below Critically Endangered and one step above Vulnerable. (Please see section V of the "IUCN Red List Categories and Criteria" at http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf for a detailed explanation of criteria A to E for Critically Endangered.)

Forest – A portion of land more than half a hectare in size with trees that are at least 5 meters in height and having a canopy cover of more than 10% of the land area.

Habitat – The place where a population (e.g. human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

High Conservation Value Area (HCVA) – natural habitat of outstanding significance and critical importance to species conservation because it is the habitat of threatened and/or endemic species. Any major habitat changes in this area will almost certainly lead to species extinctions and should therefore become protected areas non-negotiably.

Key Biodiversity Areas (KBA) – nationally identified sites of global significance. The identification of KBAs is an important approach to address biodiversity conservation at the site scale i.e. at the level of individual protected areas, concessions, and land management units.

Least Concern (LC) – An IUCN threat category stating that the possibility of the taxon's extinction in the wild is low. This is because it does not qualify as Near Threatened, Vulnerable, Endangered, or Critically Endangered. This category includes widespread and abundant taxa.

Lentic Body of Water – Body of water with stagnant fresh water.

Lotic Body of Water – Body of water with swiftly moving fresh water.

Near Threatened (NT) – An IUCN threat category stating that the possibility of a taxon's extinction in the wild is medium, being worse than Least Concern taxa but not as bad as Vulnerable taxa. Although it does not qualify as Vulnerable, Endangered, or Critically Endangered, it is close to being threatened and may be classified as such in the near future.

Species Occupancy Modelling – A method to show the proportion of an area, patches, or sampled units that is occupied by a species.

Species Richness – The number of species within a region.

Trigger Species – Species of high conservation importance. In this study, the trigger species were chosen based on their distribution and IUCN Red List Classification: the species (or subspecies) are endemic and/or threatened according to their IUCN Red List classification. In addition, these species should be manageable as a distinct unit.

Vulnerable (VU) – An IUCN threat category stating that the possibility of a taxon's extinction in the wild is high. This is because the best available data meet any of the criteria A to E for Vulnerable. It is one step below Endangered. (For a detailed explanation of criteria A to E for Endangered, please see section V of the "IUCN Red List Categories and Criteria" at http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf.

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Appendix 1. Methods, data analysis, species abundance and occupancy models, and species occupancy and detectability

Methods

A. Vegetation survey

In both wet and dry season surveys, a total of 320 plots measuring 20 m in radius were surveyed covering a full range of habitat and disturbance gradients across all four sites in Mt. Nacolod. The habitat survey was conducted in two ways: (i) the Broad Habitat Classification and (ii) the Detailed Habitat Assessment.

In the broad habitat classification, each transect was marked every 25 meters to assist in recording broad habitat types (cultivation, early second growth, advanced second growth, and old growth), and in assigning bird records to habitat along transects. Below is a description of each of the habitat types used to categorize each transect:

Cultivation (CVT)	Areas with active or recently abandoned farmland; included grasslands, brushlands, agricultural plots, and small orchards with fruit trees ≤ 4 meters tall.
Early Second Growth forests (ESG)	Areas of newly regenerating forest (<20 years old) dominated by saplings and other small- to medium-sized trees
Advanced Secondary Growth forests (ASG)	Forests that are c. 20–40 years old, which have a less dense understorey and are dominated by medium to large trees
Old Growth forests (OG)	Forests that are dominated by large to very large trees and have a less complex understorey compared to early secondary growth and advanced secondary growth forests (i.e. primary forest or forest c. >40 years old)

For the detailed habitat measurements, habitat variables were recorded at each 250-meter station of the same transect used in broad habitat classification. This assessment used a variable circular plot, which is nested within 10-meter, and 20-meter radius. At each sampling point, the following physical and structural habitat variables were sampled:

- Within the 10-meter radius:
  - Number and identification of large tress (>25 cm DBH)
  - Assigning large trees to different class sizes:
    - 25–50 cm diameter at breast height (DBH)
    - 50–100 cm DBH
    - >100 cm DBH
  - Number of palms, rattan, and Pandanus plants with >2 m height
  - Presence of rocks, dead woods and fallen trees with >30 cm DBH (natural and cut), fruiting trees, and flowering trees
  - Percentage ground cover of moss, ferns, grass, herbs, leaf litter, humus, rock and ground
  - Percentage cover of canopy, midstorey and understorey
- Within the 20-meter radius:
  - Number and identification of small trees >2 m tall and 6–25 cm is assessed in 20-meter radius
  - Assigning small trees to different class sizes:
    - 13–25 cm DBH
    - 6–13 cm DBH
- Five nearest trees (25–100 cm DBH) to the central point of the plot:
  - Species identification
  - Tree and canopy height in meters, DBH, height of first branch (using measuring tape for tree size and a clinometer for tree heights)
  - Evidence of scarring (indicating natural disturbances during early stages of growth), presence of termite mounds, whether fruiting and flowering

At each sampling station, the following biophysical and other attributes were also measured:

- Distance of water (<100 m) from the center point of the plot, distance from the forest edge, valley bottom, and ridge tops
- Air temperature and relative humidity using wireless digital weather station
- Aspect and gradient, using compass and clinometer, respectively
- Position and altitude, using global positioning system receiver

B. Bird surveys

In both surveys, 18 2-kilometer and 1 one-kilometer transects were traversed for bird surveys across all four municipalities of Hinunangan, Sogod, Silago and Libagon. Transect routes were surveyed for birds using a combination of transect and point count methods employing the distance sampling method.

In the Variable Transect Width Method, the transect was traversed at a normal pacing. Each bird encountered, whether seen or just heard, was recorded taking note of:

- the species
- number of individuals (N) in each group
- the horizontal perpendicular distance from transect to bird or the center of a single-species group

These details were identified using a handheld laser range finder.

At every 250-meter points, the Variable Circular Plot method was done for 8 minutes. All the same details needed in the Variable Transect Width Method were also acquired in this method. However, instead of getting the perpendicular distance of the bird/group of birds from the transect, this time, the distances were measured from the 250-meter points in the transect.

There was difficulty in determining the group size of birds detected aurally. For these cases, the mean group sizes of visual contacts were used instead of these unknown values (Mallari et al., 2011; Lee and Marsden, 2008). All bird surveys began at dawn, when bird activity is usually highest (Blake, 1992). The same method was repeated on a different day and in the reverse direction to minimize bias attributed to route direction (Karr, 1981), bird activity and time of day.

C. Mammals

In both wet and dry season assessments, 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, footprints, bite marks, and other indicators were noted during the survey. Live traps were set 5–10 m apart within the sampling plots.

To catch volant mammals, mist nets with a total length of 15–20 m were used. Nets were left open daily from dusk until midnight for several days per site (excluding days when the weather was bad or if it was raining to avoid unnecessary losses). Nets were checked and serviced (trapped animals removed and kept for identification and biometrics) every hour until before midnight. This limited capture time and the hourly checking of the nets were done to avoid the possible capture of nocturnal birds.

For non-volant mammals, live traps were used to capture target species. Traps were set in strategic areas (i.e. tree stumps, natural pathways, dead logs, etc.), where target species were more likely to be seen or encountered. For baits, roasted coconuts coated with peanut butter and live earthworms were used. Live traps were baited/re-baited daily, in the afternoon and in the morning, after the traps were checked for possible catch. Trapped animals were brought to the camp for biometrics and proper identification. A total of 10 trap lines were set for all four surveyed sites in the Mt. Nacolod KBA.

D. Reptiles and amphibians

In both surveys, a combination of methods was used to sample reptiles and amphibians (whenever possible):

- *Transect sampling.* This method was used to generate information on species assemblages and richness of the different survey sites. Two types of sampling efforts were executed:
  - Sampling in a given habitat type (primary, secondary forest, montane, and riverine habitat)
  - Sampling across a gradient of habitat types and elevations (existing human trails also served 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.
- *Plot sampling.* A total of 164 plots measuring 100 m x 10 m representing different vegetation strata were randomly surveyed for species richness and density of reptiles and amphibians.
- *Microhabitat sampling.* Specific microhabitats were searched intensively for any occupying reptile or amphibian species. Sampling was conducted between 5 to 30 minutes in areas where herps were most likely to be encountered such as tree holes, barks, tree buttresses, forest floor, palm and aroid leaf axils, epiphytes, tree ferns, aerial ferns, puddles, as well as lotic and lentic bodies of water (Diesmos, 1998).

In all methods, sampling was performed during daytime (0800-1100H and 1300-1600H) and nighttime (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 and only experienced field technicians were allowed to handle snakes.

E. Data analysis

Species abundance and occupancy models

Bird records along each transect were pooled to calculate densities (expressed as individuals per km^2 ± SE) using Distance v. 5.0 (Thomas et al., 2006). All data were right-truncated at 50 meters, removing any outlying records, to improve model fit and reduced the likelihood of a bird encounter being assigned to an incorrect habitat type (Buckland et al., 2001). For distances where detection probability is ≤ 0.1, further right-truncation of data were undertaken (Buckland et al., 2001). Uniform, half-normal, hazard rate and negative exponential function with adjustments were considered, and the model yielding the lowest Akaike's (1974) Information Criterion value (AIC) for a given set of data was selected as the best fit for those data (Buckland et al., 2001). Post-stratification of the data by habitat type enabled comparison of abundance estimates and differences in detectability in different habitats within various sites in Mt.Nacolod. Post-stratified parameters were used as the more reliable estimate of abundance in cases where combined AIC values for individual habitat detection functions were greater than the post-stratified AIC for those data (Buckland et al., 2008). Density estimates were then presented as the number of individuals per km^2 ± CV (coefficient of variation; the SE of the density estimate expressed as a percentage of it).

Species occupancy and detectability

Using the program PRESENCE v 3.1, species occupancy (ψ) and detection probability (p) values were generated (Hines, 2006). The species detection (presence/absence) for flora, birds, mammals, and herpetofauna from four different sites was used in analysis including five covariates representing different strata: mean tree DBH (ave DBH) and tree height (tr ht); percentage cover of saplings (% sapling) and rattans (% rattan); and ground exposure (% ground). The naive occupancy estimates were calculated using single-season analysis with one group model and detection probability (p) with custom model, and were run on different covariates having 31 combinations to obtain the most parsimonious model through AIC value.

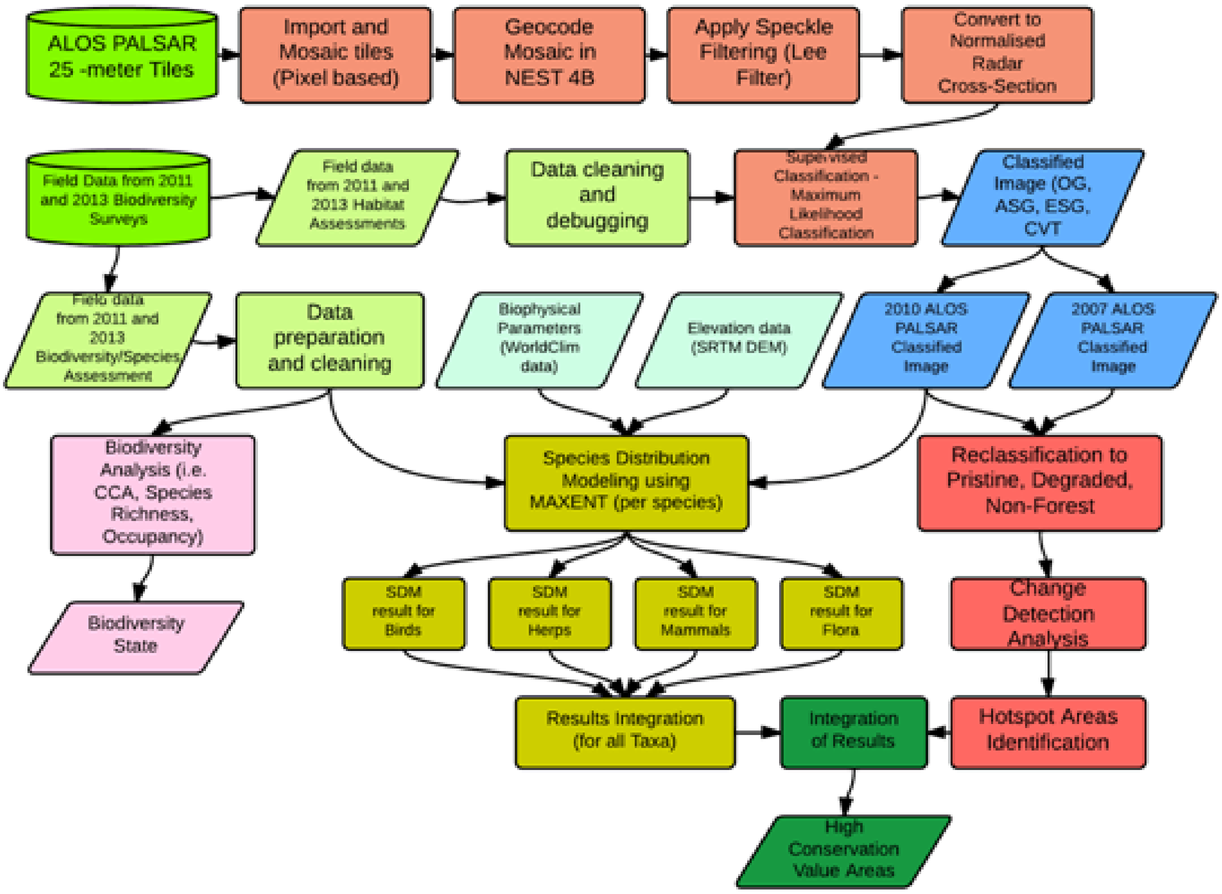
F. Remote sensing image analysis

Materials and data

This project used 6 tiles of the 25-meter ALOS PALSAR Orthorectified Mosaic covering the provinces of Leyte and Southern Leyte in Region 8, Philippines (9–12 degrees north and 123–126 degrees east). This dataset was acquired through a joint collaboration with the University of the Philippines Diliman and GIZ, which was produced and pre-processed by the Japan Aerospace Exploration Agency (JAXA).

Habitat types (OG, ASG, ESG, and CVT) were collected during the two field biodiversity surveys conducted in the municipalities of Sogod, Silago, Hinunangan, and Libagon in Southern Leyte for the wet season (2011) and dry season (2013) data gathering. These classes were further clustered into "Pristine," "Degraded" and "Non-Forest" classes.

Methodology



Pre-processing and mosaicking

The ALOS PALSAR tiles were terrain and slope corrected using the Shuttle Radar Topographic Mission 90-meter Digital Elevation Model (SRTM DEM) by JAXA. Six tiles with upper left corners Lat 10° Long 124°, Lat 10° Long 125°, Lat 11° Long 124°, Lat 11° Long 125°, Lat 12° Long 124° and Lat 12° Long 125° were mosaicked.

Geocoding and reprojection

Based on the product metadata, the ALOS PALSAR tiles were projected using Equirectagular projection (EQR). The six mosaicked tiles are reprojected to Universal Transverse Mercator (UTM) Zone 51N coordinate system and World Geodetic System (WGS) 84 datum with total root mean square error of less than 0.5, using NEST 4B software.

Speckle filtering and normalization

Radar data characteristically have signal noise that appears like speckle on an image. Using speckle filters with medium-sized kernels can reduce these noisy pixels. In this processing, Frost filter is used with 5 x 5 kernel size. Upon reduction of speckles, the digital numbers are then converted to Sigma-naught (σ) (decibels or dB) by means of normalization. The equation dB = 10(log10 DN2) + CF was used, where CF is the calibration factor with a value of -83 (JAXA-Earth Observation Research Center).

Layer stacking and image masking

The HH (images resulting from horizontally polarized radio waves), HV (images resulting from vertically polarized radio waves with received radiation restricted horizontally polarized waves) and HH/HV layers were stacked, and image masking was applied. Radar effects and ocean masks were generated using the SRTM DEM to exclude laid-over and shadowed regions where radar data may be erroneous, as well as water bodies.

Field data preparation and classification

Locations of habitat assessments (OG, ASG, ESG, and CVT) were extracted from the biodiversity survey data. These training data are used in the maximum likelihood supervised classification.

Results reclassification

For the purpose of the discussions of this study, the initial classes were redefined to pristine forest, degraded forest and non-forest areas, where:

- The pristine forest is the combination of sampling points classified in the field as old growth and advanced second growth forest
- The degraded forest is the sampling points classified in the field as early second growth forest
- The non-forest areas are the sampling points classified in the field as cultivated and non-forest areas

Change detection analysis

Pixel-based change detection was done to assess the changes in land cover. Tracking the conversion of the different classes (pristine, degraded, non-forest) was assessed and calculated.

Hot spots identification

From the result of change detection analysis, areas that have more pixel conversion from pristine forest to others have been tagged as hot spots, whereas change from degraded and non-forest to pristine forest in 3 years could have been highly doubtful, so it was tagged as a form of vegetation regrowth. This detected change could be attributed to a certain increase in the radar signal response detected by the sensor but could not specifically be captured in the chosen classification scheme.

G. Species distribution modelling

Species distribution modelling was performed for a number of species, with corresponding data points in brackets, using presence-only data:

- Almon (258)
- Apitong (11)
- Bagtikan (36)
- Cebu Cinnamon (34)
- Malayakal (31)
- Mayapis (253)
- Red Lauan (153)
- Tangile (137)
- White Lauan (92)
- Yakal (6)
- Yakal Kaliot (135)
- Yakal Sapiongan (89)
- *Tanygnathus lucionensis* (30)
- *Buceros hydrocorax* (130)
- *Gallicolumba crinigera* (5)
- *Penelopides panini* (100)
- *Prioniturus discurus* (59)
- *Megophrys stejnegeri* (20)
- *Philautus leitensis* (45)
- *Platymantis green* (22)
- *Platymantis guentheri* (46)
- *Platymantis rabori* (13)
- *Rhacophorus bimaculatus* (15)

Occurrence records were obtained during the survey using Global Positioning System (GPS). Initial records of species occurrence were filtered to avoid bias of clustered points on a cell (Hernandez et al., 2006). Environmental covariate layers are composed of vegetation derived from 2010 ALOS PALSAR image, altitude, slope, mean temperature, and precipitation for wettest and driest quarters extracted from WorldClim bioclimate database (Hijmans et al., 2005; http://www.worldclim.org) and soil from Harmonized World Soil Database v. 1.1 (Nachtergaele et al., 2009). All layers were resampled to 1 km^2 resolution using Quantum GIS v. 2.0.

Models were run using maximum entropy i.e. Maxent v. 3.3.3k (Phillips et al., 2006), one of the best performing algorithms for modelling presence-only data and scarce occurrence record (Elith et al., 2006; Hernandez et al., 2006). Linear feature of Maxent was used as recommended for small samples (Phillips and Dudík, 2008). Models were replicated five times to evaluate the responses of covariates. To further evaluate the performance of the model in discriminating presence and absence predictions, value of area under the curve (AUC) of receiver operating characteristic (ROC) was calculated. The evaluation of models using test data was not used because of the scarce occurrence record. Use of bias file or account of sampling efforts was not also employed in the models. Threshold value was determined based from lowest predicted value (LPV) of occurrence (Pearson, 2007) to ensure that no occurrence records are omitted (i.e. omission error= 0). Model outputs were reclassified using the threshold value and intersected in GIS to produce the species distribution maps.

Appendix 2. Habitat profile of Southern Leyte (sites arranged according to increasing land area)

Site	Total area (in ha)	Habitat types		
		Pristine forest (in ha)	Degraded forest (in ha)	Open area (in ha)
Tomas Oppus	8,712	3,674	1,188	3,850
Libagon	9,787	4,874	1,172	3,741
Hinunangan	13,394	5,846	1,513	6,036
Silago	19,495	10,940	3,046	5,510
Sogod	20,850	10,895	1,204	8,751
Total for survey sites	72,238	36,229	8,123	27,888
Southern Leyte Province	163,271	71,028	17,784.31	74,459
Leyte Province	546,428	233,770	135,083	248,603
Leyte Island	709,700	233,770	152,868	323,062

Shown is the summary of the result of our analyses of the forest cover extracted from the 2010 25-meter ALOS PALSAR mosaic image showing the following computed area covers in hectares: pristine forest (233,770 ha); degraded forest (152,083 ha); and non-forest areas (323,062 ha).

Appendix 3. List of flora species recorded in Southern Leyte

No.	Family name	Scientific name	Common name	2011	2013
1	Anacardiaceae	*Buchanania arborescens*	Balinghasai		X
2	Anacardiaceae	*Buchanania nitida*	Balitantan		X
3	Anacardiaceae	*Dracontomelon edule*	Lamio		X
4	Anacardiaceae	***Mangifera altissima***	**Pahutan (Vu)**	X	X
5	Anacardiaceae	*Mangifera indica*	Mango		X
6	Anacardiaceae	***Mangifera monandra***	**Malapaho Paho (EN)**		X
7	Anacardiaceae	*Pistacia chinensis*	Sangilo		X
8	Anacardiaceae	*Semicarpus philippinensis*	Kamiring		X
9	Anacardiaceae	*Spondias* sp.			X
10	Annonaceae	*Annona muricata*	Guyabano		X
11	Annonaceae	*Cananga odorata*	Ilang-ilang	X	X
12	Annonaceae	*Cananga* sp.	Angilan		X
13	Annonaceae	*Goniothalamus* sp.			X
14	Annonaceae	*Goniothalamuss elmeri*	Bigus	X	X
15	Annonaceae	*Horsfieldia castulata*	Yabnob		X
16	Annonaceae	*Pseuduvaria* sp.			X
17	Apocynaceae	*Alstonia scholaris*	Dita	X	X
18	Apocynaceae	*Tabernaemontana pandacaqui*	Pandakaki	X	X
19	Apocynaceae	*Voacanga globosa*	Bayag-usa	X	X
20	Apocynaceae	*Wrightia pubescens*	Lanete		X
21	Araliaceae	*Arthrophyllum cenabrei*	Bingliu		X
22	Araliaceae	*Osmoxylon trilobatum*	Ayum	X	X
23	Araliaceae	*Polyscias nodosa*	Malapapaya	X	X
24	Araliaceae	*Schefflera actinophylla*	Octopus tree		X
25	Araliaceae	*Schefflera insularum*	Galamay-amo		X
26	Araucariaceae	***Agathis philippinensis***	**Almaciga (Vu)**		X
27	Arecaceae	*Cocos nucifera*	Coconut/Niyog		X
28	Bignoniaceae	*Dolichandrone spathacea*	Tui		X
29	Bombaeaceae	*Durio zibethinus*	Durian		X
30	Boraginaceae	*Cordia dichotoma*	Anonang		X
31	Burseraceae	*Canarium asperum*	Pagsahingin	X	X
32	Burseraceae	*Canarium gracile*	Pagsahingin-langgam		X
33	Burseraceae	*Canarium hirsutum*	Milipili		X
34	Burseraceae	***Canarium luzonicum***	**Piling-liitan (Vu)**		X
35	Burseraceae	***Canarium ovatum***	**Pili (Vu)**		X
36	Burseraceae	*Canarium* sp.	Dulit/Pagsahingin Bulog		X
37	Burseraceae	*Canarium* sp.	Pagsahingin clemens		X
38	Burseraceae	*Canarium* sp.			X
39	Burseraceae	*Dacryodes rostrata*	Lunai		X
40	Calophyllaceae	*Calophyllum* sp.	Bitanghol linis		X

41	Calophyllaceae	*Calophyllum* sp.	Bitanghol-sibat		X
42	Calophyllaceae	*Calophyllum* sp.	Bitanghol-laparan		X
43	Calophyllaceae	*Calophyllum blancoi*	Bitanghol	X	X
44	Casuarinaceae	*Gymnostoma sumatranum*	Maribuhuk		X
45	Ceasalpiniaceae	*Bauhinia monandra*	Fringon		X
46	Celastraceae	*Siphonodon* sp.			X
47	Celastraceae	*Siphonodon celastrineus*	Malagsak		X
48	Chrysobalanaceae	*Maranthes* sp.			X
49	Clusiaceae	*Garcinia binucao*	Batuan/Binukau	X	X
50	Clusiaceae	*Garcinia busuangaensis*	Batuhan		X
51	Clusiaceae	*Garcinia garciae*	Bogalot		X
52	Clusiaceae	*Garcinia ituman*	Ituman		X
53	Clusiaceae	*Garcinia rubra*	Kamandiis	X	X
54	Combretaceae	*Terminalia foetidissima*	Talisai-gubat	X	X
55	Combretaceae	*Terminalia microcarpa*	Kalumpit		X
56	Cornaceae	*Alangium* sp.			X
57	Ctenophonaceae	*Ctenolophon parvifolius*	Sudiang		X
58	Dilleniaceae	*Dillenia indica*	Handapara	X	X
59	Dilleniaceae	***Dillenia megalantha***	**Katmon-bayani (Vu)**	X	X
60	Dilleniaceae	***Dillenia philippinensis***	**Katmon (Vu)**	X	X
61	Dipterocarpaceae	***Dipterocarpus alatus***	**Hairy-leafed Apitong (EN)**		X
62	Dipterocarpaceae	***Dipterocarpus grandiflorus***	**Apitong (CR)**		X
63	Dipterocarpaceae	*Dipterocarpus* sp.			X
64	Dipterocarpaceae	***Hopea acuminata***	**Manggachapui (CR)**		X
65	Dipterocarpaceae	***Hopea malibato***	**Yakal-kaliot (CR)**		X
66	Dipterocarpaceae	***Hopea philippinensis***	**Gisok-gisok (CR)**		X
67	Dipterocarpaceae	***Hopea plagata***	**Yakal-saplongan (CR)**		X
68	Dipterocarpaceae	***Parashorea malaanonan***	**Bagtikan (CR)**		X
69	Dipterocarpaceae	***Shorea almon***	**Almon (CR)**	X	X
70	Dipterocarpaceae	*Shorea assamica* ssp. *koordersii*	Manggasinorong-tilos		X
71	Dipterocarpaceae	*Shorea assamica* ssp. *philippinensis*	Manggasinoro		X
72	Dipterocarpaceae	***Shorea astylosa***	**Yakal (CR)**	X	X
73	Dipterocarpaceae	***Shorea contorta***	**White Lauan (CR)**	X	X
74	Dipterocarpaceae	***Shorea negrosensis***	**Red Lauan (CR)**	X	X
75	Dipterocarpaceae	***Shorea palosapis***	**Mayapis (CR)**	X	X
76	Dipterocarpaceae	***Shorea polysperma***	**Tangile (CR)**	X	X
77	Dipterocarpaceae	***Shorea seminis***	**Malayakal (CR)**		X
78	Dipterocarpaceae	*Shorea virescens*	Manggasinorong-lakihan		X
79	Ebenaceae	*Diospyros discolor*	Kamagong		X
80	Ebenaceae	*Diospyros montana*	Kamagong-gubat		X
81	Ebenaceae	*Diospyros montana var. timorensis*	Kamagong-bundok		X
82	Ebenaceae	*Diospyros nitida*	Katilma		X
83	Ebenaceae	*Diospyros philosanthera*	Bulong-eta	X	X
84	Ebenaceae	*Diospyros poncei*	Ponce Kamagong		X

85	Ebenaceae	*Diospyrus* sp.			X
86	Elaeocarpaceae	*Elaeocarpus luzonicus*	Tal-ot		X
87	Elaeocarpaceae	*Elaeocarpus macrantus*	Bayukbok		X
88	Elaeocarpaceae	*Elaeocarpus mindanensis*	Pilokao		X
89	Elaeocarpaceae	*Elaeocarpus* sp.			X
90	Elaeocarpaceae	*Sloanea sigun*	Sala		X
91	Elaeocarpaceae	*Sloanea* sp.			X
92	Euphorbiaceae	*Bridelia glauca*	Balitahan		X
93	Euphorbiaceae	*Bridelia penangiana*	Subiang		X
94	Euphorbiaceae	*Claoxylon arboretum*	Banata		X
95	Euphorbiaceae	*Claoxylon euphorbioides*			X
96	Euphorbiaceae	*Claoxylum* sp.			X
97	Euphorbiaceae	*Drypetes littoralis*	Bato-bato		X
98	Euphorbiaceae	*Euphorbia ovalifolium*			X
99	Euphorbiaceae	*Euphorbia* sp.			X
100	Euphorbiaceae	*Homalanthus polyantha*	Balanting-bilog		X
101	Euphorbiaceae	*Homalanthus populneus*	Balanti		X
102	Euphorbiaceae	*Homalanthus populneus* var. *laevis*	Malabaranti		X
103	Euphorbiaceae	*Homolanthus* sp.			X
104	Euphorbiaceae	*Macaranga amplifolia*	Binungang-laparan		X
105	Euphorbiaceae	***Macaranga bicolor***	**Hamindang (Vu)**	X	X
106	Euphorbiaceae	***Macaranga caudatifolia***	**Daha (Vu)**		X
107	Euphorbiaceae	*Macaranga tanarius*	Binunga	X	X
108	Euphorbiaceae	*Macaranga* sp.			X
109	Euphorbiaceae	*Mallotus korthalsii*	Banatong puti		X
110	Euphorbiaceae	*Mallotus mollissimus*	Hinlaumo		X
111	Euphorbiaceae	*Mallotus philippensis*	Banato	X	X
112	Euphorbiaceae	*Melanolepis multiglandulosa*	Alim	X	X
113	Euphorbiaceae	*Neotrewia cumingii*	Apanang		X
114	Euphorbiaceae	***Sapium luzonicum***	**Balakat-gubat (Vu)**		X
115	Euphorbiaceae	***Securinega flexuosa***	**Anislag (Vu)**		X
116	Euphorbiaceae	***Tectona philippinensis***	**Philippine Teak (CR)**		X
117	Euphorbiaceae	*Trigonostemon filiforme*			X
118	Euphorbiaceae	*Trigonostemon* sp.			X
119	Fabaceae	***Afzelia rhomboidea***	**Tindalo (Vu)**	X	X
120	Fabaceae	*Albizia butarek*	Butarek		X
121	Fabaceae	*Cynometra* sp.			X
122	Fabaceae	*Derris* sp.	Tubli		X
123	Fabaceae	*Erythrina fusca*	Ani-i		X
124	Fabaceae	*Gliricidia sepium*	Kakawate	X	X
125	Fabaceae	*Ormosia calavensis*	Bahai		X
126	Fabaceae	*Pongamia pinnata*	Bani		X
127	Fabaceae	***Pterocarpus indicus***	**Smooth Narra (Vu)**	X	X
128	Fabaceae	*Pterocarpusindicus cf. echinatus*	Prickly Narra		X

129	Fagaceae	*Castanopsis evansii*	Gasa		X
130	Fagaceae	*Lithocarpus llanosii*	Ulayan		X
131	Fagaceae	*Lithocarpus* sp.	Ulian puti/linis		X
132	Fagaceae	*Lithocarpus* sp.	Ulayan Pula		X
133	Flacourtiaceae	*Flacourtia jangomas*	Madagascar Plum		X
134	Flacourtiaceae	*Flacourtia* sp.			X
135	Flacourtiaceae	*Gnetum gnemon*	Bago		X
136	Flacourtiaceae	*Osmelia philippina*	Oonog		X
137	Gesneraceae	*Cyrtandra oblongata*			X
138	Gesneriaceae	*Cyrtandra* sp.		X	X
139	Hypericaceae	*Cratoxylum formosum*	Salinggogon		X
140	Hypericaceae	*Cratoxylum sumatranum*	Puguringon		X
141	Icacinaceae	*Gomphandra luzoniensis*	Mabunot		X
142	Icacinaceae	*Gonocaryum calleryanum*			X
143	Lamiaceae	*Callicarpa platyphyla*	Anuyup		X
144	Lamiaceae	*Clerodendrum intermedium*		X	X
145	Lamiaceae	*Clerodendrum minahassae*	Bagauak		X
146	Lamiaceae	*Clerodendrum flavum*	Bagauak-dilaw		X
147	Lamiaceae	*Clerodendrum* sp.	Bagauak green		X
148	Lamiaceae	*Clerodendrum* sp.	Bagauak-habaan		X
149	Lamiaceae	*Clerodendrum* sp.	Bagauak-pula		X
150	Lauraceae	*Cinnamomum cebuense*	Cebu Cinnamon		X
151	Lauraceae	*Cinnamomum* cf. *mendozai*			X
152	Lauraceae	*Cinnamomum iners*	Clove Cinnamon		X
153	Lauraceae	***Cinnamomum mercadoi***	**Mercadoi (Vu)**	X	X
154	Lauraceae	*Cinnamomum nanophyllum*	Kalingag		X
155	Lauraceae	*Cinnamomum* sp. 1	Kalingag		X
156	Lauraceae	*Cinnamomum* sp. 2	Kalingag		X
157	Lauraceae	*Cinnamomum* sp. 6	Cinnamon sp. 6		X
158	Lauraceae	*Cryptocarya* sp.			X
159	Lauraceae	*Dehaasia cairocan*	Malakadios		X
160	Lauraceae	*Litesea* cf. *megacarpa*	Duol		X
161	Lauraceae	*Litsea baractanensis*	Sablot-linis		X
162	Lauraceae	*Litsea glutinosa*	Sablot		X
163	Lauraceae	*Litsea perrottefii*	Marang		X
164	Lauraceae	*Litsea philippinensis*	Bakan		X
165	Lauraceae	*Litsea urdanetensis*	Dilak-manuk		X
166	Lauraceae	*Litsea* sp.			X
167	Lauraceae	***Neolitsea vidalii***	**Puso-puso (Vu)**		X
168	Lauraceae	*Persea americana*	Avocado		X
169	Lauraceae	*Persia* sp.	Mala-abocado		X
170	Lauraceae	*Phoebe sterculiodes*	Kaburo		X
171	Lecythidaceae	*Barringtonia racemosa*	Putat		X
172	Lecythidaceae	*Barringtonia* sp.			X

173	Lecythidaceae	*Petersianthus quadrialatus*	Toog		X
174	Lecythidaceae	*Planchonia* sp.			X
175	Lythraceae	*Lagerstroemia speciosa*	Banaba		X
176	Malvaceae	***Camptostemon philippinense***	**Gapas-gapas (EN)**		X
177	Malvaceae	*Hibiscus tiliaceus*	Malubago	X	X
178	Melastomataceae	*Astronia candolleana*	Talanak	X	X
179	Melastomataceae	*Astronia cumingiana*	Badling		X
180	Melastomataceae	*Melastoma malabathricum*		X	X
181	Meliaceae	*Aglaia elliptica*	Malasaging-liitan		X
182	Meliaceae	***Aglaia leptantha***	**Gisihan (NT)**		X
183	Meliaceae	*Aglaia* sp.			X
184	Meliaceae	*Alangium* sp.			X
185	Meliaceae	*Aphanamixis polystachya*	Kangko		X
186	Meliaceae	*Chisocheton cumingianus*	Balukanag		X
187	Meliaceae	*Chisocheton patens*	Agogoi		X
188	Meliaceae	*Chisocheton* sp.			X
189	Meliaceae	*Chisocheton cauliflorus*	Malapau		X
190	Meliaceae	*Dysoxylum gaudichaudianum*	Igyo		X
191	Meliaceae	*Melia* sp.			X
192	Meliaceae	*Reinwardtiodendron humile*	Lansones-gubat		X
193	Meliaceae	*Sandoricum koetjape*	Santol	X	X
194	Meliaceae	*Sandoricum* sp.	Malasantol	X	X
195	Meliaceae	***Swietenia mahogani***	**Mahogany (EN)**		X
196	Meliaceae	*Toona ciliate*	Lanipga		X
197	Meliaceae	*Vavaea amicorum*	Nangka-nangka		X
198	Menispermaceae	*Cyclea* sp.	Tree fern		X
199	Mimosaceae	*Adenanthera pavonina*	Matanglin		X
200	Mimosaceae	*Albizia falcataria*	Falcata		X
201	Mimosaceae	*Leucaena glauca*	Ipil-ipil		X
202	Mimosaceae	*Parkia timoriana*	Kupang		X
203	Mimosaceae	*Wallaceodendron celebicum*	Banuyo		X
204	Moraceae	***Artocarpus blancoi***	**Antipolo (Vu)**	X	X
205	Moraceae	*Artocarpus heterophyllus*	Nangka	X	X
206	Moraceae	*Artocarpus odoratissimus*	marang-banguhan		X
207	Moraceae	*Artocarpus sericicarpus*	Gumihan		X
208	Moraceae	***Artocarpus treculianus***	**Pakak (Vu)**		X
209	Moraceae	*Artocarpus* sp.			X
210	Moraceae	*Ficus altissima*	Baleteng-layugan	X	X
211	Moraceae	*Ficus ampelas*	Upling-gubat		X
212	Moraceae	*Ficus balete*	Balete	X	X
213	Moraceae	*Ficus botryocarpa*	Basikong	X	X
214	Moraceae	*Ficus callosa*	Kalukoi		X
215	Moraceae	*Ficus chrysolepis*	Baleteng Habaan		X
216	Moraceae	*Ficus congesta*	Malatibig		X

217	Moraceae	*Ficus crassiramea*	Baleteng-kapalan		X
218	Moraceae	*Ficus fistula*	Kamahiuan	X	X
219	Moraceae	*Ficus heteropoda*	Alangas		X
220	Moraceae	*Ficus irisana*	Aplas		X
221	Moraceae	*Ficus latsoni*	Tangisang-layugan		X
222	Moraceae	*Ficus linearfolia*	Daing-daing		X
223	Moraceae	*Ficus magnoliifolia*	Kanapai		X
224	Moraceae	*Ficus minahassae*	Hagimit	X	X
225	Moraceae	*Ficus nota*	Tibig	X	X
226	Moraceae	*Ficus obscura*	Kagaskas		X
227	Moraceae	*Ficus odorata*	Pakiling	X	X
228	Moraceae	*Ficus pseudopalma*	Niog-niyogan		X
229	Moraceae	*Ficus pubinervis*	Dungo		X
230	Moraceae	*Ficus septica*	Hauili	X	X
231	Moraceae	***Ficus ulmifolia***	**Is-is (Vu)**	X	X
232	Moraceae	*Ficus variegate*	Tangisang bayawak	X	X
233	Moraceae	*Ficus* sp.			X
234	Moraceae	*Parartocarpus venenosus*	Malanangka		X
235	Myricaceae	*Myrica javanica*	Hindang		X
236	Myricaceae	*Myrica* sp. *1*	Hindang laparan		X
237	Myricaceae	*Myrica* sp. *2*	Hindang liitan		X
238	Myricaceae	*Myrica* sp. *3*	Hindang-antsoan		X
239	Myristicaceae	*Knema glomerata*	Tambalau		X
240	Myristicaceae	*Knema* sp.			X
241	Myristicaceae	*Myristica guatterifolia*	Duguan-mabolo		X
242	Myristicaeae	*Myristica philippinensis*	Duguan	X	X
243	Myristicaeae	*Myristica* sp.	Duguan-lauana		X
244	Myrtaceae	*Psidium guajava*	Guava		X
245	Myrtaceae	*Syzygium aqueum*	Tambis	X	X
246	Myrtaceae	*Syzygium brevistylum*	Sagimsim		X
247	Myrtaceae	*Syzygium ciliato-setosum*	Lakangan		X
248	Myrtaceae	*Syzygium everettii*	Malahagnit		X
249	Myrtaceae	*Syzygium hutchinsonii*	Malatambis		X
250	Myrtaceae	*Syzygium longissum*	Tual		X
251	Myrtaceae	*Syzygium subcaudatum*	Malaruhat-bundok		X
252	Myrtaceae	*Syzygium* sp. *1*	Tambis-kapalan		X
253	Myrtaceae	*Syzygium* sp. *2*	Tambis-gubat		X
254	Myrtaceae	*Syzygium* sp. *3*	Tambis-tambis		X
255	Myrtaceae	*Syzygium* sp. *4*			X
256	Myrtaceae	*Tristaniopsis decorticata*	Malabayabas		X
257	Myrtaceae	*Tristaniopsis micrantha*	Tree fern		X
258	Myrtaceae	*Tristaniopsis oblongifoliadecorticate*	Tigang-habaan		X
259	Myrtaceae	*Tristaniopsis* sp.	Tiga puti/Linis		X
260	Myrtaceae	*Tristaniopsis* sp.	Tiga pula		X

261	Ochnaceae	***Brackenridgea palustris***	**Bansilai (NT)**		X
262	Pandanaeeae	*Pandanus* sp.		X	X
263	Phyllanthaceae	*Antidesma cumingii*			X
264	Phyllanthaceae	*Antidesma montanum*			X
265	Phyllanthaceae	*Antidesma* sp.			X
266	Phyllanthaceae	*Glochidion album*	Malabagang		X
267	Phyllanthaceae	*Glochidion angulatum*	Suyapaw/Sibulau		X
268	Phyllanthaceae	*Glochidion camiguinense*	Bunot-bunot		X
269	Piperacea	*Piper interruptum*	Dugtong		X
270	Podocarpaceae	*Podocarpus rumphii*	Malakauayan		X
271	Primulaceae	*Ardisia lanceolata*	Tagpong-sibat		X
272	Primulaceae	***Ardisia squamulosa***	**Tagpo (Vu)**	X	X
273	Primulaceae	*Ardisia taytayensis*	Tagpong-kapalan		X
274	Primulaceae	*Ardisia* sp. *1*	Badling Brown		X
275	Primulaceae	*Ardisia* sp. *2*	Tagpong-laparan		X
276	Primulaceae	*Ardisia* sp. *3*			X
277	Proteaceae	*Helicia robusta*	Salimai-lakihan		X
278	Proteaceae	*Helicia* sp.			X
279	Putranjivaceae	*Drypetes* sp.			X
280	Rhamnaceae	*Alphitonia philippinensis*	Tulo		X
281	Rhizophoraceae	*Carallia brachiata*	Bakauan-gubat		X
282	Rosaceae	*Prunus fragrans*	Lagong-banguhan		X
283	Rosaceae	*Prunus javanica*	Palawan Cherry		X
284	Rosaceae	*Prunus* sp. *1*	Malarosal		X
285	Rosaceae	*Prunus* sp. *2*			X
286	Rubiaceae	*Adina* sp.	Bokok		X
287	Rubiaceae	*Alphitonia philippinensis*	Tulo		X
288	Rubiaceae	*Canthium dicocum*	Malakape		X
289	Rubiaceae	*Diplospora tinangoensis*			X
290	Rubiaceae	*Diplospora* sp.			X
291	Rubiaceae	*Ixora* sp.	Wild Santan		X
292	Rubiaceae	*Ixora* sp.	Large-leaf wild santan	X	X
293	Rubiaceae	*Mussaenda philippica*	Kahoy-dalaga	X	X
294	Rubiaceae	*Mussaenda* sp.			X
295	Rubiaceae	*Nauclea* sp.	Anchuan Bangkal		X
296	Rubiaceae	*Neonauclea calycina*	Kalamansanai		X
297	Rubiaceae	*Neonauclea formicaria*	Hambabalud	X	X
298	Rubiaceae	*Neonauclea lanceolata*			X
299	Rubiaceae	*Neonauclea* sp. *1*	Hambabalud-liitan		X
300	Rubiaceae	*Neonauclea* sp. *2*			X
301	Rubiaceae	*Neonauclea* sp. *3*			X
302	Rubiaceae	*Psychotria* sp.			X
303	Rubiaceae	*Rubus* sp.	Wild Strawberry		X
304	Rubiaceae	*Rubia* sp.			X

305	Rutaceae	*Glycosmis greenei*	Patulan		X
306	Rutaceae	*Melicope triphylla*	Matang-araw		X
307	Rutaceae	*Micromelum compressum*	Tulibas-tilos		X
308	Rutaceae	*Ruta* sp.			X
309	Sapindaceae	*Dimocarpus fumatus*	Wild rambutan/Bulala		X
310	Sapindaceae	*Pometia pinnata*	Malugai	X	X
311	Sapotaceae	*Manilkara fasciculate*	Dulok-dulok/Duyok-duyok		X
312	Sapotaceae	*Palaquium glabrifolia*	Nato-linis		X
313	Sapotaceae	***Palaquium luzoniense***	**Nato pula (Vu)**		X
314	Sapotaceae	*Planchonella nitida*	Duklitan		X
315	Sapotaceae	***Pouteria villamilii***	**Nato puti (Vu)**		X
316	Sonneratiaceae	*Duabanga moluccana*	Loktob		X
317	Sterculiaceae	*Heritiera javanica*	Lumbayao		X
318	Sterculiaceae	*Heritiera sylvatica*	Dungon		X
319	Sterculiaceae	*Pterocymbium tinctorium*	Taluto		X
320	Sterculiaceae	*Pterospermum cumingii*	Talingauan		X
321	Sterculiaceae	*Pterospermum diversifolium*	Bayok		X
322	Sterculiaceae	*Pterospermum niveum*	Bayok-bayokan		X
323	Sterculiaceae	*Pterospermum obliquum*	Kulatingan		X
324	Sterculiaceae	*Sterculia comosa*	Banilad		X
325	Sterculiaceae	*Sterculia rubiginosa*	Sinaligan		X
326	Sterculiaceae	*Theobroma cacao*	Cacao		X
327	Thymelaeaceae	*Phaleria capitata*	Salagong-gubat		X
328	Thymelaeaceae	*Phaleria perrottetiana*	Tuka		X
329	Thymelaeaceae	*Wikstroemia ovata*	Salagong-bilog		X
330	Thymelaeaceae	*Wilkstroemia lanceolata*	Salagong-sibat		X
331	Thymelaeaceae	*Wilkstroemia polyantha*	Salagong-bundok		X
332	Tiliaceae	*Colona serratifolia*	Anilao		X
333	Tiliaceae	***Diplodiscus paniculatus***	**Balobo (Vu)**		X
334	Tiliaceae	*Grewia retusifolia*	Danglin		X
335	Tiliaceae	*Trichospermum involucratum*	Langosig		X
336	Ulmaceae	*Celtis philippensis*	Malaikmo		X
337	Ulmaceae	*Trema cannabina*	Anogdong		X
338	Ulmaceae	*Trema orientalis*	Anabiong		X
339	Ulticaceae	*Pipturus arborescens*	Dalunut		X
340	Urticaceae	*Dendrocnide crassifolia*	Sagai-kapalan		X
341	Urticaceae	*Dendrocnide densiflora*	Sagai		X
342	Urticaceae	*Dendrocnide stimulans.*	Lingaton		X
343	Urticaceae	*Dendrocnide* sp.	Lingataong-laparan		X
344	Urticaceae	*Leucosyke capitellata*	Alagasi		X
345	Verbenaceae	*Callicarpa paloensis*	Tigau-tigau		X
346	Verbenaceae	*Callicarpa* sp.	Tigau		X
347	Verbenaceae	*Premna odorata*	Alagau		X
348	Verbenaceae	*Tectona* sp.			X

349	Verbenaceae	*Vitex turczaninowii*	Lingo-lingo/Mumpong		X
350	Vitaceae	*Leea aculeate*	Amamali		X
351	Vitaceae	*Leea aequata*	Gulob		X
352	Vitaceae	*Leea indica*	Nutub		X
353	Vitaceae	*Leea philippinensis*	Kaliantan		X
354	Vitaceae	*Leea* sp.			X

Species in bold are threatened, categorized as Vulnerable (Vu), Endangered (EN), Critically Endangered (CR) or Near Threatened (NT) based on IUCN Red List (2013).

Appendix 4. List of avian species recorded in Southern Leyte

No.	Species	Common name	2000	2011	2013
1	*Ardea alba*	Great Egret	-	-	X
2	*Egretta intermedia*	Intermediate Egret	X	-	X
3	*Egretta garzetta*	Little Egret	X	-	X
4	***Aviceda jerdoni***	**Jerdon's Baza**	X	-	-
5	***Pernis celebensis***	**Barred Honeybuzzard**	X	-	-
6	*Haliastur indus*	Brahminy Kite	-	-	X
7	*Circus spilonotus*	Eastern Marsh-Harrier	X	-	-
8	*Circus melanoleucos*	Pied Harrier	X	-	-
9	***Accipiter virgatus***	**Besra**	X	-	-
10	*Accipiter soloensis*	Chinese Goshawk	X	-	-
11	***Accipiter trivirgatus***	**Crested Goshawk**	X	-	-
12	***Spilorinis holospilus***	**Philippine Serpent-Eagle**	X	-	-
13	***Pithecophaga jefferyi***	**Philippine Eagle (CR)**	X	-	-
14	*Hieraaetus kienerii*	Rufous-bellied Eagle	X	-	-
15	***Spizaetus philippinensis***	**Philippine Hawk-Eagle (Vu)**	X	-	-
16	***Microheirax erythrogenys***	**Philippine Falconet**	X	-	-
17	***Megapodius cumingi***	**Tabon Scrubfowl**	X	-	-
18	*Gallus gallus*	Red Junglefowl	X	X	X
19	***Gallirallus striatus***	**Slaty-breasted Rail**	X	-	-
20	***Gallirallus torquatus***	**Barred Rail**	X	-	-
21	*Rallina eurizonoides*	Slaty-legged Crake	X	-	-
22	***Porzana fusca***	**Ruddy-breasted Crake**	X	-	-
23	***Porzana cinerea***	**White-browed Crake**	X	-	-
24	***Amaurornis olivaceus***	**Plain Bush-hen**	X	-	-
25	*Amaurornis phoenicurus*	White-breasted Waterhen	X	X	X
26	*Gallinula chloropus*	Common Moorhen	X	-	-
27	*Gallicrex cinerea*	Watercock	-	-	X
28	*Treron pompadora*	Pompadour Green-Pigeon	X	-	-
29	*Treron vernans*	Pink-necked Green-Pigeon	X	-	-
30	***Phapitreron leucotis***	**White-eared Brown Dove**	X	-	X
31	***Phapitreron amethystina***	**Amethyst Brown Dove**	X	X	X
32	***Ptilinopus occipitalis***	**Yellow-breasted Fruit Dove**	X	X	X
33	***Ptilinopus leclancheri***	**Black-chinned Fruit Dove**	X	X	X
34	***Ducula poliocephala***	**Pink-bellied Imperial-pigeon (Vu)**	X	X	X
35	*Ducula aenea*	Green Imperial-pigeon	X	X	X
36	*Columba vitiensis*	Mettalic Pigeon	X	-	-
37	*Streptopelia bitorquata*	Island Collared-Dove	X	-	-
38	*Streptopelia chinensis*	Spotted-necked Dove	X	-	X
39	***Macropygia tenuirostris***	**Philippine Cuckoo Dove**	X	X	X

40	*Chalcophaps indica*	Emerald Dove	X	X	X
41	***Gallicolumba crinigera***	**Mindanao Bleeding-heart (En)**	X	X	X
42	*Caloenas nicobarica*	Nicobar Pigeon	-	-	X
43	*Bolbopsittacus lunulatus*	Guaiabero	X	X	X
44	***Cacatua haematuropygia***	**Philippine Cockatoo (CR)**	X	-	-
45	***Tanygnathus lucionensis***	**Blue-naped Parrot**	X	X	X
46	*Tanygnathus sumatranus*	Blue-backed Parrot	X	X	X
47	***Prioniturus discurus***	**Blue-crowned Racquet-tail**	X	X	X
48	***Loriculus philippensis***	**Colasisi**	X	X	X
49	*Cuculus sparverioides*	Large Hawk-cuckoo	X	-	X
50	***Cuculus pectoralis***	**Philippine Hawk-Cuckoo**	X	-	-
51	*Cuculus saturatus*	Oriental Cuckoo	X	-	-
52	*Cuculus micropterus*	Indian Cuckoo	X	-	-
53	*Cacomantis merulinus*	Plaintive Cuckoo	X	X	X
54	*Cacomantis variolosus*	Brush Cuckoo	X	X	X
55	*Chrysococcyx xanthorhynchus*	Violet Cuckoo	X	-	-
56	***Surniculus velutinus***	**Philippine Drongo-Cuckoo**	X	-	-
57	*Surniculus lugubris*	Asian Drongo Cuckoo	-	X	X
58	*Eudynamys scolopaceus*	Common Koel	X	X	X
59	*Centropus bengalensis*	Lesser Coucal	X	X	X
60	***Centropus viridis***	**Philippine Coucal**	X	X	X
61	***Centropus melanops***	**Black-faced Coucal**	X	X	X
62	***Otus megalotis***	**Philippine Scops-owl**	X	X	X
63	***Bubo philippensis***	**Philippine Eagle-owl (Vu)**	X	X	X
64	***Ninox philippensis***	**Philippine Hawk-owl**	X	X	X
65	***Batrachostomus septimus***	**Philippine Forgmouth**	X	X	X
66	*Eurostopodus macrotis*	Great-eared Nightjar	X	X	X
67	*Caprimulgus indicus*	Grey Nightjar	-	-	X
68	***Caprimulgus manillensis***	**Philippine Nightjar**	X	X	X
69	*Collocalia esculenta*	Glossy Swiftlet	X	X	X
70	***Collocalia troglodytes***	**Pygmy Swiftlet**	X	X	X
71	*Aerodramus vanikorensis*	Uniform Swiftlet	-	-	X
72	***Mearnsia picina***	**Philippine Needletail**	X	X	X
73	*Hirundapus celebensis*	Purple Needletail	X	-	X
74	*Cypsiurus balasiensis*	Asian Palm-swift	X	-	X
75	*Apus pacificus*	Fork-tailed Swift or Pacific Swift	-	-	X
76	*Hemiprocne comate*	Whiskered Treeswift	X	-	X
77	***Harpactes ardens***	**Philippine Trogon**	X	X	X
78	*Eurystomus orientalis*	Asian Dollarbird	X	X	X
79	*Halcyon coromanda*	Ruddy Kingfisher	-	X	X
80	*Alcedo atthis*	Common Kingfisher	X	-	-
81	***Alcedo argentata***	**Silvery Kingfisher (Vu)**	X	X	X
82	***Ceyx melanurus***	**Philippine Dwarf-kingfisher (Vu)**	X	X	X
83	*Halcyon capensis*	Stork-billed Kingfisher	X	-	-

84	*Halcyon smyrnensis*	White-throated Kingfisher	X	X	X
85	***Todiramphus winchelli***	**Rufous-lored Kingfisher (Vu)**	X	X	X
86	*Todiramphus chloris*	White-collared Kingfisher	X	X	X
87	*Merops viridis*	Blue-throated Bee-eater	X	X	X
88	*Merops philippinus*	Blue-tailed Bee-eater	X	X	X
89	***Penelopides panini***	**Tarictic Hornbill (EN)**	–	X	X
90	*Penelopides affinis*	Tarictic	X	–	–
91	***Buceros hydrocorax***	**Rufous Hornbill**	X	X	X
92	*Megalaima haemacephala*	Coppersmith Barbet	X	X	X
93	***Dendrocopos maculatus***	**Philippine Pygmy Woodpecker**	X	X	X
94	*Mulleripicus funebris*	Sooty Woodpecker	X	–	–
95	*Dryocopus javensis*	White-bellied Woodpecker	X	–	X
96	*Chrysocolaptes lucidus*	Greater Flameback	X	X	X
97	*Sarcophanops steerii*	Wattled Broadbill	–	X	X
98	***Eurylaimus samarensis***	**Visayan Wattled Broadbill (Vu)**	X	–	–
99	*Pitta erythrogaster*	Red-bellied Pitta	X	X	X
100	*Pitta sordida*	Hooded Pitta	X	X	X
101	***Pitta steerii***	**Azure-breasted Pitta (Vu)**	X	X	X
102	*Hirundo rustica*	Barn Swallow	X	X	X
103	*Hirundo tahitica*	Pacific Swallow	X	X	X
104	*Gerygone sulphurea*	Golden-bellied Gerygone	–	X	X
105	*Artamus leucorynchus*	White-breasted Woodswallow	–	X	X
106	*Coracina striata*	Bar-bellied Cuckoo-shrike	X	X	X
107	***Coracina mindanensis***	**Black-bibbed Cuckoo-shrike (Vu)**	X	–	X
108	***Lalage melanoleuca***	**Black-and-white Triller**	X	–	X
109	*Lalage nigra*	Pied Triller	X	X	X
110	*Pericrocotus flammeus*	Scarlet Minivet	X	–	X
111	***Chloropsis flavipennis***	**Philippine Leafbird (Vu)**	X	–	–
112	*Pycnonotus goiavier*	Yellow-vented Bulbul	X	–	–
113	***Pycnonotus urostictus***	**Yellow-wattled Bulbul**	X	–	–
114	***Ixos philippinus***	**Philippine Bulbul**	X	X	X
115	***Ixos everetti***	**Yellowish Bulbul**	X	X	X
116	*Dicrurus hottentottus*	Hair-crested Drongo	X	X	X
117	***Oriolus steerii***	**Philippine Oriole**	X	X	X
118	*Oriolus chinensis*	Black-naped Oriole	X	X	X
119	***Irena cyanogaster***	**Philippine Fairy-Bluebird**	X	X	X
120	*Corvus macrorhynchos*	Large-billed Crow	X	X	X
121	***Parus elegans***	**Elegant Tit**	X	X	X
122	***Sitta oenochlamys***	**Sulphur-billed Nuthatch**	X	X	X
123	***Rhabdornis mystacalis***	**Stripe-headed Rhabdornis**	X	X	X
124	***Rhabdophis inornatus***	**Stripe-breasted Rhbdophis**	X	–	X
125	***Ptilocichla mindanensis***	**Striated Wren-babbler**	X	X	X
126	***Stachyris plateni***	**Mindanao Pygmy-babbler**	X	X	X
127	***Stachyris nigrocapitata***	**Black-crowned Babbler**	X	–	–

128	***Macronous striaticeps***	**Brown Tit-babbler**	X	X	X
129	***Micromacronus leytensis***	**Visayan Miniature Tit-babbler**	X	-	X
130	*Copsychus saularis*	Oriental Magpie-Robin	X	X	X
131	*Saxicola caprata*	Pied Bushchat	X	-	X
132	*Monticola solitarius*	Blue Rock-Thrush	X	-	-
133	*Phylloscopus borealis*	Arctic Warbler	X	X	X
134	***Phylloscopus olivaceus***	**Philippine Leaf-warbler**	X	X	X
135	***Acrocephalus stentoreus***	**Clamorous Reed-Warbler**	X	-	-
136	*Megalurus timoriensis*	Tawny Grassbird	X	-	-
137	*Megalurus palustris*	Striated Grassbird	X	-	-
138	*Locustella fasciolata*	Gray's Grass-hopper Warbler	X	-	-
139	*Orthotomus castaneiceps*	Philippine Tailorbird	-	X	X
140	*Orthotomus samarensis*	Yellow-breasted Tailorbird	X	X	X
141	*Cisticola exilis*	Bright-capped Cisticola	X	-	-
142	*Cisticola juncidis*	Zitting Cisticola	X	-	-
143	*Rhinomyias ruficauda*	Rufous-tailed Jungle-flycatcher	X	X	X
144	*Muscicapa griseisticta*	Grey-streaked Flycatcher	X	X	X
145	***Ficedula basilanica***	**Little Slaty Flycatcher (Vu)**	-	-	X
146	*Ficedula westermanni*	Little Pied Flycatcher	-	-	X
147	*Cyornis rufigastra*	Mangrove Blue-flycatcher	X	X	X
148	*Culicicapa helianthea*	Citrine Canary-flycatcher	X	X	X
149	*Rhipidura javanica*	Pied Fantail	X	X	X
150	***Rhipidura superciliaris***	**Blue Fantail**	X	X	X
151	***Terpsiphone cinnamomea***	**Rufous Paradise-flycatcher**	-	-	X
152	*Hypothymis azurea*	Black-naped Monarch	X	X	X
153	***Hypothymis helenae***	**Short-crested Monarch**	-	-	X
154	***Pachycephala philippinensis***	**Yellow-bellied Whistler**	X	X	-
155	*Motacilla cinerea*	Grey Wagtail	X	X	X
156	*Motacilla flava*	Yellow Wagtail	X	X	X
157	*Anthus gustavi*	Pechora Pipit	X	X	X
158	*Artamus leucorhynchus*	White-breasted Wood-Swallow	X	-	-
159	*Lanius schach*	Long-tailed Shrike	X	X	X
160	*Lanius cristatus*	Brown Shrike	X	X	X
161	*Aplonis panayensis*	Asian Glossy Starling	X	X	X
162	***Sarcops calvus***	**Coleto**	X	X	X
163	*Anthreptes malacensis*	Brown-throated Sunbird	X	X	X
164	*Cinnyris jugularis*	Olive-backed Sunbird	X	X	X
165	*Leptocoma sperata*	Purple-throated Sunbird	X	X	X
166	***Aethopyga pulcherrima***	**Metallic-winged Sunbird**	X	X	X
167	*Aethopyga shelleyi*	Lovely Sunbird	X	-	-
168	*Aethopyga bella*	Handsome Sunbird	X	X	X
169	***Arachnothera clarae***	**Naked-faced Spiderhunter**	X	X	X
170	*Arachnothera longirostra*	Little Spiderhunter	X	X	X
171	***Prionochilus olivaceus***	**Olive-backed Flowerpecker**	X	X	X

172	***Dicaeum bicolor***	**Bicoloured Flowerpecker**	X	X	X
173	***Dicaeum australe***	**Red-keeled Flowerpecker**	X	X	X
174	***Dicaeum hypoleucum***	**Buzzing Flowerpecker**	X	X	X
175	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker	X	X	X
176	*Dicaeum ignipectus*	Fire-breasted Flowerpecker	X	-	X
177	*Dicaeum pygmaeum*	Pygmy Flowerpecker	X	X	X
178	*Dicaeum agile*	Thick-billed Flowerpecker	-	-	X
179	*Zosterops everetti*	Everett's White-eye	X	X	X
180	*Passer montanus*	Eurasian Tree Sparrow	X	X	X
181	*Lonchura leucogastra*	White-bellied Munia	X	X	X
182	*Lonchura atricapilla*	Black-headed Munia	X	X	X

Species in bold are endemics. Threatened species are labeled as Vulnerable (Vu), Endangered (EN) or Critically Endangered (CR) based on IUCN Red List (2013).

Secondary data obtained from Kennedy, R.S., et al, 2000. A Guide to the Birds of the Philippines. Oxford University Press, 369pp. 72 color plates.

Appendix 5. List of mammalian species recorded in Southern Leyte

	Species	Common name	1998	2011	2013
1	***Crocidura beatus***	**Mindanao Shrew**	X	X	-
2	*Suncus murinus*	Asian House Shrew	X	-	-
3	***Cynocephalus volans***	**Philippine Flying Lemur**	X	X	X
4	***Acerodon jubatus***	**Golden-capped Flying Fox (EN)**	X	X	X
5	*Cynopterus brachyotis*	Common Short-nosed Fruit Bat	X	X	X
6	*Eonycteris spelaea*	Common Dawn Bat	X	X	X
7	***Haplonycteris fischeri***	**Philippine Pygmy Fruit Bat**	X	X	X
8	***Harpyionycteris whiteheadi***	**Harpy Fruit Bat**	X	X	X
9	*Macroglossus minimus*	Lesser Long-tongued Fruit Bat	X	X	X
10	*Megaerops westmorei*	White-Collared Fruit Bat	-	X	X
11	***Ptenochirus jagori***	**Greater Musky Fruit Bat**	X	X	X
12	***Ptenochirus minor***	**Lesser Musky Fruit Bat**	X	X	X
13	*Ptenochirus pumilus*	Little Golden-mantled Flying Fox	X	-	-
14	*Pteropus hypomelanus*	Island Flying Fox	-	X	X
15	*Pteropus vampyrus*	Large Flying-fox	X	X	X
16	*Rousettus amplexicaudatus*	Geoffroy's Rousette	X	X	X
17	*Emballonura alecto*	Small Asian Sheath-Tailed Bat	X	X	-
18	*Megaderma spasma*	Lesser False Vampire	X	X	X
19	*Hipposideros ater*	Dusky Leaf-nosed Bat	-	X	X
20	*Hipposideros diadema*	Diadem Roundleaf Bat	X	X	-
21	*Hipposideros bicolor*	Bicolored Leaf-nosed Bat	-	X	X
22	***Hipposideros obscurus***	**Philippine Forest Leaf-nosed Bat**	X	-	X
23	*Rhinolophus arcuatus*	Arcuate Horseshoe Bat	X	X	X
24	***Rhinolophus inops***	**Philippine Forest Horseshoe Bat**	X	X	X
25	***Rhinolophus rufus***	**Large Rufous Horseshoe Bat**	X	-	-
26	***Rhinolophus subrufus***	**Small Rufous Horseshoe Bat**	-	X	X
27	***Rhinolophus philippinensis***	**Philippine Forest Horseshoe Bat**	-	X	-
28	*Harpiocephalus harpia*	Hairy-winged Bat	X	-	-
29	*Kerivoula hardwickii*	Common Woolly Bat	X	-	-
30	*Miniopterus australis*	Little Bent-winged Bat	X	-	-
31	*Miniopterus schreibersii*	Common Bent-winged Bat	X	-	-
32	*Miniopterus tristis*	Breater Bent-winged Bat	X	-	-
33	*Myotis muricola*	Whiskered Myotis	X	-	-
34	*Philetor brchypterus*	Narrow-winged Pipistrelle	X	-	-
35	*Scotophilus kuhlii*	Lesser Asian House Bat	X	-	-
36	*Chaerephon plicatus*	Wrinkle-lipped Bat	X	-	-
37	*Myotis muricola*	Nepalese whiskered Myotis	-	X	X
38	*Pipistrellus tenuis*	Least Pipistrelle	-	-	X
39	*Tylonycteris robustula*	Greater Bamboo Bat	-	-	X

40	*Murina suilla*	Lesser Tube-nosed Bat	-	-	X
41	***Tarsius syrichta***	**Philippine Tarsier**	X	X	X
42	*Macaca fascicularis*	Crab-eating Macaque	X	X	X
43	***Exilisciurus concinnus***	**Philippine Pygmy Squirrel**	X	-	-
44	***Sundasciurus philippinensis***	**Philippine Tree Squirrel**	X	-	X
45	***Sundasciurus samarensis***	**Samar Squirrel**	-	X	-
46	***Apomys* cf. *littoralis***	**Mindanao Lowland Forest Mouse**	-	X	X
47	***Batomys salomonseni***	**Mindanao Batomys**	X	X	-
48	***Bullimus bagobus***	**Large Mindanao Forest Rat**	X	X	X
49	***Crunomys melanius***	**Southern Philippine Shrew-mouse**	X	-	-
50	*Mus musculus*	House Mouse	X	-	-
51	***Rattus everetti***	**Common Philippine Forest Rat**	X	X	X
52	*Rattus exulans*	Spiny Rice-field Rat	X	-	-
53	*Rattus norvegicus*	Brown Rat	X	-	-
54	*Rattus tanezumi*	Oriental House Rat	X	X	X
55	*Paradoxurus hermaphroditus*	Common Palm Civet	X	X	X
56	*Viverra tangalunga*	Malay Civet	X	-	-
57	***Sus philippensis***	**Philippine Warty Pig (Vu)**	X	X	X
58	***Rusa marianna***	**Philippine Brown Deer (Vu) ***	X	X	X

Species in bold are endemics. Threatened species are labeled as Vulnerable (Vu), Endangered (EN) or Critically Endangered (CR) based on IUCN Red List (2013).
Secondary data from Heaney, L.R., et al., 1998. A Synopsis of the Mammalian Fauna of the Philippine Islands. Fieldiana. Zoology No.88.
Note: (*) data was based on ethnobiological interview.

Appendix 6. List of amphibian species recorded in Southern Leyte

No.	Species	Common Name	1994	2011	2013
1	*Rhinella marina*	CaneToad	X	-	-
2	***Pelophryne lighti***	**(Vu)**	X	X	-
3	*Platymantis corrugatus*	Rough-backed Forest Frog	X	X	X
4	***Platymantis guentheri***	**Guenther's Forest Frog (Vu)**	X	X	X
5	***Platymantis dorsalis***	-	X	-	X
6	***Platymantis spelaeus***	**(EN)**	X	-	-
7	*Platymantis* sp. *A*	(singit; new species)	X	X	X
8	*Platymantis* sp. *B*	(green; new species)	-	X	X
9	*Platymantis* sp. *C*	(limestone; undescribed species)	X	X	X
10	*Platymantis* sp. *D*	(ground; undescribed species)	-	X	X
11	***Limnonectes leytensis***	**Small Disked Frog**	X	X	X
12	*Limnonectes magnus*	Giant Philippine Frog	-	X	X
13	***Limnonectes visayanus***	**(Vu)**	X	-	-
14	*Occidozyga laevis*	Common Puddle Frog	X	X	X
15	*Fejervarya vittigera*	-	X	X	-
16	***Megophrys stejnegeri***	**Mindanao Horned Frog (Vu)**	X	X	X
17	*Kalophrynus pleurostigma*	Black-spotted Sticky Frog	X	X	X
18	*Hylarana erythraea*	Common Green Frog	X	-	-
19	*Hylarana grandocula*	-	X	X	X
20	*Sanguirana albotuberculata*	-	X	X	-
21	*Staurois natator*	Black-spotted Rock Frog	X	X	-
22	***Nyctixalus spinosus***	**Spiny Tree Frog (Vu)**	X	X	X
23	***Philautus leitensis***	**Leyte Tree Frog (Vu)**	X	X	X
24	*Philautus poecilus*	-	-	-	X
25	*Philautus surdus*	-	-	-	X
26	*Polypedates leucomystax*	White-lipped Tree Frog	X	X	-
27	*Rhacophorus appendiculatus*	Southeast Asian Tree Frog	X	X	-
28	***Rhacophorus bimaculatus***	**Tree Frog (Vu)**	-	X	X
29	*Rhacophorus pardalis*	Tree Frog	-	X	-
30	***Oreophryne anulata***	**(Vu)**	-	X	X
31	*Chaperina fusca*	-	X	-	-
32	*Kaloula* sp.	-	X	X	-
33	***Kaloula conjuncta***	**Philippine Narrow-mouth Toad**	X	-	-
34	*Kaloula picta*	Slender-digit Chorus Frog	X	-	-

Species in bold are endemics. Threatened species are labelled as Vulnerable (Vu), Endangered (EN) or Critically Endangered (CR) based on IUCN Red List (2013).

Secondary data from Denzer, W., K. Henle, M. Gaulke, J. Margraf and P.P. Milan. 1994. Annotated checklist of the reptiles and amphibians of Leyte, Philippines with notes on their ecology and conservation. Annals of Tropical Research (ATR) Vol. XVI, pp. 44-70.

Appendix 7. List of reptile species recorded in Southern Leyte

No.	Species	Common name	1994	2011	2013
1	***Cuora amboinensis***	**Southeast Asian Box Turtle (Vu)**	X	X	-
2	*Bronchocela jubata*	Green Crested Canopy Lizard	-	X	X
3	*Bronchocela cristatella*	-	X	X	-
4	***Draco bimaculatus***	**Two-spotted Flying Lizard**	X	X	-
5	*Draco cyanopterus*	-	-	X	-
6	*Draco everetti*	-	X	-	-
7	***Draco mindanensis***	**Mindanao Flying Lizard (Vu)**	-	X	X
8	***Draco ornatus***	**White Spotted Flying Lizard**	X	-	-
9	***Gonocephalus semperi***	**Mindoro Forest Dragon**	-	X	-
10	*Gonocephalus interruptus*	-	-	-	X
11	***Hydrosaurus pustulatus***	**Sailfin Lizard (Vu)**	X	X	-
12	***Lipinia pulchella***	**Yellow-striped Slender Tree Skink**	X	-	X
13	*Lipinia quadrivittata*	-	X	-	-
14	*Cyrtodactylus gubaot**		X	X	X
15	***Pseudogekko compressicorpus***	**Cylindrical-bodied Smooth-scaled Gecko**	-	X	-
16	***Brachymeles* cf. *talinis***	**Dumeril's Short-legged Skink**	-	-	X
17	*Brachymeles orientalis*	-	X	X	X
18	*Brachymeles paeforum*	-	X	-	X
19	*Brachymeles samad*	-	X	X	X
20	*Eutropis multicarinata*	-	X	X	-
21	*Eutropis multifasciata*	-	X	-	-
22	*Eutropis indeprensa*	-	X	-	X
23	***Otosaurus cumingi***	**Cuming's Sphenomorphus**	X	X	-
24	*Parvoscincus decipiens*	-	-	X	-
25	*Parvoscincus steerei*	Steere's Sphenomorphus	X	X	-
26	*Pinoyscincus coxi coxi*	Cox's Sphenomorphus	X	X	-
27	*Pinoyscincus jagori*	Jagor's Sphenomorphus	X	X	-
28	*Pinoyscincus mindanensis*	Mindanao Sphenomorphus	X	X	-
29	*Sphenomorphus acutus*	Pointed-headed Sphenomorphus	X	X	-
30	*Sphenomorphus fasciatus*	Banded Sphenomorphus	X	X	-
31	*Sphenomorphus variegatus*		X	X	X
32	*Lamprolepis smaragdina*	-	X	-	-
33	*Lamepis hardwickii*	-	X	-	-
34	*Gehyra mutilate*	-	X	-	-
35	*Hemidactylus frenatus*	Common House Gecko	X	X	-
36	*Gekko gecko*	Tokay Gecko	X	-	-
37	*Emoia atrocostata*	-	X	-	X
38	***Lepidodactylus herrei***	**White-lined Smooth-scaled Gecko**	X	-	-
39	***Ptyas luzonensis***	**Smooth-scaled Mountain Rat Snake**	X	-	-
40	***Ptychozoon intermedium***	**Philippine Flying Gecko (NT)**	X	-	-
41	*Varanus cumingi*	Mindanao Monitor	X	-	-
42	*Python reticulates*	Reticulated Python	X	X	-
43	*Ahaetulla prasina preocularis*	Gunther's Whip Snake	X	X	-
44	*Aplopeltura boa*	Blunt-head Slug Snake	-	X	-

45	*Boiga cynodon*	Large Blunt-headed Tree Snake	X	X	–
46	*Boiga dendrophilia*	Gold-tinged Cat Snake	X	–	X
47	***Boiga angulata***	**Philippine Blunt-headed Tree Snake**	X	–	–
48	*Calamaria gervaisii*	Gervais' Worm Snake	X	–	–
49	*Calamaria lumbricoidea*	Variable Reed Snake	X	X	–
50	*Coelognathus erythrura*	Reddish Rat Snake	X	X	–
51	*Cyclocorus nuchalis*	Southern Triangle-spotted Snake	X	X	–
52	*Dendrelaphis caudolineatus*	Striped Bronzeback	X	–	X
53	*Dendrelaphis marenae*	–	X	X	–
54	*Laticauda colubrina*	Yellow-lipped Sea Krait	X	–	–
55	*Lycodon aulicus*	Common Wolfsnake	X	–	–
56	***Lycodon ferroni***		X	X	–
57	***Oligodon modestum***	**Spotted-bellied Short-headed Snake (Vu)**	X	–	–
58	*Oxyrhabdium modestum*	Philippine Shrub Snake	X	X	X
59	*Oxyrhabdium maculatus*	–	–	X	–
60	*Cerberus rynchops*	Dog-faced Water Snake	X	–	–
61	*Chrysopelea paradise*	–	X	–	–
62	*Kurixalus appendiculatus*	–	X	X	–
63	*Psammodynastes pulverulentus*	Common Mock Viper	X	X	–
64	*Rhabdophis auriculata*	–	X	X	X
65	***Rhabdophis lineatus***	**Zigzag-lined Water Snake**	–	–	X
66	*Rhabdophis crysargus*	–	–	X	–
67	***Tropidonophis dendrophiops***	**Spotted Water Snake**	–	X	–
68	***Tropidonophis negrosensis***	**(Vu)**	–	X	–
69	***Naja samarensis***	**Samar Cobra**	X	X	–
70	*Ramphotyphlops braminus*	–	X	–	–
71	*Typhlops* sp.	Blind Snake	–	X	–
72	***Trimeresurus flavomaculatus***	**Philippine Pit Viper**	X	X	X
73	*Trimeresurus wagleri*	Wagler's Keeled Green Pit Viper	–	X	X
74	*Tropidolaemus philippensis*	–	–	X	–
75	*Tropidolaemus subannulatus*	Bornean Keeled Green Pit Viper	X	X	–
76	***Tropidophorus grayi***	**Spiny Waterside Skink**	X	–	–
77	*Crocodylus* sp.	–	X	–	–

Species in bold are endemics. Threatened species are labelled as Vulnerable (Vu), Endangered (EN) or Critically Endangered (CR) based on IUCN Red List (2013).

Secondary data from Denzer, W., K. Henle, M. Gaulke, J. Margraf and P.P. Milan. 1994. Annotated checklist of the reptiles and amphibians of Leyte, Philippines with notes on their ecology and conservation. Annals of Tropical Research (ATR) Vol. XVI, pp. 44-70.

Appendix 8. Key species of flora used in the species occupancy modelling

Species	Habitat	IUCN Red List 2013
Afzelia rhomboidea	Forests at low and medium altitudes	VU
Agathis philippinensis	Montane rain forests to 2200 m alt.	
Aglaia leptantha	Primary forests; 20-1700 m altitude.	NT
Ardisia squamulosa	Primary forests	VU
Artocarpus treculianus	Lowland forests	VU
Brackenridgea palustris	Lowland peat swamp and kerangas forest	NT
Canarium ovatum	Primary forests, but widely cultivated	VU
Cinnamomum mercadoi	Lowland and montane forests to 2000 m alt.	VU
Cinnamomum cebuense	Terrestrial	
Cinnamomum iners	Undisturbed to disturbed mixed dipterocarp and sub-montane forests or in open sites, up to 1800 m altitude	
Dillenia philippinensis	Primary and secondary forests at low to medium altitudes, rarely to 2000 m alt.	VU
Diplodiscus paniculatus	Primary and secondary forests	VU
Dipterocarpus alatus	Occurs gregariously along rivers, in mixed dipterocarp forest in seasonal areas at low and medium alt. And up to 500 m alt	EN
Dipterocarpus grandiflorus	Occurring in primary semi-evergreen and Evergreen dipterocarp forest.	CR
Ficus ulmifolia	Secondary forests and thickets	VU
Hopea acuminata	Lowland evergreen and semi-evergreen rain forests	CR
Hopea malibato	Terrestrial	CR
Hopea philippinensis	Non-seasonal evergreen forest	CR
Hopea plagata	Semi-evergreen forest and sometimes evergreen forest.	CR
Macaranga bicolor	Second-growth forests at low altitudes	VU
Macaranga caudatifolia	Terrestrial	VU
Mangifera monandra	Wet evergreen lowland forest	VU
Neolitsea vidalii	Primary and secondary forest	VU
Palaquium luzoniense	Primary forests	VU
Parashorea malaanonan	Forests up to 1,300 m alt.	CR
Pouteria villamilii	Primary lowland forest	VU
Sapium luzonicum	Primary forests	VU
Securinega flexuosa	Terrestrial	VU
Shorea almon	Found on hills in lowland mixed dipterocarp forest	CR
Shorea assamica	Flat land as well as undulating and hilly ground at altitudes between 150-1000 m	
Shorea astylosa	Lowland primary evergreen dipterocarp forest	CR
Shorea contorta	Lowland seasonal semi-evergreen dipterocarp forest.	CR
Shorea cummingiana	Dipterocarp forest	
Shorea negrosensis	Lowland seasonal and evergreen dipterocarp forest.	CR
Shorea palosapis	Evergreen mixed dipterocarp forests	CR
Shorea polysperma	Evergreen mixed dipterocarp forests	CR

Shorea seminis	In patches in lowland areas	CR
Shorea virescens	Dipterocarp forest	
Tectona grandis	Mixed deciduous forest	

Species in bold letters threatened and categorized as Endangered (EN) or Critically Endangered (CR) based on IUCN Red List (2013).
N = 39

Appendix 9. List of key species of birds used to model species–habitat association

Species	Known Habitats	IUCN Red List (2013)
Alcedo argentata	Forest, Streams	VU
Bolbopsittacus lunulatus	Forest, Lowland	LC
Buceros hydrocorax	Forest, primary, mature, secondary logged forests	NT
Centropus melanops	Forest, Lowland	LC
Centropus viridis	Forest, Grassland	LC
Chalcophaps indica	Forest, Lowland	LC
Columba vitiensis	Forest, High Evaluation	LC
Culicicapa helianthea	Forest, Montane	LC
Dendrocopos maculatus	Forest, Lowland and Montane	LC
Dicrurus hottentottus	Forest, below 1500 m	LC
Ducula aenea	Forest, lowland to mid-elevation	LC
Ducula poliocephala	Forest, lowland up to 1500 m	NT
Eurystomus orientalis	Forest edge, lowland	LC
Gallicolumba crinigera	Forest, lowland to mid-mountain	VU
Gallus gallus	Forest, forest edge from lowland to 2000 m	LC
Harpactes ardens	Forest, up to 2000 m	LC
Hypothymis azurea	Forest, forest edge, disturbed areas	LC
Irena cyanogastra	Forest, lowland to midelevation, forest dge	NT
Ixos everetti	Forest, forest edge, lowland	LC
Ixos philippinus	Forest, forest edge, up to 2,000 m	LC
Loriculus philippensis	Non-forest (even urban areas), forest up to 2,500 m	LC
Macronous striaticeps	Forest, up to about 1,500 m elevation	LC
Macropygia tenuirostris	Forest, early 2nd growth, montane mossy above 2,000m	LC
Micromacronus leytensis	Forest and forest edge up to 1,300 m	DD
Oriolus chinensis	Non-forest and forest edge	LC
Oriolus steerii	Forest, forest edge, lowland	LC
Pachycephala philippinensis	Forest, all elevations	LC
Parus elegans	Forest, lowland to montane mossy	LC
Penelopides panini	Forest, forest edge up to about 1,500 m	EN
Phapitreron amethystina	Forest, primary to secondary, from 500 m to 2,000 m	LC
Phapitreron leucotis	Forest, lowland to about 1,600 m	LC
Prioniturus discurus	Forest, forest edge; non-forest, up to 1,500 m	LC
Ptilinopus leclancheri	Forest, lowland to mid-elevation	LC
Ptilinopus occipitalis	Forest, contiguous up to 1,800 m	LC
Ptilocichla mindanensis	Forest, lowland to mid-elevation	LC
Rhinomyias ruficauda	Forest, lowland to mid-elevation	LC
Tanygnathus lucionensis	Forest, forest edge	NT
Zosterops everetti	Forest, forest edge, lowland	LC

Species in bold are categorized as Endangered (EN) based on IUCN Red List (2013).
N = 39

Appendix 10. List of key species of amphibians used to model species-habitat association

Species	Habitat	IUCN Red List (2013)
Hylarana erythraea	Non-forest, vegetational ponds	LC
Limnonectes leytensis	Swamps, streams, rivers in low elevation forests and forest edges	LC
Limnonectes magnus	Undisturbed and disturbed streams, rivers in lower montane and lowland forests	NT
Megophrys stejnegeri	Floor leaf-litter of montane and lowland rainforest; breeds in mountain streams	VU
Nyctixalus spinosus	Floor litter of montain and lowland forests; breeds, lays eggs in tree holes	VU
Occidozyga laevis	Shallow muddy pudles, pools near streams of lowland forest edge, lower montane	LC
Oreophryne anulata	Forest, mossy and disturbed lower montane arboreal microhabitats	VU
Pelophryne lighti	Forest, lowland to montane arboreal microhabitats in riverine areas	VU
Philautus leitensis	Lowland forest, lower montane arboreal microhabitats	VU
Philautus poecilius	Rainforest, mossy and montane arboreal microhabitats	VU
Philautus surdus	Lowland forest, lower montane arboreal microhabitats	LC
Platymantis corrugatus	Forest, lowland to lower montane forest floor stratum	LC
Platymantis dorsalis	Forest, lowland to lower montane forest floor stratum	LC
Platymantis sp. *A*	-	-
Platymantis sp. *B*	-	-
Platymantis sp. *C*	-	-
Platymantis sp. *D*	-	-
Platymantis guentheri	Forest, lowland to lower montane, arboreal	VU
Rhacophorus bimaculatus	Arboreal microhabitats nearswamps, ponds, rivers of undisturbed lower montain and lowland forests	VU
Rhacophorus pardalis	Rainforest, primary and secondary in higher strata to shrub layer; breeds in swampy pools	LC
Sanguirana alboturcelata	Forest, lowland to lower montane streams	DD

N = 21

Appendix 11. List of key species of reptiles used to model species-habitat association

Species	Habitat	IUCN Red List (2013)
Ahaetulla prasina	Forest, primary and secondary, lowland and montane, up to 1,300 m elevation	LC
Boiga dendrophilia	Forest, lowland; mangrove swamps	NE
Brachymeles orientalis	Forest, lowland primary and secondary, semifossorial; non-forest	LC
Brachymeles paeforum	Forest, lowland, semifossorial	NA
Brachymeles samad	Forest, secondary, under rotting coconut husks	NA
Calamaria lumbricoidea	Forest, degraded secondary, lowland and montane; semifossorial, non-forest	LC
Cyrtodactylus gubaot	forest, secondry; riparian zones	LC
Dendrelaphis caudolineatus	Non-forest, coastal lowland to montane up to 1,500 m; low trees, grassy plains	NE
Eutropis indeprensa	Forest, secondary, up to 1,200 m	LC
Gonocephalus interruptus	Forest, secondary lowland forest edge	DD
Hemidactylus frenatus	Forest, boulders, logs, trees; non-forest	LC
Lepidodactylus herrei	Forest, trees of lowland dipterocarp, secondary, up to 800 m; freshwater swamp	LC
Oxyrhabdium modestum	-	NA
Pinoyscincus jagori	Forest, secondary dipterocarp and submontane; non-forest	LC
Pseudogekko compressicorpus	Forest, primary and secondar, arboreal	LC
Rhabdophis auriculata	Forest, disturbed, selectively logged; riparian	LC
Rhabdophis lineatus	Forest, streams and rivers in primary, forest edge	LC
Trimeresurus flavomaculatus	Forest, primary disturbed lowland to midelevation	LC
Tropidolaemus philippensis	Forest, wet lowland; non-forest, mangrove, swamp, marsh	NE

N = 19

Appendix 12. List of key species of mammals used to model species-habitat association

Species	Habitat	IUCN Red List (2013)
Non-Volant		
Apomys littoralis	Forest, Primary montane and mossy	DD
Bullimus bagobus	Forest, Lowland	LC
Crocidura beautus	Forest, Primary at middle elevation	LC
Rattus everetti	Forest, from sea level up to 2200 m	LC
Rattus tanezumi	Non-Forest, disturbed lowland up to 1800 m	LC
Tarsius syrichta	Forest, Lowland	NT
Volant		
Cynopterus brachyotis	Non-Forest (common in agricultural areas); Secondary forest from sea level to 1250 m	LC
Eonycteris spelaea	Non-forest, High density areas from sea level to 1100 m	VU
Haplonycteris fischeri	Forest, Primary at middle elevation	VU
Hapyionycteris whiteheadi	Forest, High elevation	VU
Hipposideros bicolor	Forest, roost in caves	LC
Hipposideros obscurus	Forest, Lowland	LC
Kerivoula hardwickii	Forest, lowland to montane and ridgetop mossy	LC
Macroglossus minimus	Non-forest, Forest from sea level up to 2250 m	LC
Megaderma spasma	Forest, lowland primary and disturbed	LC
Murina suilla	-	-
Pipistrellus tinuis	Forest, Primary lowland and montane from 800 m to 1700 m	LC
Ptenochirus jagori	Forest, from sea level to 1800 m	LC
Rhinolophus subrufus	Forest, Lowland	VU
Rousettus amplexicaudatus	Non-forest, lowland	LC
Tylonycteris robustula	Non-forest, disturbed lowland with bamboo stands	LC

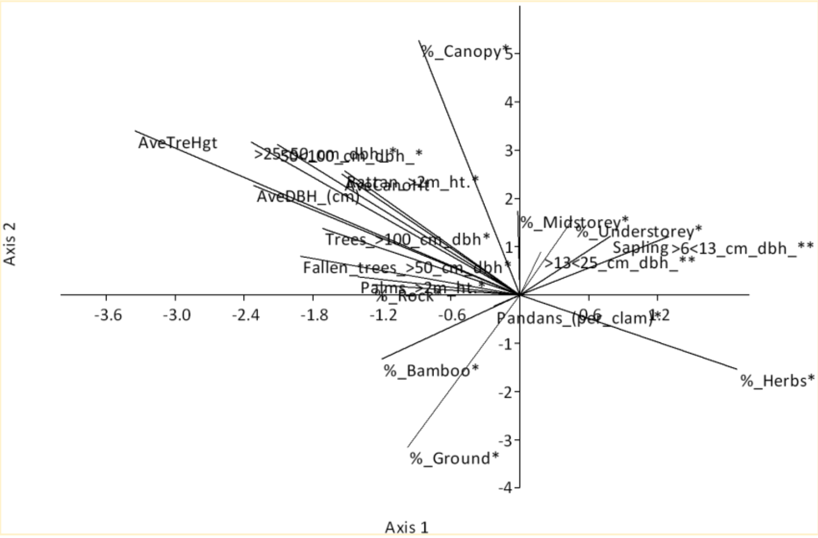
N = 21

Appendix 13. Result of the ordination of the different taxa and specific habitat vectors using Canonical Correspondence Analysis (CCA)

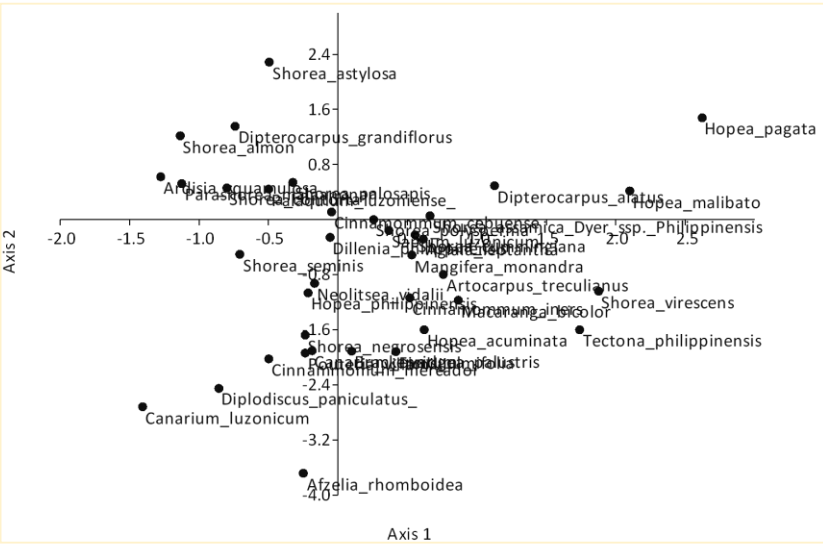
Key findings

1. Flora

   - CCA of 37 tree species and 20 habitat variables resulted to two main axes. In the graph, arrows of environmental covariates projecting above the main axis suggest that this axis is an axis of forest habitat (% canopy; ave tree ht; ave DBH; % rattan; trees with >25<50, >50<100 and >100 cm DBH), whereas arrows projecting below the main axis suggest that this is an axis that describes non-forest habitats (% herbs; % ground; % bamboo).



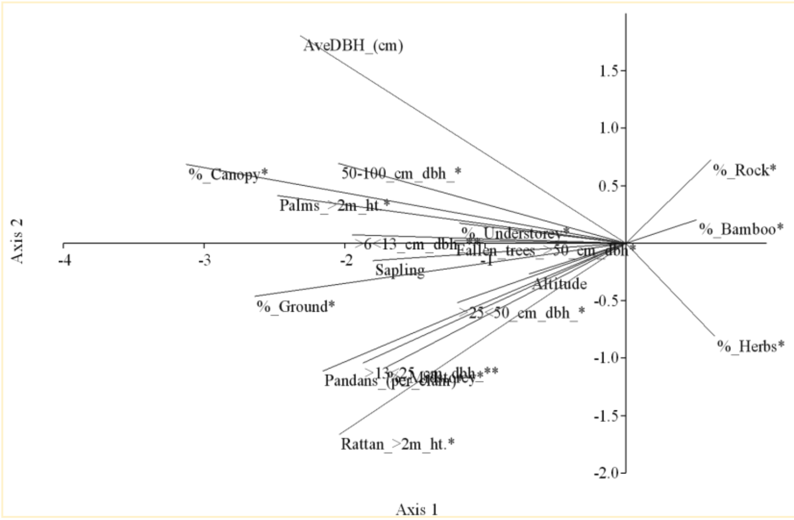
Ordination of habitat vectors for tree species



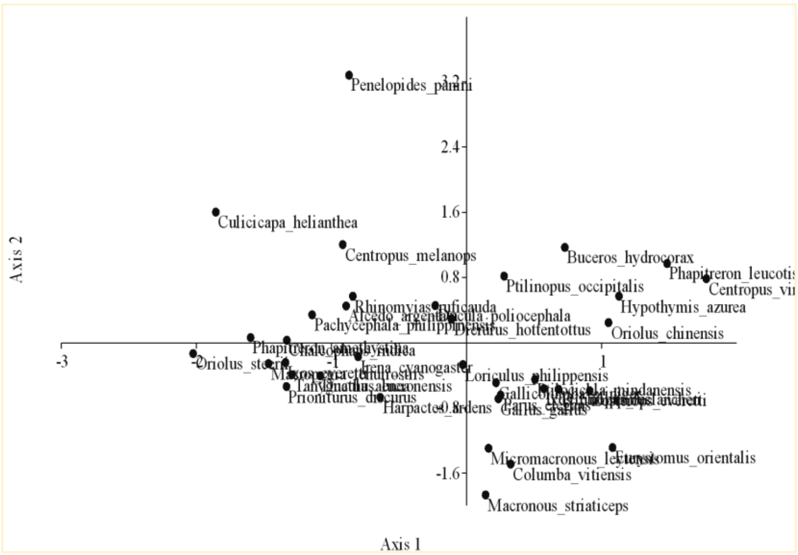
Species ordination of tree species

2. Birds

- CCA of 36 avian species and 18 habitat variables resulted to two main axes. In the graph, arrows of environmental variables projecting left from the main axis suggest that this axis is an axis of high biomass or increasing forest quality (% canopy; ave DBH; pandan; rattan with >2 m ht; palms with >2 m ht; % ground; trees with >6<13cm, >13<25 cm, >25<50 cm and 50-100 cm DBH; sapling; % understorey), whereas arrows projecting right of the main axis suggest that this is an axis of low biomass or decreasing forest quality (% rock; % bamboo; % herbs).
- Two species, the Tarictic Hornbill (*Penelopides panini*) and the Brown Tit-babbler (*Macronus striaticeps*) are outliers. This implies that these two species are generalists – species that can tolerate increasing forest quality and degraded habitats as well.



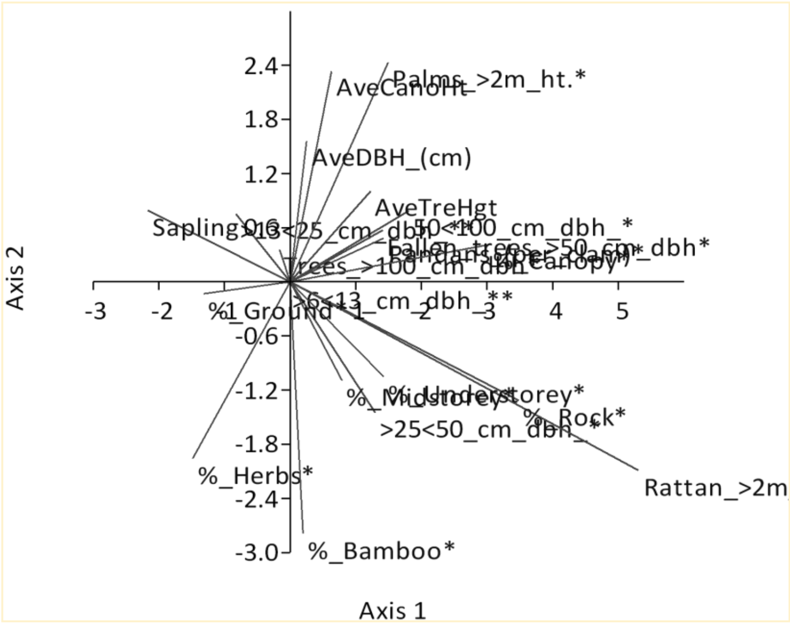
Ordination of selected avifauna habitat vectors



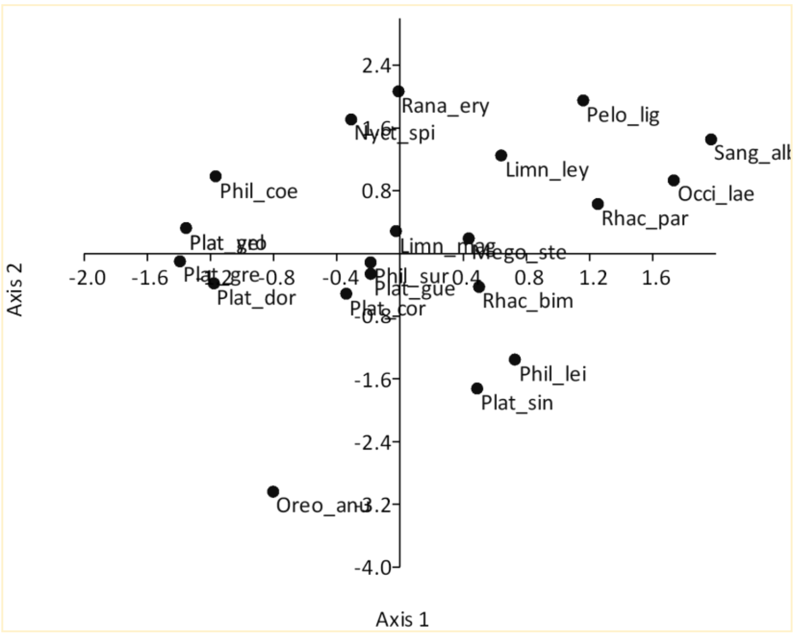
Species ordination of selected bird species

3. Amphibians

- CCA of 20 species of amphibians with 17 habitat variables resulted to two main axes. In the graph, arrows of environmental variables projecting right from the main axis suggest that this axis is an axis of high biomass or increasing forest quality (ave. canopy ht; palms with >2 m ht; rattan with >2 m ht; ave DBH; trees with 50–100 cm and >100 cm DBH; % understorey, % mid-storey), whereas arrows projecting left of the main axis suggest that this is an axis of low biomass or decreasing forest quality (% herbs; sapling and trees with >13<25 cm DBH; % ground).



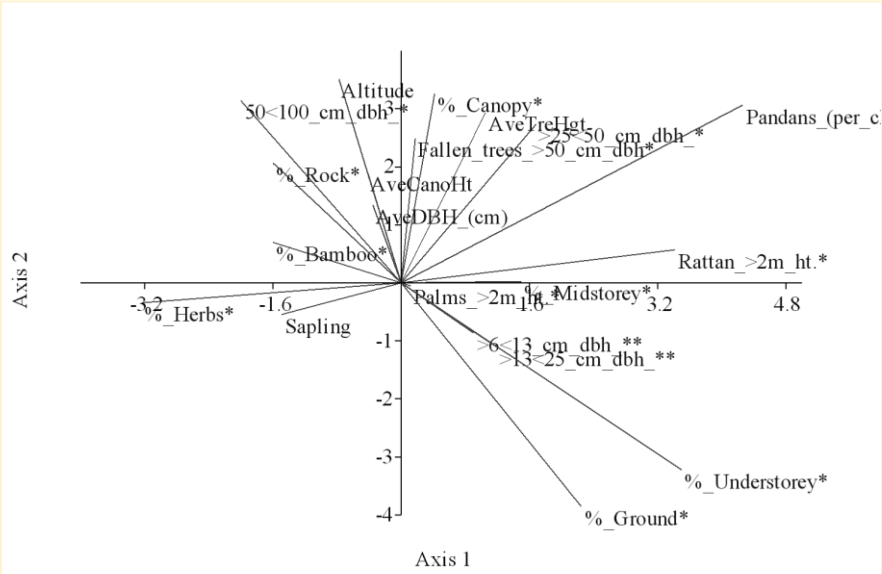
Ordination of selected amphibian habitat vectors



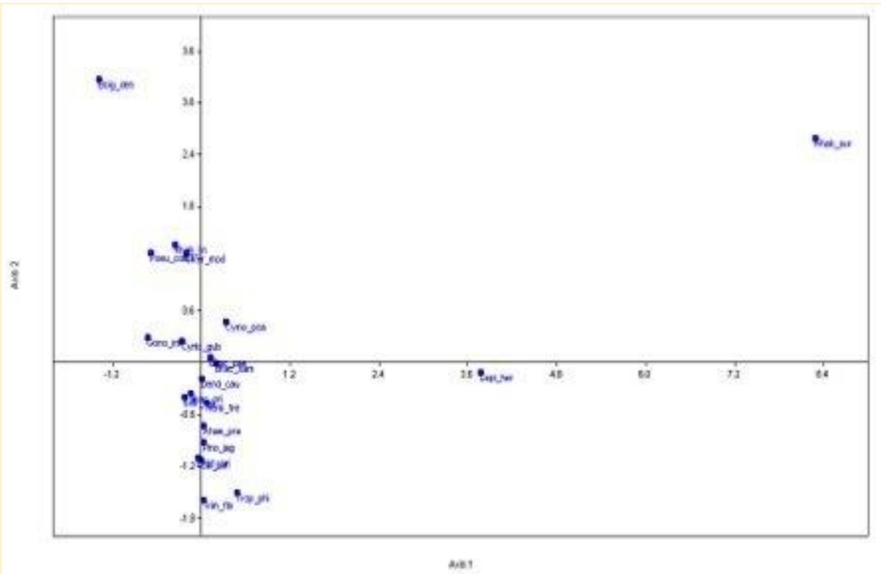
Species ordination of selected amphibians

4. Reptiles

- CCA of 19 species of reptiles with 20 habitat variables resulted to two main axes. In the graph, arrows of environmental variables projecting right from the main axis suggest that this axis is an axis of high biomass or increasing forest quality (% understorey; % ground; pandan; rattan with >2 m ht; % canopy; ave tree ht; % midstorey; trees with >6<13 cm, >13<25 cm, >25<50 cm DBH), whereas arrows projecting left of the main axis suggest that this is an axis of low biomass or decreasing forest quality (% herbs; sapling; % bamboo; % rocks).



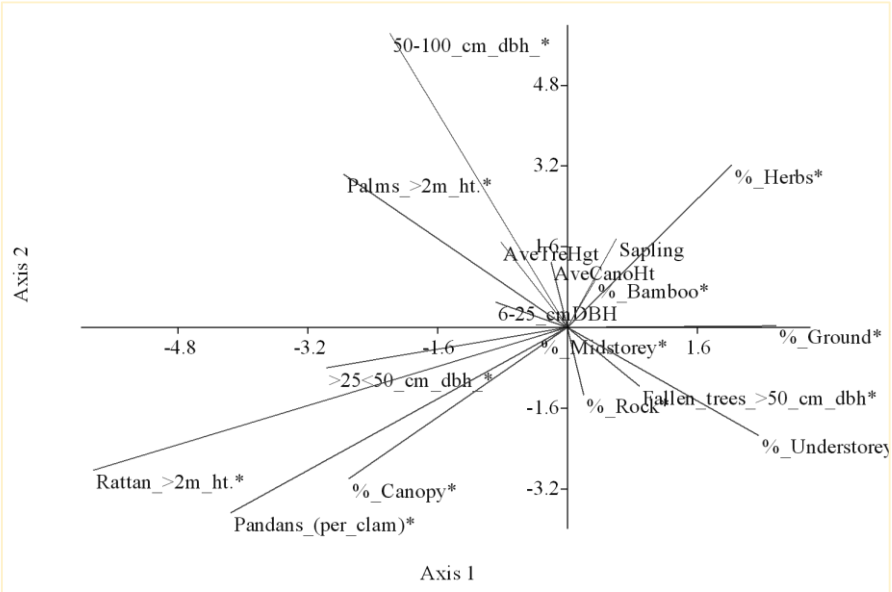
Ordination of selected reptile habitat vectors



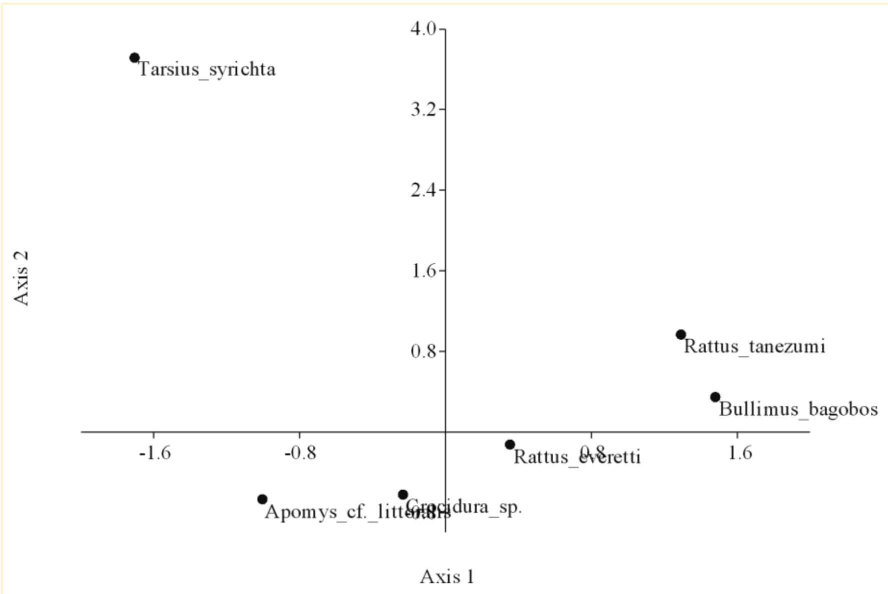
Species ordination of selected reptiles

5. Non-volant mammals

- CCA of six non-volant mammals and 17 habitat variables resulted to two main axes. In the graph, arrows of environmental variables projecting left from the main axis suggest that this axis is an axis of high biomass or increasing forest quality (trees with 50-100cm DBH; rattan >2 m ht; pandan; palms >2 m ht; % canopy; >25<50 cm DBH), whereas arrows projecting right of the main axis suggest that this is an axis of low biomass or decreasing forest quality (% understorey; % herbs; % grounds; saplings; % bamboo; % rocks; fallen trees with >50cm DBH).



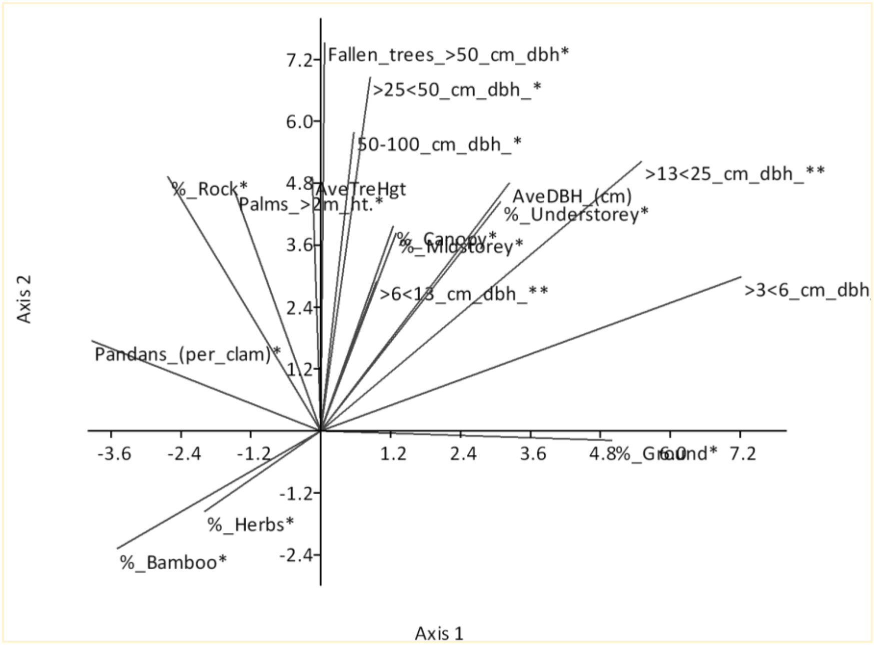
Ordination of habitat vectors for non-volant mammals



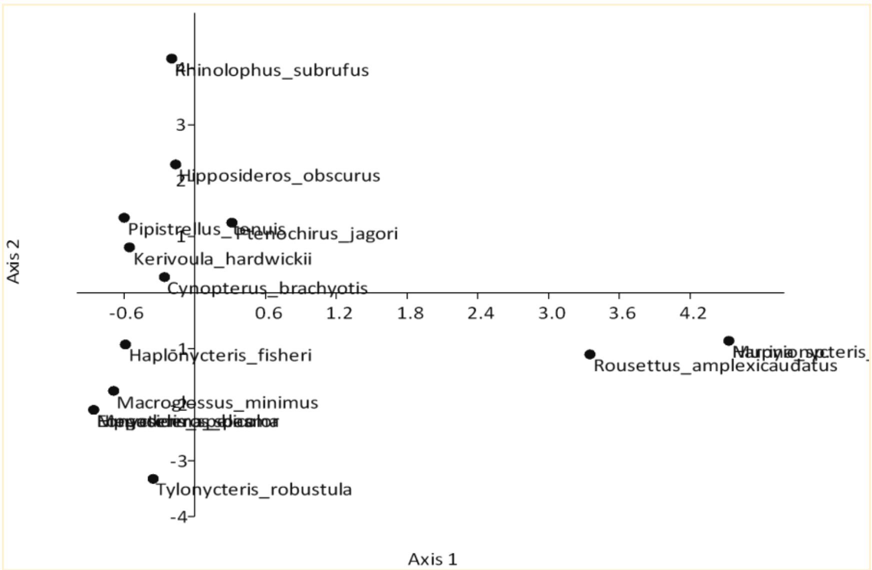
Species ordination of non-volant mammals

6. Volant mammals

- CCA of 15 volant mammals and 18 habitat variables resulted to two main axes. In the graph, arrows of environmental variables projecting upward from the main axis suggest that this axis is an axis of high biomass (trees with >6<13 cm, >13<25 cm, >25<50 cm and 50-100 cm DBH; % understorey; pandans; palms; % rocks; ave tree ht; % canopy; % midstorey), whereas arrows projecting downward suggest that this is an axis of low biomass (% bamboo; % herbs; % ground).



Ordination of habitat vectors for volant mammals



Species ordination of volant mammals

Appendix 14. Economically valuable species of flora recorded in Southern Leyte

Species	Common name	Uses
Afzelia rhomboidea	Tindalo	High quality wood for furniture, cabinets and construction
Alstonia scholaris	Dita	Light construction, boxes and crates, coffins; medicine; chewing gum
Annona muricata	Guyabano	Food
Antidesma ilocanum	Arusip	Firewood, food
Artocarpus heterophyllus	Nangka	Food
Canarium asperum	Pagsahingin	Wood for light construction, resin for fuel and lighting
Celtis philippensis	Malaikmo	Wood for bridges, flooring, steps, construction; medicine
Cocos nucifera	Coconut/niyog	Food; medicine; timber
Ficus septica	Hauili	Fruits; leaves are smoke; medicine (roots, leaves, latex)
Gliricidia sepium	Kakawate	Medicine; ornamental
Gnetum gnemon	Bago	Food
Litsea glutinosa	Sablot	Wood (medong) for light construction; fruit; medicine
Mallotus philippensis	Binato	Wood for temporary construction, chopsticks, handles, fibreboard, paper and pulp production; firewood; medicine; sudorific (bark and leaves)
Mangifera indica	Mangga	Food; medicine; ornamental
Musa textilis	Abaca	Source of fiber
Persea americana	Avocado	Food
Polyscias nodosa	Malapapaya	Wood for boxes, matches, shoes, chopsticks, posts, and plywood; medicine (leaves); fish poison; ornamental plant
Premna odorata	Alagau	Wood for construction and household implements; medicine
Psidium guajava	Guava/bayabas	Firewood, fruit, leaves as fodder
Pteropermum diversifolium	Bayok	Wood for flooring, handles, bridges; pulp; plywood; medicine
Pteropus indicus	Narra	High quality wood for furniture, cabinets and construction
Sandoricum koetjape	Santol	Food
Semicarpus philippinensis	Kamiring	Wood for boxes and crates; medicine; edible fruits

Appendix 15. Economically valuable species of fauna recorded in Southern Leyte

Species	Common name	Uses
Birds		
Bolbopsittacus lunulatus	Guaiabero	Sold for pet trade
Buceros hydrocorax	Rufous Hornbill	Sold for trade, zoo exhibitions, and private collection; prized trophy for hunters; pet
Chalcophaps indica	Common Emerald Dove	Food; sold for pet trade
Gallicolumba crinigera	Mindanao Bleeding-Heart	Food; sold for pet trade
Gallus gallus	Red Jungle Fowl	Food
Haliastur indus	Brahminy Kite	Sold for trade and private collection
Ixos everetti	Yellowish Bulbul	Food
Ixos philippinus	Philippine Bulbul	Food
Lonchura atricapilla	Black-headed Munia	Sold for pet trade
Loriculus philippensis	Philippine Hanging-parrot	Sold for pet trade
Macropygia tenuirostris	Philippine Cuckoo-dove	Food; pet
Penelopides panini	Tarictic Hornbill	Sold for trade, zoo exhibitions, and private collection; prized trophy for hunters; pet
Phapitreron amethystinus	Amethyst-Brown dove	Food; sold for pet trade
Phapitreron leucotis	White-eared Brown-dove	Food; sold for pet trade
Pithecophaga jefferyi	Philippine Eagle	Food; sold for trade, exhibitions, and private collections; prized trophy for hunters
Prioniturus discurus	Blue-crowned Racquet-tail	Food; sold for pet trade
Ptilinopus leclancheri	Black-chinned Fruit-dove	Food; sold for pet trade
Ptilinopus occipitalis	Yellow-breasted Fruit-dove	Food
Sarcops calvus	Coleto	Sold for trade
Tanygnathus lucionensis	Blue-naped Parrot	Sold for cagebird trade; pet
Mammals		
Acerodon jubatus	Golden crowned-flying fox	Food, sold for trade; sold for cash (Php 30.00/piece)
Cynocephalus volans	Kagwang	Sold for trade
Macaca fascicularis	Long-tailed Macaque	Food, sold for trade; pet
Paradoxurus hermaphroditus	Common palm civet	Food
Pteropus hypomelanus	Kabug	Food, sold for trade; sold for cash (Php 30.00/piece)
Pteropus vampyrus	Large Flying Fox	Food, sold for trade; sold for cash (Php 30.00/piece)
Rusa marianna	Philippine Brown Deer	Food
Sus barbatus	Philippine warty pig	Food, used as a barter for rice
Viverra tangalunga	Malay civet	Food
Herpetofauna		
Bronchocela cristatella		Sold for trade; pet
Gekko gecko	Tokay Gecko	Sold for trade; pet
Gonocephalus interruptus		Sold for trade; pet
Hydrosaurus pustulatus	Sailfin Lizard	Sold for trade; pet
Hylarana erythraea	Commno Green Frog	Food
Kaloula conjuncta	Philippine Narrow-mouth Toad	Pet trade
Kaloula picta	Slender-digit Chorus Frog	Pet trade
Limnonectes leytensis	Small Disked Frog	Food
Limnonectes magnus	Giant Philippine Frog	Food

Python reticulatus	Reticulated python	Food; sold for trade; pet
Rhinella marina	Cane toad	Introduced as a biological pest control agent
Varanus cumingi	Mindanao monitor	Sold for trade; pet

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