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Ecological Assessments in the B+WISER Sites

(Northern Sierra Madre Natural Park, Upper Marikina-Kaliwa Forest Reserve, Bago River Watershed and Forest Reserve, Naujan Lake National Park and Subwatersheds, Mt. Kitanglad Range Natural Park and Mt. Apo Natural Park)

Philippines Biodiversity & Watersheds Improved for Stronger Economy & Ecosystem Resilience (B+WISER)

23 March 2015

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Ecological Assessments in the B+WISER Sites

Philippines Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience (B+WISER) Program

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ACRONYMS

	A
AIC	Akaike's Information Criterion
ASG	Advanced Secondary Growth forest
	B
BRWFR	Bago River Watershed Forest Reserve
BRWFRMC	Bago River Watershed Forest Reserve Management Council
B+WISER	Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience
	C
CCA	Canonical Correspondence Analysis
CPA	Conservation Priority Area
CR	Critically Endangered (based on IUCN RedList)
CVT	Cultivated
	D
DBH	Diameter at Breast Height
DD	Data Deficient (based on IUCN RedList)
DENR	Department of Environment and Natural Resources
DENR-BMB	Department of Environment and Natural Resources –Biodiversity Management Bureau
	E
EBA	Endemic Bird Area
EN	Endangered (based on IUCN RedList)
ESG	Early Secondary Growth forest
	F
FAO	Food and Agriculture Organization
FFI PH	Fauna & Flora International Philippines
	G
GIS	Geographic Information System
GPS	Global Positioning System
	H
HCVA	High Conservation Value Area
	I
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
	K
KBA	Key Biodiversity Area
KWFR	Kaliwa Watershed Forest Reserve

L

LC	Least Concern (based on IUCN RedList)
LGU	Local Government Unit (barangay and/or municipal levels)

M

MANP	Mt. Apo Natural Park
MKNP	Mt. Kanla-on Natural Park
MKRNP	Mt. Kitanglad Range Natural Park

N

NCIP	National Commission on Indigenous Peoples
NLNP	Naujan Lake Natural Park & Subwatersheds
NNNP	North Negros Natural Park
NSMNP	Northern Sierra Madre Natural Park
NT	Near Threatened (based on IUCN RedList)

O

OG	Old Growth forest

P

PAIC	Pleistocene Aggregate Island Complexes
PAMB	Protected Area Management Board
PA	Protected Area
PAO	Proportion of Area Occupied
PSR	Pressure-State-Response

R

RR	Restricted Range

S

SDM	Species Distribution Model

U

UMRBPL	Upper Marikina River Basin Protected Landscape
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

The Philippines Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience (B+WISER) Program supports the Department of Environment and Natural Resources in achieving improved management of natural resources. Delivery of the program is ensured by the conduct of integrated baseline assessments on forest cover, biodiversity and watershed functions, in the seven program sites. The results of these assessments will update and enhance management tools to enable the DENR, local government units, and protected area management boards to incorporate contemporary concerns of climate change, vulnerability, disaster preparedness, and integrating ecosystems approach to natural resource management.

This report is a consolidation of the ecological assessments that employed the High Conservation Value Areas approach or HCVA (Mallari et al. in prep) which aimed at generating robust ecological baselines on each B+WISER site. Four types of ecological modeling, the Canonical Correspondence Analysis, Species Occupancy, Distance Sampling, and Maximum Entropy Algorithm, were employed to generate species-habitat relationships, species' spatial requirement, population density estimates, and species distribution models, respectively. These analyses were complemented with land-cover analysis aimed to generate the extent of forest cover and habitat gradients (e.g., forest – old growth, advanced second growth, interface of forest and non-forest – early second growth and non-forest – cultivated areas) for each site. Change detection analysis was also performed to explicitly locate areas undergoing changes and produce a change matrix showing the changes between the different land cover classes during the period 2003-2010.

These ecological assessments were conducted in the six B+WISER sites (Northern Sierra Madre Natural Park, Upper-Marikina River Basin Protected Landscape-Kaliwa Watershed Forest Reserve, Naujan Lake Natural Park and subwatersheds, Bago River Watershed Forest Reserve including Mt. Kanla-on Natural Park and North Negros Natural Park, Mt. Kitanglad Range Natural Park and Mt. Apo Natural Park). These assessments were implemented by Fauna & Flora International Philippines (FFI PH) in collaboration with Mabuwaya Foundation Incorporated (MFI) and the Philippine Eagle Foundation Incorporated (PEFI) from March to October 2014.

Through the State, Pressure and Response model, the key findings and recommendations of the ecological assessment on each site are presented below in tabular form. The STATE section summarizes the key findings on the land cover analysis, species profile, species-habitat relation, species occupancy, population density estimates, and species distribution. Under the PRESSURE section, key findings on the change detection analysis and the identified key drivers of deforestation are enumerated. Lastly, the RESPONSE section reflects the recommendations based on the implications of the species survival envelopes (the ecological niche the species can survive in) on the species.

This report was designed to provide decision-making tools/inputs for protected area management of the B+WISER Program sites to set specific biodiversity conservation targets. It is envisaged these scientific inputs will guide park management through the planning process from selection of target areas or HCVAs, site profiling and zoning to monitoring and evaluating impacts of the adopted management interventions.

B+WISER Ecological Assessment			
Sites	**State**	**Pressure**	**Response**
Northern Sierra Madre Natural Park (NSMNP)	• Survey performed on site from February to May 2014. • Total forest cover is 276,227 ha • Species recorded: 121 birds, 17 mammals, 19 amphibians, 19 reptiles and 89 trees. • New records for the park include the migratory Pale Thrush (*Turdus pallidus*), the Crab-eating frog (*Fejervarya cancrivora*) and the Emerald flying frog (*Rhacophorus pardalis).*	• Forest cover loss from 2003 to 2010 is 10,256 ha (at an annual rate of loss of 1,465 ha/yr). ▪ Key Drivers of Deforestation and Degradation for this site include: hunter trails and live hunter traps, pasture land for carabaos, carabao trails, access trails, irrigation canals, old logging trails, kaingin, and main access roads.	▪ Four HCVAs were identified in these following areas: (1) Municipality of Divilacan: Dicatian, Dicambangan, Ditarum, Dilakit and Bicobian. (2) Municipality of San Mariano: Dibuluan, Disalup and San Jose; (3) Municipality of Palanan: Villa Robles, Bisag, Santa Jacinta, Dicadyuan and Marikit; (4) Municipality of Cabagan: Union ▪ Management plan should be revised in consideration of the HCVAs as core protection zones.
Upper Marikina River Basin Protected Landscape (UMRBPL)-Kaliwa Watershed Forest Reserve (KWFR)	• Survey performed in proxy site Ipo Dam Watershed located in Norzagaray, Bulacan in April 21-28 and July 24-August 5, 2014. • Total forest cover is 6,111 ha in UMRBPL and 12,470 ha in KWFR • Species recorded: 20 trees, 93 birds, 12 amphibians, 15 reptiles, and 14 mammals. • 16 Luzon endemic species were detected.	• Total area deforested in seven years (2003-2010) was 2,247 ha with an annual deforestation rate of 321 ha/yr. • Tanay has the highest net negative change from forest to non-forest. • Key drivers of deforestation for this site include: legal and illegal logging, kaingin and charcoal consumption.	▪ One HCVA identified, located in the municipalities of Rodriguez and Norzagaray. ▪ Management plan should be revised in consideration of the HCVA as core protection zone.
Bago River Watershed Forest Reserve (BRWFR) including Mt. Kanlaon Natural Park (MKNP) and North Negros Natural Park (NNNP)	▪ Survey performed on site from September to October 2014. ▪ Total forest cover as of 2010 is 10,098 ha. ▪ Species recorded: 26 trees, 109 birds, 25 bats, 10 amphibians, and 11 reptiles. ▪ 71 Philippine endemic species were detected. 22 spp. are categorized as threatened. ▪ Noteworthy species include the following: Philippine bare-backed fruit bat, which was captured once, and is Critically Endangered (CR); the endemic and endangered Philippine tube-nosed fruit bat, which was captured several times in both survey sites; threatened species of frogs of the genus *Platymantis*, were recorded,	▪ From 2003-2010, net forest change is reported at 1,068 ha with Salvador Benedicto having the highest net forest change of 1,014 ha. ▪ Key driver of deforestation and degradation is increasing land conversion. There is also hunting pressure on wildlife species i.e. Visayan warty pigs and Visayan spotted deer, both of which are threatened species. ▪ Three (3) hotspots were identified and are located in the following areas: (1) Municipality of Salvador Benedicto - Brgy. Bagong Silang, Brgy. Bunga, Brgy. Kumaliskis, Brgy. Igmaya-an, Brgy. Pandanon-silos; Silay City – Brgy. Patag; Municipality of Murcia – Brgy. Canlandog and Brgy.	

B+WISER Ecological Assessment			
Sites	**State**	**Pressure**	**Response**
	e.g., *P. negrosensis*, and *P. hazelae*; and about five species of threatened dipterocarps were recorded.	Buenavista; Talisay City – Brgy. Cabatangan and Brgy. San Fernando; Cadiz - Brgy. Villacin; Sagay City – Brgy. Puey; Municipality of Calatrava – Brgy. Lalong; (2) Brgy. Minoyan, Municipality of Murcia; and (3) Brgy. Cabagnag-an, Municipality of La Castellana.	
Naujan Lake National Park (NLNP) and sub-watersheds	• Total forest cover in NLNP is estimated at 25,000 ha. • A total of 36 species were used in Species Distribution Modeling. These include three Critically Endangered, two Endangered, and four Vulnerable birds and amphibians.	• Forest cover loss reached 3,899 ha (557 ha/yr) from 2003 to 2010. • Five hotspots or priority areas were identified. These are the following: (1) Puerto Galera, Baco, San Teodoro of Oriental Mindoro and Abra de Ilog of Occidental Mindoro; (2) Lubang Group of Islands; (3) Naujan and Pola of Oriental Mindoro; (4) Sablayan of Occidental Mindoro; and (5) San Jose and Magsaysay of Occidental Mindoro.	▪ Three HCVAs were identified: (1) Puerto Galera, Baco, San Teodoro, Calapan, Naujan, Pola, Victoria and Soccorro of Oriental Mindoro and Abra de Ilog of Occidental Mindoro; (2) Lubang Group of Islands; and (3) Palaun, Mamburao and Sta. Cruz of Occidental Mindoro. ▪ Management plan should be revised in consideration of the HCVAs as core protection zone.
Mt. Kitanglad Range Natural Park (MKRNP)	• Survey performed on site during the months of January, February, March, and October 2014. • Total forest cover for MKRNP is estimated at 43,000 ha. • Recorded species include: 124 birds, including the Amethyst Brown Dove; 32 mammals; 20 frogs; 15 reptiles; and 81 trees.	• Total forest gain is 4,788 ha from 2003 to 2010. • Total forest loss is 1,014 ha from 2003 to 2010. • Threats observed in the area include habitat conversion and logging. • Three hotspots were observed, which are: (1) Municipality of Malaybalay – Brgy. Mapayag and Brgy. Imbayao,Municipality of Sumilao – Brgy. Lupiagan and Brgy. Licoan; (2) Municipality of Libona – Brgy. Sil-ipon and Brgy. Dahilayan, Municipality of Baungon – Brgy. San Vicente; (3) Municipality of Lantapan – Brgy. Kibangan, Brgy. Cawayan, and Brgy. Victory.	▪ Three HCVAs were identified in the following areas: (1) Municipalities of Malaybalay and Sumilao; (2) Municipalities of Libona and Baungon; and (3) Municipality of Lantapan. ▪ Management plan should be revised in consideration of the HCVAs as core protection zone.

B+WISER Ecological Assessment			
Sites	**State**	**Pressure**	**Response**
Mt. Apo Natural Park (MANP)	• Survey done on site from June to July 2014. • Total forest cover for MANP is estimated at 19,000 ha. • Species recorded include 70 birds, 37 of which are Philippine endemics, with 6 species endemic to the island of Mindanao, 20 mammals, 12 amphibians, 7 reptiles, and 76 trees. • Noteworthy species recorded in MANP are the Critically Endangered Philippine Eagle (*Pithecophaga jefferyi*), and the Philippine Large-headed Fruit Bat (*Dyacopterus rickartii*).	• Forest loss reached 11,088 ha (1,584 ha/year) from 2003 to 2010. • For MANP, identified drivers of deforestation and degradation include cultivated area inside the protected area, resource extraction, management or land conflict, and development such as roads and possible construction of energy resource extraction. • Three hotspot areas were identified in the following locations: (1) Municipalty of Makilala – Brgy. Buhay, Brgy. Garsika, Brgy. New Cebu,Municipality of Bansalang – Brgy. Sibayan, Brgy. Tinungtungan, Municipality of Bigos – Brgy. Kapatagan; (2) Municipality of Davao – Brgy. Talomo, Brgy Tagurano,Municipality of Atan-awe – Brgy. Kapatagan; and (3) Municipality of Sta. Cruz – Brgy. Tibolo.	• Three HCVAs were identified in the following areas: (1) Municipalities of Makilala, Bansalang, and Bigos; (2)Municipalities of Davao and Atan-awe; (3) Municipality of Sta.Cruz. • Management plan should be revised in consideration of the HCVAs as core protection zone.

I. INTRODUCTION

1.1. RECOGNIZING THE CONSTRAINTS IN MAKING INFORMED MANAGEMENT DECISIONS

The gap between management systems/infrastructure and science-based conservation planning resulting to a mismatch between the conservation needs at the species/sites level and the Protected Area Management Plans clearly undermines the efficacy of PAs in the Philippines. This is the same criticism made by many protected areas especially in the developing world where there is a dearth of technical expertise to support and guide conservation planning (Carwardine et al. 2007; Lovejoy 2006; Wilson et al. 2007). The mismatch of conservation intervention vis-à-vis priorities is attributable to a number of factors: (a) national and local natural resources statutes that lack scientific basis (e.g., Ribot & Peluso 2003); (b) limitations in the technical capacity in many protected areas (Hayes 2006) and (c) the simplistic data requirements (e.g., vegetative cover, list of threatened and endangered species and list of threats to the protected area) and short-cuts for management planning prescribed by law (Lindenmayer et al. 2006).

This weakness of the management plans of many PAs globally lie in their failure to take into account the importance of the quality (Johnson 2007) and extent of lowland forests where most of the threatened species are found (Collar et al. 1999). For example, key lowland habitats and key species are under enormous anthropogenic or human-induced pressures of habitat loss and degradation as well as direct exploitation (Wells et al. 2007). The current management regime in most PAs in the Philippines (including management zoning) were found to be inadequate in securing these key lowland habitats and species since these key habitats have lower protection status (i.e. currently designated as buffer zones) than high-elevation forest (i.e. currently designated as core zone) and there seems to be an absence of a clear conservation program and biodiversity monitoring protocol (Mallari et al. 2013). Another key finding of the PA assessment in the Philippines (Mallari et al. 2011) is the importance of intermediate habitats and ecotones (usually in lowlands), where species richness and abundance was highest. This pattern of increasing bird species richness and abundance in intermediate habitats illustrated by recent studies, for example, study of edge effect and ecotonal species; comparison of bird community differences in mature and secondary growth forest; edge influence on forest structure and composition in fragmented landscapes; and studies on ecological responses to habitat edges (Becker & Agreda 2005; Harper et al. 2005). However, with the current zoning system in the Philippines, all of these lowland second growth forests are in buffer zones or multiple use zones and are therefore accorded lower protection status. This reinforces the need to incorporate these habitat types into the strict protection zones bearing in mind the responses of key species to habitat gradients.

This report was designed to provide decision-making tools/inputs for protected area management of the B+WISER Program sites to set biodiversity conservation targets that will take into account people's legitimate livelihood interests inside or around its boundaries. It is envisaged that this will provide scientific inputs to guide park management through the planning process from selection of HCVAs, site profiling, and zoning to monitoring and evaluating impacts of the adopted management interventions.

1.2. ADDRESSING THE CONSTRAINTS (TECHNICAL APPROACH: BIODIVERSITY ASSESSMENT VS ECOLOGICAL ASSESSMENT)

Information Tiers

The main agenda of the Convention on Biological Diversity was to develop strategies aimed at protecting vulnerable species, habitats, and ecosystems (McNeely 1999 and 2004). At the level of the species, species conservation action plans are developed to address conservation issues of biodiversity (Mulongoy & Chape 2004) whilst at the level of the habitats/ecosystems or sites, protected areas are established to address species conservation issues at the landscape level, which includes many other economic, social, and political dimensions (Lovejoy 2006).

The key weakness in the PA management planning process globally is that the biodiversity baselines are based only on species richness/diversity data (biodiversity assessments/inventories or Tier 1), but lack population densities of key species including natural and anthropogenic (human-induced) determinants of diversity and abundance (Tiers 2&3). Quantitative baselines such as population densities improve the ability of protected area managers to design appropriate management interventions as well as provide indicators for change (Brito & Grelle 2004; Lindenmayer et al. 2008; Monadjem 2003; Purvis et al. 2000). These baselines are also essential to determine and report the conservation significance of any management intervention through changes in numbers of target /focal species. Coupled with the minimum required dataset (i.e. list of threatened and endangered species, vegetative cover and land use, ethnographic forest occupants' data) for the General Management Planning Strategy (GMPS)[1], the management plan may now be able to articulate site-level (landscape) conservation strategies as well as species-level management interventions (Tier 4), which are currently lacking. The hierarchy of the data organization (following an increasing level of complexity) is as follows:

Tier 1 – Species inventories resulting to identification of species richness and diversity i.e.Υ -diversity β-diversity α-diversity. (see section 3.2.1)

Tier 2 – determine Species Survival envelopes. This will inform management of species-habitat relationships, which indicate levels of tolerance to varying degrees of habitat 'naturalness', and disturbance indices. (see section 3.2.2)

Tier 3 – determine Species Occupancy and Population. At this tier, it is determined how much of the species is present and how much of the habitat is required to inform management planning on impacts of natural and anthropogenic factors on key species. (see section 3.2.3).

Tier 4 – determine hotspots. Here, it is analyzed how much of the habitats required are available and where these are, (see section 3.4), and their threats are identified. (see section 4.2.2)

HCVA approach

[1] See Implementing Rules and Regulations or the National Integrated Protected Areas System or NIPAS law and the DENR Department Administrative Order No. 25, Series of 1992

One novel and practical approach in providing the guidance to site managers is the High Conservation Value Areas (HCVAs) approach. HCVAs are natural areas containing significant concentration of biodiversity (e.g., endemic and threatened species), providing basic environmental services, and are culturally important to local communities (FSC 2002). HCVAs are where biological, ecological, social, or cultural values are considered outstandingly significant or critically important at the national, regional, or global level. The concept of HCVA was first introduced by the Forest Stewardship Council (FSC) in 1999 (FSC 2002). It was originally used in forest management certification until it became widely used in conservation and natural resources management particularly in identifying priority areas (UNEP-WCMC 2013) even within pre-determined priority areas such as Important Biodiversity/Bird Areas (Mallari et al. 2001) or Key biodiversity Areas (DENR 2002). Identification of HCVAs is mainly anchored on FSC principles and criteria (FSC 2002). It includes the compilation of data on significant record of species and their distribution, in addition to key habitats (e.g., Clark 2006). However, another work (e.g., Kennard 2010) used the combination of spatial technologies and species records to delineate HCVAs. Examples of HCV approach applications include their use to identify important aquatic ecosystems in Northern Australia (Kennard 2010) and forest ecosystems and landscapes in Canada (Timoney and Sherwood Park 2003). The approach was also used in Reducing Carbon Emissions from forest Degradation and Deforestation (REDD) projects – a mechanism used to mitigate climate change impacts — in developing countries e.g., Kasigau Corridor REDD project in Kenya (Freund 2011). In the Philippines, the Fauna & Flora International is piloting the use of HCV approach for a REDD+ project in Southern Leyte and Southern Palawan (FFI 2013a).

All natural habitats possess some inherent conservation values, including the presence of rare or endemic species, provision of ecosystem services, sacred sites, or resources harvested by local residents. However, some values are more significant or critical than others, and the HCVA approach offers an objective way of identifying which values should be maintained or enhanced. The key to the concept of HCVAs is the identification of High Conservation Values (HCVs) (http://www.hcvnetwork.org/about-hcvf/the-six-high-conservation-values). HCVAs must possess one or more of the following attributes (HCVs):

HCV1 - Areas containing globally, regionally, or nationally significant concentrations of biodiversity values (e.g., endemism, endangered species, refugia).

HCV2 - Globally, regionally, or nationally significant large landscape-level areas where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.

HCV3 - Areas that are in or contain rare, threatened, or endangered ecosystems, e.g., patches of a regionally rare type of freshwater swamp.

HCV4 - Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes, e.g., forest on steep slopes with avalanche risk above a town.

HCV5 - Areas fundamental to meeting basic needs of local communities (e.g., for livelihoods, subsistence, health, nutrition, water) identified through engagement with these communities or indigenous peoples, e.g., key hunting areas for communities living at subsistence level.

HCV6 – Sites, resources, habitats, and landscapes of that have national or global or national cultural, archaeological, or historical significance as well as being and/or of critical cultural, ecological, economic, or religious/sacred importance to the traditional cultures of local communities or indigenous peoples identified through engagement with these local communities or indigenous peoples, e.g., sacred burial grounds within a forest management area or new agricultural plantation.

HCV criteria and respective identified HCVAs are not mutually exclusive but in many cases overlap. This ecological assessment focuses on the identification of areas mainly with the first three attributes or HCV criteria with focus on HCV 1 and 2.

II. RESEARCH METHODOLOGY

2.1 PRE-SURVEY

Stratification and Sampling design

Stratified sampling was used in this assessment. Stratification focused on the habitat particularly on the different forest classes/habitat types that were based mainly on forest structure (dominance), elevation, rainfall and degree of disturbance. To achieve this, the following general approach on stratification was used:

- Delineation of the project area boundary.
- Review of available literature on the habitat requirements of the focal species or taxa.
- Develop a habitat stratification system based on what is expected to coincide with the key species' habitat requirements
- Use the forest stratification map to review the project area, and select study areas, which are representative of the project area, in terms of the types of strata they contain.
- Lay out on the map the possible location of transects and sample points.

Transect establishment

Main biodiversity transects were established by stratified random sampling along various disturbance and elevation gradients, such that each would cover different habitat types. Transects comprised of a 1-or 2-km line with point stations marked at every 250 meters (0.0, 1.0, 2.0….) while transect sections were marked at every 25 meters (0.1, 0.2, 0.3….).

Proxy Sites

The on-going discussions and negotiations with the National Commission on Indigenous Peoples (NCIP) at various levels caused serious delays in the conduct of baseline ecological assessments in all relevant B+WISER sites. Because these negotiations took longer than expected, further delays in the baseline assessments would have very serious effects on the entire project (PA/watershed planning) cycle. Therefore, proxy sites were identified to establish the baselines of the B+WISER sites through these ecological equivalents/surrogates or proxy sites.

Table 1 shows the tabulated proxy sites vis-à-vis the relevant B+WISER sites for the Mindoro and Luzon Sites. Each table shows the species and their corresponding endemic bird areas, International Union for Conservation of Nature (IUCN) status, and main habitats in each location. Also listed under are the Priority Important Bird Areas (IBAs), which represent the full assemblage of key species in that particular bio-geographic region. A combination of these Priority IBAs should be considered in designing a conservation agenda for the whole area.

Table 1. List of Endemic Bird Areas (EBAs): Mindoro

SPECIES	Endemic Bird Areas	Red Data Book	MAIN HABITATS	Naujan (main site)	Halcon (proxy site)	Siburan (proxy site)
Philippine Duck *Anas luzonica*	E	VU	Wetlands	X	0	X
Philippine Hawk-eagle *Spizaetus philippensis*	E	VU	Forest	0	X	X
Mindoro Bleeding-heart *Gallicolumba platenae*	RR	CR	Lowland forest	X**	X	X
Mindoro Imperial-pigeon *Ducula mindorensis*	RR	VU	Montane forest	X**	X	X
Spotted Imperial-pigeon *Ducula carola*	E	VU	Forest	X**	X	X
Philippine Cockatoo *Cacatua haematuropygia*	E	CR	Lowland forest	X**	X	X
Black-hooded Coucal *Centropus steerii*	RR	CR	Lowland forest	X**	X	X
Mindoro Scops-owl *Otus mindorensis*	RR	NT	Montane forest	X**	X	X
Mindoro Hornbill *Penelopides mindorensis*	RR	EN	Lowland forest	X**	X	X
Mountain Shrike *Lanius validirostris*	RR	NT	Montane forest	0	X	X
Ashy Thrush *Zoothera cinerea*	RR	VU	Lowland forest	X	X	X
Scarlet-collared Flowerpecker *Dicaeum retrocinctum*	RR	VU	Lowland forest	0	X	X

X** - species recorded in Mindoro Experimental Forest in Victoria, Oriental Mindoro (not located in Naujan Lake proper).

Key:
SPECIES: All threatened and restricted-range species which occur in this EBA are listed, with those species which are endemic to the EBA in **bold** (note that species marked with an asterisk are mainly confined to the EBA, but are also known by a few records from elsewhere);
EBA: Species marked "RR" have restricted ranges, and were used in BirdLife International's EBA analysis; species marked "E" are national endemics to the Philippines, but are too widespread within the archipelago to be considered to have restricted ranges;
RDB: The IUCN threat categories from Collar et al. (1999), CR = Critical, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient;
MAIN HABITAT: The most important habitat of each species. Note that many "Lowland forest" species may sometimes occur outside this habitat type, and species vary considerably in their tolerance of habitat degradation. Species coded "Forest" either occurs in both lowland and montane forest, and the available data do not clearly indicate a preference for one of these habitat types.

The key points of the above presented tables are summarized to justify proxy site selection.

Key points

- Ten restricted-range species occur in this EBA, of which five are confined to it and seven are globally threatened. An additional four threatened species also occur there.
- No large areas of lowland forest remain in the Mindoro EBA, and the three lowland specialists that are endemic to Mindoro are all highly threatened.
- The areas of montane forest that remain on Mindoro are relatively large and less immediately threatened than the lowland forests, and the two montane specialists which are endemic to Mindoro are not as highly threatened as the lowland endemics.
- The similarity in the bird species composition between the three sites is evidence that Halcon and Siburan can be used as proxy sites for Naujan.

Priority Important Bird Areas (IBAs)

- Siburan is the best remaining area of lowland forest on Mindoro, and therefore a top priority site for conservation.
- Despite their relatively small size, the other areas of lowland forest on Mindoro are also important: Mt Calavite; Puerto Galera; Mt Halcon; Iglit-Baco Mountains; Malpalon; Bogbog, Bongabong and Mt Hitdong; and Mt Hinunduang.
- Several IBAs contain large areas of montane forest, notably Mt Halcon, and also Iglit-Baco Mountains and Mt Hinunduang.
- All of the IBAs on Mindoro require more detailed ecological assessment.
- Particularly poorly known IBAs, where surveys are required to establish both the extent and quality of the remaining habitats as well as the current status of the birds and other biodiversity are: Mt Calavite; Lake Naujan; Bogbog, Bongabong and Mt Hitding; and Mt Hinunduang.

Table 2. List of Endemic Bird Areas (EBAs): Luzon

SPECIES	Endemic Bird Areas	Red Data Book	MAIN HABITATS	NSMNP (main site)	Angat-Ipo (proxy site)
Spot-billed Pelican *Pelecanus philippensis*		VU	Wetlands	0	0
Chinese Egret *Egretta eulophotes*		EN	Wetlands	0	0
Japanese Night-heron *Gorsachius goisagi*		VU	Forest	0	0
Oriental Stork *Ciconia boyciana*		EN	Wetlands	X	0
Black-faced Spoonbill *Platalea minor*		CR	Wetlands	0	0
Philippine Duck *Anas luzonica*	E	VU	Wetlands	X	0
Philippine Eagle *Pithecophaga jefferyi*	E	CR	Forest	X	X
Philippine Hawk-eagle *Spizaetus philippensis*	E	VU	Forest	X	X
Spotted Buttonquail *Turnix ocellata**	RR	LC	Grassland	X	X
Worcester's Buttonquail *Turnix worcesteri*	RR	DD	Grassland	0	X
Brown-banded Rail *Lewinia mirificus**	RR	DD	Grassland	0	0
Nordmann's Greenshank *Tringa guttifer*		EN	Wetlands	0	0
Chinese Crested-tern *Sterna bernsteini*		CR	Wetlands	0	0
Luzon Bleeding-heart *Gallicolumba luzonica*	RR	NT	Lowland forest	X	X
Flame-breasted Fruit-dove *Ptilinopus marchei*	RR	VU	Montane forest	X	X
Cream-bellied Fruit-dove *Ptilinopus merrilli*	RR	NT	Lowland forest	X	X
Spotted Imperial-pigeon *Ducula carola*	E	VU	Forest	X	X
Philippine Cockatoo *Cacatua haematuropygia*	E	CR	Lowland forest	X	?
Luzon Racquet-tail *Prioniturus montanus*	RR	NT	Montane forest	X	?
Green Racquet-tail *Prioniturus luconensis*	RR	VU	Lowland forest	X	X
Red-crested Malkoha *Phaenicophaeus superciliosus*	RR	LC	Lowland forest	X	X
Scale-feathered Malkoha *Phaenicophaeus cumingi*	RR	LC	Forest	X	X
Rufous Coucal *Centropus unirufus*	RR	NT	Lowland forest	X	X
Luzon Scops-owl *Otus longicornis*	RR	NT	Montane forest	X	X
Philippine Eagle-owl *Bubo philippensis*	E	VU	Lowland forest	X	X
Whitehead's Swiftlet *Collocalia whiteheadi*	RR	DD	Montane forest	X	X
Philippine Kingfisher *Ceyx melanurus*	E	VU	Lowland forest	X	X

SPECIES	Endemic Bird Areas	Red Data Book	MAIN HABITATS	NSMNP (main site)	Angat-Ipo (proxy site)
Luzon Hornbill *Penelopides manillae*	RR	LC	Lowland forest	X	X
Whiskered Pitta *Pitta kochi*	RR	VU	Montane forest	X	X
Blackish Cuckoo-shrike *Coracina coerulescens**	RR	LC	Lowland forest	X	X
Mountain Shrike *Lanius validirostris*	RR	NT	Montane forest	X	X
Ashy Thrush *Zoothera cinerea*	RR	VU	Lowland forest	X	X
Luzon Water-redstart *Rhyacornis bicolor*	RR	VU	Montane forest	X	0
Rabor's Wren-babbler *Napothera rabori*	RR	NT	Lowland forest	X	X
Golden-crowned Babbler *Stachyris dennistouni*	RR	NT	Lowland forest	X	0
Chestnut-faced Babbler *Stachyris whiteheadi*	RR	LC	Montane forest	X	0
Luzon Striped-babbler *Stachyris striata*	RR	NT	Lowland forest	X	X
Ijima's Leaf-warbler *Phylloscopus ijimae*		VU	Forest	0	0
Streaked Reed-warbler *Acrocephalus sorghophilus*		VU	Wetlands	0	0
Philippine Bush-warbler *Cettia seebohmi*	RR	LC	Montane forest	0	0
Long-tailed Bush-warbler *Bradypterus caudatus*	RR	LC	Montane forest	0	0
Grey-backed Tailorbird *Orthotomus derbianus**	RR	LC	Lowland forest	X	X
White-browed Jungle-flycatcher *Rhinomyias insignis*	RR	VU	Montane forest	X	0
Ashy-breasted Flycatcher *Muscicapa randi**	RR	VU	Lowland forest	X	X
Furtive Flycatcher *Ficedula disposita*	RR	NT	Lowland forest	X	X
Blue-breasted Flycatcher *Cyornis herioti*	RR	LC	Lowland forest	X	0
Short-crested Monarch *Hypothymis helenae*	RR	NT	Lowland forest	X	0
Celestial Monarch *Hypothymis coelestis*	RR	VU	Lowland forest	X	X
Green-backed Whistler *Pachycephala albiventris*	RR	LC	Forest	X	0
White-fronted Tit *Parus semilarvatus*	RR	NT	Lowland forest	X	X
Long-billed Rhabdornis *Rhabdornis grandis*	RR	LC	Lowland forest	X	X
Flame-crowned Flowerpecker *Dicaeum anthonyi*	RR	NT	Montane forest	X	0
White-cheeked Bullfinch *Pyrrhula leucogenis*	RR	LC	Montane forest	X	0
Green-faced Parrotfinch *Erythrura viridifacies*	RR	VU	Montane forest	X	X
White-lored Oriole *Oriolus albiloris*	RR	LC	Lowland forest	X	X
Isabela Oriole *Oriolus isabellae*	RR	EN	Lowland forest	X	0
Yellow Bunting *Emberiza sulphurata*		VU	Open areas, scrub	0	0

Key: refer to Table 1 for EBA: Mindoro.

Key points

- Forty restricted-range species occur in this EBA, of which 28 are mainly confined to it, and 10 are globally threatened and three are Data Deficient. An additional 17 threatened species also occur there.
- Most of the endemic birds of Luzon occur in both lowland and montane forest, but there are several lowland forest specialists, and a group of montane species, which are mainly confined to the Cordillera Central and the montane forests of the Sierra Madre.

- The habitat requirements, distributions and seasonal movements of three of the highly threatened species of Luzon, Worcester's Buttonquail, Brown-banded Rail and Isabela Oriole, are exceptionally poorly known.
- The similarity in the bird species composition between the two sites is evidence that the Angat-Ipo Watershed can be used as proxy sites.

Priority Important Bird Areas

- The NSMNP is exceptional in the Philippines, because of the large area of pristine lowland forest that survives there, and because unbroken forests extend from the beach forests on the coast to montane forest on the highest peaks.
- Several other IBAs on Luzon are reported to contain substantial areas of lowland forest: Bataan Natural Park and Subic Bay National Park; Aurora Memorial Park; Angat Watershed; Mt Makiling; Caramoan peninsula; and Catanduanes Watershed Forest Reserve . It is possible that significant areas of lowland forest also remain in some of the more poorly known IBAs, such as Mt Cagua; Central Sierra Madre mountains; Mt Dingalan; and Mt Irid-Mt Angilo.
- The Sierra Madre mountains support an important population of Philippine Eagle, and the IBAs that are crucial for the survival of the Luzon population, notably: Mt Cetaceo; Northern Sierra Madre Nature Park; Central Sierra Madre mountains; Aurora Memorial Park; and Mt Dingalan, and probably also Mt Cagua and Mt Irid-Mt Angilo.
- Almost all of the IBAs on Luzon require more detailed ecological assessment.

Table 3. List of Endemic Bird Areas: Negros and Panay

SPECIES	Endemic Bird Areas	Red Data Book	MAIN HABITAT
Japanese Night-heron *Gorsachius goisagi*		VU	Forest
Philippine Duck *Anas luzonica*	E	VU	Wetlands
Philippine Hawk-eagle *Spizaetus philippensis*	E	VU	Forest
Spotted Buttonquail *Turnix ocellata*	RR	LC	Grassland
Negros Bleeding-heart *Gallicolumba keayi*	RR	CR	Lowland forest
Negros Fruit-dove *Ptilinopus arcanus*	RR	CR	Montane forest?
Spotted Imperial-pigeon *Ducula carola*	E	VU	Forest
Philippine Cockatoo *Cacatua haematuropygia*	E	CR	Lowland forest
Philippine Needletail *Mearnsia picina*	RR	NT	Lowland forest
Rufous-lored Kingfisher *Todirhamphus winchelli*	E	VU	Lowland forest
Visayan Hornbill *Penelopides panini*	RR	EN	Lowland forest
Writhed-billed Hornbill *Aceros waldeni*	RR	CR	Lowland forest
White-winged Cuckoo-shrike *Coracina ostenta*	RR	VU	Lowland forest
Mountain Shrike *Lanius validirostris*	RR	NT	Montane forest
Flame-templed Babbler *Stachyris speciosa*	RR	EN	Lowland forest
Panay Striped-babbler *Stachyris latistriata*	RR	NT	Montane forest
Negros Striped-babbler *Stachyris nigrorum*	RR	EN	Montane forest
Streaked Reed-warbler *Acrocephalus sorghophilus*		VU	Wetlands
White-throated Jungle-flycatcher *Rhinomyias albigularis*	RR	EN	Lowland forest
Ashy-breasted Flycatcher *Muscicapa randi*	RR	VU	Lowland forest
Celestial Monarch *Hypothymis coelestis*	RR	VU	Lowland forest
Visayan Flowerpecker *Dicaeum haematostictum*	RR	VU	Lowland forest
Scarlet-collared Flowerpecker *Dicaeum retrocinctum*	RR	VU	Lowland forest
Green-faced Parrotfinch *Erythrura viridifacies*	RR	VU	Montane forest

Key: see the table for EBA 150: Mindoro.

Key points:

- Seventeen restricted-range species occur in this EBA, of which 10 are confined to it and 13 are globally threatened. An additional seven threatened species also occur there.
- Very few extensive areas of lowland forest remain in the Negros and Panay EBA, and five of the seven lowland and lower montane specialists that are endemic to this EBA are highly threatened.
- The areas of montane forest which remain on Negros and Panay are relatively large and less immediately threatened than the lowland forests, and the two montane specialists that are endemic to this EBA are not as highly threatened as the lowland endemics.

Priority Important Bird Areas

- Despite their relatively small size, the other areas of lowland forest on Negros and Panay are also important: lower altitude forests in Mt. Kanlaon National Park (MKNP); Ban-ban; and Hinoba-an.
- Several IBAs contain large areas of montane forest, notably the Central Panay Mountains and MKNP, and also Mt Silay and Mt Mandalangan and the Cuernos de Negros.
- MKNP is the only known locality in the world for the Negros Fruit-dove, although there are no recent confirmed records there.
- The Central Panay Mountains IBA supports the entire global population of the Panay Striped-babbler.
- Cuernos de Negros is the most important locality in the world for Negros Striped-babbler (which is otherwise only known by a single record in Mt Kanlaon National Park.
- All of the IBAs on Negros and Panay require more detailed biological surveys
- A particularly poorly known IBA, where surveys are required to establish the extent and quality of the remaining lowland forests and the current status of the birds and other biodiversity is the western section of the Cuernos de Negros.
- The applicability of looking at this in the case of Bago Watershed is that since it is not an identified IBA, and therefore, at the outset, it has low biodiversity value. Therefore, the Negros-Panay biogeographic region was examined to ascertain the combination of IBAs that will ensure full coverage and representativeness of this biogeographic region. In this analysis, it shows that the Kanlaon and Negros IBAs represent biodiversity assemblages that represent this biogeographic area. By adding these two IBAs to Bago Watershed, its biodiversity value increases.

Table 4. List of Endemic Bird Areas: Mindanao and the Eastern Visayas

SPECIES	Endemic Bird Areas	Red Data Book	MAIN HABITAT
Spot-billed Pelican *Pelecanus philippensis*		VU	Wetlands
Chinese Egret *Egretta eulophotes*		EN	Wetlands
Japanese Night-heron *Gorsachius goisagi*		VU	Forest
Philippine Duck *Anas luzonica*	E	VU	Wetlands
Philippine Eagle *Pithecophaga jefferyi*	E	CR	Forest
Philippine Hawk-eagle *Spizaetus philippensis*	E	VU	Forest
Brown-banded Rail *Lewinia mirificus*	RR	DD	Grassland?
Mindanao Bleeding-heart *Gallicolumba criniger*	RR	EN	Lowland forest
Mindanao Brown-dove *Phapitreron brunneiceps*	RR	VU	Forest
Spotted Imperial-pigeon *Ducula carola*	E	VU	Forest
Mindanao Lorikeet *Trichoglossus johnstoniae*	RR	NT	Montane forest
Philippine Cockatoo *Cacatua haematuropygia*	E	CR	Lowland forest
Mindanao Racquet-tail *Prioniturus waterstradti*	RR	NT	Montane forest
Mindanao Scops-owl *Otus mirus*	RR	NT	Montane forest

SPECIES	Endemic Bird Areas	Red Data Book	MAIN HABITAT
Lesser Eagle-owl *Mimizuku gurneyi*	RR	VU	Lowland forest
Philippine Eagle-owl *Bubo philippensis*	E	VU	Lowland forest
Whitehead's Swiftlet *Collocalia whiteheadi*	RR	DD	Montane forest
Philippine Needletail *Mearnsia picina*	RR	NT	Lowland forest
Silvery Kingfisher *Alcedo argentata*	RR	VU	Lowland forest
Philippine Kingfisher *Ceyx melanurus*	E	VU	Lowland forest
Rufous-lored Kingfisher *Todirhamphus winchelli*	E	VU	Lowland forest
Blue-capped Kingfisher *Actenoides hombroni*	RR	VU	Montane forest
Samar Hornbill *Penelopides samarensis*	RR	LC	Lowland forest
Mindanao Hornbill *Penelopides affinis*	RR	LC	Lowland forest
Writhed Hornbill *Aceros leucocephalus*	RR	NT	Lowland forest
Wattled Broadbill *Eurylaimus steerii*	RR	VU	Lowland forest
Visayan Broadbill *Eurylaimus samarensis*	RR	VU	Lowland forest
Azure-breasted Pitta *Pitta steerii*	RR	VU	Lowland forest
McGregor's Cuckoo-shrike *Coracina mcgregori*	RR	NT	Montane forest
Zamboanga Bulbul *Ixos rufigularis*	RR	NT	Forest
Yellowish Bulbul *Ixos everetti*	RR	LC	Lowland forest
Philippine Leafbird *Chloropsis flavipennis*	RR	VU	Lowland forest
Mountain Shrike *Lanius validirostris*	RR	NT	Montane forest
Bagobo Babbler *Trichastoma woodi*	RR	LC	Montane forest
Striated Wren-babbler *Ptilocichla mindanensis*	RR	LC	Lowland forest
Pygmy Babbler *Stachyris plateni*	RR	NT	Lowland forest
Rusty-crowned Babbler *Stachyris capitalis*	RR	LC	Lowland forest
Miniature Tit-babbler *Micromacronus leytensis*	RR	DD	Forest
Long-tailed Bush-warbler *Bradypterus caudatus*	RR	LC	Montane forest
Streaked Reed-warbler *Acrocephalus sorghophilus*		VU	Wetlands
Rufous-headed Tailorbird *Orthotomus heterolaemus*	RR	LC	Montane forest
Yellow-breasted Tailorbird *Orthotomus samarensis*	RR	NT	Lowland forest
Black-headed Tailorbird *Orthotomus nigriceps*	RR	LC	Lowland forest
White-eared Tailorbird *Orthotomus cinereiceps*	RR	LC	Lowland forest
Slaty-backed Jungle-flycatcher *Rhinomyias goodfellowi*	RR	NT	Montane forest
Ashy-breasted Flycatcher *Muscicapa randi*	RR	VU	Lowland forest
Little Slaty Flycatcher *Ficedula basilanica*	RR	VU	Lowland forest
Cryptic Flycatcher *Ficedula crypta*	RR	LC	Forest
Short-crested Monarch *Hypothymis helenae*	RR	NT	Lowland forest
Celestial Monarch *Hypothymis coelestis*	RR	VU	Lowland forest
Black-and-cinnamon Fantail *Rhipidura nigrocinnamomea*	RR	LC	Montane forest
White-fronted Tit *Parus semilarvatus*	RR	NT	Lowland forest
Whiskered Flowerpecker *Dicaeum proprium*	RR	NT	Montane forest
Olive-capped Flowerpecker *Dicaeum nigrilore*	RR	LC	Montane forest
Flame-crowned Flowerpecker *Dicaeum anthonyi*	RR	NT	Montane forest
Grey-hooded Sunbird *Aethopyga primigenius*	RR	NT	Montane forest
Apo Sunbird *Aethopyga boltoni*	RR	NT	Montane forest
Lina's Sunbird *Aethopyga linaraborae*	RR	NT	Montane forest
Black-masked White-eye *Lophozosterops goodfellowi*	RR	LC	Montane forest
Cinnamon Ibon *Hypocryptadius cinnamomeus*	RR	LC	Montane forest
Mountain Serin *Serinus estherae*	RR	LC	Montane forest
White-cheeked Bullfinch *Pyrrhula leucogenis*	RR	LC	Montane forest
Red-eared Parrotfinch *Erythrura coloria*	RR	NT	Montane forest
Apo Myna *Basilornis miranda*	RR	NT	Montane forest

Key: see the table for EBA 150: Mindoro.

Key points

- Fifty-two restricted-range species occur in this EBA, of which 39 are confined to it, 12 are globally threatened and three are Data Deficient. An additional 12 threatened species also occur there.
- The Mindanao and Eastern Visayas EBAs have distinct lowland and montane avifaunas, with 27 of the threatened and restricted-range birds confined to lowland forest, and 24 confined to montane forest.
- The lowland forests are under great pressure and are being rapidly lost, and many of the endemic lowland forest birds are threatened.
- The montane forests are relatively secure, and few of the endemic montane forest birds are threatened.
- Some of the restricted-range species are confined to particular parts of the EBA, notably Samar Hornbill, Visayan Broadbill and Yellow-breasted Tailorbird, which are found only on Samar, Leyte and Bohol, and Zamboanga Bulbul, which is mainly confined to the Zamboanga peninsula in western Mindanao.

Priority IBAs

- Several of the large protected areas on Mindanao formerly included substantial areas of lowland forest, but have now lost most of this habitat type, notably: Mt Kitanglad; Mt Apo; and Mt Malindang.
- Several IBAs contain large areas of montane forest which are likely to support populations of most of the montane threatened and endemic birds of the Mindanao and Eastern Visayas EBA: Mt Hilong-hilong; Mt Puting Bato-Kampalili-Mayo complex; Mt Kaluayan-Mt Kinabalian complex; Mt Kitanglad; Kalatungan Mountains; Mt Piagayungan; Mt Apo; Mt Matutum; Mt Busa-Kiamba; and Mt Malindang.
- Many IBAs on Samar, Leyte and Mindanao support important populations of Philippine Eagle, and together form networks of sites which are essential for the survival of the remaining populations of this Critically Endangered species.
- Particularly poorly known IBAs, where surveys are required to establish the extent and quality of the remaining forests and the current status of the birds and other biodiversity are: Mt Yacgun-Mt Sohoton complex; Bulosao River Watershed Forest Reserve; Mt Nacolod; Mt Balatukan; Mt Kaluayan-Mt Kinabalian complex; Mt Tago Range; Kalatungan Mountains; Butig Mountains; Liguasan Marsh; Mt Daguma; Mt Timolan; and Lituban-Quipit Watersheds.
- In this case, looking at Priority IBAs, including MKRNP and MANP which are in the same biogeographic region, helps in validating the additionality of having two sites.

Transect layout

The site level figures that follow show transects and sampling points that were surveyed for each B+WISER site.

Northern Sierra Madre Natural Park (NSMNP)

The ecological assessment for NSMNP was conducted in Dicaruyan, Ilagan and Sapinit from February to May 2014. Eighteen transects, measuring 34.5 km, were surveyed that span an elevation range from 38 meters above sea level (masl) to 732 masl.

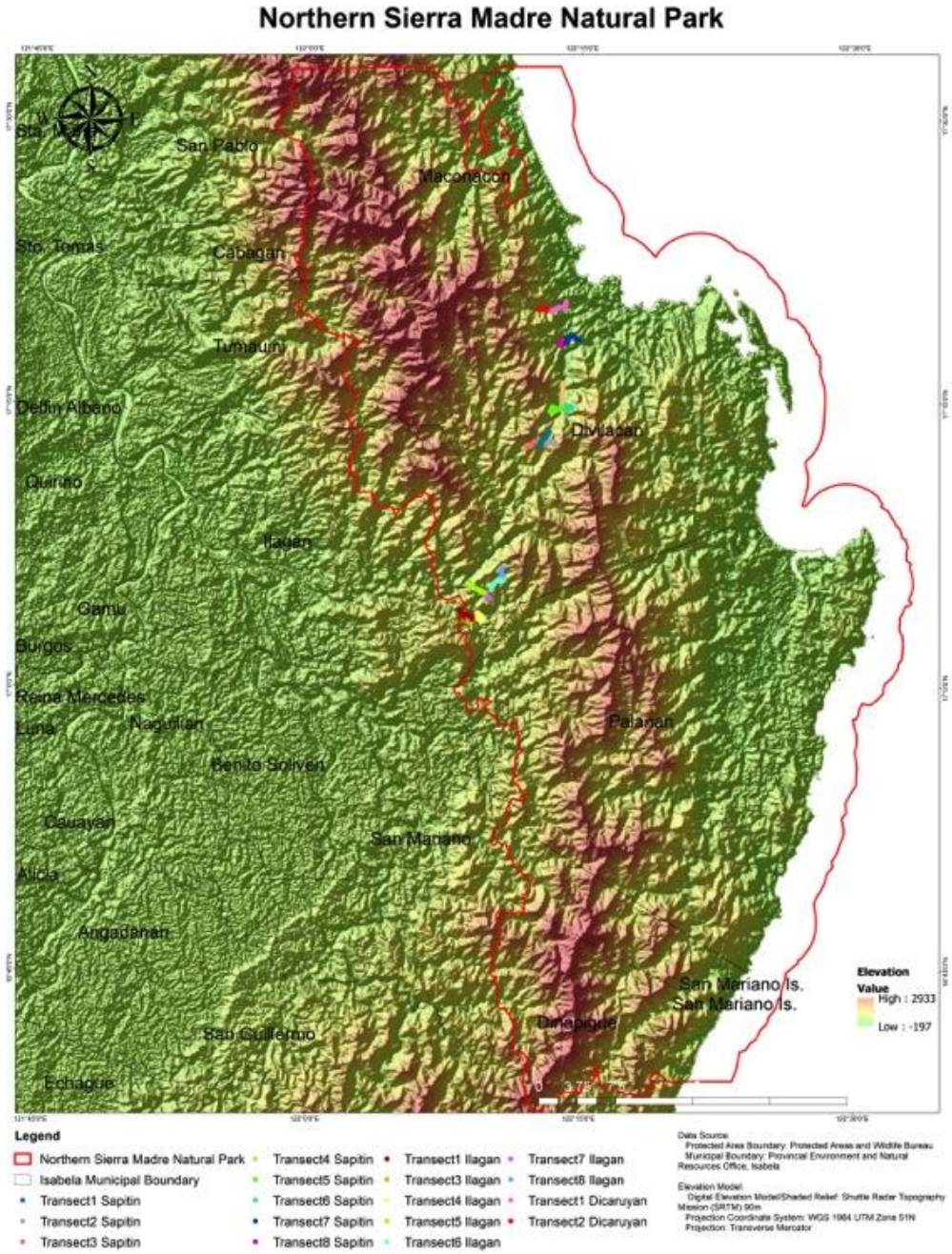

Figure 1. Transects surveyed in Northern Sierra Madre Natural Park.

Kaliwa Watershed Forest Reserve (KWFR) and Upper Marikina River Basin Protected Landscape (UMRBPL)

The ecological assessment was conducted in Ipo Dam, a proxy site for the UMRBPL-KWFR. This was the consequence of insurgency problems and issues regarding the certificate of precondition in the actual B+WISER site. Six transect lines were established and surveyed in Ipo Dam, Norzagaray, Bulacan in April 21-28 and July 24-August 5, 2014.

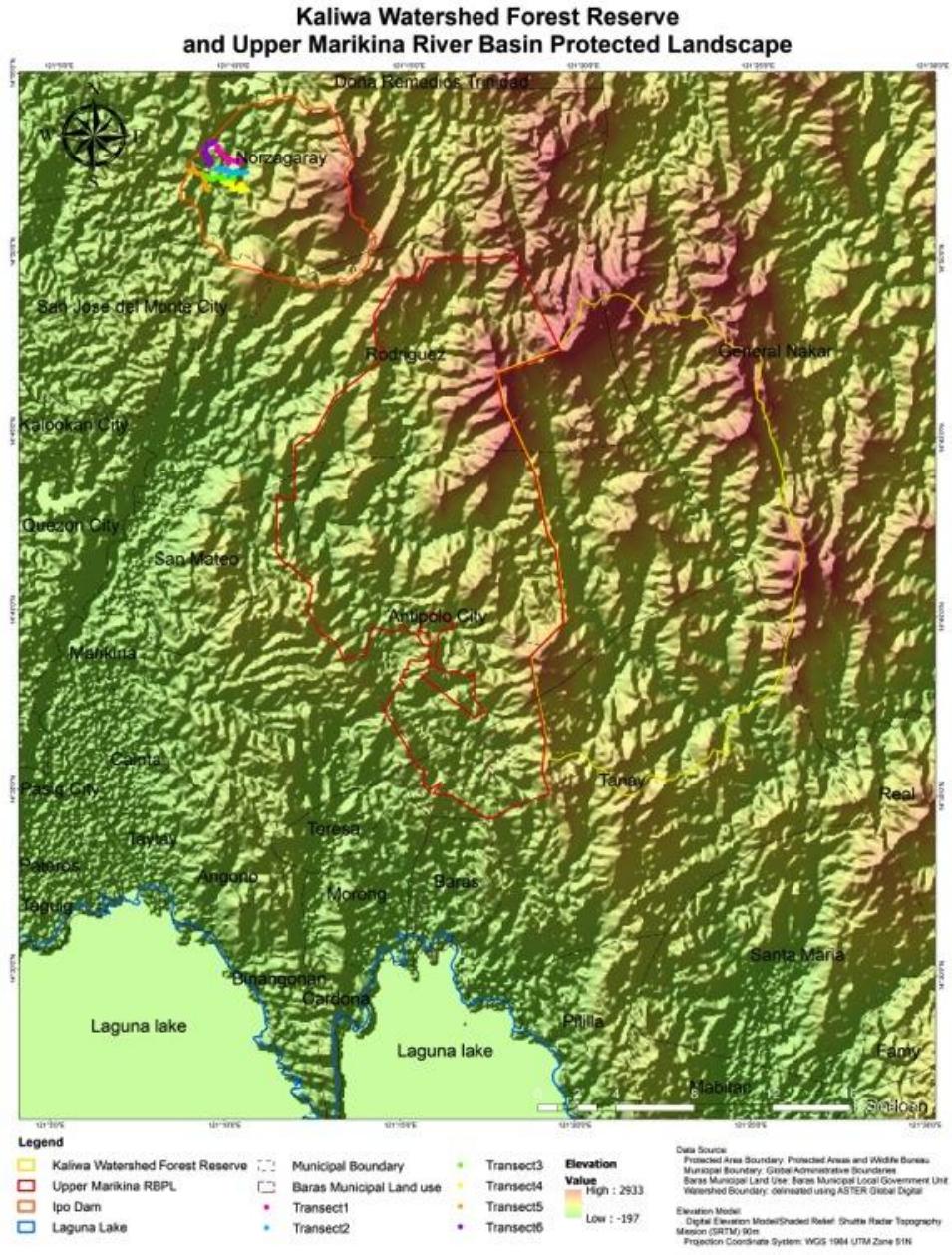

Figure 2. Transects surveyed in Ipo Dam, Norzagary, Bulacan and boundaries for Kaliwa Forest Watershed Reserve and Upper Marikina Basin Protected Landscape.

Bago River Watershed, Mt Kanlaon Natural Park (MKNP) and North Negros Natural Park (NNNP)

The ecological assessment for Bago Watershed, MKNP and NNNP were conducted in Brgy. Bagong Silang, Salvador Benedicto, and Brgy. Mailum, Bago City between September and October 2014. A total of 14 transects were sampled, of which seven were established per locality.

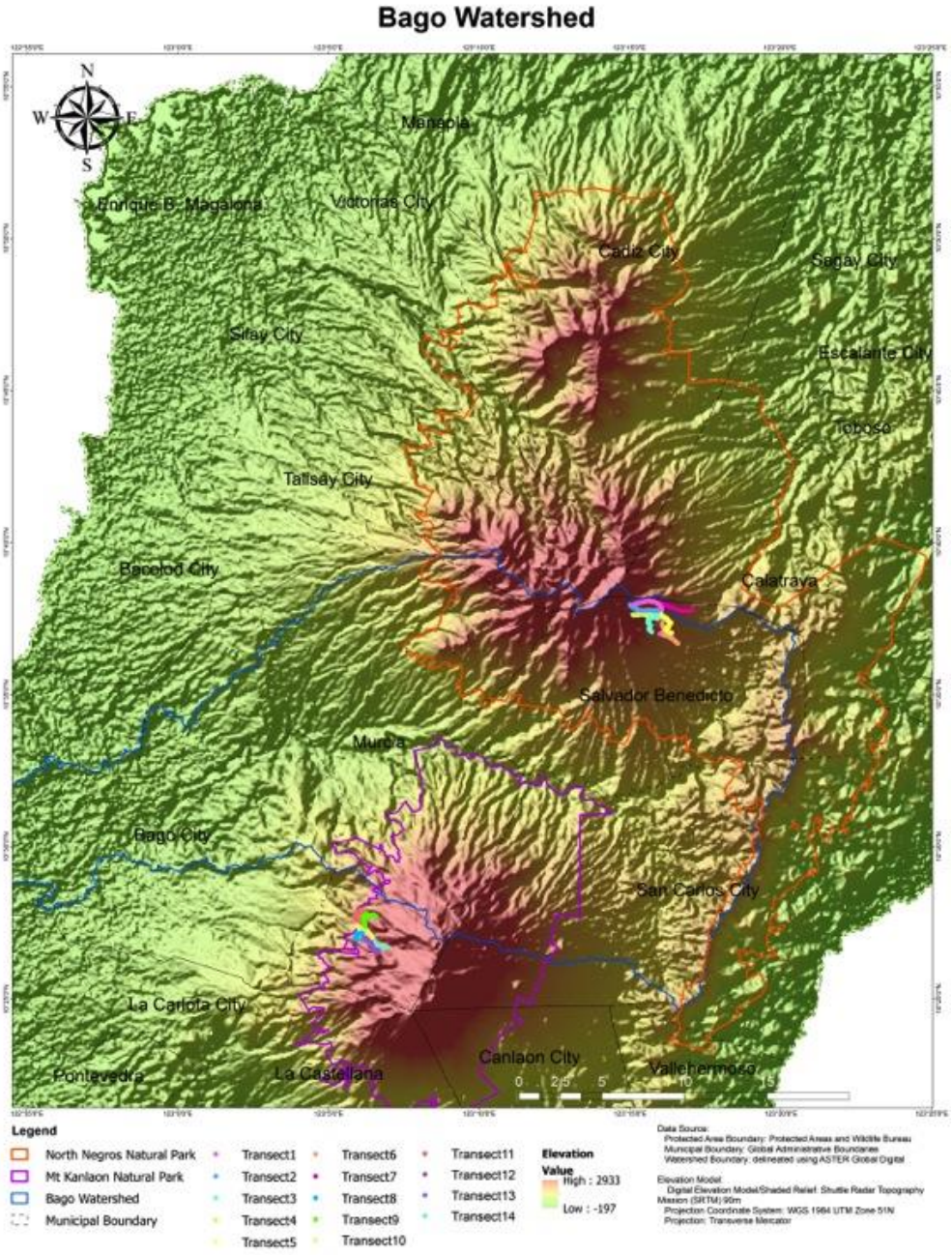

Figure 3. Transects surveyed in Bago River Watershed Forest Reserve.

Mt. Kitanglad Range Natural Park (MKRNP)

For MKRNP, the ecological assessment was conducted in Barangay Kaatuan (January 22 – February 14 and October 27 – 30), Barangay Lupiagan (February 21 – March 19), Barangay Lacolac (October 20 – 23, and Barangay Ondingan (October 24 – 25) – all in 2014. A total of 24 transects were established. Twelve were surveyed in Kaatuan, eight in Luipiagan, three in Lacolac and one transect in Ondingan.

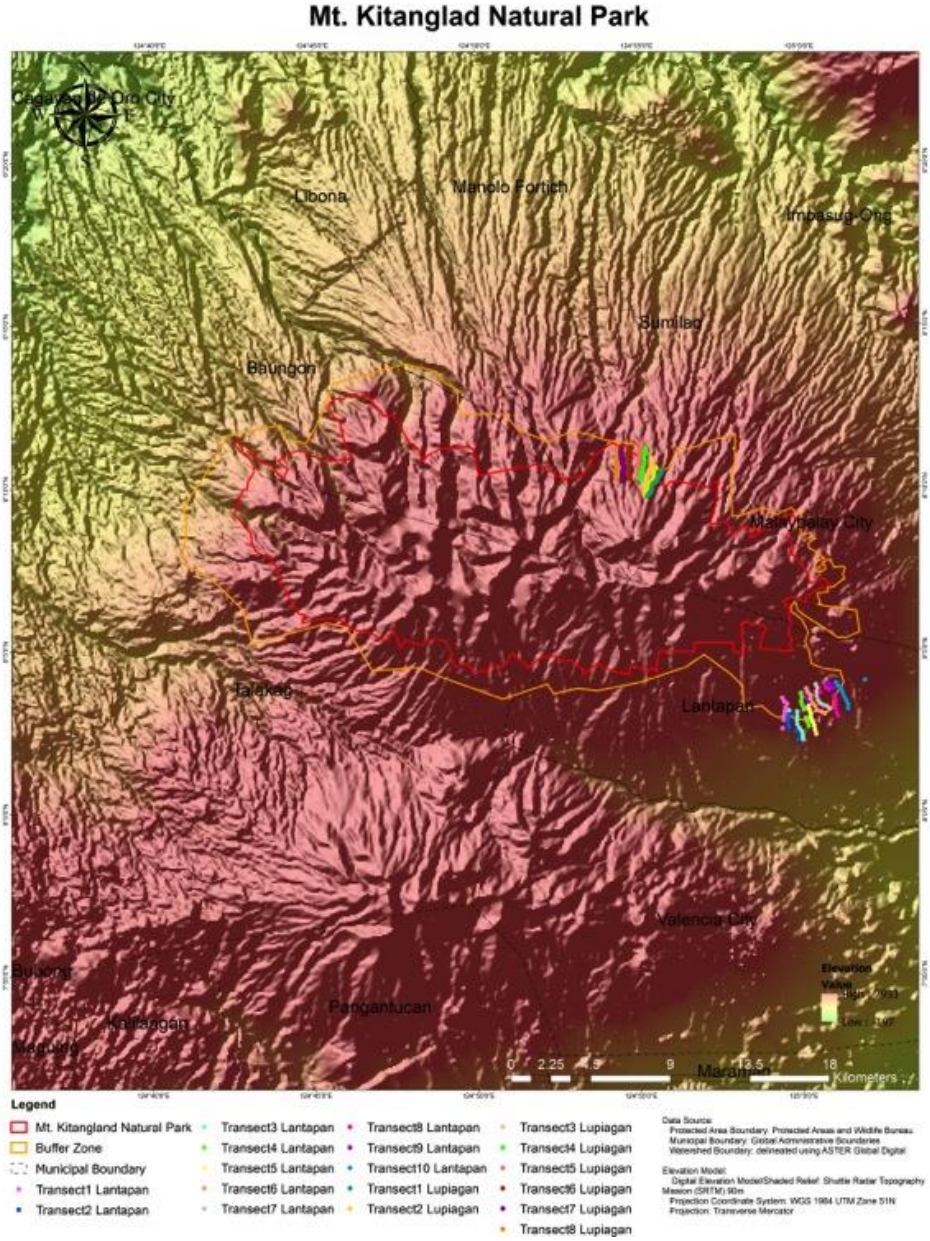

Figure 4. Transects surveyed in Mt. Kitanglad Range Natural Park.

Mt. Apo Natural Park (MANP)

The ecological assessment for Mt. Apo Natural Park was moved from January to June 2014 because of issues pertaining to procurement of permits from NCIP. After several deliberations, the field survey was finally conducted in Sibulan, Toril, Davao City from June to July 2014. Eight transects were surveyed in this area. Another site to be surveyed within MKRNP (as proxy for the stratum respesentative of old growth forest for MANP) was arranged but because of delays in permit processing, the ecological assessment for the second site was not conducted. As of press time, NCIP is still processing the permit application to allow suveys to commence in the area.

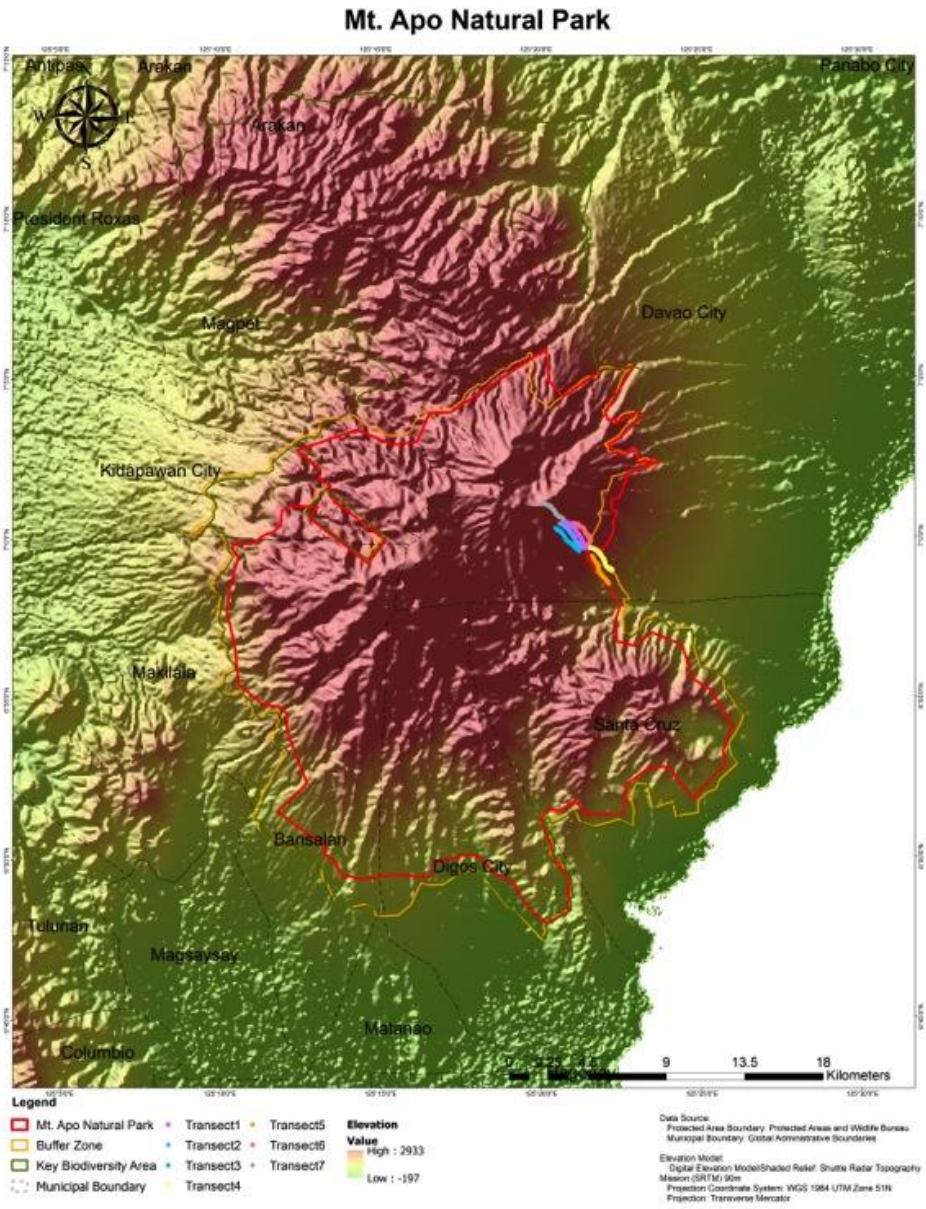

Figure 5. Transects surveyed in Mt. Apo Natural Park.

2.2. FIELD SURVEY PROPER

Vegetation/Habitat Assessment (Tier 1)

Habitat assessment was conducted in three phases: (i) the Broad Habitat Classification, (ii) the Detailed Habitat Assessment, and (iii) Tree Diversity and Stand Composition.

Broad Habitat Classification

Broad habitat types (cultivation, early second growth, advanced second growth, old growth dipterocarp, and old growth mossy forest) were identified for every point station and transect section. **Table 5** gives a description of these habitat types as adapted from Mallari et al. (2011):

Table 5. Description of the different habitat types adapted from Mallari et al. (2011)

Habitat types	Description
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) -	Divided in two categories, namely mixed-dipterocarp forest and mossy forest. a. *Mixed Dipterocarp forest (OGD)* - Members of the family Dipterocarpacea dominate this forest type in terms of biomass and emergents. This also includes the five recognised subtypes, namely: *Lauan forest, Lauan-apitong forest, Yakal-lauan forest, Lauan-hagakhak, and Montane forest* (Razal *et.al.* 2003). Extent of the area is not limited to the lower and upper altitudinal limit of the dipterocarp forest but also includes primary forest or forests >40 years old which are dominated by large to very large trees and have a less complex understorey compared to ESG and ASG. b. *Mossy forest (OGM)* - consists of dwarfed and stunted trees with trunks and branches commonly covered with epiphytes (mosses and liverworts) and occur in high elevation areas (usually above 1000 m elevation with the upper limits varying depending on the locality and height of the mountains) having relatively low temperature, high and uniform humidity, short sunshine duration, and strong winds (Razal *et.al.*2003).

Detailed Habitat Assessment

Habitat variables were recorded at every point station using the variable circular plot method and modified point-center quarter method, which is nested within a 10-meter, and 20-meter radius. The variable circular plot was placed perpendicular to the main transect and subdivided into four quarters (NW, NE, SE and SW). **Table 6** summarizes the physical and structural habitat parameters sampled:

Table 6. Summary list of sampled habitat parameters sampled in every point station with its corresponding coverage.

Habitat parameters	Coverage
a. General Habitat (Forest threat parameters) • Presence of dead wood and fallen trees >30 cm dbh (natural and cut), • Presence of fruiting trees and flowering trees. • Percentage cover of canopy, midstorey, and understorey. • Humus or leaf litter thickness • Signs of anthropogenic disturbances occurring in the plot.	20 m
b. Understorey Parameters* • Percentage ground cover of moss, ferns, grass, herbs, rock, leaf litter and ground (bare soil) • Number of saplings, palms, and pandan per strata • Number of clumps of rattan and bamboo per strata	20 m
c. Overstorey Parameters** • Tree species name • Tree height, merchantable height, canopy height, crown cover and diameter (DBH) • Presence of scarring, lianas and climbing bamboo in each measured tree	10 m
d. Biophysical parameters • Distance of water (<100 m) from the center point of the plot • Distance from the forest edge, valley bottom, and the ridge tops • Position and altitude of the point station using a global positioning system (GPS) receiver	

Note:
*The parameters were measured vertically in each quadrat within the range of 0-0.5m, 0.5-2m, 2-5m and 5-12m
** Five nearest trees in each quarter with greater than 25 cm diameter at breast height (DBH) were measured in this parameter. The distance from the center point of the plot to the nearest tree was at least 0.1meter.

Tree Diversity and Stand Composition

The numbers of trees within the given radius and DBH range including its species name were also recorded. Trees 25-50cm, 50-100 cm, and above 100 cm DBH were tallied within a 20-meter radius while 6-12 cm and 12-25 cm DBH were recorded within 10-m radius.

Faunal Assessment (Tier 1)

Avifauna

Bird samplings were conducted at dawn when bird activity is highest (Loiselle & Blake 1991). A combination of the Variable Transect Width Method (transect walk) and the Variable Circular Width Method (point count) were employed on the main biodiversity transect lines sampled for this survey. During favourable weather conditions all birds that were observed visually or aurally were recorded at a transect walk speed of 1 km/hr. The perpendicular distances from the bird(s) to the transect line were also recorded. Point counts were done by recording all birds observed for eight minutes at every point station and measuring the distance from the sample to the point station. Additional parameters were noted which includes: number of birds in a group, type of contact, height from where the sample was first encountered, and its activity. The bird samplings were repeated on a different day in the reverse direction to minimise bias due to route direction (Karr 1981), bird activity, and the time of day.

Mammals

Survey technique using mist nets and cage traps were used in determining the species occurrence of mammals. Additional ethno-survey amongst local people and indirect evidences of species presence such as feces/scats, footprints, bite marks, and other indicators. The survey focused on Volant (bats) Non-Volant (rodents) mammals.

In capturing Volant (flying) ammals, mist nets measuring 6-m and 12-m were used. These mist nets were set along natural flyways and laid at varying points within the designated main transect line. The nets were left open for two consecutive nights per transect. Nets were left open daily from dusk (between five and six o'clock, depending on the time of year) until nine o'clock in the evening. Nets were checked and trapped animals were removed and kept for identification and biometrics every 30 minutes or more frequent. The nets were kept closed in days when weather was bad to: (i) avoid possible capture of non-target species such as nocturnal birds; (ii) to prevent excessive entanglement in the nets that may result to eventual death of specimen/s; and (iii) to avoid possible escape of trapped specimen.

To capture non-volant mammals (rodents), live traps baited with roasted coconut coated with peanut butter (in combination with dried fish in some occasions) were used. A minimum of three trap lines, spread across the two-kilometer transect were laid per transect line. Each trap line is composed of at least eight live traps that were set in strategic areas (i.e. tree stumps, natural pathways, dead logs, etc.), where target species are more likely to be observed or encountered. Traps were set 5–10 m apart within the trap line, noting the distance of each of the traps from the nearest transect section of the main transect line. Baiting and re-baiting of traps were done twice 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.

Other pertinent data per transect that were recorded include the following:

i. Specific coordinates of each of the established net line and trap line (whenever possible);
ii. Distance of the trap (mist net or live trap) from the main transect line and/or body of water;
iii. Photograph of species caught from the mist net or live trap; and
iv. Presence or absence of fruiting tree/s and cave/s in the area.

Amphibians and Reptiles

A combination of methods was used to sample reptiles and amphibians. The herpetofauna surveys were performed in the 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. Methods used for the survey are as follows:

- *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 and sampling across a gradient of habitat types and elevation.
- *Plot sampling.* Plots measuring 100m x 10m representing different vegetation strata, were randomly surveyed for species richness and density of reptiles and amphibians. Data generated from this sampling technique can be used later to monitor the herpetofauna in the area.

- *Microhabitat sampling.* Specific microhabitats were searched intensively for any occupying reptile or amphibian species. Sampling was conducted within 5 to 30 minutes in areas where the herpetofauna are 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).

2.3. Determination of Key Drivers of Deforestation and Degradation

Threats that were observed at the transect level in the project site were recorded by the team. It is envisaged that these threats are validated and triangulated by the results of the other teams, i.e., the socioeconomic, governance, and field management teams. Photos for documentation were also taken, some of which are presented on page 107.

2.4. Data Processing and Analysis

Species-habitat Ordination analysis (Tier 2)

To show the relationships between species and their environment, an ordination technique called the Canonical Correspondence Analysis (CCA) was used (ter Braak, 1986; Braak, 1987). CCA is a multivariate analytic method that determines the association of two sets of variables: (1) the dependent matrix, which refers to the species to be ordinated, and (2) the environmental matrix, which are measurable ecological parameters that describe environmental conditions. This results into a final ordination diagram where species and environmental data are incorporated.

- NSMNP: 35 species and 23 environmental variables for birds, and 36 species and 24 variables for flora. Only species with >5 observations were included in the analysis (Appendix 7.3.1.1).
- Kaliwa and UMRBPL: Thirty-seven species of birds; 23 species of trees; 16 mammals and 16 species of herpetofauna were used in the CCA (Appendix 7.3.1.2).
- Bago: Flora: 26 species and 21 environmental variables; birds: 34 species and 19 habitat variables; amphibians: 11 species and 23 environmental variables; reptiles: 12 species and 30 environmental variable; and mammals: 13 species and 18 environmental variables. Only species with >5 observations were included in the analysis (Appendix 7.3.1.3).
- MKRNP: 40 species and 23 environmental variables for birds, 13 bats and 25 environmental variables, 21 species of reptiles and 17 environmental variables, and 22 species and 18 habitat covariates for amphibians were used. A total of 46 species and 15 habitat covariates were used for CCA of flora (Appendix 7.3.1.4)
- MANP: 40 species and 23 environmental variables for birds, 13 bats and 25 environmental variables, 21 species of reptiles and 17 environmental variables, and 22 species and 18 habitat covariates for amphibians were used. A total of 46 species and 15 habitat covariates were used for CCA of flora (Appendix 7.3.1.5).
- CCA was performed in R v.3.1.1 using the vegan 2.0 package (Oksanen et al. 2007).

Species Occupancy Modeling (Tier 3)

Determination of species space requirement or the proportion of area occupied by the species (ψ) was done using PRESENCE v.3.1 (Hines 2006). The contribution of a particular environmental factor (ω) on species occupancy was determined using the Akaike Information Criterion (AIC) cumulative model weight. Environmental variable used in the analysis were as follows:

- NSMNP: The modeling was performed on six species of bats, 20 bird species, 25 tree species and 25 amphibians and reptiles.
- Kaliwa and UMRBPL: The modeling was performed on 15 species of bats, 15 birds, 13 trees and 14 amphibians and reptiles.
- Bago: The modeling was performed for 12 species of trees, 31 birds, 11 amphibians, 13 reptiles, and 12 bats.
- MKRNP: The modeling was performed for 9 species of trees, 18 species of birds, 15 amphibians, 11 reptiles and 12 bats. MANP: The modeling was performed for 18 species of birds, 15 amphibians, 11 reptiles and 12 bats.

Estimating Populations of Key species (Tier 3)

Estimation of population of key species was done only for the NSMNP site because it has the most robust set of data. The criterion for selection for analysis is that there must be at least 30 unique encounters per species. Twenty-three species of birds were analyzed. The other sites have low encounter rates partially due to the fact that the assessments were done during rainy season.

- Species population density was estimated using the distance sampling technique (Buckland 1993; Buckland et al. 2004). Point count data, species radial distance and area of habitats were used to perform the analysis.
- Program Distance v.6.0. (Thomas et al. 2010) was used. Half-normal key function was used and the best model fit was chosen based on lowest AIC score.
- Post-stratification was performed to determine the variation of population density across different habitat types.
- The result of the analysis is presented in a table showing the estimated population density of each species on each habitat type.

Species Distribution Modeling (Tier 4)

Species distribution models were produced using the Maximum Entropy Algorithm (MAXENT) v.3.3.3.k. (Phillips et al. 2006).

- NSMNP: Four species of bats, 51 birds, 26 trees and 10 reptiles and amphibians. Species with <5 occurrences were not included in the analysis.
- Kaliwa and UMRBPL: Only species of birds were used. The other taxa were not included in the analysis since they have species with <5 occurrences.
- NLNP: Twelve birds and 10 herpetofauna while 15 environmental variables were used.
- Bago: Five species of flora, 31 birds, 12 reptiles and amphibians, and seven mammals were used to run the analysis. Species with <5 occurrences were not included in the analysis. Five environmental variables (per taxa) were used as predictors. Elevation and climate datasets were obtained from WorldClim (Hijmans et al. 2005), land cover 2009

from European Space Agency (ESA; Bontemps et al. 2010) and soil from Harmonized World Soil Database (HWSD; Nachtergaele et al. 2009).

- MKRNP: Twelve birds and 10 species of trees were used. Species with <5 occurrences were not included in the analysis. Fifteen environmental variables comprising of temperature, precipitation, elevation and land cover were used. Elevation and climate datasets were obtained from WorldClim (Hijmans et al. 2005), land cover 2009 from European Space Agency (ESA; Bontemps et al. 2010) and soil from Harmonized World Soil Database (HWSD; Nachtergaele et al. 2009).
- MANP: Twenty-four environmental variables comprising of temperature, precipitation, elevation and land cover were used. Elevation and climate datasets were obtained from WorldClim (Hijmans et al. 2005), land cover 2009 from European Space Agency (ESA; Bontemps et al. 2010) and soil from Harmonized World Soil Database (HWSD; Nachtergaele et al. 2009).
- Species distribution models were presented as maps (Sec 3.4).

2.5. SPECIES AND SITE DIAGNOSIS

Determining Species survival envelopes (Tier 2)

The results of the CCA were presented in an ordination diagram where the points represent the species and the vectors indicate the environmental variables. Clustering of points indicate the relationship of the species and the environmental variables (Appendix 7.3). Niche width and niche position was presented using a boxplot. Species niche width and niche position indicates the habitat preference and tolerance of the species. These were determined using the CCA site scores for all taxa used (Appendix 7.3). The results from the boxplot were tabularized to easily show the habitat preference or the tolerance of a species to various habitat alterations (see section 3.2 Results of Ordination).

Analysis of congruence of the various Species Distribution Models (Tier 4)

- Key species to model were selected based on several factors such as conservation status, extent of occurrence, surrogate or proxy species and number of available records.
- All model output were collated and transformed into binary maps (0-absence; 1-presence).
- Using GIS, all rasters were added to produce another raster grid, which contains the richness or overlaps of the species. The maximum number of overlaps must be the total number of key species modeled.
- Areas with high value for conservation were then determined through the output maps of areas with high number of species overlaps.

Identifying hotspots of land use changes via change detection analysis (Tier 4)

- Prior to identifying the hotspots for the different B+WISER sites, historical forest cover change analysis was conducted using NAMRIA 2003 and 2010 land cover maps in each of the sites. Land area figures of forest changes were computed using ArcGIS v.10. Areas showing forest loss or change from forest in 2003 to non-forest in 2010 were identified as hotspots. The forest change areas were overlaid with results of Maxent species distribution models to show pressures (forest loss) vis-a-vis high species richness areas in each of the sites.

2.6. SURVEY EFFORT

The total survey effort for each site is tabulated below by site (Tables 7-12). This includes the total transect length and sampling points that were surveyed throughout the sites. This also includes the total number of trap nights and net nights for mammals, and net hours surveyed for birds. Overall, the survey effort for all sites is as follows:

Table 7. Overall survey effort for all sites.

Assessment Group	Total Survey Effort
Habitat & Flora	141.5 km (700 stations)
Avifaunal	264.5 km (1404 stations)
Mammals	2446 net nights (volant mammals) 3204 trap nights (non-volant mammals)
Amphibians & Reptiles	232 km (1192 stations)

Table 8. Survey effort for NSMNP

Assessment Group	Total Survey Effort
Habitat & Flora	34.5 km (154 stations)
Avifaunal	68.5 km (304 stations)
Mammals	496 net nights (volant mammals) 1054 trap nights (non-volant mammals)
Amphibians & Reptiles	102 km (472 stations)

Table 9. Survey effort for Kaliwa and UMRBPL

Assessment Group	Total Survey Effort
Habitat and Flora	19 km transect 86 point station
Avifaunal	20 km transect 180 sampling points
Mammals	10km transect 320 net nights (volant mammals)
Amphibians & Reptiles	72 sampling points

The ecological assessment was not conducted in NLNP because the permits needed to conduct the field survey were not issued on time. Nonetheless, ecological modeling was done from data collected from Philippine National Museum, California Academy of Sciences, Field Museum of Natural History, and Kansas University.

Table 10. Survey effort for BRWFR

Assessment Group	Total Survey Effort
Habitat and Flora	26 km transect 118 point stations
Avifaunal	52 km transect 236 point stations
Mammals	250 net nights (volant mammals) 360 trap nights (non-volant mammals)
Amphibians & Reptiles	10 km transect 90 point stations

Table 11. Survey effort for MKRNP

Assessment Group	Total Survey Effort
Habitat and Trees	48-km transect
	216 survey points
Birds	96-km transect
	432 survey points
	9700 net hours
Mammas	96-km transect
	432 survey points
	1200 net nights (volant mammals)
	1120 trap nights (non-volant mamals)
Amphibians and Reptiles	96-km transect
	432 survey points

Table 12. Survey effort for MANP

Assessment Group	Total Survey Effort
Habitat and Trees	14 km transect
	126 survey points
Avifauna	28 km transect
	252 survey points
	3500 net hours
Mammals	14 km transect
	126 survey points
	490 trap nights (non-volant mammals)
	350 net nights (volant mammals)
Amphibians and Reptiles	14 km transect
	126 survey points

III. RESULTS AND DISCUSSION

3.1. Species Richness, Endemism and IUCN Threat Status

In this section the results of the species (=biodiversity) inventories (see Tier 1 in section 1.2) across the sites are presented, with focus on the measures of species richness (number of species), endemism and their IUCN status. Notable species records per site are highlighted. The results of this Tier 1 analysis will then feed into the Tier 2 and Tier 3 analyses in the succeeding sections.

NSMNP

A total of 265 species of flora and fauna were recorded in NSMNP. Among the faunal species, birds were the most numerous with 121 species observed, including the migratory Pale Thrush (*Turdus pallidus*). This is followed by amphibians and reptiles with 19 species recorded for each taxon, including the Crab-eating frog (*Fejervarya cancrivora*) and the Emerald flying frog (*Rhacophorus pardalis*), which are new records for the park. Seventeen mammals were also recorded and 89 species trees were observed. Table 13 below summarizes the number of endemic and threatened species in NSMNP. For the total list of species recorded during the survey, see Appendix 7.1.1.

Table 13. Summary of endemicity and the threatened status (according to the 2014 IUCN Red List) of species surveyed in NSMNP.

Taxa	Philippine Endemic	Non Endemic	Threatened			Total
			CR	EN	VU	
Flora (trees)	8 (9%)	81 (91%)	10 (11%)	3 (3%)	18 (20%)	89
Birds	56 (46.3%)	65 (53.7%)	0 (0%)	0 (0%)	5 (4%)	121
Mammals	8 (47%)	9 (53%)	0 (0%)	0 (0%)	2 (12%)	17
Amphibians	13 (68%)	6 (32%)	0 (0%)	2 (11%)	3 (16%)	19
Reptiles	15 (79%)	4 (21%)	0 (0%)	0 (0%)	2 (11%)	19

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon.

Plants (Trees)

Key Findings:

- A total of 89 species of plants were recorded, 9% of which are endemic to the Philippines. Ten critically endangered species were observed and these include Dipterocarpus grandiflorus, Pterocarpus indicus and three species of Shorea (S. astylosa, S. guiso, and S. palosapis).

Birds

Key Findings:

- A total of 121 species of birds were recorded, 56 or 46.3% of which is endemic to the Philippines. Five vulnerable species were observed, these are the Green Racquet-tail (Prioniturus luconensis), Ashy Ground-Thrush (Zoothera cinerea), Black-bibbed Cuckoo-Shrike (Coracina mindanensis), Philippine Dwarf-Kingfisher (Ceyx melanurus), and North Philippine Hawk-Eagle (Nisaetus philippensis).
- The migratory Pale Thrush (Turdus pallidus) is a new record for the park.

Mammals

Key Findings:

- There were 17 species (12 volant, five non-volant) of mammals observed. Two are vulnerable and endemic species, the Philippine warty pig and Philippine brown deer, which are also the more commonly hunted species in the area. Eight species are endemic to the Philippines; these include the Mottle-winged Flying Fox (Desmalopex leucopterus), Philippine dawn bat (Eonycteris robusta), Fischer's pygmy fruit bat (Haplonycteris fischeri), and the Philippine forest rat (Rattus everetti).

Reptiles and Amphibians

Key Findings:

- Nineteen amphibians and 19 reptiles were identified.
- Seven species are threatened, including the Kalinga Narrowmouth Toad (Kaloula kalingensis), Mcnamara's Burrowing Snake (Pseudorhabdion cf mcnamerae) and three species of Platymantis (P. cagayanensis, P. pygmaeus, and P. taylori).
- The Crab-eating frog (Fejervarya cancrivora) and the Emerald flying frog (Rhacophorus pardalis) are new species records for NSMNP
- Philippine endemics include 13 amphibians and 15 reptiles
- Some species of amphibians (n=3) and reptiles (n=4) are in the process of taxonomic verification.

KWFR and UMRBPL

A total of 154 floral and faunal species were recorded in the proxy site during the conduct of the survey, of which 16 are endemic to the Luzon Island (Table 14). Six species observed were Vulnerable, most of which are trees, while 10 species were classified as Near Threatened (Table 15). For a more detailed list of species, see Appendix 7.1.2.

Table 14. Summary of endemicity of the species surveyed in UMRBPL-KWFR.

Taxa	Philippine endemic	Luzon endemic	Total
Flora (trees)	6 (30%)	0 (0 %)	20
Birds	47 (51%)	9 (10%)	93
Mammals	3 (21%)	0 (0%)	14
Amphibians	6 (50%)	4 (33%)	12
Reptiles	7 (47%)	3 (20%)	15
TOTAL	69 (45%)	16 (10%)	154

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon.

Table 15. Summary of the threatened status of species surveyed in UMRBPL-KWFR according to the 2014 IUCN Red List.

Taxa	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)	Least Concern (LC)	Not Assessed (NA)	Data Deficient	Total
Flora (trees)	0 (0%)	0 (0%)	5 (26%)	0 (0%)	0 (0%)	14 (74%)	0 (0%)	19
Birds	0 (0%)	0 (0%)	1 (1%)	6 (7%)	83 (91%)	0 (0%)	1 (1%)	91
Mammals	0 (0%)	0 (0%)	0 (0%)	1 (7%)	13 (93%)	0 (0%)	0 (0%)	14
Amphibians	0 (0%)	0 (0%)	0 (0%)	3 (25%)	9 (75%)	0 (0%)	0 (0%)	12
Reptiles	0 (0%)	0 (0%)	0 (0%)	0 (0%)	7 (47%)	8 (53%)	0 (0%)	15
TOTAL	0 (0%)	0 (0%)	6 (4%)	10 (6%)	112 (73%)	26 (17%)	1 (0.01%)	154

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Plants (Trees)

Key Findings:

- A total of 20 tree species was identified. Five species were considered threatened, namely Narra (Pterocarpus indicus) (VU), Mahogany (Swietenia macrophylla) (VU), Lanutan (Mitrephora lanotan) (VU), Takip Asin (Macaranga grandifolia) (VU) and Pili (Canarium ovatum) (VU).

Birds

Key Findings:

- Ninety species of birds were recorded. Of these, 47 are Philippine endemics.
- Seven recorded species are threatened based on the IUCN Red List of Threatened Species (IUCN 2014).
- Frequently encountered species recorded were the Scale-Feathered Malkoha (Phaenicophaeus cumingi) and the Red-crested Malkoha (Phaenicophaeus superciliosus), which are unique to Luzon Island and are common in forest, forest edges and clearings (Kennedy et al. 2001)

Mammals

Key Findings:

- A total of 14 species were encountered belonging to 6 families. Seven of these are considered as frugivorous while the other half are insectivores.
- Three species are Philippine endemics namely the Greater Musky Fruit Bat (Ptenochirus jagori), Philippine Pygmy Fruit Bat (Haplonycteris fischeri) and the Philippine Nectar Bat (Eonycteris robusta).

Reptiles and Amphibians

Key Findings:

- There were 12 amphibian species recorded during the survey. Four of which are Luzon endemics.
- Three species of amphibians are Near Threatened, namely Husky-voiced Wrinkled Ground Frog (Platymantis mimulus), Luzon Fanged Frog (Limnonectes macrocephalus) and Luzon Striped Stream Frog (Hylarana similis).
- Fifteen reptile species were recorded. Three species are Luzon endemics, which include Philippine Flying Dragon (Draco spilopterus) Banded Worm Snake (Calamaria bitorques) and Red-headed Worm Snake (Malayotyphlops ruficaudus).

NLNP

Data used for NLNP ecological assessment were collected from the Philippine National Museum, California Academy of Sciences, Field Museum of Natural History and Kansas University from 1980 to 2010. A total of 36 species of birds, amphibians and reptiles were used to determine suitable habitats in the park (**Tables 16** and **17**).

Table 16. Endemicity of species on Mindoro Island.

Taxa	Philippine endemic	Mindoro endemic	Not endemic	Introduced	Migratory	Total
Birds	5 (56%)	4 (44%)	0 (0%)	0 (0%)	0 (0%)	9
Amphibians	10 (56%)	3 (17%)	4 (22%)	1 (5%)	0 (0%)	18
Reptiles	11 (48%)	1 (4%)	11 (48%)	0 (0%)	0 (0%)	23
TOTAL	**26 (52%)**	**8 (16%)**	**15 (30%)**	**1 (2%)**	**0** (0%)	**50**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Table 17. Conservation status of species recorded in Mindoro Island based on the IUCN Red List (2014).

Taxa	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)	Least Concern (LC)	Not Assessed (NA)	Data Deficient	Total
Birds	3 (33%)	2 (22%)	4 (45%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	9
Amphibians	0 (0%)	2 (12%)	3 (18%)	0 (0%)	10 (59%)	1 (6%)	1 (6%)	17
Reptiles	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (43%)	12 (52%)	1 (4%)	23
TOTAL	**3 (6%)**	**4 (8%)**	**7 (14%)**	**0** (0%)	**20 (41%)**	**13 (27%)**	**2 (4%)**	**49**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Birds

Key Findings:

- Data gathered from Vertnet revealed that five out of nine species were Philippine endemic Philippine Duck (Anas luzonica), Philippine Cockatoo (Cacatua haematuropygia), Scarlet-collared Flowerpecker (Dicaeum retrocinctum), Spotted Imperial-pigeon (Ducula carola), and Ashy Thrush (Zoothera cinerea), while four of them are island endemic Black-hooded Coucal (Centropus steerii), Mindoro Imperial-pigeon (Ducula mindorensis), Mindoro Bleeding-heart (Gallicolumba platenae), Mindoro Hornbill (Penelopides mindorensis).
- Nine were categorized as Threatened species. Three species were Critically Endangered which are Philippine Cockatoo, Black-hooded Coucal and Mindoro Bleeding-heart, two species were Endangered these are Mindoro Imperial-pigeon and Mindoro Hornbill. Philippine Duck, Scarlet-collared Flowerpecker, Spotted Imperial-pigeon and Ashy Thrush are under the category of Vulnerable.

Reptiles and Amphibians

Key Findings:

- Ten out of 21 species were Philippine endemics, the Masked wrinkled ground Frog (Platymantis corrugatus), Whistling wrinkled ground frog (Platymantis dorsalis), Mindanao flying frog (Rhacophorus bimaculatus), Philippine painted narrowmouth (Kaloula picta), Philippine grass frog (Fejervarya vittigera), Brackish Frog (Fejervarya moodiei), Palawan fanged-Frog (Limnonectes acanthi), Western mindanao dwarf toad (Pelophryne brevipes), Visayan fanged-frog (Limnonectes visayanus), and Philippine narrowmouth toad (Kaloula conjuncta), three were island endemic Mindoro striped stream frog (Hylarana mangyanum, Mindoro litter frog (Leptobrachium mangyanorum), and Mindoro bush frog (Philautus schmackeri), One introduced species Chinese tiger frog (Hoplobatrachus rugolosus) and the rest are well distributed in Southeast Asia.
- A total of five species were categorized threatened. Two species were endangered namely Mindoro striped stream frog and the Mindoro bush frog. The Palawan fanged frog, Visayan fanged frog and Mindanao flying frog were categorized as Vulnerable due to their severely fragmented distribution, and the continuing decline of their habitat.

- Eleven out of 23 species were Philippine endemic such as the Stub-limbed Burrowing Skink (Brachymeles bonitae), Gervais' Worm Snake (Calamaria gervaisi), Mindoro Narrow-disked Gecko (Gekko mindorensis), Mindoro Forest Dragon (Gonocephalus semperi), Small Broad-tailed Smooth-scaled Gecko (Lepidodactylus planicaudus), Cox's Sphenomorphus (Sphenomorphus coxi), Cuming's Sphenomorphus (Sphenomorphus cumingi), Jagor's Sphenomorphus (Sphenomorphus jagori), Steere's Sphenomorphus (Sphenomorphus steerei), Northern Triangle-spotted Snake (Cyclocorus lineatus), and (Dendrelaphis fuliginosus). One island endemic was recorded the Mindoro Short-legged Skink (Brachymeles mindorensis) and 11 were Southeast Asian species.

Bago Watershed, MKNP and NNNP

One hundred fifty-five species of terrestrial vertebrates (109 birds, 25 mammals, 10 amphibians, and 11 reptiles) and 26 species of trees were recorded (**Table 18**). Of these, 71 species are Philippine endemics and 22 are threatened species, including the Critically Endangered Philippine barebacked fruit bat (*Dobsonia chapmani*), as shown in **Table 19**. For a complete list of species observed in the forest reserve, see Appendix 7.1.4.

Table 18. Summary of endemicity and distribution of species recorded in BRWFR.

Taxa	Philippine Endemic	Negros Endemic	Resident	Introduced	Migratory	Total
Flora (trees)	6 (23%)	0 (0%)	20 (77%)	0 (0%)	0 (0%)	26
Birds	41 (38%)	0 (0%)	56 (51%)	4 (4%)	8 (7%)	109
Mammals	8 (32%)	2 (8%)	10 (40%)	5 (20%)	0 (0%)	25
Amphibians	3 (14%)	3 (14%)	4 (19%)	0 (0%)	0 (0%)	10
Reptiles	6 (55%)	2 (18%)	3 (27%)	0 (0%)	0 (0%)	11
TOTAL	**64 (35%)**	**7 (4%)**	**93 (51%)**	**9 (5%)**	**8 (4%)**	**181**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon.

Table 19. Summary of the threatened status of species surveyed in BRWFR according to the IUCN Red List (2014).

Taxa	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)	Least Concern (LC)	Not Assessed (NA)	Data Deficient (DD)	Total
Flora (trees)	4 (15%)	0 (0%)	3 (12%)	0 (0%)	1 (4%)	18 (69%)	0 (0%)	26
Birds	0 (0%)	2 (2%)	4 (4%)	1 (1%)	102 (93%)	0 (0%)	0 (0%)	109
Mammals	2 (8%)	3 (12.5%)	0 (0%)	3 (12.5%)	15 (63%)	0 (0%)	1 (4%)	24
Amphibians	0 (0%)	2 (20%)	1 (10%)	0 (0%)	6 (60%)	0 (0%)	1 (10%)	10
Reptiles	0 (0%)	1 (10%)	0 (0%)	0 (0%)	3 (30%)	0 (0%)	7 (70%)	11
TOTAL	**6 (3%)**	**8 (4%)**	**8 (4%)**	**4 (2%)**	**127 (69%)**	**21 (11%)**	**9 (5%)**	**183**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Plants (Trees)

Key Findings:

- About 388 individual trees belonging to 11 families, 12 genera, and 26 species (including 12 unidentified specimens) were recorded. Dominant species of flora belong to Family Myrtaceae and Family Dipterocarpaceae.
- Seven species are threatened (IUCN RedList 2014) which includes four (4) Critically Endangered species - Parashorea malaanonan, Shorea contortam, S. polysperma and S. negrosensis. While the remaining three (3) threatened species are considered as Vulnerable, include Macaranga bicolor, Palaquium luzoniense, and Swietenia macrophylla.
- Six species namely: Macaranga bicolor, Myristica philippinensis, Palaquium luzoniense, Shorea contorta, S. negrosensis and S. polysperma are endemic to the Philippines.

Birds

Key Findings:

- There were 109 bird species encountered. Of these, 41 (37.61%) are Philippine endemics, 4 (3.67%) are introduced species, 8 (7.34%) are migratory species and the remaining 56 (57.38%) species are non-endemics and/or resident species.
- Seven (7) species are threatened (IUCN 2014) and these include the following: Endangered species - Tarictic Hornbill (*Penelopides panini*) and Negros Striped Babbler (*Stachyris nigrorum*); Vulnerable species - Philippine hawk-eagle (*Spizaetus philippensis pinskeri*), Pink-bellied imperial pigeon (*Ducula poliocephala*), White-winged cuckoo shrike (*Coracina ostentata*), and Celestial monarch (*Hypothymis coelestis*); and one Near Threatened (NT) species – Rufous Hornbill (*Buceros hydrocorax*).

Mammals

Key Findings:

- Of the 56 terrestrial mammals recorded for Negros Island (Heaney et al. 2014), 25 of which were recorded during the survey. Eight species are Philippine endemics namely: Golden-crowned flying fox (*Acerodon jubatus*), Philippine pygmy fruit bat (*Haplonycteris fischeri*), Harpy fruit bat (*Harpyionycteris whiteheadi*), Philippine tube-nosed fruit bat (*Nyctimene rabori*), Musky fruit bat (*Ptenochirus jagori*), Little golden-mantled flying fox (*Pteropus pumilus*), Yellow-faced horseshoe bat (*Rhinolophus virgo*), and Visayan spotted deer (*Rusa alfredi*).
- Aside from the Philippine endemics, two species of terrestrial mammals are found only within the Negros-Panay Faunal Region, the Visayan warty pig (*Sus cebifrons*) and Philippine barebacked fruit bat (*Dobsonia chapmani*). Both are Critically Endangered (CR) species. The latter has not been recorded since 1964, despite intensive surveys and therefore (inaccurately) considered as Extinct (IUCN 2014) because extant populations were recently rediscovered in Cebu (2001) and Negros (2003). Fortunately for this survey, the group was able to capture a single individual that yet again validates the species' presence on the island.

Reptiles and Amphibians

Key Findings:

- Ten amphibian species was recorded, two of which are Philippine endemics and three are found in the Negros-Panay Faunal Region.
- Three amphibians were recorded as threatened (IUCN RedList 2014) namely Negros Horned Toad (*Platymantis negrosensis)*, Hazel's Cloud Frog (*P. hazelae*) and Visayan

Fanged Frog (*Limnonectes visayanus*). Both species of *Platymantis* are regarded as Endangered (EN) while the *Limnonectes visayanus* is a Vulnerable (VU) species.

- Of the 11 reptile species recorded, only one species is considered as Endangered (EN) – Mountain Burrowing Snake (*Pseudorabdion montanum*). The species is endemic only to Negros Island.
- Six species are endemic to the Philippines, which include among others the Dumeril's Short-legged Skink (*Brachymeles talinis*), Marbled Crested Lizard (*Bronchocela marmorata*) Negros Forest Dragon *(Gonocephalus sophiae*) and Jagor's Sphenomorphus (*Pinoyscincus jagori*). Apparently, all of these species are also Data Deficient (DD) and thus, need further research to establish its distribution and other ecological and biological data, distinct to the species or taxa.

MKRNP

About 272 species of fauna and flora were observed in MKRNP during the ecological assessment. Of these, 124 were birds, 32 were mammals, 20 amphibians, and 15 reptiles while 81 species of trees were also observed (Table 20). A total of 84 species are endemic to the Philippines while 29 are restricted to the Island of Mindanao. Three species were classified as Critically Endangered (two trees; one bird) one Endangered and 22 Vulnerable as seen in Table 21. See Appendix 7.1.5 for a more detailed list of species.

Table 20. Summary of species recorded in MKRNP.

Taxa	Philippine endemic	Mindanao endemic	Not endemic	Introduced	Migratory	Total
Flora (trees)	16 (20%)	6 (7%)	43 (53%)	16 (20%)	0 (0%)	81
Birds	41 (33%)	12 (10%)	64 (52%)	0 (0%)	7 (6%)	124
Mammals	10 (31%)	11 (34%)	11 (34%)	0 (0%)	0 (0%)	32
Amphibians	11 (50%)	5 (25%)	3 (15%)	1 (5%)	0 (0%)	20
Reptiles	6 (40%)	6 (40%)	3 (20%)	0 (0%)	0 (0%)	15
TOTAL	**84 (31%)**	**29 (11%)**	**24 (46%)**	**17 (6%)**	**7 (3%)**	**272**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Table 21. Conservation status of species observed in MKRNP based on IUCN Red List (2014).

Taxa	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)	Least Concern (LC)	Not Assessed (NA)	Data Deficient	Total
Flora (trees)	2 (2%)	0 (0%)	7 (9%)	1 (1%)	9 (11%)	59 (73%)	3 (4%)	81
Birds	1 (1%)	1 (1%)	5 (4%)	11 (9%)	106 (85%)	0 (0%)	0 (0%)	124
Mammals	0 (0%)	0 (0%)	3 (9%)	0 (0%)	0 (0%)	0 (0%)	29 (91%)	32
Amphibians	0 (0%)	0 (0%)	9 (45%)	1 (5%)	8 (40%)	2 (10%)	0 (0%)	20
Reptiles	0 (0%)	0 (0%)	1 (7%)	0 (0%)	10 (67%)	2 (13%)	2 (13%)	15
TOTAL	**3 (1%)**	**1 (0.4%)**	**22 (9%)**	**13 (5%)**	**133 (55%)**	**63 (26%)**	**5 (2%)**	**240**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Plants (Trees)

Key Findings:

- Two critically endangered species were recorded: Red Lauan (Shorea negrosensis) and Tanguile (Shore polysperma). Both dipterocarps are endemic in the Philippines.
- Sixteen species observed were introduced such as Artocarpus heterophyllus, Aphanamixis polystachya, Calliandra haematocephala, Cassia javanica, and Durio zibethinus.
- A total of 81 species of trees belonging to 68 genera and 40 families were recorded.

Birds

Key Findings:

- Rare and threatened species like Mindanao brown dove (*Phapitreron brunneiceps*) and Black-bibbed cuckoo-shrike (*Coracina mindanensis*) were recorded in the lowland forest of Baungon.
- Several threatened species were recorded one of which is Critically Endangered (Philippine eagle, *Pithecophaga jefferyi*); one Endangered (Pinsker's hawk eagle, *Nisaetus pinskeri*); five Vulnerable: Mindanao brown dove (*Phapitreron brunneiceps*), Black-bibbed cuckooshrike (*Coracina mindanensis*), Blue-capped kingfisher (*Actenoides hombroni*), Philippine leafbird (*Chloropsis flavipennis*), and Celestial monarch (*Hypothymis coelestis*). Eleven birds were classified as Near Threatened such as Mindanao boobook (*Ninox philippensis)*, Short-crest Monarch (*Hypothymis helenae*) and Slaty-backed Jungle Flycatcher (*Rhinomyias goodfellowi*) were also recorded.
- Out of 124 bird species recorded, 63 (42.74%) of these are endemic. 41 (33.06%) are Philippine endemic and 12 (9.68%) are restricted to Mindanao.

Mammals

Key Findings:

- A total of 32 species of mammals were observed. Three are Vulnerable namely; Philippine warty pig (*Sus philippensis*), Philippine deer (*Rusa marianna*), and White collared fruit bat (*Megaerops wetmorei*).

Reptiles and Amphibians

Key Findings:

- Of the 20 species of frogs, nine were Vulnerable (Rabor's forest frog *Platymantis rabori*, Montane narrow-mouthed frog *Oreophyrne anulata*, Guenther's forest frog *Platymantis guentheri*, Eastern Mindanao Dwarf Toad *Pelophryne lighti*, Southeast Asian Horned Toad *Megophrys stejnegeri*, Spiny Cinnamon Frog *Nyctixalus spinosus*) and one Near Threatened (Giant litter frog *Limnonectes magnus*).
- A total of 15 species of reptiles were observed. Six are found only in the Philippines (*Elaphe erythrura, Sphenomorphus jagori, Trimeresurus flavomaculatus, Rhabdophis auriculata, Cyclorus lineatus,* and *Oxyrhabdium modestum*) and six were island restricted (*Gonocephalus interruptus, Sphenomorphus diwata, Sphenomorphus coxi, Draco mindanensis, Tropidophorus davaoensis*, and *Cyrtodactylus agusanensis*).
- One Vulnerable species was found, *Draco mindanensis*.

MANP

A total of 184 flora and fauna comprising of 76 species of trees, 70 birds, 19 mammals, 12 amphibians and seven species of reptiles were recorded for MANP during the survey (Table 22). There are 69 species in MANP that are Philippine endemic while 21 are island endemics (Table 22). As for threatened species in the site, five were recorded to be Critically Endangered, one Endangered bird species, and 13 were Vulnerable (Table 23). See Appendix 7.1.6 for the species list.

Table 22. Distribution of species surveyed in MANP.

Taxa	Philippine endemic	Mindanao endemic	Not endemic	Introduced	Migratory	Total
Flora (trees)	17 (27%)	4 (6%)	42 (67%)	0 (0%)	0 (0%)	63
Birds	37 (53%)	6 (9%)	27 (39%)	0 (0%)	0 (0%)	70
Mammals	8 (42%)	3 (16%)	7 (37%)	1 (5%)	0 (0%)	19
Amphibians	5 (42%)	5 (42%)	2 (17%)	0 (0%)	0 (0%)	12
Reptiles	2 (29%)	3 (43%)	2 (29%)	0 (0%)	0 (0%)	7
TOTAL	**69 (38%)**	**21(11%)**	**80 (43.5%)**	**1 (0.5%)**	**0 (0%)**	**171**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Table 23. Summary of threatened species surveyed in MANP according to the 2014 IUCN Red List.

Taxa	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near Threatened (NT)	Least Concern (LC)	Not Assessed (NA)	Data Deficient	Total
Flora (trees)	4 (5%)	0 (0%)	2 (3%)	1 (1%)	8 (11%)	60 (79%)	1 (1%)	76
Birds	1 (1%)	1 (1%)	0 (0%)	8 (11%)	60 (86%)	0 (0%)	0 (0%)	70
Mammals	0 (0%)	0 (0%)	2 (11%)	0 (0%)	16 (84%)	0 (0%)	1 (5%)	19
Amphibians	0 (0%)	0 (0%)	9 (75%)	0 (0%)	2 (17%)	1 (8%)	0 (0%)	12
Reptiles	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (71%)	2 (29%)	0 (0%)	7
TOTAL	**5 (3%)**	**1 (0.5%)**	**13 (7%)**	**9 (5%)**	**91 (49.5%)**	**63 (34%)**	**2 (1%)**	**184**

Note: Values in parentheses are percentages (%) relative to total number of the species per taxon

Plants (Trees)

Key Findings:

- There were 76 species of trees documented belonging to 63 genera and 41 families.
- Four Critically Endangered tree species were documented in the area: Philippine mahogany (*Shorea almon*), White Lauan (*Shorea contorta*), Red Lauan (*Shorea negrosensis*), and Tanguile (*Shorea polysperma*), which are all endemic to the Philippines. *Agathis dammara* and the Philippine endemic *Cinnamomum mercadoi* are Vulnerable.

Birds

Key Findings:

- A total of 70 bird species were recorded where 37 are endemic to the Philippines while six are endemic to island of Mindanao.

- Ten threatened bird species were detected. These include the Critically Endangered Philippine Eagle (*Pithecophaga jefferyi)* and the Endangered South Philippine Hawk-eagle *(Nisaetus pinskeri)*.

Mammals

Key Findings:

- The rare Philippine Large-headed Fruit Bat (*Dyacopterus rickartii*) was observed. Previous records from Mindanao were only from Mt. Kitanglad, Mt. Mahuson and Mt. Tagub-Kampalili.
- A total of 20 mammal species were recorded. Eight species were Philippine endemic, which includes Mindanao Flying-squirrel (*Petinomys crinitus*), Philippine warty pig (*Sus philippinensis)*, Philippine forest rat *(Rattus everetti*), Mindanao treeshrew *(urogale everetti*), Philippine large-headed fruit bat (*Dyacopterus rickartii*), Philippine pygmy fruit bat (*Haplonycteris fischeri),* Harpy Fruit bat (*Harpyionycteris whiteheadi*), Hardwick's woolly bat (*Kerivoula hardwickii),* Greater musky fruit bat (*Ptenochirus jagori),* Lesser Musky fruit bat (*Ptenochirus minor*), and Philippine forest horseshoe bat (*Rhinolopus inops).*

Reptiles and Amphibians

Key Findings:

- Five of 12 amphibians documented during the survey are endemic to the Philippines while another five species are island endemics.
- The following species were classified as threatened: Muller's Toad (*Ansonia muellerii*), Southeast Asian Horned Toad (*Megophrys stejnegeri*), Pointed Snout Tree Frog (*Philautus acutirostris*), Smooth Skinned Tree Frog (*Philautus worcesteri*), Mottled Tree Frog *(Philautus poecillus),* Common Forest Tree Frog (*Philautus surdus),* Guenther's Forest Frog (*Platymantis guentheri*), and White-lipped Tree Frog (*Polypedates leucomystax).*
- Out of seven reptiles observed, two are Philippine endemics: Philippine rat snake (*Elaphe erythrura*) and White lined water snake (*Rhabdophis auriculata*). Three are Mindanao endemic: Graceful short-legged skink (*Brachymeles gracilis*), Striped bronzeback snake (*Dendrelaphis caudolineatus terrificus*) and Agusan bent-toed gecko (*Cyrtodactylus agusanensis*).

3.2. RESULTS OF ORDINATION

This section presents the key findings of the analysis for each taxon using Canonical Correspondence Analysis (CCA) to determine the relationship between the species and its habitat. For a more detailed interpretation of the ordination results, see Appendix 7.3 for the ordination diagrams presented in biplots and Appendix 7.4. The result of this analysis is a description of the mean niche position on each selected gradient (niche position) for each species, which represents a measure of the distance between the mean conditions used by the species and the mean conditions of the study area for that gradient. This is referred to as Species Survival Envelope.

NSMNP

Plants (Trees)

Key Findings (**Table 24**):

- Most of the tree species are associated with disturbed and forest interface habitats.
- The ordination results suggest that the community (species composition and diversity) of trees is determined largely by elevation, increasing thickness of leaf litter and increasing number of palms (see Appendix A6).
- Species positioned in forest habitats with narrow niche width (forest specialist) include the endemic and threatened *Agathis philippinensis*, *Diospyrus philippinensis* and *Palaquium luzoniensis*.
- *Macaranga bicolor*, *Octomeles sumatrana* and *Parkia timoriana* are some of the species positioned in forest interface that are also tolerant to cultivated areas (forest generalists).
- Species such as *Dillenia philippinensis*, *Shorea negrosensis*, *Shorea palosapis*, *Shorea polysperma* and *Syzigium ciliato-setosum* appear to be generalists.

Table 24. Species survival envelopes for tree species in NSMNP generated using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species.

Species	Common Name	Forest Dependent	Degraded Forest	Interface of forest and non-forest	Non-forest/ Cultivation
Anisoptera thurifera	Palosapis	✓	✓		
Shorea guiso	Guijo	✓	✓		
Diptetrocarpus grandiflorus	Apitong	✓	✓		
Shorea polysperma	Tangile	✓	✓	✓	
Syzigium ciliato-setosum	Lakangan	✓	✓	✓	
Syzygium tripinnatum	Hagis	✓	✓	✓	
Shorea contorta	White Lauan	✓	✓	✓	✓
Shorea negrosensis	Red Lauan	✓	✓	✓	✓
Palaquium luzoniensis	Nato		✓		
Celtis philippinensis	Malaikmo		✓		
Diospyrus philippensis	Oi-Oi		✓	✓	
Garcinia venulosa	Gatasan		✓	✓	
Guisat*	Guisat*		✓	✓	
Kanaring*	Kanaring*		✓	✓	
Kulipapa*	Kulipapa*		✓	✓	
Lithocarpus sp.			✓	✓	
Parashorea malaanonan	Bagtikan		✓	✓	
Artocarpus rigidus	Monkey jak		✓	✓	
Calophyllum inophyllum	Bitaog		✓	✓	
Shorea palosapis	Mayapis		✓	✓	✓
Dillenia philippinensis	Katmon		✓	✓	✓
Litsea leytensis	Batikuling		✓	✓	✓
Macaranga tanarius	Binunga		✓	✓	✓
Mangifera altissima	Pahutan		✓	✓	✓
Palaquium philippense	Malakmalak		✓	✓	✓
Dracontomelon dao	Dao			✓	✓

Species	Common Name	Forest Dependent	Degraded Forest	Interface of forest and non-forest	Non-forest/ Cultivation
Duabanga moluccana	Loktob			✓	✓
Ficus nota	Tibig			✓	✓
Ficus sp.				✓	✓
Ficus variegata	Tangisang Baywak			✓	✓
Macaranga bicolor	Hamindang			✓	✓
Nephelium lappaceum	Kapulasan			✓	✓
Octomeles sumatrana	Binuang			✓	✓
Pterocarpus indicus	Narra			✓	✓
Shorea astylosa	Yakal			✓	
Nauclea orientalis	Bangkal				✓

Birds

Key Findings (**Table 25**):

- The ordination results suggest that most of the bird species are associated with the forest habitats.
- The bird community (species composition and diversity) is influenced mainly by elevation, increasing thickness of leaf litter and humus, and increasing number of fruit trees.
- Species with narrow niche width indicate that they are habitat specialists. Examples of the forest specialists or obligates include the Sooty Woodpecker (*Mulleripicus funebris*), Flaming Sunbird (*Aethopyga flagrans*) and Yellow-wattled Bulbul (*Pycnonotus urostictus*).
- The White-lored Oriole (*Oriolus albiloris*) appears tolerant to early second growth forest and cultivated lands and the Red-keeled Flowerpecker (*Dicaeum australe*) in early and advanced second growth forest.
- Generalist species such as the Philippine Bulbul (*Ixos philippinus)*, Elegant Tit *(Parus elegans)*, the Orange-bellied Flowerpecker (*Dicaeum trigonostigma)* and the Philippine Tailorbird (*Orthotomus castaneiceps)* and appear tolerant to varying degrees of disturbance.

Table 25. Species survival envelopes for birds in NSMNP using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species.

Species	Common Name	Intact Forest	Degraded Forest	Interface of forest and non-forest	Non-forest/ Cultivation
Phapitreron amethystinus	Amethyst Brown-dove	✓	✓		
Dicrurus balicassius	Balicassiao	✓	✓		
Phaenicophaeus cumingi	Scale-feathered Malkoha	✓	✓		
Mulleripicus funebris	Sooty Woodpecker	✓	✓		
Coracina coerulescens	Blackish Cuckoo-Shrike	✓	✓		
Dicaeum hypoleucum	Buzzing Flowerpecker	✓	✓		

Species	Common Name	Intact Forest	Degraded Forest	Interface of forest and non-forest	Non-forest/ Cultivation
Loriculus philippensis	Colasisi	✓	✓		
Chalcophaps indica	Common Emerald Dove	✓	✓		
Aethopyga flagrans	Flaming Sunbird	✓	✓		
Phylloscopus cebuensis	Lemon-throated Leaf-warbler	✓	✓		
Pycnonotus urostictus	Yellow-wattled Bulbul	✓	✓		
Dicaeum australe	Red-keeled Flowerpecker	✓	✓		
Coracina striata	Bar-bellied Cuckoo-Shrike		✓	✓	
Oriolus albiloris	White-lored Oriole			✓	✓
Lanius cristatus	Brown Shrike	✓	✓	✓	
Zosterops nigrorum	Yellowish White-eye	✓	✓	✓	
Pachycephala philippinensis	Yellow-bellied Whistler	✓	✓	✓	
Harpactes ardens	Philippine Trogon	✓	✓	✓	
Irena cyanogastra	Philippine Fairy Blue-bird	✓	✓	✓	
Hypothymis azurea	Black-naped Monarch	✓	✓	✓	
Centropus viridis	Philippine Coucal		✓	✓	✓
Nectarinia sperata	Purple-throated Sunbird		✓	✓	✓
Centropus unirufus	Rufous Coucal		✓	✓	✓
Orthotomus castaneiceps	Philippine Tailorbird	✓	✓	✓	✓
Lonchura leucogastra	White-breasted Munia	✓	✓	✓	✓
Copsychus luzoniensis	White-browed Shama	✓	✓	✓	✓
Phapitreron leucotis	White-eared Brown-dove	✓	✓	✓	✓
Rhipidura cyaniceps	Blue-headed Fantail	✓	✓	✓	✓
Parus elegans	Elegant Tit	✓	✓	✓	✓
Bolbopsittacus lunulatus	Guaiabero	✓	✓	✓	✓
Prionochilus olivaceus	Olive-backed Flowerpecker	✓	✓	✓	✓
Cinnyris jugularis	Olive-backed Sunbird	✓	✓	✓	✓
Dicaeum trigonostigma	Orange-bellied Flowerpecker	✓	✓	✓	✓
Ixos philippinus	Philippine Bulbul	✓	✓	✓	✓

KWFR and UMRBPL

Plants (Trees)

Key Findings (**Table 26**):

- Tree species such as Tibig *(Ficus nota)*, Takip Asin *(Macaranga grandiflora)*, Lanutan *(Mitrephora lanotan)* and Malapapaya *(Polyscias nodosa)* were found to be forest dependent. However, these species are also found in more degraded areas suggesting that these may be remnant of the original habitat.
- Rain tree (*Samanea saman)* and Makaasim (*Syzygium nitidum)* were found to tolerate degraded areas and the interface between forest and non-forest areas.

Table 26. Species survival envelopes of trees in KWFR-UMRBPL using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species.

Scientific Name	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Ficus nota	Tibig	✓			
Mitrephora lanotan	Lanutan	✓			
Macaranga grandiflora	Takip Asin	✓			
Polyscias nodosa	Malapapaya	✓	✓		
Ceiba pentandra	Kapok		✓		
Gmelina arborea	Gmelina		✓		
Nauclea orientalis	Bangkal		✓		
Pterocarpus indicus	Narra		✓		
Swietenia macrophylla	Mahogany		✓		
Syzygium cumini	Duhat		✓		
Samanea saman	Rain Tree		✓	✓	
Syzygium nitidum	Makaasim		✓	✓	
Brousonnetia luzonica	Himbabao			✓	
Celtis philippinensis	Malaikmo			✓	
Diospyros pilosanthera	Bolong Eta			✓	
Ficus variegata	Tangisang Bayawak			✓	
Lagerstromeia speciosa	Banaba			✓	
Antidesma bunius	Bignai			✓	
Canarium ovatum	Piling liitan				✓
Ficus balete	Balete				✓
Ficus odorata	Pakiling				✓
Heritiera sylvatica	Dungon				✓
Hopea acuminata	Manggachapui				✓

Birds

Key Findings (**Table 27**):

- Five species have wide niche width (Balicassiao *Dicrurus balicassius*, Common Emerald-Dove *Chalcophaps endica*, White-eared Brown-Dove *Phapitreron leucotis*, Elegant Tit *Parus elegans*, Philippine Bulbul *Ixos philippinus*). They extend from forest to cultivation, which indicate that they do not have specific habitat preference.

- *Cacomantis variolosus* and *Orthotomus cuculatus* are species with narrow niche width associated with forest. These suggest that they are intolerant to degraded forest or cultivation.

Table 27. Species survival envelopes for birds in KWFR-UMRBPL using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species.

Species	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest/ Cultivation
Dicrurus balicassius	Balicassiao	✓	✓	✓	✓
Ixos philippinus	Philippine Bulbul	✓	✓	✓	✓
Phapitreron leucotis	White-eared Brown-dove	✓	✓	✓	✓
Chalcophaps endica	Common Emerald-Dove	✓	✓	✓	✓
Parus elegans	Elegant Tit	✓	✓	✓	✓
Bolbopsittacus lunulatus	Guaiabero	✓	✓	✓	
Orthotomus castaneiceps	Philippine Tailorbird	✓	✓	✓	
Phaenicophaeus superciliosus	Red-crested Malkoha	✓	✓	✓	
Phaenicophaeus cumingi	Scale-feathered Malkoha	✓	✓	✓	
Pycnonotus goiavier	Yellow-vented Bulbul	✓	✓	✓	
Pycnonotus urostictus	Yellow-wattled Bulbul	✓	✓	✓	
Stachyris whiteheadi	Chestnut-faced Babbler	✓	✓		
Megalaima haemacephala	Coppersmith Barbet	✓	✓		
Macropygia tenuirostris	Philippine Cuckoo-Dove	✓	✓		
Ptilinopus occipitalis	Yellow-breasted Fruit-Dove	✓	✓		
Cacomantis variolosus	Brush Cuckoo	✓			
Orthotomus cuculatus	Mountain Tailorbird	✓			
Sarcops calvus	Coleto		✓	✓	✓
Centropus bengalensis	Lesser Coucal		✓	✓	✓
Centropus viridis	Philippine Coucal		✓	✓	✓
Buceros hydrocorax	Rufous Hornbill		✓	✓	✓
Corvus macrorhynchos	Large-billed Crow		✓	✓	
Stachyris striata	Luzon-striped Babbler		✓	✓	
Brachypterix montana	White-browed Shortwing		✓	✓	
Halcyon smyrnensis	White-throated Kingfisher		✓	✓	
Caprimulgus manillensis	Philippine Nightjar		✓		
Phapitreron amethystina	Amethyst Brown-Dove			✓	✓

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest/ Cultivation
Loriculus philippensis	Colasisi			✓	✓
Dendrocopos maculatus	Philippine Pygmy Woodpecker			✓	✓
Centropus unirufus	Rufous Coucal			✓	✓
Streptopelia chinensis	Spotted Dove			✓	✓
Chrysocolaptes lucidus	Greater Flameback			✓	
Penelopides manillae	Tarictic Hornbill			✓	
Harpactes ardens	Philippine Trogon			✓	
Pitta erythrogaster	Red-bellied Pitta			✓	
Copsychus luzoniensis	White-browed Shama			✓	
Penelopides manillae					✓

Mammals

Key Findings (**Table 28**):

- Diadem Leaf-nosed Bat *(Hipposideros diadema)* and Luzon Fruit Bat *Otopterupus cartilagonodus* are generalist species that can be found in all habitat types.
- Most species are found in the interface between forest and non-forest, e.g., Common Short-nosed Fruit Bat (*Cynopterus brachyotis),* Philippine Nectar Bat *(Eonycterus robusta),* Common Dawn Bat *(Eonycterus spelaean),* Lesser Long-tongued Fruit Bat (*Macroglossus minimus),* Bare-rumped Sheathtail Bat *(Saccolaimus saccolaimus)* and Greater Flat-headed Bat *(Tylonycteris robustula*. These species are tolerant to high degree of habitat disturbance.

Table 28. Species survival envelopes of bats in KWFR-UMRBPL using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species.

Scientific Name	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest
Hipposideros diadema	Diadem Leaf-nosed Bat	✓	✓	✓	✓
Otopterupus cartilagonodus	Luzon Fruit Bat	✓	✓	✓	✓
Cynopterus brachyotis	Common Short-nosed Fruit Bat			✓	
Eonycterus robusta	Philippine Nectar Bat			✓	
Eonycterus spelaean	Common Dawn Bat			✓	
Haplonycteris fischeri	Philippine Pygmy Fruit Bat			✓	
Kerivoula whiteheadi	Whitehead's Woolly Bat			✓	
Macroglossus minimus	Lesser Long-tongued Fruit Bat			✓	
Megaderma spasma	Lesser False Vampire			✓	

Scientific Name	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest
Myotis muricola	Wall-roosting mouse-eared bat			✓	
Pterochirus jagori	Greater Musky Fruit Bat			✓	
Rhinolopus arcuatus	Arcuate Horseshoe Bat			✓	
Rouseffus amplexicaudatus	Geoffroy's rousette			✓	
Saccolaimus saccolaimus	Bare-rumped Sheathtail Bat			✓	
Tylonycteris pachypus	Lesser Bamboo Bat			✓	
Tylonycteris robustula	Greater Flat-headed Bat			✓	

Amphibians

Key Findings (**Table 29)**:

- The Masked wrinkled ground frog (*Platymantis corrugatus),* Whistling wrinkled ground frog *(Platymantis dorsalis),* Asiatic painted narrowmouth toad *(Kaloula picta),* Luzon striped stream frog *(Hylarana similis)* and the Common puddle frog *(Occidozyga laevis)* are species that can tolerate a wide range of habitat, degraded to open areas.

Table 29. Species survival envelopes of amphibians in KWFR-UMRBPL using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species

Species	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest/ Cultivation
Polypedates leucomystax	Four-lined tree frog	✓			
Platymantis corrugatus	Masked wrinkled ground frog		✓	✓	✓
Platymantis dorsalis	Whistling wrinkled ground frog		✓	✓	✓
Kaloula picta	Asiatic painted narrowmouth toad		✓	✓	
Hylarana similis	Luzon striped stream frog		✓	✓	
Limnonectes macrocephalus	Luzon fanged frog		✓		
Occidozyga laevis	Common puddle frog			✓	✓

Note: Checkmark indicates extent of occurrence/presence of the species.

Reptiles

Key Findings (**Table 30**):

- The Negros forest dragon (*Gonocephalus sophiae)* appears to be forest dependent.
- The Gunther's Whip Snake (*Ahaetulla prasina),* Common House Gecko *(Hemidactylus frenatus),* Philippine Flying Dragon *(Draco spilopterus),* Many-keeled Mabuya *(Eutropis multicarinata),* Tokay Gecko *(Gekko gecko),* Jagor's Sphenomorphus *(Pinoyscinus*

jagori) and the Philippine pit viper (*Trimeresurus flavomaculatus)* are found in degraded to non-forested areas.

Table 30. Species survival envelopes of reptiles in KWFR-UMRBPL using Canonical Correspondence Analysis.

Note: Checkmarks indicate extent of occurrence/presence of species.

Species	Common Name	Forest dependent	Degraded forest	Interface of forest and non-forest	Non-forest
Bronchocela cristatella	Green crested lizard	✓	✓		
Gonocephalus sophiae	Negros forest dragon	✓			
Gekko gecko	Tokay Gecko		✓	✓	
Hemidactylus frenatus	Common house gecko			✓	✓
Ahaetulla prasina	Gunther's whip snake				✓
Draco spilopterus	Philippine flying dragon				✓
Eutropis multicarinata	Many-keeled mabuya				✓
Pinoyscinus jagori	Jagor's sphenomorphus				✓
Trimeresurus flavomaculatus	Philippine vit viper				✓

Bago Watershed, MKNP and NNNP

Plants (Trees)

Key Findings (**Table 31**):

- *Syzygium sp.9* and *Tristianopis decorticate* are specialists that prefer intact forest habitats.
- *Syzygium sp.1, Agathis philippensis, Dendrocnide sp., Parashorea malaanonan, Shorea negrosensis,* and *Shorea polysperma* are dipterocarps that are forest dependents but are tolerant to anthropogenic disturbances.

Table 31. Species survival envelopes of trees in Bago Watershed, MKNP and NNNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Scientific Name	Common Name	Intact Forest	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Syzygium sp. 9		✓			
Tristianopsis decorticata	Malabayabas	✓			
Syzygium sp. 1		✓	✓		
Agathis philippensis	Almaciga	✓	✓		
Dendrocnide sp.		✓	✓		
Bischofia javanica	Tuai	✓	✓	✓	
Palaquium sp. 2		✓	✓	✓	

Scientific Name	Common Name	Intact Forest	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Parashorea malaanonan	Bagtikan	✓	✓		
Shorea negrosensis	Red Lauan	✓	✓	✓	
Shorea polysperma	Tangile	✓	✓	✓	
Palaquium sp. 1			✓		
Macaranga bicolor	Hamindang		✓		
Swietenia macrophylla	Mahogany		✓		
Syzygium sp. 5			✓		
Dacryocarpus imbricata	Igem		✓	✓	
Shorea contorta	White Lauan		✓	✓	
Syzygium sp. 2			✓	✓	
Syzygium sp. 6			✓	✓	
Syzygium sp. 7			✓	✓	
Myristica philippinensis	Duguan			✓	
Syzygium sp. 3				✓	
Syzygium sp. 4				✓	
Syzygium sp. 8				✓	

Birds

Key Findings (**Table 32**):

- Results showed that 25 species (Amethyst brown-dove, Balicassiao, Blue-headed fantail, Blue-backed parrot, Coleto, Elegant tit, Metallic pigeon, Mountain white-eye, Mountain verditer flycatcher, Negros striped babbler, Pink-bellied imperial pigeon, Philippine pygmy woodpecker, Philippine tailorbird, Pied triller, Snowy-browed flycatcher, White-breasted wood-swallow, White-eared brown-dove, White-vented whistler, White-winged cuckoo-shrike, Yellow-bellied whistler, Yellow-vented bulbul, Yellow-wattled bulbul, and Yellow-breasted fruit-dove) have preference to mature forest type but with some degree of tolerance to habitat degradation. With a wide niche width, these species can also occupy a wide range of forest habitat types ranging from old growth to early secondary growth forests.
- Species such as Blue-naped parrot, Tarictic hornbill, White-bellied wood-pecker, Lovely sunbird, Philippine tailorbird, Cetrine canary flycatcher and Philippine coucal show a higher preference to advance secondary growth and old growth forests suggesting that these species are forest obligates.

Table 32. Species survival envelopes of birds in Bago Watershed, MKNP and NNNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Intact forest	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Phapitreron amethystina	Amethyst brown dove	✓	✓	✓	
Dicrurus balicassius	Balicassiao	✓	✓	✓	✓
Rhipidura cyaniceps	Blue-headed fantail	✓	✓	✓	
Tanygnathus sumatranus	Blue-backed parrot	✓	✓	✓	

Species	Common Name	Intact forest	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Tanygnathus lucionensis salvadorii	Blue-naped parrot	✓			
Culicicapa helianthea	Citrine canary flycatcher	✓			
Sarcops calvus	Coleto	✓	✓	✓	✓
Parus elegans	Elegant tit	✓	✓	✓	
Aethopyga shelleyi	Lovely sunbird	✓			
Columba vitiensis anthracina	Metallic imperial-pigeon	✓	✓	✓	✓
Zosterops montanus	Mountain white-eye		✓	✓	
Eumyias panayensis	Mountain verditer flycatcher	✓	✓	✓	✓
Stachyris nigrorum	Negros striped-babbler		✓	✓	
Ducula poliocephala	Pink-bellied imperial-pigeon	✓	✓	✓	✓
Macropygia tenuirostris tenuirostris	Philippine cuckoo-dove		✓	✓	
Ixos philippinus	Philippine bulbul	✓	✓	✓	✓
Centropus viridis	Philippine coucal	✓	✓		
Dendrocopos maculatus	Philippine pygmy woodpecker			✓	
Orthotomus castaneiceps	Philippine tailorbird		✓	✓	
Lalage nigra	Pied triller			✓	✓
Ficedula hyperythra nigrorum	Snowy-browed flycatcher	✓	✓	✓	✓
Penelopides panini	Visayan hornbill	✓	✓		
Brachypteryx montana	White-browed shortwing	✓	✓	✓	✓
Dryocopus javensis	White-bellied woodpecker		✓	✓	✓
Phapitreron leucotis nigrorum	White-eared brown dove	✓	✓	✓	✓
Pachycephala homeyeri	White-vented whistler		✓	✓	
Coracina ostenta	White-winged cuckoo-shrike		✓	✓	
Ptilinopus occipitalis occipitalis	Yellow-breasted fruit-dove	✓	✓		
Zosterops nigrorum	Yellowish white-eye		✓	✓	
Pycnonotus goiavier	Yellow-vented bulbul		✓	✓	
Pycnonotus urostictus	Yellow-wattled bulbul	✓	✓		

Mammals

Key Findings (**Table 33)**:

- *Myotis rufopictus, Rhinolophus virgo, Haplonycteris fischeri* and *Nyctimene rabori* are associated with advanced secondary growth forests. While those species associated with more degraded habitats include *Rhinolophus arcuatus* and *Macroglossus minimus.*
- Noteworthy species such as the endemic and Critically Endangered *Dobsonia chapmani* and the Endangered *Nyctimene rabori* were mainly observed only in advanced secondary growth. This suggests that this type of habitat is more preferred by the species.

- Almost all species of bats recorded during the survey are associated with forest habitats, may it be pristine or degraded in condition.
- The Critically Endangered *Dobsonia chapmani* (Barebacked fruit bat) is a forest species with very narrow niche width suggesting that the species is a specialist. The same goes with the Near Threatened *Miniopterus schreibersii* (Common bent-winged bat) whose narrow niche width may have contributed to its very low occurrence in area/s where the species is most likely to be found.

Table 33. Species survival envelopes of mammals in Bago Watershed, MKNP and NNNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Scientific Name	Common Name	Intact Forest	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Cynopterus brachyotis	Common Short-nosed Fruit Bat		✓	✓	✓
Dobsonia chapmani	Philippine naked-backed fruit bat	✓			
Haplonysteris fischeri	Philippine Pygmy Fruit Bat	✓	✓	✓	
Harpyionycteris whiteheadi	Harpy fruit bat	✓	✓		
Macroglossus minimus	Lesser Long-tongued Fruit Bat		✓	✓	✓
Miniopterus schreibersii	Common bent-wing bat	✓	✓		
Nyctimene rabori	Philippine tube-nosed fruit bat	✓	✓	✓	
Ptenochirus jagori	Greater Musky Fruit Bat	✓	✓	✓	
Pteropus pumilus	Little golden-mantled flying fox	✓	✓		
Rhinolophus arcuatus	Arcuate Horseshoe Bat		✓	✓	✓
Rhinolophus virgo	Yellow-faced horseshoe bat		✓		
Rousettus amplexicaudatus	Geoffroy's rousette			✓	✓

Amphibians

Key Findings (**Table 34**):

- Hylarana everetti, Platymantis guentheri, Polypedates leucomystax, Rhacophorus pardalis, Platymantis hazelae and Occidozyga laevis prefer ASG forest.
- The results of the species are positioned closely to habitat continuum (secondary growth forest to forest edges). Occidozyga laevis shows a wide range of habitat preference, ranging from degraded forest-to-forest edges. L. visayanus prefer habitat on forest edges.
- All the frog species selected have tolerance to degraded forest except for Limnonectes visayanus. Occidozyga laevis also prefer habitat on forest edges aside from degraded forest.

Table 34. Species survival envelopes of amphibians in Bago Watershed, MKNP and NNNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Intact Forest	Degraded forest	Interface of forest and non-forest	Non-forest / Open Forest
Limnonectes visayanus	Philippine wart frog			✓	
Hylarana erythraea	Common green frog		✓		
Platymantis corrugatus	Masked wrinkled ground frog		✓		
Platymantis dorsalis	Whistling wrinkled ground frog		✓		
Platymantis guentheri	Guenther's forest frog		✓		
Platymantis hazelae	Hazel's wrinkled ground frog		✓		
Polypedates leucomystax	Four-lined tree frog		✓		
Occidozyga laevis	Common puddle frog		✓	✓	
Sanguirana everetti	Everett's frog		✓		
Rhacophorus pardalis	Harlequin tree frog		✓		

MKNRP

Plants (Trees)

Key Findings (**Table 35**):

- The following species of trees prefer forest habitats: *Agathis philippinensis*, *Calophyllum inophyllum*, *Mallotus mollisimus*, and *Syzygium nitidum*. This suggests that these species are intolerant to habitat disturbance.
- *Cinnamomum mercadoi*, *Dacrycarpus imbricatus* and *Palaquium tenuipetoliatum* prefer wide range of habitat from forest to non-forest, which indicate that these species are generalists and can withstand habitat disturbance.
- *Shorea negrosensis* (Red Lauan) and *Shorea polysperma* (Tanguile), both classified as Critically Endangered, showed association with degraded forest. This indicates that these species can possibly tolerate certain degree of disturbance.

Table 35. Species survival envelopes of trees in MKRNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Agathis philippinensis	Almaciga	✓	✓		
Calophyllum inophyllum	Bitaog	✓	✓		
Mallotus mollisimus	Hinlaumo	✓	✓		
Syzygium nitidum	Makaasim	✓	✓		

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Acer laurinum	Philippine Maple	✓	✓	✓	
Cinnamomum mercadoi	Kalingag	✓	✓	✓	✓
Dacrycarpus imbricatus	Igem	✓	✓	✓	✓
Palaquium tenuipetoliatum	Maniknik		✓	✓	✓
Shorea negrosensis	Red Lauan		✓	✓	
Shorea polysperma	Tangile		✓	✓	

Birds

Key Findings (**Table 36**):

- Short-crested monarch (*Hypothymis helenae*) and Mindanao White-eye (*Lophozosterops goodfellowi*) have narrow niche widths that indicate their sensitivity with forest degradation and deforestation.
- *Phapitreron amethystinus, Basilornis mirandus, Prioniturus discurus, Centropus melanops, Rhipidura superciliaris, Hypocryptadius cinnamomeus, Prioniturus montanus* and *Rhabdotorrhinus leucocephalus* are forest species with wide niche width that can inhabit varying forest habitats.
- *Rhipidura nigrocinnamomea, Ptilinopus occipitalis, Aethopyga primigenius, Irena cyanogastra* and *Penelopides panini panini* are species that prefer forest habitats and can tolerate forests that are highly degraded. This suggests that these species can be indicators of habitat disturbance.
- Colasisi and White-eared Brown dove are forest obligate species but are very tolerant of various degrees of degradation and anthropogenic disturbances.
- The highly elusive Black-bibbed Cuckoo-shrike, categorized as Vulnerable, prefer forest habitats but showed tolerance to various degrees of forest degradation.

Table 36. Species survival envelopes of birds in MKRNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Hypothymis helenae	Short crested monarch	✓			
Lophozosterops goodfellowi	Black-masked White-eye	✓			
Phapitreron amethystina	Amethyst brown dove	✓	✓		
Basilornis mirandus	Apo myna	✓	✓		
Prioniturus discurus	Blue-crowned Racquet-tail	✓	✓		
Centropus melanops	Black-masked coucal	✓	✓		
Rhipidura superciliaris	Blue fantail	✓	✓		
Hypocryptadius cinnamomeus	Cinnamon ibon	✓	✓		
Prioniturus montanus	Mountain Racquet-tail	✓	✓		
Rhabdotorrhinus leucocephalus	Writhed hornbill	✓	✓		

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Rhipidura nigrocinnamomea	Black and cinnamon fantail	✓	✓	✓	
Ptilinopus occipitalis	Yellow-breasted Fruit Dove	✓	✓	✓	
Aethopyga primigenius	Grey-hooded sunbird	✓	✓	✓	
Irena cyanogastra	Philippine fairy bluebird	✓	✓	✓	
Penelopides affinis	Mindanao hornbill	✓	✓	✓	
Loriculus philippensis	Colasisi	✓	✓	✓	✓
Phapitreron leucotis	White-eared Brown Dove	✓	✓	✓	✓
Corasina mindanensis	Black-bibbed Cuckoo Shrike		✓	✓	

Mammals

Key Findings (**Table 37)**:

- *Eonycteris spelaea* and *Rhinolophus inops* are forest species but are very tolerant to habitat degradation.
- *Macroglossus minimus, Ptenochirus jagori* and *Ptenochirus minor* have wide niche widths and can be observed in different habitat types from forest to non-forest areas or generalists.
- *Cynopterus brachyotis, Harpyionycteris whiteheadi, Kerivoula hardwicki, Pipistrellus javanicus, and Dyacopterus rickartii* are forest generalists. These cannot survive in non-forest habitats but have high level of tolerance to disturbance gradients.

Table 37. Species survival envelopes of mammals in MKRNP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Scientific Name	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Eonycteris spelaea	Common Dawn Bat	✓	✓		
Rhinolophus inops	Philippine forest horseshoe bat	✓	✓	✓	
Macroglossus minimus	Lesser Long-tongued Fruit Bat	✓	✓	✓	✓
Ptenochirus jagori	Greater Musky Fruit Bat	✓	✓	✓	✓
Ptenochirus minor		✓	✓	✓	✓
Cynopterus brachyotis	Common Short-nosed Fruit Bat		✓	✓	✓
Harpyionycteris whiteheadi	Harpy fruit bat		✓	✓	
Kerivoula cf hardwickii	Hardwicke's woolly bat		✓	✓	
Pipistrellus cf javanicus	Java pipistrelle		✓	✓	
Dyacopterus rickartii	Philippine Large-headed Fruit bat		✓	✓	

Reptiles

Key Findings (**Table 38**):

- Negros Forest Dragon (*Gonocephalus sophiae)* preference for intact forest, which indicates that this species is a forest obligate and cannot tolerate degraded habitats.
- Cox's sphenomorphus (*Sphenomorphus coxi)*, Diwata sphenomorphus (*Sphenomorphus diwata)*, Northern Triangle-spotted Snake (*Cyclocorus lineatus*), and White-lined Water Snake (*Rhabdophis auriculata*) are forest generalists - tolerant of habitat varying degrees of degradation.
- Banded Malaysian burrowing snake (*Calliophis intestinalis*), Non-banded Philippine burrowing snake (*Oxyrhabdium modestum*), Philippine Pit viper (*Trimeresurus flavomaculatus)* and Davao waterside skink (*Tropidophorus davaoensis*) are species that thrive in degraded forest habitats.

Table 38. Species survival envelopes of reptiles in MKRNP using Canonical Correspondece Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Gonocephalus sophiae	Negros forest dragon	✓			
Sphenomorphus coxi	Cox's sphenomorphus	✓	✓		
Sphenomorphus diwata	Diwata sphenomorphus	✓	✓		
Cyclocorus lineatus	Northern triangle-spotted snake	✓	✓		
Rhabdophis auriculata	White-lined water snake	✓	✓	✓	
Calliophis intestinalis	Malaysian burrowing snake		✓	✓	
Oxyrhabdium modestum	Philippine burrowing snake		✓	✓	
Trimeresurus flavomaculatus	Philippine pt viper		✓	✓	
Tropidophorus davaoensis	Davao waterside skink		✓	✓	
Varanus salvator	Common water monitor		✓	✓	

MANP

Plants (Trees)

Key Findings (**Table 39**):

- The following species of trees prefer forest habitats but intolerant degradation: *A. philippinensis, C. inophyllum, M. mollisimus,* and *S. nitidum.*
- *C. mercadoi, D. imbricatus* and *P. tenuipetoliatum* prefer a wide range of habitat from forest to non-forest, which indicates that these species are generalists and can withstand habitat disturbance.

Table 39. Species survival envelopes of trees in MANP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Scientific Name	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Agathis philippinensis	Almaciga	✓	✓		
Calophyllum inophyllum	Bitaog	✓	✓		
Mallotus mollisimus	Hinlaumo	✓	✓		
Syzygium nitidum	Makaasim	✓	✓		
Acer laurinum	Philippine Maple	✓	✓	✓	
Cinnamomum mercadoi	Kalingag	✓	✓	✓	✓
Dacrycarpus imbricatus	Igem	✓	✓	✓	✓
Palaquium tenuipetoliatum	Maniknik		✓	✓	✓
Shorea negrosensis	Red Lauan		✓	✓	
Shorea polysperma	Tangile		✓	✓	

Birds

Key Findings (**Table 40**):

- Short-crested monarch (*H. helenae*) has narrow niche width that indicates its sensitivity to forest degradation and deforestation.
- The following forest species with wide niche width that can inhabit varying forest habitats: *P. amethystinus, B. mirandus, P. discurus, C. melanops, R. superciliaris, H. cinnamomeus, P. montanus* and *R. leucocephalus*.
- *R. nigrocinnamomea, P. occipitalis, A. primigenius, I. cyanogastra* and *P. panini panini* are species that prefer forest habitats and can tolerate degraded forests. This suggests that these species can be indicators of habitat disturbance.
- Colasisi and White-eared Brown dove are forest obligate species but are very tolerant of various degrees of degradation and habitat disturbances.

Table 40. Species survival envelopes of birds in MANP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Hypothymis helenae	Short crested monarch	✓			
Lophozosterops goodfellowi	Black-masked White-eye	✓			
Phapitreron amethystina	Amethyst brown dove	✓	✓		
Basilornis mirandus	Apo myna	✓	✓		
Prioniturus discurus	Blue-crowned Racquet-tail	✓	✓		
Centropus melanops	Black-masked coucal	✓	✓		
Rhipidura superciliaris	Blue fantail	✓	✓		
Hypocryptadius cinnamomeus	Cinnamon ibon	✓	✓		

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Prioniturus montanus	Mountain Racquet-tail	✓	✓		
Rhabdotorrhinus leucocephalus	Writhed hornbill	✓	✓		
Rhipidura nigrocinnamomea	Black and cinnamon fantail	✓	✓	✓	
Ptilinopus occipitalis	Yellow-breasted Fruit Dove	✓	✓	✓	
Aethopyga primigenius	Grey-hooded sunbird	✓	✓	✓	
Irena cyanogastra	Philippine fairy bluebird	✓	✓	✓	
Penelopides affinis	Mindanao hornbill	✓	✓	✓	
Loriculus philippensis	Colasisi	✓	✓	✓	✓
Phapitreron leucotis	White-eared Brown Dove	✓	✓	✓	✓
Corasina mindanensis	Black-bibbed Cuckoo Shrike		✓	✓	

Mammals

Key Findings (**Table 41**):

- *E. spelaea* and *R. inops* are forest species but are very tolerable to habitat degradation.
- *M. minimus, P. jagori* and *P. minor* have wide niche widths and can be observed in different habitat types from forest to non-forest areas.
- *C. brachyotis, H. whiteheadi, K. hardwicki, P. javanicus, and D. rickartii* are species with high level of tolerance to disturbed gradients but not extending to non-forest areas.

Table 41. Species survival envelopes of bats in MANP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Scientific Name	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Eonycteris spelaea	Common Dawn Bat	✓	✓		
Rhinolophus inops	Philippine forest horseshoe bat	✓	✓	✓	
Macroglossus minimus	Lesser Long-tongued Fruit Bat	✓	✓	✓	✓
Ptenochirus jagori	Greater Musky Fruit Bat	✓	✓	✓	✓
Ptenochirus minor		✓	✓	✓	✓
Cynopterus brachyotis	Common Short-nosed Fruit Bat		✓	✓	✓
Harpyionycteris whiteheadi	Harpy fruit bat		✓	✓	
Kerivoula cf hardwickii	Hardwicke's woolly bat		✓	✓	
Pipistrellus cf javanicus	Java pipistrelle		✓	✓	
Dyacopterus rickartii	Philippine Large-headed Fruit bat		✓	✓	

Reptiles

Key Findings (**Table 42**):

- Negros Forest Dragon (*G. sophiae)* showed association with intact forest, which indicate that this species is a forest obligate and cannot tolerate anthropogenic disturbances.
- The following are forest species but are tolerant of habitat degradation at a certain degree: Cox's sphenomorphus (*S. coxi)*, Diwata sphenomorphus (*S. diwata)*, Northern Triangle-spotted Snake (*C. lineatus*), and White-lined Water Snake (*R. auriculata*).
- Banded Malaysian burrowing snake (*C. intestinalis*), Non-banded Philippine burrowing snake (*O. modestum*), Philippine Pit viper (*T. flavomaculatus)* and Davao waterside skink (*T. davaoensis*) are species that thrive in degraded forest habitats.

Table 42. Species survival envelopes of reptiles in MANP using Canonical Correspondence Analysis.

Note: Checkmark indicates extent of occurrence/presence of the species.

Species	Common Name	Intact Forest	Degraded Forest	Forest Edge	Non-forest
Gonocephalus sophiae	Negros forest dragon	✓			
Sphenomorphus coxi	Cox's sphenomorphus	✓	✓		
Sphenomorphus diwata	Diwata sphenomorphus	✓	✓		
Cyclocorus lineatus	Northern triangle-spotted snake	✓	✓		
Rhabdophis auriculata	White-lined water snake	✓	✓	✓	
Calliophis intestinalis	Malaysia burrowing snake		✓	✓	
Oxyrhabdium modestum	Non-banded Philippine burrowing snake		✓	✓	
Trimeresurus flavomaculatus	Philippine pit viper		✓	✓	
Tropidophorus davaoensis	Davao waterside skink		✓	✓	
Varanus salvator	Common water monitor		✓	✓	

3.3. Results of Species Occupancy Modeling of Trees, Birds, Reptiles, Amphibians and Mammals and Population Estimation of Birds

This section presents the result of the occupancy modeling which estimates the proportion of sites occupied by a single species during a short time interval (single breeding season) when a probability of detecting a species is less than one. These models are based on detection histories for each site constructed using straightforward probabilistic arguments and permits maximum likelihood estimation of the modeled parameters. (See section 4.1.)

NSMNP

Plants (Trees)

Key Findings (**Table 43**):

- Five species of trees have >50% occupancy (*Calophylllum inophyllum*, *Dipterocarpus grandiflorus*, *Ficus variegata*, *Shorea contorta*, *Shorea negrosensis*). These species occupy a significant area of the park. This also suggests that these species are the most abundant and dominant.
- Seven tree species have 5% occupancy. This includes the forest-restricted species such as the endangered Manggachapoi *Hopea acuminata* and the critically endangered Kalantas *Toona kalantas.* These two species appear to naturally occur in low densities in the park.
- *Macaranga grandifolia* is another species with only 5% occupancy. This species is an indicator of regenerating forest habitats.
- Environmental variables with the highest contribution to most species' occupancy and detection are elevation, humus thickness and extent of ground exposure.

Table 43. Occupancy models of selected tree in NSMNP.

Scientific Name	Common Name	Occupancy, Ψ (%)[1]	Environmental factors influencing species occupancy, ω[2]				
			Elevation	Humus	Canopy Cover	Avg. Ground exposure	Trees with DBH 25-50cm
Agathis philippinensis	Almaciga	11	45.14	41.99	44.68	65.15	34.08
Calophylllum inophyllum	Bitaog	50	18.56	49.85	18.56	18.56	46.06
Canarium ovatum	Piling Liitan	11	34.55	47.9	43.99	57.14	29.41
Dillenia philippinensis	Katmon	38	39.41	92.53	29.25	84.15	99.27
Diospyros philippinensis	Oi-Oi	16	52.8	57.3	61.82	90.46	97.19
Dipterocarpus grandiflorus	Apitong	72	99.69	76.1	47.91	96.13	47.64
Dracontomelon dao	Dao	16	93.52	39.22	29.11	27.45	82.12
Ficus minahassae	Hagimit	5	64.87	61.39	52.73	45	51.67
Ficus variegata	Tangisang bayawak	50	32.37	38.89	36.47	44.11	47.98
Gmelina arborea	Gmelina	5	27.54	39.96	55.57	71.85	36.96
Hopea acuminata	Manggachapui	5	42.15	32.42	39.8	52.26	41.35
Macaranga grandifolia	Takip Asin	5	57.07	34.73	47.39	64.23	42.15
Macaranga tanarius	Binunga	33	33.35	60.17	59.36	47.1	45.95
Nauclea orientalis	Bangkal	11	33.04	85.9	63.8	48.16	50.29
Nephelium lappaceum	Usau	22	31.04	50.26	34.3	43.75	54.5
Palaquium luzoniensis	Nato	11	34.64	59.12	35.5	97.2	94.11
Palaquium philippense	Malakmak	16	41.14	41.14	59.52	52.16	35.02
Parkia timoriana	Kupang	5	63.1	47.39	60.86	46.24	29.8
Pterocarpus indicus	Narra	33	99.66	58.4	58.14	92.29	37.11
Shorea contorta	White Lauan	83	22.8	48.46	22.8	22.8	38.94

Scientific Name	Common Name	Occupancy, Ψ (%)[1]	Environmental factors influencing species occupancy, ω[2]				
			Elevation	Humus	Canopy Cover	Avg. Ground exposure	Trees with DBH 25-50cm
Shorea negrosensis	Red Lauan	88	37.86	79.69	77.51	69.08	21.55
Syzygium tripinnatum	Hagis	27	29.85	28.57	38.3	87.38	90.85
Toona kalantas	Kalantas	5	35.61	35.82	46.61	39	45.85
Tristaniopsis decorticata	Malabayabas	11	45.46	34.24	62.13	62.7	40.33
Vitex parviflora	Molave	5	51.67	34.51	43.21	43.85	53.48

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Birds

Key Findings (**Table 44**):

- Eight species of birds have an occupancy of >20% (see Table 44). These species include the endemic Yellow-wattled Bulbul (*Pycnonotus urostictus*), White-lored Oriole (*Oriolus albiloris*), Balicassiao (*Dicrurus balicassius*), Blue-breasted Flycatcher (*Cyornis herioti*) and the near- threatened Sooty Woodpecker (*Mulleripicus funebris*). This result indicates that these species were commonly detected and appeared abundant in the survey sites.
- Species with 5% occupancy include the endemic Luzon Hornbill (*Penelopides manillae*), Philippine Dwarf-Kingfisher (*Ceyx melanurus*), Philippine Hawk-Eagle (*Nisaetus philippenis*) and Red-crested Malkoha (*Dasylophus superciliosus*). These species are naturally wide-ranging but the results suggest that these species occur in low densities and occupy small areas.
- Environmental variables with significant contribution to most species are saplings, rattan and canopy cover. It suggests that these parameters are predictors of the species' occurrence.

Table 44. Occupancy models of selected birds in NSMNP.

Species	Common Name	Occupancy, Ψ (%) [1]	Environmental factors influencing species occupancy, ω [2]				
			Saplings	Rattan	Large Trees	Ground cover	Canopy cover
Dicrurus balicassius	Balicassiao	35	35%	38%	39%	40%	41%
Cyornis herioti	Blue-breasted Flycatcher	23	42%	35%	59%	49%	62%
Chalcophaps indica	Common Emerald-Dove	23	70%	41%	94%	41%	39%
Ficedula disposita	Furtive Flycatcher	5	36%	33%	29%	33%	31%
Sterrhoptilus dennistouni	Golden-crowned Babbler	11	40%	46%	35%	35%	39%
Penelopides manillae	Luzon Hornbill	5	41%	42%	37%	46%	33%
Prionochilus olivaceus	Olive-backed Flowerpecker	27	33%	35%	25%	34%	30%
Ceyx melanurus	Philippine Dwarf_Kingfisher	5	40%	52%	35%	42%	43%
Nisaetus philippensis	Philippine Hawk-Eagle	5	40%	61%	35%	35%	40%

Species	Common Name	Occupancy, Ψ (%) [1]	Environmental factors influencing species occupancy, ω [2]				
			Saplings	Rattan	Large Trees	Ground cover	Canopy cover
Otus megalotis	Philippine Scops-Owl	11	51%	71%	32%	46%	46%
Gallus gallus	Red Junglefowl	5	58%	35%	36%	42%	53%
Phaenicophaeus superciliosus	Red-crested Malkoha	5	42%	55%	45%	42%	52%
Centropus unirufus	Rufous Coucal	16	39%	44%	42%	36%	39%
Phaenicophaeus cumingi	Scale-feathered Malkoha	27	50%	32%	34%	51%	34%
Hypothymis helenae	Short-crested Monarch	11	51%	34%	44%	46%	51%
Corvus enca	Slender-billed Crow	5	41%	42%	39%	46%	32%
Mulleripicus funebris	Sooty Woodpecker	22	47%	48%	30%	31%	38%
Oriolus albiloris	White-lored Oriole	22	78%	31%	48%	44%	51%
Ptilinopus occipitalis	Yellow-breasted Fruit-Dove	5	42%	55%	45%	42%	52%
Pycnonotus urostictus	Yellow-wattled Bulbul	22	68%	50%	37%	37%	36%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Amphibians

Key Findings (**Table 45**):

- Of the eight amphibian species modeled for occupancy, five have <20% occupancy. This includes the endangered *Platymantis cagayanensis* and the vulnerable *Kaloula kalingensis*.
- *Hylarana similis*, *Limnonectes macrocephalus* and *Occidozyga laevis* have >20% occupancy. This result suggest that these species common in the park.
- Water bodies and the presence of saplings influence amphibian occupancy in the park suggesting preference of riverine ecosystem.

Table 45. Occupancy models of selected amphibians in NSMNP.

Species	Common Name	Occupancy	Environmental factors influencing species occupancy, ω [2]				
		Ψ (%) [1]	Elevation	Distance from Water Bodies	Canopy Cover	Humus	Sapling
Fejervarya cancrivora	Asian brackish frog	5	39.61%	56.72%	53.39%	29.91%	78.28%
Fejervarya vittigera	Luzon wart frog	16	33.11%	45.58%	53.90%	41.97%	57.94%
Hylarana similis	Laguna del bay frog	33	39.86%	82.69%	39.08%	40.49%	66.40%
Kaloula kalingensis	Smooth-fingered narrow-mouthed frog	11	47.08%	57.77%	55.75%	42.86%	51.88%
Limnonectes macrocephalus	Luzon fanged frog	22	46.54%	78.23%	57.60%	46.46%	73.83%

Species	Common Name	Occupancy	Environmental factors influencing species occupancy, ω [2]				
		Ψ (%) [1]	Elevation	Distance from Water Bodies	Canopy Cover	Humus	Sapling
Occidozyga laevis	Common puddle frog	38	43.31%	35.79%	54.35%	50.51%	24.47%
Platymantis cagayanensis	Cagayan forest frog	16	85.91%	69.64%	65.87%	48.22%	26.42%
Sanguirana luzonensis	Luzon stream frog	16	51.51%	56.72%	53.39%	29.91%	78.28%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Kaliwa and UMRBPL

Plants (Trees)

Key Findings (**Table 46**):

- *Lagerstroemia speciosa, Antidesma bunius, Broussonetia luzonica Nauclea orientalis, Hopea acuminata* and *Polyscias nodosa* have low occupancy (10%). It indicates that these species do not require large areas but require a specific combination of habitat parameters such as rock, understorey and leaf litter.

Table 46. Occupancy models of selected trees in Kaliwa and UMRBPL.

Scientific Name	Common Name	Occupancy, Ψ (%) [1]	Environmental factors affecting occupancy (ω) [2]				
			Leaf Litter	Canopy	Ferns	Rock	Under-storey
Antidesma bunius	Bignai	10	47.03%	39.71%	36.12%	36.00%	79.31%
Broussonetia luzonica	Himbabao	10	33.95%	44.94%	34.58%	56.05%	35.36%
Canarium ovatum	Piling liitan	20	36.81%	40.54%	56.64%	39.95%	37.93%
Celtis philippinensis	Malaikmo	20	40.67%	36.27%	58.49%	53.44%	48.27%
Ficus balete	Balete	20	57.22%	42.76%	42.73%	42.68%	57.86%
Ficus nota	Tibig	40	52.77%	38.46%	95.68%	55.34%	70.75%
Ficus odorata	Pakiling	20	49.62%	28.52%	31.98%	70.60%	47.87%
Ficus variegata	Tangisang Bayawak	30	46.55%	46.49%	87.32%	60.53%	57.16%
Lagerstroemia speciosa	Banaba	10	34.30%	45.23%	34.91%	56.28%	35.16%
Nauclea orientalis	Bangkal	10	33.95%	44.94%	34.58%	56.05%	35.36%
Hopea acuminata	Manggachapui	10	73.11%	45.43%	40.53%	48.18%	34.63%
Polyscias nodosa	Malapapaya	10	33.95%	44.94%	34.58%	56.05%	35.36%
Syzygium nitidum	Makaasim	30	53.29%	38.22%	65.32%	34.74%	56.61%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Birds

Key Findings (**Table 47**):

- Luzon-Bleeding Heart *(Gallicolumba luzonica)*, Philippine Fairy-Bluebird *(Irena cyanogaster)* and Sooty Woodpecker *(Mulleripicus funebris)* have the lowest occupancy (10%). Although these species do not require wide areas, they are influenced by certain habitat requirements such as humus/leaf litter.
- Philippine bulbul *(Ixos philippinus)* and the Philippine coucal *(Centropus viridis)* have the highest occupancy at 50%. These species occupy wide areas in the watershed.

Table 47. Occupancy models of selected birds in KWFR and UMRBPL.

Species	Common Name	Occupancy (%) [1]	Environmental factors affecting occupancy (ω) [2]				
			Canopy	Moss	Ferns	Humus/ Litter Thickness	Midstorey
Phapitreron amethystina	Amethyst Brown-Dove	40	47.6	48.48	42.28	38.03	40.17
Loriculus philippensis	Colasisi	40	55.99	62.94	30.72	64.55	64.55
Parus elegans	Elegant Tit	40	39.73	45.21	41.94	34.55	34.47
Gallicolumba luzonica	Luzon Bleeding-Heart	10	34.93	35.38	35.6	41.65	38.96
Stachyris striata	Luzon-striped Babbler	20	43.62	40.66	60.9	69.6	66.44
Irena cyanogaster	Philippine Fairy-Bluebird	10	34.93	35.38	35.6	41.65	38.96
Ixos philippinus	Philippine Bulbul	50	36.5	48.22	39.42	38.96	36.63
Centropus viridis	Philippine Coucal	50	43.05	47.99	46.29	42.71	44.44
Phaenicophaeus superciliosus	Red-crested Malkoha	20	39.6	32.5	33.7	34.21	30.66
Centropus unirufus	Rufous Coucal	40	65.87	53.82	40.94	43.83	61.87
Buceros hydrocorax	Rufous Hornbill	20	52.64	44.78	42.67	34.08	29.76
Mulleripicus funebris	Sooty Woodpecker	10	30.97	30.57	35.95	57.23	51.84
Phapitreron leucotis	White-eared Brown-dove	40	38.3	47.68	41.23	35.94	36.98
Pycnonotus goiavier	Yellow-vented Bulbul	20	47.99	44.46	68.41	71.86	68.33
Pycnonotus urostictus	Yellow-wattled Bulbul	30	34.6	36.33	44.49	31.35	31.67

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Mammals

Key Findings (**Table 48**):

- Two species of bats, the Common Short-nosed Fruit Bat (*Cynopterus brachyotis)* and the Greater Musky Fruit Bat *(Pterochirus jagori)* have the highest occupancy (50%). The midstorey habitat variable influences their occupancy. This suggests that these species are vulnerable to landscape-wide changes.
- Whitehead's Woolly Bat (*Kerivoula whiteheadi)*, Wall-roosting mouse-eared bat (*Myotis muricola)* and Pouch bat *(Saccolaimus saccolaimus)* have the lowest occupancy (10%).

These species are insect eating bats that do not require large areas but need specific habitat requirements such as fruiting/ flowering trees and canopy cover.

Table 48. Occupancy models of selected mammals in Kaliwa and UMRBPL.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental factors affecting occupancy (ω) [2]				
			Distance to Ridge Top	Fruiting/ Flowering Trees	Canopy	Midstorey	Rattan
Cynopterus brachyotis	Common Short-nosed Fruit Bat	50	41.15%	41.39%	39.75%	44.99%	41.60%
Eonycterus robusta	Philippine Nectar Bat	30	35.87%	36.18%	53.67%	54.30%	46.21%
Eonycterus spelaean	Common Dawn Bat	20	37.32%	26.96%	50.31%	36.68%	87.57%
Haplonycteris fischeri	Philippine Pygmy Fruit Bat	20	55.00%	41.07%	73.40%	44.44%	49.49%
Hipposideros diadema	Diadem Leaf-nosed Bat	20	36.72%	39.81%	43.09%	35.63%	57.90%
Kerivoula whiteheadi	Whitehead's Woolly Bat	10	45.99%	35.00%	56.54%	43.99%	33.52%
Macroglossus minimus	Lesser Long-tongued Fruit Bat	30	43.24%	39.29%	52.62%	53.60%	67.11%
Megaderma spasma	Lesser False Vampire	30	55.04%	32.16%	46.20%	46.82%	42.95%
Myotis muricola	Wall-roosting mouse-eared bat	10	36.07%	58.00%	37.79%	36.32%	38.14%
Otopterupus cartilagonodus	Luzon Fruit Bat	10	52.84%	35.44%	45.66%	43.93%	35.38%
Pterochirus jagori	Greater Musky Fruit Bat	50	41.05%	41.30%	39.65%	44.89%	41.49%
Rhinolopus arcuatus	Arcuate Horseshoe Bat	30	42.13%	35.95%	52.00%	51.95%	67.16%
Saccolaimus saccolaimus	Bare-rumped Sheathtail Bat	10	35.07%	58.80%	39.01%	35.58%	37.09%
Tylonycteris pachypus	Lesser Bamboo Bat	30	48.01%	33.71%	57.69%	29.25%	53.21%
Tylonycteris robustula	Greater Flat-headed Bat	40	55.31%	31.38%	65.42%	54.81%	41.62%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Amphibians

Key Findings (**Table 49**):

- All four species of frogs have occupancy of 40-60%. Canopy cover, large diameter of trees, saplings and the presence of water bodies influence these four species' occupancy.

Table 49. Occupancy models of selected amphibians in KWFR and UMRBPL.

Species	Common Name	Occupancy (%) [1]	Environmental factors affecting occupancy (ω) [2]				
			Distance to Water Bodies	% Canopy	Saplings	Rattan	50-100 cm DBH
Platymantis corrugatus	Masked wrinkled ground frog	60	45%	61%	51%	37%	57%
Platymantis mimulus	Diminutive forest frog	40	58%	47%	62%	35%	50%
Hylarana similis	Luzon striped stream frog	60	55%	34%	51%	30%	59%
Polypedates leucomystax	Four-lined tree frog	60	64%	38%	30%	29%	62%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Reptiles

Key Findings (**Table 50**):

- *Ahaetulla prasina, Eutropis multicarinata, Pinoyscincus jagori, and Trimeresurus flavomaculatus* have high occupancy (100%). This indicates that these species are widely occuring in the watershed.
- *Bronchocela cristatella, Gekko gecko,* Common House Gecko (*Hemidactylus frenatus)* and Philippine Bent-toed Gecko (*Cyrtodactylus philippinicus)* have the least occupancy (40%). Occupancy of these species is influenced by humus/litter thickness and canopy.

Table 50. Occupancy models of selected reptiles in KWFR and UMRBPL.

Species	Occupancy Ψ (%) [1]	Environmental factors affecting occupancy (ω) [2]				
		% Canopy	50-100 cm DBH	Saplings	Humus/Litter Thickness	Dead Woods (Natural)
Ahaetulla prasina	100	28.81	28.81	33.61	33.61	33.61
Bronchocela cristatella	40	43.09	31.44	38.17	46.05	39.88
Cyrtodactylus philippinicus	40	58.98	27.77	45.88	60.84	46.15
Draco spilopterus	60	65.97	29.36	32.19	47.28	45.09
Eutropis multicarinata	100	28.81	28.81	33.61	33.61	33.61
Gekko gecko	40	35.82	35.73	39.19	45.83	45.73
Gonocephalus sophiae	80	57.71	29.88	19.89	32.67	32.67
Hemidactylus frenatus	40	61.99	33.82	50.22	41.77	41.69
Pinoyscincus jagori	100	29.08	29.08	33.95	33.95	33.95
Trimeresurus flavomaculatus	100	27.69	27.69	32.28	32.28	32.28
Ahaetulla prasina	100	28.81	28.81	33.61	33.61	33.61

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Bago Watershed, MKNP and NNNP.

Plants (Trees)

Key Findings (**Table 51**):

- The occupancy (Ψ) models of selected flora species in Bago Watershed showed that most tree species selected have occupancy of above 50%. This scenario suggests that wider landscape is needed for these key species. Most of the selected species with higher occupancy are part of the Dipterocarpaceae group and tree species that thrives from lower to upper montane forests. *Bischofia javanica* has the lowest area occupied (21%) together with *Shorea polysperma* (28%).

Table 51. Occupancy models of selected trees in Bago Watershed, MKNP and NNNP.

Species	Common Name	Occupancy, Ψ (%) [1]	Environmental Factors Influencing Species Occupancy (ω) [2]				
			25-100 DBH	% Canopy	% Moss	Saplings	Palms
Agathis philippinensis	Almaciga	21	76.31	32.76	54.19	79.87	35.71
Bischofia javanica	Tuai	43	77.54	31.85	40.26	32.7	78.77
Dacrycarpus imbricatus	Igem	14	71.42	46.33	47.58	47.08	79.05
Macaranga bicolor	Hamindang	7	34.45	37.01	44.2	45.24	62.24
M. tanarius	Binunga	14	31.31	42.22	85.94	49.83	31.64
Myristica philippinensis	Duguan	14	39.06	42.97	47.24	43.81	33.93
Palaquium luzoniense	Nato	36	41.29	64.49	85.04	50.76	45.13
Parashorea malaanonan	Bagtikan	21	31.94	80.1	33.68	40.08	69
Shorea contorta	White Lauan	43	36.69	44.97	63.43	38.85	41.61
S. negrosensis	Red Lauan	50	32.4	31.88	32.75	35.9	35.89
S. polysperma	Tangile	29	33.03	29.85	52.93	35.42	34.59
Tristianopsis decorticata	Malabayabas	7	38.87	38.95	41.55	38.2	66.28

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Birds

Key Findings (**Table 52**):

- The occupancy (Ψ) models of selected bird species in BRWFR showed that Dicrurus balicassius, Culicicapa helianthea, Rhipidura cyaniceps, and Stachyris nigrorum, Phapitreron leucotis nigrorum and Penelopides panini both Island endemic species and sub-species have occupancy value of 50% and greater than 50%, whilst the species Phapitreron amethystina maculipectus, Coracina ostenta, Ducula poliocephala and Macropygia tenuirostris tenuirostris having less than 50% naïve occupancy and Tanygnathus lucionensis salvadorii have the lowest naïve occupancy.
- The results of occupancy models further showed that the selected species have significant response to the environmental variables used. Penelopides panini, Coracina ostenta, Phapitreron leucotis nigrorum, Rhipidura cyaniceps and Macropygia tenuirostris tenuirostris were strongly influenced by presence of rattan. While species Phapitreron amethystina maculipectus occupancy was influenced by DBH (61%) and ground (82%), Stachyris nigrorum and Tanygnathus lucionensis salvadorii occupancy are influenced by DBH (32% and 35%, respectively).

Table 52. Occupancy models of selected birds in Bago Watershed, MKNP and NNNP.

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencing Species Occupancy (ω) 2				
			% Canopy	Saplings	Rattan	25-50 cm DBH	Ground
Phapitreron amethystina maculipectus	Amethyst brown dove	0.3571	41%	36%	31%	61%	82%
Stachyris nigrorum	Negros striped-babbler	0.7143	2%	2%	30%	32%	28%
Penelopides panini	Visayan hornbill	0.5	44%	86%	63%	51%	75%
Coracina ostenta	White-winged cuckoo-shrike	0.2143	43%	77%	85%	78%	33%
Phapitreron leucotis nigrorum	White-eared brown dove	0.7143	28%	28%	36%	33%	40%
Dicrurus balicassius	Balicassiao	0.8571	28%	28%	26%	27%	28%
Rhipidura cyaniceps	Blue-headed fantail	0.8571	2%	2%	26%	27%	18%
Tanygnathus lucionensis salvadorii	Blue-naped parrot	0.1429	34%	34%	38%	35%	30%
Culicicapa helianthea	Citrine canary flycatcher	0.7143	9%	9%	25%	29%	40%
Ducula poliocephala	Pink-bellied imperial-pigeon	0.3571	44%	77%	36%	51%	75%
Macropygia tenuirostris tenuirostris	Philippine cuckoo-dove	0.4286	43%	46%	49%	53%	49%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Mammals

Key Findings (**Table 53**):

- The occupancy (Ψ) models of selected mammal species in BRWFR showed that Common short-nosed fruit bat (*Cynopterus brachyotis*), Philippine pygmy fruit bat *(Haplonycteris fischeri*), Harpy fruit bat (*Harpyionycteris whiteheadi*), Dagger-toothed fruit bat (*Macroglossus minimus*), and Philippine tube-nosed fruit bat (*Nyctimene rabori*) have occupancy values of 35.7. This suggests that these species occupy a relatively small area.
- *H. whiteheadi* (Harpy fruit bat), *N. rabori* (Philippine tube-nosed fruit bat) and *Pteropus pumilus* (Little golden-mantled flying fox) were strongly influenced by fruiting and flowering trees. All three species are Philippine endemics and with the exception of H. *whiteheadi,* the other two are considered as threatened species (IUCN RedList 2014) as Endangered (E) and Near Threatened (NT), respectively.
- Eight (8) out of the 13 species recorded were strongly influenced by the presence of trees with 25-100cm DBH. These species include: *Cynopterus brachyotis, D. chapmani, H. fischeri, Macroglossus minimus, Myotis rufopictus, Ptenochirus jagori, Rhinolophus arcuatus* and *R. virgo*. This suggests that these species occupy forested areas with medium to large trees.
- *D. chapmani, Miniopterus schreibersii, M. rufopictus, R. virgo,* and *Rousettus amplexicaudatus*, have low occupancy at 7%. The species were encountered only once

during the course of the survey. Hence, the very low species detection rate and probably explains why they also showed very low occupancy.

- As expected, frugivorous species of bats such as *Pteopus pumilus*, *Nyctimene rabori* and *H. whiteheadi* are associated with fruiting and flowering trees as evidenced by the higher values of environmental factors affecting occupancy.
- Known to be a forest specialist, the endemic *P. jagori* is associated to trees with 25-100 cm DBH that validates the specie's preference to forested areas over that of open and cultivated habitats.

Table 53. Occupancy models of selected bats in Bago Watershed, MKNP and NNNP.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencing Species Occupancy (ω) [2]				
			FRTrees	Canopy	Sapling	% Herbs	25-100 cm DBH
Cynopterus brachyotis	Common Short-nosed Fruit Bat	35.71	38.61	35.95	30.72	32.21	50.49
Dobsonia chapmani	Philippine naked-backed fruit bat	7.14	39.88	55.57	34.31	32.90	56.35
Haplonycteris fischeri	Philippine Pygmy Fruit Bat	35.71	37.95	35.33	30.11	31.48	49.47
Harpyionycteris whiteheadi	Lesser Long-tongued Fruit Bat	35.71	62.84	31.93	36.61	54.20	56.47
Macroglossus minimus	Lesser Long-tongued Fruit Bat	35.71	40.21	36.74	31.56	31.98	50.31
Miniopterus schreibersii	Common bent-wing bat	7.14	34.00	52.02	61.09	46.56	37.86
Myotis rufopictus	Orange fingered Myotis	7.14	39.88	55.57	34.31	32.90	56.35
Nyctimene rabori	Philippine tube-nosed fruit bat	35.71	58.85	40.69	47.20	43.79	38.30
Ptenochirus jagori	Greater Musky Fruit Bat	28.57	35.48	36.49	34.99	29.40	56.21
Pteropus pumilus	Little golden-mantled flying fox	14.29	51.14	45.71	50.26	47.44	45.03
Rhinolophus arcuatus	Arcuate Horseshoe Bat	28.57	43.21	35.95	32.06	41.34	47.87
Rhinolophus virgo	Yellow-faced horseshoe bat	7.14	39.88	55.57	34.31	32.90	56.35
Rousettus amplexicaudatus	Little golden-mantled flying fox	7.14	34.00	52.02	61.09	46.56	37.86

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

MKNRP

Plants (Trees)

Key Findings (**Table 54**):

- Kalingag (*Cinnamomum mercadoi*) has the highest occupancy (65%) suggesting it is common in the park. Trees with 50-100cm dbh appear to influence its occupancy.
- *Dacrycarpus cumingii* has the lowest occupancy that suggests low species density because of low encounter rates with high association to litter thickness.
- Occupancy of tree species such as *C. inophyllum, A. rhomboidea and A. philippinensis* are influenced by canopy height by having the highest weight scores. This suggests that conservation intervention on trees should consider canopy height.

Table 54. Occupancy models of selected trees in MKRNP.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Altitude	Litter Thickness	Under-storey	Canopy Height	50-100 cm dbh
Shorea negrosensis	Red Lauan	10%	39%	29%	63%	32%	72%
Agathis philippinensis	Almaciga	13%	48%	49%	74%	40%	34%
Calophyllum inophyllum	Bitaog	26%	94%	48%	57%	97%	53%
Cinnamomum mercadoi	Kalingag	65%	21%	0%	0%	0%	79%
Dacrycarpus cumingii	Igem	3%	73%	93%	36%	56%	54%
Afzelia rhomboidea	Tindalo	26%	98%	38%	52%	98%	84%
Shorea almon	Almon	32%	54%	54%	44%	66%	43%
Alseodaphne philippinensis	Boga	10%	87%	40%	75%	96%	48%
Palaquium tenuipetiolatum	Maniknik	48%	69%	95%	44%	36%	59%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Birds

Key Findings (**Table 55**):

- Rhipidura nigrocinnamomea, Hypocryptadius cinnamomeus, Loriculus philippensis, Phapitreron leucotis, Aethopyga primigenius, and Ptilinopus occipitalis are abundant and common in the park, occupying greater than 50% of the area surveyed. This suggests that these species are susceptible to landscape-wide change.
- Phapitreron amethystinus, Basilornis mirandus, Prioniturus discurus, Centropus melanops, Rhipidura supercliaris, Lophozosterops goodfellowi, Prioniturus montanus, Irena cyanogastra, Hypothymis helenae, Penelopides panini, Coracina mindanensis and Rhabdotorrhinus leucocephalus have low occupancy. These species do not require large areas but they need specific habitat parameters such as medium to large trees (25-50 dbh), altitude, understorey, rattan and grass.

Table 55. Occupancy models of selected birds in MKRNP.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencing Species Occupancy (ω) [2]				
			Altitude	DBH 25-50 cm	Rattan	Under-storey	Grass
Phapitreron amethystinus	Amethyst brown dove	19%	32%	38%	31%	27%	26%
Basilornis mirandus	Apo myna	26%	53%	45%	37%	36%	55%
Rhipidura nigrocinnamomea	Black and cinnamon fantail	81%	0%	10%	3%	0%	1%
Corasina mindanensis	Black-bibbed Cuckoo Shrike	10%	96%	86%	25%	41%	74%
Prioniturus discurus	Blue-crowned Racquet-tail	26%	29%	40%	32%	30%	26%

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencing Species Occupancy (ω) [2]				
			Altitude	DBH 25-50 cm	Rattan	Under-storey	Grass
Centropus melanops	Black-masked coucal	26%	39%	46%	68%	48%	71%
Rhipidura superciliaris	Blue fantail	16%	51%	66%	52%	65%	32%
Lophozosterops goodfellowi	Black-masked White-eye	13%	47%	70%	49%	42%	44%
Hypocryptadius cinnamomeus	Cinnamon ibon	53%	0%	51%	72%	44%	36%
Loriculus philippensis	Colasisi	58%	57%	38%	43%	60%	73%
Aethopyga primigenius	Grey-hooded sunbird	77%	6%	105%	85%	6%	175%
Prioniturus montanus	Mountain Racquet-tail	35%	38%	30%	33%	35%	83%
Irena cyanogastra	Philippine fairy bluebird	32%	36%	50%	41%	31%	29%
Hypothymis helenae	Short crested monarch	26%	32%	34%	35%	44%	41%
Penelopides panini panini	Mindanao hornbill	45%	57%	70%	76%	46%	32%
Phapitreron leucotis	White-eared Brown Dove	66%	0%	47%	11%	0%	17%
Rhabdotorrhinus leucocephalus	Writhed hornbill	10%	69%	40%	73%	72%	78%
Ptilinopus occipitalis	Yellow-breasted Fruit Dove	68%	74%	41%	51%	43%	49%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Mammals

Key Findings (**Table 56**):

- *Macroglossus minimus*, *Cynopterus brachyotis*, *Haplonycteris fischeri*, and *Megaerops wetmorei* have high occupancy with high species density. These species were the most common in the project site. *Ptenochirus jagori*, *Rhinolopus inops*, *Pipistrellus cf javanicus*, and *Ptenochirus jagori* have lower occupancy and low species density.
- *Harpyionycteris whiteheadi*, *Kerivoula hardwicki*, *Dyacopterus rickartii* and *Eonycteris spelea* have occupancy less than 0.15. These species have low detection rates and are uncommon in the site such as *D. rickartii*, which typically inhabits caves.
- *P. jagori*, *E. spelaea*, and *H. fischeri*, as expected, are associated to fruiting and flowering trees which the species' preferred source of food. *P. minor*, *H. whiteheadi* and *K. hardwickii* showed association to elevation gradients. *Macroglossus minimus* and *Megaerops wetmorei* are both associated to anthropogenic disturbances. These species are known to thrive in lowland areas and are commonly observed in plantations.

Table 56. Occupancy models of selected bats in MKRNP.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Altitude	Distance to Water Bodies (m)	Distance to Valley Bottom (m)	Fruiting/ Flowering Trees	Anthro-pogenic Disturbance
Eonycteris spelaea	Common Dawn Bat	14%	35.2	42.83	38.28	50.21	30.79
Macroglossus minimus	Lesser Long-tongued Fruit Bat	57%	39.44	35.94	72.35	41.05	84.03
Ptenochirus jagori	Greater Musky Fruit Bat	29%	45.33	45.26	33.08	84.68	29.9
Harpyionycteris whiteheadi	Harpy fruit bat	14%	40.28	38.23	38.96	42.11	39.36
Kerivoula cf hardwickii	Hardwicke's woolly bat	14%	49.2	42.43	33.14	40.07	48.11
Pipistrellus cf javanicus	Java pipistrelle	29%	56.09	38.92	40.16	57.31	30.08
Cynopterus brachyotis	Common Short-nosed Fruit Bat	86%	39.16	37.68	81.64	41.58	27.4
Ptenochirus minor	Lesser musky fruit bat	43%	84.85	28.98	29.38	83.57	30.85
Rhinolophus inops	Philippine forest horseshoe bat	43%	27.41	40	29.68	43.79	29
Dyacopterus rickartii	Philippine Large-headed Fruit bat	14%	41.38	41.47	34.69	48.18	32.73
Haplonycteris fischeri	Philippine Pygmy Fruit Bat	71%	49.51	49.4	26.23	86.8	28.7
Megaerops wetmorei	White-collared fruit bat	57%	41.13	23.02	60.26	36.64	75.91

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Amphibians

Key Findings (**Table 57**):

- *Leptobrachium lumadorum*, *Megophrys stejnegeri*, *Peolphryne brevipes*, and *Philautus acutirostris* showed to have high space requirement (32 to 45%). These species are susceptible to landscape wide changes.
- *Ansonia muelleri*, *Kalophrynus pleurostigma*, *Limnonectes parvus*, *Nyctixalus spinosus*, *Pelophryne lighti*, *Philautus poecilus*, *Philautus worcesteri*, *Platymantis corrogatus*, *Platymantis guentheri*, and *Starois natator* have low occupancies and low species density due to specific habitat requirement.

Table 57. Occupancy models of selected amphibians in MKRNP.

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Distance to Water Bodies (m)	Canopy	Saplings	Rattan	50-100 cm dbh
Ansonia muelleri	Mueller's Toad	16%	40.49	68.68	83.23	42.91	73.96
Kalophrynus pleurostigma	Black-spotted sticky frog	16%	55.75	74.90	28.47	43.93	84.51
Leptobrachium lumadorum		42%	49.78	48.60	61.00	40.74	51.50
Limnonectes magnus	Giant Philippine frog	10%	72.92	82.07	60.35	80.89	49.71
Limnonectes parvus	Philippine small-disked frog	13%	33.86	77.12	75.31	65.87	36.35
Megophrys stejnegeri	Southeast Asian horned toad	32%	55.94	28.68	18.18	86.04	75.69
Nyctixalus spinosus	Spiny tree frog	12%	40.60	43.37	43.91	49.22	48.06
Pelophryne brevipes		45%	99.99	99.95	25.77	29.76	29.73
Pelophryne lighti		19%	79.35	27.63	69.37	43.34	46.09
Philautus acutirostris	Philippine bubble-nest frog	68%	87.76	34.75	90.11	90.16	88.98
Philautus poecilus	Mottled tree frog	13%	34.10	54.33	54.40	35.01	28.59
Philautus worcesteri	Smooth-skinned tree frog	13%	34.11	54.34	54.40	35.01	28.59
Platymantis corrogatus	Masked wrinkled ground frog	19%	18.04	77.51	86.33	86.45	31.39
Platymantis guentheri	Gunether's ground frog	19%	52.01	74.55	38.28	40.95	72.39
Starois natator	Black-spotted rock frog	23%	48.09	44.94	42.09	52.44	36.67

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Reptiles

Key Findings (**Table 58**):

- *Sphenomorphus coxi, S. diwata and T. flavomaculatus* have the highest occupancy among selected reptile species. This suggests that species are more susceptible to landscape changes.
- *Cyclocorus lineatus, G. sophiae, T. davaoensis and V. salvator* are species with low occupancies. These species do not require large areas but they need specific habitat parameters such as medium to large trees (50-100 dbh), dead woods and canopy.

Table 58. Occupancy models of selected reptiles in MKRNP.

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Canopy	50-100 cm dbh	Saplings	Humus	Natural Deadwood
Brachymeles gracilis	Short-legged skink	3%	50.96	34.56	46.31	37.52	46.52
Cyclocorus lineatus	Northern Triangle-spotted snake	3%	33.95	40.49	56.61	52.66	59.11
Gonocephalus sophiae	Negros forest dragon	3%	37.94	64.51	59.64	44.24	40.46
MatIcora intestinalis	Banded Malaysian coral snake	6%	44.16	88.34	53.85	31.28	41.54
Oxyrhabdium modestum	Philippine shrub snake	6%	38.58	76.52	53.84	35.57	39.14
Rhabdophis auriculata	White-lined water snake	4%	86.97	34.42	58.61	30.82	64.17
Sphenomorphus coxi	Cox's sphenomorphus	10%	93.53	51.37	59.29	53.03	39.23
Sphenomorphus diwata	Diwata sphenomorphus	10%	32.36	50.20	33.61	78.10	60.80
Trimeresurus flavomaculatus	Philippine pit viper	10%	56.22	43.54	42.59	68.87	52.79
Tropidophorus davaoensis	Davao waterside skink	3%	40.69	67.00	45.94	33.72	42.01
Varanus salvator	Common Water monitor	3%	40.69	67.00	45.94	33.72	42.01

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

MANP

Plants (Trees)

Key Findings (**Table 59**):

- Kalingag (*Cinnamomum mercadoi*) has the highest occupancy (65%) suggesting it is common in the park. Trees with 50-100cm dbh appear to influence its occupancy.
- *Dacrycarpus cumingii* has the lowest occupancy that suggests low species density because of low encounter rates with high association to litter thickness.
- Occupancy of tree species such as Bitaog (*C. inophyllum),* Tindalo *(A. rhomboidea)* and Almaciga *(A. philippinensis)* are influenced by canopy height by having the highest weight scores. This suggests that conservation intervention on trees should consider canopy height.

Table 59. Occupancy models of selected trees in MANP.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Altitude	Litter Thickness	Under-storey	Canopy Height	50-100 cm dbh
Shorea negrosensis	Red Lauan	10%	39%	29%	63%	32%	72%
Agathis philippinensis	Almaciga	13%	48%	49%	74%	40%	34%
Calophyllum inophyllum	Bitaog	26%	94%	48%	57%	97%	53%
Cinnamomum mercadoi	Kalingag	65%	21%	0%	0%	0%	79%
Dacrycarpus cumingii	Igem	3%	73%	93%	36%	56%	54%
Afzelia rhomboidea	Tindalo	26%	98%	38%	52%	98%	84%
Shorea almon	Almon	32%	54%	54%	44%	66%	43%
Alseodaphne philippinensis	Boga	10%	87%	40%	75%	96%	48%
Palaquium tenuipetiolatum	Maniknik	48%	69%	95%	44%	36%	59%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Birds

Key Findings (**Table 60**):

- *R. nigrocinnamomea, H. cinnamomeus, L. philippensis, P. leucotis, Aet primigenius*, and *Ptilinopus occipitalis* are abundant and common in the park, occupying greater than 50% of the area surveyed. This suggests that these species are susceptible to landscape-wide change.
- *P. amethystinus, B. mirandus, P. discurus, C. melanops, R. supercliaris, L. goodfellowi, P. montanus, I. cyanogastra, H. helenae, P. panini, C. mindanensis* and *R. leucocephalus* have low occupancy. These species do not require large areas but they need specific habitat parameters such as medium to large trees (25-50 dbh), altitude, understorey, rattan and grass.

Table 60. Occupancy models of selected birds in MANP.

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencing Species Occupancy (ω) [2]				
			Altitude	DBH 25-50 cm	Rattan	Understorey	Grass
Phapitreron amethystinus	Amethyst brown dove	19%	32%	38%	31%	27%	26%
Basilornis mirandus	Apo myna	26%	53%	45%	37%	36%	55%
Rhipidura nigrocinnamomea	Black and cinnamon fantail	81%	0%	10%	3%	0%	1%
Corasina mindanensis	Black-bibbed Cuckoo Shrike	10%	96%	86%	25%	41%	74%
Prioniturus discurus	Blue-crowned Racquet-tail	26%	29%	40%	32%	30%	26%
Centropus melanops	Black-masked coucal	26%	39%	46%	68%	48%	71%
Rhipidura superciliaris	Blue fantail	16%	51%	66%	52%	65%	32%
Lophozosterops goodfellowi	Black-masked White-eye	13%	47%	70%	49%	42%	44%

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencing Species Occupancy (ω) [2]				
			Altitude	DBH 25-50 cm	Rattan	Understorey	Grass
Hypocryptadius cinnamomeus	Cinnamon ibon	53%	0%	51%	72%	44%	36%
Loriculus philippensis	Colasisi	58%	57%	38%	43%	60%	73%
Aethopyga primigenius	Grey-hooded sunbird	77%	6%	105%	85%	6%	175%
Prioniturus montanus	Mountain Racquet-tail	35%	38%	30%	33%	35%	83%
Irena cyanogastra	Philippine fairy bluebird	32%	36%	50%	41%	31%	29%
Hypothymis helenae	Short crested monarch	26%	32%	34%	35%	44%	41%
Penelopides panini panini	Mindanao hornbill	45%	57%	70%	76%	46%	32%
Phapitreron leucotis	White-eared Brown Dove	66%	0%	47%	11%	0%	17%
Rhabdotorrhinus leucocephalus	Writhed hornbill	10%	69%	40%	73%	72%	78%
Ptilinopus occipitalis	Yellow-breasted Fruit Dove	68%	74%	41%	51%	43%	49%

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Mammals

Key Findings (**Table 61**):

- *M. minimus*, *C. brachyotis*, *H. fischeri*, and *M. wetmorei* have high occupancy with high species density. These species were the most common in the project site. *P. jagori*, *R. inops*, *P. cf javanicus*, and *P. jagori* have lower occupancy and low species density.
- *H. whiteheadi*, *K. hardwicki*, *D. rickartii* and *E. spelea* have occupancy less than 0.15. These species have low detection rates and are uncommon in the site such as *D. rickartii*, which typically inhabits caves.
- *P. jagori*, *E. spelaea*, and *H. fischeri*, as expected, are associated to fruiting and flowering trees which the species' preferred source of food. *P. minor*, *H. whiteheadi* and *K. hardwickii* showed association to elevation gradients. *Macroglossus minimus* and *Megaerops wetmorei* are both associated to anthropogenic disturbances. These species are known to thrive in lowland areas and are commonly observed in plantations.

Table 61. Occupancy models of selected bats in MANP.

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Altitude	Distance to Water Bodies (m)	Distance to Valley Bottom (m)	Fruiting/ Flowering Trees	Anthro-pogenic Disturbance
Eonycteris spelaea	Common Dawn Bat	14%	35.2	42.83	38.28	50.21	30.79
Macroglossus minimus	Lesser Long-tongued Fruit Bat	57%	39.44	35.94	72.35	41.05	84.03
Ptenochirus jagori	Greater Musky Fruit Bat	29%	45.33	45.26	33.08	84.68	29.9

Scientific Name	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Altitude	Distance to Water Bodies (m)	Distance to Valley Bottom (m)	Fruiting/ Flowering Trees	Anthro-pogenic Disturbance
Harpyionycteris whiteheadi	Harpy fruit bat	14%	40.28	38.23	38.96	42.11	39.36
Kerivoula cf hardwickii	Hardwicke's woolly bat	14%	49.2	42.43	33.14	40.07	48.11
Pipistrellus cf javanicus	Java pipistrelle	29%	56.09	38.92	40.16	57.31	30.08
Cynopterus brachyotis	Common Short-nosed Fruit Bat	86%	39.16	37.68	81.64	41.58	27.4
Ptenochirus minor	Lesser musky fruit bat	43%	84.85	28.98	29.38	83.57	30.85
Rhinolophus inops	Philippine forest horseshoe bat	43%	27.41	40	29.68	43.79	29
Dyacopterus rickartii	Philippine Large-headed Fruit bat	14%	41.38	41.47	34.69	48.18	32.73
Haplonycteris fischeri	Philippine Pygmy Fruit Bat	71%	49.51	49.4	26.23	86.8	28.7
Megaerops wetmorei	White-collared fruit bat	57%	41.13	23.02	60.26	36.64	75.91

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Amphibians

Key Findings (**Table 62**):

- *L. lumadorum*, *M. stejnegeri*, *P. brevipes*, and *P. acutirostris* showed to have high space requirement (32 to 45%). These species are susceptible to landscape wide changes.
- *muelleri*, *K. pleurostigma*, *L. parvus*, *N. spinosus*, *P. lighti*, *P. poecilus*, *P. worcesteri*, *P. corrogatus*, *P. guentheri*, and *S. natator* have low occupancies and low species density due to specific habitat requirement.

Table 62. Occupancy models of selected amphibians in MKRNP.

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Distance to Water Bodies (m)	Canopy	Saplings	Rattan	50-100 cm dbh
Ansonia muelleri	Mueller's Toad	16%	40.49	68.68	83.23	42.91	73.96
Kalophrynus pleurostigma	Black-spotted sticky frog	16%	55.75	74.90	28.47	43.93	84.51
Leptobrachium lumadorum		42%	49.78	48.60	61.00	40.74	51.50
Limnonectes magnus	Giant Philippine frog	10%	72.92	82.07	60.35	80.89	49.71
Limnonectes parvus	Philippine small-disked frog	13%	33.86	77.12	75.31	65.87	36.35
Megophrys	Southeast Asian	32%	55.94	28.68	18.18	86.04	75.69

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Distance to Water Bodies (m)	Canopy	Saplings	Rattan	50-100 cm dbh
stejnegeri	horned toad						
Nyctixalus spinosus	Spiny tree frog	12%	40.60	43.37	43.91	49.22	48.06
Pelophryne brevipes		45%	99.99	99.95	25.77	29.76	29.73
Pelophryne lighti		19%	79.35	27.63	69.37	43.34	46.09
Philautus acutirostris	Philippine bubble-nest frog	68%	87.76	34.75	90.11	90.16	88.98
Philautus poecillus	Mottled tree frog	13%	34.10	54.33	54.40	35.01	28.59
Philautus worcesteri	Smooth-skinned tree frog	13%	34.11	54.34	54.40	35.01	28.59
Platymantis corrogatus	Masked wrinkled ground frog	19%	18.04	77.51	86.33	86.45	31.39
Platymantis guentheri	Gunether's ground frog	19%	52.01	74.55	38.28	40.95	72.39
Starois natator	Black-spotted rock frog	23%	48.09	44.94	42.09	52.44	36.67

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Reptiles

Key Findings (**Table 63**):

- *Sphenomorphus coxi, S. diwata and T. flavomaculatus* have the highest occupancy among selected reptile species. This suggests that species are more susceptible to landscape changes.
- *Cyclocorus lineatus, G. sophiae, T. davaoensis and V. salvator* are species with low occupancies. These species do not require large areas but they need specific habitat parameters such as medium to large trees (50-100 dbh), dead woods and canopy.

Table 63. Occupancy models of selected reptiles in MANP.

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Canopy	50-100 cm dbh	Saplings	Humus	Natural Deadwood
Brachymeles gracilis	Short-legged skink	3%	50.96	34.56	46.31	37.52	46.52
Cyclocorus lineatus	Northern Triangle-spotted snake	3%	33.95	40.49	56.61	52.66	59.11
Gonocephalus sophiae	Negros forest dragon	3%	37.94	64.51	59.64	44.24	40.46
MatIcora intestinalis	Banded Malaysian coral snake	6%	44.16	88.34	53.85	31.28	41.54
Oxyrhabdium modestum	Philippine shrub snake	6%	38.58	76.52	53.84	35.57	39.14

Species	Common Name	Occupancy (%) [1]	Environmental Factors Influencng Species Occupancy (ω) [2]				
			Canopy	50-100 cm dbh	Saplings	Humus	Natural Deadwood
Rhabdophis auriculata	White-lined water snake	4%	86.97	34.42	58.61	30.82	64.17
Sphenomorphus coxi	Cox's sphenomorphus	10%	93.53	51.37	59.29	53.03	39.23
Sphenomorphus diwata	Diwata sphenomorphus	10%	32.36	50.20	33.61	78.10	60.80
Trimeresurus flavomaculatus	Philippine pit viper	10%	56.22	43.54	42.59	68.87	52.79
Tropidophorus davaoensis	Davao waterside skink	3%	40.69	67.00	45.94	33.72	42.01
Varanus salvator	Common Water monitor	3%	40.69	67.00	45.94	33.72	42.01

[1] Occupancy indicates the proportion of area occupied (PAO) by the species in the site.
[2] Akaike's Information Criterion (AIC) cummulative weights of five environmental covariates indicating level of support for each model.

Population Density Estimates for Birds in NSMNP

Key Findings (**Table 64**):

- The population density estimates generated for the 23 selected species of birds is the first attempt to provide population baseline for these species.
- Species having high densities in second growth forests are Yellow-breasted Fruit-dove (*Ptilinopus occipitalis*) and the Near Threatened Philippine Fairy-bluebird (*Irena cyanogaster*). To secure these species, conservation intervention should be directed in this habitat, the second growth forest.

Table 64. Population density estimates (number per hectare) of 23 species of birds across different habitat types.

Species	Density Estimates±CV (number/ha)			
	CVT	ESG	ASG	OGF
Amethyst Brown-Dove	0±0	1.97±22.60	1.96±30.21	3.48±42.73
Balicassiao	1.76±50.00	0.68±55.50	0.50±79.69	0.25±97.47
Bar-bellied Cuckoo-Shrike	5.30±100.00	3.77±47.03	1.58±49.07	0.75±97.47
Black-and-White Triller	0±0*	1.23±38.45	1.44±36.08	0.50±97.47
Blackish Cuckoo-Shrike	0.21±100	1.96±41.05	3.32±36.21	1.51±65.19
Black-naped Monarch	0±0*	4.45±47.81	1.97±55.89	5.40±78.02
Blue-headed Fantail	0±0*	11.06±75.52	5.09±39.27	2.02±65.19
Buzzing Flowerpecker	0±0*	6.47±49.81	4.35±52.05	11.62±53.21
Elegant Tit	0±0*	2.98±39.62	2.10±37.08	4.92±44.59
Hodgson's Hawk-Cuckoo	0±0*	0.85±34.57	0.81±36.97	0.37±97.47
Olive-backed Flowerpecker	0±0	4.85±46.40	3.21±99.07	2.52±97.47
Orange-bellied Flowerpecker	0±0*	5.61±35.34	6.47±64.49	6.06±54.20

Species	Density Estimates±CV (number/ha)			
	CVT	ESG	ASG	OGF
Philippine Bulbul	3.83±57.67	24.60±41.05	23.94±53.40	4.21±31.39
Philippine Coucal	1.20±50.92	3.13±42.35	1.28±57.77	1.01±97.47
Philippine Fairy-Bluebird	0±0*	3.85±30.05	4.35±30.12	3.94±39.54
Philippine Tailorbird	12.06±69.66	13.75±23.56	10.71±21.18	7.40±22.39
Purple-throated Sunbird	0±0	7.27±46.91	0.57±99.07	0±0
White-browed Shama	3.53±100.00	5.12±40.99	2.12±36.89	0±0
White-eared Brown-Dove	0±0*	3.46±17.72	1.56±27.72	3.18±46.92
White-lored Oriole	0±0*	1.27±43.51	0.93±38.51	0.60±117.38
Yellow-bellied Whistler	0±0*	1.64±36.15	0.87±54.20	4.54±81.14
Yellow-breasted Fruit-Dove	0±0*	2.15±46.89	9.39±39.23	3.03±82.92
Yellow-wattled Bulbul	0±0	0.96±69.42	1.20±65.98	4.54 ±69.52

Note: Coefficient of variation (CV) or relative standard error (SE) is expressed in percentage that indicates the precision of the estimates. A value of zero indicates that there was no observation of the species in that particular habitat.

3.4. High Conservation Value Areas using congruence of the various Species Distribution Models

This section presents the congruence analysis or finding geographic overlaps of the different species distribution models across the landscape (See Section 4.2).

NSMNP

Key Findings:

- Based on the combined species distribution model results, areas with high congruence of species are located in lowlands particularly in Divilacan. Increasing color shading the overlapping species richness on a 1-km^2 pixel.
- Coverage of HCVAs for birds is the largest whilst the non-volant (non-flying) vertebrates showed smaller coverage.
- Species tend to pack in lowland forests around the Palanan point and west of San Ildefonso point.

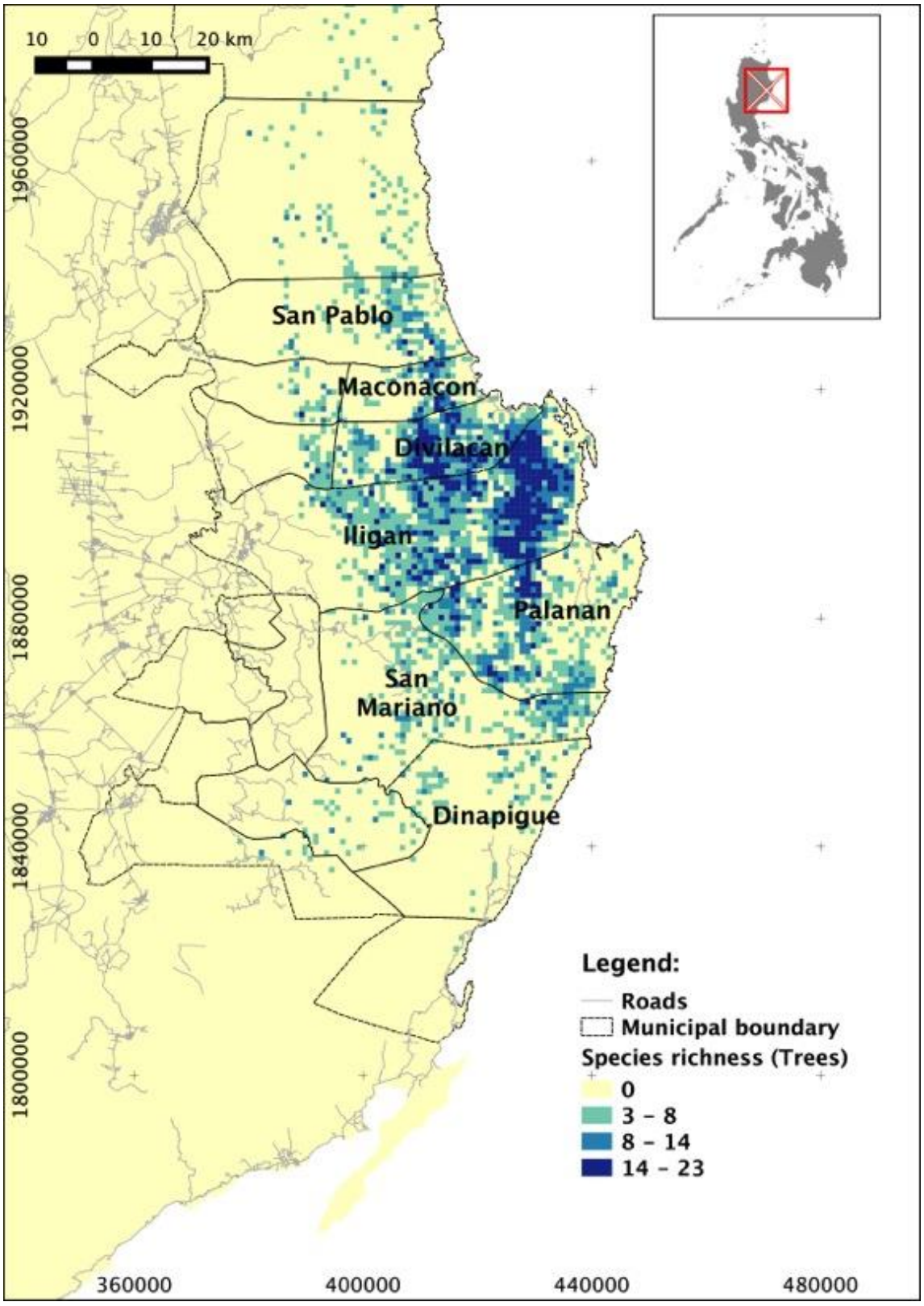

Figure 6. Species distribution of selected tree species in NSMNP.

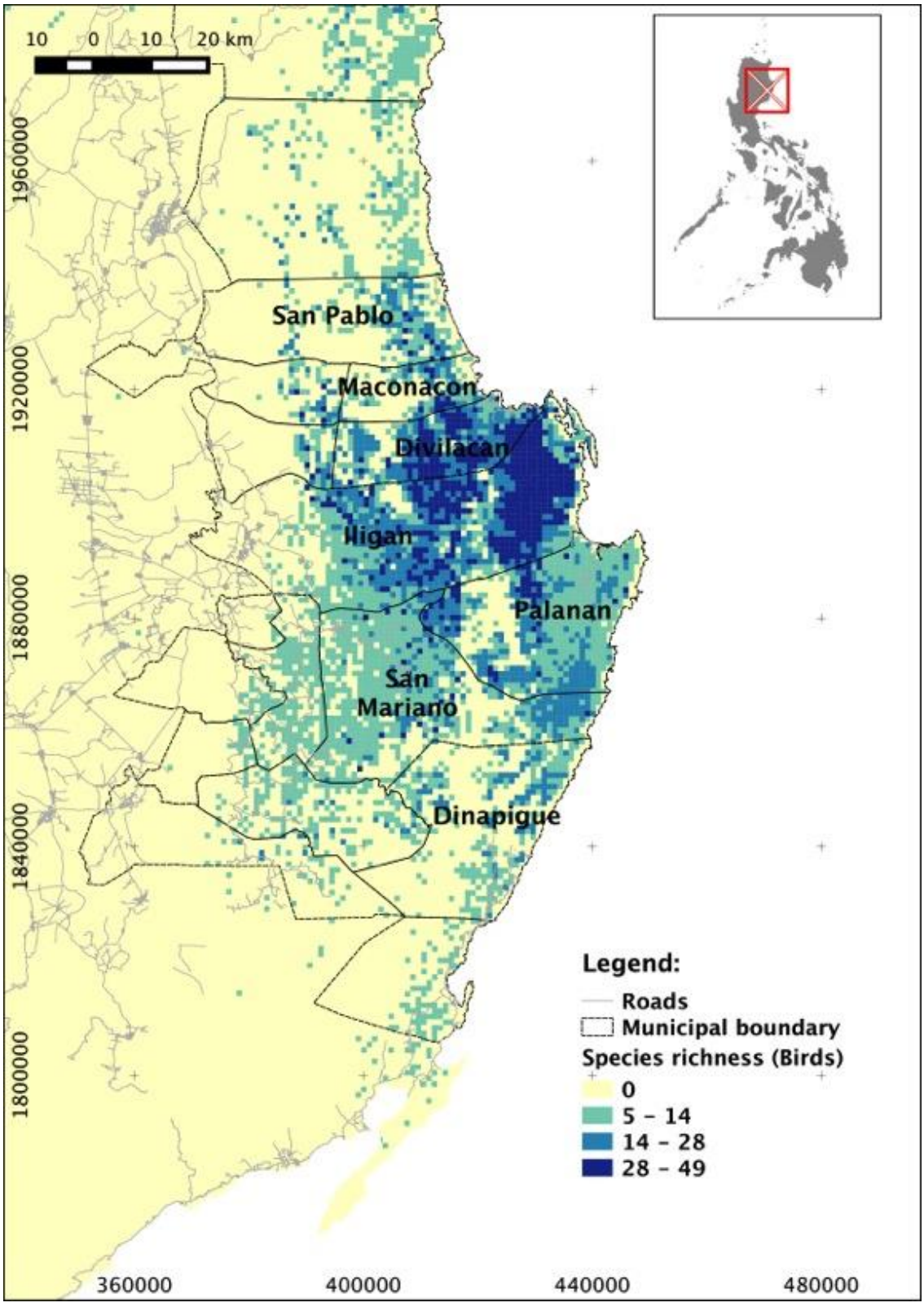

Figure 7. Species Distribution of selected species of birds in NSMNP.

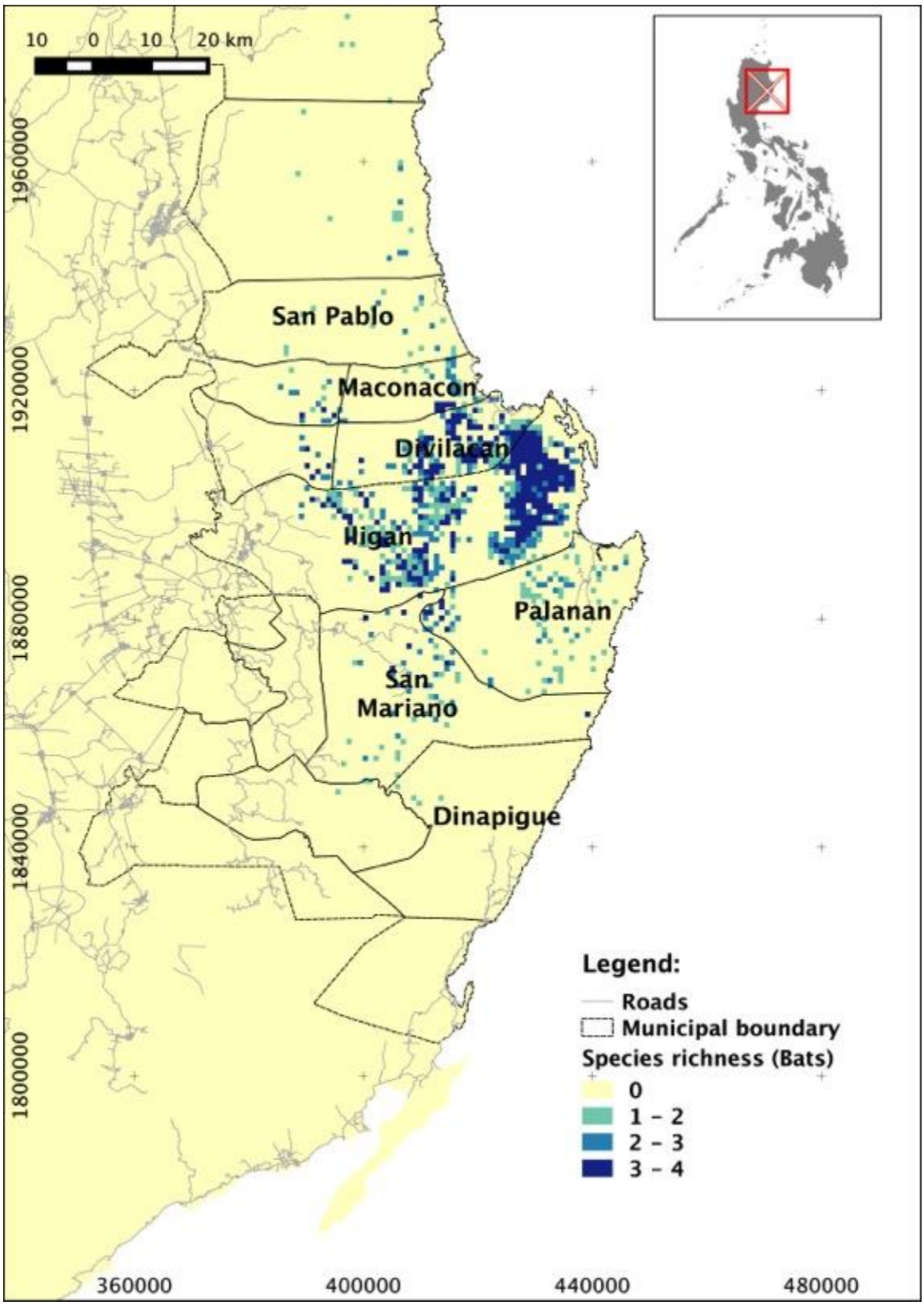

Figure 8. Species distribution of selected bat species in NSMNP.

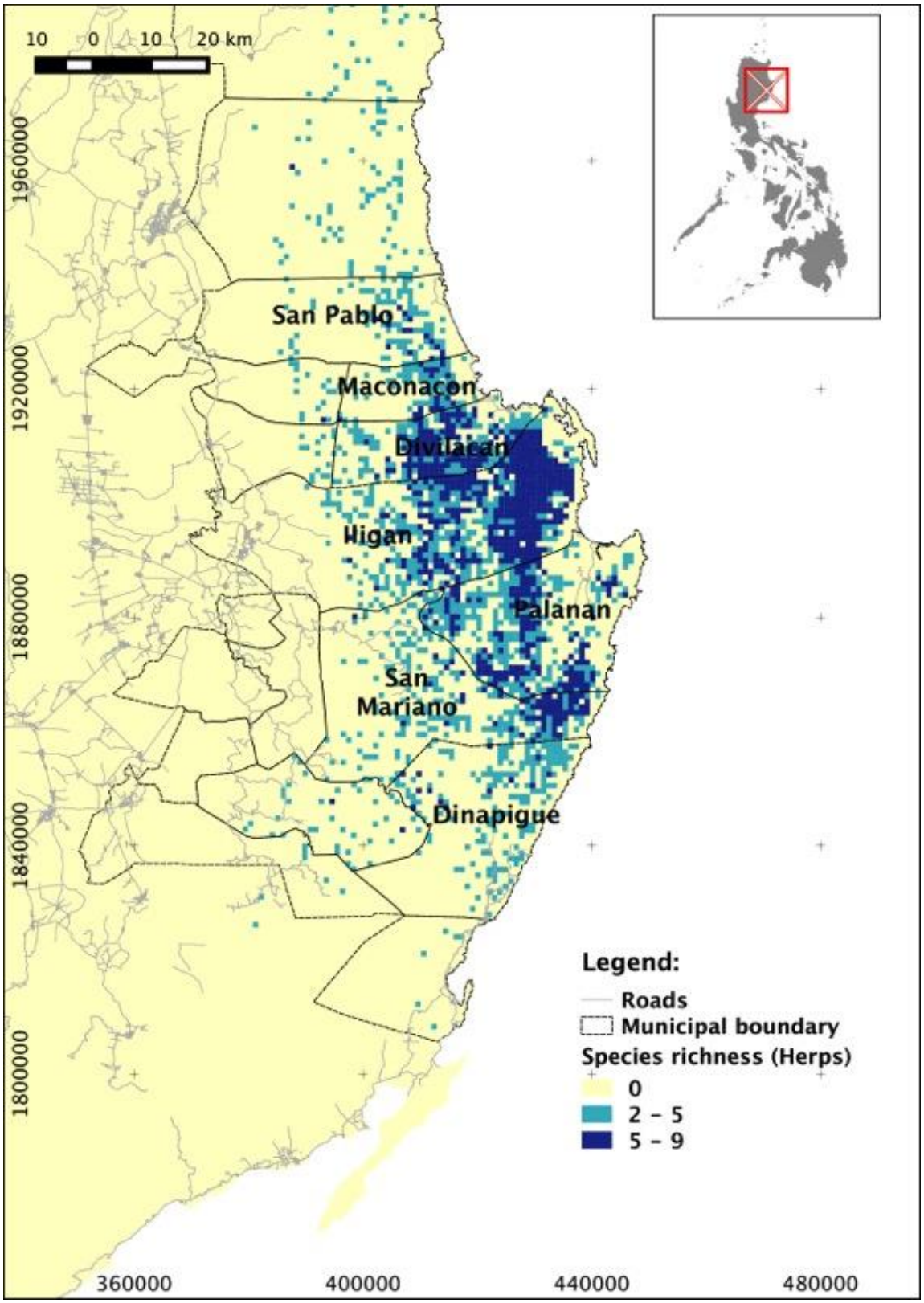

Figure 9. Species distribution model of selected amphibians and reptile species in NSMNP.

KWFR and UMRBPL

Key Findings:

- The prediction of the bird species distribution model using data from the proxy sites was projected within the boundaries of the Upper Marikina River Basin Protected Landscape (UMRBPL) and Kaliwa Watershed Forest Reserve (KWFR) although most of these are outside the current boundaries.
- Large extent of predicted suitable habitats of four (4) bird species is high in the northwestern portion of UMRBPL and KWFR.

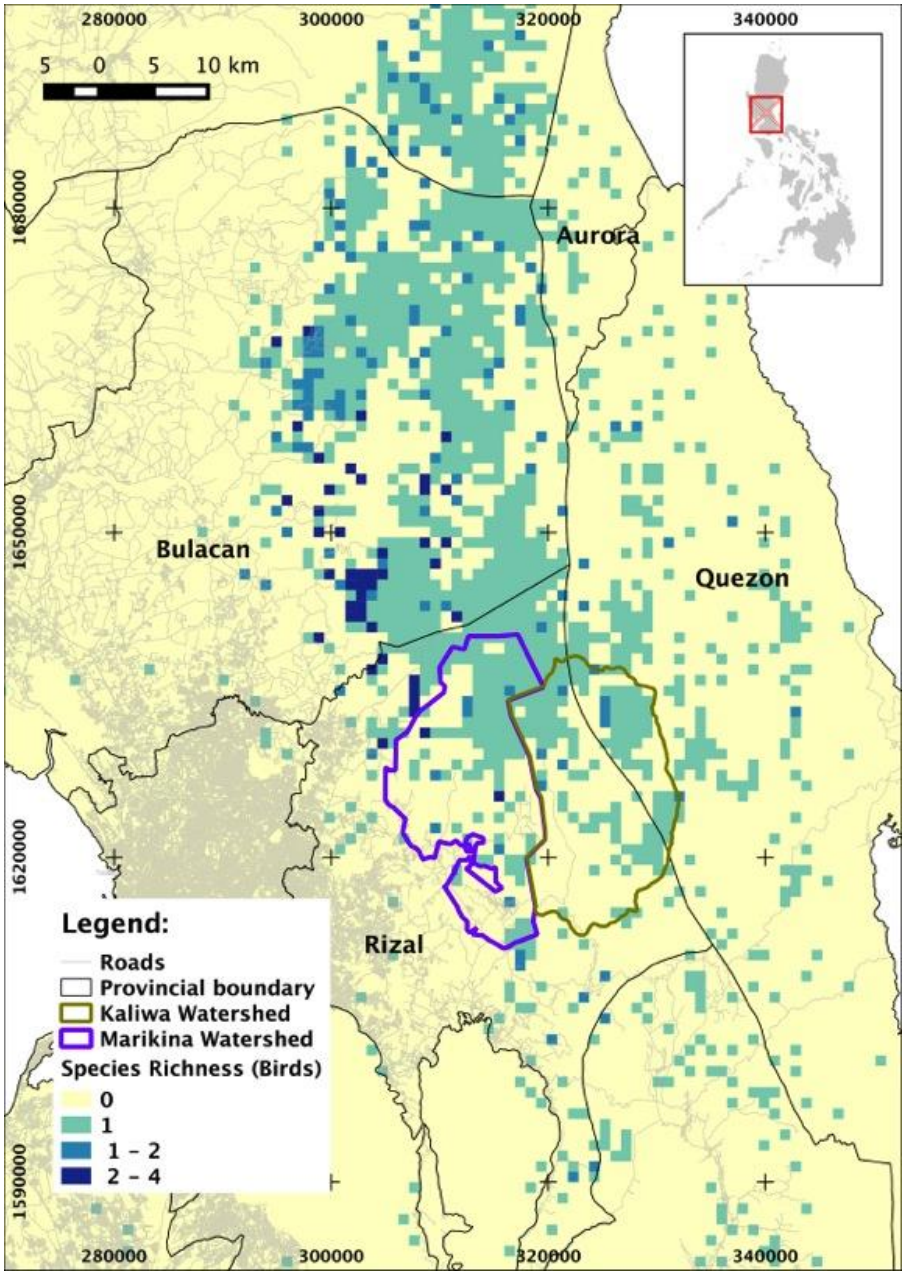

Figure 10. Species distribution model of selected bird species in Kaliwa-UMRBPL.

NLNP

Key Findings:

- The SDM performed on birds and herpetofauna predicted the northeastern section of Mindoro as the suitable habitats for these groups of species (Appendix 3 for list of species).
- The high species congruence of both groups were almost similarly located mostly at the Northern segments of Oriental and Occidental Mindoro.
- Low congruence of species occupied the areas at the Southern part of Mindoro.
- The amalgamated results of species distribution models suggest that the northern part of the island has the highest congruence of species (Figure 4).

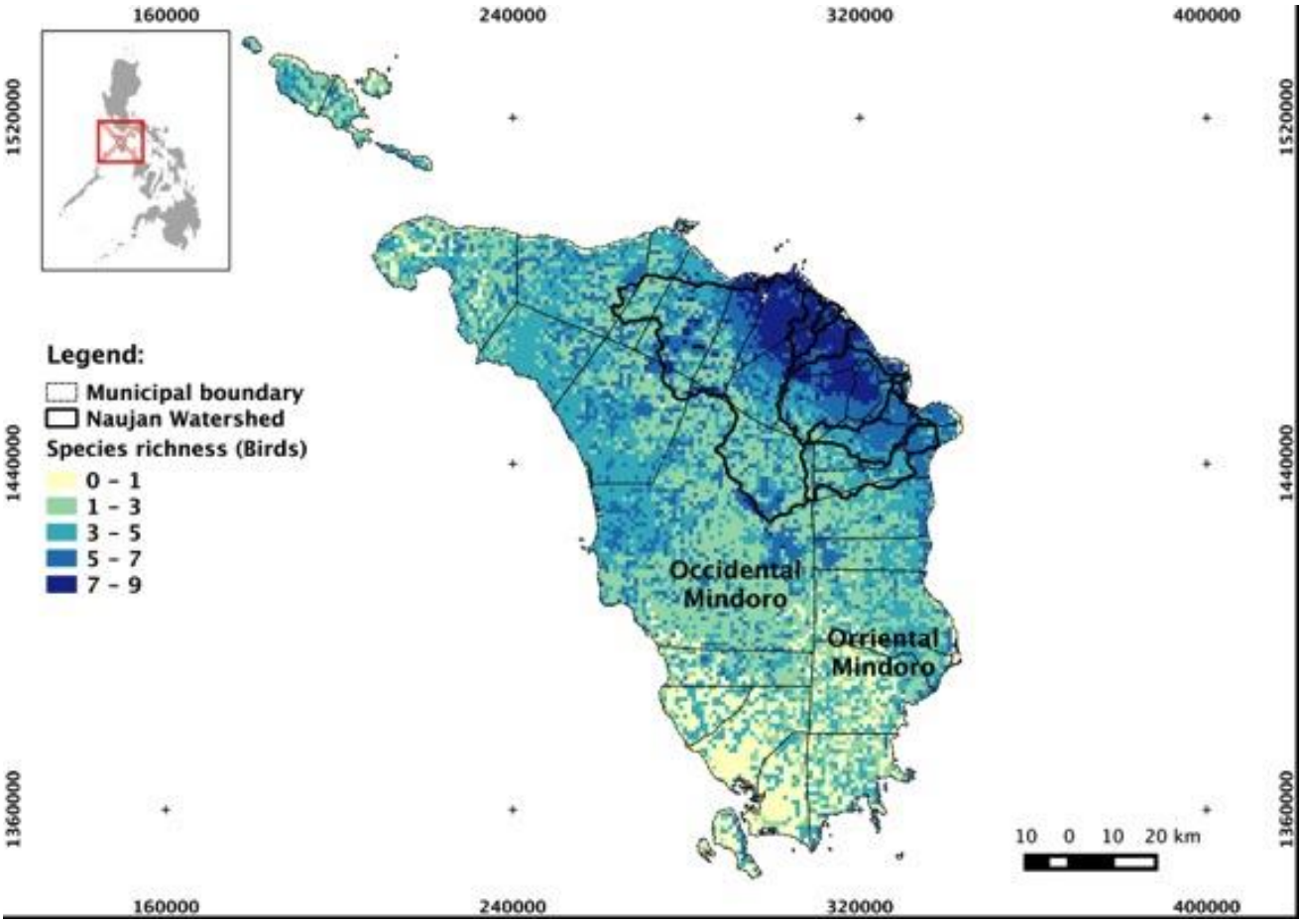

Figure 11. Species distribution model of selected bird species in NLNP.

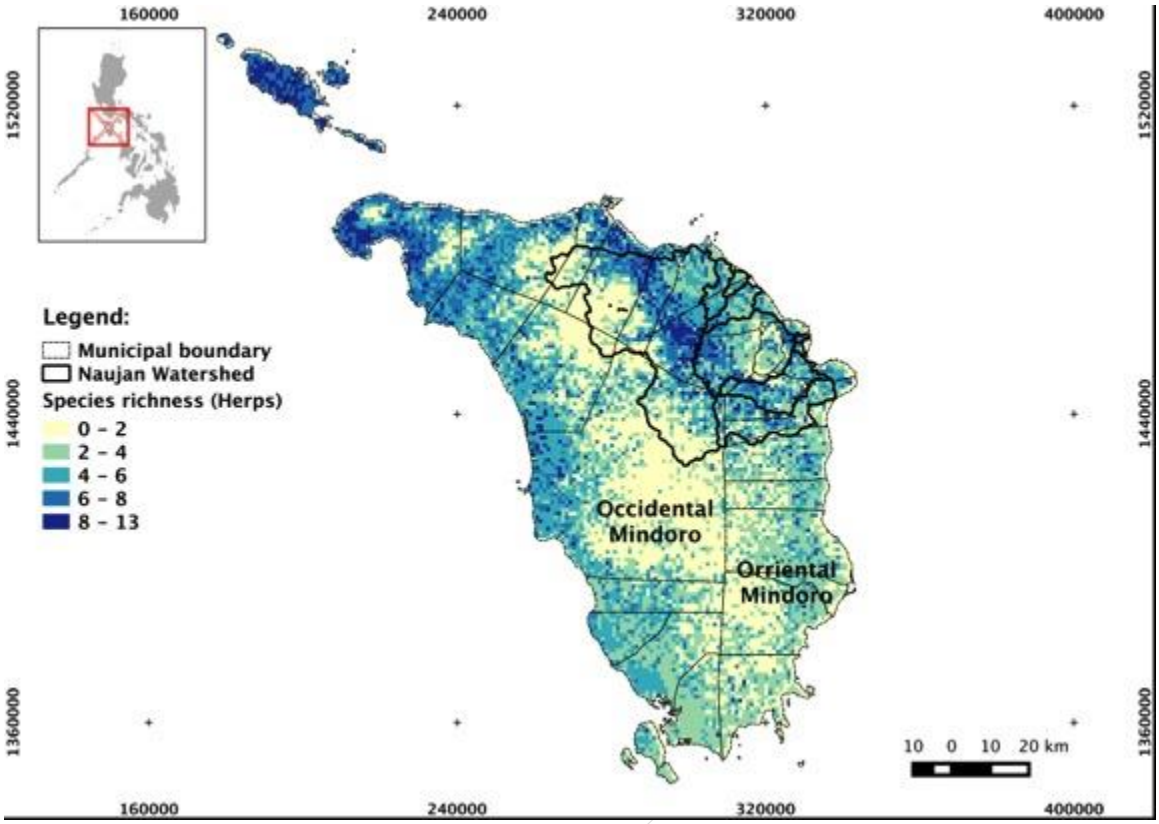

Figure 12. Species distribution model of selected species of herps in NLNP.

Bago

Birds

Key Findings:

- The HCVAs were likewise identified for 31 trigger species of birds in BRWFR. These 31 key species are *Phapitreron amethystine maculipectus, Dicrurus balicassius, Rhipidura cyaniceps, Tanygnathus sumatranus, T. lucionensis salvadorii, Culicicapa helianthea, Sarcops calvus, Parus elegans, Aethopyga shelleyi, Columba vitiensis anthracina, Zosterops montanus, Eumyias panayensis, Stachyris nigrorum, Ducula poliocephala, Macropygia tenuitris tenuistris, Ixos philippinus, Centropus viridis, Dendrocopus maculatus, Orthotomus castaneiceps, Lalage nigra, Ficedula hyperythra nigrorum, Penelopides Panini, Brachypterys Montana, Dryocopus javensis, Phapitreron leucotis nigrorum, Pachycephala homeyeri, Coracina ostentata, Ptilinopus occipitalis occipitalis, Zosterops nigrorum, Pycnonotus goiavier* and *P. urostictus.*
- As shown below, high concentrations of the trigger species of birds are predicted to be located on the northern side of the watershed covering the Municipaitiy of Salvador Benedicto and Silay City; and on the southern southern part that covers the Muncipality of Murcia.

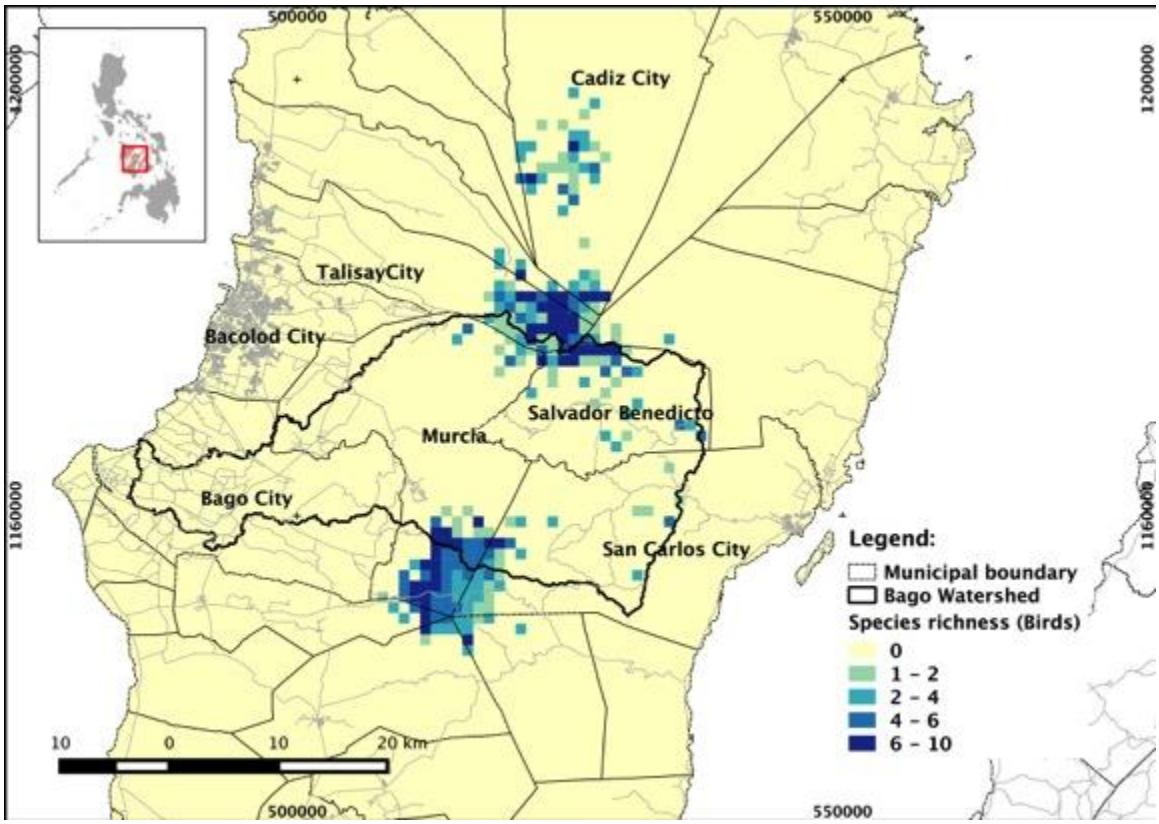

Figure 13. Species distribution model of selected bird species in BRFWR.

Bats

Key Findings:

- The HCVAs were likewise identified for seven (7) trigger species of bats in BRWFR. These key species include *Cynopterus brachyotis, Haplonycteris fischeri, Harpyionycteris whiteheadi, Macroglossus minimus, Nyctimene rabori, Ptenochirus jagori and Rhinolophus arcuatus.*
- Almost the same pattern for all taxa are projected for the BRWFR site. For bats however, the major big difference is the intensity and congruence with which the species are concentrated in areas where they are most likely to be found.
- A large portion of the key species of bats tend to clump along the boundaries of Silay City and Talisay City where the remaining forests are currently situated. Same goes for the Municipality of Murcia that overlaps with both BRWFR and NNNP where majority of the key species of mammals are predicted still to be most likely to be found.

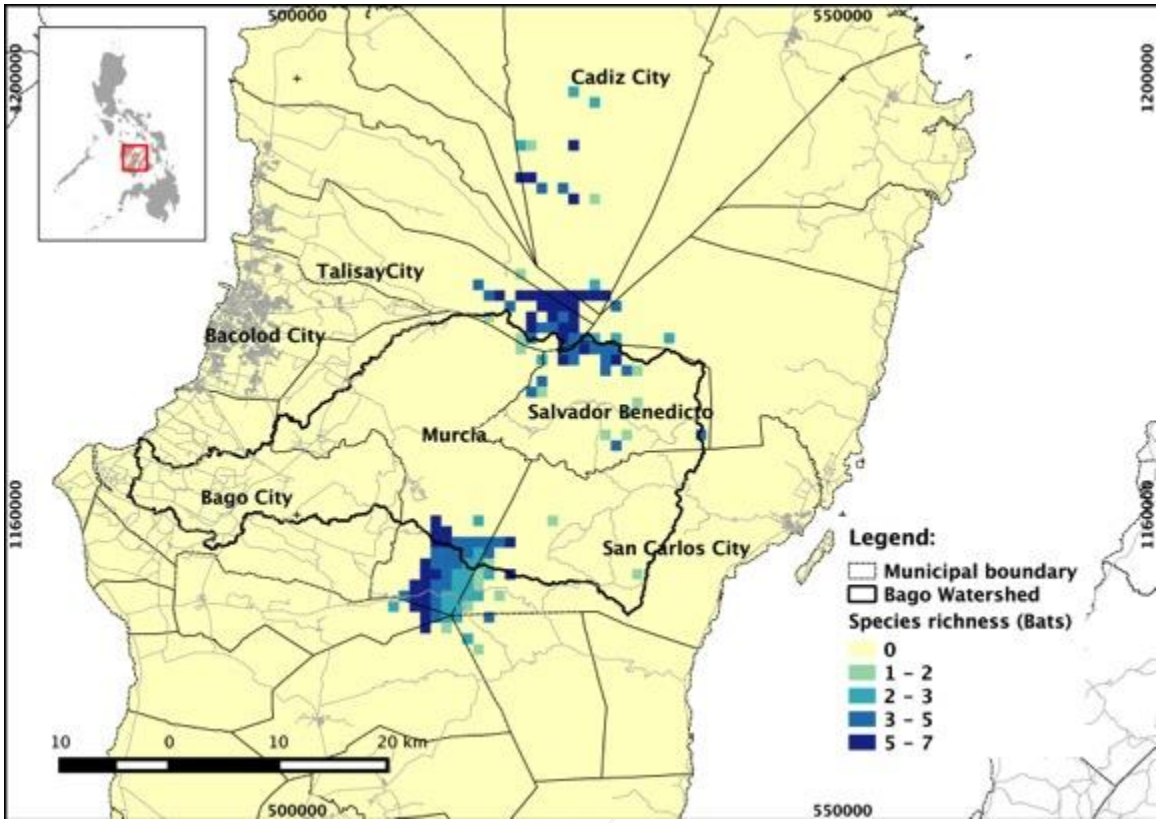

Figure 14. Species distribution model of bats in BRFWR.

Herps

Key Findings:

- The HCVAs were identified for 12 trigger species of herps in Bago Watershed, MKNP and NNNP. These 12 key species include six (6) amphibians - *Platymantis corrugatus, P. dorsalis, P. guentheri, P. hazelae, Occidozyga laevis, Rhacophorus pardalis,* and six (6) reptile species – *Draco spilopterus, Gonocephalus sophiae, Pinoyscincus jagori, Ahaetulla prasina, Pseudorabdion montanum, Cyclocorus lineatus* and *Psammodynastes pulverulentus.*
- Key species of reptiles and amphibians analysed for SDM were predicted to be concentrated just a little inside Bago Watershed on the side of Salvador Benedicto and extends beyond Silay City, Talisay City Municipality of Calatrava and Cadiz City. Note that this portion of the province overlaps with the NNNP.
- The same scenario is predicted on the southwestern flank of the watershed – where most of the key herpetofaunal species are most likely to be present in the Municipality of Murcia that overlaps with MKNP.
- Sporadic predictions of the key species of reptiles were recorded for Canlaon City, Municipality of La Castella and La Carlota City.

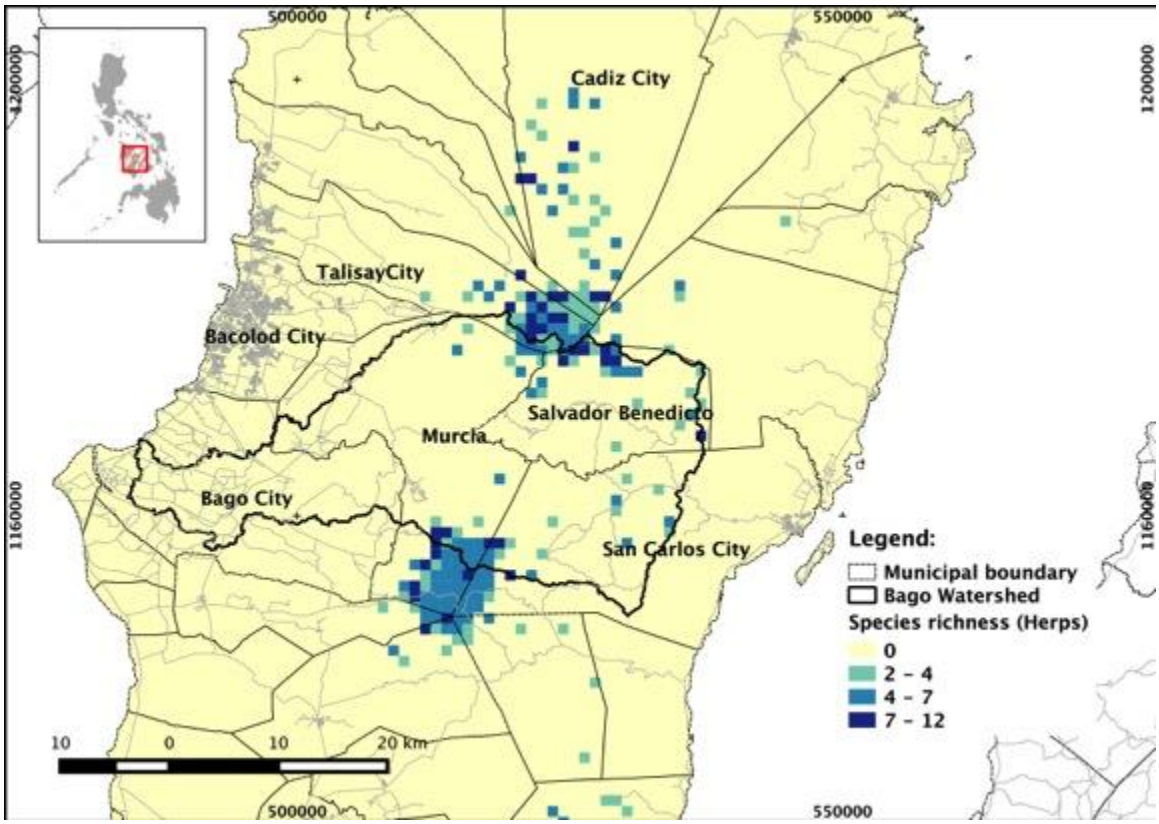

Figure 15. Species distribution model of selected species of herps in BRFWR.

Trees

Key Findings:

- The HCVA for five (5) key species of trees were identified using Species Distribution Modelling (SDM) throughout Bago Watershed, MKNP and NNNP. These species include *Bischofia javanica, Palaquium luzoniense, Shorea contorta, S. negrosensis* and *S. polysperma.*
- Key tree species analysed for SDM are mostly concentrated on the northern most side of the watershed covering the Municipality of Salvador Benedicto. This type of species distribution pattern also extends toward the Mt. Kanla-on Natural Park, particularly in Cadiz City and parts of Silay City and Talisay City as well. Note though that this part of NNNP is beyond the boundaries of the watershed except for a very small portion that overlaps with Talisay City.
- The part of Murcia that overlaps with Bago Watershed on its southwestern flank is another spot where the five key tree species were also predicted to be present in the area.

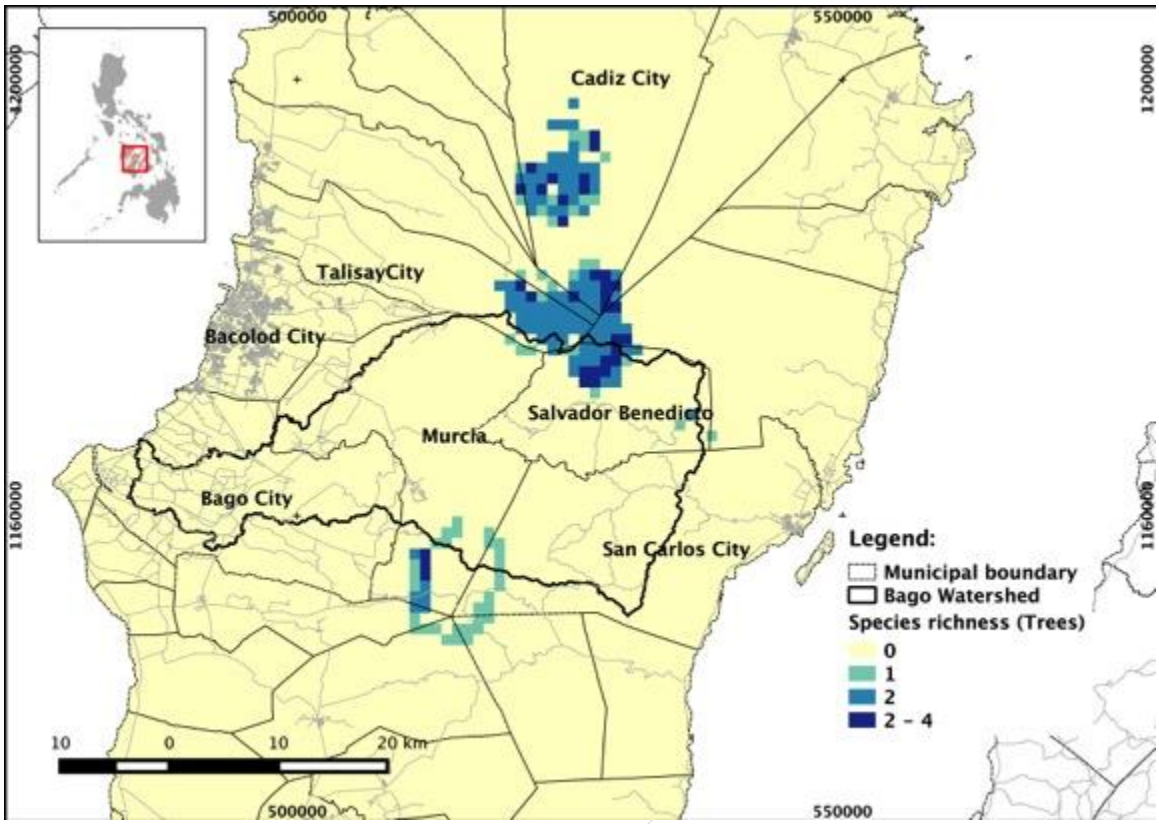

Figure 16. Species distribution model of selected tree species in BRFWR.

MKRNP

Birds

Key Findings:

- There is low congruence of species in high elevation areas while high species congruence was observed in lowland areas, within the buffer zones and outside the park boundary.
- Species distribution models for species of birds: Cinnamon Ibon, Black and Cinnamon Fantail, Black-bibbed Cuckoo Shrike, Black-faced Coucal, Celestial Monarch, Grey-hooded Sunbird, Mindanao Hornbill, Mountain Racquet-tail, Philippine Hawk Eagle, Philippine Fairy Bluebird, and Writhed Horbill based on the logistic output of Maxent.

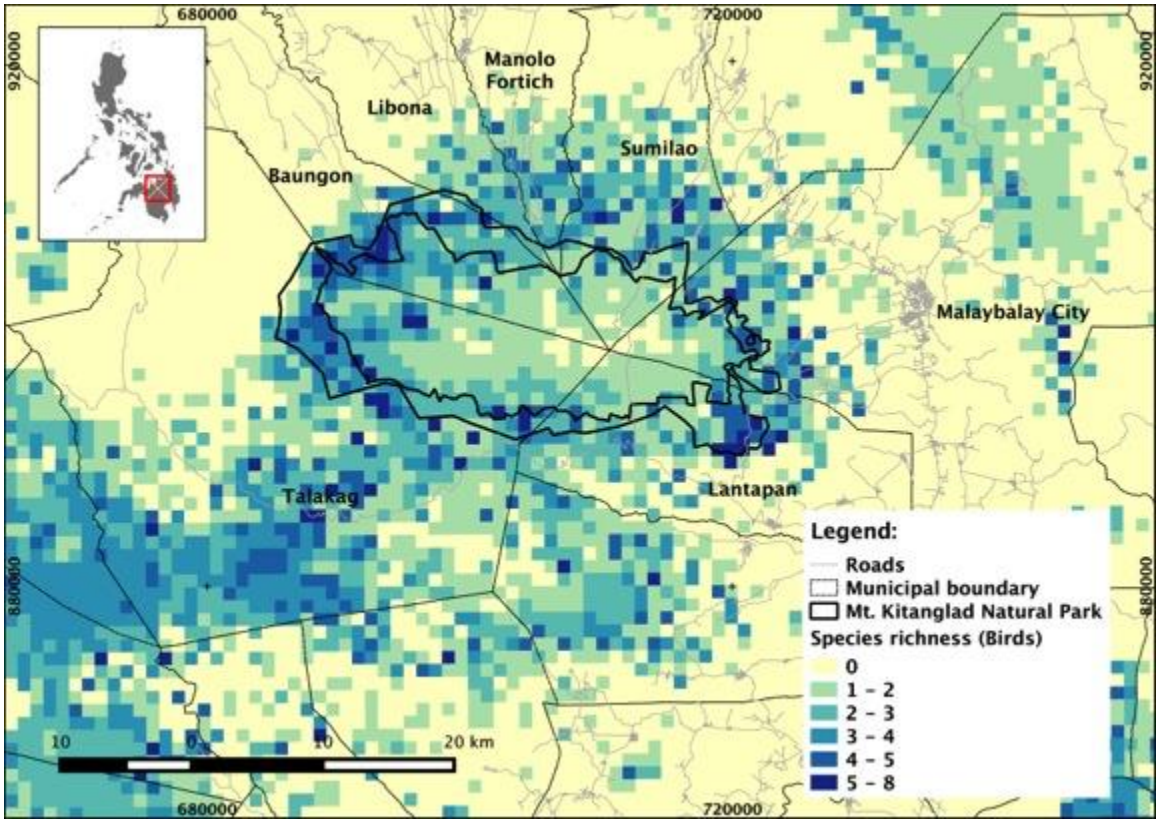

Figure 17. Species distribution model of selected species of birds in MKRNP.

Flora

Key Findings:

- Areas with high congruence of species for trees were located on the northern and northeastern part of MKRNP, which are lowland areas.
- There is poor species congruence in the highland areas of the park and an even lower congruence on the western part.
- Species distribution models for species of birds: *Acer laurinum, Shorea contorta, Cinnamomum mercadoi, Agathis philippinensis, Dacrycarpus imbricatus, Calophyllum inophyllum, Palaquium tenuipetiolatum, Syzygium nitidum, Mallotus mollisimus, Shorea negrosensis,* and *Shorea polysperma* based on the logistic output of Maxent. Increasing color shading represents overlapping number of species richness on a 1-km^2 pixel.

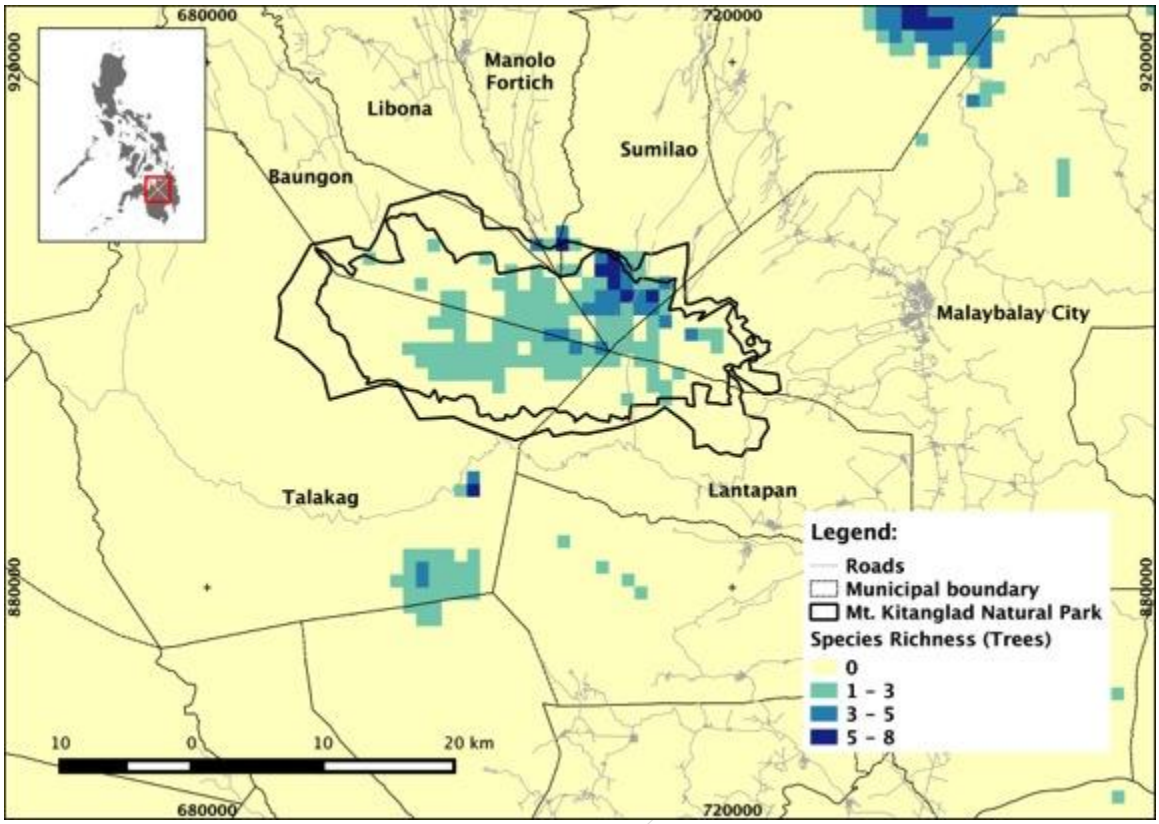

Figure 18. Species distribution model of tree species in MKRNP.

MANP

Birds

Key Findings:

- Dark shadings in the map indicate areas with high species congruence in terms of suitable habitats. These areas are low elevation forests.
- Species congruence is lower at higher elevations.
- It can also be noted that species richness for birds is higher in areas outside the protected area.
- Species distribution models for species of birds: Cinnamon Ibon, Black and Cinnamon Fantail, Black-bibbed Cuckoo Shrike, Black-faced Coucal, Celestial Monarch, Grey-hooded Sunbird, Mindanao Hornbill, Mountain Racquet-tail, Philippine Hawk Eagle, Philippine Fairy Bluebird, and Writhed Hornbill based on the logistic output of Maxent.

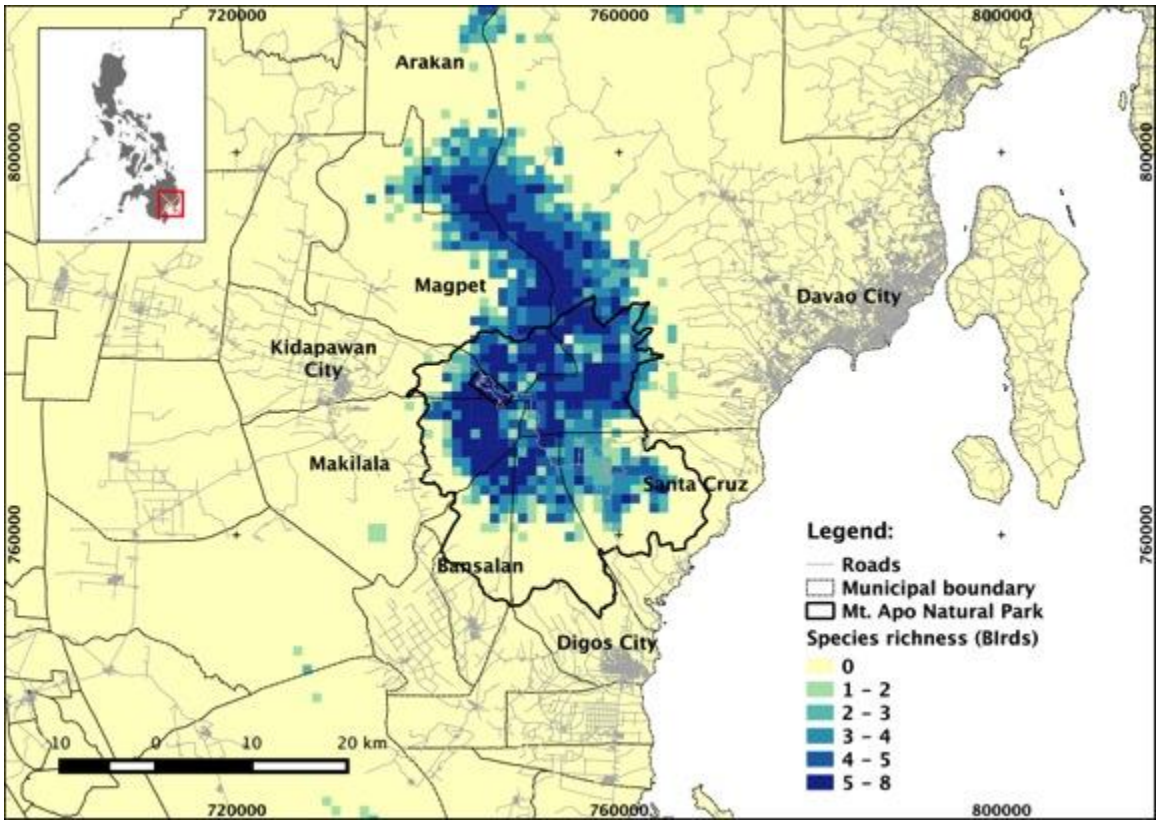

Figure 19. Species distribution model of birds in MANP.

Trees

Key Findings:

- Areas with high congruence of species of trees were located on the upper part and outside of MANP.
- There is low species congruence in the highland areas of the park.
- Species distribution models for species of trees: *Acer laurinum, Shorea contorta, Cinnamomum mercadoi, Agathis philippinensis, Dacrycarpus imbricatus, Calophyllum inophyllum, Palaquium tenuipetiolatum, Syzygium nitidum, Mallotus mollisimus, Shorea negrosensis,* and *Shorea polysperma* based on the logistic output of Maxent.

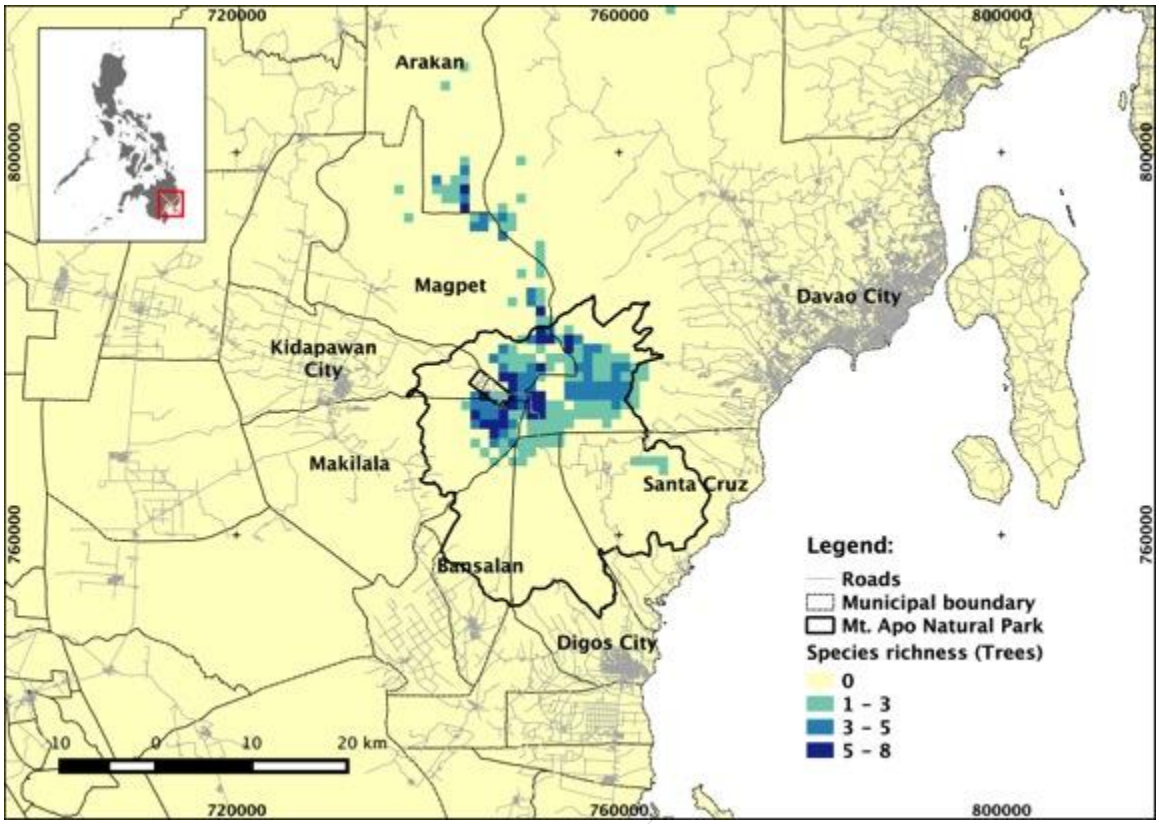

Figure 20. Species distribution model of selected trees in MANP.

3.5. LAND USE CHANGES VIA CHANGE DETECTION ANALYSIS USING REMOTE-SENSED DATA

NSMNP

Key Findings:

- The total natural forest loss in seven years (2003 to 2010) is 10,256 ha.
- The total forest gain through either reforestation or natural regeneration is 5,715 ha.
- The annual rate of net change per year based on 2003 to 2010 data is 649 ha./yr.

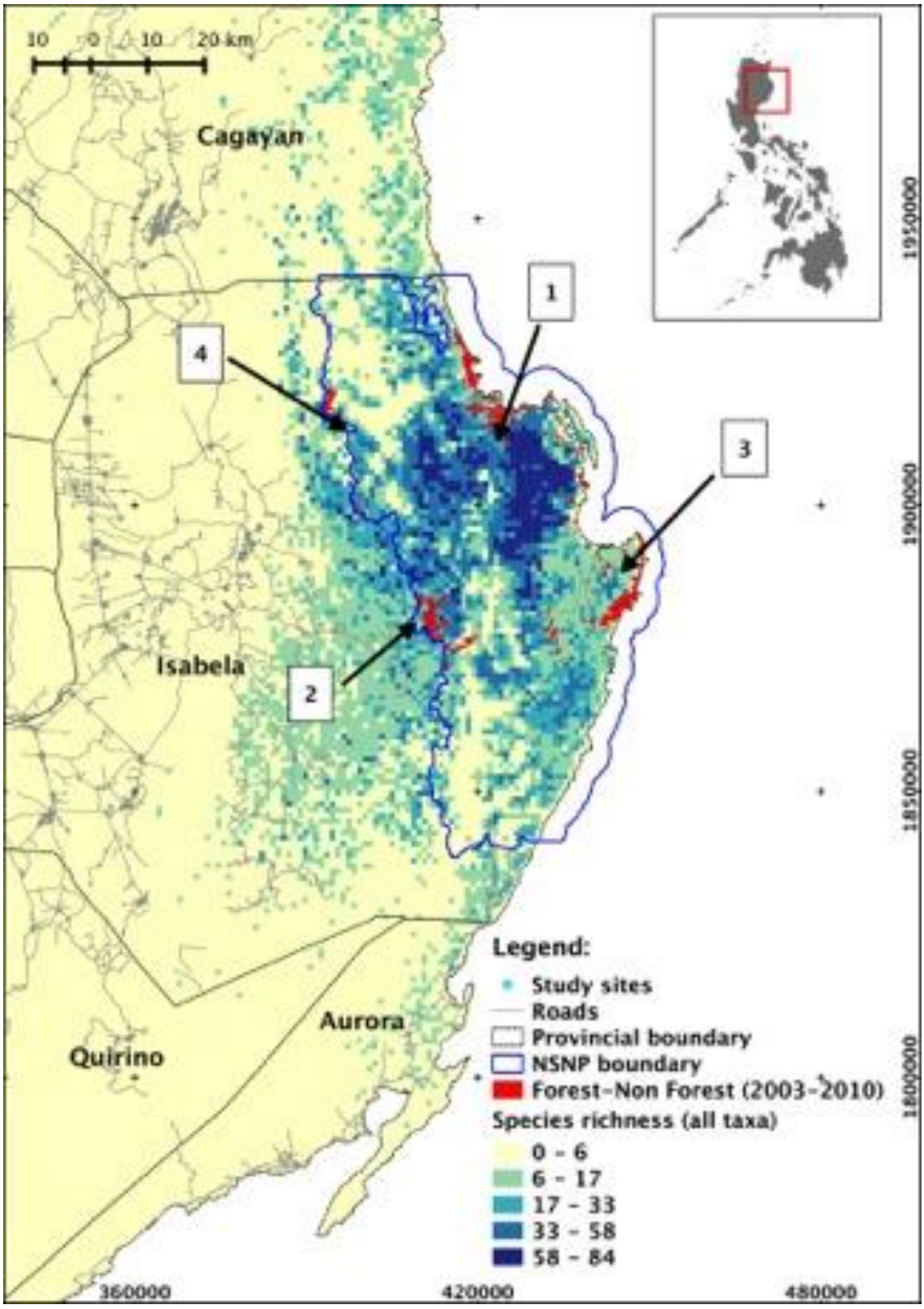

Figure 21. Areas within NSMNP with extensive forest change.

KWFR and UMRBPL

Key Findings:

- Total area deforested over a span of seven years (2003-2010) was 2,247 ha with annual deforestation rate of 321 ha/yr.
- From among the different municipalities that have jurisdiction over UMRBPL and KWFR, the municipality of Tanay had the highest net negative change from forest to non-forest of 2,204 ha (over 7 yrs) and an annual net loss of 315 ha/yr. (Table 14)
- The previous trend is quite contrary to the municipality of Gen. Nakar where a seemingly positive net gain of forests occurred over the period of 2003-2010, having a rate of 92 ha/yr of positive net forest change.

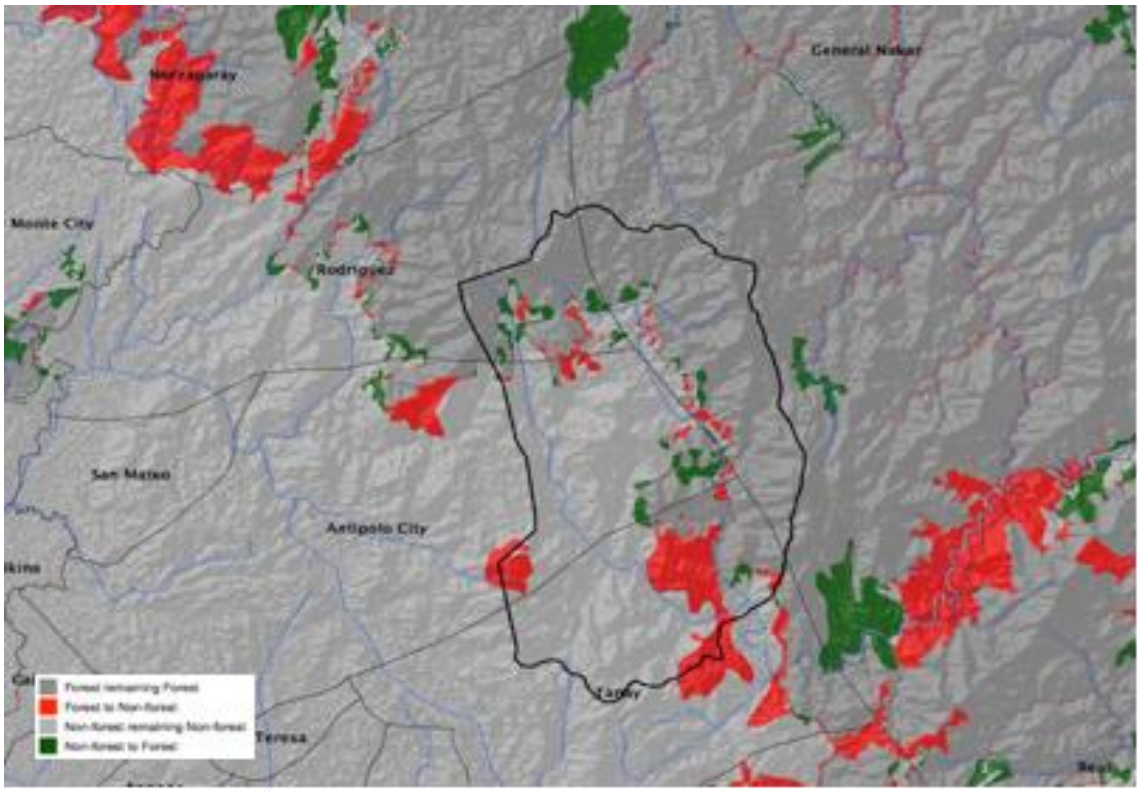

Figure 22. Forest cover change detection from 2003 to 2010 at KWFR and UMBPLR.

NLNP

Key Findings:

- Forest cover loss reached 3,899 ha (557 ha/yr) from 2003 to 2010
- On the same period, proximate watersheds in NLNP had a net negative forestchange of 99 ha/year in Pula watershed, while a net positive forest cover change was happened in Butas watershed with 202 ha/yr gain.
- Naujan had the highest net negative forest change and highest rate of net negative forest change on annual basis (4,321 ha; 617 ha/yr).
- The analysis identified 5 hotspots of forest cover change, these are the following;
    1. Puerto Galera, Baco, San Teodoro of Oriental Mindoro and Abra de Ilog of Occidental Mindoro
    2. Lubang Group of Islands
    3. Naujan and Pola of Oriental Mindoro
    4. Sablayan of Occidental Mindoro

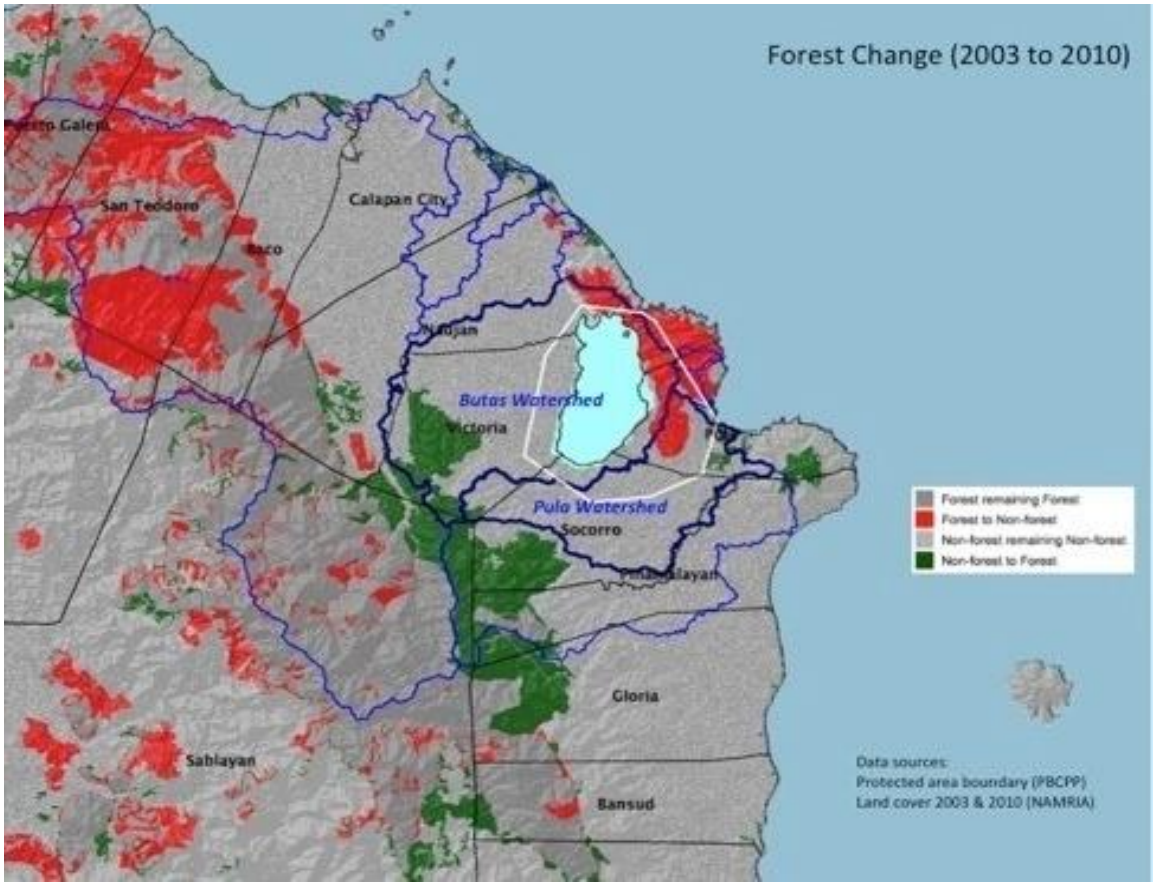

Figure 23. Forest cover change detection from 2003 to 2010 at NLNP.

Bago Watershed, MKNP and NNNP

Key Findings:

- In a span of seven years, both forest loss (2,169 ha; 310 ha/yr) and forest gain (1,101 ha; 157 ha/yr) was observed from 2003 to 2010 within Bago Watershed. A total of 8,997 ha of forests remained comprising 11.5% of the total land area of the watershed.
- In terms of forest to non-forest change, Salvador Benedicto (7.1%) had the highest percent change against total land area followed by Murcia (2.6%). Highest total forest cover loss was similarly observed in Salvador Benedicto (1,286 ha) followed by Murcia (933 ha) within the period. The lowest percent change against total land area was observed in Bago City (0%). Lowest total forest cover loss, with the exception of Bago City, occurred in San Carlos City (215 ha) and Talisay City (227 ha).
- All municipalities exhibited change from non-forest to forest (forest gain) perhaps due to extensive reforestation efforts. Murcia has the highest percent change against total land area (5.5%) followed by Salvador Benedicto (1.5%). Calatrava (0.1%) and Bago City (0.7%) showed the lowest percent change against total land area. Murcia (4,915 ha) similarly exhibited the highest total forest gain observed within the period, which was even higher compared to the forest gain observed within BRWFR.
- In terms of forests in 2003 remaining as forests in 2010, the most extensive forests remained in Murcia (7,703 ha; 21.2% of total area) followed by Talisay City (5,160 ha; 25.9% of total area).

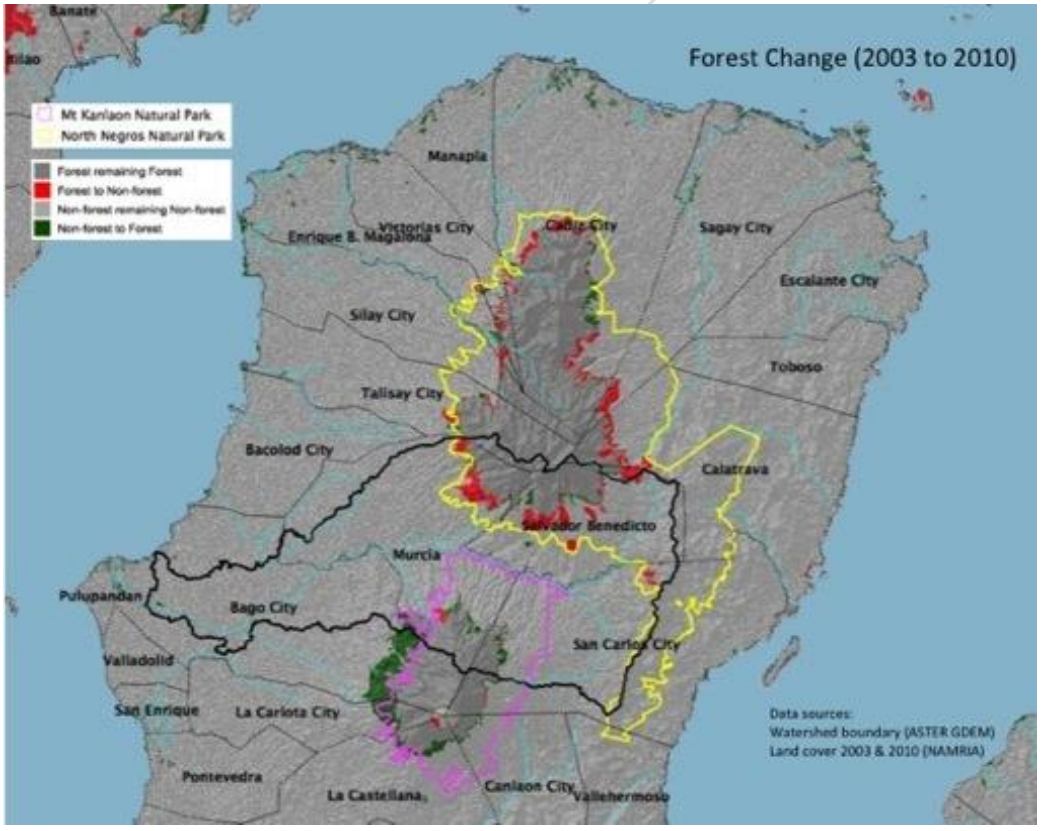

Figure 24. Forest cover change detection from 2003 to 2010 at BRWFR (black), NNNP (yellow), and MKNP (pink).

MKNRP

Key Findings:

- There is 4,788 ha (10.1%) forest gain and 1,014 ha (2.1%) forest loss from 2003 to 2010 in MKRNP.
- The total natural forest loss either from deforestation or forest degradation is 1,014 ha.
- The total forest gain through natural regeneration from 2003 to 2010 is 4,788.
- The annual rate of net change per year is 539 ha/yr.

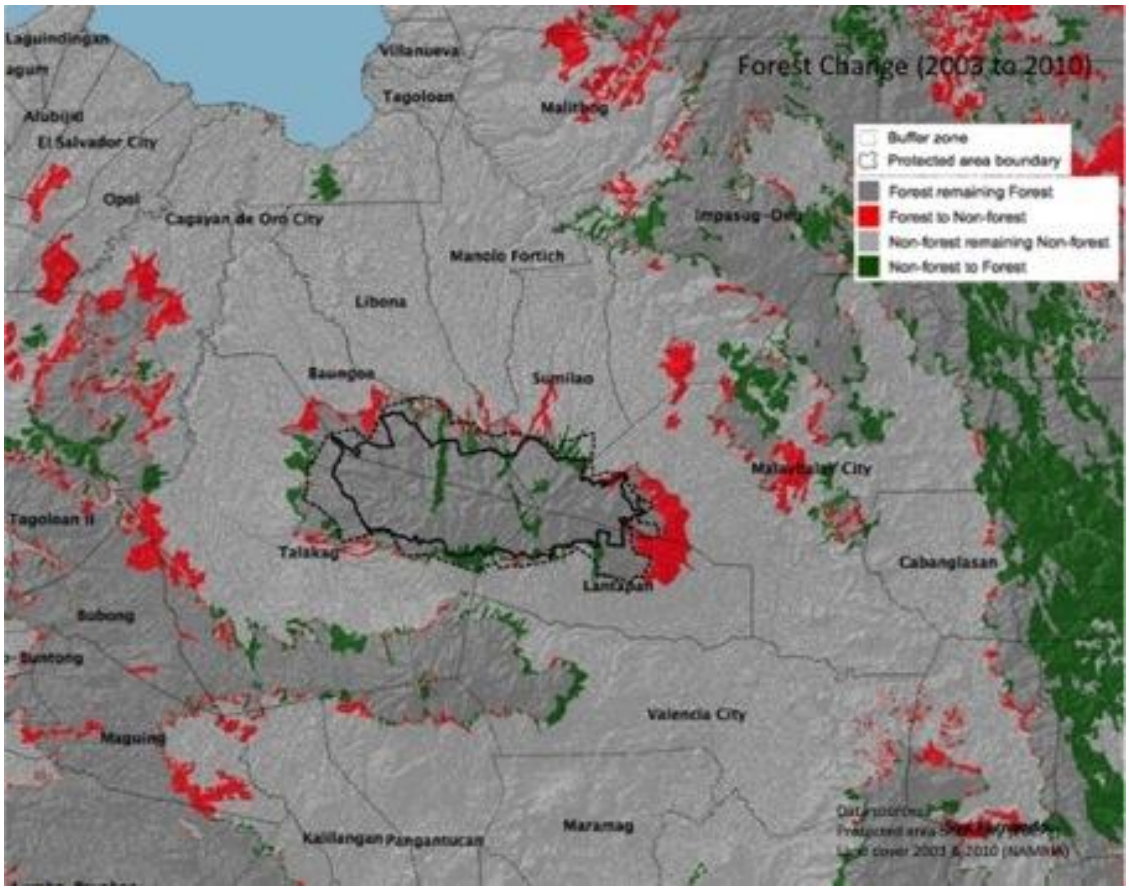

Figure 25. Forest cover change detection from 2003 to 2010 at MKRNP.

MANP

Key Findings:

- Forest loss in MANP reached 11,088 ha or 1,1584 ha/year from 2003 to 2010.

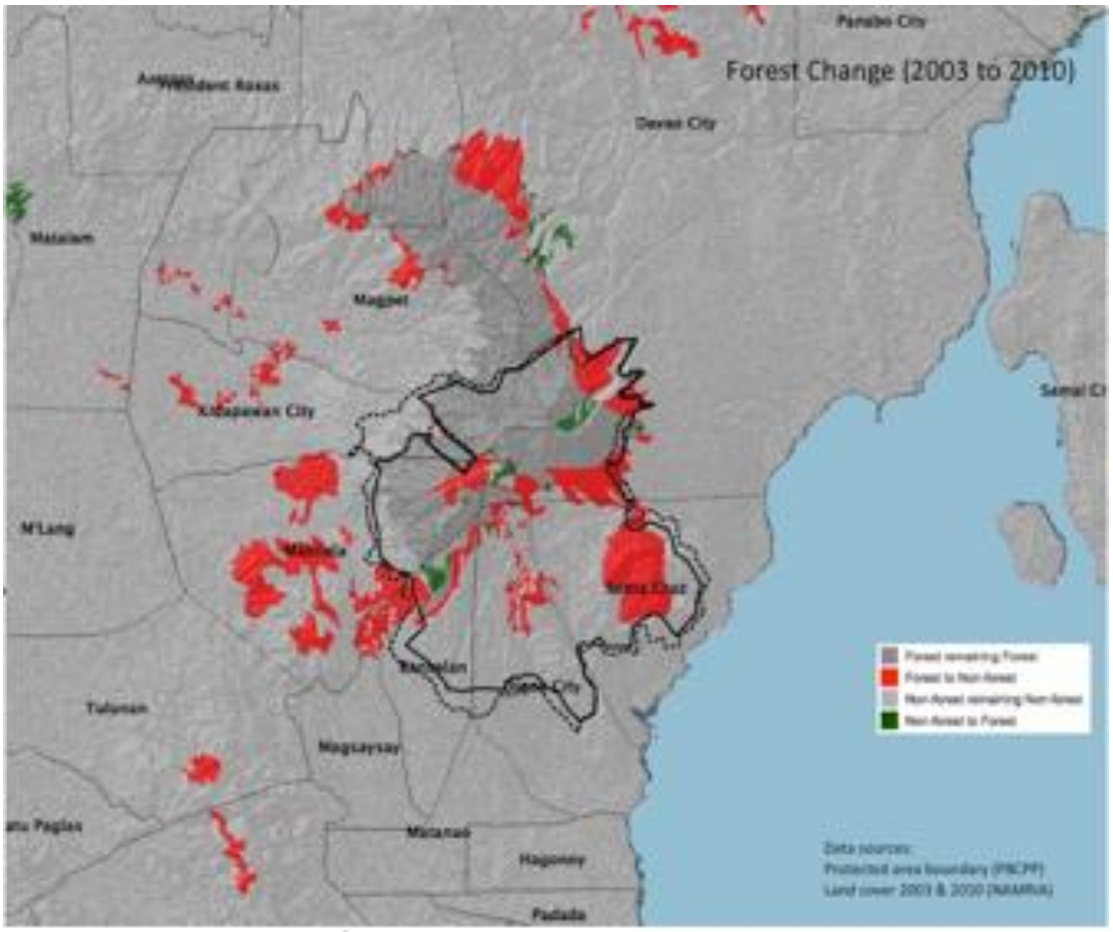

Figure 26. Forest cover change detection from 2003 to 2010 at MANP.

3.6 KEY DRIVERS OF DEFORESTATION AND DEGRADATION

NSMNP

The following are the threats observed by the team in each municipality during the study:

Ilagan

- Hunter trails and live hunter traps
- Pasture land for Carabaos
- Carabao trails
- Access trails

Dicaruyan

- Irrigation canal
- Hunter trail
- Old logging trail
- Kaingin
- Residential areas

Sapinit

- Main access roads
- Old logging trail
- Kaingin
- Hunter trails and live hunter traps
- Residential areas

Figure 27. Photo documentation of threats and key drivers of deforestation and degradation in NSMNP.

(a) Logging roads, (b) Cartmen with their crafts full of illegal logs, (c) rice paddies, (d) snare traps along hunter trails, (e) aerial view of Sapinit showing the proximity of residential and farmlands to forest lands

Kaliwa and UMRBPL

Based on the feasibility study report entitled "Developing Community Carbon Pools for Reduced Emissions from Deforestation and Forest Degradation, plus Enhancing forest carbon stocks (REDD+) projects in selected ASEAN countries" (FFI, in draft), the following are the drivers of deforestation and forest degradation within the UMRBPL-KWFR:

Legal and Illegal logging

- Logging companies practiced selective logging system until the 1990's, wherein large diameter trees were cut and exported.
- Confiscated forest products from nearby municipalities of Gen. Nakar have an average of 4,000 m^3/month with an estimated value of Php 33,000.
- In recent years, there are continuing reports on confiscated forest products retained at the Community Environment and Natural Resources Office. It only shows that despite the efforts to lessen or eliminate logging, it continues to happen within the area.
- On the Ipo Watershed proxy site, remnants of logging are very evident in the site. Sound of the saw used in cutting trees can also be heard. Some logs were also transported from the mountain through the river.

Kaingin Making/Shifting Cultivation

- Non-IP migration forces the IPs (original shifting-cultivators of the land) to move to the upper portions of the forest; thus, giving options for the IPs to use more advanced forested areas for kaingin.
- Land claimants open up kaingin in untitled lands. They are hoping that in due time, the said land will be given titles under their names.
- On the Ipo Watershed proxy site, there are patches of kaingin within the area.

Charcoal consumption

- There are demands for charcoal in urban and per-urban areas adjacent to Gen. Nakar. However, in the area of Gen Nakar, the charcoal consumption has been reduced by 50% because most people are now using charcoal cooking stoves that require lesser volume of charcoal than the more traditional ones.

Bago Watershed, MKNP and NNNP

The following are the threats observed by the team during the study:

Bagong Silang, Municipality of Salvador Benedicto

- Collection of dead twigs (and trees) for fuel and charcoal making.
- Increasing land conversion i.e. forested area converted to agricultural lands and some other land use forms like resorts for recreational purposes.
- Increasing demand for poultry, thereby increasing forest land being converted to accommodate such economic demand.

- Increasing number of 'trails' made towards the interior of the remaining forests which increases access to forest lands.

Brgy. Mailum, Bago City

- Hunting of wild pigs (possibly that of the Critically Endangered (CR) Visayan warty pig) and Visayan spotted deer (Endangered, IUCN RedList 2014)
- Flying foxes are being hunted and poached for source of meat.

MKRNP

The following are threats observed to occur in the area:

Habitat conversion

- Lowland forests in the area are now converted into tree plantation, pasture land and cultivated areas like vegetable garden, corn, coffee plantation, sugarcane plantation, etc.

Logging

- In finding intact primary forest, only sites that are within intact closed canopy forest with little disturbance could be found. It was intended to include lowland forest habitats as these are usually areas with high species diversity and most vertebrate species decrease in richness with higher elevation due to lower temperature, higher precipitation, and change in vegetation. Fruit bats, for example, have shown a decrease in species richness and abundance at higher elevation though there is also an observed increase of endemics at higher elevations. Changes are predicted to be associated with the reduce abundance of *Ficus* species at higher elevation, which fruit bat species rely on (Heaney et al 1989).

- Baungon and Libona survey sites were also under logging concession in the past but selected survey areas are now under closed canopy forest and more than 200m away from the edge. Although these areas were disturbed but it is difficult to locate lowland forest in the Mt. Kitanglad Natural Park that have not undergone logging in the past or even at present. Disturbed lowland forests have also been shown to be important for biodiversity. Studies conducted in logged forest of Southeast Asia have shown to support recovery of bird species richness and may harbor high species diversity after logging activities have stopped. Although forest fragments (400 ha), if unrestored, have shown continued decrease in species diversity even after years of isolation. Mammals have also shown to recover in logged over forest. Many species were found to persist after habitat degradation and logged forest were able to retain species found in undisturbed habitat although species diversity were lower as compared to undisturbed forest (Koh et al 2013). These show how important logged over forest are to monitoring status forest restoration initiatives and species persistence. Rehabilitated forests, for example, have been shown to be important for insectivore bird diversity. Forest rehabilitation in Sabah and Borneo has led to an increase in abundance of insectivorous birds (Edwards et al 2009).

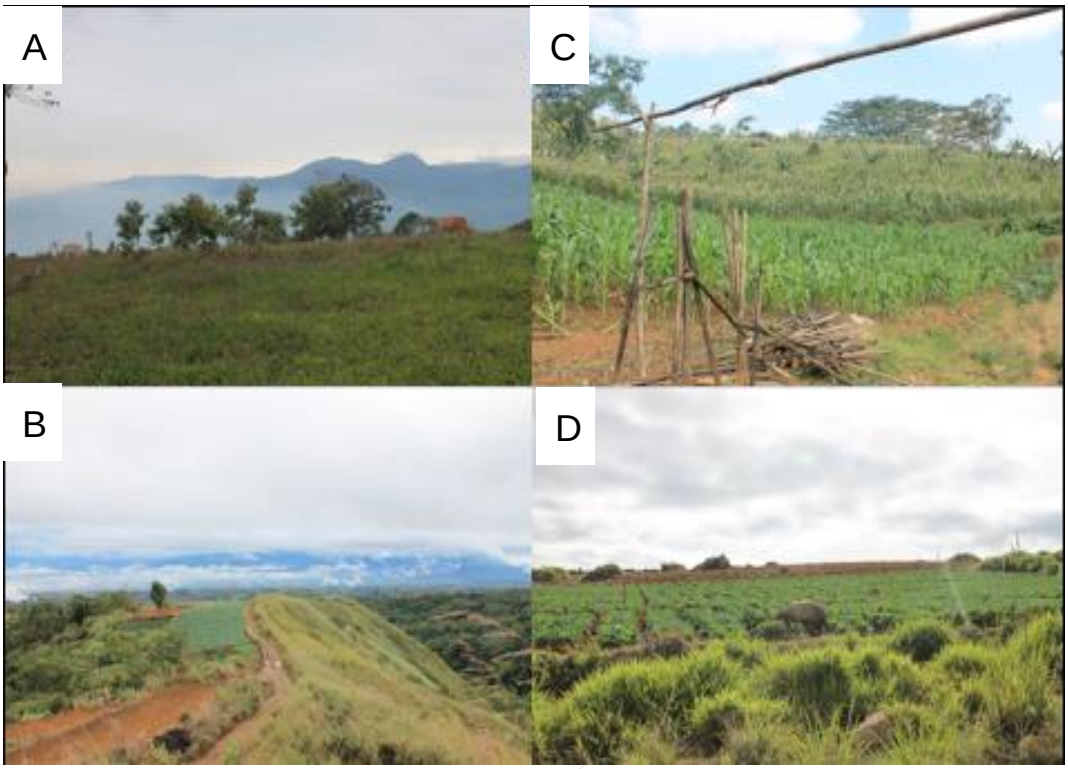

Figure 28. Habitat conversion in Mt. Kitanglad Range Natural Park.
(A) Pasture land in Brgy. Kaatuan, Lantapan; (B) Corn and banana plantation in Lantapan; (C) and (D) Vegetable garden in Lupiagan.

MANP

The following are the threats observed by the team during the study:

Cultivated area inside the protected area

- Abaca and banana plantation surrounds the periphery of the forest in the area surveyed at Mount Apo Natural Park. These cultivated areas are still within the boundaries of the park. Fruit trees like *durian* and *lanzones* were also observed in the area. And, coffee is one of the important products of the area.

Resource extraction

- Timber poaching and rattan collection are still present in the area. Some trees are also harvested for local use.

Management or land conflict

- Conflict between the Indigenous People Organization in the area and the barangay local government unit can be an indirect threat to deforestation and degradation. Management conflict and conflict of interest between the two groups are very evident during the survey.

Development

- Road development is already encroaching towards the park. The indigenous people's organization in the area is also concern about the possible application of including the forested area surveyed for energy resource extraction purposes to address energy crisis in Mindanao.

IV. CONCLUSIONS AND RECOMMENDATIONS: IMPLICATIONS FOR MANAGEMENT

4.1. SPECIES LEVEL INTERVENTIONS (SSE, OCCUPANCY VIS-À-VIS BMS AND RESTORATION)

In general terms, across the sites evaluated, the analysis of the species survival envelopes at the community level (using CCA) with an added dimension of space requirement (occupancy) and at the landcape scale (species distribution modeling) provided the information at all the tiers described in the introduction. The results clearly demonstrate how the information generated at every tier enriches our understanding of the conservation requirements of the various species. These then can be translated into measurable and verifiable conservation targets, which are the cornerstones of the PA management plan.

The various species-habitat ordinations illustrated a range of habitat fidelity and exclusivity, which ultimately suggest survival potentials of triggers species in each of the PAs in corresponding habitat conditions. To match conservation intervention to these various degrees of habitat fidelity and exclusivity will be the centerpiece of the activities leading to the improvement/enhancement of the management plans. For example, to apply this approach, the species survival envelopes of the tree species modelled can help guide the restoration and rehabilitation initiative using the knowledge of species-habitat parameter matching i.e. species that are strict forest obligates will be a poor choice for reforestation but good to excellent for rehabilitation (planting on recently altered forest edge); conversely, species that are not forest obligates are good pioneers (can be planted in open areas).

Occupancy on the other hand, showed a range of survival envelopes in terms of space. For example, species with high occupancy implies commonness and dominance but may also imply, in conservation terms, vulnerability to habitat contractions. Species with low occupancy, on the other hand, suggests that these species are rare and occur naturally in small populations. This may suggest that these species may not respond to landscape wide habitat change (contraction) per se but on the changes in its microhabitat. These species that will not respond to landscape scale interventions but would require direct species management intervention, e.g., control hunting etc. It is also possible that in areas where these species occur special habitat management will be necessary, e.g., the maintenance of understorey habitat characteristics (presence of saplings and leaf-litter) which influence its area of occupancy.

In this section, a number of indicator species are suggested that will help the PA identify conservation targets, e.g., no net loss of old growth forest in the next 5 years. To monitor this target, occupancy or population density estimates of indicator species will be used as baseline and monitored. Changes in its densities will indicate levels and extent of degradation. Conversely, if the target was to reduce the level of degradation by X% in X years, the species indicators that can be used are species that thrive in degraded habitats. An increase in population and occupancy will suggest that there has been an expansion of the preferred habitats of these species.

NSMNP

- Forest restricted species with narrow niche width that are intolerant to disturbance should be included in the biodiversity monitoring protocol as indicators of good quality forest. These species are as follows: bird species include Sooty Woodpecker (*Mulleripicus funebris*), Flaming Sunbird (*Aethopyga flagrans*), and Yellow-wattled Bulbul (Pycnonotus urostictus), while for tree species are *Agathis philippinensis*, *Diospyrus philippinensis* and *Palaquium luzoniense*.

- Birds such as Philippine Bulbul (*Ixos philippinus)*, Elegant Tit *(Parus elegans)*, the Orange-bellied Flowerpecker (*Dicaeum trigonostigma)* and the Philippine Tailorbird (*Orthotomus castaneiceps)* are forest species that can tolerate various levels of degradation. These are good indicators of disturbance in natural forests.
- The Philippine endemic *Anisoptera thurifera* (Palosapis) and *Shorea polysperma* (Tangile), and the non-endemic *Dipterocarpus grandiflorus* (Apitong) and *Shorea guise* (Guijo) are forest generalists that are tolerant to various degrees of degradation. These species can be used for forest restoration.
- *Macaranga tanarius* (Binunga) is a fast-growing forest generalist with a wide niche width suggesting very high tolerance to high degree of habitat disturbance (including open areas). This species can be used for reforestation purposes.
- The central strategy in delivering conservation of key species will be the habitat management of the HCVAs.

KWFR and UMRBPL

- Forest restricted species that were found to be intolerant to disturbance are suggested to be used in the monitoring biodiversity as indicators of good quality forest. These birds include, *Cacomantis variolosus* (Brush cuckoo) and *Orthotomus cucullatus* (Mountain tailorbird).
- The following are bird species that can tolerate various levels of degradation and should be used as indicators of disturbance in natural forests: *Dicrucus balicassius* (Balicassiao), *Ixos philippinus* (Philippine Bulbul), *Phapitreron leucotis* (White-eared brown dove), *Chalcophaps endica* (Common emerald dove) and *Parus elegans* (Elegant tit).
- For Ipo Dam, as a proxy site for Kaliwa-UMRBPL, the team has observed prevailance of invasive and exotic species such as *Swietenia macrophylla* (Mahogany), *Gmelina arbor* (Gmelina) and *Ceiba pentrandra* (Malabulak), showing evidence of how the reforestation program was implemented in the area in the past. In line with this, it is recommended using *Macaranga grandiflora* and *Polyscias nodosa* for reforestation.

NLNP

- Key species such as the Mindoro Bleeding-heart (*Gallicolumba platenae*), Mindoro Imperial-pigeon (*Ducula mindorensis*), Mindoro Hornbill (*Penelopides mindorensis*), Scarlet-collared Flowerpecker (Dicaeum retrocinctum), Spotted Imperial-pigeon (*Ducula carola*), Ashy Thrush (*Zoothera cinerea*), Mindoro Striped Stream Frog (*Hylarana mangyanum*), Mindoro Bush Frog (*Philautus schmackeri*), Palawan Fanged Frog (*Limnonectes acanthi*), Visayan Fanged Frog (*Limnonectes visayanus*) and Mindanao Flying Frog (*Rhacophorus bimaculatus*) are trigger species that needs to be included in the management plan for the reason that they are indicator of good forest habitat type.

Bago Watershed, MKNP and NNNP

- Species with very narrow niche width are those that also show very low tolerance to disturbance. Such species will make excellent indicators of gauging the quality of a forest. The Critically Endangered (CR) *Dobsonia chapmani* (Philippine bare-backed fruit bat) and *Sus cebifrons* (Philippine warty pig) can be utilised as indicator species in a biodiversity monitoring protocol that may be developed in a particular area i.e. HCVA or hotspot.
- The most dominant tree species are the dipterocarps i.e. *Shorea negrosensis* (Red lauan), *S. contorta* (White lauan), and *S. polysperma* (Tangile). These species showed very narrow niche width which suggests that these species are forest specialists.. These species can also be used for forest restoration purposes.
- *Tristianopsis decorticate* (Malabayabas) and *Macaranga bicolor* (Hamindang) are forest generalist species that have high tolerance to varying degrees of anthropogenic disturbances or

habitat alteration, to the extent that these can survive on open areas. This might be a good candidate to be used for reforestation.

MKNRP

- Forest restricted species such as Short-crested monarch and Black-Masked White-eye could be used as indicator of good quality forest because these are intolerant of habitat degradation.
- Species such as the Amethyst Brown Dove, Apo Myna, Blue-crowned Racquet-tail, Blue Fantail, Cinnamon Ibon, Mountain Racquet-tail and Black-and-Cinnamon Fantail could be used as indicators of degraded forest habitats. These species are forest obligates but can tolerate habitat degradation and deforestation.
- The Critically Endangered *Shorea negrosensis* and *Shorea polysperma* had survival envelopes that range from degraded forest habitats to the interface of forest and non-forest, which suggests its tolerance of degradation. These species were also recorded at high numbers in the project site. It is recommended a further reassessment of the status for both species of *Shorea.*

MANP

- Short-crested monarch and the lizard *Gonocephalus sophiae* could be used as indicator of forests with minimal disturbances because of their restriction to forest habitats.
- Amethyst Brown Dove, Apo Myna, Blue-crowned Racquet-tail, Blue Fantail, Cinnamon Ibon, Mountain Racquet-tail and Black-and-Cinnamon Fantail could be used as indicators of degraded forest habitats.
- Wide niche widths of *Acer laudanum* (Philippine Maple) and *Dacrycarpus imbricatus* (Igem) suggest that these can be used as indicators for degraded forest habitats. The niche position of these species is forest but with a rather wide niche width suggesting these are forest generalists but unlikely to survive outside of forest. These species can be considered for restoration interventions in the park.
- *Mallotus mollisimus, Agathis philippinensis,* and *Syzygium nitidum* (Makaasim) are fast-growing species that can be used for reforestation.

4.2. LANDSCAPE LEVEL INTERVENTIONS

The philosophy used in the ecological modelling (SDM) follows the convention and recommendations that guide many protected areas in the tropics. The main guiding principle in the modelling is the protection of large tracts of forest especially in the lowlands (Curran et al. 2004; Sodhi et al. 2004a). The knowledge of how different indicator species from vertebrate taxa use forest and non-forest habitat is therefore essential in planning conservation strategies (Arriaga-Weiss et al. 2008; Lee et al. 2007; Sekercioglu & Sodhi 2007; Wells et al. 2007). The ecological modelling has also underscored the importance of intermediate habitats or edge habitats (Harper et al. 2005), which are connected to a large old growth forest (Hughes et al. 2002). The removal of such intermediate habitats will constrict the movements of birds, for example) across different habitat types (Paquet et al. 2006). The choice of a mixture of threatened species, non-threatened endemic species and rare forest non-endemics as focal species was to provide a representative sample of important biodiversity elements through which population responses to land-cover and land-use changes could be simulated, in order to test if the philosophy/model of 'full protection' will achieve the biodiversity conservation aims of the protected area.

The long-term survival of the threatened endemic species will rely on their protection across the whole biogeographic region (landscape approach). Most of the key species modelled are predicted to respond positively to landscape-scale protection and management approaches (especially those with high species

occupancy) whilst those with smaller occupancy will not. In this section, recommendations based on the analysis of hotspots are provided i.e. the juxtaposition of current and potential land use/cover change vis-avis the HCVAs.

HCVAs vis-à-vis PA/WS management regimes and boundaries

NSMNP

- There are three identified HCVAs found in the following areas (See Figure 21):
  - HCVA No. 1: Northern: Peñablanca-San Pablo-Maconacon
  - HCVA No. 2: Western: Maconacon-Divilacan-Iligan-Palanan-San Mariano-Dinapigue
  - HCVA No. 3: Eastern: Maconacon-Divilacan-Iligan-Palanan-San Mariano-Dinapigue
- Identified HCVAs should be included in management plan as core protection zone (see Figure 21). Revision of management regimes must be considered.
- High conservation values areas found outside the existing boundary of the park should be put under some form of management regimes.

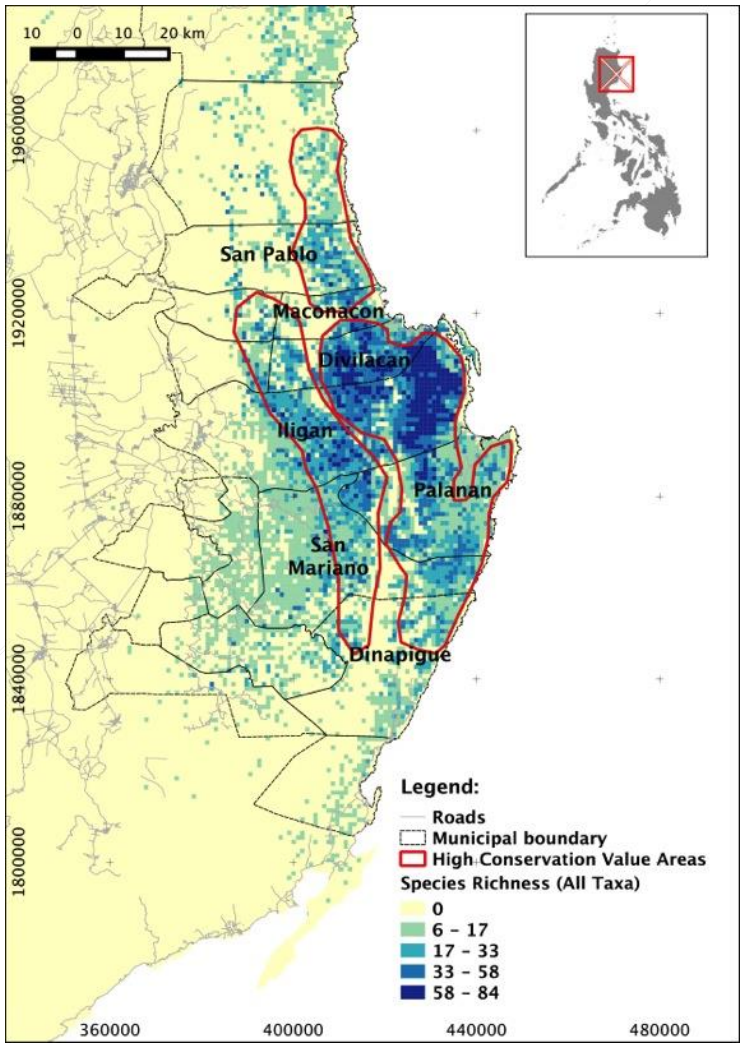

Figure 21. Identified High Conservation Value Areas in NSMNP.

KWFR and UMRBPL

- The sole HCVA that resulted from model encompasses majority of the southern portion of the Sierra Madre Mountain Range, spanning the provinces of Nueva Ecija, Bulacan, Aurora, Quezon, and Rizal (See Figure 22).
- The identified HCVA is found outside of the two protected areas. The government should contemplate reconfiguration of the current management zones of these sites.
- The two protected areas are severely fragmented. Reforestation from the forest edge is a proven cost-effective approach to initiate forest restoration and must be undertaken to re-link fragments and patches of habitats. Intensive monitoring and patrol in these forest edges are also recommended to reduce or completely reverse deforestation and degradation in these areas.

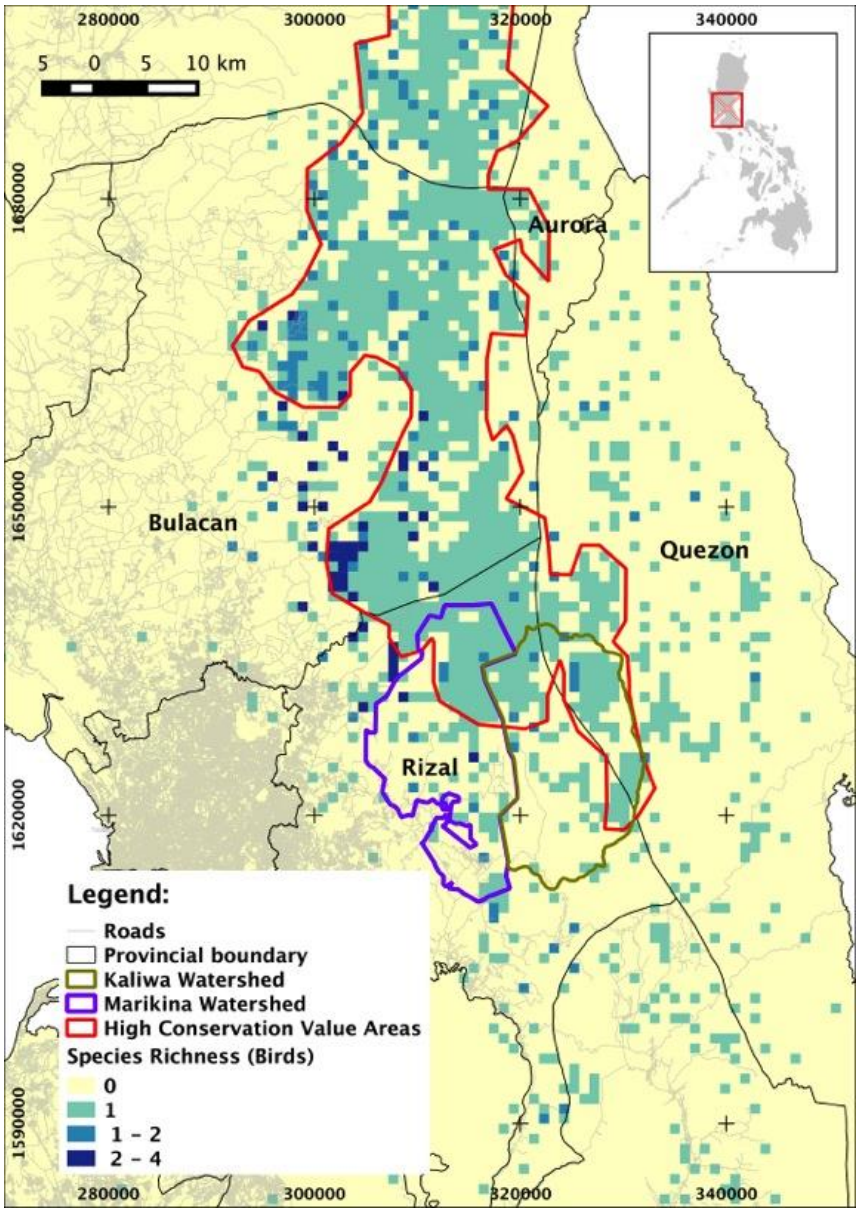

Figure 22. Identified High Conservation Value Area in Kaliwa-UMRBPL.

NLNP

- Three HCVAs (see Figure 23) outside of NLNP were identified, namely:
  - HCVA No. 1: Eastern: Puerto Galera, Baco, San Teodoro and Calapan
  - HCVA No. 2: Western: Areas in Abra de ilog, Paluan, Mamburao and Sta. Cruz
  - HCVA No. 3: Lubang Island
- Based on high species congruence, the Lubang island HCVA is worth investigating by the DENR as a potential protected area candidate as critical habitat of key Mindoro species.
- Identified HCVAs on Mindoro, particularly the most proximate to NLNP should be considered as potential areas of expansion for NLNP.

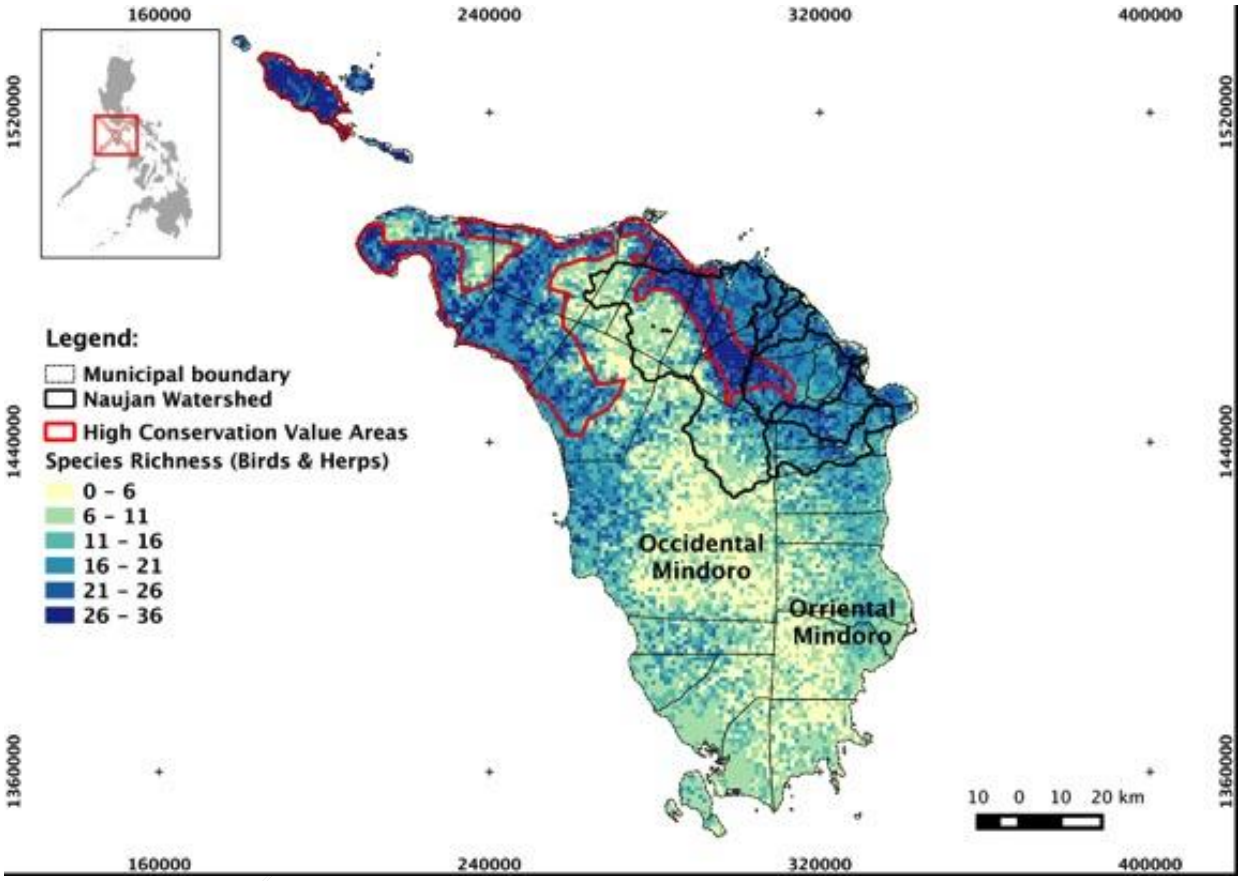

Figure 23. Identified High Conservation Value Area in NLNP.

Bago Watershed, MKNP and NNNP

- Three HCVAs were identified (See Figure 24), namely:
  - HCVA No. 1: Cadiz City that is within MKNP
  - HCVA No. 2: BRWFR – Salvador Benedicto; MKNP - Talisay City, Silay City and Cadiz City
  - HCVA No. 3: BRWFR – Murcia; NNNP – Murcia, La Carlota City and Canla-on City
- There should be a review and reconfiguration of the existing conservation management regimes of BRWFR to include and define the proposed HCVAs as Strict Protection Zones (SPZs) and establish areas surrounding SPZs as buffer zones.
- Conservation measures of the overlapping PAs should be streamlined to ensure efficient delivery of conservation targets.
- Monitoring activities especially in areas where hotspots are identified must be intensified. However, priority should be given where a hotspot and an HCVA overlaps.

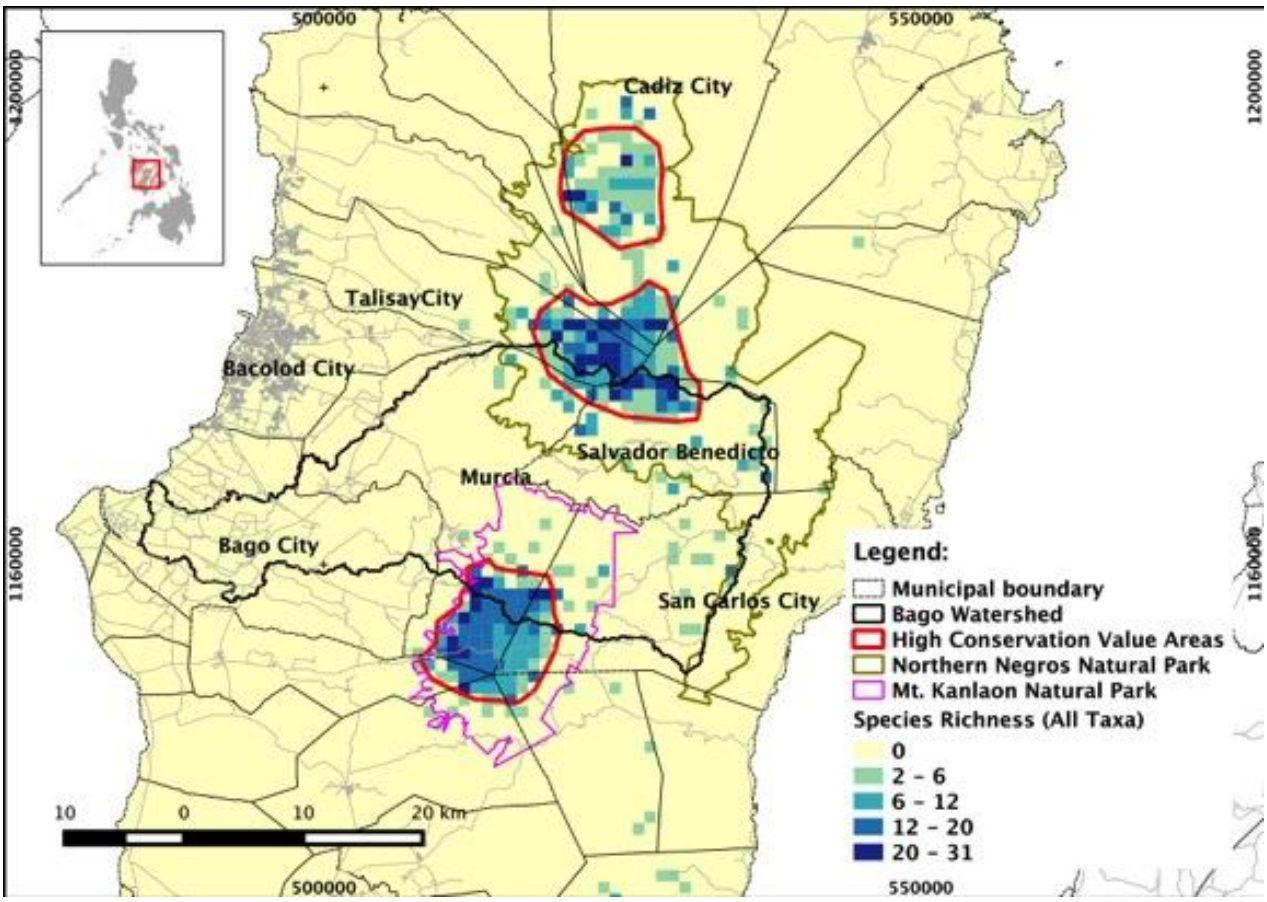

Figure 24. Identified High Conservation Value Areas in BRFWR.

MKRNP

- Three HCVAs were identified for MKRNP. These are as follows (see Figure 25):
  - HCVA No. 1: Municipality of Malaybalay – Brgy. Mapayag and Brgy. Imbayao; Municipality of Sumilao – Brgy. Lupiagan and Brgy. Licoan
  - HCVA No. 2: Municipality of Libona – Brgy. Sil-ipon and Brgy. Dahilayan; Municipality of Baungon – Brgy. San Vicente
  - HCVA No. 3: Municipality of Lantapan – Brgy. Kibangan, Brgy. Cawayan, and Brgy. Victory
- HCVAs identified are located within the buffer zone. Reconfiguration of the park's boundary is recommended to increase.

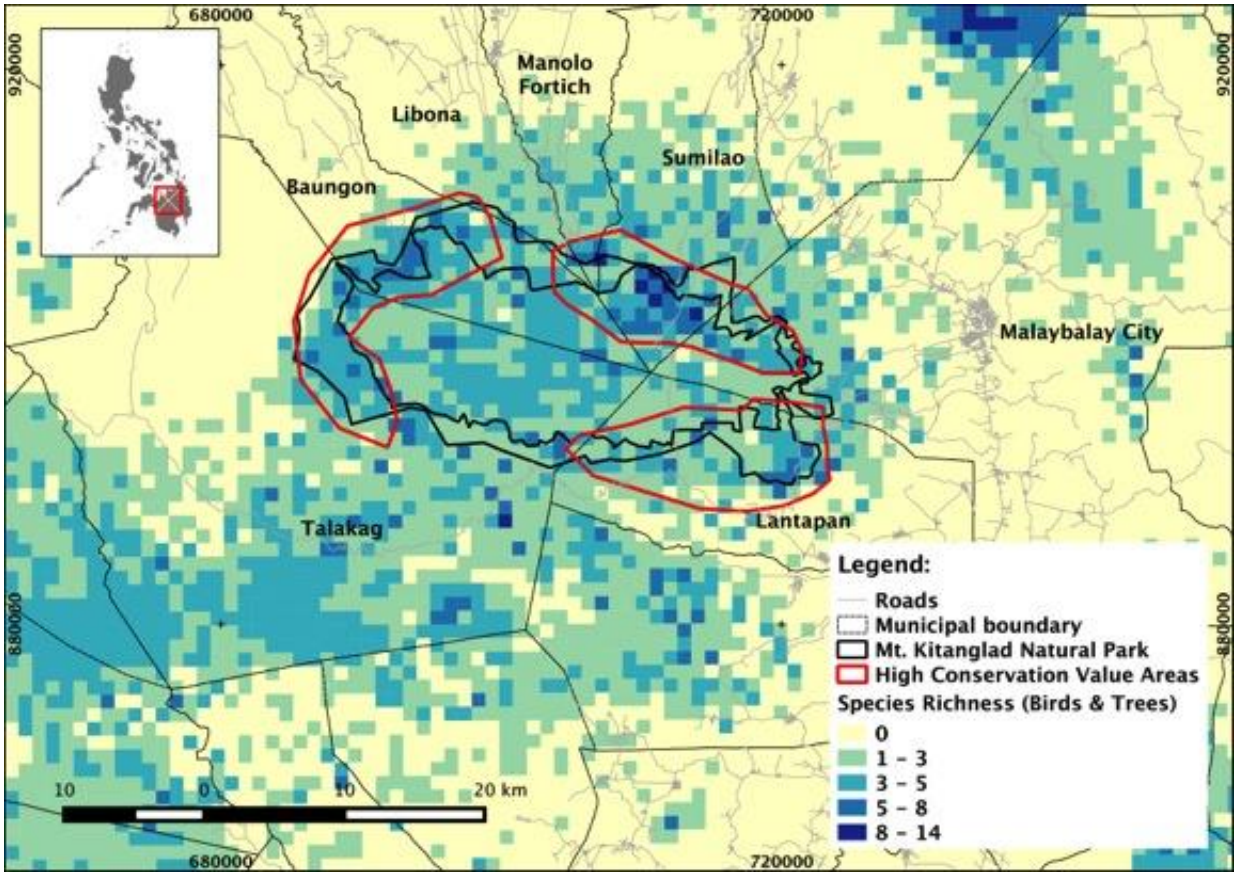

Figure 25. Identified High Conservation Value Areas in MKRNP.

MANP

- HCVAs identified are located in the upper part and some outside of the park (See Figure 26). These areas represent the high congruence of environmental requirements of key species, and therefore must be priority sites for conservation. They are:
  - HCVA No. 1: Municipality of Makilala – Brgy. Buhay, Brgy. Garsika, Brgy. New Ceby; Municipality of Bansalang – Brgy. Sibayan, Brgy. Tinungtungan; Municipality of Bigos – Brgy. Kapatagan
  - HCVA No. 2: Municipality of Davao – Brgy. Talomo, Brgy Tagurano; Municipality of Atan-awe – Brgy. Kapatagan
  - HCVA No. 3: Municipality of Sta. Cruz – Brgy. Tibolo
- The management zones of the park must be reconfigured to assign the HCVAs as strict protection zones and include its surrounding areas as buffer zones. Core zones of MANP should also be extended to include the identified HCVAs in the Makilala, especially since some HCVAs are at lower elevations.
- MANP is severely fragmented. Reforestation from the deforested area should be initiated to facilitate the closure of forest gaps.
- Intensive monitoring and patrol inside and perimeter of the park should be undertaken.
- It could also help also to address the degradation inside the park by creating programs that will form cohesion within the indigenous peoples of Bagobo Tagabawa.

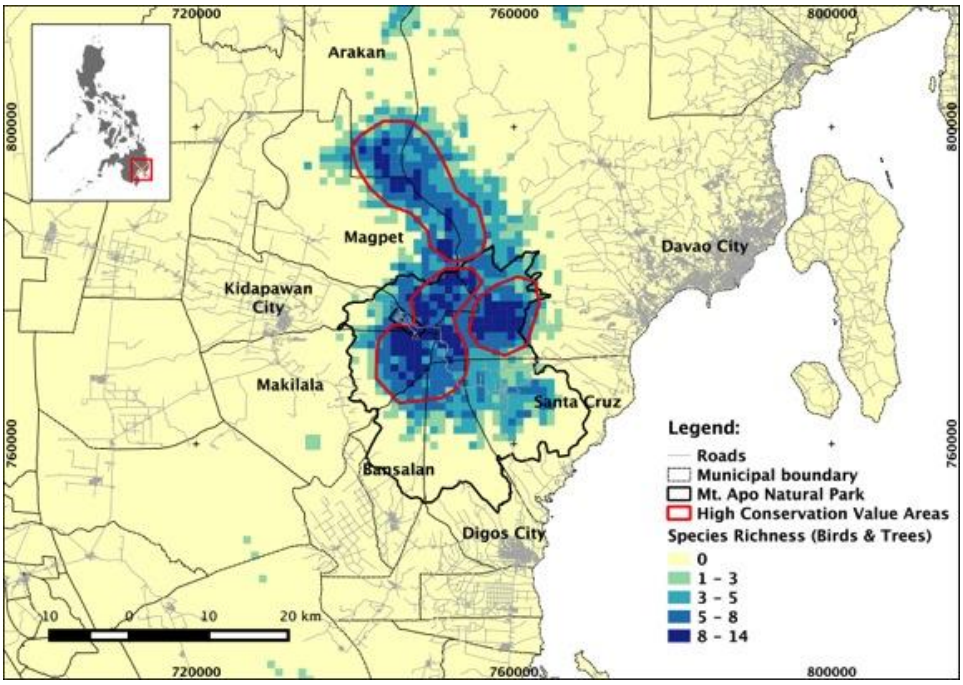

Figure 26. Identified High Conservation Value Areas in MANP.

HCVA vis-à-vis Hotspots

Conservation hotspots are areas where there is high concentration of trigger and endemic species that are under severe threats i.e. habitat loss. The generic recommendations for these hotspots are either to (1) intensify the patrolling to prevent further degradation or loss on these hotspots or (2) target these hotspots for restoration activities to allow these patches to rehabilitated. Based on the results conducted on the various analysis for all taxa surveyed, the locations of these HCVA hotspots are enumerated:

NSMNP

- Four areas identified as conservation hotspots:
  - Hotspot 1
    - Municipality of Divilacan: Dicatian, Dicambangan, Ditarum, Dilakit and Bicobian.
  - Hotspot 2
    - Municipality of San Mariano: Dibuluan, Disalup and San Jose
  - Hotspot 3
    - Municipality of Palanan: Villa Robles, Bisag, Santa Jacinta, Dicadyuan and Marikit
  - Hotspot 4
    - Municipality of Cabagan: Union

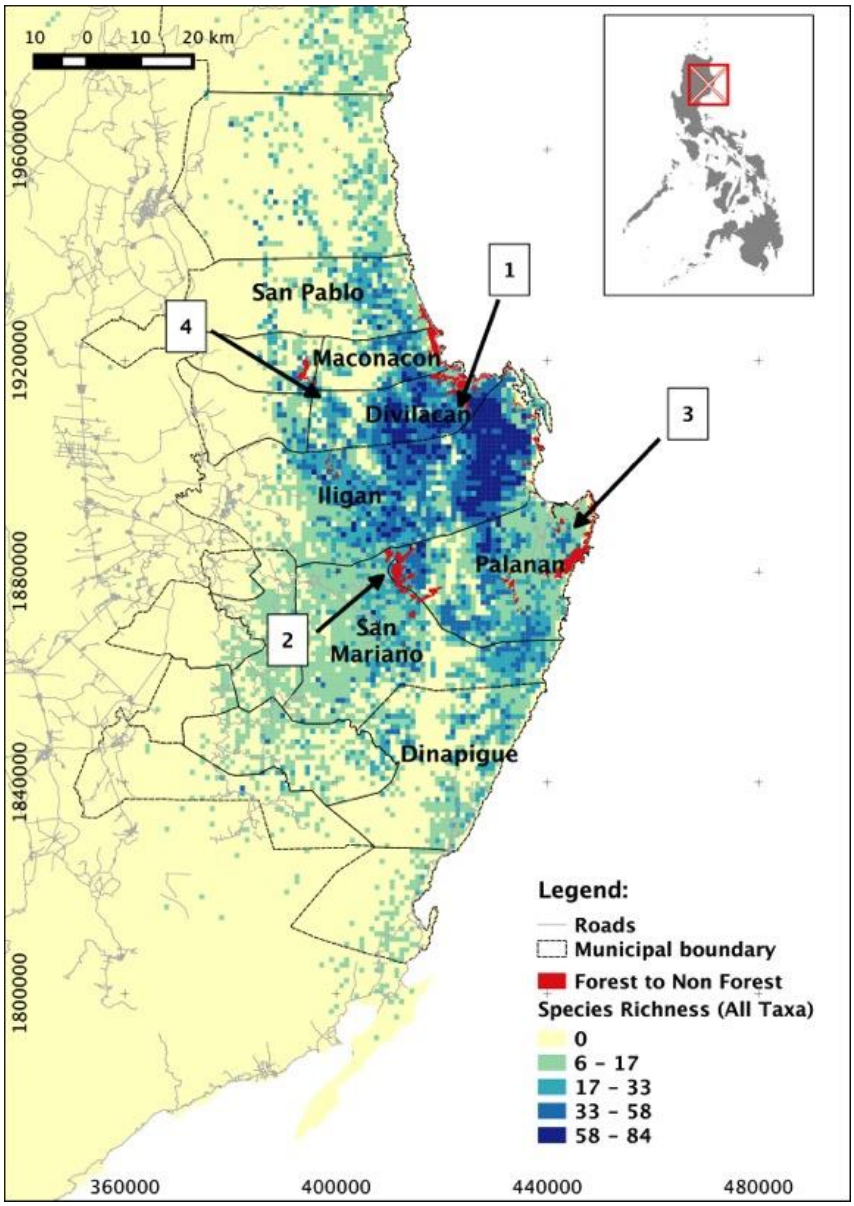

Figure 27. Identified conservation hotspots in NSMNP.

UMRBPL-KWFR

- The following are areas are identified as conservation hotspots:
  - Hotspot 1
    - Antipolo City (Upper left portion)
  - Hotspot 2
    - Antipolo City-Rodriguez
  - Hotspot 3
    - Tanay
  - Hotspot 4
    - Antipolo City (Lower left portion)

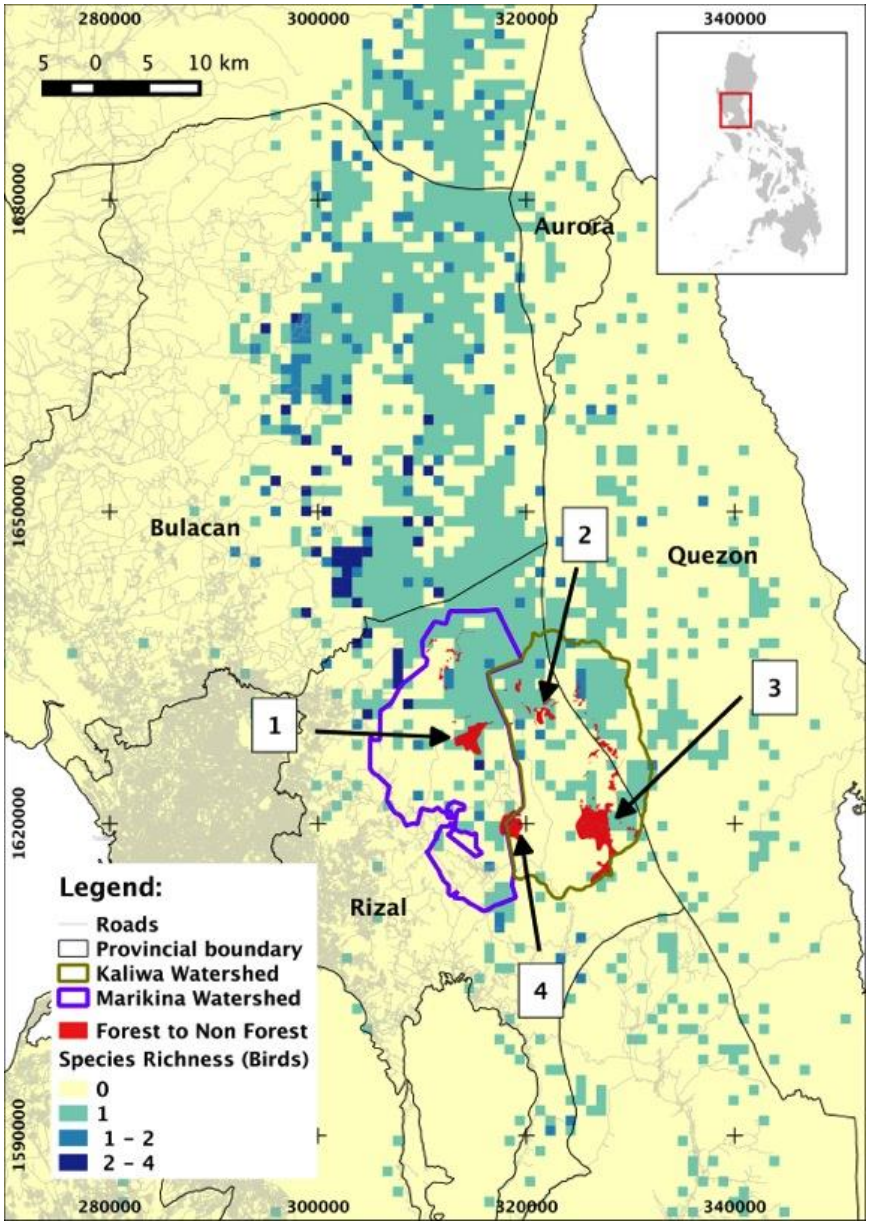

Figure 28. Identified conservation hotspots in KWFR-UMRBPL.

NLNP

- The following are areas are identified as conservation hotspots:
  - Hotspot 1
    - Puerto Galera, Baco, San Teodoro of Oriental Mindoro and Abra de Ilog of Occidental Mindoro
  - Hotspot 2
    - Lubang Group of Islands
  - Hotspot 3
    - Naujan and Pola of Oriental Mindoro
  - Hotspot 4
    - Sablayan of Occidental Mindoro

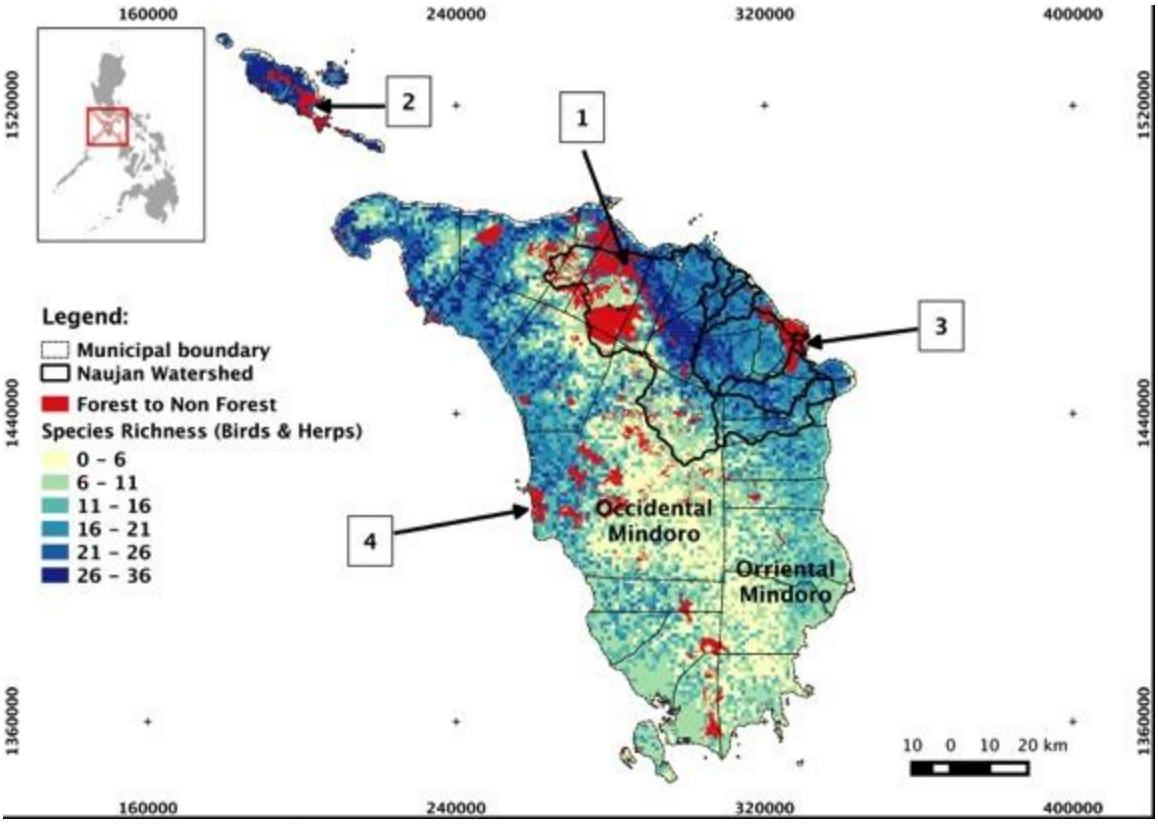

Figure 29. Identified conservation hotspots in NLNP.

Bago Watershed, MKNP and NNNP

- The following are HCVA hotspots identified for Bago Watershed, MKNP and NNNP:
  - Hotspot 1
    - Municipality of Salvador Benedicto - Brgy. Bagong Silang, Brgy. Bunga, Brgy. Kumaliskis, Brgy. Igmaya-an, Brgy. Pandanon-silos
    - Silay City – Brgy. Patag
    - Municipality of Murcia – Brgy. Canlandog and Brgy. Buenavista
    - Talisay City – Brgy. Cabatangan and Brgy. San Fernando
    - Cadiz - Brgy. Villacin
    - Sagay City – Brgy. Puey
    - Municipality of Calatrava – Brgy. Lalong
  - Hotspot 2 - this includes Brgy. Minoyan, Municipality of Murcia
  - Hotspot 3 - this includes Brgy. Cabagnag-an, Municipality of La Castellana

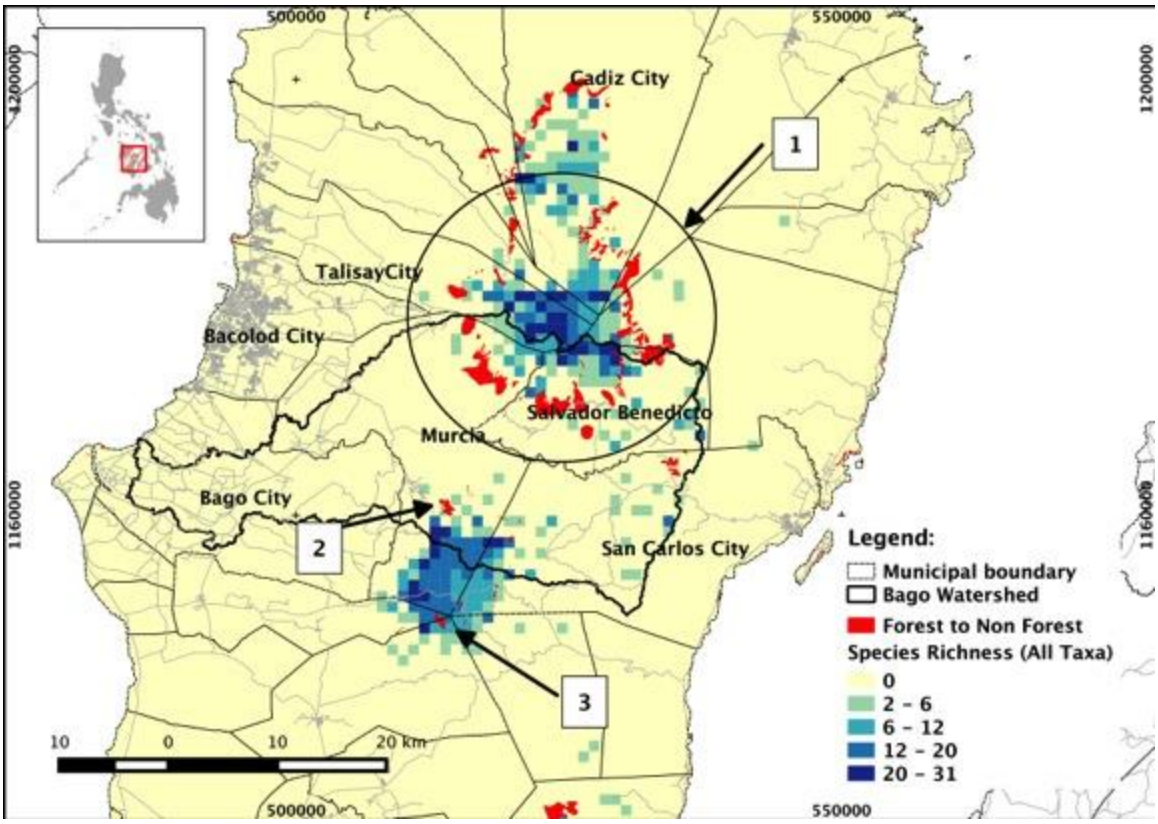

Figure 30. Identified conservation hotspots in BRFWR.

MKRNP

- The following are HCVA hotspots identified for MKRNP:
  - Hotspot 1
    - Municipality of Malaybalay – Brgy. Mapayag and Brgy. Imbayao; and Municipality of Sumilao – Brgy. Lupiagan and Brgy. Licoan
  - Hotspot 2
    - Municipality of Libona – Brgy. Sil-ipon and Brgy. Dahilayan; and Municipality of Baungon – Brgy. San Vicente
  - Hotspot 3
    - Municipality of Lantapan – Brgy. Kibangan, Brgy. Cawayan, and Brgy. Victory

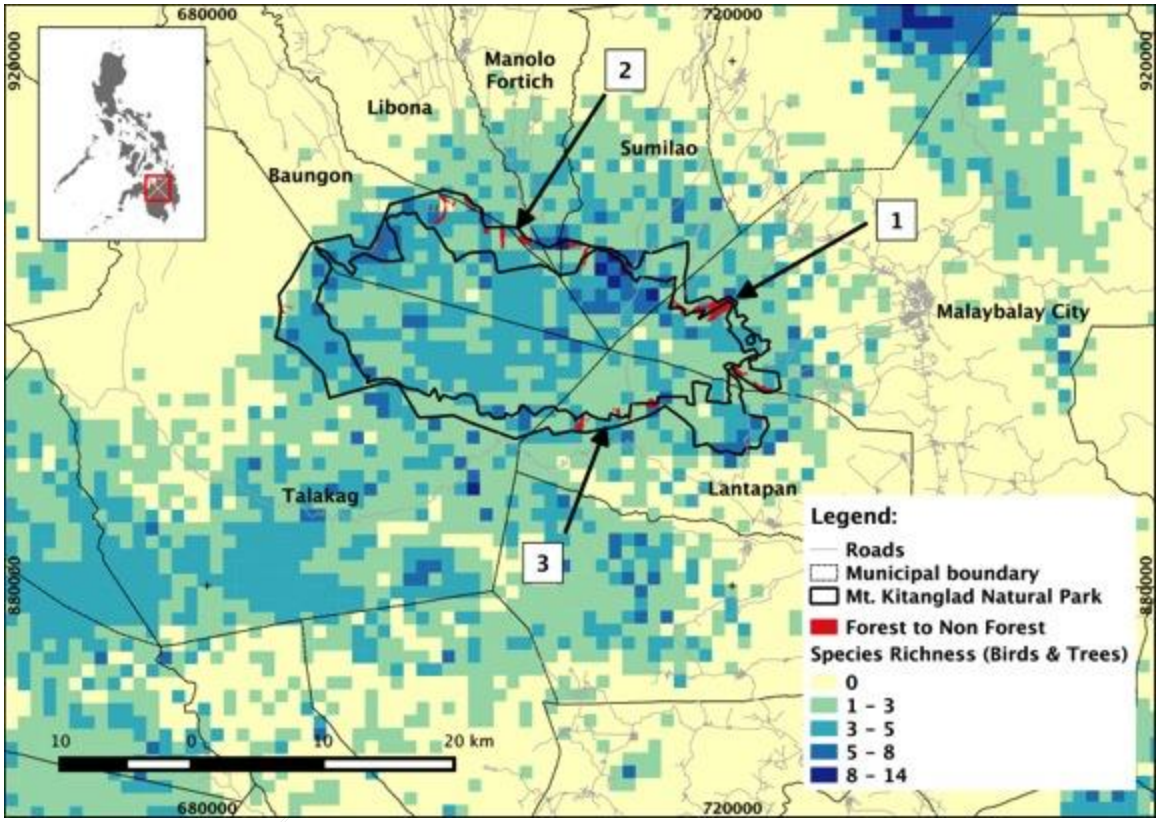

Figure 31. Identified conservation hotspots in MKRNP.

MANP

- The following are HCVA hotspots identified for MANP:
  - Hotspot 1
    - Municipality of Makilala - Brgy. Buhay, Brgy. Garsika, Brgy. New Cebu
    - Municipality of Bansalang – Brgy. Sibayan, Brgy. Tinungtungan
  - Hotspot 2
    - Davao City – Brgy. Talomo, Brgy Tagurano
  - Hotspot 3x
    - Municipality of Atan-awe – Brgy. Kapatagan, 3. Municipality of Sta. Cruz – Brgy. Tibolo

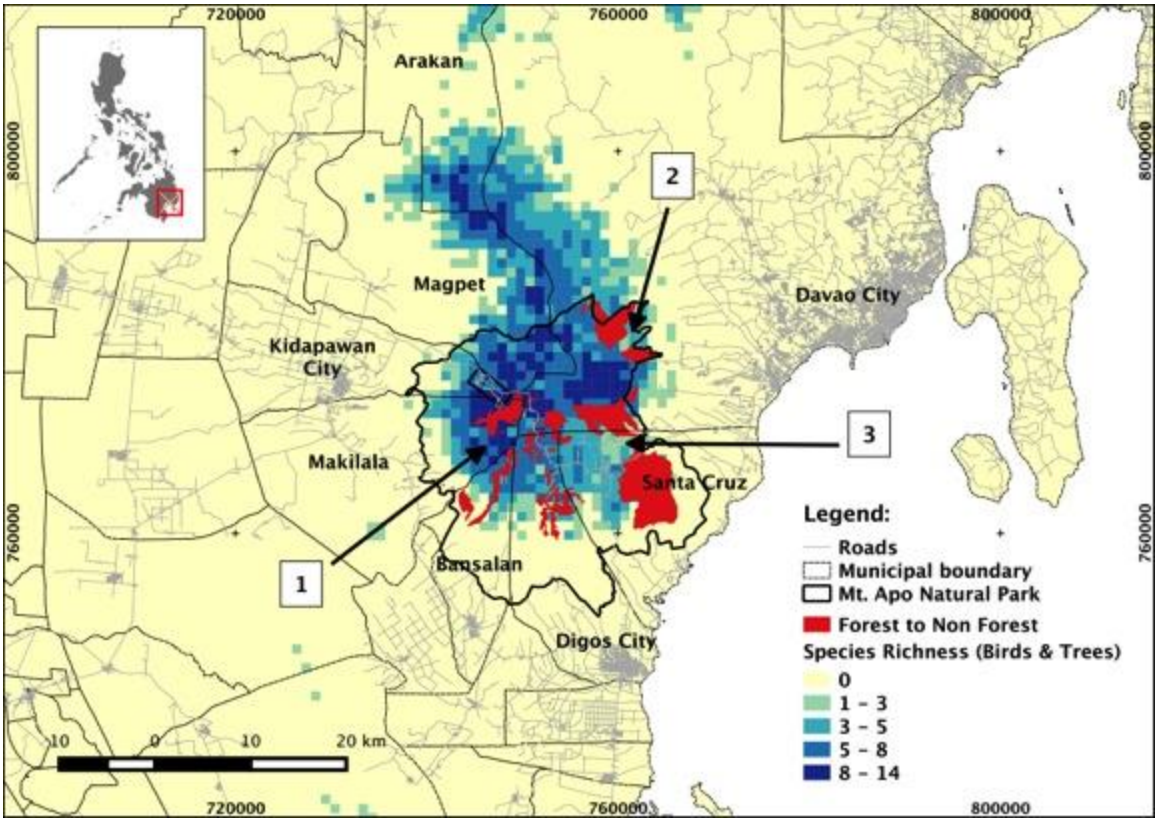

Figure 32. Identified conservation hotspots in MANP.

V. GLOSSARY OF TERMS AND ACRONYMS

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.

Conservation hotspot – areas where high concentrations of trigger and endemic species which facing extraordinary loss of habitats.

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.

Eigenvalues –is a number value, telling you how much variance there is in the dataset. In PCA, they are calculated and used in deciding how many factors to extract in the overall factor analysis. It is the scaling factor of eigenvector.

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.)

Endemic – a species that is only found in a given region or location and nowhere else in the world.

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. It usually has a slope greater than 18%.

Forest dependent – relating to a species that is restricted in forest habitat.

Forest edge – refers to the interface or boundary between the forest and non-forest 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 non-negotiable protected areas.

Introduced – a species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental.

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.

Lowland Forest – natural forests between 500m to 900m altitude.

Migratory - are species which perform cyclical movements between two distinct geographical areas, one of which is usually the area in which they breed.

Montane Forest – natural forests, above 1200m altitude, with canoopy cover that is greater than 30%.

Not Assessed (NA) – An IUCN threat category that has not yet been evaluated.

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.

Niche width – refers to theoretical range of conditions that a species could inhabit and successfully survive and reproduce in.

Non-forest – all land that is not classified as forest area (i.e cultivated, wooded grassland, built-up area, grassland, barren, fallow land).

Non-Volant Mammals – This term refers to species of mammals that are not capable of flight such as rodents, squirrels, pigs, and flying lemurs.

Open Forest – Forest where the canopy cover is between 10 and 40 percent of the area.

Proxy Sites – substitute areas to surveyed as an alternative to the proposed project sites due to issues on permits, certifications, and insurgency problems.

Species Distribution Modelling - A technique used to predict and produce spatially explicit distribution of animals and plants. (Elith and Leathwick 2009b).

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

Survival envelopes – defines the limits of environmental features essential to that species' survival, or "niche." The result of this analysis is a description of the mean niche position on each selected gradient (niche position) for each species, which represents a measure of the distance between the mean conditions used by the species and the mean conditions of the study area for that gradient.

Taxa/Taxon – A taxon (pl. taxa) refers to a taxonomic unit, a population or group of population of organisms that are phylogenetically related.

Transect – A transect is a cut or path established along different elevation and disturbance gradients, in which counts and species occurrence are recorded.

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.

Volant Mammals – Mammals that are capable of flying such as bats.

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 Vulnerable, 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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VII. ANNEXES

ANNEX A. SPECIES LIST

NSMNP

Annex 1.1a. Summary of tree species recorded in NSMNP, their extent of occurrence and conservation status based on the IUCN Red List of Threatened Species (2014).

Scientific Name	Common/Local Name	Extent of Occurrence*	IUCN Status**
Agathis philippinensis	Almaciga		VU
	Alahan		
Alstonia scholaris	Batino		LC
Anisoptera thurifera	Palosapis		CR
Artocarpus blancoi	Nangka		VU
Artocarpus rigidus	Monkey Jak		
Azadirachta sp.			
	Bignai Kalabaw		
Bischofia javanica	Tuai		
Calophyllum inophyllum	Bitaog		LC
Canarium ovatum	Piling liitan	Endemic	VU
Canthium dicoccum	Luing-luing		VU
Celtis philippinensis	Malaikmo		
Citrus sp.			
Claoxylon purpureum	Anot-ot		
Dillenia philippinensis	Katmon	Endemic	VU
Diospyrus philippensis	Oi-Oi		CR
Diospyrus pilosanthera	Bolong Eta		EN
Diptetrocarpus grandiflorus	Apitong		CR
Dracontomelon dao	Dao		VU
Duabanga moluccana	Loktob		
Ficus minahassae	Hagimit		
Ficus nota	Tibig		
Ficus sp.			
Ficus variegata	Tangisang bayawak		VU
Garcinia venulosa	Gatasan		
Glochidion album	Malabagang		
Gmelina arborea	Gmelina		
	Guisat		
Hopea accuminata	Manggachapui		EN
	Kanagitan		
	Kanaring		

Scientific Name	Common/Local Name	Extent of Occurrence*	IUCN Status**
	Kantingan		
	Kasiray		
Kleinhovia hospita	Tan-ag		
Knema sp.			
Koordersiodendron pinnatum	Amugis		VU
	Kulipapa		
Lithocarpus sp.			
Litsea leytensis	Batikuling		VU
Luecaena luecocephala	Ipil-pil		LC
Macaranga bicolor	Hamindang		VU
Macaranga grandifolia	Takip-Asin	Endemic	VU
Macaranga tanarius	Binunga		
	Malugay		
Mangifera altissima	Pahutan		VU
	Maraceda		
	Marachesa		
	Maragawid		
	Marakasiray		
	Marasida		
Melastoma malabathricum			
Myristica philippensis	Duguan		VU
Nauclea orientalis	Bangkal		
Nephelium lappaceum			LC
Octomeles sumatrana	Binuang		LC
Palaquium luzoniensis	Nato	Endemic	VU
Palaquium philippense	Malakmak		VU
Parashorea malaanonan	Bagtikan		CR
Parkia timoriana	Kupang		
Pouteria campechiana			
Pterocarpus indicus	Narra		CR
Sapindus sapunaria	Kusibeng		
Semicarpus cuneiformis			
Semicarpus longifolius			
Seralbizia acle			
Shorea astylosa	Yakal		CR
Shorea contorta	White Lauan	Endemic	VU
Shorea guiso	Guijo		CR
Shorea negrosensis	Red Lauan	Endemic	VU
Shorea palosapis	Mayapis		CR
Shorea polysperma	Tangile	Endemic	VU

Scientific Name	Common/Local Name	Extent of Occurrence*	IUCN Status**
Sterculia foetida	Kalumpang		
Syzigium ciliato-setosum	Lakangan		
Syzygium nitidum	Makaasim		
Syzygium tripinnatum	Hagis		
Toona kalantas	Kalantas		CR
Trema orientalis	Anabiong		
Tristaniopsis decorticata	Malabayabas	Endemic	CR
Vitex parviflora	Molave		EN
Voacanga globosa			

*Extent of occurrence refers to the species endemic (EN) to the Philippines.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR)

Annex 1.1b. Summary of bird species recorded in NSMNP, their extent of occurrence and conservation status based on the IUCN Red List of Threatened Species (2014).

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Phapitreron amethystinus	Amethyst Brown-Dove	Endemic	LC
Phylloscopus borealis	Arctic Warbler		
Zoothera cinerea	Ashy Ground-Thrush	Endemic	VU
Cypsiurus balasiensis	Asian Palm-Swift		
Dicrurus balicassius	Balicassiao	Endemic	LC
Coracina striata	Bar-bellied Cuckoo-Shrike		LC
Gallirallus torquatus	Barred Rail		
Dicaeum bicolo	Bicolored Flowerpecker	Endemic	LC
Lalage melanoleuca	Black-and-White Triller	Endemic	LC
Coracina mindanensis	Black-bibbed Cuckoo-Shrike	Endemic	VU
Ptilinopus leclancheri	Black-chinned Fruit-dove	Endemic	LC
Coracina coerulescens	Blackish Cuckoo-Shrike	Endemic	LC
Hypothymis azurea	Black-naped Monarch		
Cyornis herioti	Blue-breasted Flycatcher	Endemic	LC
Rhipidura cyaniceps	Blue-headed Fantail	Endemic	LC
Merops viridis	Blue-throated Bee-eater		
Cisticola exilis	Bright-capped Cisticola		
Brown Shrike	Brown Shrike		
Cacomantis variolosus	Brush Cuckoo		
Coracina coerulescens	Blackish Cuckoo-Shrike	Endemic	LC
Lonchura atricapilla	Chestnut Munia		
Loriculus philippensis	Colasisi		LC
Sarcops calvus	Coleto	Endemic	LC
Chalcophaps indica	Common Emerald-Dove		
Eudynamys scolopaceus	Common Koel		

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Actitis hypoleucos	Common Sandpiper		
Psilopogon haemacephalus	Coppersmith Barbet		
Ramphiculus merrilli	Cream-bellied Fruit-dove	Endemic	NT
Acridotheres cristatellus	Crested Myna		
Eurystomus orientalis	Dollarbird		
Parus elegans	Elegant Tit	Endemic	LC
Aethopyga flagrans	Flaming Sunbird		
Ficedula disposita	Furtive Flycatcher	Endemic	NT
Sterrhoptilus dennistouni	Golden-crowned Babbler	Endemic	NT
Lyncornis macrotis	Great-eared Nightjar		
chrysocolaptes guttacristatus	Greater Flameback		
Prioniturus luconensis	Green Racquet tail	Endemic	VU
Ardea cinerea	Grey Heron		
Motacilla cinerea	Grey Wagtail		
Muscicapa griseisticta	Grey-streaked Flycatcher		
Tringa brevipes	Grey-tailed Tattler		
Bolbopsittacus lunulatus	Guaiabero		
Cuculus fugax	Hodgson's Hawk-Cuckoo	Endemic	LC
Pitta sordida	Hooded Pitta		
Alcedo cyanopectus	Indigo-banded Kingfisher		
Mesophoyx intermedia	Intermediate Egret		
Accipiter gularis	Japanese Sparrowhawk		
Corvus macrorhynchos	Large-billed Crow		
Phylloscopus cebuensis	Lemon-throated Leaf-Warbler		
Centropus bengalensis	Lesser Coucal		
Egretta garzetta	Little Egret		
Gallicolumba luzonica	Luzon Bleeding-Heart	Endemic	NT
Penelopides manillae	Luzon Hornbill	Endemic	LC
Zosterornis striatus	Luzon-striped Babbler	Endemic	NT
Aethopyga pulcherrima	Metallic-winged Sunbird	Endemic	LC
Prionochilus olivaceus	Olive-backed Flowerpecker	Endemic	LC
Cinnyris jugularis	Olive-backed Sunbird		
Dicaeum trigonostigma	Orange-bellied Flowerpecker		
Hirundo tahitica	Pacific Swallow		
Rostratula benghalensis	Painted Snipe		
Turdus pallidus	Pale Thrush		
Anthus gustavi	Pechora Pipit		
Hypsipetes philippinus	Philippine Bulbul	Endemic	LC
Centropus viridis	Philippine Coucal	Endemic	LC
Macropygia tenuirostris	Philippine Cuckoo-Dove	Endemic	LC
Ceyx melanurus	Philippine Dwarf Kingfisher	Endemic	VU

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Irena cyanogastra	Philippine Fairy-Bluebird	Endemic	
Microhierax erythrogenys	Philippine Falconet	Endemic	LC
Batrachostomus septimus	Philippine Frogmouth	Endemic	LC
Nisaetus philippensis	Philippine Hawk-Eagle	Endemic	VU
Ninox philippensis	Philippine Hawk-Owl	Endemic	LC
Caprimulgus manillensis	Philippine Nightjar	Endemic	LC
Dendrocopos maculatus	Philippine Pygmy Woodpecker	Endemic	LC
Otus megalotis	Philippine Scops-Owl	Endemic	LC
Spilornis holospilus	Philippine Serpent-Eagle	Endemic	LC
Orthotomus castaneiceps	Philippine Tailorbird	Endemic	LC
Harpactes ardens	Philippine Trogon	Endemic	LC
Saxicola caprata	Pied Bushchat		
Ducula poliocephala	Pink-bellied Imperial Pigeon	Endemic	NT
Amaurornis olivacea	Plain Bush-hen	Endemic	LC
Anthreptes malacensis	Plain-throated Sunbird		
Cacomantis merulinus	Plaintive Cuckoo		
Treron pompadora	Pompadour Green-Pigeon		
Hirundapus celebensis	Purple Needletail		
Nectarinia sperata	Purple-throated Sunbird		
Dicaeum pygmaeum	Pygmy Flowerpecker		
Collocalia troglodytes	Pygmy Swiftlet		
Gallus gallus	Red Junglefowl		
Erythropitta erythrogaster	Red-bellied Pitta		
Phaenicophaeus superciliosus	Red-crested Malkoha	Endemic	LC
Dicaeum australe	Red-keeled Flowerpecker	Endemic	
Anthus richard	Richard's Pipit		
Halcyon coromanda	Ruddy Kingfisher		
Centropus unirufus	Rufous Coucal	Endemic	NT
Buceros hydrocorax	Rufous Hornbill	Endemic	NT
Terpsiphone cinnamomea	Rufous Paradise-Flycatcher		
Phaenicophaeus cumingi	Scale-feathered Malkoha	Endemic	LC
Zoothera dauma	Scaly Ground-Trush		
Hypothymis helenae	Short-crested Monarch	Endemic	NT
Luscinia calliope	Siberian Rubythroat		
Robsonius thompsoni	Sierra Madre Ground-Warbler	Endemic	NT
Corvus enca	Slender-billed Crow		
Mulleripicus funebris	Sooty Woodpecker	Endemic	LC
Actenoides lindsayi	Spotted Wood-Kingfisher	Endemic	LC
Megalurus palustris	Striated Grassbird		LC

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Rhabdornis mystacalis	Stripe-headed Rhabdornis	Endemic	LC
Hemiprocne comata	Whiskered Tree-Swift		
Lonchura leucogastra	White-bellied Munia		
Dryocopus javensis	White-bellied Woodpecker		
Amaurornis phoenicurus	White-breasted Waterhen		
Artamus leucorynchus	White-breasted Woodswallow		
Porzana cinerea	White-browed Crake		
Copsychus luzoniensis	White-browed Shama	Endemic	LC
Oriolus albiloris	White-lored Oriole	Endemic	LC
White-throated Kingfisher	White-throated Kingfisher		
Motacilla flava	Yellow Wagtail		
Pachycephala philippinensis	Yellow-bellied Whistler	Endemic	LC
Ptilinopus occipitalis	Yellow-breasted Fruit-Dove	Endemic	LC
Zosterops nigrorum	Yellowish White-eye	Endemic	LC
Pycnonotus goiavier	Yellow-vented Bulbul		
Pycnonotus urostictus	Yellow-wattled Bulbul	Endemic	LC

*Extent of occurrence refers to the species endemic (EN) to the Philippines.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR)

Annex 1.1c. Summary of mammal species recorded in NSMNP, their extent of occurrence and conservation status based on the IUCN Red List of Threatened Species (2014).

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
VOLANT MAMMALS			
Cynopterus brachyotis	Lesser short-nosed fruit bat		LC
Eonycteris robusta	Philippine dawn bat	Endemic	NT
Haplonycteris fischeri	Fischer's pygmy fruit bat	Endemic	LC
Macroglossus minimus	Long-tongued nectar bat		LC
Otopteropus cartilagonodus	Luzon pygmy fruit bat	Endemic	LC
Ptenochirus jagori	Musky fruit bat	Endemic	
Desmalopex leucopterus	Mottle-winged flying fox	Endemic	LC
Rousettus amplexicaudatus	Common rousette		
Hipposideros diadema	Diadem leaf-nosed bat		LC
Megaderma spasma	Lesser false vampire bat		LC
Rhinolophus arcuatus	Arcuate horseshoe bat		LC
NONVOLANT MAMMALS			
Rattus everetti	Philippine forest rat	Endemic	LC
Rattus sp			
Paradoxurus hermaphroditus	Asian palm civet		LC
Sus philippensis	Philippine warty pig	Endemic	VU
Macaca fascicularis	Long-tailed Macaque		NT

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Rusa marianna	Philippine brown deer	Endemic	VU

*Extent of occurrence refers to the species endemic (EN) to the Philippines.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR)

Annex 1.1d. Summary of amphibians and species recorded in NSMNP, their extent of occurrence and conservation status based on the IUCN Red List of Threatened Species (2014).

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Brachymeles bonitae	Stub-limbed Burrowing Skink	Endemic	LC
Brachymeles sp			
Calamaria gervaisi	Gervais' Worm Snake	Endemic	LC
Cuora amboinensis	South Asian Box Turtle	Endemic	VU
Cyrtodactylus philippinicus	Philippine Bent-toed Gecko	Endemic	LC
Dendrelaphis luzonensis	Gray Bronzeback	Endemic	LC
Draco spilopterus	Philippine Flying Dragon		
Eutropis cumingi	Cuming's Mabuya	Endemic	LC
Eutropis multicarinata borealis		Endemic	LC
Fejervarya cancrivora	Crab-eating Frog		LC
Fejervarya vittigera	Common Pond Frog	Endemic	LC
Gekko sp			
Gonocephalus sp			
Hylarana similis		Endemic	NT
Kaloula kalingensis	Kalinga Narrowmouth Toad	Endemic	VU
Kaloula picta	Painted narrowmouth toad	Endemic	LC
Kaloula rigida	Luzon narrow-mouthed frog	Endemic	VU
Lamprolepis smaragdina philippinica	Emerald Green Tree Skink	Endemic	
Limnonectes macrocephalus	Luzon fanged frog	Endemic	NT
Limnonectes woodworthi	Woodworth's frog	Endemic	LC
Lycodon capucinus	Indian Wolf Snake		LC
Lycodon muelleri	Muller's Wolf Snake	Endemic	LC
Occidozyga laevis	Common Puddle Frog		LC
Otosaurus cumingi	Cuming's Sphenomorphus	Endemic	LC
Oxyrhabdium leporinum leporinum	Banded Philippine Burrowing Snake	Endemic	LC
Pinoyscincus abdictus aquilonius		Endemic	LC
Platymantis cagayanensis		Endemic	EN
Platymantis corrugatus		Endemic	LC
Platymantis dorsalis		Endemic	LC
Platymantis luzonensis		Endemic	NT
Platymantis pygmaeus		Endemic	VU
Platymantis sp			

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Platymantis sp seeyok			
Platymantis taylori		Endemic	EN
Polypedates leucomystax	Common tree frog		LC
Pseudorabdion cf mcnamarae	Mcnamara's Burrowing Snake	Endemic	VU
Ramphotyphlops braminus	Brahminy blindsnake		
Rhabdophis spilogaster		Endemic	LC
Rhacophorus pardalis	Emerald Flying Frog		LC
Rhinella marina			LC
Sanguirana luzonensis		Endemic	NT
Sphenomorphus hadrus			
Sphenomorphus sp			
Sphenomorphus tagapayo	Aurora Mountain Skink	Endemic	NT
Trimeresurus flavomaculatus flavomaculatus	Philippine Pit Viper	Endemic	NT

*Extent of occurrence refer to the species endemic (EN) to the Philippines.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR)

Kaliwa – UMRBPL

Annex 1.2a.List of all floral species recorded from the survey for the proxy sites of UMRBPL-KWFR. Shown also is the species conservation status based on IUCN 2014 and their endemicity.

Scientific Name	Common Name	State of Occurrence*	IUCN Status**
Polyscias nodosa	Malapapaya	Non Endemic	NA
Nauclea orientalis	Bangkal	Non Endemic	NA
Diospyros pilosanthera	Bolong Eta	Non Endemic	NA
Heritiera sylvatica	Dungon	Non Endemic	NA
Ficus balete	Balite	Philippine Endemic	NA
Ficus variegata	Tangisang Bayawak	Non Endemic	NA
Celtis philippinensis	Malaikmo	Non Endemic	NA
Pterocarpus indicus	Narra	Non Endemic	VU
Ceiba pentandra	Malabulak	Non Endemic	NA
Samanea saman	RainTree	Non Endemic	NA
Swietenia macrophylla	Mahogany	Non Endemic	VU
Mitrephora lanotan	Lanutan	Philippine Endemic	VU
Macaranga grandifolia	Takip Asin	Philippine Endemic	VU
Canarium ovatum	Pili	Philippine Endemic	VU
Broussonetia luzonica	Himbabao	Philippine Endemic	NA
Syzygium cumini	Duhat	Non Endemic	NA
Pterocymbium tinctorium	Taluto	Non Endemic	NA
Gmelina arborea	Gmelina	Non Endemic	NA
Ficus odorata	Pakiling	Philippine Endemic	NA

Scientific Name	Common Name	State of Occurrence*	IUCN Status**
Lagerstroemia speciosa	Banaba	Non Endemic	NA
Ficus nota	Tibig	Non Endemic	NA
Hopea acuminata	Manggachapui	Philippine Endemic	CR
Antidesma bunius	Bignai		

*Extent of occurrence refers to the species endemic to the Philippines
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR)

Annex 1.2b. List of all bird species from the survey for the proxy sites of UMRBPL-KWFR. Shown also is the species conservation status based on IUCN and their occurrence in the study sites.

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Pandion haliaetus	Osprey	Migratory	LC
Haliastur indus	Brahminy Kite	Resident	LC
Haliaeetus leucogaster	White-bellied Sea-Eagle	Resident	LC
Spilornis holospilus	Philippine Serpent-Eagle	Endemic	LC
Gallus gallus	Red Junglefowl	Resident	LC
Turnix worcesteri	Worcester's Buttonquail	Endemic	DD
Phapitreron leucotis	White-eared Brown-Dove	Endemic	LC
Phapitreron amethystina	Amethyst Brown-Dove	Endemic	LC
Ptilinopus occipitalis	Yellow-breasted Fruit-Dove	Endemic	LC
Ptilinopus leclancheri	Black-chinned Fruit-Dove	Endemic	LC
Ducula aenea	Green Imperial-Pigeon	Resident	LC
Macropygia tenuirostris	Philippine Cuckoo-Dove	Endemic	LC
Streptopelia chinensis	Spotted Dove	Resident	LC
Geopelia striata	Zebra Dove	Resident	LC
Chalcophaps indica	Common Emerald-Dove	Resident	LC
Gallicolumba luzonica	Luzon Bleeding-heart	Endemic	NT
Bolbopsittacus lunulatus	Guaiabero	Endemic	LC
Loriculus philippensis	Colasisi	Endemic	LC
Cacomantis merulinus	Plaintive Cuckoo	Resident	LC
Cacomantis variolosus	Brush Cuckoo	Resident	LC
Surniculus velutinus	Philippine Drongo-Cuckoo	Endemic	LC
Eudynamys scolopacea	Common Koel	Resident	LC
Phaenicophaeus cumingi	Scale-feathered Malkoha	Endemic	LC
Phaenicophaeus superciliosus	Red-crested Malkoha	Endemic	LC
Centropus bengalensis	Lesser Coucal	Resident	LC
Centropus viridis	Philippine Coucal	Endemic	LC
Centropus unirufus	Rufous Coucal	Endemic	NT
Otus longicornis	Luzon Scops-Owl	Endemic	NT
Otus megalotis	Philippine Scops-Owl	Endemic	LC

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Batrachostomus septimus	Philippine Frogmouth	Endemic	LC
Eurostopodus macrotis	Great Eared Nightjar	Resident	LC
Caprimulgus manillensis	Philippine Nightjar	Endemic	LC
Collocalia vanikorensis	Island Swiftlet	Resident	LC
Collocalia mearnsi	Philippine Swiftlet	Endemic	LC
Collocalia esculenta	Glossy Swiftlet	Resident	LC
Collocalia troglodytes	Pygmy Swiftlet	Endemic	LC
Harpactes ardens	Philippine Trogon	Endemic	LC
Eurystomus orientalis	Dollarbird	Resident	LC
Alcedo atthis	Common Kingfisher	Migratory	LC
Alcedo cyanopecta	Indigo-banded Kingfisher	Endemic	LC
Ceyx melanurus	Philippine Dwarf-Kingfisher	Endemic	VU
Halcyon coromanda	Ruddy Kingfisher	Resident	LC
Halcyon smyrnensis	White-throated Kingfisher	Resident	LC
Halcyon chloris	White-collared Kingfisher	Resident	LC
Merops viridis	Blue-throated Bee-eater	Resident	LC
Merops philippinus	Blue-tailed Bee-eater	Resident	LC
Penelopides manillae	Luzon Tarictic	Endemic	LC
Buceros hydrocorax	Rufous Hornbill	Endemic	NT
Megalaima haemacephala	Coppersmith Barbet	Resident	LC
Dendrocopos maculatus	Philippine Pygmy Woodpecker	Endemic	LC
Mulleripicus funebris	Sooty Woodpecker	Endemic	LC
Dryocopus javensis	White-bellied Woodpecker	Resident	LC
Pitta erythrogaster	Red-bellied Pitta	Resident	LC
Pitta sordida	Hooded Pitta	Resident	LC
Hirundo tahitica	Pacific Swallow	Resident	LC
Coracina striata	Bar-bellied Cuckoo-shrike	Resident	LC
Pycnonotus goiavier	Yellow-vented Bulbul	Resident	LC
Pycnonotus urostictus	Yellow-wattled Bulbul	Endemic	LC
Hypsipetes philippinus	Philippine Bulbul	Endemic	LC
Dicrurus balicassius	Balicassiao	Endemic	LC
Oriolus chinensis	Black-naped Oriole	Resident	LC
Irena cyanogaster	Philippine Fairy-Bluebird	Endemic	LC
Corvus macrorhynchos	Large-billed Crow	Resident	LC
Parus elegans	Elegant Tit	Endemic	LC
Stachyris striata	Luzon Striped-Babbler	Endemic	NT
Brachypteryx montana	White-browed Shortwing	Resident	LC
Copsychus saularis	Oriental Magpie-Robin	Resident	LC
Copsychus luzoniensis	White-browed Shama	Endemic	LC
Megalurus timoriensis	Tawny Grassbird	Resident	LC

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Orthotomus castaneiceps	Philippine Tailorbird	Endemic	LC
Hypothymis azurea	Black-naped Monarch	Resident	LC
Lanius schach	Long-tailed Shrike	Resident	LC
Lanius cristatus	Brown Shrike	Migratory	LC
Aplonis panayensis	Asian Glossy Starling	Resident	LC
Sarcops calvus	Coleto	Endemic	LC
Anthreptes malacensis	Plain-throated Sunbird	Resident	LC
Nectarinia jugularis	Olive-backed Sunbird	Resident	LC
Nectarinia sperata	Purple-throated Sunbird	Resident	LC
Aethopyga shelleyi	Lovely Sunbird	Endemic	LC
Arachnothera clarae	Naked-faced Spiderhunter	Endemic	LC
Prionochilus olivaceus	Olive-backed Flowerpecker	Endemic	LC
Dicaeum anthonyi	Flame-crowned Flowerpecker	Endemic	NT
Dicaeum australe	Red-keeled Flowerpecker	Endemic	LC
Dicaeum hypoleucum	Buzzing Flowerpecker	Endemic	LC
Dicaeum trigonostigma	Orange-bellied Flowerpecker	Resident	LC
Dicaeum pygmaeum	Pygmy Flowerpecker	Endemic	LC
Zosterops meyeni	Lowland White-eye	Endemic	LC
Passer montanus	Eurasian Tree Sparrow	Resident	LC
Lonchura leucogastra	White-bellied Munia	Resident	LC
Lonchura punctulata	Scaly-breasted Munia	Resident	LC
Lonchura atricapilla	Black-headed Munia	Resident	LC

*Extent of occurrence refers to the species endemic to the Philippines
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex.1.2c. List of all mammal species recorded from the survey for the proxy sites of UMRBPL-KWFR. Shown also is the species conservation status based on IUCN and their occurrence in the study sites.

Scientific Name	Common name	Extent of Occurrence*	Threat Level**		
			IUCN	CITES	DAO
Cynopterus brachyotis	Common Short-nosed Fruit Bat	Common	LC	NA	NA
Ptenochirus jagori	Greater Musky Fruit Bat	Philippine Endemic	LC	NA	NA
Eonycteris spelaea	Common Dawn Bat	Common	LC	NA	NA
Eonycteris robusta	Philippine Nectar Bat	Philippine Endemic	NT	NA	NA
Haplonycteris fischeri	Philippine Pygmy Fruit Bat	Philippine Endemic	LC	NA	NA
Rousettus amplexicaudatus	Geoffroy's Rousette	Common	LC	NA	NA
Macroglossus minimus	Lesser Long-tongued Fruit Bat	Common	LC	NA	NA
Hipposideros diadema	Diadem Leaf-nosed Bat	Common	LC	NA	NA
Megaderma spasma	Lesser False Vampire	Common	LC	NA	NA
Rhinolophus arcuatus	Arcuate Horseshoe Bat	Common	LC	NA	NA
Saccolaimus saccolaimus	Bare-rumped Sheathtail Bat	Common	LC	NA	NA
Tylonycteris pachypus	Lesser Bamboo Bat	Common	LC	NA	NA
Tylonycteris robustula	Greater Flat-headed Bat	Common	LC	NA	NA
Octopterupus cartilagonodus	Luzon Fruit Bat	Luzon Endemic	LC	NA	NA
Kerivoula whiteheadi	Whitehead's Woolly Bat	Common	LC	NA	NA

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.2d. List of all amphibian species recorded from the survey for the proxy sites of UMRBPL-KWFR. Shown also is the species conservation status based on IUCN and their occurrence in the study sites.

Scientific Name	Common Name	Extent of Occurrence*	Threat Level**		
			IUCN	CITES	DAO
Rhinella marina	Cane Toad	Widespread	LC	NA	NA
Platymantis corrugatus	Masked Wrinkled Ground Frog	Philippine Endemic	LC	NA	NA
Platymantis dorsalis	Whistling Wrinkled Ground Frog	Philippine Endemic	LC	NA	NA
Platymantis mimulus	Husky-voiced Wrinkled Ground Frog	Luzon PAIC Endemic	NT	NA	NA

Scientific Name	Common Name	Extent of Occurrence*	Threat Level**		
			IUCN	CITES	DAO
Limnonectes macrocephalus	Luzon Fanged Frog	Luzon PAIC Endemic	NT	NA	NA
Limnonectes woodworthi	Luzon Swamp Frog	Luzon PAIC Endemic	LC	NA	NA
Occidozyga laevis	Common Puddle Frog	Widespread	LC	NA	NA
Kaloula pulchra	Asiatic Painted Narrowmouth Toad	Widespread	LC	NA	NA
Hylarana erythraea	Green Paddy Frog	Widespread	LC	NA	NA
Hylarana similis	Luzon Striped Stream Frog	Luzon PAIC Endemic	NT	NA	NA
Hylarana signata	Spotted Stream Frog	Widespread	LC	NA	NA
Polypedates leucomystax	Asiatic Tree Frog	Widespread	LC	NA	NA

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.2e. List of all reptile species recorded from the survey for the proxy sites of UMRBPL-KWFR. Shown also is the species conservation status based on IUCN and their occurrence in the study sites.

Scientific Name	Common Name	Extent of Occurrence*	Threat Level**		
			IUCN	CITES	DAO
Bronchocela cristatella	Green crested Lizard	Widespread	NA	NA	NA
Draco spilopterus	Philippine Flying Dragon	Luzon PAIC Endemic	NA	NA	NA
Gonocephalus sophiae	Negros Forest Dragon	Philippine Endemic	DD	NA	NA
Cyrtodactylus philippinicus	Philippine Bent-toed Gecko	Philippine Endemic	LC	NA	NA
Gekko gecko	Tokay Gecko	Widespread	NA	NA	NA
Hemidactylus frenatus	Common House Gecko	Widespread	NA	NA	NA
Lepidodactylus lugubris	Common Smooth-Scaled Gecko	Widespread	NA	NA	NA
Eutropis multicarinata	Many-keeled Mabuya	Widespread	NA	NA	NA

Scientific Name	Common Name	Extent of Occurrence*	Threat Level**		
			IUCN	CITES	DAO
Pinoyscincus jagori	Jagor's Sphenomorphus	Philippine Endemic	NA	NA	NA
Ahaetulla prasina	Gunther's Whip Snake	Widespread	LC	NA	NA
Boiga dendrophila	Mangrove Cat Snake	Widespread	NA	NA	NA
Boiga cynodon	Dog-toothed Cat Snake	Widespread	LC	NA	NA
Calamaria bitorques	Banded Worm Snake	Luzon PAIC Endemic	LC	NA	NA
Malayotyphlops ruficaudus	Red-headed Worm Snake	Luzon PAIC Endemic	LC	NA	NA
Trimeresurus flavomaculatus	Philippine Pit Viper	Philippine Endemic	LC	NA	NA

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

NLNP

Annex 1.3a. List of bird species in NLNP used for the ecological assessment as collected from the Philippine National Museum, California Academy of Sciences, Field Museum of Natural History and Kansas University.

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Anas luzonica	Philippine Duck	Philippine Endemic	VU
Cacatua haematuropygia	Philippine Cockatoo, Red-vented Cockatoo	Philippine Endemic	CR
Centropus steerii	Black-hooded Coucal	Mindoro Island	CR
Dicaeum retrocinctum	Scarlet-collared Flowerpecker	Philippine Endemic	VU
Ducula carola	Spotted Imperial-pigeon	Philippine Endemic	VU
Ducula mindorensis	Mindoro Imperial-pigeon	Mindoro Island	EN
Gallicolumba platenae	Mindoro Bleeding-heart	Mindoro Island	CR
Penelopides mindorensis	Mindoro Hornbill	Mindoro Island	EN
Zoothera cinerea	Ashy Thrush	Philippine Endemic	VU

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.3b. List of amphibians in NLNP used for the ecological assessment as collected from the Philippine National Museum, California Academy of Sciences, Field Museum of Natural History and Kansas University.

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Fejervarya cancrivora	Asian Brackish Frog	Southeast Asia	LC
Fejervarya moodiei	Brackish Frog	Philippines	DD
Fejervarya vittigera	Philippine Grass Frog	Philippines	LC
Hoplobatrachus rugulosus	Chinese Tiger Frog	Southeast Asia	LC
Hylarana mangyanum	Mindoro Striped Stream Frog	Mindoro Island	EN
Kaloula conjuncta	Narrowmouth Toad	Philippines	LC
Kaloula picta	Philippine Painted Narrowmouth	Philippines	LC
Leptobrachium mangyanorum	Mindoro Litter Frog	Mindoro Island	NA
Limnonectes acanthi	Palawan Fanged Frog	Palawan and Mindoro	VU
Limnonectes visayanus	Visayan Fanged Frog	Negros-Panay PAIC	VU
Occidozyga laevis laevis	Philippine Oriental Frog	Southeast Asia	LC
Pelophryne brevipes	Western Mindanao Dwarf Toad	Mindanao PAIC	LC
Philautus schmackeri	Mindoro Bush Frog	Mindoro Island	EN
Platymantis corrugatus	Masked Wrinkled Ground Frog	Philippine Endemic	LC
Platymantis dorsalis	Whistling Wrinkled Ground Frog	Philippine Endemic	LC
Rhacophorus bimaculatus	Mindanao Flying Frog	Philippine Endemic	VU
Rhinella marina	Cane Toad	Widely Distributed	LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.3c. List of amphibians in NLNP used for the ecological assessment as collected from the Philippine National Museum, California Academy of Sciences, Field Museum of Natural History and Kansas University.

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Brachymeles bonitae	Stub-limbed Burrowing Skink	Philippine Endemic	LC
Brachymeles mindorensis	Mindoro Short-legged Skink	Mindoro Island	NA
Bronchocela cristatella	Green crested lizard	Southeast Asia	NA
Calamaria gervaisi	Gervais' Worm Snake	Philippine Endemic	LC
Cosymbotus platyurus	Flat-tailed House Gecko	Southeast Asia	NA
Cyclocorus lineatus	Northern Triangle-spotted Snake	Negros-Panay PAIC	LC
Cyrtodactylus jambangan		Southeast Asia	NA
Cyrtodactylus philippinicus	Philippine Bow-fingered Gecko	Southeast Asia	NA
Dendrelaphis fuliginosus		Negros-Panay PAIC	NA
Eutropis indeprensa	Brown's Mabuya	Southeast Asia	NA

Scientific Name	Common Name	Extent of Occurrence*	IUCN Status**
Eutropis multicarinata		Southeast Asia	NA
Gehyra mutilate	Common Four-clawed Gecko	Southeast Asia	NA
Gekko gecko	Tokay Gecko	Southeast Asia	NA
Gekko mindorensis	Mindoro Narrow-disked Gecko	Philippine Endemic	LC
Gonocephalus semperi	Mindoro Forest Dragon	Philippine Endemic	DD
Hemidactylus frenatus	Common House Gecko	Southeast Asia	LC
Lamprolepis smaragdina	Emerald Skink	Southeast Asia	NA
Lepidodactylus planicaudus	Small Broad-tailed Smooth-scaled Gecko	Philippine Endemic	LC
Sphenomorphus coxi	Cox's Sphenomorphus	Philippine Endemic	LC
Sphenomorphus cumingi	Cuming's Sphenomorphus	Philippine Endemic	LC
Sphenomorphus jagori	Jagor's Sphenomorphus	Philippine Endemic	LC
Sphenomorphus steerei	Steere's Sphenomorphus	Philippine Endemic	LC
Sphenomorphus variegatus		Southeast Asia	NA

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

BRWFR

Annex 1.4a. List of all floral species recorded from the survey for the proxy sites of BRWFR. Shown also is the species conservation status based on IUCN 2014 and their endemicity.

Scientific Name	Common Name	Extent of Occurence*	IUCN Status**
Agathis philippinensis	Almaciga	Non Endemic	
Artocarpus heterophyllus	Nangka	Non Endemic	
Bischofia javanica	Tu-og	Non Endemic	
Dacrycarpus imbricatus	Igem	Non Endemic	LC
Dendrochnide sp.	Alingatong		
Macaranga bicolor	Hamindang	Philippine Endemic	VU
Macaranga tanarius	Binunga	Non Endemic	
Myristica philippinensis	Duguan	Philippine Endemic	
Palaquium luzoniense	Nato	Philippine Endemic	VU
Palaquium sp. 1	Nato Puti		
Palaquium sp. 2	Nato Pula		
Parashorea malaanonan	Bagtikan	Non Endemic	CR
Shorea contorta	White Lauan	Philippine Endemic	CR
Shorea negrosensis	Red Lauan	Philippine Endemic	CR
Shorea polysperma	Tangile	Philippine Endemic	CR
Swietenia macrophylla	Mahogany	Non Endemic	VU
Syzygium sp. 1	Udling		
Syzygium sp. 2	Udling Puti		
Syzygium sp. 3	Udling Pula		

Scientific Name	Common Name	Extent of Occurence*	IUCN Status**
Syzygium sp. 4	Udling Pinhan		
Syzygium sp. 5	Udling Malabahi		
Syzygium sp. 6	Udling lanahan		
Syzygium sp. 7	Udling Tagabinlod		
Syzygium sp. 8	Udling Tisa		
Syzygium sp. 9	Ublas		
Tristaniopsis decorticata	Malabayabas	Non Endemic	

List of species that are only identified through their common or local names

Agumit	Baslayan	Koldemon	Rod Tree
Ahos-ahos	Batikuling	Labnog	Tabayog
Alowhaw	Bay-ang	Laco Laco	Tagi lumboy
Anagdong	Bay-ang Lantuan	Lambunao	Tago Santol
Anilaw	Bay-ang lantuhan	Lawi-lawi	Tago-Binlod
Bagobinlod	Bay-ang Puti	Malaiba	Tagosantol
Baguilumboy	Beri	Malatabaco	Talot
Bahai	Bulo Bacado	Malatisa	Taulay
Bakan	Coldemon	Manudtod	Tulan manok
Bakan mandulawnun	Dalaquit	Mindang/Anilaw	Tulo Tabako
Bakan Puti	Habon-habon	Ngot-ngotan	Ulo-Anonang
Bakan yellow	Halpo	Pangguom	Wilti green
Balabaga	Haras	Panubol	
Balukanag	Kabal Tree	Pitik-pitik	

*Extent of occurrence refers to the species endemic (EN) to the Philippines.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR)

Annex 1.4.b List of birds recorded in BRWFR during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common Name	Extent of Occurrence	SB, Bagong Silang	BC, Mailum	IUCN Status
Bubulcus ibis coromandus	Cattle Egret	Resident	3	3	LC
Haliastur indus intermedius	Brahminy Kite	Resident	3	3	LC
Accipiter soloensis	Chinese Goshawk	Migratory		3	LC
Accipiter trivirgatus extimus	Crested Goshawk	Resident	3		LC
Spilornis holospilus	Philippine Serpent-Eagle	Endemic	3	3	LC
Spizaetus philippensis pinskeri	Philippine Hawk-Eagle	Endemic	3	3	VU
Gallus gallus	Red Junglefowl	Introduced		3	LC
Phapitreron leucotis nigrorum	White-eared Brown-Dove	Endemic	3	3	LC
Phapitreron amethystina maculipectus	Amethyst Brown-Dove	Endemic	3	3	LC

Scientific Name	Common Name	Extent of Occurrence	SB, Bagong Silang	BC, Mailum	IUCN Status
Ptilinopus occipitalis occipitalis	Yellow-breasted Fruit-Dove	Endemic	3	3	LC
Ptilinopus leclancheri	Black-chinned Fruit-Dove	Endemic			LC
Ducula poliocephala	Pink-bellied Imperial-Pigeon	Endemic	3	3	VU
Columba vitiensis anthracina	Metallic Imperial-Pigeon	Resident		3	LC
Macropygia tenuirostris tenuirostris	Philippine Cuckoo-Dove	Endemic	3	3	LC
Streptopelia chinensis	Spotted Dove	Resident		3	LC
Geopelia striata striata	Zebra Dove	Intro		3	LC
Chalcophaps indica indica	Common Emerald-Dove	Resident	3	3	LC
Gallicolumba keayi	Negros Bleeding-heart	Negros-Panay			LC
Tanygnathus lucionensis salvadorii	Blue-naped Parrot	Endemic		3	LC
Tanygnathus sumatranus	Blue-backed Parrot	Resident		3	LC
Loriculus philippensis regulus	Colasisi	Endemic	3	3	LC
Cacomantis merulinus	Plaintive Cuckoo	Resident		3	LC
Cacomantis variolosus	Brush Cuckoo	Resident	3	3	LC
Eudynamys scolopacea	Common Koel	Resident	3		LC
Centropus bengalensis	Lesser Coucal	Resident	3	3	LC
Centropus viridis	Philippine Coucal	Endemic	3	3	LC
Otus megalotis	Philippine Scops-Owl	Endemic		3	LC
Batrachostomus septimus	Philippine Frogmouth	Endemic	3	3	LC
Caprimulgus manillensis	Philippine Nightjar	Endemic	3	3	LC
Collocalia mearnsi	Philippine Swiftlet	Endemic	3	3	LC
Collocalia esculenta	Glossy Swiftlet	Resident	3	3	LC
Collocalia troglodytes	Pygmy Swiftlet	Endemic	3	3	LC
Alcedo cyanopecta	Indigo-banded Kingfisher	Endemic	3	3	LC
Ceyx lepidus	Variable Kingfisher	Resident		3	LC
Ceyx erithacus	Oriental Kingfisher	Resident		3	LC
Halcyon smyrnensis	White-throated Kingfisher	Resident		3	LC
Halcyon winchelli	Rufous-lored Kingfisher	Endemic			LC
Halcyon chloris	White-collared Kingfisher	Resident		3	LC
Actenoides lindsayi	Spotted Wood-Kingfisher	Endemic		3	LC
Merops viridis	Blue-throated Bee-eater	Resident		3	LC
Merops philippinus	Blue-tailed Bee-eater	Resident		3	LC
Penelopides panini	Visayan Hornbill	Negros-Panay	3	3	EN
Buceros hydrocorax	Rufous Hornbill	Endemic			NT

Scientific Name	Common Name	Extent of Occurrence	SB, Bagong Silang	BC, Mailum	IUCN Status
Megalaima haemacephala	Coppersmith Barbet	Resident			LC
Dendrocopos maculatus	Philippine Pygmy Woodpecker	Endemic	3	3	LC
Dryocopus javensis	White-bellied Woodpecker	Resident	3	3	LC
Chrysocolaptes lucidus	Greater Flameback	Resident			LC
Pitta erythrogaster	Red-bellied Pitta	Resident			LC
Pitta sordida	Hooded Pitta	Resident	3	3	LC
Hirundo rustica	Barn Swallow	Migratory		3	LC
Hirundo tahitica	Pacific Swallow	Resident	3	3	LC
Coracina striata	Bar-bellied Cuckoo-shrike	Resident	3	3	LC
Coracina ostenta	White-winged Cuckoo-shrike	Negros-Panay	3	3	VU
Lalage nigra	Pied Triller	Resident	3	3	LC
Pericrocotus divaricatus	Ashy Minivet	Migratory			LC
Pericrocotus flammeus	Scarlet Minivet	Resident			LC
Pycnonotus goiavier	Yellow-vented Bulbul	Resident	3	3	LC
Pycnonotus urostictus	Yellow-wattled Bulbul	Endemic	3	3	LC
Ixos philippinus	Philippine Bulbul	Endemic	3	3	LC
Dicrurus balicassius	Balicassiao	Endemic	3	3	LC
Oriolus steerii	Philippine Oriole	Endemic		3	LC
Oriolus chinensis	Black-naped Oriole	Resident	3	3	LC
Corvus macrorhynchos	Large-billed Crow	Resident	3	3	LC
Parus elegans	Elegant Tit	Endemic	3	3	LC
Sitta oenochlamys	Sulphur-billed Nuthatch	Endemic	3	3	LC
Stachyris speciosa	Flame-templed Babbler	Negros-Panay		3	LC
Stachyris nigrorum	Negros Striped-Babbler	Negros-Panay	3	3	EN
Brachypteryx montana	White-browed Shortwing	Resident	3	3	LC
Luscinia calliope	Siberian Rubythroat	Migratory			LC
Copsychus saularis	Oriental Magpie-Robin	Resident			LC
Copsychus luzoniensis	White-browed Shama	Endemic		3	LC
Phylloscopus borealis	Arctic Warbler	Migratory		3	LC
Phylloscopus olivaceus	Philippine Leaf-Warbler	Endemic			LC
Phylloscopus cebuensis	Lemon-throated Leaf-Warbler	Endemic	3		LC
Megalurus timoriensis	Tawny Grassbird	Resident	3	3	LC
Orthotomus castaneiceps	Philippine Tailorbird	Endemic	3	3	LC
Eumyias panayensis	Mountain Verditer-Flycatcher	Resident		3	LC
Ficedula hyperythra nigrorum	Snowy-browed Flycatcher	Resident	3	3	LC

Scientific Name	Common Name	Extent of Occurrence	SB, Bagong Silang	BC, Mailum	IUCN Status
Culicicapa helianthea	Citrine Canary-Flycatcher	Resident	3	3	LC
Rhipidura javanica	Pied Fantail	Resident	3	3	LC
Rhipidura cyaniceps	Blue-headed Fantail	Endemic	3	3	LC
Terpsiphone cinnamomea	Rufous Paradise-Flycatcher	Resident	3		LC
Hypothymis azurea	Black-naped Monarch	Resident	3	3	LC
Hypothymis coelestis	Celestial Monarch	Endemic			VU
Pachycephala homeyeri	White-vented Whistler	Endemic	3	3	LC
Motacilla cinerea	Grey Wagtail	Migratory	3	3	LC
Motacilla flava	Yellow Wagtail	Migratory	3	3	LC
Lanius schach	Long-tailed Shrike	Resident	3	3	LC
Lanius cristatus	Brown Shrike	Migratory	3	3	LC
Aplonis panayensis	Asian Glossy Starling	Resident		3	LC
Sarcops calvus	Coleto	Endemic	3	3	LC
Acridotheres cristatellus	Crested Myna	Introduced			LC
Anthreptes malacensis	Plain-throated Sunbird	Resident	3	3	LC
Nectarinia jugularis	Olive-backed Sunbird	Resident	3	3	LC
Nectarinia sperata	Purple-throated Sunbird	Resident		3	LC
Aethopyga flagrans	Flaming Sunbird	Endemic		3	LC
Aethopyga shelleyi	Lovely Sunbird	Endemic	3	3	LC
Aethopyga siparaja	Crimson Sunbird	Resident		3	LC
Dicaeum aeruginosum	Striped Flowerpecker	Endemic			LC
Dicaeum bicolor	Bicolored Flowerpecker	Endemic		3	LC
Dicaeum trigonostigma	Orange-bellied Flowerpecker	Resident	3	3	LC
Dicaeum ignipectus	Fire-breasted Flowerpecker	Resident			LC
Dicaeum pygmaeum	Pygmy Flowerpecker	Endemic	3	3	LC
Zosterops nigrorum	Yellowish White-eye	Endemic		3	LC
Zosterops montanus	Mountain White-eye	Resident	3	3	LC
Passer montanus	Eurasian Tree Sparrow	Introduced	3	3	LC
Lonchura leucogastra	White-bellied Munia	Resident	3	3	LC
Lonchura punctulata	Scaly-breasted Munia	Resident	3	3	LC
Lonchura atricapilla	Black-headed Munia	Resident	3	3	LC

*Extent of occurrence refers to the species endemic to the Philippines
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

MKRNP

Annex 1.5a. List of trees recorded in MKRNP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Acalypha cardiophylla		Non endemic				3	
Acer laurinum	Philippine Maple	Non endemic				3	
Afzelia rhomboidea	Tindalo	Non endemic				3	VU
Agathis dammara		Non endemic	3				VU
Alseodaphne philippinensis	Boga	Mindanao endemic			3		
Alstonia scholaris	Batino	Non endemic				3	LC
Aphanamixis polystachya	Kangko	Introduced				3	LC
Aquilaria sp.		Non endemic				3	
Artocarpus heterophyllus	Nangka	Introduced			3		
Astrocalyx calycina	Tanghau	Philippine endemic	3				
Astronia megalantha		Philippine endemic	3				
Breynia cernua	Matang-katang	Non endemic					
Calliandra haematocephala	Fireball	Introduced			3	3	
Calophyllum inophyllum	Bitaog	Non endemic	3	3	3	3	LC
Canarium asperum	Pagsahingin	Philippine endemic			3		LC
Cassia javanica		Introduced			3		
Castanopsis philippensis	Philippine chestnut	Philippine endemic			3	3	
Casuarina equisitifolia	Agoho	Non endemic	3				
Cinchona calisaya	Quinine	Cultivated			3		
Cinnamomum mercadoi	Kalingag	Philippine endemic			3	3	VU
Dacrycarpus imbricarus	Igem	Non endemic			3	3	LC
Dacrycarpus cumingii	Cumingi Igem	Non endemic		3			LC
Dacryodes rostrata	Lunai	Non endemic			3		LC
Decaspermum parviflorum		Non endemic	3	3	3		
Dendrocnide stimulans	Lingaton	Philippine endemic			3		
Dillenia philippinensis	Katmon	Philippine endemic			3		VU
Dodonaea angustifolia		Non endemic				3	
Durio zibethinus	Durian	Introduced			3		
Elaeocarpus angustifolius		Non endemic	3			3	
Magnolia pubescens		Mindanao endemic	3				DD
Erythrina subumbrans	Rarang	Non endemic			3		
Eucalyptus deglupta	Bagras	Non endemic			3		
Eugenia aherniana		Non endemic			3		
Eusideroxylon zwageri		Non endemic			3	3	VU
Melicope mindanaensis	Liuaan	Mindanao endemic				3	
Ficus botryocarpa		Non endemic	3	3	3	3	
Ficus callosa	Kalukoi	Non endemic			3		

Scientific Name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Ficus heteropleura	Kalapat	Non endemic			3	3	
Ficus involucrata	Agosahis	Non endemic				3	
Ficus minahassae	Hagimit	Endemic			3		
Ficus nota	Tibig	Non endemic			3		
Gmelina arborea	Gmelina	Introduced			3		
Gnetum gnemon	Bago	Non endemic				3	LC
Guioa keolreuteria	Alahan	Non endemic			3	3	
Omalanthus macradenius		Philippine endemic				3	
Lagerstroemia speciosa	Banaba	Non endemic			3		
Leucaena leucocephala	Ipil-ipil	Introduced			3		
Limnophila rugosa		Non endemic				3	LC
Lithocapus philippinensis	Pangan-bundok	Non endemic				3	
Lithocarpus celebicus	Celebes Oak	Non endemic	3	3	3	3	
Maesopsis eminii		Introduced			3		
Mallotus molissimus	Hinlaumo	Non endemic				3	
Mangifera indica	Mango	Introduced			3		DD
Melastoma setosum		Mindanao endemic				3	
Melia azedarach		Cultivated			3		
Melicope mindanaensis	Liuaan	Mindanao endemic				3	
Myrica javanica	Hindang	Non endemic				3	
Palaquium polyandrum	Tipurus	Philippine endemic			3		
Palaquium tenuipetiolatum	Maniknik	Non endemic			3	3	
Paraserianthes falcataria	Moluccan Sau	Introduced	3		3	3	
Parasponia rugosa	Hanagdong	Non endemic			3		
Persea americana	Avocado	Introduced			3		
Phyllocadus hypophyllus		Non endemic		3		3	
Phyllocadus hypophyllus		Non endemic			3		
Podocarpus rumphii	Malakauayan	Non endemic		3	3	3	NT
Pterocarpus indicus	Narra	Non endemic			3		VU
Pterocymbium tinctorium	Taluto	Non endemic				3	
Sandoricum koetjape	Santol	Introduced					
Schefflera bukidnonensis		Mindanao endemic				3	
Shorea negrosensis	Red Lauan	Philippine endemic	3				CE
Shorea polysperma	Tangile	Philippine endemic	3	3	3		CE
Spathodea campanualata	African Tulip	Introduced			3		
Sweitenia macrophylla	Mahogany	Introduced			3		VU
Syzygium decipiens	Malaruhat-pula	Non endemic				3	
Syzygium nitidum	Makaasim	Non endemic				3	
Syzygium astronioides	Langauisan	Philippine endemic	3			3	
Toona calantas	Kalantas	Non endemic			3		DD

Scientific Name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Trema orientalis	Anabiong	Non endemic				3	
Tristianopsis decorticata	Malabayabas	Philippine endemic				3	
Vatica odorata	Narig	Philippine endemic	3	3			
Weinmannia urdanetensis		Non endemic				3	

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.5b. List of birds recorded in MKRNP during the ecological assessment, their threat status and extent of occurrence.

Scientific name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Actenoides hombroni	Blue-capped kingfisher	Mindanao endemic				3	VU
Aethopyga primigenia	Grey-hooded sunbird	Mindanao endemic	3	3	3	3	NT
Amaurornis phoenicurus	White-breasted waterhen	Resident				3	LC
Aplonis panayensis	Asian Glossy Starling	Resident			3	3	LC
Basilornis mirandus	Apo Myna	Mindanao endemic				3	NT
Brachpyteryx montana	White-browed shortwing	Resident	3	3	3	3	LC
Butastur indicus	Grey-faced buzzard	Migratory				3	LC
Cacomantis variolosus	Brush Cuckoo	Resident	3	3	3	3	LC
Caprimulgus manillensis	Philippine nightjar	Resident				3	LC
Centropus viridis	Philippine Coucal	Philippine endemic	3		3	3	LC
Chloropsis flavipennis	Philippine leafbird	Philippine endemic				3	VU
Chrysocolaptes lucidus	Buff-spotted flameback	Resident			3	3	LC
Collocalia esculenta	Glossy swiftlet	Resident			3	3	LC
Collocalia troglodytes	Pygmy swiftlet	Philippine endemic			3	3	LC
Copsychus saularis	Oriental Magpie-Robin	Resident			3	3	LC
Cuculus fugax	Hodgson's hawk cuckoo	Resident				3	LC
Dendrocopos maculatus	Philippine pygmy woodpecker	Philippine endemic			3	3	LC
Dicaeum anthonyi	Flame-crowned flowerpecker	Philippine endemic				3	NT
Dicaeum australe	Red-keeled flowerpecker	Philippine endemic	3		3	3	LC
Dicaeum hypoleucum	Buzzing flowerpecker	Philippine endemic	3	3	3	3	LC
Dicaeum trigonostigma	Orange-bellied	Resident	3		3		LC

Scientific name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
	flowerpecker						
Dicaeum pygmaeum	Pygmy flowerpecker	Philippine endemic	3	3	3	3	LC
Dicrurus bracteatus	Spangled Drongo	Resident	3	3	3	3	LC
Dryocopus javensis	White-bellied woodpecker	Resident	3	3	3	3	LC
Eumyias panayensis	Island flycatcher	Resident	3	3	3	3	LC
Erythrura coloria	Red eared parrotfinch	Mindanao endemic				3	NT
Eurystomus orientalis	Oriental dollarbird	Resident				3	LC
Ficedula hyperythra	Snowy-browed flycatcher	Resident				3	LC
Ficedula westermanni	Little Pied flycatcher	Resident			3	3	LC
Gallus gallus	Red junglefowl	Resident			3	3	LC
Harpactes ardens	Philippine Trogon	Philippine endemic	3	3		3	LC
Hemiprocne comate	Whiskered treeswift	Resident			3	3	LC
Hypocryptadius cinnamomeus	Cinnamon Ibon	Mindanao endemic		3	3	3	LC
Hypothymis helenae	Short-crested monarch	Philippine endemic	3	3	3	3	NT
Hypothymis azurea	Black-naped monarch	Resident			3	3	LC
Hypothymis coelestis	Celestial Monarch	Philippine endemic				3	VU
Irena cyanogastra	Philippine fairy-bluebird	Philippine endemic	3		3	3	NT
Ixos philippinus	Philippine Bulbul	Philippine endemic	3	3	3	3	LC
Lanius cristatus	Brown shrike	Migratory			3	3	LC
Lanius schach	Long-tailed shrike	Resident			3	3	LC
Lonchura atricapilla	Chestnut munia	Resident			3	3	LC
Lophozosterops goodfellowi	Black-masked white-eye	Mindanao endemic			3	3	LC
Loriculus philippensis	Philippine hanging-parrot	Philippine endemic		3	3	3	LC
Macronous striaticeps	Brown tit-babbler	Philippine endemic	3		3	3	LC
Macropygia tenuirostris	Philippine Cuckoo-dove	Resident	3	3	3	3	LC
Psilopogon haemacephalus	Coppersmith barbet	Resident			3	3	LC
Megalurus palustris	Striated Grassbird	Resident			3	3	LC
Megalurus timoriensis	Tawny grassbird	Resident			3	3	LC
Motacilla flava	Yellow wagtail	Migratory			3	3	LC
Muscicapa greseisticta	Grey streaked flycatcher	Migratory			3	3	LC
Nectarinia jugularis	Olive-backed	Resident			3	3	LC

Scientific name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
	sunbird						
Ninox philippensis	Mindanao boobook	Mindanao endemic				3	NT
Nisaetus pinskeri	South Philippine Hawk-eagle	Philippine endemic	3		3	3	EN
Orthotomus castaneiceps	Philippine tailorbird	Philippine endemic	3	3	3	3	LC
Orthotomus cuculatus	Mountain tailorbird	Resident			3	3	LC
Pachycephala philippensis	Yellow-bellied whistler	Philippine endemic	3	3	3	3	LC
Parus elegans	Elegant tit	Philippine endemic	3	3	3	3	LC
Penelopides affinis	Mindanao hornbill	Mindanao endemic	3	3	3	3	LC
Pericocrotus flammeus	Scarlet Minivet	Resident	3			3	LC
Pernis ptilorhynchus	Oriental Honey-buzzard	Resident	3		3	3	LC
Phaphitreron amethystinus	Amethyst brown-dove	Philippine endemic			3	3	LC
Phaphitreron leucotis	White-eared brown-dove	Philippine endemic	3	3	3	3	LC
Phylloscopus olivaceus	Philippine leaf-warbler	Philippine endemic	3		3	3	LC
Pithecophaga jefferyi	Philippine eagle	Philippine endemic			3	3	CR
Prioniturus discurus	Blue-crowned raquet-tail	Philippine endemic				3	LC
Ramphiculus lechlancheri	Black-chinned fruit-dove	Resident			3	3	LC
Ramphiculus occipitalis	Yellow-breasted fruit-dove	Philippine endemic	3	3	3	3	LC
Pycnonotus goaivier	Yellow vented bulbul	Resident			3	3	LC
Pyrrhula leucogenis	White-cheeked bullfinch	Philippine endemic				3	LC
Rhinomyias goodfellowi	Slaty-backed jungle-flycatcher	Mindanao endemic			3	3	NT
Rhipidura nigrocinnamomea	Black-and-cinnamon fantail	Philippine endemic	3	3	3	3	LC
Sarcops calvus	Coleto	Philippine endemic	3	3	3	3	LC
Saxicola caprata	Pied bushchat	Resident				3	LC
Scolopax bukidnonensis	Philippine woodcock	Philippine endemic			3	3	LC
Sitta oenochlamys	Sulphur-billed nuthatch	Resident	3	3	3	3	LC
Spilornis holospilus	Philippine serpent-eagle	Philippine endemic	3	3	3	3	LC
Turdus obscurus	Eyebrowed thrush	Migratory			3	3	LC

Scientific name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Turdus poliocephalus	Island Thrush	Resident	3		3	3	LC
Zosterops montanus	Mountain white-eye	Resident	3	3	3	3	LC
Arachnothera clarae	Naked-faced Spiderhunter	Philippine endemic	3				LC
Centropus melanops	Black-faced Coucal	Mindanao endemic	3	3	3		LC
Corasina mindanensis	Black-bibbed Cuckoo-shrike	Philippine endemic	3				VU
Dicaeum bicolor	Bicoloured Flowerpecker	Philippine endemic	3				LC
Lonchura leucogastra	White-bellied Munia	Resident	3		3		LC
Nectarinia sperata	Purple-throated Sunbird	Resident	3	3	3		LC
Pachycephala homeyeri	White-vented Whistler	Resident	3				LC
Phapitreron brunneiceps	Dark-eared Brown-Dove	Mindanao endemic	3				VU
Prioniturus montanus	Montane Racquet-tail	Philippine endemic	3	3	3		NT
Rhabdotorrhinus leucocephalus	Writhed Hornbill	Mindanao endemic	3				NT
Rhipidura superciliaris	Blue Fantail	Philippine endemic	3	3	3		LC
Anthreptes malacensis	Plain-throated sunbird	Resident			3		LC
Columba vitiensis	Metallic pigeon	Resident			3		LC
Cuculos micropterus	Indian Cuckoo	migratory			3		LC
Microhierax erythrogenys	Philippine Falconet	Philippine endemic			3		LC
Aplonis minor	Short tailed starling	Resident			3		LC
Artamus leucorynchus	White breasted woodswallow	Resident			3		LC
Batrachostomus septimus	Philippine frogmouth	Philippine endemic			3		LC
Chalcophaps indica	Grey-capped emerald dove	Resident			3		LC
Cisticola juncidis	Zitting Cisticola	Resident			3		LC
Aerodramus vanikorensis	Uniform swiftlet	Resident			3		LC
Coracina striata	Bar-bellied cuckooshrike	Resident			3		LC
Corvus macrorhynchos	Large billed crow	Resident			3		LC
Culicicapa helianthea	Citrine canary flycatcher	Resident			3		LC
Cypsiurus balasiensis	Asian Palm swift	Resident			3		LC
Falco peregrinus	Peregrine falcon	migratory			3		LC
Hypotaenidia torquata	Barred rail	Resident			3		LC

Scientific name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Geopelia striata	Zebra dove	Resident			3		LC
Gerygone sulphurea	Golden bellied gerygone	Resident			3		LC
Halcyon coromanda	Ruddy kingfisher	Resident			3		LC
Halcyon smyrnensis	White-breasted kingfisher	Resident			3		LC
Haliastur indus	Brahminy kite	Resident			3		LC
Hirundo tahitica	Pacific swallow	Resident			3		LC
Lanius validirostris	Mountain shrike	Philippine endemic			3		NT
Merops viridis	Blue throarted bee-eater	Resident			3		LC
Nycticorax caledonicus	Rufous Night heron	Resident			3		LC
Oriolus chinensis	Black naped oriole	Resident			3		LC
Passer montanus	Eurasian tree sparrow	Resident			3		LC
Phylloscopus nigrorum	Mountain leaf warbler	Philippine endemic			3		LC
Pitta sordida	Hooded pitta	Resident			3		LC
Ptilocichla mindanensis	Striated wren babbler	Philippine endemic			3		LC
Rhabdornis inornatus	Stripe-breasted rhabdornis	Philippine endemic			3		LC
Rhipidura javanica	Pied fantail	Resident			3		LC
Spilopelia chinensis	Eastern Spotted dove	Resident			3		LC
Todiramphus chloris	Collared kingfisher	Resident			3		LC
Zosterops everetti	Everette's white-eye	Resident			3		LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.5c. List of mammals recorded in MKRNP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Cynocephalus volans	Philippine flying lemur	Mindanao endemic	3	3	3	3	LC
Sus philippensis	Philippine warty pig	Philippine endemic	3	3	3	3	VU
Petinomys crinitus	Mindanao flying squirrel	Mindanao endemic	3	3	3	3	LC
Paradoxurus hermaphroditus	Common palm civet	Resident	3	3	3	3	LC
Rusa marianna	Philippine deer	Philippine endemic		3		3	VU

Scientific Name	Common name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Sundasciurus philippinensis	Philippine tree squirrel	Mindanao endemic	3				LC
Urogale everetti	Midanao tree shrew	Mindanao endemic	3				LC
Apomys hylocoetes	Mindanao mossy forest apomys	Mindanao endemic			3		LC
Rattus everetti	Philippine forest rat	Philippine endemic			3	3	LC
Macaca fascicularis	Crab-eating macaque	Resident			3	3	LC
Bullimus bagobus	Mindanao bullimus	Mindanao endemic			3	3	LC
Podogymnura truei	Mindanao gymnure	Mindanao endemic				3	LC
Batomys salomonseni	Mindanao batomys	Mindanao endemic			3	3	LC
Rattus tanezumi	Oriental house rat	Introduced			3		LC
Alionycteris paucidentata	Mindanao pygmy fruit bat	Mindanao endemic				3	LC
Coelops hirsutus	Philippine tailless leafnosed bat	Mindanao endemic				3	DD
Harpyionycteris whiteheadi	Harpy fruit bat	Philippine endemic				3	LC
Hipposideros sp.	Roundleaf bat	Unidentified					DD
Rhinolophus sp	Horse shoe bat	Unidentified					NL
Hipposideros obscurus	Philippine forest leafnosed bat	Philippine endemic	3				LC
Cynopterus luzoniensis	Peter's fruitbat	Resident	3		3	3	LC
Haplonycteris fischeri	Philippine pygmy fruitbat	Philippine endemic	3	3		3	LC
Megaerops wetmorei	White collared fruitbat	Resident	3		3		VU
Ptenochirus minor	Lesser musky fruitbat	Mindanao endemic	3		3	3	LC
Ptenochirus jagori	Greater musky fruitbat	Philippine endemic	3	3	3	3	LC
Rhinolophus subrufus	Small rufous horseshoe bat	Philippine endemic					LC
Philetor brachypterus	Short-winged Pipistrelle	Resident			3		LC
Kerivoula herdwickii	Hardwicke's wolly bat	Philippine endemic					LC
Macrglossus minimus	Long tongued nectar bat	Resident			3	3	LC
Eonycteris spelaea	Dawn bat	Resident			3		LC

Scientific Name	Common name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Haplonycteris fischeri	Philippine pygmy fruit bat	Philippine endemic			3		LC
Hipposideros diadema	Diadem leaf-nosed bat	Resident			3		LC
Pipistrellus cf javanicus	Javan pipistrelle	Resident			3	3	3

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex.1.5d. List of amphibians recorded in MKRNP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common Name	Extent of Occrrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Hylarana grandocula	Big eyed frog	Philipppine endemic	3		3	3	LC
Kalophrynus pleurostigma	Rufous-sided sticky frog	Resident	3		3		LC
Leptobrachium lumadorum	Litter frog	Mindanao endemic	3	3	3	3	NL
Limnonectes magnus	Giant Philippine Frog	Philipppine endemic	3		3	3	NT
Megophrys stejnegeri	Southeast Asian Horned Toad	Philipppine endemic	3	3	3	3	VU
Nyctixalus spinosus	Litter frog	Mindanao endemic			3		VU
Pelophryne brevipes	Southeast asian toadlet	Resident	3	3	3		NL
Pelophryne lighti		Philipppine endemic			3		VU
Philautus acutirostris	Pointed snouted tree frog	Mindanao endemic	3	3	3	3	VU
Philautus surdus	Common Forest Tree Frog	Philipppine endemic			3	3	LC
Staurois natator	Rock frog	Mindanao endemic	3	3	3	3	LC
Ansonia muelleri	Mueller's toad	Philippine endemic	3			3	VU
Platymantis corrugatus		Philippine endemic				3	LC
Platymantis dorsalis	Common Forest Frog	Philippine endemic	3		3	3	LC
Platymantis guentheri	Guenther's Forest Frog	Philippine endemic	3			3	VU
Polypedates leucomystax	White-lipped tree frog	Introduced				3	LC
Occidozyga laevis	Puddle frog	Resident	3				LC

Scientific Name	Common Name	Extent of Occrrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Platymantis rabori	Rabor's forest frog	Philippine endemic	3				VU
Oreophryne anulata	Montane Narrow-mouthed frog	Philippine endemic		3	3		VU
Philautus poecilius	Mottled tree frog	Mindanao endemic			3		VU

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.5e. List of reptiles recorded in MKRNP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common Name	Extent of Occurrence*	Baungon	Libona	Lantapan	Lupiagan	IUCN Status**
Elaphe erythrura	Philippine rat snake	Philippine endemic			3		LC
Gonocephalus interruptus		Mindanao endemic			3		LC
Psammodyanstes pulverulentus		Resident	3		3		LC
Sphenomorphus diwata	Diwata Sphenomorphus	Mindanao endemic			3	3	LC
Sphenomorphus jagori	Jagor's Sphenomorphus	Philippine endemic	3		3	3	LC
Trimeresurus flavomaculatus	Philippine pit viper	Philippine endemic	3		3		LC
Rhabdophis auriculata	White-lined water snake	Philippine endemic	3	3	3	3	LC
Sphenomorphus coxi	Cox's Sphenomorphus	Mindanao endemic				3	LC
Cyclocorus lineatus	Northern Triangle-spotted Snake	Philippine endemic	3				LC
Draco mindanensis		Mindanao endemic	3				LC
Maticora intestinalis philippina	Striped Coral Snake	Resident	3	3			LC
Tropidophorus davaoensis	Davao waterside skink	Mindanao endemic	3				LC
Varanus salvator	Common water monitor	Resident	3				LC
Cyrtodactylus agusanensis	Mindanao bow-fingered gecko	Mindanao endemic		3			LC
Oxyrhabdium modestum	Non-banded Philippine Burrowing Snake	Philippine endemic		3	3		LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

MANP

Annex 1.6a. List of trees recorded in MANP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common name	Extent of Occurrence*	IUCN status**
Acer laurinum		Non endemic	Not listed
Actinodaphne apoensis		Mindanao endemic	Not listed
Adinandra sp			Not listed
Agathis dammara	Amboina Pitch tree	Non endemic	VU
Aglaia leucophylla		Non endemic	Near Threatened
Alstonia scholaris	White cheesewood	Non endemic	LC
Alstonia scholaris	White cheesewood	Non endemic	LC
Ardisia copelandii		Non endemic	Not listed
Artcarpus heterophyllus	Jackfruit	Introduced	Not listed
Artocarpus odoratisimus		Non endemic	Not listed
Ascarina philippinensis		Non endemic	Not listed
Astronia megalantha		Philippine endemic	Not listed
Astronia williamsii		Philippine endemic	Not listed
Breynia cernua		Non endemic	Not listed
Spiraeopsis celebica		Non endemic	Not listed
Callicarpa longifolia		Non endemic	LC
Calophyllum blancoi	Bitaog	Non endemic	Not listed
Canarium asperum		Philippine endemic	LC
Castanopsis philippensis		Philippine endemic	Not listed
Castanopsis philippensis		Philippine endemic	Not listed
Cordia dichotoma	Anonang/Soap berry	Non endemic	Not listed
Cinnamomum mercadoi	Cinnamomon	Philippine endemic	VU
Cinnamomum sp.			Not listed
Clethra canescens		Non endemic	Not listed
Dacrycarpus cumingii		Non endemic	LC
Dacrydium beccarii		Non endemic	LC
Daphniphyllum luzonense		Philippine endemic	Not listed
Dendrocnide venosa		Philippine endemic	Not listed
Dysoxylum arborescens		Non endemic	Not listed
Durio sp.	Durian	Introduced	Not listed
Durio zibethinus	Durian	Introduced	Not listed
Elaeocarpus culminicola		Philippine endemic	Not listed
Engelhardia apoensis		Non endemic	Not listed
Erythrina subumbrans		Non endemic	Not listed
Eurya trichocarpa		Philippine endemic	Not listed
Eusideroxylon zwageri		Non endemic	Not listed
Ficus balete		Non endemic	Not listed

Scientific Name	Common name	Extent of Occurrence*	IUCN status**
Ficus botryocarpa		Non endemic	Not listed
Ficus callosa		Non endemic	Not listed
Garcinia mindanensis		Mindanao endemic	Not listed
Gordonia sp		Philippine endemic	Not listed
Gymnostoma rumphianum		Non endemic	Not listed
Helicia robusta		Non endemic	Not listed
Omalanthus populneus		Non endemic	Not listed
Lansium parasiticum		Introduced	Not listed
Leptospermum amboinense		Non endemic	Not listed
Leucaena leucocephala	White lead tree	Introduced	Not listed
Lithocarpus apoensis		Non endemic	Not listed
Lithocarpus caudatifolius		Non endemic	Not listed
Litsea baruringensis		Mindanao endemic	Not listed
Macaranga cumingii		Philippine endemic	Not listed
Mallotus mollisimus		Non endemic	Not listed
Mangifera indica	Mango	Introduced	DD
Melia azedarach		Cultivated	Not listed
Meliosma pinnata		Non endemic	Not listed
Myrsine mindanaensis		Philippine endemic	Not listed
Neolitsea villosa		Non endemic	Not listed
Palaquium montanum		Philippine endemic	Not listed
Persea americana	Avocado	Introduced	Not listed
Phyllocladus hypophyllus		Non endemic	Not listed
Podocarpus neriifolius	Brown pine	Non endemic	LC
Podocarpus pilgeri		Non endemic	Not listed
Polyosma integrifolia		Non endemic	Not listed
Prumnopitys amara		Non endemic	Not listed
Prunus grisea		Non endemic	LC
Sandoricum koetjape	Santol	Introduced	Not listed
Shorea almon	Philippine mahogany	Philippine endemic	CR
Shorea contorta	White Lauan	Philippine endemic	CR
Shorea negrosensis	Red Lauan	Philippine endemic	CR
Shorea polysperma	Tanguile	Philippine endemic	CR
Spathodea campanulata	Indian tulip tree	Introduced	Not listed
Syzygium globosum		Non endemic	Not listed
Trema orientalis	Charcoal tree	Non endemic	Not listed
Turpinia pomifera		Non endemic	Not listed
Viburnum luzonicum		Mindanao endemic	Not listed
Weinmannia urdanetensis		Non endemic	Not listed

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.6b. List of birds recorded in MANP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common name	Extent of Occurrence*	IUCN Status**
Accipiter gularis	Japanese sparrowhawk	Migrant	LC
Accippter virgatus	Besra	Resident	LC
Aethopyga primigenia	Grey-hooded sunbird	Mindanao endemic	NT
Aethopyga pulcherrima	Metallic-winged sunbird	Philippine endemic	LC
Amaurornis phoenicurus	White-breasted waterhen	Resident	LC
Arachnothera clarae	Naked-faced spiderhunter	Philippine endemic	LC
Basilornis mirandus	Apo myna	Philippine endemic	NT
Brachypteryx montana	White-browed shortwing	Resident	LC
Buceros mindanensis	Southern Rufous hornbill	Philippine endemic	NT
Cacomantis variolosus	Brush cuckoo	Resident	LC
Centropus melanops	Black-faced coucal	Philippine endemic	LC
Centropus viridis	Philippine coucal	Philippine endemic	LC
Chalcophaps indica	Grey-capped emerald-dove	Resident	LC
Chrysocolaptes lucidus	Buff-spotted flameback	Philippine endemic	LC
Collocalia troglodytes	Pygmy swiftlet	Philippine endemic	LC
Columba vitiensis	Metallic pigeon	Resident	LC
Copsychus saularis	Philippine magpie-robin	Philippine endemic	LC
Corvus macrorhynchos	Large-billed crow	Resident	LC
Dicaeum australe	Red-striped flowerpecker	Philippine endemic	LC
Dicaeum hypoleucum	Buzzing flowperpecker	Philippine endemic	LC
Dicaeum pygmaeum	Pygmy flowerpecker	Philippine endemic	LC
Dicaeum trigonostigma	Orange-bellied flowerpecker	Resident	LC
Dicrurus hottentottus	Hair-crested drongo	Resident	LC
Dryocopus javensis	White-bellied woodpecker	Resident	LC
Eumyias panayensis	Island flycatcher	Resident	LC
Ficedula westermanni	Little pied flycatcher	Resident	LC
Gallirallus torquatus	Barred rail	Resident	LC
Gallus gallus	Red junglefowl	Resident	LC
Harpactes ardens	Philippine trogon	Philippine endemic	LC
Hemiprocne comata	Whiskered treeswift	Resident	LC
Hypocryptadius cinnamomeus	Cinnamon ibon	Mindanao endemic	LC
Hypothymis helenae	Short-crested monarch	Philippine endemic	NT
Irena cyanogastra	Philippine fairy-bluebird	Philippine endemic	NT
Ixos philippinus	Philippine bulbul	Philippine endemic	LC
Lalage nigra	Pied triller	Resident	LC
Lonchura atricapilla	Chestnut munia	Resident	LC
Lophozosterops goodfellowi	Mindanao white-eye	Philippine endemic	LC
Loriculus philippensis	Philippine Hanging-parrot	Philippine endemic	LC

Scientific Name	Common name	Extent of Occurrence*	IUCN Status**
Macronous striaticeps	Brown tit-babbler	Philippine endemic	LC
Macropygia tenuirostris	Philippine cuckoo-dove	Philippine endemic	LC
Psilopogon haemacephalus	Coppersmith barbet	Resident	LC
Megalurus timoriensis	Tawny grassbird	Resident	LC
Microhierax erythrogenys	Philippine falconet	Philippine endemic	LC
Nectarinia jugularis	Olive-backed sunbird	Resident	LC
Orthotomus castaneiceps	Philippine tailorbird	Philippine endemic	LC
Pachycephala philippinensis	Yellow-bellied whistler	Philippine endemic	LC
Penelopides affinis	Mindanao Hornbill	Mindanao endemic	LC
Periparus elegans	Elegant tit	Philippine endemic	LC
Phapitreron leucotis	White-eared brown-dove	Philippine endemic	LC
Phylloscopus olivaceus	Philippine leaf-warbler	Philippine endemic	LC
Pithecophaga jefferyi	Philippine eagle	Philippine endemic	CE
Prioniturus waterstradti	Mindanao racket-tail	Mindanao endemic	NT
Prionochilus olivaceus	Olive-backed flowerpecker	Philippine endemic	LC
Ptilinopus occipitalis	Yellow-breasted fruit-dove	Philippine endemic	LC
Pycnonotus goiavier	Yellow-vented bulbul	Resident	LC
Pycnonotus urostictus	Yellow-wattled bulbul	Philippine endemic	LC
Rhinomyias goodfellowi	Slaty-backed jungle-flycatcher	Mindanao endemic	NT
Rhipidura javanica	Pied fantail	Resident	LC
Rhipidura nigrocinnamomea	Black -and-cinnamon fantail	Philippine endemic	LC
Sarcops calvus	Coleto	Philippine endemic	LC
Sitta oenochlamys	Sulfur-billed nutchatch	Philippine endemic	LC
Spilornis holospilus	Philippine serpent eagle	Philippine endemic	LC
Nisaetus pinskeri	South Philippine Hawk-eagle	Philippine endemic	E
Todiramphus chloris	Collard kingfisher	Resident	LC
Turdus poliocephalus	Island thrush	Resident	LC
Zosterops montanus	Mountain white-eye	Resident	LC
Batrachostomus septimus	Philippine frogmouth	Philippine endemic	LC
Otus everetti	Mindanao Lowland Scops-owl	Philippine endemic	LC
Otus mirus	Mindanao Highland Scops-owl	Mindanao endemic	NT
Rallina eurizonoides	Slatty-legged crake	Resident	LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.6c. List of mammals recorded in MANP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common name	Extent of Occurrence*	IUCN Status**
Paradoxurus hermaphroditus	Common palm civet	Resident	LC
Petinomys crinitus	Mindanao flying squirrel	Mindanao endemic	LC
Sus philippensis	Philippine warty pig	Philippine endemic	VU
Rattus argentiventer	Ricefield rat	Resident	LC
Rattus everetti	Philippine forest rat	Philippine endemic	LC
Rattus tanezumi	Oriental house rat	Introduced	LC
Urogale everetti	Mindanao treeshrew	Mindanao endemic	LC
Cynopterus luzonieinsis	Peter's Fruit bat	Resident	LC
Dyacopterus rickartii	Philippine Large headed fruit bat	Philippine endemic	DD
Eonycteris spelaea	Dawn Bat	Resident	LC
Haplonycteris fischeri	Philippine pygmy fruit bat	Philippine endemic	LC
Harpyionycteris whiteheadi	Harpy fruitbat	Philippine endemic	LC
Kerivoula cf hardwickii	Hardwick's woolly bat	Philippine endemic	LC
Macroglossus minimus	Dagger toothed long-nosed fruitbat	Resident	LC
Megaerops wetmorei	White collared fruit bat	Resident	VU
Pipistrellus cf javanicus	Javan pipistrelle	Resident	LC
Ptenochirus jagori	Greater Musky fruit bat	Philippine endemic	LC
Ptenochirus minor	Lesser Musky fruit bat	Mindanao endemic	LC
Rhinolophus inops	Philippine Forest horseshoe bat	Philippine endemic	LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.6d. List of amphibians recorded in MANP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common name	Extent of Occurrence*	IUCN Status**
Ansonia muelleri	Mueller's toad	Philippine endemic	VU
Kalophrynus pleurostigma	Rufous-sided sticky frog	Resident	LC
Leptobrachium lumadorum	Litter frog	Mindanao endemic	NA
Limnonectes parvus	Philippine small disked frog	Mindanao endemic	VU
Megophrys stejnegeri	Southeast asian horned toad	Philippine endemic	VU
Philautus acutirostris	Pointed snouted tree frog	Mindanao endemic	VU
Philautus poecilius	Mottled tree frog	Mindanao endemic	VU
Philautus surdus	Common forest tree frog	Philippine endemic	VU

Scientific Name	Common name	Extent of Occurrence*	IUCN Status**
Philautus worcesteri	Smooth skinned tree frog	Philippine endemic	VU
Platymantis guentheri	Guenther's forest frog	Philippine endemic	VU
Polypedates leucomystax	White-lipped tree frog	Resident	VU
Staurois natator	Rock frog	Mindanao endemic	LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

Annex 1.6e. List of reptiles recorded in MANP during the ecological assessment, their threat status and extent of occurrence.

Scientific Name	Common name	Extent of Occurrence*	IUCN Status**
Elaphe erythrura	Philippine rat snake	Philippine endemic	NA
Ahaetulla prasina preocularis	Asian vine snake	Resident	LC
Brachymeles gracilis	Graceful short-legged skink	Mindanao endemic	LC
Cyrtodactylus agusanensis	Agusan bent-toed gecko	Mindanao endemic	LC
Dendrelaphis caudolineatus terrificus	Striped bronzeback snake	Mindanao endemic	NA
Psammodynastes pulverulentus	Common mock viper	Resident	LC
Rhabdophis auriculata	White-lined water snake	Philippine endemic	LC

*Extent of occurrence refers to the species endemic to the Philippines or non-endemics.
**Conservation status of species according to the IUC Red List of Threatened Species (2014): Least Concern (LC), Near Threatened (NT), Endangered (EN), Vulnerable (VU), and Critically Endangered (CR).

ANNEX B. SPREADSHEET OF RAW DATA (SEE ATTACHMENT)

ANNEX C. CANONICAL CORRESPONDENCE ANALYSIS BIPLOTS

NSMNP

Flora (Trees)

- The eigenvalue for Axis 1 is 0.42 while Axis 2 is 0.38, and the accounted variance is 16.07% and 14.75%, respectively.
- Centroids of most tree species are projected on the right-hand side of the ordination plot. This suggests that many species are associated to disturbed and forest interface habitats.
- The community of trees is determined by elevation, increasing thickness of leaf litter and increasing number of palms.

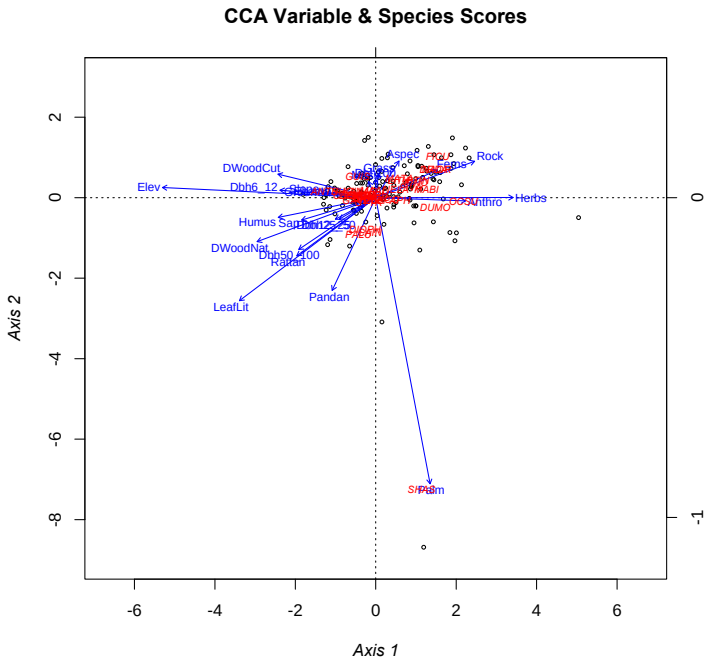

Figure 41. CCA biplot of 36 species of trees and 24 environmental variables.

Line vectors represent the variables, texts in red font represent the species and circles indicate the sites. Species are coded as follows: ANTH *Anisoptera thurifera* ARRI *Artocarpus rigidus* CAIN *Calophyllum inophyllum* CEPH *Celtis philippinensis* DIPH *Dillenia philippinensis* DIOPH *Diospyrus philippensis* DIGR *Diptetrocarpus grandiflorus* DRDA *Dracontomelon dao* DUMO *Duabanga moluccana* FINO *Ficus nota* FICU *Ficus sp.* FIVA *Ficus variegata* GAVE *Garcinia venulosa* GUIS *Guisat* KANAR *Kanaring* KULI *Kulipapa* LITH *Lithocarpus sp.* LILE *Litsea leytensis* MABI *Macaranga bicolor* MATA *Macaranga tanarius* MAAL *Mangifera altissima* NAOR *Nauclea orientalis* NELA *Nephelium lappaceum,* OCSU *Octomeles sumatrana* PALU *Palaquium luzoniensis* PAPH *Palaquium philippense* PAMA *Parashorea malaanonan* PTIN *Pterocarpus indicus* SHAS *Shorea astylosa* SHCO *Shorea contorta* SHGU *Shorea guiso* SHNE *Shorea negrosensis* SHPA *Shorea palosapis* SHPO *Shorea polysperma* SYCI *Syzigium ciliato-setosum* SYTR *Syzygium tripinnatum.*

Birds

- Species-habitat association of 25 birds and 23 environmental variables was attained by CCA Axes 1 and 2 with eigenvalues of 0.26 and 0.22, and accounted variance of 13.09% and 11.13%, respectively.
- Most species centroids are projected on the upper side of the ordination plot suggesting many species are associated to forest habitats.
- Bird's community is influenced mainly by elevation, increasing thickness of leaf litter and humus, and increasing number of fruit trees.

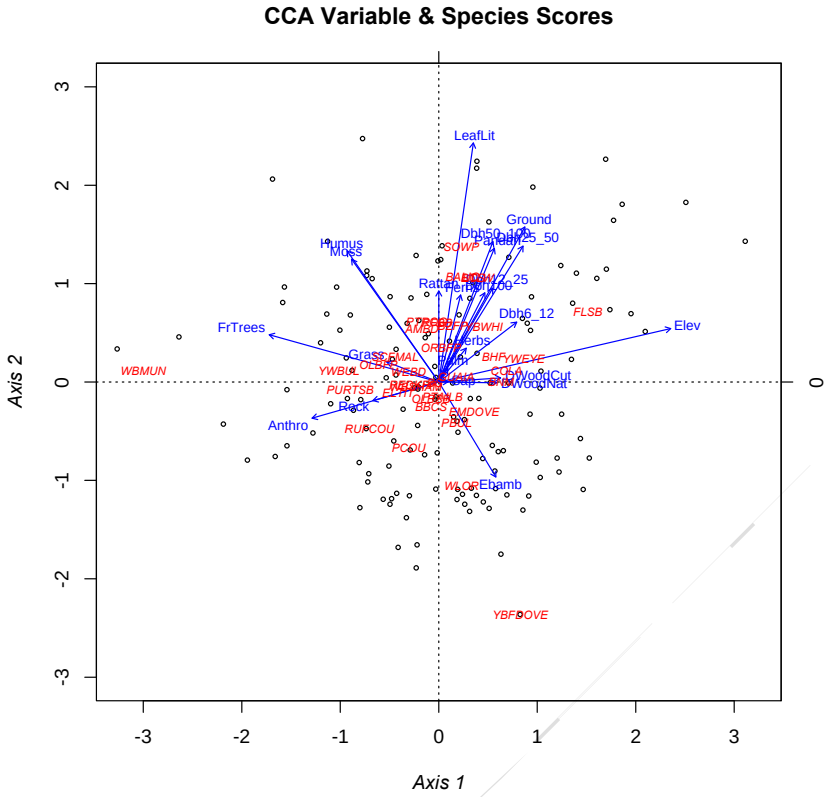

Figure 42. CCA biplot of 35 species of birds and 23 environmental variables.

Line vectors represent the variables, texts in red font represent the species and circles indicate the sites. Species are coded as follows: AMBD *Phapitreron amethystinus,* BALIC *Dicrurus balicassius,* BBCS *Coracina striata,* BCS *Coracina coerulescens,* BNM *Hypothymis azurea,* BHF *Rhipidura cyaniceps,* BS *Brown Shrike,* BZFP *Dicaeum,* COLA *Loriculus philippensis,* EMDOVE *Chalcophaps indica,* ELTIT *Parus elegans,* FLSB *Parus elegans* GUAIA *Bolbopsittacus lunulatus* LTLW *Phylloscopus cebuensis*OLBFP *Prionochilus olivaceus*OLBSB *Cinnyris jugularis*ORBFP *Dicaeum trigonostigma* PBUL *Ixos philippinus*PCOU *Centropus viridis* PFBB *Irena cyanogastra,* PTAILB *Orthotomus castaneiceps,* PTROG *Harpactes ardens* PURTSB *Nectarinia sperata* REDKFP *Dicaeum australe* RUFCOU *Centropus unirufus* SCFMAL *Phaenicophaeus cumingi* SOWP *Mulleripicus funebris* WBMUN *Lonchura leucogastra* WBSHAM *Copsychus luzoniensis* WEBD *Phapitreron leucotis* WLOR *Oriolus albiloris* YBWHI *Pachycephala philippinensis* YBFDOVE *Ptilinopus occipitalis* YWEYE *Zosterops nigrorum* YWBUL *Pycnonotus urostictu.*

Kaliwa-UMRBPL

Flora (Trees)

- Eigenvalues for Axes 1 and 2 are 0.97 and 0.98, respectively. Accounted variance for Axis 1 is 11.56% and Axis 2 11.61%.
- Species centroids above the x-axis such as *Macaranga grandifolia, Mitrephora lanotan* and *Polyscias nodosa* are indicative of less degraded habitats. Whereas, species centroids located below the x-axis such as *Canarium ovatum, Ficus variegata* and *Heritiera sylvatica* are those that are associated with open and highly degraded habitats.
- Presence and distribution of trees can be attributed to the following environmental variables: leaf litter, humus and canopy.
- Most of the tree species can be found in both degraded and interface of forest and non-forest habitat types.

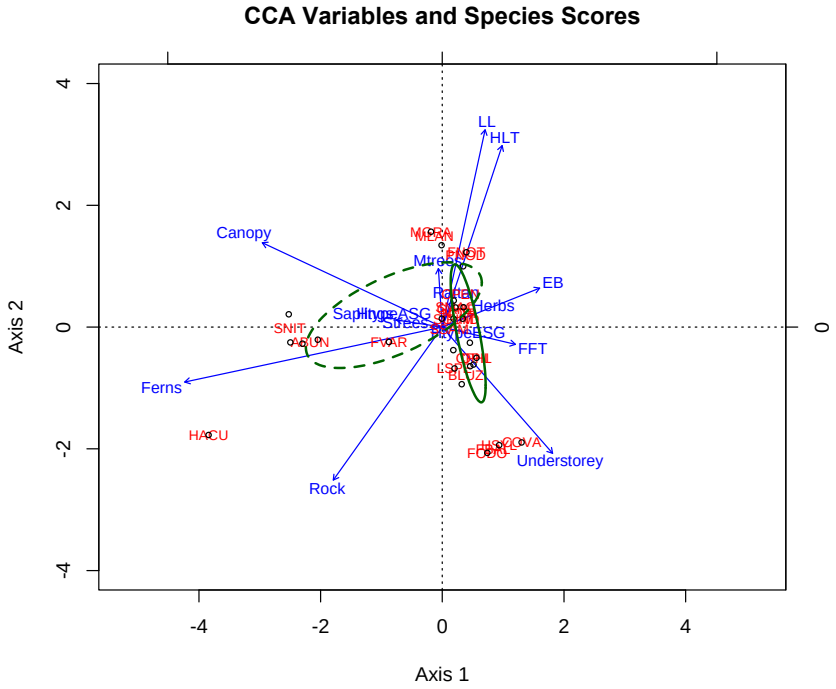

Figure 43. CCA Biplot of 23 species of trees and 11 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are humus/litter thickness (HLT), present of fruiting trees/flowering trees (FFT), saplings, erecting bamboo (EB), rattan, herbs, ferns, rock, leaf litter (LL), trees with 6-25cm dbh (Strees) and trees with 25-50cm dbh (Mtrees), Canopy and Understorey cover as represented by line vectors. Species are coded as follows: BLUZ *Broussonetia luzonica,* COVA *Canarium ovatum* CPEN *Ceiba pentandra* CPHI *Celtis philippinensis* DPIL *Diospyros pilosanthera* FBAL *Ficus balete* FNOT *Ficus nota* FODO *Ficus odorata* FVAR *Ficus variegate* GARB *Gmelina arborea* HSYL *Heritiera sylvatica* LSPE *Lagerstroemia speciosa* MGRA *Macaranga grandifolia* MLAN *Mitrephora lanotan* NORI *Nauclea orientalis* PNOD *Polyscias nodosa* PIND *Pterocarpus indicus* SSAM *Samanea saman* SMAC *Swietenia macrophyla* SCUM *Syzygium cumini* and SNIT *Syzygium nitidum.*

Birds

- Eigenvalues and accounted variance for Axis 1 and Axis 2 are 0.42, 11.60% and 0.39, 10.70%, respectively.
- The ordination projected to habitat types; regenerating forest on the right hand side as indicated by increasing numbers of saplings and early secondary forest on the left with presence of anthropogenic disturbance.
- Species associated in regenerating forest include Yellow-bellied whistler, Philippine Coucal, Philippine nightjar and Brush cuckoo while Amethyst brown dove, Rufous hornbill and Philippine pygmy woodpecker are associated with early secondary forest.

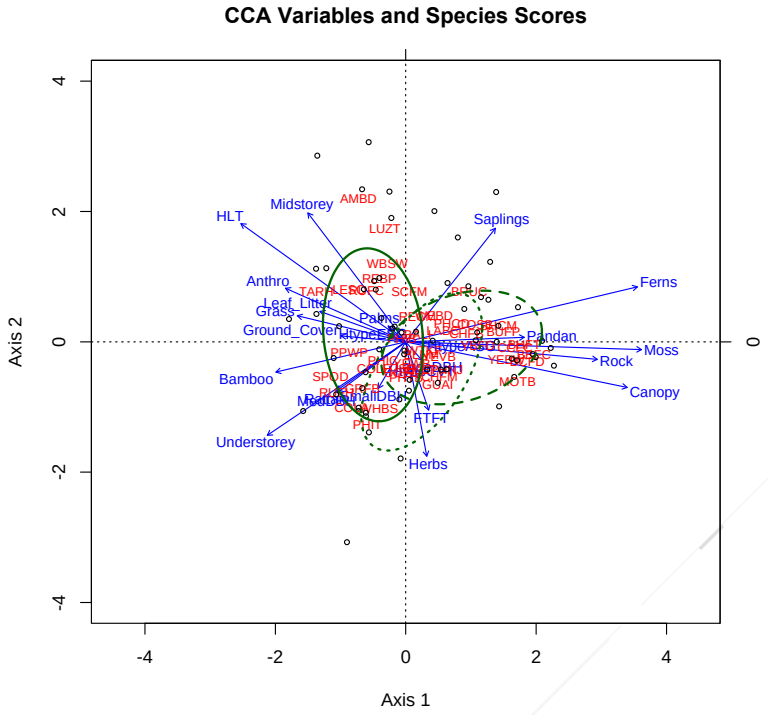

Figure 44. CCA biplot of 37 birds and 18 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used are humus/litter thickness (HLT), present of fruiting trees/flowering trees (FFT), saplings, erecting bamboo (EB), rattan, palms, pandan, grass, herbs, ferns, rock, moss, leaf litter (LL), trees with 6-25cm dbh (SmallDBH), trees with 25-50cm dbh (MedDBH) and trees with 100cm above dbh (LargeDBH), Ground, Canopy, Midstorey and Understorey cover and signs of anthropogenic disturbances (Anthro) as represented by line vectors. Species are coded as follows: AMBD *Phapitreron amethystine* BALI *Dicrurus balicassius* BCFD *Ptilinopus leclancheri* BLNM *Hypothymis azurea* BRUC *Cacomantis variolosus* BUFP *Dicaeum hypoleucum* COED *Chalcophaps indica* COLA *Loriculus philippensis* COLE *Sarcops calvus* COSB *Megalaima haemacephala* ELET *Parus elegans* GRFB GUAI *Bolbopsittacus lunulatus* LABC *Corvus macrorhynchos* LESC *Centropus bengalensis* LUSB *Stachyris striata* LUZT *Penelopides manillae* PHCD *Macropygia tenuirostris* PHIB *Ixos philippinus* PHIC *Centropus viridis* PHIT *Harpactes ardens* PHTB *Orthotomus castaneiceps* PPWP *Dendrocopos maculatus* REBP *Pitta erythrogaster* RECM *Phaenicophaeus superciliosus* RUFC *Centropus unirufus* RUFH *Buceros hydrocorax* SCFM *Phaenicophaeus cumingi* SPOD *Streptopelia chinensis* WBSW *Brachypteryx montana* WEBD *Phapitreron leucotis* WHBS *Copsychus luzoniensis* WTKF *Halcyon smyrnensis* YBFD *Ptilinopus occipitalis* YEVB *Pycnonotus goiavier* YEWB *Pycnonotus urostictus.*

Amphibians

- CCA Axes 1 and 2 had eigenvalues of 0.38 and 0.20, respectively while their accounted variances are 36.10% and 18.90%.

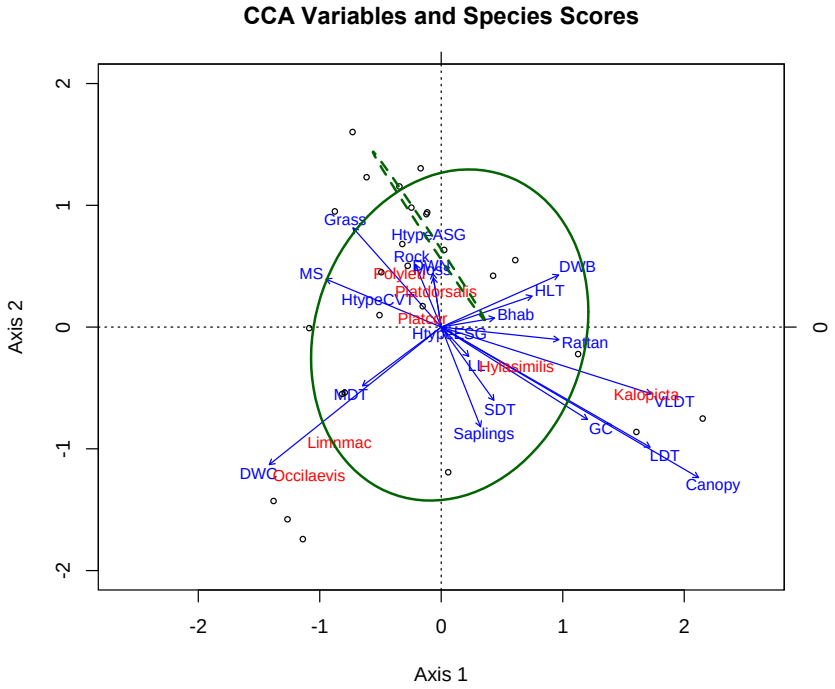

Figure 45. CCA Biplot of 7 amphibians and environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The variables used in this analysis are distance from bodies of water (DWB), humus/litter thickness (HLT), present of natural dead wood (DWN), cut dead wood (DWC), fruiting trees/flowering trees (FFT), saplings, erecting bamboo (EB), rattan, palms, pandan, grass, herbs, ferns, rock, moss, leaf litter (LL), trees with 6-25cm dbh (SDT), trees with 25-50cm dbh (MDT) and trees with 100cm above dbh (LDT/VLDT), Ground (GC), Canopy, Midstorey (MS) and Understorey (US) cover as represented by line vectors. Species are coded as Platcor *Platymantis corrugatus* Platdorsalis *Platymantis dorsalis* Kalopicta *Kaloula picta,* Hylasimilis *Hylarana similis* Occilaevis *Occidozyga laevis* Limnmac *Limnonectes macrocephalus and* Polyleu *Polypedates leucomystax.*

Bats

- CCA of Axes 1 and 2 with eigenvalues of 0.34 and 0.18 attained species habitat association and their accounted variance is 35.10% and 18.30%, respectively.

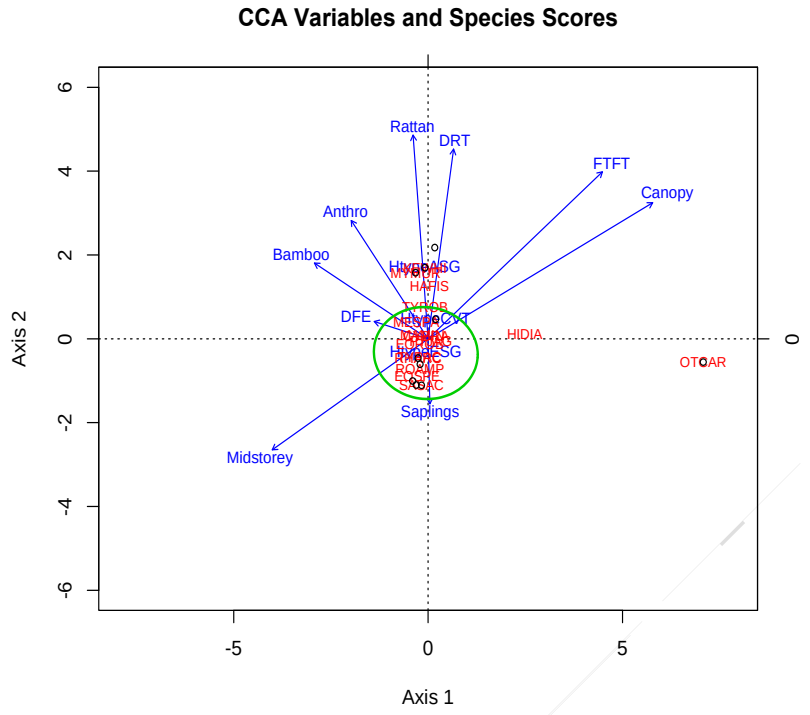

Figure 46. CCA biplot of 15 species of bats and environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used are distance to ridge top (DRT), distance to forest edge (DFE), average tree height (ATH), crown cover (ACC), canopy height (ACH), present of fruiting trees/flowering trees (FFT), saplings, erecting bamboo (EB), rattan, palms, grass, herbs, rock, moss, trees with 6-25cm dbh (Stress), trees with 25-50cm dbh (Mtrees) and trees with 100cm above dbh (Ltrees), Canopy, Midstorey (MS) and Understorey (US) cover and signs of anthropogenic disturbances (Anthro) as represented by line vectors. **Species coded as** CYBRA *Cynopterus brachyotis* EOROB *Eonycteris robusta* EOSPE *Eonycteris spelaea* HAFIS *Haplonycteris fischeri* HIDIA *Hipposideros diadema* KEWHI *Kerivoula whiteheadi* MAMIN *Macroglossus minimus* MESPA *Megaderma spasma* OTCAR *Octopterupus cartilagonodus* PTJAG *Ptenochirus jagori* RHARC *Rhinolophus arcuatus* ROAMP *Rousettus amplexicaudatus* SASAC *Saccolaimus saccolaimus* TYPAC *Tylonycteris pachypus* TYROB *Tylonycteris robustula.*

BRFWR

Flora (Trees)

- CCA Axis 1 has an eigenvalue of 0.36 while CCA Axis 2 has an eigenvalue of 0.32. Accounted variance is 14.6% and 12.6%, respectively.
- Species centroids positioned on the left-hand side of the main axis such as *Macaranga bicolor, M. tanarius and Bischofia javanica* are associated with disturbed forests.
- Centroids of species positioned on the right-hand side of the main axis are associated to advance secondary (ASG) to old growth forest (OG). These include dipterocarp species such as Red lauan (*Shorea negrosensis*), White lauan (*Shorea contorta*), and Tanguile (*Shorea polysperma*), all of which are considered as Critically Endangered (CR) species (IUCN, 2014).

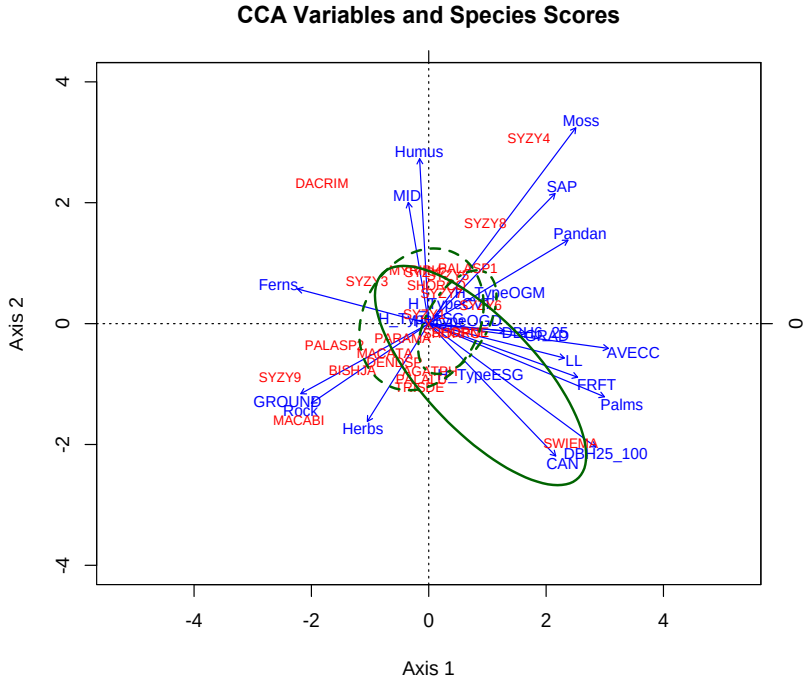

Figure 47. CCA biplot of 26 species of trees and 21 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are: gradient (GRAD), humus, fruiting trees/flowering trees (FRFT), canopy (CAN), midstorey (MID), understorey (UND), sapling (SAP), erecting bamboo (EBAMB), rattan, palms, pandan, grass, herbs, ferns, rock, moss, leaf litter (LL) ground cover (GROUND), tree diameter measuring 6-25cm (DBH6_25), tree diameter measuring 26-100cm (DBH25_100), average crown cover (AVECC) as represented by line vectors. Species are coded as follows: AGATHPH *Agathis philippinensis,* BISCHJA *Bischofia javanica*, DACRIM *Dacrycarpus imbricatus*, DENDSP *Dendrochnide sp.*, MACABI *Macaranga bicolor*, MACATA *Macaranga tanarius*, MYRIPH *Myristica philippinensis*, PALALU *Palaquium luzoniense*, PALASP1 Palaquium sp. 1, PALASP2 Palaquium sp. 2, PARAMA *Parashorea malaanonan*, SHORCO *Shorea contorta*, SHORNE *Shorea negrosensis*, SHORPO *Shorea polysperma*, SWIEMA *Swietenia macrophylla*, SYZY1 Syzygium sp. 1, SYZY2 Syzygium sp. 2, SYZY3 Syzygium sp. 3 , SYZY4 Syzygium sp. 4, SYZY5 Syzygium sp. 5, SYZY6 Syzygium sp. 6, SYZY7 Syzygium sp. 7, SYZY8 Syzygium sp. 8, SYZY9 Syzygium sp. 9, TRISDE *Tristaniopsis decorticate*

Birds

- Species-habitat association was attained by two CCA axes (1 and 2) with eigenvalues of 0.58 and 0.19, with accounted variance of 41.2% and 13.7%, respectively.
- Species centroids positioned on the right-hand side are associated to cultivated and degraded forests. These include *Eumyias panayensis* (Mountain Verditer Flycatcher), *Orthotomus castaneiceps* (Philippine Tailorbird), *Pycnonotus goiav*ier (Yellow-vented Bulbul), and Centropus viridis (Philippine Coucal), which are able to tolerate habitats with presence of anthropogenic disturbances. *Penelopides panini* (Tarictic Hornbill), a vulnerable species (IUCN, 2014), was recorded in forest edges.
- Centroids of species positioned on the left-hand side of main axis are associated to advance secondary and old growth forests. These include *Tanygnathus lucionensis salvadorii (*Blue-naped Parrot) and *Phapitreron amethystina* (Amethyst Brown Dove) that are forest-dependent species.

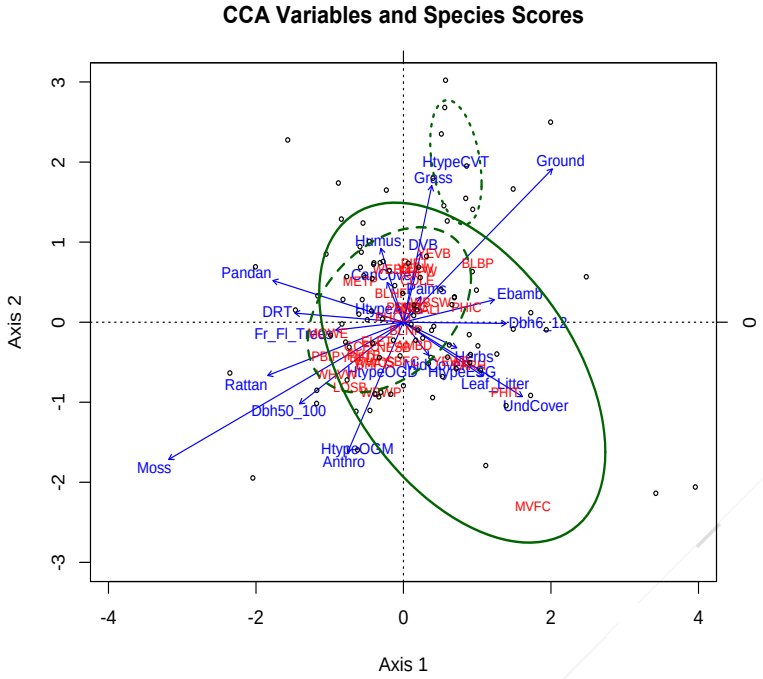

Figure 48. CCA biplot of 34 species of birds and 19 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used are distance to ridge top (DRT), distance to valley bottom (DVB), humus/litter thickness (Humus), present of fruiting trees/flowering trees (Fr_Fl_Trees), erecting bamboo (Ebamb), rattan, palms, pandan, grass, herbs, moss, leaf litter (Leaf_Litter), trees with 6-12cm dbh (Dbh6_12) and trees with 50-100cm dbh (Dbh50_100), ground, Canopy cover (CanCover), Midstorey cover (MidCover), Understorey cover (UndCover) and signs of anthropogenic disturbances (Anthro). Species are coded as follows: AMBD *Phapitreron amethystine* BALI *Dicrurus balicassius* BHFT *Rhipidura cyaniceps* BLBP *Tanygnathus sumatranus* BLNP *Tanygnathus lucionensis salvadorii* CCFC *Culicicapa helianthea* COLE *Sarcops calvus* ELET *Parus elegans* LOSB *Aethopyga shelleyi* METP *Columba vitiensis anthracina* MOWE *Zosterops montanus* MVFC *Eumyias panayensis* NESB *Stachyris nigrorum* PBIP *Ducula poliocephala* PHCD *Macropygia tenuirostris* PHIB *Ixos philippinus* PHIC *Centropus viridis* PHIT *Harpactes ardens* PHTB *Orthotomus castaneiceps* PHWP *Dendrocopos maculatus* PIET *Lalage nigra* SBFC *Ficedula hyperythra nigrorum* TARH *Penelopides panini* WBSW *Brachypteryx montana* WBWP *Dryocopus javensis* WEBD *Phapitreron leucotis* WHVW *Pachycephala homeyeri* WWCS *Coracina ostenta* YBFD *Ptilinopus occipitalis* YEWE *Zosterops nigrorum* YEVB *Pycnonotus goiavier* YEWB *Pycnonotus urostictus.*

Bats

- Eigenvalues for Axis 1 and Axis 2 are 0.40 and 0.24 while their accounted variance are 38.3% and 23.4%, respectively.

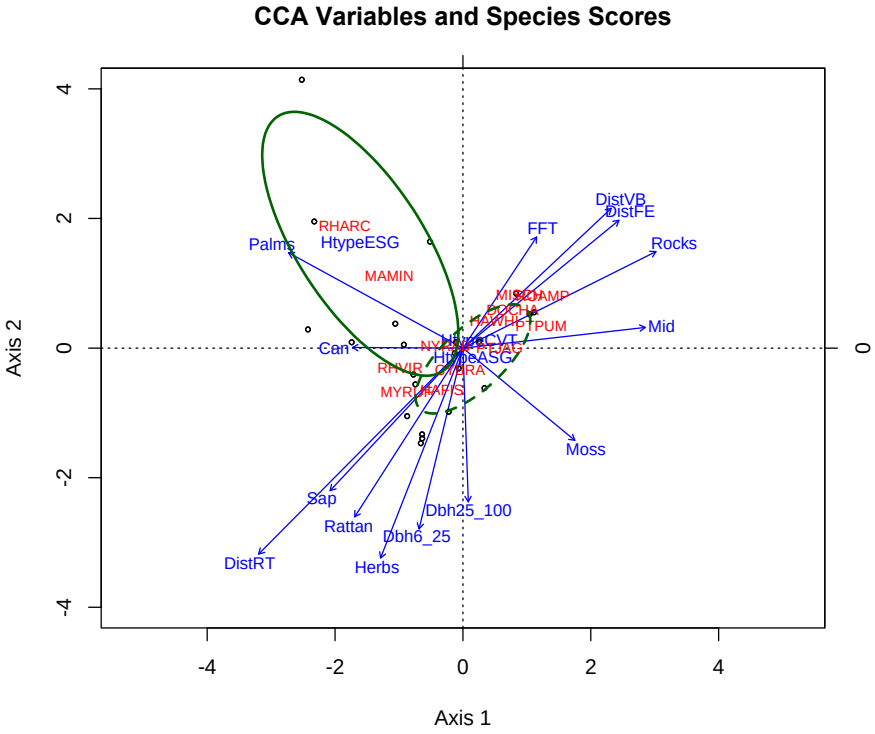

Figure 49. CCA biplot of 13 mammals and 18 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used are distance to ridge top (DisRT), distance to valley bottom (DisVB), distance to forest edge (DisFE), present of fruiting trees/flowering trees (Fr_Fl_Trees), saplings (Sap), rattan, palms, herbs, rock, moss, trees with 6-25cm dbh (Dbh6_25) and trees with 25-100cm dbh (Dbh25_100), Canopy cover (Can), Midstorey cover (Mid), Understorey cover (Und) and signs of anthropogenic disturbances (Anthro). Species are coded as follows: CYBRA *Cynopterus brachyotis* DOCHA *Dobsonia chapmani* HAFIS *Haplonycteris fischeri* HAWHI *Harpyionycteris whiteheadi* MAMIN *Macroglossus minimus MISCH Miniopterus schreibersii MYRUF Myotis rufopictus* PTJAG *Ptenochirus jagori* PTPUM *Pteropus pumilus* RHARC *Rhinolophus arcuatus* RHVIR *Rhinolophus virgo,* and ROAMP *Rousettus amplexicaudatus*

Amphibians

- Eigenvalue for CCA Axis 1 is 0.28 and CCA axis 2 is 0.19 while the accounted variance is 37.9% and 25.9%, respectively.

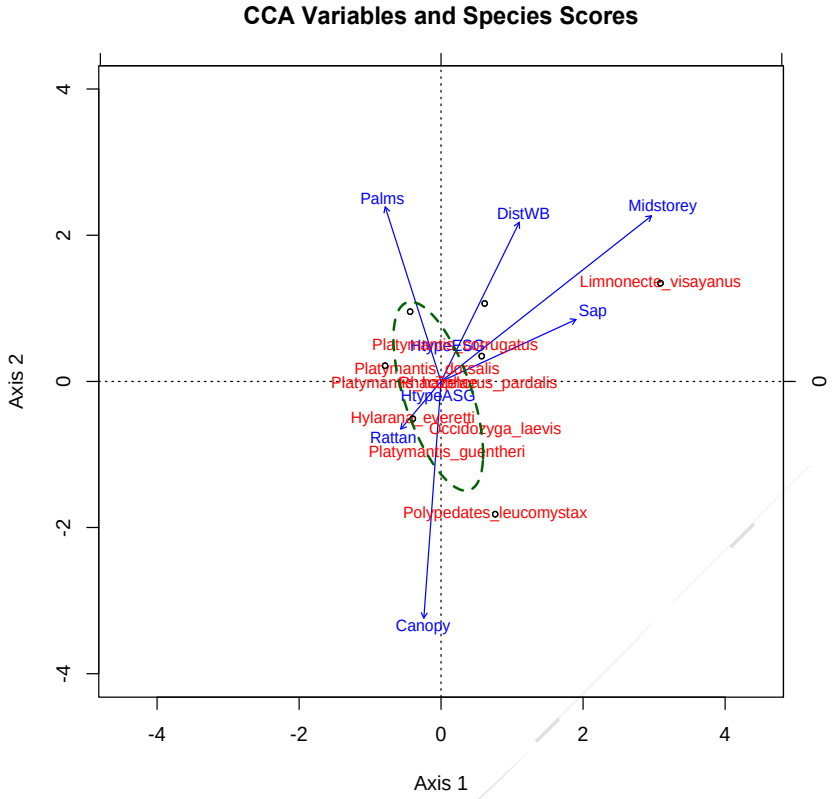

Figure 50. CCA biplot of 11 species of amphibians and 23 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are ground temperature (GroundTemp), relative humiditiy (RelHum), distance to water bodies (Diswb), present of saplings (Sap), erecting bamboo (Ebamb), rattan, palms, pandan, grass, herbs, ferns, rock, moss, leaf litter (Leaf_Litter), trees with 6-12cm dbh (Dbh6_12) and trees with 12-25cm dbh (Dbh12_25), trees with 25-50cm dbh (Dbh25_50), ground cover, Canopy cover (Can), Midstorey cover (Mid), Understorey cover (Und) and signs of anthropogenic disturbances (Anthro). Species ordinated are Limnonecte_visayanus Hylarana_erythreae Platymantis_corrugatus Platymantis_dorsalis Platymantis_guentheri Platymantis_hazelae Polypedates_leucomystax Occidozyga_laevis Hylarana_everetti and Rhacophorus_pardalis

Reptiles

- CCA Axis 1 has an eigenvalue of 0.50 with an accounted variance of 27.4%. Axis 2 has an eigenvalue of 0.33 and 18.2% accounted variance.

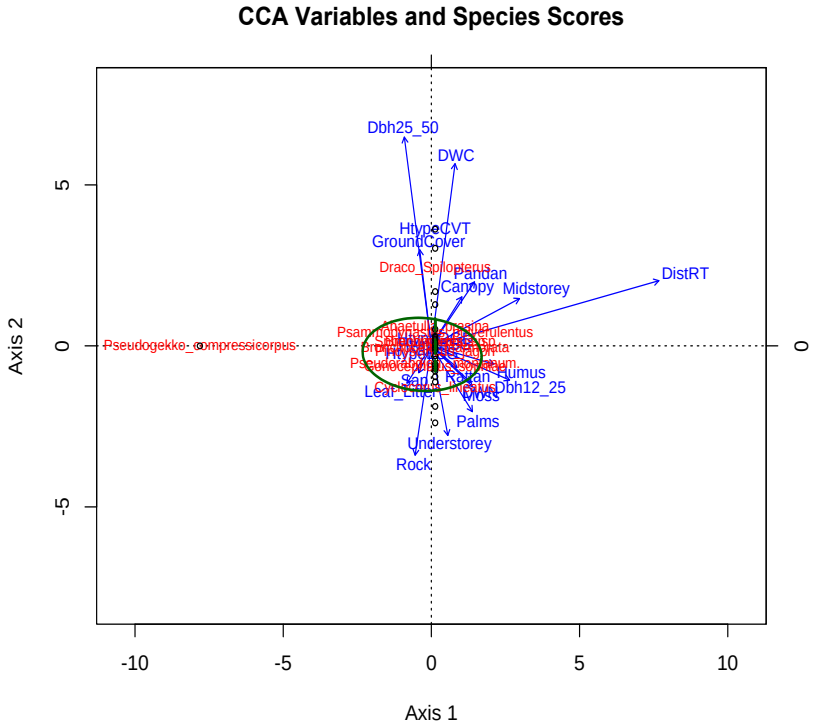

Figure 51. CCA biplot of 12 reptiles and 30 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are ground temperature (GroundTemp), relative humiditiy (RelHum), distance to ridge top (Diswb), humus/litter thickness (Humus) average crown cover (AveCC), present of natural dead woods and cut dead woods, natural (FLN) and cut (FLC) fallen logs, saplings (Sap), erecting bamboo (Ebamb), rattan, palms, pandan, grass, herbs, ferns, rock, moss, leaf litter (Leaf_Litter), trees with 6-12cm dbh (Dbh6_12) and trees with 12-25cm dbh (Dbh12_25), trees with 25-50cm dbh (Dbh25_50), ground cover, Canopy cover, Midstorey cover and Understorey cover. The species that were ordinated are Brachymeles_sp, Bronchocela_marmorata, Draco_Spilopterus, Pseudogekko_compressicorpus, Gonocephalus_sophiae, Pinoyscincus_jagori, Ahaetulla_prasina, Pseudorabdion _montanum, Cyclocorus_lineatus, Psammodynastes_pulverulentus and Sphenomorphus_sp.

MKNRP

Flora (Trees)

- Species-habitat association of 46 trees and 15 habitat variables was attained by CCA axes 1 and 2 with axis 1 having an eigenvalue of 0.84 and an accounted variation of 27.3% while axis 2 have 0.70 eigenvalue and 22.8% accounted variation.

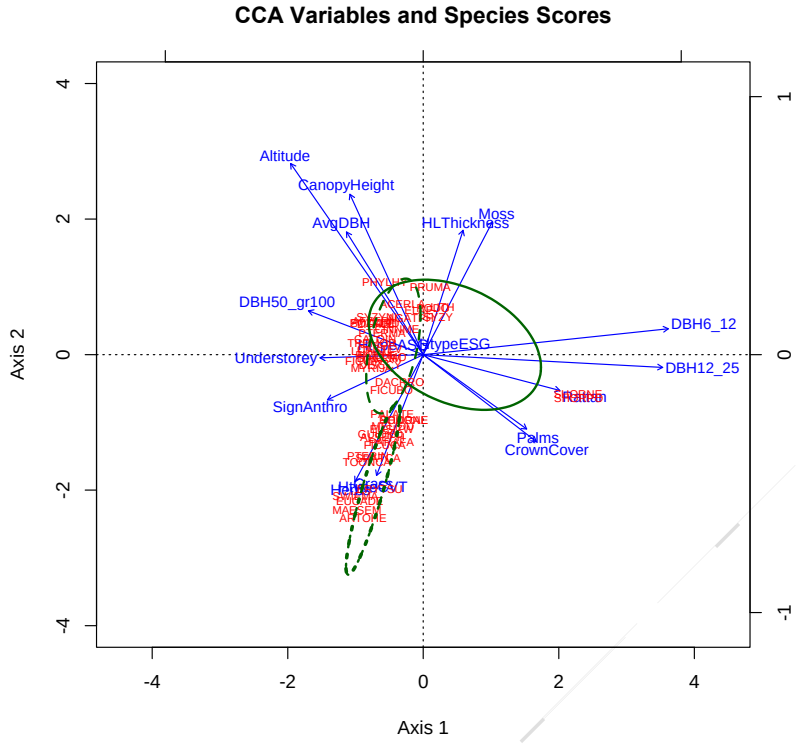

Figure 52. CCA biplot of 46 tree species and 15 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterecarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are: altitude, canopy height, average DBH (AvgDBH), moss, humus/litter thickness (HLThickness), tree diameter measuring 6-12cm (DBH6_12), tree diameter measuring 12-25cm (DBH12_25), tree diameter measuring 50-100cm (DBH50_100), understorey, signs of anthropogenic disturbance (SignAnthro), palms, crown cover, rattan, grass and herbs as represented by line vectors. Species are coded as follows: ACERLA *Acer laurinum*, AGATPH *Agathis philippinensis*, CALOIN *Calophyllum inophyllum*, CINNME *Cinnamomum mercadoi*, DACRIM *Dacrycarpus imbricatus*, MALLMO *Mallotus mollisimus*, PALATE *Palaquium tenuipetiolatum*, SHORNE *Shorea negrosensis*, SHORPO *Shorea polysperma,* SYZYNI *Syzygium nitidum.*

Birds

- The eigenvalue for Axis 1 is 0.36 with an accounted variance of 29.8% while Axis 2 is 0.19 and 15..3%.
- *Pycnonotus goiavier* (Yellow-vented Bulbul), *Centropus viridis* (Philippine Coucal), and *Loriculus philippensis* (Colasisi) are associated to non-forest habitats. Sightings of the endangered *Spizaetus philippensis* (Philippine Hawk-Eagle) are made in areas associated with cultivated habitats.
- The left-hand side of the main axis represents forest habitats as evinced by increasing presence of medium to large trees (25-50 cm DBH and 50-100 cm DBH) and dense canopy cover. Species associated to this habitat type include the vulnerable *Coracina mindanensis* (Black-bibbed Cuckoo-shrike), the near-threatened *Basilornis miranda* (Apo Myna), the near-threatened *Hypothymis helenae* (Short-crested Monarch), and the near-threatened *Rhynomyias goodfellowi* (Slaty-backed Jungle Flycatcher).

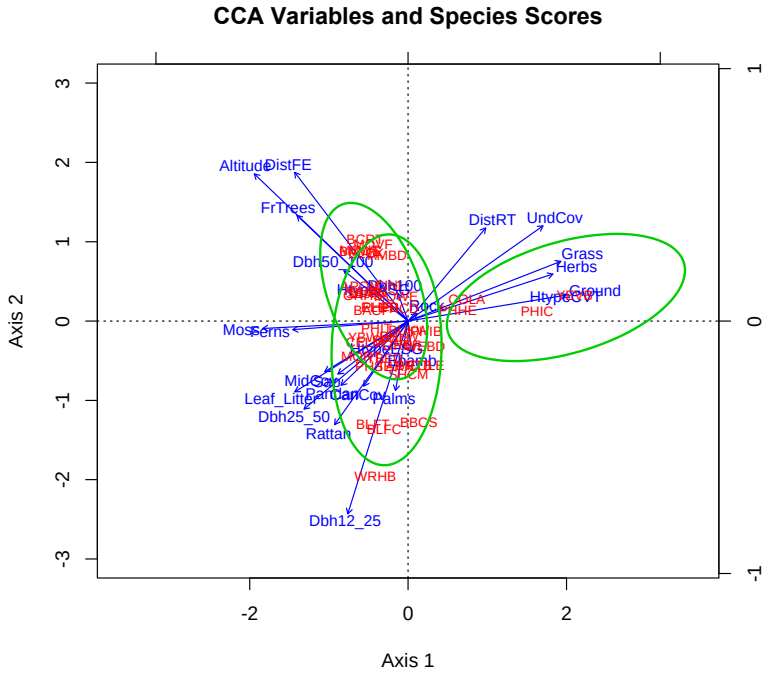

Figure 53. CCA biplot of 40 birds and 23 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterocarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are: distance to ridge top (DistRT), distance to forest edge (DistFE), fruiting trees (FrTrees), percentage canopy (CanCov), percentage midstorey (MidCov), percentage understorey (UndCov), sapling (Sap), erecting bamboo (Ebamb), rattan, palms, pandan, grass herbs, ferns, rock, moss, leaf litter, ground, altitude, tree diameter measuring 12-25cm (Dbh12_25), tree diameter measuring 25-50cm (Dbh25_50), tree diameter measuring 50-100 (Dbh50_100) and tree diameter measuring 100 cm (Dbh100). Species are coded as follows: AMBD *Phapitreron amethystine* APOM *Basilornis mirandus* BACF *Rhipidura nigrocinnamomea* BBCS *Corasina mindanensis* BCRT *Prioniturus discurus* BLCK *Actenoides hombroni* BLFC *Centropus melanops* BLFT *Rhipidura superciliaris* BMWE *Lophozosterops goodfellowi* BRTB *Macronous striaticeps* BUKW *Scolopax bukidnonensis* CELM *Hypothymis coelestis* CINI *Hypocryptadius cinnamomeus* COLA *Loriculus philippensis* COLE *Sarcops calvus* ELET *Parus elegans* GREF *Muscicapa griseistica* GRHS *Aethopyga primigenius* MORT *Prioniturus montanus* MOUT *Orthotomus cuculatus* MOVF *Eumyias panayensis* MOWE *Zosterops montanus* PHCD *Macropygia tenuirostris* PHFB *Irena cyanogastra* PHIB *Ixos philippinus* PHIC *Centropus viridis* PHIT *Harpactes ardens* PHLW *Phylloscopus olivaceus* PHSE *Spilornis holospilus* SBJF *Rhinomyias goodfellowi* SHCM *Hypothymis helenae* SPAD *Dicrurus bracteatus* SUBN *Sitta oenochlamys* TARH *Penelopides panini,*WEBD *Phapitreron leucotis* WRHB *Rhabdotorrhinus leucocephalus* YBFD *Ptilinopus occipitalis* YBWH *Pachycephala philippensis* and YEVB *Pycnonotus goiavier* .

Bats

- CCA Axis 1 has an eigenvalue of 0.50 with an accounted variance of 37.90%. CCA Axis 2 has an eigenvalue of 0.31 and accounted variance of 23%,
- Bat centroids on the left-hand side of the axis such as *Cynopterus brachyotis* (Lesser dog-faced fruit bat), *Macroglossus minimus* (Dagger-toothed long-nosed fruit bat) and the endemic *Ptenochirus jagori* (Greater Musky fruit bat) are associated with cultivated and degraded habitats.
- Species found on the right-hand side of the axis include *Harpyionycteris whiteheadi* (Harpy fruit bat), *Rhinolophus inops* (Philippine forest horseshoe bat) and *Haplonycteris fischeri* (Philippine pygmy fruit), all of which are associated with early secondary to advanced secondary forests. Both *R. inops* and *H. fischeri* are endemic to the Philippines.

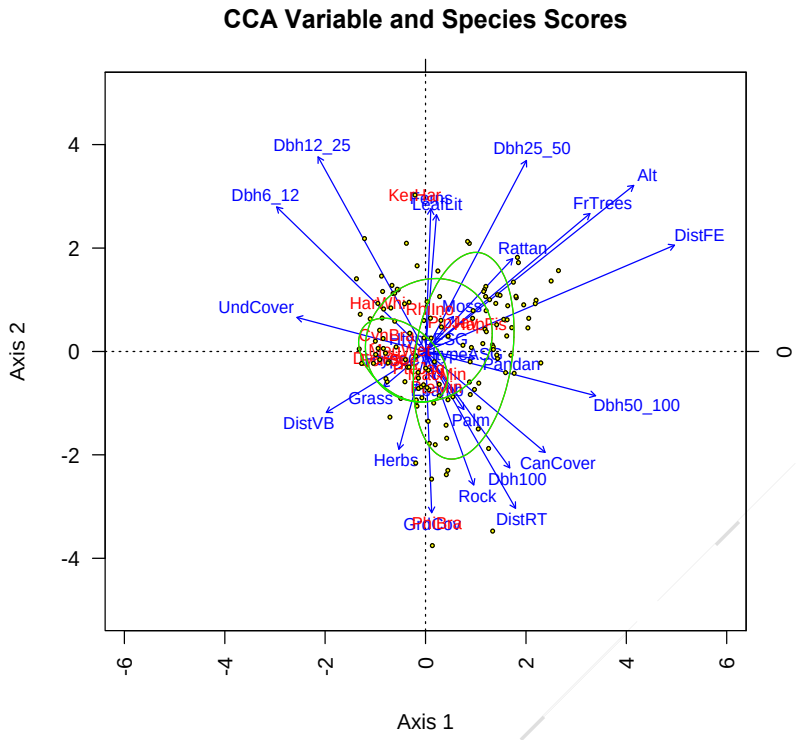

Figure 54. CCA biplot of 13 species of bats and 25 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterocarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are: distance to ridge top (DistRT), distance to forest edge (DistFE), distance to valley bottom (DistVB), fruiting trees (FrTrees), percentage canopy (CanCover), percentage midstorey (MidCover), percentage understorey (UndCover), sapling (Sap), erecting bamboo (Ebamb), rattan (Rat), palm, pandan, grass, herbs, ferns, rock, moss, leaf litter (LeafLit), percentage ground cover (GrdCov), tree diameter measuring 6-12cm (Dbh6_12), tree diameter measuring 12-25cm (Dbh12_25), tree diameter measuring 25-50cm (Dbh25_50), tree diameter measuring 50-100cm (Dbh50_100) and tree diameter measuring 100cm (Dbh100). Species used for this analysis are *Cynopterus brachyotis, Dyacopterus rickartii, Eonycteris spelaea, Haplonycteris fischeri, Harpyionycteris whiteheadi, Kerivoula cf hardwickii, Macroglossus minimus, Megaerops wetmorei, Philetor brachypterus, Pipistrellus cf javanicus, Ptenochirus jagori, Ptenochirus minor and Rhinolophus inops.*

Amphibians

- The eigenvalue for CCA axis 1 is 0.54 while Axis 2 is 0.44. The accounted variance is 23.03% and 18.63%, respectively.

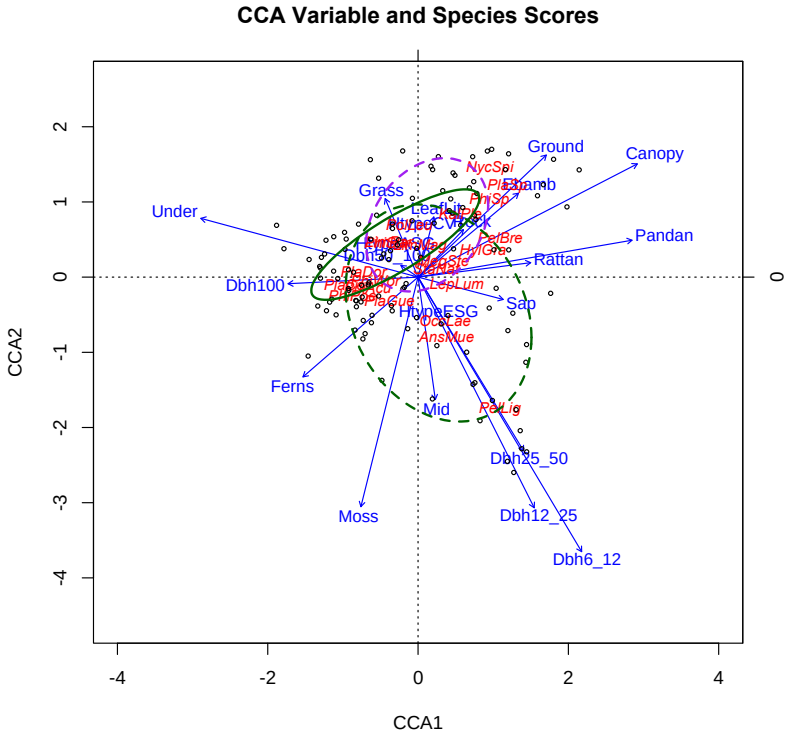

Figure 54. CCA biplot for 22 species of frogs and 18 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterocarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are: percentage canopy, percentage midstorey (Mid), percentage understorey (Under), sapling (Sap), erecting bamboo (Ebamb), rattan, pandan, grass, ferns, rock, moss, leaf litter (LeafLit), percentage ground cover (Ground), tree diameter measuring 6-12cm (Dbh6_12), tree diameter measuring 12-25cm (Dbh12_25), tree diameter measuring 25-50cm (Dbh25_50), tree diameter measuring 50-100cm (Dbh50_100) and tree diameter measuring 100cm (Dbh100). Species are coded as follows: AnsMue *Ansonia muelleri* HylGra *Hylarana grandocula* KalPle *Kalophrynus pleurostigma* LepLum *Leptobrachium lumadorum* LimMag *Limnonectes magnus* MegSte *Megophrys stejnegeri* NycSpi OccLae *Occidozyga laevis* PelBre *Pelophryne brevipes* PelLig PhiAcu *Philautus acutirostris* PhiSur *Philautus surdus* PhiSp *Philautus sp.* PlaCor *Platymantis corrugatus* PlaDor *Platymantis dorsalis* PlaGue *Platymantis guentheri* PlaSp *Platymantis sp.* PolLeu *Polypedates leucomystax* StaNat *Staurois natator* LimPar *Limnonectes parvus* PhiPoe *Philautus poecilius* PhiWor *Philautus worcesteri.*

Reptiles

- The eigenvalue for CCA Axis 1 is 0.87 while Axis 2 is 0.85 and the accounted variance is 12.9% and 12.7%.
- Species positioned on the lower part of the ordination are associated with early secondary forest. This includes *Sphenomorphus coxi*, *Sphenomorphus diwata* and *Tropidophorus davaoensis*. Species community in this habitat is influenced mainly by understorey parameters as indcated by increasing thickness of leaf litter, increasing presence grass and ferns.
- While species on the upper part are associated to advanced secondary forest. Environmental parameters that mainly influence the reptile's community are small to medium trees, increasing presence of rattan and moss.

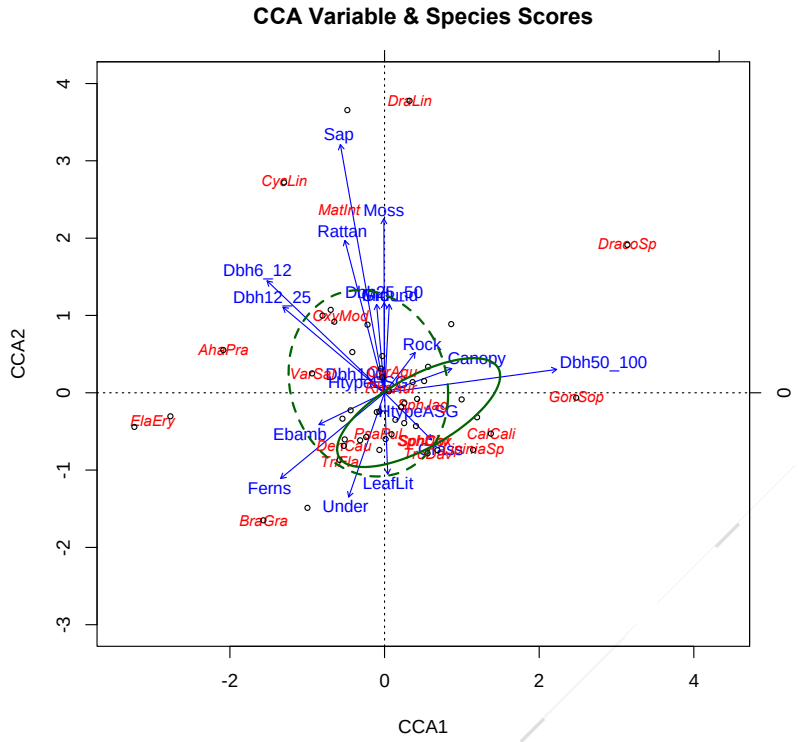

Figure 55. CCA biplot of 21 reptiles and 17 environmental variables.

Line vectors represent the variables, texts in red font represent the species, and circles indicate the sites. Polygons indicate the different habitat types (HtypeCVT=Cultivated, HtypeESG=Early Second Growth, HtypeASG=Advance Second Growth, HtypeOGD=Old Growth Dipterocarp Forest, HtpyeOGM=Old Growth Mossy Forest). The environmental variables used in this analysis are: percentage canopy, percentage midstorey (Mid), percentage understorey (Under), sapling (Sap), erecting bamboo (Ebamb), rattan, grass, ferns, rock, moss, leaf litter (LeafLit), percentage ground cover (Ground), tree diameter measuring 6-12cm (Dbh6_12), tree diameter measuring 12-25cm (Dbh12_25), tree diameter measuring 25-50cm (Dbh25_50), tree diameter measuring 50-100cm (Dbh50_100) and tree diameter measuring 100cm (Dbh100). Species are coded as follows: DracoSp *Draco sp.*, CycLin *Cyclocorus lineatus,*CyrAgu *Cyrtodactylus agusanensis* DraLin *Draco lineatus* MatInt *Maticora intestinalis* OxyMod *Oxyrhabdium modestum* RhaAur *Rabdophis auriculata* SphCox *Sphenomorphus coxi* SphDiw *Sphenomorphus diwata* SphJag *Sphenomorphus jagori* PsaPul *Psammodynastes pulverulentus* GonSop *Gonocephalus interruptus* LipiniaSp *Lipinia sp.* TriFla *Trimeresurus flavomaculatus* TroDav *Tropidophorus davaoensis* VarSal *Varanus salvator* AhaPra *Ahaetulla prasina preocularis* BraGra *Brachymeles gracilis* DenCau *Dendrelaphis caudolineatus* ElaEry *Elaphe erythrura.*

ANNEX D. NICHE WIDTH AND NICHE POSITION OF KEY SPECIES

NSMNP

Flora (Trees)

- Species positioned in forest habitats with narrow niche width include the endemic *Celtis philippinesis, Agathis philippinensis, Diospyrus philippinensis* and *Palaquium luzoniense*.
- *Macaranga bicolor*, *Octomeles sumatrana* and *Parkia timoriana* are some species positioned in forest interface and can withstand in cultivated areas.
- Species such as *Dillenia philippinensis*, *Shorea negrosensis*, *Shorea palosapis*, *Shorea polysperma* and *Syzigium ciliato-setosum* appeared as forest generalists with wide niche.

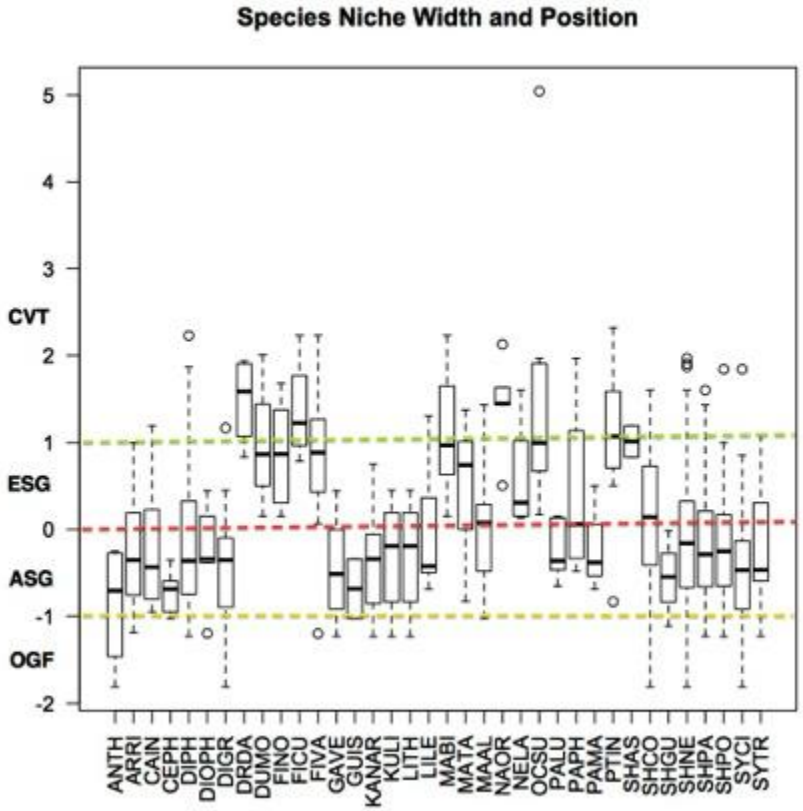

Figure 56. Niche width and niche position of 35 species of birds in different habitat types.
Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest.

ANTH *Anisoptera thurifera* ARRI *Artocarpus rigidus* CAIN *Calophyllum inophyllum* CEPH *Celtis philippinensis* DIPH *Dillenia philippinensis* DIOPH *Diospyrus philippensis* DIGR *Diptetrocarpus grandiflorus* DRDA *Dracontomelon dao* DUMO *Duabanga moluccana* FINO *Ficus nota* FICU *Ficus sp.* FIVA *Ficus variegata* GAVE *Garcinia venulosa* GUIS *Guisat* KANAR *Kanaring* KULI *Kulipapa* LITH *Lithocarpus sp.* LILE *Litsea leytensis* MABI *Macaranga bicolor* MATA *Macaranga tanarius* MAAL *Mangifera altissima* NAOR *Nauclea orientalis* NELA *Nephelium lappaceum,* OCSU *Octomeles sumatrana* PALU *Palaquium luzoniensis* PAPH *Palaquium philippense* PAMA *Parashorea malaanonan* PTIN *Pterocarpus indicus* SHAS *Shorea astylosa* SHCO *Shorea contorta* SHGU *Shorea guiso* SHNE *Shorea negrosensis* SHPA *Shorea palosapis* SHPO *Shorea polysperma* SYCI *Syzigium ciliato-setosum* SYTR *Syzygium tripinnatum*

Birds

- Species positioned in forest habitats with narrow niche include the endemic species *Mulleripicus funebris* (Sooty Woodpecker), *Aethopyga flagrans* (Flaming Sunbird), *Lepidogrammus cumingi*

(Scale-feathered Malkoha) and *Dicaeum australe* (Red-keeled Flowerpecker). This suggests that these species are specialist.

- Species with wide niche that extends from forest to disturbed habitats include *Parus elegans* (Elegant Tit), *Dicaeum trigonostigma* (Orange-bellied Flowerpecker), *Ixos philippinus* (Philippine Bulbul) and *Orthotomus castaneiceps* (Philippine Tailorbird). This result suggests that these species are generalist and have high tolerance to disturbance.

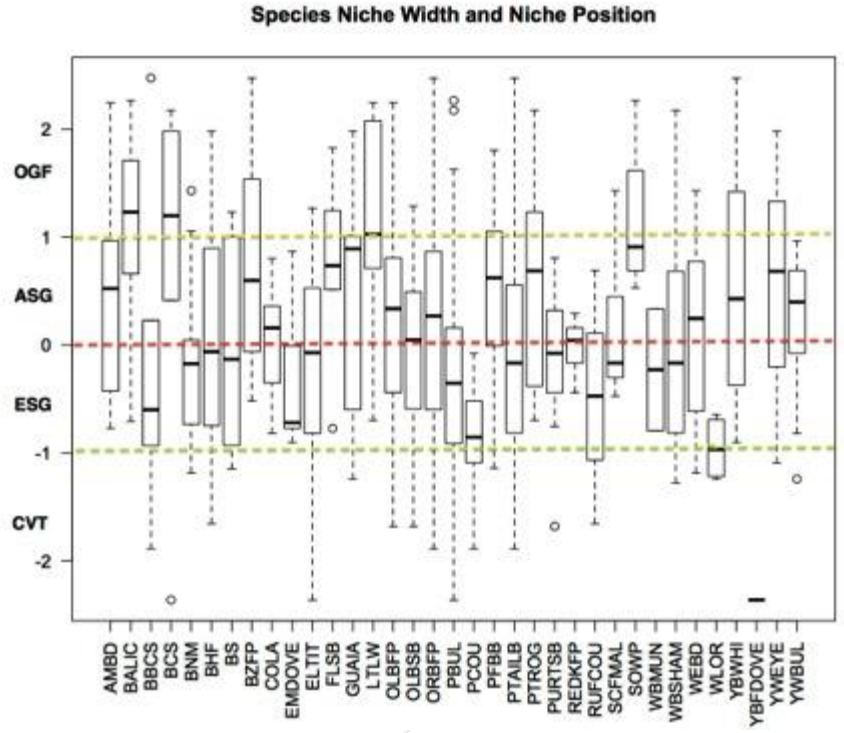

Figure 57. Niche width and niche position of 36 species of trees in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. AMBD *Phapitreron amethystinus,* BALIC *Dicrurus balicassius,* BBCS *Coracina striata,* BCS *Coracina coerulescens,* BNM *Hypothymis azurea,* BHF *Rhipidura cyaniceps,* BS *Brown Shrike,* BZFP *Dicaeum,* COLA *Loriculus philippensis,* EMDOVE *Chalcophaps indica,* ELTIT *Parus elegans,* FLSB *Aethopyga flagrans*, GUAIA *Bolbopsittacus lunulatus* LTLW *Phylloscopus cebuensis* OLBFP *Prionochilus olivaceus*OLBSB *Cinnyris jugularis*ORBFP *Dicaeum trigonostigma* PBUL *Ixos philippinus*PCOU *Centropus viridis* PFBB *Irena cyanogastra,* PTAILB *Orthotomus castaneiceps,* PTROG *Harpactes ardens* PURTSB *Nectarinia sperata* REDKFP *Dicaeum australe* RUFCOU *Centropus unirufus* SCFMAL *Phaenicophaeus cumingi* SOWP *Mulleripicus funebris* WBMUN *Lonchura leucogastra* WBSHAM *Copsychus luzoniensis* WEBD *Phapitreron leucotis* WLOR *Oriolus albiloris* YBWHI *Pachycephala philippinensis* YBFDOVE *Ptilinopus occipitalis* YWEYE *Zosterops nigrorum* YWBUL *Pycnonotus urostictus.*

Kaliwa-UMRBPL

Flora (Trees)

- Species niche positions suggest that *Canarium ovatum*, *Ficus balete*, *Ficus odorata*, *Heritiera sylvatica*, and *Hopea acuminate* prefer cultivated and degraded forest habitats. *Broussonetia luzonica*, *Celtis philippinensis*, *Ficus variegate*, *Lagerstroemia speciosa*, and *Antidesma bunius* prefer early second growth forests while *Ceiba pentandra*, *Gmelina arborea*, *Nauclea orientalis*, *Pterocarpus indicus*, *Samanea saman*, and *Swietenia macrophyla* has their mean positioned in advance second growth forest.

- Most of the trees have narrow niche width this could either mean that these trees are specialists or because of few samples.

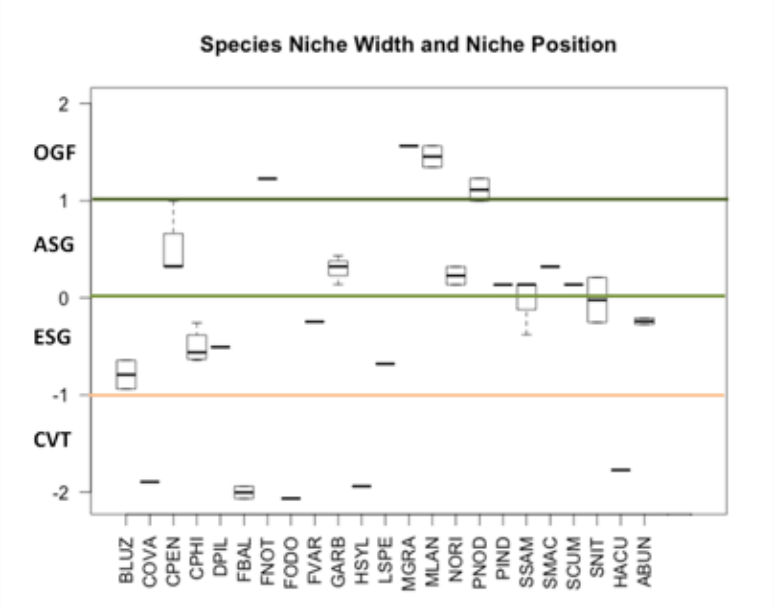

Figure 58. Niche width and niche position of trees in Kaliwa-UMRBPL in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest.Species are coded as follows: BLUZ *Broussonetia luzonica,* COVA *Canarium ovatum* CPEN *Ceiba pentandra* CPHI *Celtis philippinensis* DPIL *Diospyros pilosanthera* FBAL *Ficus balete* FNOT *Ficus nota* FODO *Ficus odorata* FVAR *Ficus variegate* GARB *Gmelina arborea* HSYL *Heritiera sylvatica* LSPE *Lagerstroemia speciosa* MGRA *Macaranga grandifolia* MLAN *Mitrephora lanotan* NORI *Nauclea orientalis* PNOD *Polyscias nodosa* PIND *Pterocarpus indicus* SSAM *Samanea saman* SMAC *Swietenia macrophyla* SCUM *Syzygium cumini,* SNIT *Syzygium nitidum,* HACU *Hopea acuminate,* ABUN *Antidesma bunius.*

Birds

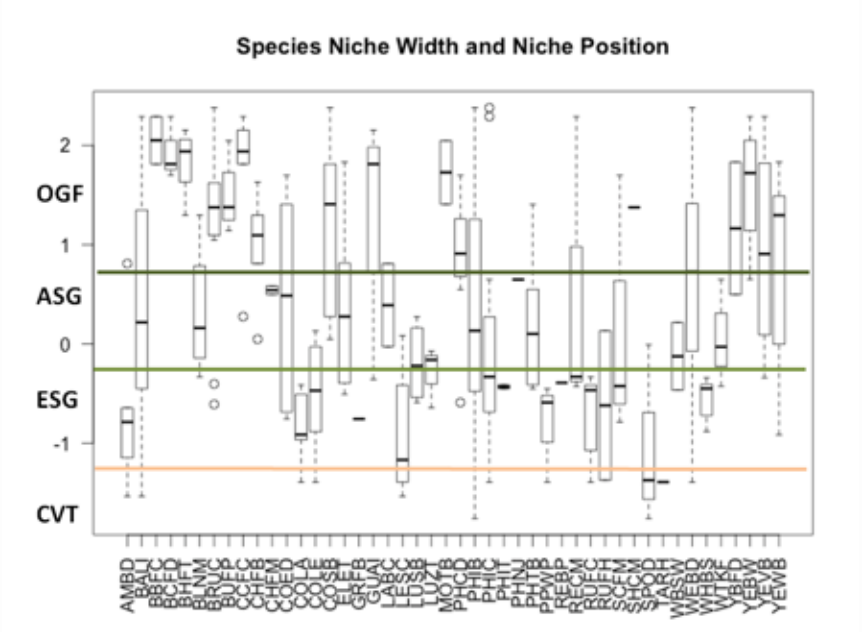

Figure 59. Niche width and niche position of birds in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species coded as follows: AMBD *Phapitreron amethystine* BALI *Dicrurus balicassius* BCFD *Ptilinopus leclancheri* BLNM *Hypothymis azurea* BRUC *Cacomantis variolosus* BUFP *Dicaeum hypoleucum* COED *Chalcophaps indica* COLA *Loriculus philippensis* COLE *Sarcops calvus* COSB *Megalaima haemacephala* ELET *Parus elegans* GRFB GUAI *Bolbopsittacus lunulatus* LABC *Corvus macrorhynchos* LESC *Centropus bengalensis* LUSB *Stachyris striata* LUZT *Penelopides manillae* PHCD *Macropygia tenuirostris* PHIB *Ixos philippinus* PHIC *Centropus viridis* PHIT *Harpactes ardens* PHTB *Orthotomus castaneiceps* PPWP *Dendrocopos maculatus* REBP *Pitta erythrogaster* RECM *Phaenicophaeus superciliosus* RUFC *Centropus unirufus* RUFH *Buceros hydrocorax* SCFM *Phaenicophaeus cumingi* SPOD *Streptopelia chinensis* WBSW *Brachypteryx montana* WEBD *Phapitreron leucotis* WHBS *Copsychus luzoniensis* WTKF *Halcyon smyrnensis* YBFD *Ptilinopus occipitalis* YEVB *Pycnonotus goiavier* YEWB *Pycnonotus urostictus.*

Amphibians

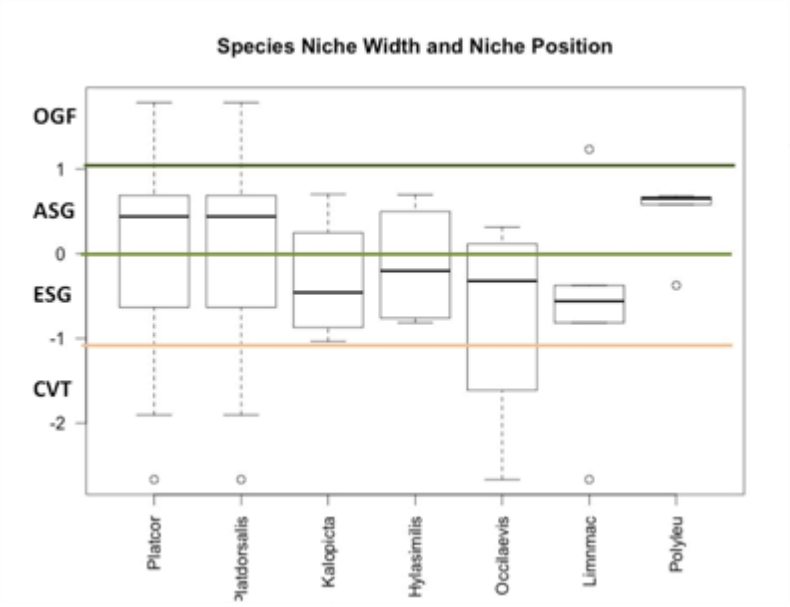

Figure 60. Niche width and niche position of amphibians in different habitats.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: Platcor *Platymantis corrugatus*, Platdorsalis *Platymantis dorsalis* Kalopicta *Kaloula picta,* Hylasimilis *Hylarana similis* Occilaevis *Occidozyga laevis* Limnmac *Limnonectes macrocephalus and* Polyleu *Polypedates leucomystax.*

Reptiles

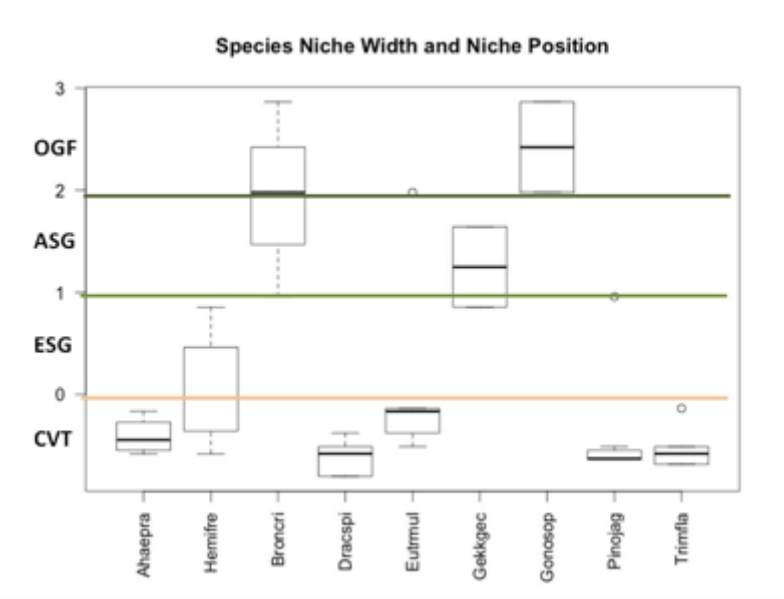

Figure 61. Niche width and niche position of reptiles in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest.

Bats

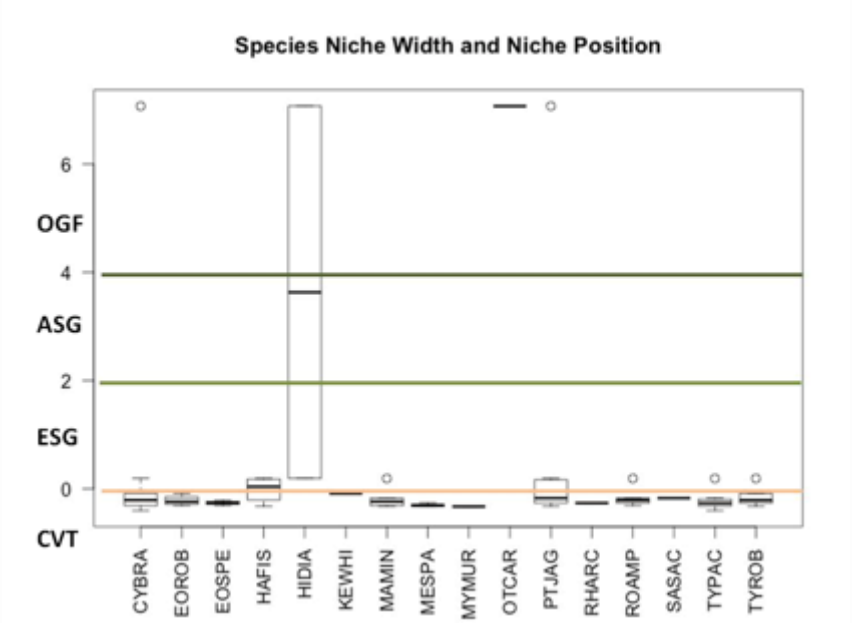

Figure 62. Niche width and niche position of mammals in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as CYBRA *cynopterus brachyotis* EOROB *eonycteris robusta* EOSPE *eonycteris spelaea* HAFIS *haplonycteris fischeri* HIDIA *hipposideros diadema* KEWHI *kerivoula whiteheadi* MAMIN *macroglossus minimus* MESPA *megaderma spasma* OTCAR *octopterupus cartilagonodus* PTJAG *ptenochirus jagori* RHARC *rhinolophus arcuatus* ROAMP *rousettus amplexicaudatus* SASAC *saccolaimus saccolaimus* TYPAC *tylonycteris pachypus* TYROB *tylonycteris robustula.*

BRWFR

Flora (Trees)

- The boxplot results show that medians of 13 species of trees are positioned below the mean, which could indicate preference to increasing forest quality. *Agathis philippinensis (AGATPH), (DENDSP), Macaranga bicolor (MACABI), Palaquium luzoniense (PALALU), Palaquium sp.1 (PALASP1), Parashorea malaanonan (PARAMA), Syzygium sp.1 (SYZY1), Syzygium sp.2 (SYZY2), Syzygium sp.5 (SYZY5), Syzygium sp.9 (SYZY9), Tristianopsis decorticata (TRISDE),* show exclusive preference to forested areas, ranging from advanced secondary growth (ASG) to old growth forest (OG). Exhibiting a narrow niche width, these species may be regarded as forest dependents.
- Five species of trees, *Bischofia javanica* (BISHJA), *Palaquium sp.2* (PALASP2), *Shorea negrosensis* (SHORNE), *S. polysperma* (SHORPO), *Syzygium sp.6* (SYZY6) shows wider niche widths suggesting that these species can occupy a wide range of habitat types. The Critically Endangered (CR) *Shorea contorta* (SHORCO) and *Syzygium sp.2* (SYZYSP2) are positioned above the mean which may be suggestive of the species' preference to forested areas specifically the lowland types.
- The boxplot results show that medians of ten (10) species are positioned below the mean, which may indicate preference to increasing forest quality. *Agathis philippinensis (AGATPH), Dendrocnide sp. (DENDSP), Macaranga bicolor (MACABI), Palaquium luzoniense (PALALU), Parashorea malaanonan (PARAMA), Swietenia macrophylla (SWIEMA) Syzygium sp.1 (SYZY1), Syzygium sp.5 (SYZY5), Syzygium sp.9 (SYZY9), Tristianopsis decorticata (TRISDE),* show

exclusive preference to forested area ranging from advanced secondary growth to old growth forest. Thus, they tend to have narrow niche width, which confirms the species dependence to relatively good forest habitats.

- Five species *Bischofia javanica* (BISHJA), *Palaquium sp.2* (PALASP2), *Shorea negrosensis* (SHORNE), *Shorea polysperma* (SHORPO), *Syzgium sp.6* (SYZY6) shows wider niche width indicating that these species may be found in a wide range of habitat types. The Critically Endangered *Shorea contorta* (SHORCO) and *Syzgium sp.2* (SYZYSP2) are positioned above the mean, which could suggest that although the species prefer forest habitats, it can also, tolerate some degree of habitat disturbance.

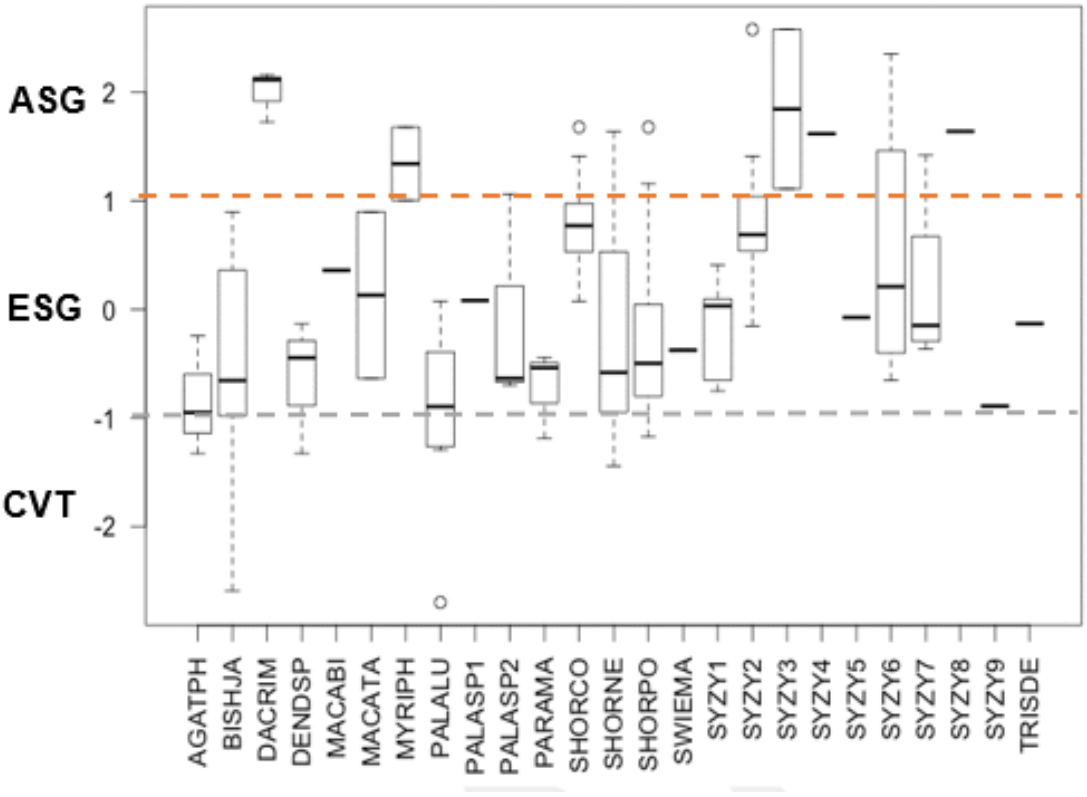

Figure 63. Niche width and niche position of trees in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: AGATHPH *Agathis philippinensis,* BISCHJA *Bischofia javanica*, DACRIM *Dacrycarpus imbricatus*, DENDSP *Dendrochnide sp.*, MACABI *Macaranga bicolor*, MACATA *Macaranga tanarius*, MYRIPH *Myristica philippinensis*, PALALU *Palaquium luzoniense*, PALASP1 Palaquium sp. 1, PALASP2 Palaquium sp. 2, PARAMA *Parashorea malaanonan*, SHORCO *Shorea contorta*, SHORNE *Shorea negrosensis*, SHORPO *Shorea polysperma*, SWIEMA *Swietenia macrophylla*, SYZY1 Syzygium sp. 1, SYZY2 Syzygium sp. 2, SYZY3 Syzygium sp. 3 , SYZY4 Syzygium sp. 4, SYZY5 Syzygium sp. 5, SYZY6 Syzygium sp. 6, SYZY7 Syzygium sp. 7, SYZY8 Syzygium sp. 8, SYZY9 Syzygium sp. 9, TRISDE *Tristaniopsis decorticate.*

Birds

- For the survival envelopes of key species of birds, results show that the median of all 34 bird species were positioned close to or on the center of the habitat continuum (matured stage to early stage), confirming that all of these species prefer forest with some degree of disturbance.
- 25 species (Amethyst brown-dove, Balicassiao, Blue-headed fantail, Blue-backed parrot, Coleto, Elegant tit, Metallic pigeon, Mountain white-eye, Mountain verditer flycatcher, Negros striped

babbler, Pink-bellied imperial pigeon, Philippine pygmy woodpecker, Philippine tailorbird, Pied triller, Snowy-browed flycatcher, White-breasted wood-swallow, White-eared brown-dove, White-vented whistler, White-winged cuckoo-shrike, Yellow-bellied whistler, Yellow-vented bulbul, Yellow-wattled bulbul, and Yellow-breasted fruit-dove) are positioned above the mean, which may indicate preference to matured forest type but with some degree of tolerance to habitat degradation. With a wide niche width, these species can also occupy a wide range of forest habitat types ranging from OG to ESG forests.

- Species such as Blue-naped parrot, Tarictic hornbill, White-bellied wood-pecker, Lovely sunbird, Philippine tailorbird, Cetrine canary flycatcher and Philippine coucal show a higher preference to advance secondary growth (ASG) and old growth (OG) forests.

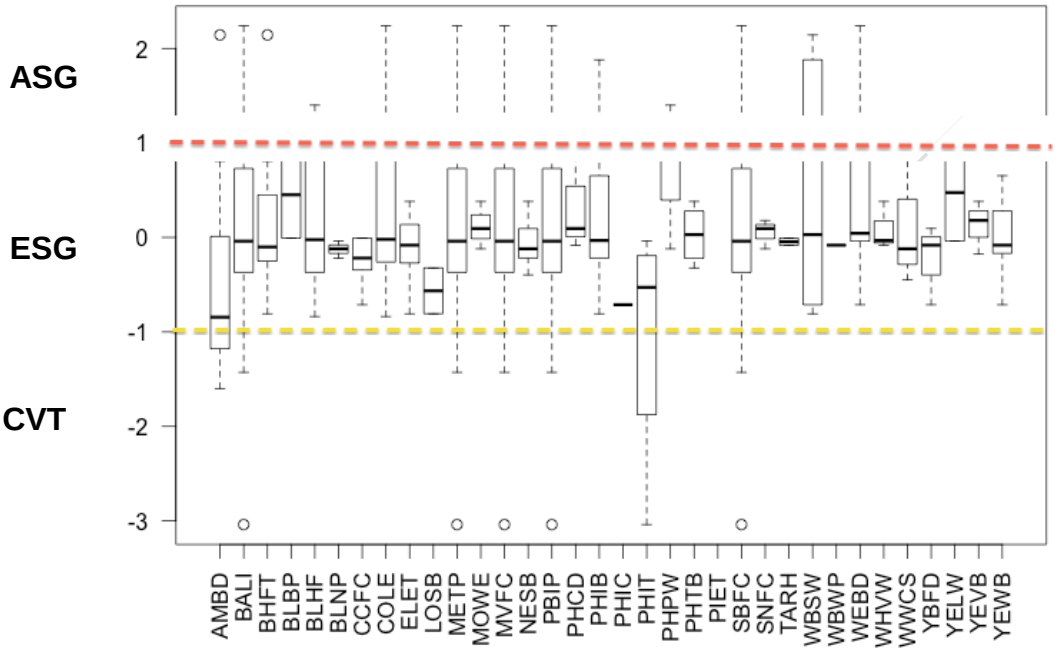

Figure 64. Niche width and niche position of birds in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: AMBD *Phapitreron amethystine* BALI *Dicrurus balicassius* BHFT *Rhipidura cyaniceps* BLBP *Tanygnathus sumatranus* BLNP *Tanygnathus lucionensis salvadorii* CCFC *Culicicapa helianthea* COLE *Sarcops calvus* ELET *Parus elegans* LOSB *Aethopyga shelleyi* METP *Columba vitiensis anthracina* MOWE *Zosterops montanus* MVFC *Eumyias panayensis* NESB *Stachyris nigrorum* PBIP *Ducula poliocephala* PHCD *Macropygia tenuirostris* PHIB *Ixos philippinus* PHIC *Centropus viridis* PHIT *Harpactes ardens* PHTB *Orthotomus castaneiceps* PHWP *Dendrocopos maculatus* PIET *Lalage nigra* SBFC *Ficedula hyperythra nigrorum* TARH *Penelopides panini* WBSW *Brachypteryx montana* WBWP *Dryocopus javensis* WEBD *Phapitreron leucotis* WHVW *Pachycephala homeyeri* WWCS *Coracina ostenta* YBFD *Ptilinopus occipitalis* YEWE *Zosterops nigrorum* YEVB *Pycnonotus goiavier* YEWB *Pycnonotus urostictus.*

Bats

- Species that show a narrow range in niche width include Yellow-faced horseshoe bat (*Rhinolophus virgo*), Orange-fingered myotis (*Myotis rufopictus*) and Little golden-mantled flying fox (*Pteropus pumilus*). The latter is endemic to the Philippines and is considered as a Near Threatened (NT) species (IUCN RedList 2014).
- Species with wider range of niche width include Common short-nosed fruit bat (*Cynopterus brachyotis*), Philippine pygmy fruit bat (*Haplonycteris fischeri*), Dagger-toothed fruit bat

(*Macroglossus minimus*), Philippine tube-nosed fruit bat (*Nyctimene rabori*), Musky fruit bat (*Ptenochirus jagori*) and Arcuate horseshoe bat (*Rhinolophus arcuatus*).

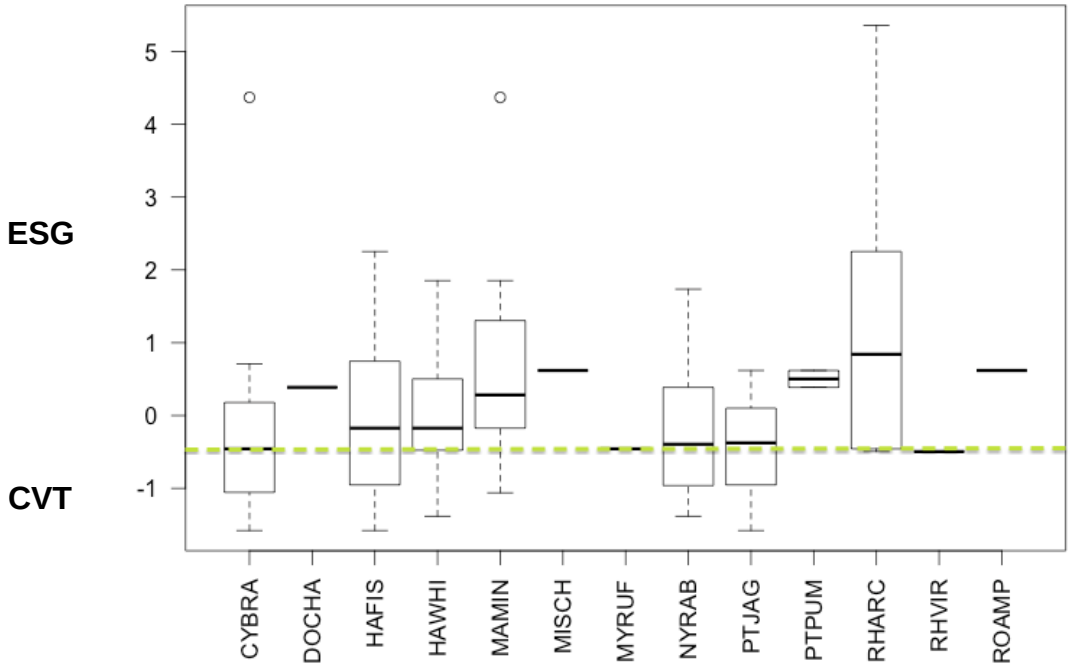

Figure 65. Niche width and niche position of bats in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: CYBRA *Cynopterus brachyotis* DOCHA *Dobsonia chapmani* HAFIS *Haplonycteris fischeri* HAWHI *Harpyionycteris whiteheadi* MAMIN *Macroglossus minimus MISCH Miniopterus schreibersii MYRUF Myotis rufopictus* PTJAG *Ptenochirus jagori* PTPUM *Pteropus pumilus* RHARC *Rhinolophus arcuatus* RHVIR *Rhinolophus virgo,* and ROAMP *Rousettus amplexicaudatus*

Amphibians

- The results of the species are positioned closely to habitat continuum (secondary growth forest to forest edges). All the frog species except *Limnonectes visayanus* are positioned below the mean, which may indicate preference to secondary growth forest. On the other hand, *Occidozyga laevis* shows a wide range of habitat preference, ranging from degraded forest to forest edges. *L. visayanus* prefer habitat on forest edges.
- All the frog species selected have tolerance to degraded forest except for *Limnonectes visayanus. Occidozyga laevis* prefer also habitat on forest edges aside from degraded forest.

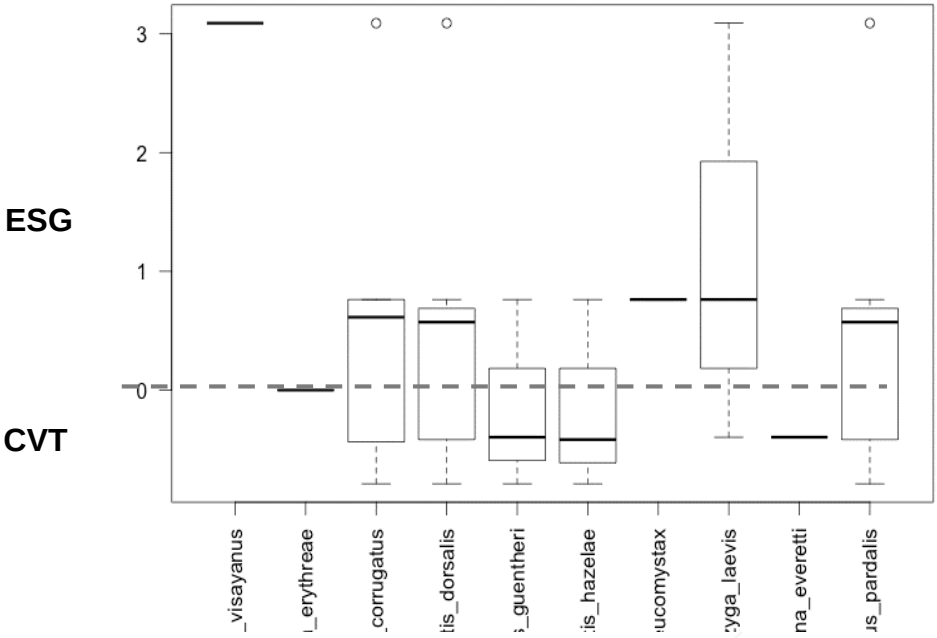

Figure 66. Niche width and niche position of amphibians in different habitats.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: *Limnonecte_visayanus Hylarana_erythreae Platymantis_corrugatus Platymantis_dorsalis Platymantis_guentheri Platymantis_hazelae Polypedates_leucomystax Occidozyga_laevis Hylarana_everetti and Rhacophorus_pardalis*

MKRNP and MANP

Flora (Trees)

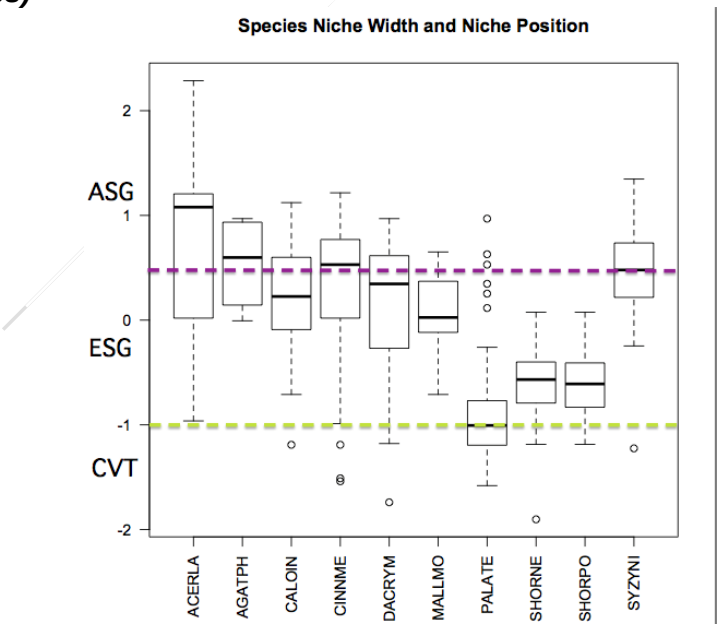

Figure 67. Niche width and niche position of trees in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: ACERLA *Acer laurinum*, AGATPH *Agathis philippinensis*, CALOIN

Calophyllum inophyllum, CINNME *Cinnamomum mercadoi*, DACRIM *Dacrycarpus imbricatus*, MALLMO *Mallotus mollisimus*, PALATE *Palaquium tenuipetiolatum*, SHORNE *Shorea negrosensis*, SHORPO *Shorea polysperma,* SYZYNI *Syzygium nitidum.*

Birds

- Species with narrow niche width are the vulnerable *Actenoides hombroni* (Blue-capped Kingfisher), *Centropus melanops* (Black-faced Coucal), and *Rhiphidura superciliaris* (Blue fantail). These species are specialists and have lower tolerance to disturbances.
- *Loriculus philippensis, Centropus viridis, and Phapitreron leucotis* (White-eared Brown Dove) are examples of species with wide niche width, denoting higher tolerance to anthropogenic disturbances.

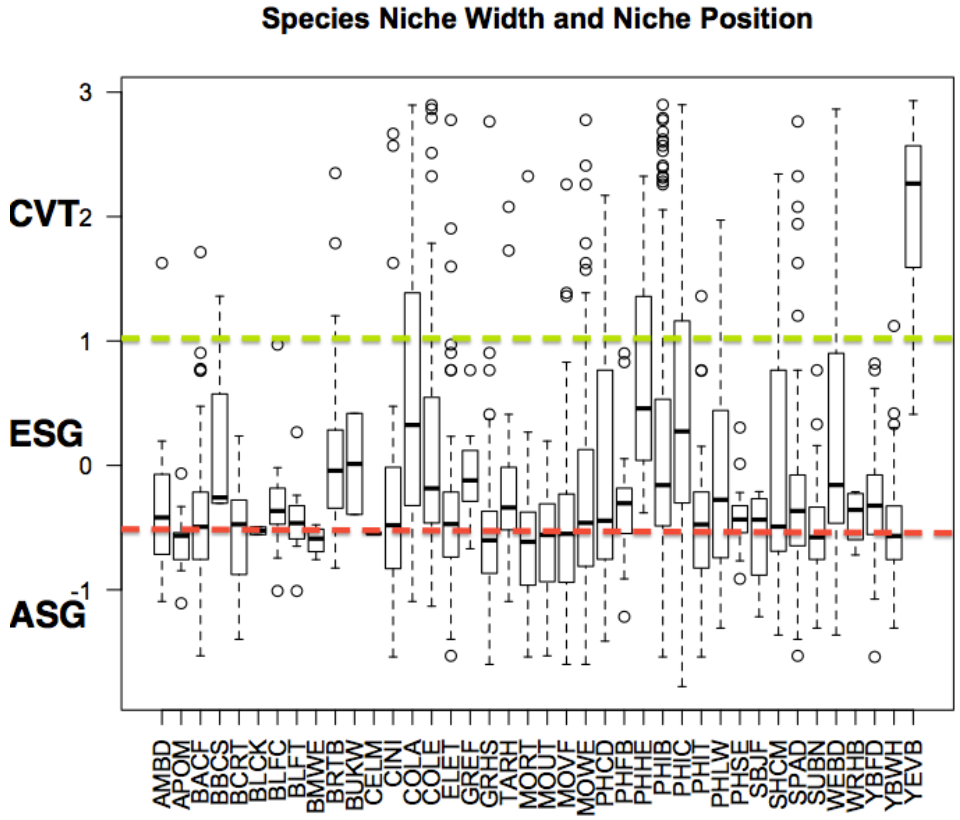

Figure 68. Niche width and niche position of birds in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: AMBD *Phapitreron amethystine* APOM *Basilornis mirandus* BACF *Rhipidura nigrocinnamomea* BBCS *Corasina mindanensis* BCRT *Prioniturus discurus* BLCK *Actenoides hombroni* BLFC *Centropus melanops* BLFT *Rhipidura superciliaris* BMWE *Lophozosterops goodfellowi* BRTB *Macronous striaticeps* BUKW *Scolopax bukidnonensis* CELM *Hypothymis coelestis* CINI *Hypocryptadius cinnamomeus* COLA *Loriculus philippensis* COLE *Sarcops calvus* ELET *Parus elegans* GREF *Muscicapa griseistica* GRHS *Aethopyga primigenius* MORT *Prioniturus montanus* MOUT *Orthotomus cuculatus* MOVF *Eumyias panayensis* MOWE *Zosterops montanus* PHCD *Macropygia tenuirostris* PHFB *Irena cyanogastra* PHIB *Ixos philippinus* PHIC *Centropus viridis* PHIT *Harpactes ardens* PHLW *Phylloscopus olivaceus* PHSE *Spilornis holospilus* SBJF *Rhinomyias goodfellowi* SHCM *Hypothymis helenae* SPAD *Dicrurus bracteatus* SUBN *Sitta oenochlamys* TARH *Penelopides panini,*WEBD *Phapitreron leucotis* WRHB *Rhabdotorrhinus leucocephalus* YBFD *Ptilinopus occipitalis* YBWH *Pachycephala philippensis* and YEVB *Pycnonotus goiavier* .

Bats

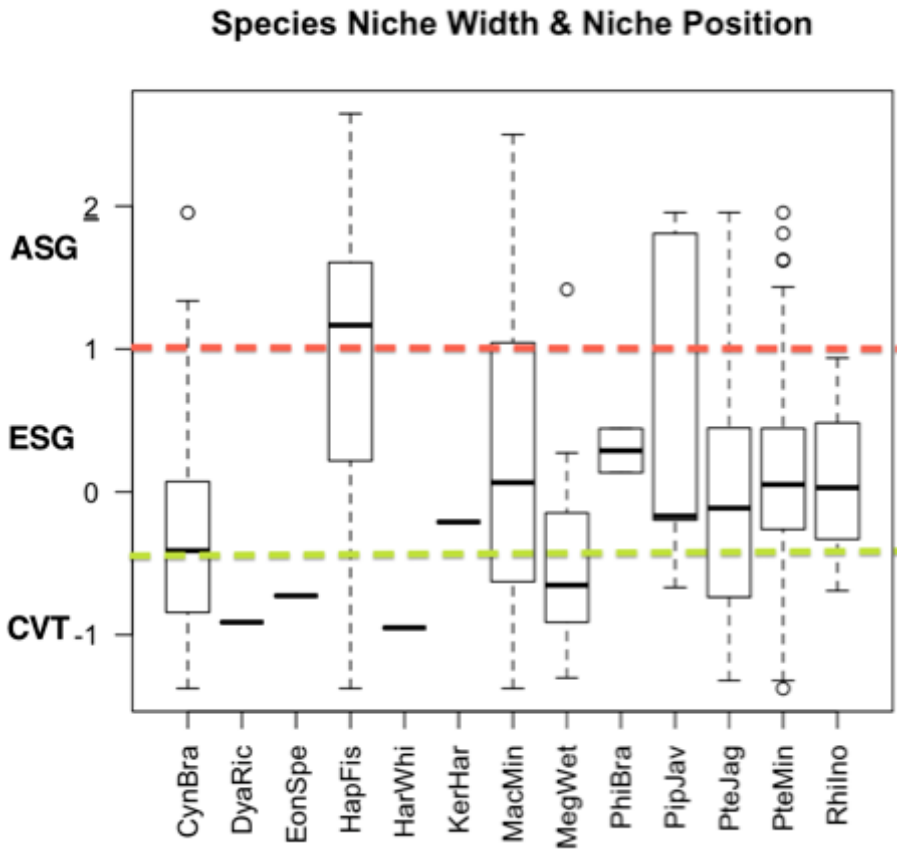

Figure 69. Niche width and niche position of bats in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species used for this analysis are *Cynopterus brachyotis, Dyacopterus rickartii, Eonycteris spelaea, Haplonycteris fischeri, Harpyionycteris whiteheadi, Kerivoula cf hardwickii, Macroglossus minimus, Megaerops wetmorei, Philetor brachypterus, Pipistrellus cf javanicus, Ptenochirus jagori, Ptenochirus minor and Rhinolophus inops*

Reptiles

- Species positioned in early secondary forest with wide niche, e.g., *Sphenomorphus coxi*, *Sphenomorphus diwata* and *Rhabdophis auriculata* are more generalist, which indicate that they do not have specific habitat requirement as compared to specialist species such as *Brachymeles gracilis*.

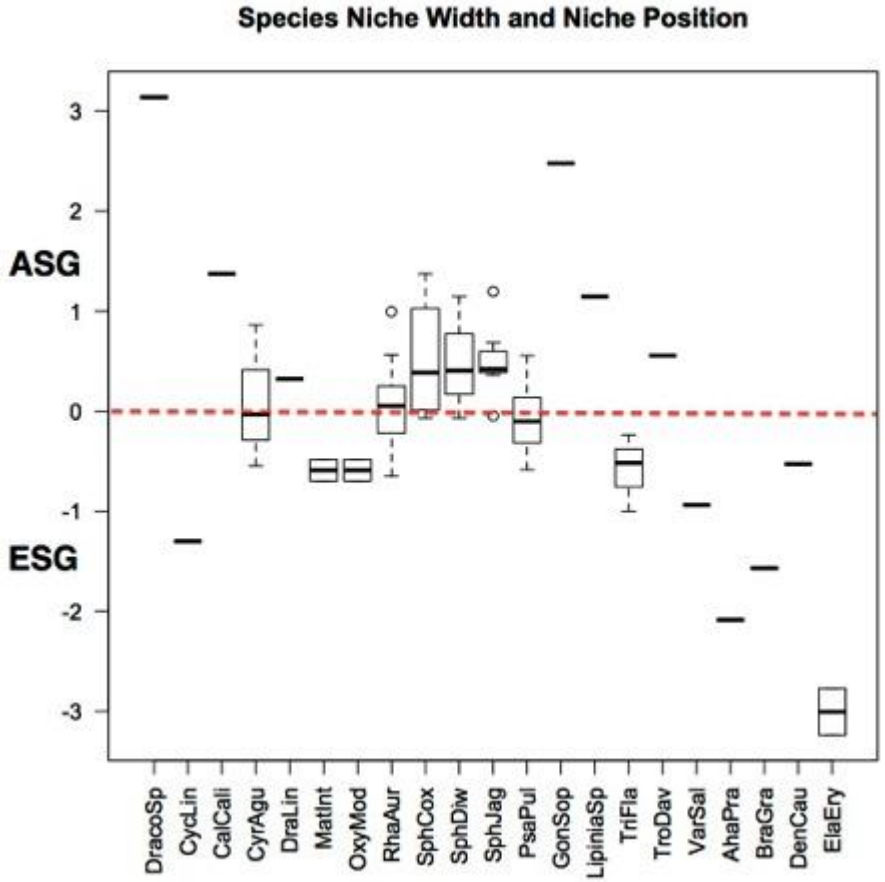

Figure 70. Niche width and niche position of reptiles in different habitat types.

Habitat types are labeled as follows: CVT=Cultivated, ESG=Early Second Growth Forest, ASG=Advance Second Growth Forest, OGF=Old Growth Forest. Species are coded as follows: DracoSp *Draco sp.*, CycLin *Cyclocorus lineatus,*CyrAgu *Cyrtodactylus agusanensis* DraLin *Draco lineatus* MatInt *Maticora intestinalis* OxyMod *Oxyrhabdium modestum* RhaAur *Rabdophis auriculata* SphCox *Sphenomorphus coxi* SphDiw *Sphenomorphus diwata* SphJag *Sphenomorphus jagori* PsaPul *Psammodynastes pulverulentus* GonSop *Gonocephalus interruptus* LipiniaSp *Lipinia sp.* TriFla *Trimeresurus flavomaculatus* TroDav *Tropidophorus davaoensis* VarSal *Varanus salvator* AhaPra *Ahaetulla prasina preocularis* BraGra *Brachymeles gracilis* DenCau *Dendrelaphis caudolineatus* ElaEry *Elaphe erythrura.*

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