PROJECT OVERVIEW

PROJECT NAME: Assessment of the Tamaraw and its habitat

Three research components will be conducted:

I. Dietary Analysis of Tamaraw (*Bubalus mindorensis*) in Mindoro Island, Philippines.
II. Biophysical Profile Survey in Mt. Gimparay
III. Tamaraw Population Analysis in Mt. Gimparay

PROPONENT

Mindoro Biodiversity Conservation Foundation, Inc. (MBCFI)

PROJECT SUMMARY

The Mindoro Island endemic Tamaraw is the largest native land mammal in the Philippines. However, its population declined severely over the last century due to hunting and habitat loss and is classified as critically endangered. In the last two decades, Tamaraws were thought to occur only in the following sites of Occidental Mindoro: Mts. Iglit-Baco Natural Park (MIBNP), Aruyan-Malati Tamaraw Reserve, and Mt. Calavite Wildlife Sanctuary. Until recently, a population was reconfirmed in Oriental Mindoro particularly in Mt. Gimparay which varies greatly in its flora compared to the three sites initially mentioned.

I. A dietary analysis using fecal samples from the Tamaraw will be conducted to identify a vegetation diet list through metabarcoding in Mts. Iglit-Baco Natural Park and Mt. Gimparay. Results from the study can aid in identifying more suitable habitats for the species and help stakeholders in planning and decision-making in the management and conservation of the species and its habitat. Moreover, the project will capacitate local communities in Mt. Gimparay as Wildlife Enforcement Officer (WEO) to increase enforcement measures in the project sites and provide the appropriate field gears to support in establishing the enforcement network across the identified Tamaraw habitats.

II. Prior to the dietary study concerning the Tamaraws, a biophysical profile survey will be conducted in Mt. Gimparay to provide a comprehensive species lists and biodiversity data of the site to support conservation efforts in area, generate a biodiversity profile of the site which will serve as baseline for comparison with subsequent monitoring surveys and establish biodiversity monitoring plots for subsequent regular monitoring surveys. Fauna (birds, mammals, reptiles, amphibians, and insects) and flora will be collected during the survey period for identification.

III. Using camera traps in a prolonged period of time, the study aims to update the population estimate of the Tamaraw and monitor the abundance, diversity and animal distribution depending on the trapping rate (no. of photos per unit of sampling effort) of the species in Mt. Gimparay. Camera traps will be installed randomly in each sampling grid and will be checked once a month for the next 6 months.

PROJECT BACKGROUND

The Tamaraw (*Bubalus mindorensis*), also known as Mindoro Dwarf Buffalo, is the largest endemic land mammal in the Philippines particularly in Mindoro Island. It is classified as critically endangered under the IUCN Red List of Threatened Species and the Philippines national list of threatened fauna (DAO 2004-15). Extremely low population, hunting and habitat loss restricted the Tamaraws in Occidental Mindoro: MIBNP, Aruyan-Malati and Mt. Calavite Wildlife Sanctuary (Harper, 1945; Schult, 2001; 1996; Long et al, 2018). Since 2018, collaborative exploratory surveys were conducted which reconfirmed the presence of the Tamaraws in Upper Amnay Watershed which overlaps both provinces of Mindoro (Schütz 2019;). Mt. Gimparay is one of the most promising habitats sites where the species were reconfirmed in Oriental Mindoro after 127 years (Steere, 1981; Tabaranza et al unpubl).

Tamaraws are herbivores consuming various grasses, bamboo shoots and aquatic plants (Pollisco, Miller, and Byers, 1996). However, their diet may not be restricted to these species given that the reconfirmed site has various vegetation compared to the three sites mentioned. According to Monge (2019), Tamaraws are generalists contrary to its popular notion as an obligate grassland grazer (refer to the compiled diet list in Table 6.4.2). In addition, Tamaraw populations in the forested habitats were noted to have a more fibre-rich diet compared to the grassland populations (Schütz 2019).

Moreover, MBCFI is working to implement various biodiversity conservation initiatives in Mindoro Island. One of MBCFI's objectives is to promote greater awareness and concern for the environment through improved information generation and dissemination, including continuing scientific research, education and advocacy. Results of the scientific research may serve as a basis for developing public interest and stakeholder participation in the formulation and implementation of responsive policies and plans for effective resource management and biodiversity conservation. Identified sites for this study are in MIBNP of Occidental Mindoro and Mt. Gimparay of Oriental Mindoro. A biophysical profile survey was already conducted in the former last 2017 by MBCFI. In Mt. Gimparay, aside from the Tamaraw Verification Survey conducted last June of 2018, thorough studies on its biodiversity is yet to be conducted.

In Mt. Gimparay, a Tamaraw Population Estimate of 25-30 individuals were identified from the Tamaraw Population Verification by hoofmark tracks, fecal deposits and actual species observation. Long period studies on the population analysis of the Tamaraw by using multiple camera traps has not been conducted yet.

OUTCOMES & OBJECTIVES

This study aims to conduct a dietary analysis using fecal samples from the Tamaraw to identify a vegetation diet list through metabarcoding. Results from the study can aid in identifying more suitable habitats for the species and help stakeholders in planning and decision-making in the management and conservation of the species and its habitat. Moreover, the project will capacitate local communities as Wildlife Enforcement Officer (WEO) to increase enforcement measures in the project sites and provide the appropriate field gears to support in establishing the enforcement network across the identified Tamaraw habitats.

Prior to the studies concerning the Tamaraw, a biophysical profile survey will be conducted in Mt. Gimparay to provide a comprehensive species lists and biodiversity data of the site to support conservation efforts in area, generate a biodiversity profile of the site which will serve as baseline for comparison with subsequent monitoring surveys and establish biodiversity monitoring plots for subsequent regular monitoring surveys.

A population analysis will be conducted in Mt. Gimparay. By using the camera traps, the study aims to update the population estimate of the Tamaraw and monitor the abundance, diversity and animal distribution depending on the trapping rate (no. of photos per unit of sampling effort) of the species. Camera traps will be installed randomly in each sampling grid and will be checked once a month for the next 6 months.

COLLABORATORS

- Chester Zoo
- University of the Philippines Diliman – Institute of Biology (UP Diliman – IBS)
- Tamaraw Conservation Program (TCP)
- Mts. Iglit-Baco Natural Park Protected Area Management Office (MIBNP PAMO)
- Philippine Genome Center (PGC)
- Global Wildlife Conservation (GWC)

FIELD SITES AND SAMPLING

- Surveys will be conducted (1) in Mt. Iglit-Baco Natural Park Occidental Mindoro and (2) Mt. Gimparay, Oriental Mindoro. Surveys are conducted at the end of each season.
    - Preliminary Testing will be conducted prior to the actual surveys by collecting fecal samples from the last captive tamaraw, Kalibasib, located in Gene Pool, Manoot, Rizal of Occidental Mindoro to identify the appropriate kit for the analysis for metabarcoding.

    - During actual surveys, vegetation specimens will be collected by using silica gel
    - Camera traps will be installed in Mt. Gimparay during this field survey for the dietary analysis.
- Biophysical profile survey will be conducted in Mt. Gimparay of Oriental Mindoro on June prior to the studies on the Tamaraw to provide information on its biodiversity and better understand the habitats in the area
    - Species of fauna (birds, mammals, reptiles & amphibians) and flora will be collected
- The field team will establish forest camps in sampling localities

METHODOLOGY

I. **Dietary Analysis**

a. Faecal Collection

A 500m-by-500m grid has been established across the selected sites (MIBNP and Mt. Gimparay). Opportunistic collection of faecal deposits from Tamaraws will be collected within the established grid cells, regardless whether an individual was observed or not. However, if a Tamaraw is encountered, the researcher will first observe its feeding and note its consumed vegetation until it leaves the area. The researcher will then proceed to the area where the Tamaraw previously stood and collect faecal samples and obtain vegetation samples that species consumed. In each faecal sample, 3 replicates of 5g will be collected separately with a sterile filter paper in a zip-locked bags. At least 30 faecal samples will be collected per site and per season. A total of 120 samples will be collected from the two sites in both wet and dry season. Samples will then be sent to the University of the Philippines Diliman (UPD) for processing and analysis

b. Plant Collection and Identification

The surrounding plants where the faecal samples of the Tamaraw are located will be collected. Plants previously identified as part of the diet of the species will also be collected (Monge, 2019). Collection of plant samples for the molecular analysis will be limited to the budget amount to process 150 species per site; a total of 300 plant species will be collected for molecular analysis. However, plant samples collected for herbarium or morphological analysis will not be limited to the identified quantity; plants near any indirect signs (hoofmarks, faecal deposits, horn-rubbed stems and trunks, and wallowing and resting areas) of the Tamaraw will also be collected.

The collected Voucher specimens will be stored UPD Herbarium. Morphological characteristics of the plant specimens will be noted to aid plant identification of the processed molecular samples.

c. DNA Metabarcoding

A DNA metabarcoding approach will be used to determine the composition of plants in the faecal samples (Pompanon et al, 2011). Available plant metabarcoding libraries and sequences will be used to target the plant material in the faecal samples by using universal primers (rbcL and trnH-psbA) or developed primers by the UPD – Institute of Biology.

Plant samples for molecular analysis will be collected in zip-loc bags with silica, and sent to the Philippine Genome Center for processing and analysis. DNA will be extracted from the leaf samples and will be amplified by using universal primers and PCR conditions. Amplified results will be used for DNA sequencing reactions. Generated sequences will be used to identify the species of the plant and will be used to cross-checked to the sequences produced from the faecal samples. Integrative

molecular identification approach will be used to compare and confirm the molecular and morphological identification of the collected samples (Dapar et al, 2020).

d. Data analysis

The difference between plant species identified in faeces from the two sites will be compared using the Bray-Curtis similarity index. Generalised Linear Models will be used to investigate the relationship between food plant distribution and Tamaraw population density (from Schütz 2019).

II. Biophysical Profile Survey

a. Fauna

i. Birds

Birds will be surveyed using line transects (approximately 1-2 km long), that will be randomly walked by observers from 5:30AM to 9:00AM. Bird observations will be continued throughout the day targeting threatened endemic species. The species accumulation curve will be used in determining sampling efforts. Mist netting across different habitat types (lowland forest, montane forest and grassland) will also conducted. Netting efforts will target understory skulking species and fruit-eating birds as well as ground-dwelling birds.

ii. Mammals

To assess bat species, mist-netting will be used following standardized methodologies described in Barlow (1999) and slightly modified to suit local conditions. Mist nets of varying lengths will be set close to the ground level and across still portions of rivers to capture both fruit-eating and insectivorous bats. High nets will also erected along ridgetops and known flyways of flying foxes and fruit-eating bats. Net lines will be opened just before dusk and checked regularly throughout the night.

Species discovery curves will be used to determine sufficient level of sampling effort. Biometrical measurements of captured bats will also be taken and species will be identified. The Key to the Bats of the Philippine Islands by Ingle and Heaney (1992), A Guide to the Mammals of Borneo by Payne and Francis (2005) and the Bats of Krau Wildlife Reserve by Kingston et al. (2006) will be used to identify the bats. Collection of voucher specimens will be conducted for unidentified species following stipulations in the Gratuitous Permit (GP) to be issued by the DENR. The species diversity and abundance in different sites will be compared using the following computations:

$$\text{Relative Density} = \frac{\text{number of individuals for a species}}{\text{total number of individuals for all species}}$$

Shannon-Weiner Index of Diversity $H = -\Sigma pi\ (\ln pi)$

Where pi = proportion of total sample belonging to the species

iii. Reptiles & Amphibians

Transect lines, approximately 1km in length will be established. Transects will be marked at 100m intervals and will be sampled during day and night for a minimum of five days per site (Bennett, 1999).

Opportunistic sampling using hand capture, searching microhabitat, such as rotten logs, leaf litter, tree holes, burrow and small ponds, will also be performed (Bennett, 1999; Diesmos et al., 2003). Body measurements of captured species will be taken. Photographs of captured specimens will be taken for documentation prior to release back to their original habitat (Ledesma, unpublished; Brown, 2000). Seen and heard species (uncaptured) will also be recorded. The species diversity and abundance in different sites will be compared using the same computations presented in mammals section.

The elevation, coordinates, time and weather condition during the time of capture will also recorded. Habitats and microhabitats, where the species is going to be taken, will also be described. Five different habitat and microhabitats will be sampled during the survey: (a) Streams/rivers; (b) Rocks/boulders/rock crevices; (c) Leaf litter; (d) Soil; and (e) Tree branches.

iv. **Insects**

Three substations, (lowland, montane and mossy forest) will be assessed for Arthropod diversity. For each substation, a transect line will be established and will be divided into four stations/plots to set permanent field plots. The length of the transect line will be based on the terrain which will be determined on the first day of field work. For each plot, arthropods will be collected using sweep net method, pitfall trapping, and opportunistic sampling.

1. Sweeping - This method is designed to survey arthropods which are above-ground dwellers. One sweeping i.e. 20 bilateral sweeps will be conducted for each plot. Collected arthropods will be placed in 500mL containers which will then be poured with alcohol, labelled, sealed and transported for sorting and identification in the UPLB-Museum of Natural History laboratory.
2. Pitfall trapping - This method is intended to collect ground-dwelling arthropods. Five pitfall traps left exposed for about 24 hours will be set for each plot. Each trap will be covered with microwaveable plastics which sides have dome-like opening to protect the trap in case of rains. This will be conducted for three consecutive days replacing the alcohol with arthropods trapped from each cup with new 95% ethyl alcohol. Likewise, collected arthropods will be placed in 500mL containers which will then be poured with alcohol, labelled, sealed and transported for sorting and identification in the UPLB-Museum of Natural History laboratory.
3. Opportunistic sampling. This will be conducted to collect specific arthropods including butterflies, dragonflies and damselflies which are usually near water bodies or artificial water pools, and arachnids. Opportunistic sampling will also be conducted at night to specifically collect stick and leaf insects which are nocturnal. Collected arthropods will be placed in 250mL containers which will then be poured with alcohol, labelled, sealed and transported for sorting and identification in the UPLB-Museum of Natural History laboratory.
4. Data Management. The arthropod diversity indices will be computed for each station using the program Paleontological Statistics (PAST) software.

b. **Flora**

Listing of plant species found in the project site, including identification of useful plants (in terms of ecological, medicinal and economic parameters, among others), endemism and conservation values (using the latest IUCN and DENR classification of threatened species), and alien and exotic plant species (and how they are impacting the vegetation of the project site). Based on available information, type of ecosystems will be identified for sampling. Within the forest, the following methods will be used:

1. Ten quadrats (20mx20m) will be laid out in stratified random in secondary forest (green) and mixed agricultural (yellow) areas; and a comprehensive inventory of mature trees (>10cm dbh) at the priority lot (approximately 3,000 sqm)
2. All mature tree species found in the quadrat will be identified. Parameters like diameter at breast height (dbh), number of individuals per species, and frequency, will be recorded for mature trees (>10cm dbh). From these parameters, the relative density (RD), relative frequency (RF) and relative dominance (RDom) will be calculated. The importance value (IV) of each species will be calculated by summing up the three mentioned parameters;
3. Some plant samples may have to be collected for further taxonomic identification at the botanical herbarium;
4. Voucher specimens will be deposited at the botanical herbarium, Museum of Natural History (MNH) at the University of the Philippines in Los Banos (UPLB); and
5. Other parameters that will be recorded/noted are the economic significance of the plant species and their conservation status

III. **Camera-trapping Survey**

Within the established grids, a total of 25 camera traps will be installed and chained or cable-locked with CT security case against device thievery. Upon the installation and establishment of camera trap set ups within specific habitat points, the area will be undisturbed for a certain time range giving an opportunity for the Tamaraws to freely and actively behave and associate with each other. Camera trap sites will be checked once a month for the next 6 months in both sites where memory cards and batteries will be retrieved and replaced with fresh sets

MATERIALS TO BE USED/DATA GATHERING INSTRUMENTS

- Tubes
- Silica gel
- Soil Sampling probe
- Ziplock
- Shovel
- Gloves
- GPS
- Cameras
- Camera Traps
- Mist nets with an average mesh size of 36mm, height of 2.5m, and length of 6 and 12 meters
- Biometrics instruments (pesola scale, ruler, dial caliper)
- Bird/bat bags
- Cage traps (rodents)
- Pit-fall traps (reptiles and amphibians)

- Materials for preservation of specimen (ethyl alcohol, formaldehyde, containers)
- Field guides for mammals, birds, reptiles, amphibians and flora species
- Data sheets

SCOPE AND LIMITATION OF THE STUDY

I. Seasonal surveys will be conducted both in Mt. Iglit-Baco Natural Park Occidental Mindoro and (2) Mt. Gimparay, Oriental Mindoro and will focus on the Tamaraw (including the fecal samples and its surrounding soil) and flora species. Surveys in Mt Iglit Baco Natural Park, Occidental Mindoro will only be conducted within the No Hunting Agreement Zone.

II. Biophysical profile survey will be conducted in Mt. Gimparay, Oriental which will focus on the survey of terrestrial faunal (birds, mammals, reptiles and amphibians), and floral species prior studies on the Tamaraw.

III. Population analysis will be conducted in Mt. Gimparay due to limited funds in purchasing camera traps.

PERMITS

- The numbers of specimens of each species that will be collected are stipulated in official Gratuitous Permit (GP) issued by DENR-BMB
- Free and Prior Informed Consent will be secured from NCIP for study sites that are under NCIP ancestral domain titles/claims.
- Local Transport Permit (for preserved scientific specimens of animals) will be procured from the CENRO or PENRO or relevant offices of the DENR to transport the specimens to Manila

RESEARCHERS AND FIELD TEAM MEMBERS

1. Elyza Hazel Tan (MBCFI)
   Earned her degree in BS Biology at Xavier University – Ateneo de Cagayan, Cagayan de Oro City in 2016. Started as a research assistant of MBCFI back in October 2017. Currently, she is the Project Development and Resource Officer of the organization. As a biologist, her primary interest is in botany.

NEEDS

- Memorandum of Agreement with the University of the Philippines Diliman – Institute of Biology and Philippine Genome Center
- Permits prior to the surveys
- Hire local trail guides preferably from the IP communities

OUTPUT OF THE PROJECT

Biodiversity information

- Detailed report of biophysical profile survey (species lists, conservation status of species and habitats, threats to biodiversity, etc.)
- Detailed report of field survey (list of vegetation eaten by the Tamaraw)
- Detailed report on population analysis of the Tamaraw
- Photographs of species and habitats
- Relevant biodiversity information that will arise from this research

RESPONSIBILITIES

- Coordinate work with DENR TCP
- Coordinate work with MIBNP PAMO, Occidental Mindoro and PGOrM, Oriental Mindoro
- Coordinate survey schedules with Armed Forces of the Philippines and Philippine National Police
- Secure Permits (FPIC & GP)
- Provide logistical support to field team
- Provide personnel for the fieldwork
- Distribute copies of reports to relevant stakeholders

SOURCE OF FUND

- Chester Zoo
- Mindoro Biodiversity Conservation Foundation Inc. (MBCFI)
- Global Wildlife Conservation (GWC)

Table 1. PERIOD OF RESEARCH AND CHRONOLOGY OF ACTIVITIES INVOLVED

Activities	Year 1 (2021)												Year 2 (2022)												Year 3 (2023)											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Outcome 1: Increased knowledge on identifying suitable and prospect habitats for the Tamaraw **Outcome 2: Better understanding on the population dynamics of the species to the availability of food within the habitat**																																				
Secure Permits		x	x				x	x	x	x	x	x	x	X	x	x	X	X																		
Preliminary Testing									x	x				X	x	x	X	X																		
Secure MOA with UPD and PGC					x	x	x	x	x	x	x	x	x	x	x	x																					
Field Surveys																					x	x	x					x	x	x						
Lab Analysis and Process Samples																							x	x	x	x			x	x	x	x				
Draft Report																															x	x	x	x		
Presentation and validation of report to relevant stakeholders																																		x	x	
Preparation and submission of Final Report																																			x	x
Preparation and submission of Project Year End Status Report to Chester Zoo (CZ)																							x	x										x	x	
Preparation and Submission of the Final Project Report to CZ																																			x	x

*Cells filled with yellow = Adaptive management

1 Workshop identification activities to rehabilitate prospect habitats for the Tamaraw

1 Wildlife Enforcement Deputation Training

Fundraising Event

MAP

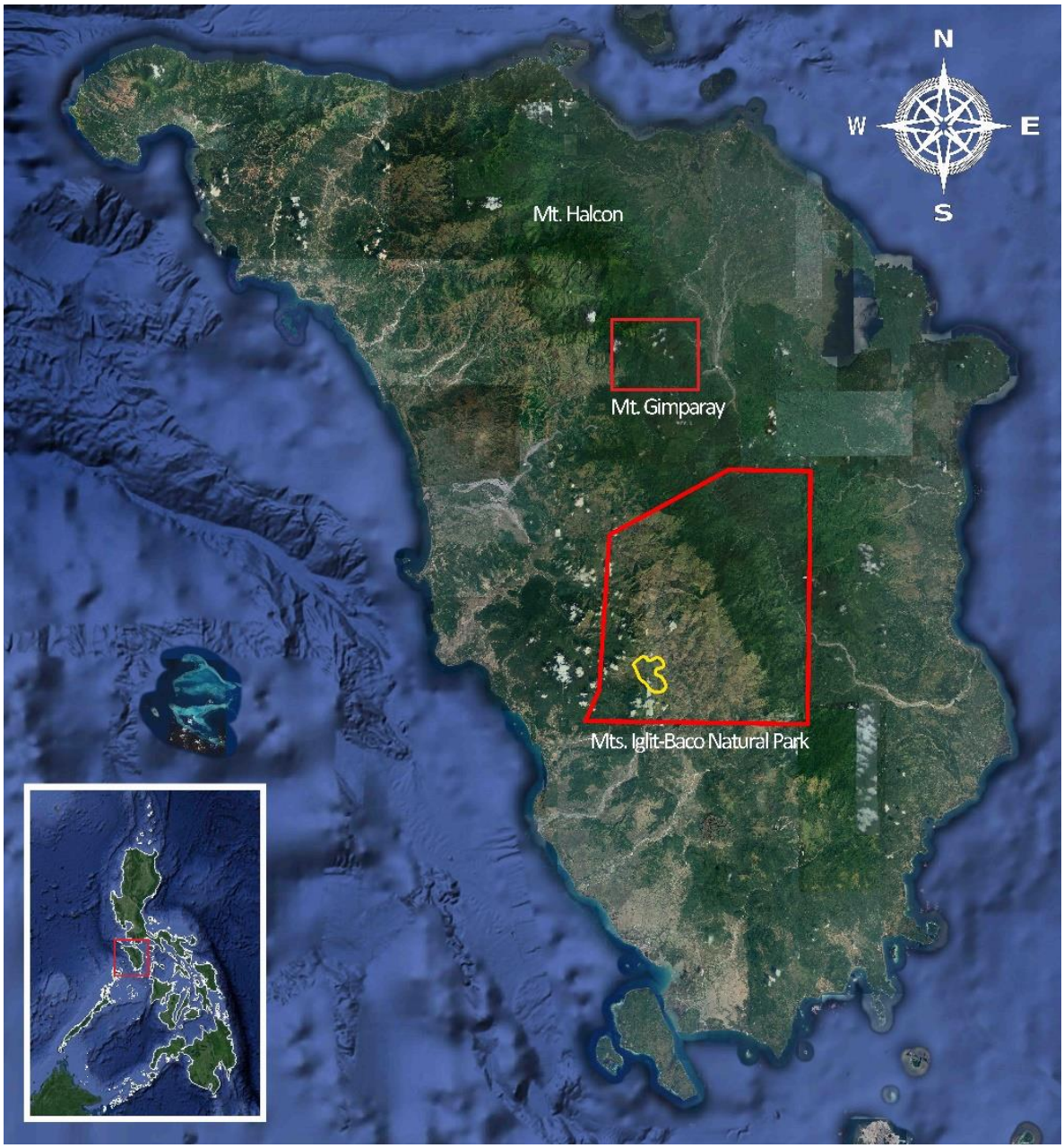

Figure 1. Selected Project Sites: Mts. Iglit-Baco Natural Park, Occidental Mindoro (No Indigenous People (IP) Hunting Zone - Yellow), and Mt. Gimparay (South of Halcon Range), Oriental Mindoro

Figure 2. Mt. Iglit-Baco Natural Park, Occidental Mindoro

Figure 3. Mt. Gimparay, Oriental Mindoro

Table 2. List of Tamaraw Food Species and Parts Consumed from the consultation sessions with the Tamaraw rangers and Indigenous People members (Monge, 2019)

Vernacular name	**Scientific name**	**Plant part eaten**
cogon	*Imperata cylindrica*	leaves
bulso	*Melastoma malabathricum*	flower and leaves
talahib	*Saccharum spontaneum*	leaves
saong	*Mikania cordata*	leaves
napnap	*Cephalostachyum mindorense*	leaves
samong-samong	*Themeda triandra*	leaves
bunglay	*Blumea axillaris*	leaves
kollokolot		leaves
Mongo-mongo	*Calopogonium mucunoides*	flower and leaves
patani	*Canavalia rosea*	flower and leaves
agyon	*Themeda arguens*	leaves
Mani-mani	*Desmodium styracifolium*	leaves
barit	*Scleria ciliaris*	leaves
tagyangfet		leaves
alongang	*Senna occidentalis*	leaves
tanrak		root and leaves
tagbal		fruit
banaba	*Lagerstroemia speciosa*	leaves
banglad		leaves
laptang		seeds
bulingling		leaves and fruit
tigablang		leaves
bakbe	*Mucuna pruriens*	leaves
lanlanos		leaves
pandan	*Pandanus tectorius*	fruit
barere		leaves
bangkal	*Nauclea orientalis*	fruit and leaves
ene	*Miscanthus sinensis*	leaves
amorsecos	*Chrysopogon aciculatus*	leaves
tanglad-tangladan	*Themeda gigantea*	leaves
tan-ag	*Kleinhovia hospita*	bark

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