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Green Assessment in Siargao Island Protected Landscape and Seascape (SIPLAS) Stage 2

COMPREHENSIVE APPRAISAL: RAPID BIODIVERSITY ASSESSMENT

TECHNICAL REPORT

Photo: John Bibar

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Imprint

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- Municipality of Socorro
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- Barangay Dose, Dapa
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ABSTRACT

On December 16, 2023, Siargao Island Protected Landscape and Seascape (SIPLAS) was severely hit by category 5 Typhoon Odette. The intensity of the typhoon impacted not only the community and economy but also the ecosystem's state. To identify the post-disaster impacts on wildlife and their habitat conditions, a rapid biodiversity assessment was conducted from September 5 to October 8, 2022. We recorded a total of 325 species of flora and fauna (194 plants, 69 birds, 19 amphibians, 15 reptiles, and 28 mammals). Among the different species recorded, one is a newly discovered species of *Begonia* (Begoniaceae). The results also revealed potentially new distribution records of Mindanao gymnure, Mindanao shrew, and a species of *Platymantis*. Despite incomplete species detection during the assessment, the number of species encountered was high. We suspect that low species detection could be attributed to rampant anthropogenic disturbances on the ground. Timber poaching was common in the area even prior to the typhoon. Each sampling site was highly disturbed, except for Bucas Grande (Socorro). Crown defoliation was not evident, but a few trees were uprooted and some broken branches were found on the forest floor, which were collected and utilized by locals for house reconstruction. Because most parts of SIPLAS were already anthropogenically modified pre-disaster, we cannot conclude which habitat modifications were caused by the typhoon. Areas dominated by shrubs barely had structural modifications, while recolonization of pioneering species and quick regeneration of mixed vegetation and shrublands were observed in damaged areas. Based on the ground observations and results, the following interventions are needed: (1) revegetation activities, which will need removal of disturbance agents beforehand; (2) strengthening of environmental enforcement to protect and sustain existing rare, threatened, and endangered species of flora and fauna; and (3) landscape-lens planning aimed at restoring natural vegetation.

Keywords: *Green Assessment, Rapid Biodiversity Assessment, Damage Assessment*

1 Introduction

In December 2021, category 5 Typhoon Odette struck the Philippines and caused substantial damage to ecosystems and human settlements. Siargao Island Protected Landscape and Seascape (SIPLAS) was hit hard and left with damages estimated at P20 billion, with approximately 35,844 families affected (Mendoza, 2021; Lopez, 2021). The torrential downpour and strong winds brought by Odette were expected to bring vegetation damages that could immediately influence plant and animal species composition, vegetation structure, soil nutrient-cycling process, and ecosystem stability (Bin et al., 2012; Fengjin & Qiufeng, 2022). Unfortunately, in post-disaster scenarios like this, environmental concerns are not always sufficiently incorporated into strategic planning at the outset of the reconstruction process. Hence, little information is available on the ecosystem response and the extent of a typhoon's damage to the forests and wildlife remains unknown. Moreover, reconstruction efforts, if any, sometimes further contribute to the degradation of severely-damaged areas, making the ecosystems vulnerable to future disasters. This called for an urgent need to develop a framework to address future disaster risks and achieve green reconstruction and resilience.

As a response to post-disaster needs, the Green Assessment framework was established. The Framework maximizes the collection of ecological and socio-economic data in order to make informed decisions during strategic planning. The Green Assessment framework is an assessment tool used to ascertain the status of existing ecosystems, biodiversity, and communities after a disaster. The results of the assessment are crucial in understanding the impacts of a typhoon on high conservation values so that rehabilitation and recovery plans can be drawn upon. This allows for science-driven recommendations toward reducing risks from future potential disasters and enables communities to strengthen reconstruction efforts and build towards resilience using a participatory approach.

The Green Assessment Framework consists of three stages: 1) rapid appraisal; 2) post-disaster assessment of biodiversity, ecosystems, and ecosystem services; and 3) green reconstruction and resiliency planning (Figure 1). The second stage is conducting comprehensive appraisals through aerial ground truthing and ground validation surveys on biodiversity and land-use change using conventional field techniques and foot patrols. To evaluate the damages in typhoon-affected areas in Siargao Island, we conducted a rapid biodiversity assessment in the municipalities of San Benito, Del Carmen, Dapa, and Socorro. The assessment aimed to determine the status of threatened and endemic species and their habitats. The data and information collected will allow for determining appropriate science-driven strategies toward green reconstruction and resilience.

Figure 1

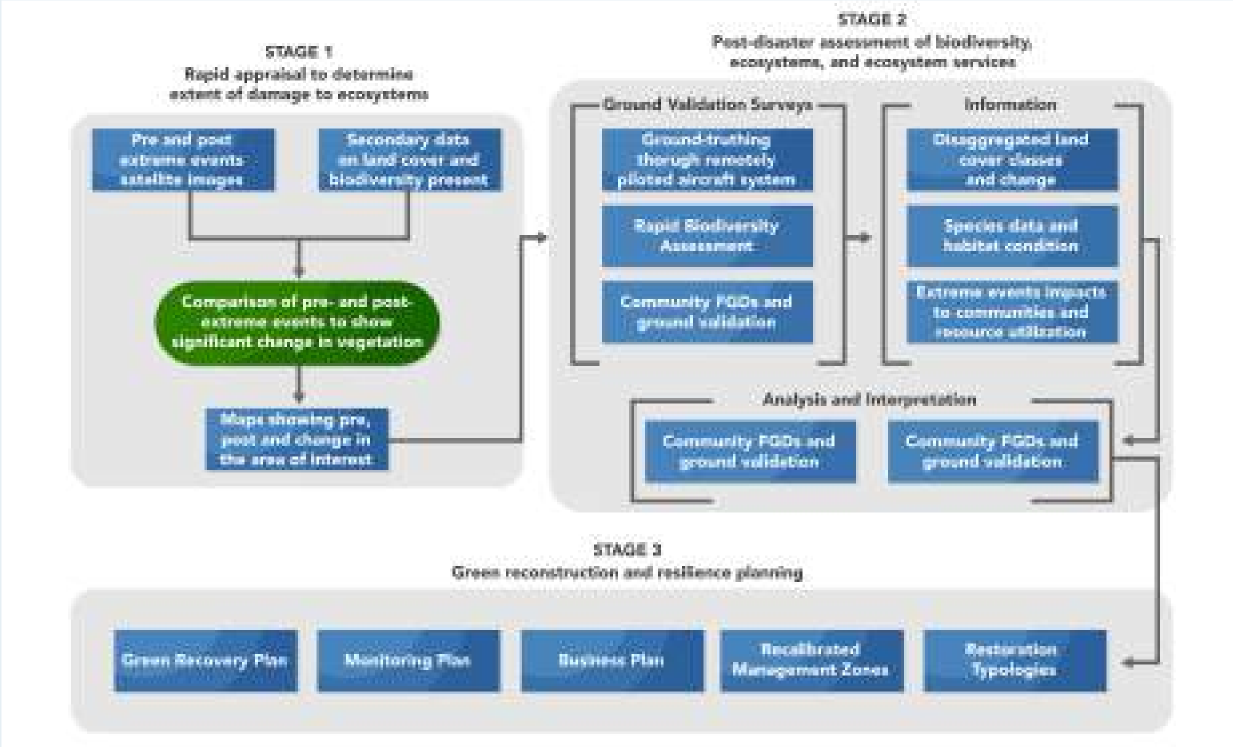

Figure 1. The Green Assessment Framework diagram showing the three stages: (1) rapid appraisal to determine extent of damage to ecosystems; (2) post-disaster assessment of biodiversity, ecosystems, and local communities; and (3) green reconstruction and resilience planning. The red box represents the sub-activity that will be the subject matter in this report.

2: Methods

2 Methods

Identification of sampling sites

Site selection was based on the maps generated during the green assessment rapid appraisal (Stage 1) and the areas identified during stakeholders' consultation. We used land cover maps and other relevant maps generated in Stage 1 to identify forest areas that were likely damaged by super typhoon Odette. Sampling sites were identified from selected municipalities based on vegetation cover and accessibility of the area. A stakeholders' consultation was conducted to verify which barangays had severe vegetation damage. Biodiversity transects and plots were laid out in four (4) barangays identified during the consultation process:

a. Municipality of San Benito

Barangay Nuevo Campo (9.95460246, 126.032363)

The Rapid Biodiversity Assessment (RBA) was conducted in Barangay Nuevo Campo, San Benito from September 5 to 9, 2022. Three 2-km biodiversity transects were established along varied disturbance gradients (Figure 2). Coconut plantations and remnants of limestone and ultramafic forests dominated the area (Figure 3). Timber poaching was commonly observed in all transect locations.

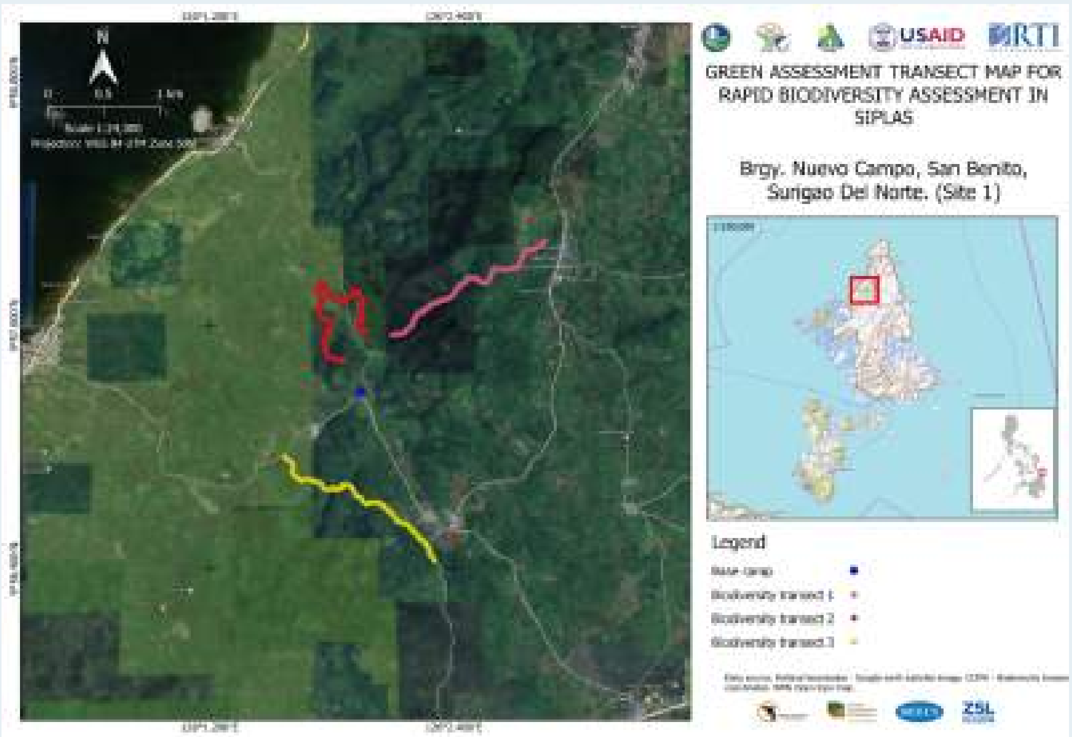

Figure 2. Location of the three biodiversity transects sampled in San Benito, Siargao Island Protected Landscape and Seascape for the rapid biodiversity assessment.

Figure 3. Biodiversity transects sampled in Barangay Nuevo Campo, showing areas with vegetation dominated by saplings (left), and limestone area covered by herbaceous flora (right). *Trees are seldom observed. Trees are often cut for timber poaching.*

b. Municipality of Del Carmen

Barangay Mahayahay (9.8579901, 126.0381866)

The RBA was also held in Barangay Mahayahay, Del Carmen from September 12 to 16, 2022. Three biodiversity transects (Figure 4) were strategically established at Siargao Peak and Del Carmen Watershed (Figure 5). Several areas were characterized as limestone forest remnants, while others are shrublands and grasslands that are dominated by cogon, and ferns (locally known as "agsam").

Figures 4 & 5

Figure 4. Location of three biodiversity transects sampled in Del Carmen, Siargao Island Protected Landscape and Seascape for the rapid biodiversity assessment.

Figure 5. Sampling areas in Del Carmen Watershed (left) and Siargao Peak (right). *The photos show open areas composed of patchy shrubs, bushes, and Cogon grass within the watershed, and disturbed limestone forest along Siargao Peak.*

c. Municipality of Dapa

Barangay Osmeña (9.8028837, 126.0611556)
Barangay 12 (9.78581373, 126.0356129)

Two sampling sites were established in the Municipality of Dapa, namely in: (1) Sitio Fatima (Barangay Osmena); and (2) Sitio Lobo (Barangay 12). The RBA was conducted from September 19 to 23 and September 27 to 30, 2022 in Sitio Fatima and in Sitio Lobo, respectively. Five biodiversity transects (Figure 6) were established in strict protection zones. Each area had forest patches with signs of timber poaching and road construction. There were also areas with disturbances as indicated by the dominance of ferns and coconuts (Figure 7).

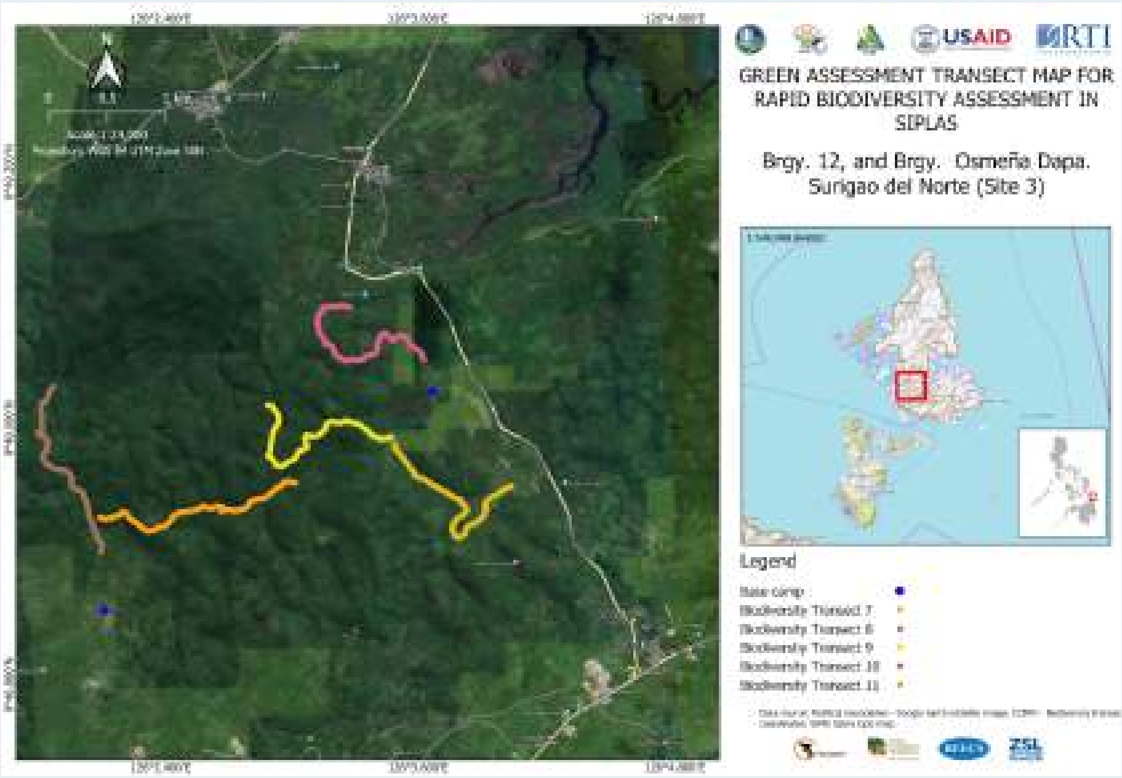

Figure 6. Location of five biodiversity transects sampled in Dapa, Siargao Island Protected Landscape and Seascape for the rapid biodiversity assessment.

Figure 7. An area in Sitio Lobo was highly disturbed as indicated by the dominance of ferns (*Nephrolepis* spp.) and coconuts (*Cocos nucifera*).

d. Municipality of Socorro

Barangay Sudlon (9.594701, 125.93804)

From October 3 to 8, 2022, an RBA was conducted in Sitio Inayaran, Barangay Sudlon in the Municipality of Socorro. Three biodiversity transects (Figure 8) were established within the strict protection zone. The topography is mainly karst, characterized by sharp limestones and swampy areas. Permanent infrastructure such as farmhouses and ongoing construction thereof, were observed (Figure 9). Forested areas were seen to have patches that have been recently cleared of trees and understorey vegetation.

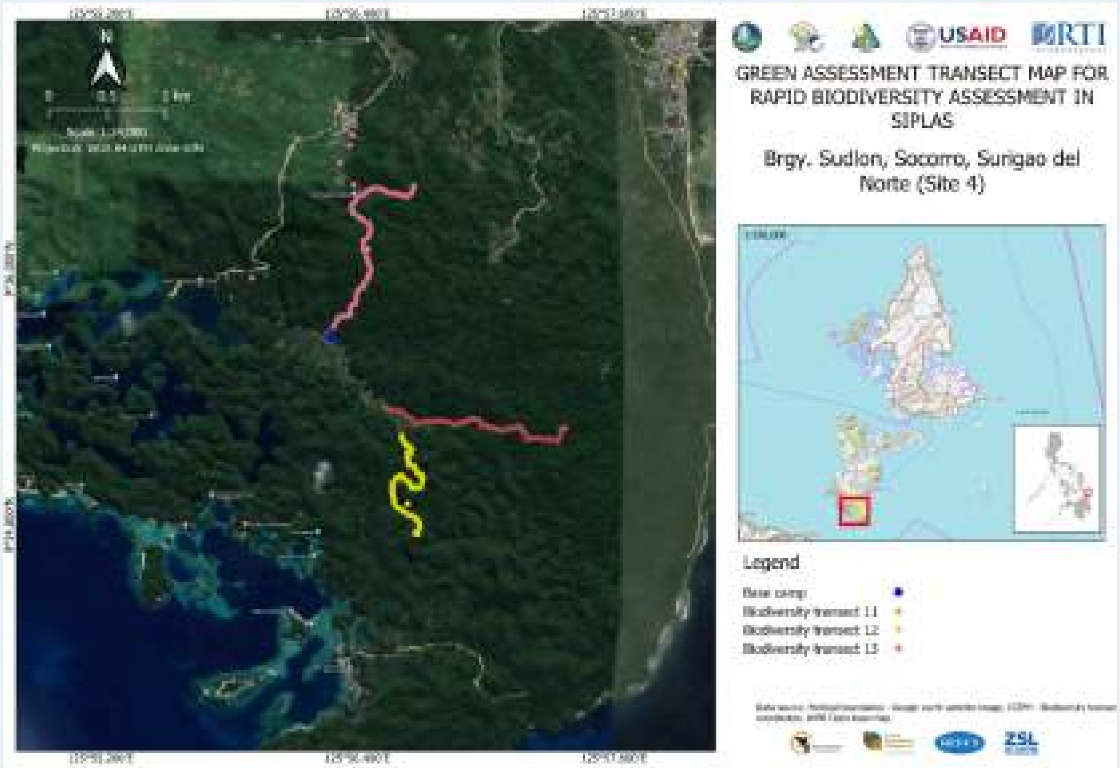

Figure 8. Location of three biodiversity transects sampled in Socorro, Siargao Island Protected Landscape and Seascape for the rapid biodiversity assessment.

Figure 9. Limestone forests near swampy areas (left), and farmhouses (right) within the strict protection zone of Barangay Sudlon, Socorro.

Transect establishment

The post-disaster RBA was done by placing biodiversity transects along selected sites that have shown to be severely affected by typhoon Odette. This step was done by making sure that each transect line does not overlap over another. A total of 14 2-km biodiversity transects were established, covering approximately 224 ha. Each transect was laid along the slope of the terrain so that various elevation and habitat gradients are covered. Every 25 m and 250 m (point station) were marked with a brightly colored ribbon, and geotagged.

Flora assessment

The nested quadrat sampling technique was utilized to assess and characterize habitat damage, vegetation structure, and species composition of various plant communities. Quadrats were laid out two to five meters away from the biodiversity transect to avoid sampling bias. A total of nine 20 m x 20 m quadrats were established in each biodiversity transect, wherein trees (>10 cm diameter at breast height) were identified, measured, and counted. Small trees (<10 cm diameter at breast height), poles, saplings, and shrubs were also identified and quantified inside the nested 5 m x 5 m quadrat (Figure 10). The percent cover of each ground cover vegetation (i.e. grasses, small ferns, and herbaceous plants) was estimated within the 1 m x 1 m quadrat.

Figure 10. The assessment team members measured the diameter of the tree at breast height during flora survey.

General observations or opportunistic vegetation surveys involving free walks for additional listing, and photo documentation of the different species were carried out to account for the maximum number of possible species in the area. Species identification was accomplished with the use of dichotomous keys, published plant descriptions, illustrations, photographs, and comparisons with properly identified herbarium specimens. Photographs of live plants were compared to Co's Digital Flora of the Philippines (Pelser et al. 2011 onwards).

Habitat damage assessment

To gauge the extent of vegetation damage in each site, we employed visual assessments on uprooted trees, crown condition of a tree, and its leaning angle. The extent of damages was categorized using a matrix (see Annex 1). We also evaluated the potential of an area for forest recovery by quantifying the number of seedlings or regenerants (<1m in height) per quadrat.

Figure 11. Data collection during habitat damage assessment.

Avifauna Assessment

We used forward and reverse sampling in assessing the avifauna present in each biodiversity transect. The surveys were done when bird activity was highest between 0500 H to 1000 H. The overall sampling effort covered a total of 224 ha (28 km in length; 80m in width). Both direct and indirect observations of birds were recorded while making sure that records were taken perpendicular to the transect. We also did point counts at sampling stations where bird observations were done for eight minutes. This involved measuring the distance from a species observed relative to the center of the station, counting the number of birds in a group, and identifying the type of contact, height, and bird activity.

Figure 12. The avifauna assessment involved observation of birds using a spotting scope.

Mammal Assessment

To assess volant and non-volant mammals, mist nets and cage traps were deployed strategically along the 2 km biodiversity transects (Figure 13). Volant mammals were captured using mist nets (size = 12 x 3 m; mesh = 9.5 mm) along potential bat flyways. Cage traps were used to capture small non-volant mammals. Toasted coconut meat with peanut butter was used as bait for the cage traps, then deployed in tracks that are likely used by small non-volant mammals. A total effort of 224 net nights for volant mammals and 790 trap nights for non-volant mammals were rendered for the mammal assessment.

We conducted net watching and specimen retrieval for volant mammals every night, from 1700 H to 1900 H, to account for insect bats (microchiropterans). All captured specimens were retrieved from the nets the next morning at 0600 H. Specimens were then measured, identified, and documented before releasing back into the wild. Cage traps were also checked every morning. Each caught specimen was retrieved, measured, and documented before releasing back to the wild. Cage traps were re-baited with fresh bait every afternoon. Chance observations such as tarsiers and flying lemurs were also documented.

Figure 13. The assessment team establishing mist nets for capturing volant mammals (left), and deploying cage traps for non-volant mammals (right).

Herpetofauna Assessment

We conducted night surveys from 1800 H to 2200 H by pacing along the biodiversity transects. A total sampling effort of 168 man-hours was completed. Each amphibian or reptile encountered was recorded, including incidental catches during the day. We also captured individuals that needed further identification in order to obtain morphometric measurements and photo documentation. All captured individuals were released back into the wild.

Figure 14. Night surveys were conducted to assess the presence of reptiles and amphibians.

Species Accumulation and Rarefaction Curves

The adequacy of the assessment and sampling effort was evaluated using species accumulation curves and rarefaction curves (Figure 15). The results show that for the given amount of effort and number of sites sampled, there was still an incomplete detection of species for all taxa in the sampling sites. The analysis, however, showed that we were able to record the common species present in the area as indicated by the rising curves.

Constant anthropogenic disturbances (i.e. logging and timber poaching) were rampant on the ground. Human disturbances in natural landscapes often lead to homogeneity in species composition (Smart et al. 2006). From this, we can infer that the existing human disturbances, habitat modifications, and consequently, homogenization of species composition, have possibly contributed to low encounter rates and incomplete detection of species. As the remaining forests in SIPLAS (particularly in the central part of Siargao and in the southern tip of Socorro) have undergone massive anthropogenic and natural disturbances, it is expected that the accumulation and rarefaction curves will not reach a plateau.

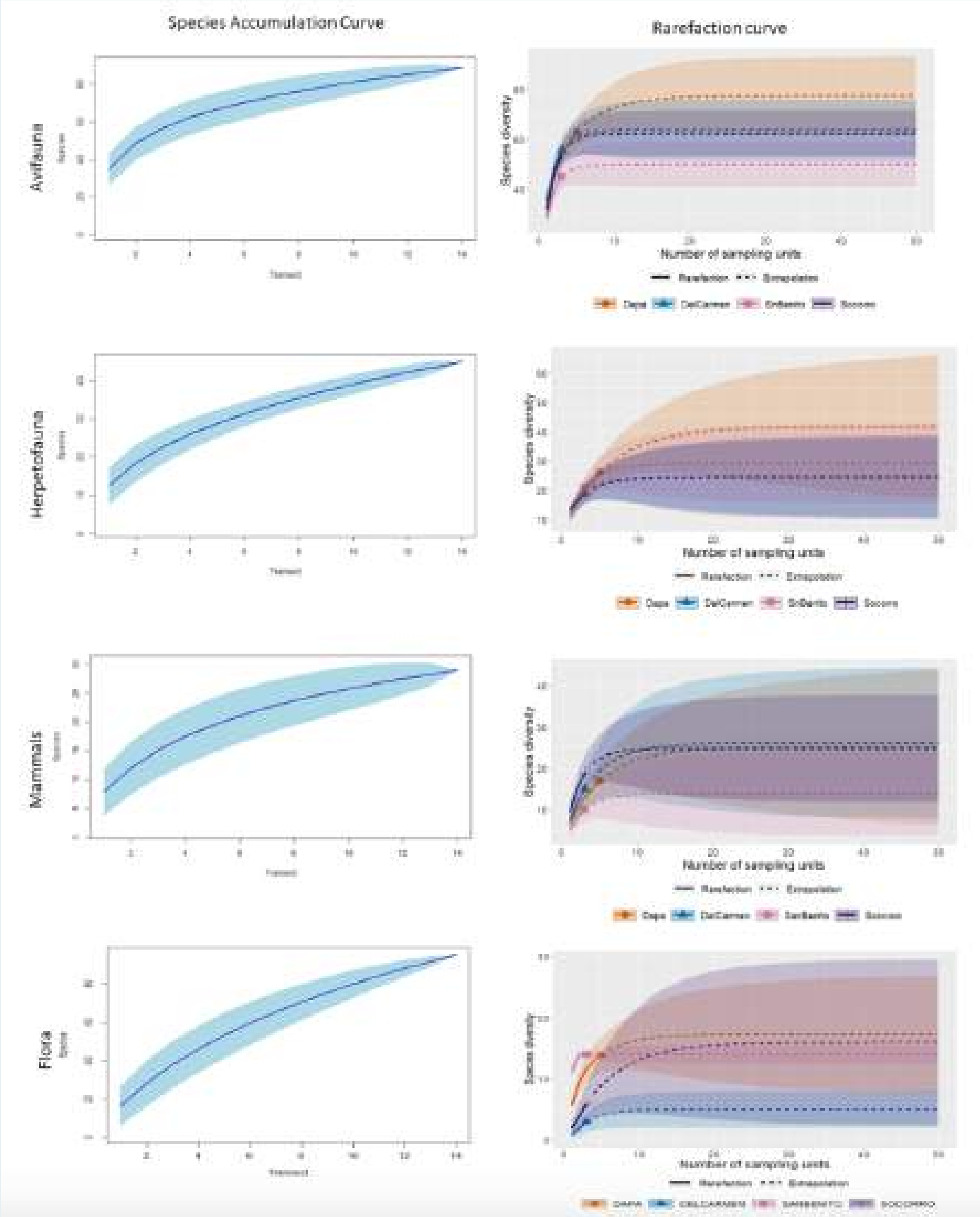

Figure 15. Species accumulation and rarefaction curves for avifauna, herpetofauna, mammals, and flora. *The rarefaction curves for all taxa were used to evaluate the species richness based on the results of the assessment only and not indicative of the total species richness for SIPLAS. The rarefaction curves shown above denote the minimum and maximum number of species that are potentially present in the area based on the size of the sample collected during the assessment. The analysis also projects species that were missed out, especially those that are rare.*

3 Biodiversity Status Amidst Post-Odette Scenarios

Species Summary

Flora

A total of 194 plant species were recorded in Siargao, comprising 111 trees, 40 understories, and 43 ground cover vegetation. Fifty-five (28%) of these species are endemic to the Philippines. Eighteen (9%) are considered threatened by the IUCN Red List (2016, 2017, 2018, 2019), which include the Endangered (EN) Yakal (*Shorea astylosa*), Guisok-guisok (*Hopea philippinensis*), Apitong (*Dipterocarpus grandiflorus*), Kamagong-gubat (*Diospyros poncei*), Narra (*Pterocarpus indicus*), Bago-tambis (*Syzygium leytense*) and Vulnerable (VU) Mangachapoi (*Vatica mangachapoi*), Red Balau (*Shorea guiso*), Panau (*Dipterocarpus gracilis*), Palosapis (*Anisoptera thurifera*), Takip-asin (*Macaranga grandifolia*), Bayong (*Afzelia rhomboidea)*, Tugop (*Artocarpus treculianus*), Is-is (*Ficus ulmifolia*), Sagimsim (*Syzygium mainitense*), Mangkono (*Xanthostemon verdugonianus*), Malakawayan (*Podocarpus polystachyus*), and Pitcher Plant (*Nepenthes merrilliana*).

Thirty species (15%) are nationally protected and considered threatened in DAO 2017-11 (4 Critically Endangered, 6 Endangered, 9 Vulnerable, 11 Other Threatened Species). Most of these nationally threatened species are also red-listed by the IUCN, except for the nationally EN Tree fern (*Sphaeropteris glauca* ≡ *Cyathea contaminans*); five Vulnerable (VU) species: White Lauan (*Pentacme paucinervis* ≡ *Shorea contorta*), Kamagong (*Diospyros discolor* ≡ *Diospyros blancoi*), Kalantas (*Toona calantas*), Malak-malak (*Palaquium philippense*), Panaon (*Alpinia elegans*); and 11 Other Threatened Species (OTS) i.e., Balinghasai (*Buchanania arborescens*), Amugis (*Koordersiodendron pinnatum*), Pili (*Canarium ovatum*), Mountain Agoho (*Gymnostoma rumphianum*), Kaningag (*Cinnamomum mercadoi*), Mata-mata (*Aglaia rimosa*), Duguan (*Myristica philippensis*), Anislag (*Flueggea flexuosa*), Rattan-palasan (*Calamus zollingeri* ssp. *merrillii*), Pakong-kalabaw (*Angiopteris evecta* ≡ *Angiopteris palmiformis*), One-leaf plant (*Monophyllaea merrilliana*). See Table A2.1 in Annex 2 for the list of flora species recorded during the assessment.

Many herbaceous plants were documented in the crevices of limestone forests in SIPLAS, including the species belonging to Araceae, Begoniaceae, Gesneriaceae, and Orchidaceae. A new species of *Begonia* was discovered in the limestone areas of Barangay Sudlon, Socorro (Figure 16). The species was growing near *Monophyllaea merrilliana, Epithema philippinum*, and other *Elatostema* species along limestone areas. This species is quite distinct by having conspicuous glabrous stipules despite the hirsute stems.

A high number of threatened and endemic species were recorded in Siargao but the number of observations per species were relatively low. Most of the tree species observed were not in their reproductive stage since mature trees were being poached for timber and forested areas were converted to coconut plantations and croplands. Threatened and endemic species were mostly recorded in Socorro, also known as Bucas Grande Island. This might be attributed to the intact forest patches in the aforementioned municipality.

Figure 16. Photos of some flora species recorded during the assessment. (A) *Begonia* (new species), (B) *Calanthe siaragaoensis*, (C) *Monophyllaea merrilliana*, and (D) *Xanthostemon verdugonianus*

Birds

We recorded a total of 69 species of birds. Twenty-two (32%) of these are endemic to the Philippines. Although none of these are of global conservation importance, five (7%) are nationally protected through DAO 2019-09, namely: (1) the Critically Endangered (CR) Philippine hanging parrot (*Loriculus philippensis*); (2) Endangered (EN) Rufous hornbill (*Buceros mindanensis*, split from *Buceros hydrocorax*); (3) Mindanao hornbill (*Penelopides affinis*); (4) Vulnerable (VU) Mindanao hawk-owl (*Ninox spilocephala*); and Other Threatened Species (OTS) Grey-throated sunbird (*Anthreptes griseigularis*). See Table A2.2 in Annex 2 for the complete list of birds recorded during the assessment.

In addition to the species recorded along the biodiversity transects, we also observed the presence of two other species near the sampling sites: (1) South Philippine Hawk Eagle (*Nisaetus pinskeri*); and (2) Philippine duck (*Anas luzonica*). Both of these species are endemic and of global conservation importance as they are assessed as EN (IUCN, 2016a) and VU (IUCN 2016b), respectively.

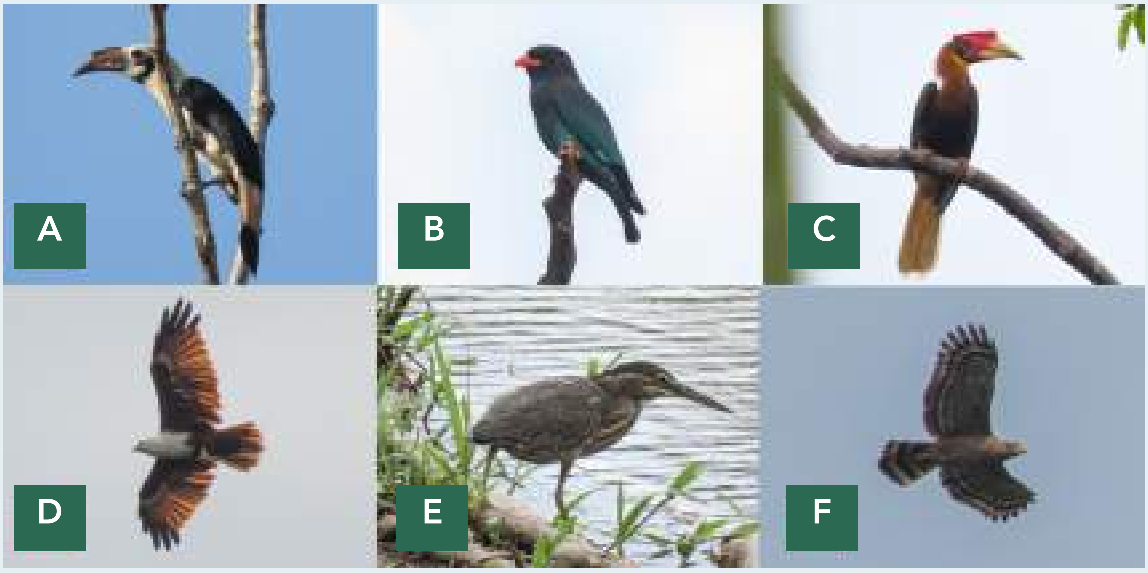

Figure 17. Photos of selected birds recorded during the assessment: (A) *Penelopides affinis*, (B) *Eurystomus orientalis*, (C) *Buceros mindanensis* seen perching; (D) *Haliastur indus*, (E) *Butorides striata*, and (F) *Spilornis holospilus*.

The results of the assessment revealed a relatively lower occurrence of frugivorous birds compared to insectivores. In highly disturbed areas of tropical regions, however, the tolerance of frugivorous species to degraded landscapes is important at the onset of forest succession and restoration (Herrera, 1984; Corlett, 1998). This is because they provide a significant contribution to seed dissemination and forest recovery by enhancing seed deposition, and thereby resulting in high seedling regeneration (Lozada et al., 2007). The presence of insectivores could be attributed to the fact that insectivores are often the most species-rich and abundant in various ecosystem types as insect availability is not highly affected by season and phenological events (Tanalgo et al., 2015). On the contrary, the abundance and richness of frugivorous bird species are positively correlated with the presence of fruit trees (Blake & Loiselle, 1991, Moegenburg & Levey 2003), which are often directly impacted by typhoon events.

The structure and composition of avifauna communities change in space and time with the availability of food resources, and variation tends to be most visible among bird species that feed on patchy and temporary food resources, such as fruit and nectar (Fleming, 1992). Hence, in a post-typhoon scenario, the most vulnerable birds are those species whose diet is dependent on nectar, fruit, or seeds. With the low number of frugivores, it is apparent that the large extent of damage to forest ecosystems (both natural and anthropogenic) resulted in a low number of native fruiting and flowering trees. Nonetheless, it is noteworthy that during the assessment, we were able to record the presence of species belonging to Pycnonotidae (bulbul), Columbidae (doves), and Oriolidae (orioles), which is a good indicator of forest regeneration in semi-degraded/disturbed habitats.

Amphibians

Nineteen species of amphibians were recorded, with nine (47%) species being endemic to the Philippines, namely: (1) Gunther's wrinkled ground frog (*Platymantis guentheri*); (2) *Platymantis corrugatus*; (3) Crab-eating frog (*Fejervarya moodiei*); (4) Leyte wart frog (*Limnonectes leytensis*); (5) Mindanao horned frog (*Megophrys stejnegeri*); (6) Philippine narrowmouth toad (*Kaloula conjuncta*); (7) Big-eyed frog (*Pulchrana grandocula*); (8) Spiny Indonesian tree frog (*Nyctixalus spinosus*); and (9) Mindanao bush frog (*Philautus leitensis*). One of which has been recognized with national importance i.e., the Other Threatened Species (OTS) M. stejnegeri (DAO 2019-09). Although the aforementioned species are Least Concern according to the IUCN Red List, their presence post-Odette needs to be taken into account as they are known to inhabit a limited range of geographic distribution. See Table A2.3 in Annex 2 for the complete list of amphibians recorded during the assessment.

More than half (58%) of the amphibian species recorded are associated with forest to wetland (inland) habitats. Only four species (21%) are primarily forest-associated and endemic to the Philippines, namely: *P. guentheri, P. leitensis, P. corrugatus,* and *N. spinosus*. Interestingly, a possibly new species or distribution record under the genus Platymantis was observed in the municipalities of Del Carmen, Dapa, and Socorro. However, further verification is still needed.

Figure 18. Photos of (A) *Platymantis guentheri*, and (B) *Kurixalus appendiculatus* encountered during the assessment.

Species Summary: Reptiles

Reptiles

Fifteen species of reptiles (7 lizards; 7 snakes; one turtle) were recorded. Of these, eight (53%) are endemic to the Philippines: (1) the Negros forest dragon (*Gonocephalus sophiae*); (2) Philippine sailfin lizard (*Hydrosaurus pustulatus*); (3) Philippine groundsnake (*Stegnotus muelleri*); (4) Philippine blunt-headed tree snake (*Boiga angulate*); (5) Philippine bronzeback tree snake (*Dendrelaphis philippinensis*); (6) Agusan bent-toed gecko (*Cyrtodactylus agusanensis*); (7) Caraga sun skink (*Eutropis caraga*); and (8) Yellow-headed water monitor (*Varanus cumingi*). Gonocephalus sophiae, H. pustulatus, and B. angulate are nationally protected through DAO 2019-09 with an OTS Red List classification. Two other species that are nationally protected are the Reticulated python (*Malayopython reticulatus*) and the Southeast Asian box turtle (*Cuora amboinensis*); the latter being globally Red Listed as endangered (IUCN, 2018). Seven (47%) species of the reptiles observed are entirely forest-associated, while three species (20%) are known to inhabit habitats within forest to marine ecosystems. Only one species, the Philippine groundsnake (*Stegonotus muelleri*), is known to occur in habitats that are associated with forests, caves, and subterranean habitats. This species was recorded only in the municipality of San Benito. See Table A2.3 in Annex 2 for the complete list of reptiles recorded during the assessment.

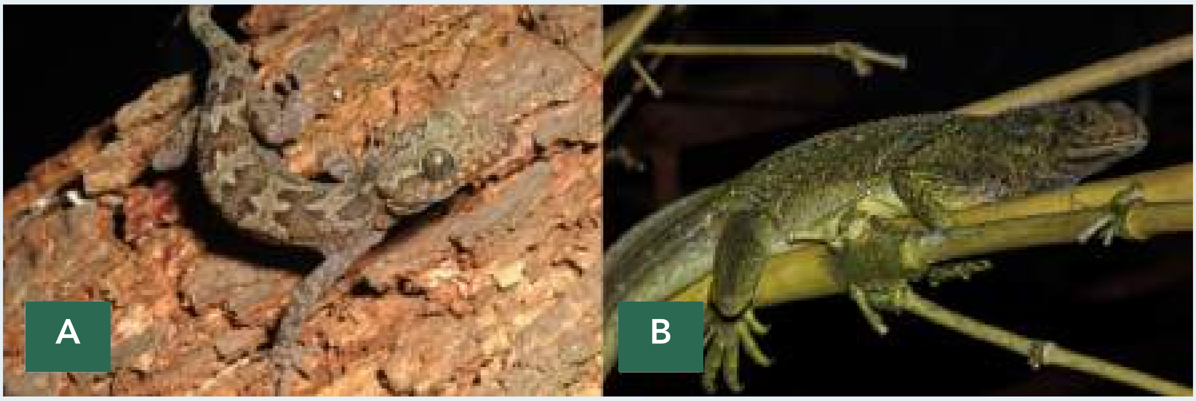

Figure 19. Photos of (A) *Cyrtodactylus agusanensis* seen perching on a trunk, and (B) *Hydrosaurus pustulatus* perching on bamboo.

Volant mammals

There were 18 species of volant mammals recorded. Five (28%) are endemic to the Philippines, namely the Philippine forest leaf-nosed bat (*Hipposideros obscurus*), Philippine pygmy leaf-nosed bat (*Hipposideros pygmaeus*), Greater musky fruit bat (*Ptenochirus jagori*), Yellow-faced horseshoe bat (*Rhinolophus virgo*), and Philippine dawn bat (*Eonycteris robusta*). Among these species, only E. *robusta* is included in the Red List of threatened species and categorized as VU both nationally (DAO 2019-09) and globally (IUCN, 2020). See Table A2.4 in Annex 2 for the complete list of volant mammals recorded during the assessment.

The presence of the Arcuate horseshoe bat (*Rhinolophus arcuatus*) was also documented, with high record observations in the strict protection zone of Dapa. The species is an insectivorous bat, which prefers to roost in limestone caves (IUCN, 2023) and is suspected to roost in nearby undisturbed caves in Dapa. However, recent ongoing road developments seen during the survey may likely cause habitat disturbance to the species' roosting sites. In Socorro, Little golden-mantled flying foxes (*Pteropus pumilus*) were observed roosting on defoliated trees. We also encountered a notably electrified corpse of the species hanging on a power line, which was not included in the survey counts as it was spotted outside the biodiversity transect.

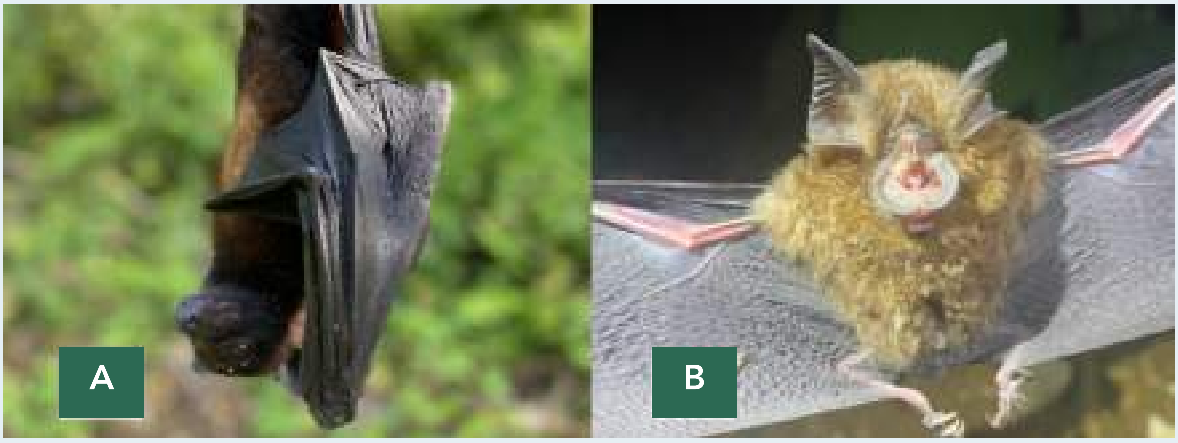

Figure 20. Photos of selected volant mammals recorded during the assessment: (A) *Pteropus hypomelanus,* and (B) *Rhinolophus arcuatus*.

Non-volant mammals

A total of ten species of non-volant mammals were recorded (one species needs further identification). None of these are globally or nationally Red-listed. Nevertheless, seven species (70%) are of high conservation value (HCV 1) as they are endemic to the Philippines. These are the Mindanao gymnure (*Podogymnura truei*), Mindanao bullimus (*Bullimus bagobus*), Philippine forest rat (*Rattus everetti*), Philippine tree squirrel (*Sundasciurus philippinensis*), Mindanao shrew (*Crocidura beatus*), Philippine tarsier (*Tarsius syrichta*), and Mindanao tree shrew (*Tupaia everetti*). See Table A2.4 in Annex 2 for the complete list of non-volant mammals recorded during the assessment.

The Mindanao gymnure observed in Socorro island is a potential new distribution record. The species reportedly prefers primary montane and mossy forest habitats (IUCN, 2023), but it was caught in recently cleared vegetation patches in the limestone forest of Brgy. Sudlon. We also have a suspected new species distribution record of the Mindanao shrew, which was encountered in Brgy. Mahayahay, Del Carmen. The species is a forest dweller, which is slightly tolerant to habitat disturbances (IUCN, 2023). Another noteworthy observation was that of the Philippine tarsier in Siargao. The tarsier was seen to have a relatively larger body size with a hairy tail compared to tarsiers found in the Visayan region.

Among the non-volant mammals recorded, one species recorded was an indicator of anthropogenic disturbance, i.e., the Oriental House Rat (*Rattus tanezumi*). Individuals of the species were occasionally caught near forest patches where the Mindanao bullimus (*Bullimus bagobus*) was also captured. This may be indicative of pervasive anthropogenic encroachment in the remaining forests of Siargao.

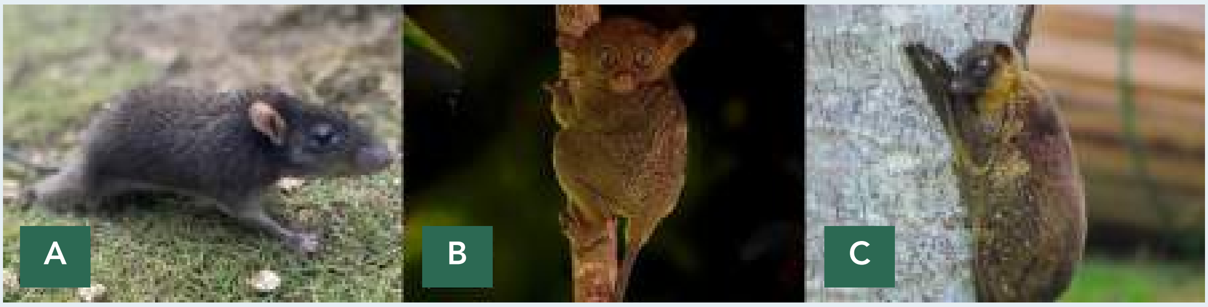

Figure 21. Photos of selected non-volant mammals recorded during the assessment: (A) *Bullimus bagobus*; (B) *Tarsius syrichta*; and (C) *Cynocephalus volans*.

Habitat Condition in Siargao Island Protected Landscape and Seascape

The Siargao Island Protected Landscape and Seascape (SIPLAS) is dominated by coconut plantations and shrublands with patches of various forest formations. Lowland semi-evergreen forests in Barangays Sudlon and Dapa were dominated by dipterocarps such as yakal, lauan, and guisok. Remnants of ultramafic forests were also observed in San Benito, characterized by igneous rock formations and high mineral deposits. Stunted premium trees might have previously dominated the area but the current vegetation is predominantly composed of ultramafic shrubs from Phyllanthaceae. Limestone forests in Socorro (Sohoton Cove, Sitio Inayaran) support a wide range of vegetation such as mangkono and several species of *Begonia*, aroids, lithophytic orchids, and pitcher plants (Figure 22). Cave habitats in Sohoton Cove were found to be roosting sites of several species of bats (e.g. *Rhinolophus* spp., *Hipposideros* spp.). However, these areas are exposed to insufficiently supervised tourist activities, causing noise and light disturbance, which can disrupt the functions of the nocturnal cave dwellers. Likewise, there seem to be no clear regulations on tourism activities featuring stingless jellyfish found in the same area.

Figure 22. Intact lowland forest in Barangay Sudlon, Socorro (left) and karst forest in Sohoton Cove (right). *The thin layer of soil in the limestone rocks in Sohoton Cove is covered with stunted trees (Xanthostemon, Podocarpus), shrubs (Dracaena), and herbaceous flora such as Begonia, Nepenthes, and orchids.*

Crown defoliation was not that evident during the survey. Few trees were uprooted and some broken branches were found in the forest floor, but in areas dominated by shrubs and other vegetation, structural alterations were barely discernible. Mixed vegetation and shrublands quickly regenerated after the typhoon. Grasses, shrubs, vines, and wildlings of pioneer species were observed to recolonize the area. We do not know enough about how typhoons affect non-tree vegetation or even non-forest vegetation but previous studies suggest that non-tree vegetation such as ferns and vines recover quickly (Heartsill-Scalley & Lopez-Marrero, 2021).

Although shrublands and mixed vegetation can regenerate quickly, it is important to consider that these are not Siargao's original vegetation. When Siargao's primary forests were cleared, anthropogenic shrublands and mixed vegetation formed as part of the succession process. Eventually, early successional or pioneer species present in these shrublands or mixed vegetation will be replaced by mid-successional species with stronger roots and stems (Ashton et al., 2021). But in areas with continuous disturbance and lack sources of mid-successional species, this process may never occur. Interruptions to forest succession following typhoon disturbance can impede biomass accumulation and species recruitment (Abbas et al., 2019). As a result, succession can be arrested at an early stage.

Figure 23. A forest patch littered with uprooted trees and broken branches.

Figure 24. A typical 'mixed vegetation' in SIPLAS. The photo shows an area dominated by various shrubs, poles, ferns, grasses, and crops such as coconuts and bananas.

Based on the accounts of local community members, coconut plantations suffered from extensive damage as well. During the assessment, uprooted coconuts and native trees were already extracted from the sites (Figure 25) and utilized for rebuilding houses and infrastructure in the community. Apart from the collection of fallen trees for household utilization, poaching of live trees was also evident in most areas.

Previous land-use history is considered a driver of species composition and successional trajectories beyond the effects of natural disasters in forested landscapes (Hogan et al. 2016, Hogan et al., 2017). Because most parts of SIPLAS were already anthropogenically modified prior to Odette, it cannot be concluded that the changes in ecosystem conditions were primarily attributed to the typhoon's devastation. Although typhoons and other natural disturbances can alter ecosystem structure and species composition, they do so over a landscape that has been subject to long-term human activities and practices, operating as a result of several cumulative, interrelated disturbances.

Figure 25. Timber poaching incidence observed in the biodiversity transect lines in mainland Siargao.

4: Management Implications

4 Management Implications

The conduct of RBA assisted and capacitated the Protected Area Management Office (PAMO) and local government units (LGUs) in assessing the state of biodiversity and the extent of habitat damage in a post-typhoon scenario. The RBA experience and training are expected to enable them to replicate the assessment process in other (non-SIBOL) areas hit by Typhoon Odette. The results of the assessment will enable them to identify changes in biodiversity and ecosystem and inform science-based decisions for recovery planning and resilience-based management.

Based on the habitat assessment, repeated anthropogenic and natural disturbances have removed much of Siargao's original vegetative cover. Some of which may have been replaced by exotic species or agricultural crops. The remaining forests of Siargao have lost their former ecological integrity and are observed to have undergone stages of 'degradation'. In this case, degradation is not defined by the absence of trees, but the loss of forest structure, productivity, and native species diversity. Some degraded ecosystems recover on their own, while others do not. There are several plausible explanations for this: (1) few of the original plant and animal biota can survive at the site; (2) some components of the biophysical environment have been altered, such as soil fertility; or (3) repeated disruptions have prevented successional development. Even in areas where natural recovery is occurring, the process may be slow. This increases the likelihood of subsequent disruptions and degradation. As a result of these factors, immediate management interventions may be required to either commence or speed up the recovery process.

Immediate management interventions do not necessarily mean active tree-planting activities. Prior to any revegetation activities, disturbance agents must be removed. If disturbances such as timber poaching or quarrying persist, succession will inevitably be interrupted and recovery will not be plausible. In addition, active and efficient environmental enforcement must be strengthened to protect the existing native flora and fauna. Native plants and animals must be sustained on-site or within the region as they are potential sources of new colonizers/regenerants. The remaining biodiversity must be protected and they should be able to move or disperse across the landscape and recolonize the damaged and degraded areas. The rate of recolonization slows down when the source populations are further apart and the surrounding landscape becomes more biologically depleted. Conversely, the more forest fragments or "stepping stones" in the intervening lands the faster the process will be.

In management planning, degradation needs to be addressed in a variety of ways and at a range of scales. There must be landscape-level planning initiatives aimed at restoring natural vegetation throughout the island. The LGUs, PAMOs, community members, and other stakeholders should actively participate in all science-driven activities needed to restore Siargao's ecosystem. From minimizing disturbance, removal of invasive species, strengthening protection of remaining biodiversity, and revegetation efforts that promote ecological integrity, to responsible and biodiversity-friendly tourism regulations, each stakeholder must provide collaborative efforts for the accomplishment of restoration objectives.

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Annex

Annex 1. Assessment Matrix for Post-Disaster Vegetation Damage

Table A1. Matrix used for assessing post-disaster vegetation damage.

Assessment Code	Extent of Damage	Description
1	Light	• A range of 0 to 10% of trees are damaged. • Only branches are broken from trees, with minor damage to tree stems across the stand. • Crowns are defoliated by 10-25%. • Most lean or bent trees are bent less than 45 degrees from vertical.
2	Moderate	• An average of 35% damage (approximately one tree of three damaged) with a range of 10%-50% damage in the stand. • Branches are broken from trees with visible damage to tree stems across the stand. Eleven to 50% of the stems in the stand have visible damage to tree stems. • Crowns are defoliated by 25-60 %. • Up to half the trees in the stand may be snapped, noticeably uprooted, or have severe lean greater than 45 degrees from vertical.
3	Severe	• An average of 75% damage (three trees of four damaged) with a range of 50%-100% damage in the stand. • Fifty-one to 100% of the stems are broken • Sixty-one to 100% of the crowns are defoliated • Tops broken out across the stand • Trees bent more than 45 degrees from vertical.

Annex 2. List of Species Recorded During the the Assessment

Table A2.1. List of flora species recorded, and their conservation status and endemism.

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Trees						
1	Araliaceae	*Polyscias nodosa*	Malapapaya	LC	OWS	N
2	Achariaceae	*Pangium edule*	Pangi	LC	OWS	N
3	Anacardiaceae	*Buchanania arborescens*	Balinghasai	LC	OTS	N
4	Anacardiaceae	*Koordersiodendron pinnatum*	Amugis	LC	OTS	N
5	Annonaceae	*Cananga odorata*	Inangilan	LC	-	I
6	Annonaceae	*Neo-uvaria merrillii*	Banlag	LC	OWS	E
7	Apocynaceae	*Alstonia macrophylla*	Manga-manga	LC	OWS	N
8	Apocynaceae	*Alstonia scholaris*	Dita	LC	OWS	N
9	Apocynaceae	*Wrightia candollei*	Lanete	LC	OWS	N
10	Apocynaceae	*Cerbera manghas*	Baraibai	LC	OWS	N
11	Bignoniaceae	*Oroxylum indicum*	Pinka-pinkahan	-	OWS	N
12	Bignoniaceae	*Radermachera quadripinnata*	Banai-banai	LC	OWS	N
13	Brownlowiaceae (Malvaceae s.l.)	*Diplodiscus paniculatus*	Balobo	LC	OWS	E
14	Burseraceae	*Canarium ovatum*	Pili	LC	OTS	E
15	Burseraceae	*Canarium asperum*	Pagsahingin	LC	OWS	N
16	Byttneriaceae (Malvaceae s.l.)	*Kleinhovia hospita*	Tan-ag	-	OWS	N
17	Byttneriaceae (Malvaceae s.l.)	*Commersonia bartramia*	Suyapao	LC	OWS	N
18	Calophyllaceae	*Calophyllum blancoi*	Bitanghol	-	OWS	N
19	Calophyllaceae	*Calophyllum inophyllum*	Bitaog	LC	OWS	N
20	Cannabaceae	*Celtis philippinensis*	Jagao/Yagao	-	OWS	N
21	Cannabaceae	*Trema orientales*	Anabiong	LC	OWS	N
22	Capparaceae	*Crateva adansonii*	Salinbobog	LC	OWS	N
23	Casuarinaceae	*Gymnostoma rumphianum*	Mountain Agoho	-	OTS	N
24	Clusiaceae	*Cratoxylum sumatranum*	Ulingon	LC	OWS	N
25	Clusiaceae	*Garcinia binucao*	Batwan	-	OWS	E
26	Combretaceae	*Terminalia foetidissima*	Magotalisay	LC	OWS	N
27	Combretaceae	*Terminalia catappa*	Talisay	LC	OWS	N

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Trees						
28	Cordiaceae	*Cordia dichotoma*	Anonang	LC	OWS	N
29	Dipterocarpaceae	*Vatica mangachapoi*	Mangachapoi	VU	EN	N
30	Dipterocarpaceae	*Ruboshorea palosapis (Shorea palosapis)*	Mayapis	LC	OWS	E
31	Dipterocarpaceae	*Pentacme paucinervis (Shorea contorta)*	White Lauan	LC	VU	E
32	Dipterocarpaceae	*Shorea astylosa*	Yakal	EN	CR	E
33	Dipterocarpaceae	*Parashorea malaanonan*	Bagtikan	LC	OWS	N
34	Dipterocarpaceae	*Hopea philippinensis*	Guisok-guisok	EN	CR	E
35	Dipterocarpaceae	*Shorea guiso*	Red Balau	VU	OWS	N
36	Dipterocarpaceae	*Dipterocarpus gracilis*	Panau	VU	VU	N
37	Dipterocarpaceae	*Anthoshorea assamica (Shorea assamica)*	Mangasinoro	LC	OWS	N
38	Dipterocarpaceae	*Anisoptera thurifera*	Palosapis	VU	EN	N
39	Dipterocarpaceae	*Dipterocarpus grandiflorus*	Apitong	EN	VU	N
40	Ebenaceae	*Diospyros discolor*	Ituman/ Kamagong	-	VU	N
41	Ebenaceae	*Diospyros poncei*	Kamagong gubat	EN	CR	E
42	Euphorbiaceae	*Endospermum peltatum*	Bay-ang	LC	OWS	N
43	Euphorbiaceae	*Mallotus philippinensis*	Banato	LC	OWS	N
44	Euphorbiaceae	*Mallotus cumingii*	Apanang	LC	OWS	N
45	Euphorbiaceae	*Homalanthus populneus*	Bayante	-	OWS	N
46	Euphorbiaceae	*Macaranga bicolor*	Hindang	LC	OWS	E
47	Euphorbiaceae	*Macaranga tanarius*	Binunga	LC	OWS	N
48	Euphorbiaceae	*Macaranga grandifolia*	Takip-asin	VU	OWS	N
49	Euphorbiaceae	*Croton sp.*	Page-page	-	OWS	N
50	Fabaceae	*Falcataria falcata*	Falcata	LC	-	I
51	Fabaceae	*Schizolobium parahyba*	Brazillian Fire tree	LC	-	I
52	Fabaceae	*Acacia mangium*	Mangium	LC	-	I

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Trees						
53	Fabaceae	*Erythrina variegata*	Dapdap	LC	OWS	N
54	Fabaceae	*Afzelia rhomboidea*	Bayong	VU	EN	N
55	Fabaceae	*Pterocarpus indicus*	Narra	EN	VU	N
56	Fabaceae	*Leucaena leucocephala*	Ipil-ipil	CD	-	I
57	Fabaceae	*Gliricidia sepium*	Mata-mata	LC	-	I
58	Fagaceae	*Lithocarpus solerianus*	Uwayan	LC	OWS	E
59	Gentianaceae	*Utania philippinensis*	Balat Buwaya	-	OWS	N
60	Gnetaceae	*Gnetum gnemon*	Bago	LC	OWS	N
61	Hypericaceae	*Cratoxylum sumatranum*	Ulingon	LC	OWS	N
62	Lamiaceae	*Premna regularis*	Abgaw	LC	OWS	N
63	Lamiaceae	*Gmelina arborea*	Yemane	LC	-	I
64	Lamiaceae	*Vitex parviflora*	Molave	LC	EN	N
65	Lauraceae	*Cinnamomum mercadoi*	Caningag	-	OTS	E
66	Lauraceae	*Litsea philippinensis*	Hindanggolo	NT	OWS	E
67	Lythraceae	*Lagerstroemia speciosa*	Banaba	-	OWS	N
68	Meliaceae	*Toona calantas*	Kalantas	DD	VU	N
69	Meliaceae	*Swietenia mahagoni*	Mahogany	NT	-	I
70	Meliaceae	*Aglaia rimosa*	Mata-mata	NT	OTS	N
71	Meliaceae	*Melia azedarach*	Bagalunga	LC	OWS	N
72	Meliaceae	*Didymocheton gaudichaudianus*	Bongliw	LC	OWS	N
73	Moraceae	*Artocarpus blancoi*	Antipoyo/ Tipoyo	LC	OWS	E
74	Moraceae	*Artocarpus treculianus*	Tugop	VU	OWS	E
75	Moraceae	*Ficus pseudopalma*	Lubi-lubi	-	OWS	N
76	Moraceae	*Ficus minahassae*	Sangay/Tindalo	LC	OWS	N
77	Moraceae	*Ficus nota*	Tibig	LC	OWS	N
78	Moraceae	*Ficus satterthwaitei*	Tabog	-	OWS	N
79	Moraceae	*Artocarpus lamellosus*	Kubi	-	OWS	E
80	Moraceae	*Parartocarpus venenosa*	Nangka-Nangka	LC	OWS	N
81	Moraceae	*Artocarpus sericicarpus*	Gumihan	LC	OWS	N
82	Moraceae	*Ficus septica*	Hauili	LC	OWS	N
83	Moraceae	*Ficus balete*	Dakit/Dayakit	LC	OWS	E
84	Moraceae	*Ficus ulmifolia*	Is-is	VU	OWS	E
85	Myristaceae	*Myristica philippensis*	Dug-an	LC	OTS	N
86	Myrtaceae	*Syzygium samarangense*	Makopa	LC	-	I
87	Myrtaceae	*Syzygium leytense*	Bago tambis	EN	OWS	E

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Trees						
88	Myrtaceae	*Psidium guajava*	Bayabas	LC	-	I
89	Myrtaceae	*Syzygium polycephaloides*	Lipote	-	OWS	N
90	Myrtaceae	*Syzygium mainitense*	Sagimsim	VU	OWS	E
91	Myrtaceae	*Xanthostemon verdugonianus*	Mangkono	VU	EN	N
92	Pandanaceae	*Pandanus exaltatus*	Wakatan	NT	OWS	E
93	Phyllanthaceae	*Antidesma ghaesembilla*	Aglimokon	LC	OWS	N
94	Phyllanthaceae	*Flueggea flexuosa*	Anislag	LC	OTS	N
95	Phyllanthaceae	*Breynia vitis-idaea*	Matang hipon	LC	OWS	N
96	Podocarpaceae	*Podocarpus polystachyus*	Malakawayan	VU	VU	N
97	Putranjivaceae	*Drypetes cumingii*	Bato-bato	-	OWS	N
98	Rhizophoraceae	*Rhizophora apiculata*	Bakawan	LC	OWS	N
99	Rubiaceae	*Nauclea orientalis*	Bangkal	LC	OWS	N
100	Rubiaceae	*Neonauclea formicaria*	Hambabayod	LC	OWS	E
101	Rutaceae	*Citrus maxima*	Pomelo	LC	-	I
102	Rutaceae	*Melicope latifolia*	Bok – Bok	-	OWS	N
103	Rutaceae	*Melicope triphylla*	Bintuko/ Bugawak	-	OWS	N
104	Rutaceae	*Lunasia amara*	Labaw	LC	OWS	N
105	Sapotaceae	*Palaquium philippense*	Malak-malak	LC	VU	E
106	Sparmanniaceae (Malvaceae s.l.)	*Trichospermum discolor*	Buntan	-	OWS	E
107	Sparmanniaceae (Malvaceae s.l.)	*Trichospermum eriopodum*	Sajapo/Tolo	-	OWS	E
108	Sterculiaceae	*Heritiera sylvatica*	Dungon	-	OWS	N
109	Sterculiaceae	*Pterocymbium tinctorium*	Sajoto	LC	OWS	N
110	Urticaceae	*Leucosyke capitellata*	Alagasi	LC	OWS	N
111	Urticaceae	*Dendrocnide stimulans*	Sagay	LC	OWS	N
	Understory					
112	Araceae	*Amorphophallus longispathaceus.*	Tugi	-	OWS	E
113	Araceae	*Cyrtosperma merkusii*	Payau	-	OWS	N
114	Araceae	*Colocasia esculenta*	Gabi	LC	OWS	N
115	Araceae	*Alocasia sp. (Alocasia aff. longiloba)*		-	OWS	N
116	Arecaceae	*Calamus zollingeri ssp. merrillii*	Palasan	-	OTS	E
117	Arecaceae	*Caryota cumingii*	Pugahan	DD	OWS	E

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Trees						
118	Arecaceae	*Cocos nucifera*	Coconut	LC	OWS	N
119	Arecaceae	*Calamus sp.*	Udlus	-	OWS	N
120	Asteraceae	*Blumea balsamifera*	Gabon	LC	OWS	N
121	Asteraceae	*Chromolaena odorata*	Hagonoy	LC	-	I
122	Asteraceae	*Ageratum conyzoides*	Bulak manok	-	-	I
123	Bromeliaceae	*Ananas comosus*	Pineapple	-	-	I
124	Caricaceae	*Carica papaya*	Papaya	DD	-	I
125	Costaceae	*Hellenia speciosa*	Tambabasi	-	OWS	N
126	Cyatheaceae	*Sphaeropteris glauca (Cyathea contaminans)*	Tree Fern	LC	EN	E
127	Cucurbitaceae	*Momordica cochinchinensis*		-	OWS	N
128	Fabaceae	*Flemingia macrophylla*	Malabalatong	-	OWS	N
129	Flagellariaceae	*Flagellaria indica*	Uhag	-	OWS	N
130	Marattiaceae	*Angiopteris evecta (Angiopteris palmiformis)*	Pakong Kalabaw	-	OTS	E
131	Melastomaceae	*Melastoma malabathricum*	Malatungaw	LC	OWS	N
132	Melastomataceae	*Medinilla teysmannii*	Medinilla	-	OWS	N
133	Musaceae	*Musa balbisiana*	Saging Matsing	LC	OWS	N
134	Musaceae	*Musa acuminata × balbisiana*	Saging Cardava	-	OWS	N
135	Pandanaceae	*Freycinetia cultella*	Freycinetia	LC	OWS	E
136	Pandanaceae	*Benstonea copelandii*	Pandan	LC	OWS	E
137	Phyllanthaceae	*Kirganelia reticulata (Phyllanthus reticulatus)*	Malatinta	LC	OWS	N
138	Phyllanthaceae	*Cathetus lancifolius (Phyllanthus lancifolius)*		-	OWS	N
139	Piperaceae	*Piper aduncum*	Buyo-buyo	LC	-	I
140	Poaceae	*Bambusa vulgaris*	Kawayan	-	-	I
141	Poaceae	*Cenchrus purpureus*	Kumpay	LC	-	I
142	Poaceae	*Imperata cylindrica*	Cogon	LC	OWS	N
143	Poaceae	*Schizostachyum lima*	Bocaue	-	OWS	N
144	Rubiaceae	*Ixora salicifolia*	Santan-gubat	-	OWS	N
145	Rubiaceae	*Mussaenda philippica*	Kahoy-dalaga/ Budjon	LC	OWS	E
146	Rubiaceae	*Mussaenda macrophylla*	Kahoy-dalaga/ Budjon	-	OWS	E

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Trees						
147	Rubiaceae	*Myrmecodia tuberosa*	Ant plant	-	OWS	N
148	Vitaceae	*Leea manillensis*	Amamali	-	OWS	N
149	Zingiberaceae	*Alpinia elegans*	Panaon	-	VU	E
150	Zingiberaceae	*Alpinia haenkei*	Tagbak	LC	OWS	E
151	Zingiberaceae	*Alpinia rufa*		-	OWS	E
Ground cover						
152	Acanthaceae	*Strobilanthes sp.*		-	OWS	N
153	Araceae	*Aglaonema densinervium*	Aglaonema	-	OWS	N
154	Araceae	*Alocasia heterophylla*		-	OWS	E
155	Araceae	*Alocasia scalprum*		-	OWS	E
156	Araceae	*Alocasia sinuata*		-	OWS	E
157	Araceae	*Homalomena philippinensis*	Payaw	-	OWS	E
158	Araceae	*Schismatoglottis calyptrata*		-	OWS	N
159	Araceae	*Schismatoglottis sp.*		-	OWS	N
160	Asteraceae	*Mikania cordata*	Uuko	-	-	I
161	Asteraceae	*Sphagneticola trilobata*		-	-	I
162	Balsaminaceae	*Impatiens platypetala*		-	OWS	N
163	Begoniaceae	*Begonia acuminatissima*	Begonia	-	OWS	E
164	Begoniaceae	*Begonia benitotanii*	Begonia	-	OWS	E
165	Begoniaceae	*Begonia makuruyot*	Begonia	-	OWS	E
166	Begoniaceae	*Begonia dimorpha*	Begonia	-	OWS	N
167	Begoniaceae	*Begonia mindorensis*	Begonia	-	OWS	E
168	Begoniaceae	*Begonia (New Species)*	Begonia	-	OWS	E
169	Commelinaceae	*Amischotolype hispida*		-	OWS	N
170	Commelinaceae	*Pollia thyrsiflora*		-	OWS	N
171	Cyperaceae	*Scleria scrobiculata*	Daat	-	OWS	N
172	Gesneriaceae	*Monophyllaea merrilliana*		-	OTS	N
173	Gesneriaceae	*Epithema philippinum*		-	OWS	E
174	Gleicheniaceae	*Dicranopteris linearis*	Agsam	LC	OWS	N
175	Fabaceae	*Mimosa pudica*	Makahiya	LC	-	I
176	Nepenthaceae	*Nepenthes merrilliana*	Pitcher plant	VU	CR	E
177	Nephrolepidaceae	*Nephrolepis brownii*	Pakong kalabaw	-	OWS	N
178	Nephrolepidaceae	*Nephrolepis biserrata*	Pacong buaya	-	OWS	N
179	Orchidaceae	*Calanthe siargaoensis*		-	OWS	E

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Ground cover						
180	Orchidaceae	*Plocoglottis plicata*		-	OWS	N
181	Orchidaceae	*Spathoglottis tomentosa*		-	OWS	E
182	Poaceae	*Paspalum conjugatum*	Carabao grass	LC	-	I
183	Poaceae	*Eleusine indica*	Paragis	LC	-	I
184	Poaceae	*Oplismenus compositus*	Basket Grass	LC	OWS	N
185	Rubiaceae	*Psychotria sibuyanensis*		-	OWS	E
186	Selaginellaceae	Selaginella cupressina	Kamariang-gubat	-	OWS	N
187	Selaginellaceae	*Selaginella jagori*	*Kamariang gubat*	-	OWS	E
188	Selaginellaceae	*Selaginella plana*	Kamariang gubat	-	-	I
189	Tectariaceae	*Tectaria decurrens*		-	OWS	N
190	Thelypteridaceae	*Christella dentata*		LC	OWS	N
191	Urticaceae	*Elatostema mindanaense*		-	OWS	E
192	Urticaceae	*Elatostematoides wenzelii*		-	OWS	E
193	Urticaceae	*Elatostema sp.*		-	OWS	N
194	Verbenaceae	*Stachytarpheta jamaicensis*	Kandi-kandilaan	LC	-	I

Table A2.2

Table A2.2. List of avifauna species recorded, their conservation status, and endemism.

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemism
1	Acanthizidae	*Georygone sulphurea*	Golden-bellied Gerygone	LC	NL	R
2	Accipitridae	*Spilornis holospilus*	Philippine Serpent Eagle	LC	OWS	E
3	Accipitridae	*Haliastur indus*	Brahminy Kite	LC	NL	R
4	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea Eagle	LC	NL	R
5	Acrocephalidae	*Acrocephalus orientalis*	Oriental Reed Warbler	LC	not listed	M
6	Alcedinidae	*Halcyon gularis*	Brown-breasted Kingfisher	LC	NL	R
7	Alcedinidae	*Todiramphus chloris*	Collared Kingfisher	LC	NL	R
8	Apodidae	*Collocalia troglodytes*	Pygmy Swiftlet	LC	OWS	E
9	Apodidae	*Aerodramus amelis*	Ameline Swiftlet	LC	OWS	E
10	Apodidae	*Apus nipalnensis*	House Swift	LC	NL	R
11	Ardeidae	*Butorides striata*	Striated Heron	LC	NL	R,M
12	Ardeidae	*Bubulcus coromandus*	Eastern Cattle Egret	LC	NL	R
13	Ardeidae	*Ardea purpurea*	Purple Heron	LC	NL	R
14	Ardeidae	*Ardea intermedia*	Intermediate Egret	LC	NL	R,M
15	Ardeidae	*Egretta garzetta*	Little Egret	LC	NL	R,M
16	Ardeidae	*Egretta sacra*	Pacific Reef Heron	LC	NL	R
17	Artamidae	*Artamus leucorynchus*	White-breasted Woodswallow	LC	not listed	R
18	Bucerotidae	*Buceros hydrocorax*	Rufous Hornbill	LC	EN	E
19	Bucerotidae	*Penelopides affinis*	Mindanao Hornbill	LC	EN	E
20	Campephagidae	*Lalage nigra*	Pied Triller	LC	not listed	R
21	Caprimulgidae	*Lyncornis macrotis*	Great Eared Nightjar	LC	NL	R
22	Cisticolidae	*Orthotomus frontalis*	Rufous-fronted Tailorbird	LC	OWS	E
23	Columbidae	*Columba livia*	Rock Dove	LC	NL	I
24	Columbidae	*Spilopelia chinensis*	Spotted Dove	LC	NL	R
25	Columbidae	*Geopelia striata*	Zebra Dove	LC	NL	R
26	Columbidae	*Phapitreron leucotis*	White-eared Brown Dove	LC	OWS	E
27	Columbidae	*Ptilinopus leclancheri*	Black-chinned Fruit Dove	LC	NL	NE
28	Columbidae	*Chalcophaps indiica*	Common Emerald-Dove	LC	NL	R

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemism
29	Columbidae	*Ducula aenea*	Green Imperial Pigeon	LC	NL	R
30	Coraciidae	*Eurystomus orientalis*	Oriental Dollarbird	LC	NL	R
31	Corvidae	*Corvus macrorhynchos*	Large-billed Crow	LC	not listed	R
32	Corvidae	*Corvus samarensis*	Small Crow	LC	OWS	E
33	Cuculidae	*Centropus melanops*	Black-faced Coucal	LC	OWS	E
34	Cuculidae	*Centropus viridis*	Philippine Coucal	LC	OWS	E
35	Cuculidae	*Eudynamys scolopaceus*	Asian Koel	LC	NL	R
36	Cuculidae	*Cacomantis merulinus*	Plantive Cuckoo	LC	NL	R
37	Dicaeidae	*Dicaeum australe*	Red-keeled Flowerpecker	LC	OWS	E
38	Estrildidae	*Lonchura leucogastra*	White-bellied Munia	LC	not listed	R
39	Estrildidae	*Lonchura atricapilla*	Chestnut Munia	LC	not listed	R
40	Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	LC	not listed	R
41	Hirundinidae	*Hirundo rustica*	Barn Swallow	LC	not listed	M
42	Hirundinidae	*Hirundo tahitica*	Pacific Swallow	LC	not listed	R
43	Laniidae	*Lanius cristatus*	Brown Shrike	LC	not listed	M
44	Locustellidae	*Megalurus palustris*	Striated Grassbird	LC	not listed	R
45	Monarchidae	*Hypothymis azurea*	Black-naped Monarch	LC	not listed	R
46	Monarchidae	*Terpsiphone cinnamomea*	Rufous Paradise Flycatcher	LC	not listed	NE
47	Motacillidae	*Anthus rufulus*	Paddyfield Pipit	LC	not listed	R
48	Muscicapidae	*Copsychus mindanensis*	Philippine Magpie-Robin	LC	OWS	E
49	Muscicapidae	*Saxicola caprata*	Pied Bush Chat	LC	not listed	R
50	Nectariniidae	*Anthreptes griseigularis*	Grey-throated Sunbird	LC	OTS	E
51	Nectariniidae	*Leptocoma sperata*	Purple-throated Sunbird	LC	OWS	E
52	Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird	LC	not listed	R
53	Nectariniidae	*Aethopyga bella*	Handsome Sunbird	LC	OWS	E
54	Oriolidae	*Oriolus chinensis*	Philippine Black-naped Oriole	LC	not listed	R
55	Pachycephalidae	*Pachycephala homeyeri*	White-vented Whistler	LC	not listed	NE
56	Passeridae	*Passer montanus*	Eurasian Tree Sparrow	LC	not listed	I

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemism
57	Pittidae	*Pitta sordida*	Hooded Pitta	LC	NL	R
58	Psittaculidae	*Loriculus philippensis*	Philippine Hanging Parrot	LC	CR	E
59	Pycnonotidae	*Hypsipetes philippinus*	Philippine Bulbul	LC	OWS	E
60	Pycnonotidae	*Poliolophus urostictus*	Yellow-wattled Bulbul	LC	OWS	E
61	Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	LC	not listed	R
62	Rallidae	*Hypotaenidia*	Buff-banded Rail	LC	NL	R
63	Rhipiduridae	*Rhipidura nigritorquis*	Philippine Pied Fantail	LC	OWS	E
64	Strigidae	*Ninox spilocephala*	Mindanao Hawk-Ow	NT	VU	E
65	Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	LC	not listed	R
66	Sturnidae	*Sarcops calvus*	Coleto	LC	not listed	NE
67	Timaliidae	*Macronus striaticeps*	Brown Tit-Babbler	LC	OWS	E
68	Trogonidae	*Harpactes ardens*	Philippine Trogon	LC	OWS	E
69	Zosteropidae	*Zosterops everetti*	Everett's White-eye	LC	not listed	NE

Table A2.3

Table A2.3. List of herpetofauna species recorded, their conservation status, and endemism

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemism
Amphibians						
1	Bufonidae	*Rhinella marina*	Cane toad	LC	not listed	I
2	Ceratobatrachidae	*Platymantis guentheri*	Gunther's Wrinkled Ground Frog	LC	OWS	E
3	Ceratobatrachidae	*Platymantis sp.*		not listed	not listed	not listed
4	Ceratobatrachidae	*Platymantis corrugatus*		LC	OWS	E
5	Ceratobatrachidae	*Platymantis sp. "limestone"*		not listed	not listed	not listed
6	Ceratobatrachidae	*Platymantis cf. rabori*	Rabori's Forest Frog	LC	not listed	not listed
7	Dicroglossidae	*Fejervarya moodiei*	Crab-Eating Frog	LC	OWS	E
8	Dicroglossidae	*Limnonectes leytensis*	Leyte Wart Frog	LC	OWS	E
9	Dicroglossidae	*Occidozyga laevis*	Common puddle frog	LC	not listed	R
10	Megophryidae	*Megophrys stejnegeri*	Mindanao Horned Frog	LC	OTS	E
11	Microhylidae	*Kalophrynus pleurostigma*	Black-spotted sticky frog	LC	not listed	R
12	Microhylidae	*Kaloula conjuncta*	Philippine narrowmouth toad	LC	OWS	E
13	Ranidae	*Pulchrana grandocula*	Big-eyed Frog	LC	OWS	E
14	Rhacophoridae	*Nyctixalus spinosus*	Spiny Indonesian Tree frog	LC	OWS	E
15	Rhacophoridae	*Philautus leitensis*	MIndanao Bush Frog	LC	OWS	E
16	Rhacophoridae	*Polypedates leucomystax*	Common tree frog	LC	not listed	R
17	Rhacophoridae	*Kurixalus appendiculatus*	Frilled tree frog	LC	not listed	R
18	Rhacophoridae	*Philautus cf. surdus*		LC	not listed	not listed
19	Rhacophoridae	*Rhacophorus pardalis*	Harlequin tree frog / Panther Flying Frog	LC	not listed	R

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemism
Reptiles						
1	Agamidae	*Bronchocela cristatella*	Green Crested Lizard	LC	not listed	R
2	Agamidae	*Gonocephalus sophiae*	Negros Forest Dragon	LC	OTS	E
3	Agamidae	*Hydrosaurus pustulatus*	Philippine sailfin lizard	LC	OTS	E
4	Colubridae	*Stegonotus muelleri*	Philippine groundsnake	LC	OWS	E
5	Colubridae	*Boiga angulata*	Philippine blunt-headed tree snake	LC	OTS	E
6	Colubridae	*Dendrelaphis philippinensis*	Philippine Bronzeback tree snake	LC	OWS	E
7	Colubridae	*Dendrelaphis marenae*	Maren's Bronzeback tree snake	LC	not listed	R
8	Gekkonidae	*Cyrtodactylus agusanensis*	Agusan Bent-toed Gecko	LC	OWS	E
9	Geoemydidae	*Cuora amboinensis*	Southeast Asian Box Turtle	EN	OTS	R
10	Lamprophiidae	*Oxyrhabdium cf. leporinum*		LC	not listed	not listed
11	Lamprophiidae	*Psammodynastes pulverulentus*	Common Mock Viper	LC	not listed	R
12	Pythonidae	*Malayopython reticulatus*	Reticulated Python	LC	OTS	R
13	Scincidae	*Eutropis caraga*	Caraga sun skink	LC	OWS	E
14	Scincidae	*Pinoyscincus cf. abdictus*		LC	not listed	not listed
15	Varanidae	*Varanus cumingi*	Yellow-headed water monitor	LC	OWS	E

Table A2.4

Table A2.4. List of mammals recorded, their conservation status, and endemism

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Non-Volant						
1	Cynocephalidae	*Cynocephalus volans*	Philippine flying lemur	LC	not listed	not listed
2	Erinaceidae	*Podogymnura truei*	Mindanao Gymnure	LC	OWS	E
3	Muridae	*Batomys sp. (Suspected: B. salomonseni/B. russatus)*	Mindanao Batomys/ Russet Batomys	-	not listed	not listed
4	Muridae	*Bullimus bagobus*	Mindanao Bullimus	LC	OWS	E
5	Muridae	*Rattus everetti*	Philippine Forest Rat	LC	OWS	E
6	Muridae	*Rattus tanezumi*	Oriental House Rat	LC	not listed	not listed
7	Sciuridae	*Sundasciurus philippinensis*	Philippine Tree Squirrel	LC	OWS	E
8	Soricidae	*Crocidura beatus*	Mindanao shrew	LC	OWS	E
9	Tarsiidae	*Tarsius (Carlito) syrichta*	Philippine Tarsier	NT	OWS	E
10	Tupaiidae	*Tupaia everetti*	Mindanao tree shrew	LC	OWS	E
Volant						
11	Hipposideridae	*Hipposideros coronatus*	fawn leaf-nosed bat	DD	not listed	not listed
12	Hipposideridae	*Hipposideros diadema*	Diadem Leaf-nosed Bat	LC	not listed	not listed
13	Hipposideridae	*Hipposideros obscurus*	Philippine Forest Leaf-nosed Bat	LC	OWS	E
14	Hipposideridae	*Hipposideros pygmaeus*	Philippine Pygmy Leaf-nosed Bat	LC	OWS	E
15	Hipposideridae	*Hipposideros sp.*	-	-	-	not listed
16	Megadermatidae	*Megaderma spasma*	Lesser False Vampire Bat	LC	not listed	not listed
17	Pteropodidae	*Eonycteris robusta*	Phillipine Dawn Bat	VU	VU	E
18	Pteropodidae	*Eonycteris spelaea*	Lesser Dawn Bat	LC	not listed	not listed

No.	Plant Family	Scientific Name	Common Name	IUCN	DAO	Endemicity
Volant						
19	Pteropodidae	*Macroglossus minimus*	Dagger-toothed Long-nosed Fruit Bat	LC	not listed	not listed
20	Pteropodidae	*Cynopterus brachyotis*	Lesser Dog-faced Fruit Bat	LC	not listed	not listed
21	Pteropodidae	*Ptenochirus jagori*	Greater Musky Fruit Bat	LC	OWS	E
22	Pteropodidae	*Pteropus hypomelanus*	Island flying fox	NT	not listed	not listed
23	Pteropodidae	*Pteropus pumilus*	Little Golden-mantled Flying Fox	NT	not listed	not listed
24	Pteropodidae	*Rousettus amplexicaudatus*	Geoffroy's Rousette	LC	not listed	not listed
25	Rhinolophidae	*Rhinolophus arcuatus*	Arcuate Horseshoe Bat	DD	not listed	not listed
26	Rhinolophidae	*Rhinolophus philippinensis*	Large-eared Horseshoe Bat	LC	not listed	not listed
27	Rhinolophidae	*Rhinolophus virgo*	Yellow-faced Horseshoe Bat	LC	OWS	E
28	Vespertilionidae	*Murina cyclotis*	Round-eared Tube-nosed Bat	LC	not listed	not listed