Center for Conservation Innovations

Identifying High Conservation Values in Arillo Estate, Nasugbu, Batangas

First Draft

December 2023

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II. Acronyms & Abbreviations

DENR	Department of Environment and Natural Resources
DAO	DENR Administrative Order
IUCN	The International Union for Conservation of Nature
Ha	Hectares
AOI	Area of interest

Species Endemism Classification

PE	Philippine-endemic
R	Resident
M	Migratory
R & M	Resident and Migratory
N	Native
I	Introduced

IUCN/DAO Red List Classification

CR	Critically Endangered
EN	Endangered
VU	Vulnerables
NT	Near-threatened
LC	Least Concern
DD	Data Deficient
NE	Not Evaluated
OTS	Other Threatened Species (DAO 2017-11/ DAO 2019-09)
OWS	Other Wildlife Species (DAO 2017-11/ DAO 2019-09)

1 Introduction

Purpose of the Assessment

The primary focus of the project entitled, **Identifying High Conservation Values in Arillo Estate, Nasugbu, Batangas, Philippines** is to assess the status of potential ecological conservation values within the 62-Ha estate. As requested by Ayala Land Incorporated (ALI), the Center for Conservation Innovations Philippines Inc. (CCIPH) will implement this project over the course of four months (November 2023 - February 2024) before any further development activities are set to commence within the Arillo property.

This project aims to accomplish the following within the said time frame:

1. Establish ecological baselines (fauna and flora) and threats to biodiversity using the High Conservation Value (HCV) framework;
2. Determine changes in land cover and location of HCVs; and
3. Provide recommendations and identify potential mitigation strategies on securing, monitoring, and reporting existing HCVs.

High Conservation Value Areas Framework (HCVA)

The HCVA approach was established in 1999 by the Forest Stewardship Council for use in forest certification. It has since evolved into a versatile tool used by both the Convention on Biodiversity and the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) in spatial planning and biodiversity conservation. Since the year 2005, the HCVA approach has been supported and promoted by the multi-national HCV Resource Network (HCVRN). The UNEP-WCMC describes HCVAs as "natural habitats, which are of outstanding significance or critical importance due to their high biological, ecological, social or cultural values" (2015). The identification and management of HCVAs shield these priority areas from the negative impacts of anthropogenic activities. There are six high conservation values under this approach (*Table 1*).

Table 1. The six HCVs as defined by the HCVRN.

HCV 1 Species Diversity	Concentrations of biological diversity including endemic species, and rare, threatened, or endangered species, that are significant at global, regional, or national levels
HCV 2 Landscape-level Ecosystems, Ecosystem Mosaics, and IFL	Landscape-level Ecosystems, Ecosystem Mosaics, and intact forest landscapes (IFL) that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance
HCV 3 Ecosystems and Habitats	Rare, threatened, or endangered ecosystems, habitats or refugia
HCV 4 Ecosystem Services	Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes
HCV 5 Community Needs	Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for livelihoods, health, nutrition, water, etc.), identified through engagement with these communities or indigenous peoples
HCV 6 Cultural Values	Sites, resources, habitats, and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological, economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples, identified through engagement with these local communities or indigenous peoples

2 Methodology

The Study Site

Nasugbu is a first-class municipality with a population of 136,524 as per the 2020 census (PSA, 2023). Arillo Estate, formerly Evercrest Golf and Country Club, is a 62-Ha property located in Sitio Batulao, Barangay Kaylaway, within the Municipality of Nasugbu, Batangas (*Figure 1*). It is situated at the foothills of Mt. Batulao, which links with the Tagaytay Range. The property is currently owned by Ayala Land Inc. and is set to be developed into a residential and commercial space. The property is currently under construction with guard staff and workers as the only inhabitants or regular visitors within the estate.

Figure 1. The Arillo estate, showing its project area boundary.

Rapid Biodiversity Assessment

We established 67 point stations spaced at 100-meter intervals for the rapid biodiversity assessment. The point stations were randomly generated in QGIS. Sampling for birds, herpetofauna, flora, and habitat was conducted along these stations. The map of the point stations and sampling sites is presented in Figure 2. Sampling was conducted during the northeast monsoon season (*Amihan*) from November 28 to December 2, 2023.

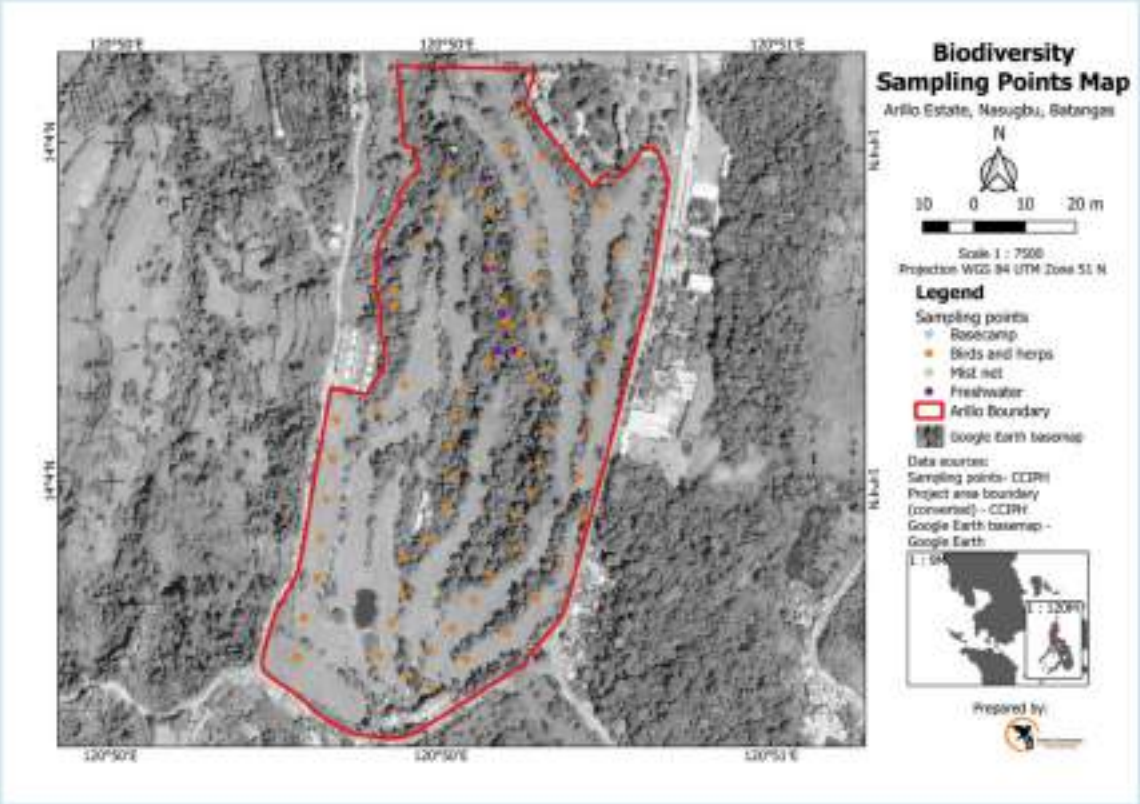


Figure 2. Map of Ascenda Estate, showing the sampling points for rapid biodiversity assessment.

Birds Survey

Point counts were conducted to survey birds inside the estate. Point count involves walking to each point station (*Figure 3*) and recording all bird contacts for five minutes before moving on to the next (Bibby et al. 1998; Pagen et al. 2002). The species, number of individuals observed, type of contact (heard or seen), distance from the bird to the observer, and bird activity (e.g., foraging, in flight, etc.) were recorded. Each point station (= 67) was surveyed twice on two separate days. Observations were made between 06:00 and 09:00 in the morning when bird activity was highest. Purposive sampling was also conducted at night to document the presence of owls, nightjars, or frogmouths. Mist-nets were also set up during the day to capture and identify more cryptic species. All birds caught in the mist-nets were immediately released after biometrics and photo documentation.

Figure 3. Bird survey in Arillo using point count.

Mammals Survey

We established four ground-based mist-net stations (= 76 net nights) to determine bat species occurring in Arillo Estate. Mist-nets were set along flyways - perpendicular to areas with moderate to dense vegetation, and along the river (Hoffman et al. 2010; *Figure 4*). We conducted net watches between 18:00 and 20:00 to remove captured bats and prevent them from being severely entangled. The mist-nets were then left open throughout the night and serviced early in the morning the next day at roughly 05:00. All captured individuals were measured, photographed, and released into the wild.

Cage traps were also used to survey rodents and other small to medium-sized mammals (Hoffman et al. 2010). We were only able to deploy 8 traps (= 16 trap nights). Each trap was baited with peanut butter-coated roasted coconut meat and was re-baited daily.

Figure 4. Mist-nets set-up in Arillo Estate

Herpetofaunal Survey

The term herpetofauna refers to both amphibians and reptiles. The line transect method was used for the herpetofauna surveys by following the direction of the established point stations. Day (08:00 to 10:00) and night (18:00 to 00:00) surveys were conducted by searching thickets of vegetation, burrows, leaf litter, and streams for herpetofauna. We utilized the hand capture technique for amphibians and lizards, while tongs and hooks were used for snakes. All captured individuals were measured, photographed, and released back to where they were caught.

Figure 5. Day and night herpetofaunal sampling in Arillo Estate.

Flora and Habitat Survey

We established 5-meter radius circular plots within each station (= 67 plots) to survey understory and ground cover vegetation, as well as habitat characteristics. We collected 98.50% of canopy cover readings and other data on the vegetation structure and composition of habitats. This data included the number of saplings, bamboo clumps, rattans, tree ferns, pandans, palms, fruiting and flowering trees, percent ground cover, and moss cover. From these data, we identified the habitat types based on the Intergovernmental Panel on Climate Change (IPCC) classification, successional stages, and forest formations. Additionally, we carried out a full inventory of canopy trees (*Figure 6*) across the 62-Ha estate. Information gathered during this inventory included specific locations (coordinates) and a comprehensive list of tree species.

Figure 6. Flora team conducting an inventory of tree species within the Arillo property.

Freshwater Habitat Survey

To assess the water quality of freshwater ecosystems, six sampling stations were established based on the accessibility and representativeness of the location (USGS, 2018, *Figure 2*). The local weather conditions and the water's atmospheric temperature, color, odor, and biological characteristics were recorded (USGS, 2018). Additionally, data on wetted width, water depth, flow rate, and physicochemical parameters of the water tributaries were collected (*Figure 7*). Measurements were done in triplicate using the concurrent water sampling method. Sampling was concurrent with the rapid biodiversity assessment.

Figure 7. Measuring of water quality using a water quality multiparameter in Arillo estate.

Geospatial Assessment: Land Cover Classification and Cover Change

Ground-truthing using a Remotely Piloted Aircraft System (RPAS) is done to validate geographic features and landscape characteristics that are not easily distinguishable from the satellite image or remotely sensed data. Four Ground Control Points (GCP) markers were set up as reference data for each flight. We recorded the coordinates of the GCP with a 0.6-meter accuracy using the Trimble Catalyst DA2. Initially, we planned to plot the GCP markers as shown in the flight plan below (*Figure 8*). After a closer inspection, we opted to lay out the GCP markers in more strategic locations because of the site's relatively hilly terrain. During the flight, we noticed the lack of established landmarks that would assist in distinguishing the GCP markers from each other. As such, we decided to use submarkers (*Figure 9*) on every GCP marker to address this issue. The submarkers were used to determine the location of GCP markers during flight acquisition and will be used to orient the orthomosaic images during processing. We successfully covered the entire 62-Ha estate area with four flight plans ranging from 15-Ha to 16-Ha per flight plan using the Autel EVO Series II RTK. The survey was conducted on December 5, 2023.

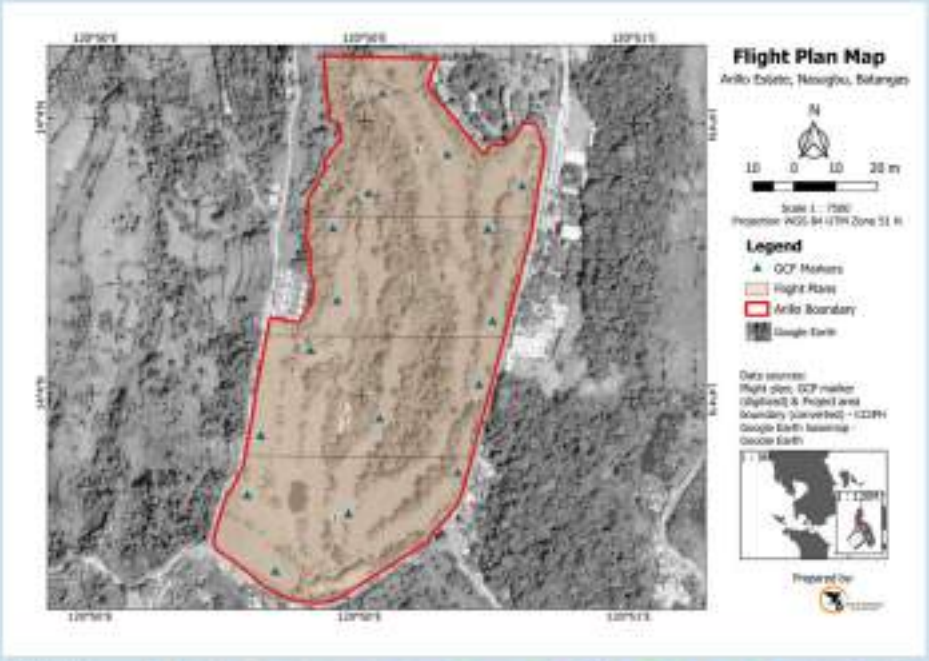


Figure 8. Arillo Flight Plan Map

Figure 9. RPAS subteam operating the RPA and conducting ground truthing activities within Arillo Estate

Socioeconomic and Cultural Assessment

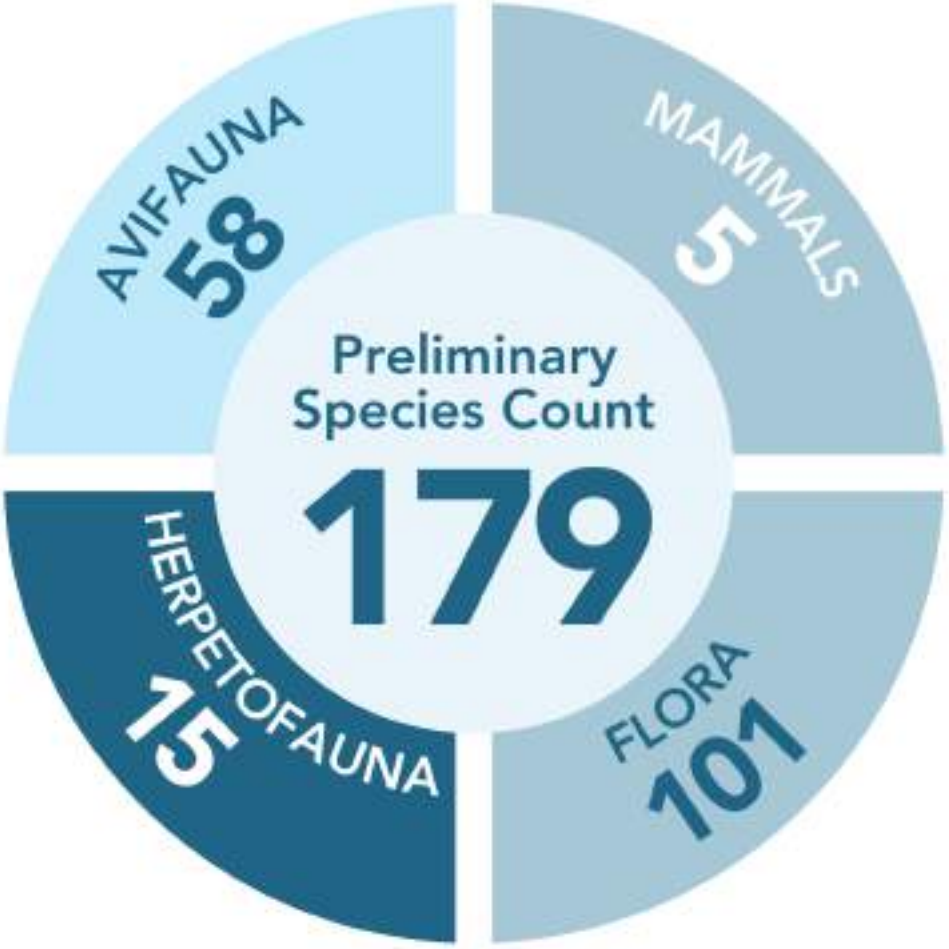
The assessment of HCVs 4, 5, and 6 was conducted on December 05, 2023 (*Figure 10*). Sixty three (63) reference points were randomly placed throughout the site. The reference points were ground-truthed to collect data on potential ecosystem services and incidents of threats to HCVs. Informal interviews were also conducted with five key informants to gather more information about potential conservation values, as well as existing and future threats to HCVs in the area.

Figure 10. Key informant interviews and ground truthing via foot patrolling were conducted as part of the socioeconomic and cultural assessment of Arillo.

3 Results of High Conservation Value Assessment

HCV 1 Species Diversity

Species of high conservation values were recorded in Arillo Estate.



Avifauna	Mammals	Herpetofauna	Flora
18 (31%) endemic 2 (3%) threatened 6 (10%) migratory	1 (20%) endemic 1 (20%) threatened	7 (46%) endemic 1 (6%) threatened	2 (2%) endemic 8 (8%) threatened

Endemic and Threatened Species in Arillo Estate

Avifauna

We recorded 58 bird species in Arillo Estate. Two species are classified as locally threatened and listed as nationally protected species by DENR (DENR DAO 2019-09). The Indigo-banded Kingfisher (*Ceyx cyanopectus*), although classified as Least Concern by the IUCN Red List, is considered Critically Endangered by DENR. This Philippine endemic kingfisher inhabits forested or densely vegetated waterways. The remaining tracts of forests throughout the range of this species are being cleared because of shifting cultivation, road construction, illegal settlements, and mining activities (Collar et al., 1999). The other threatened bird species in Arillo is the Philippine Hanging-Parrot (*Loriculus philippensis*). While not considered globally threatened, the Philippine Hanging-Parrot is one of the most commonly traded and trafficked endemic birds in the Philippines (*Collar and Kirwan, 2023*). Trade pressures led to the species being listed under the CITES II and the national government declaring it as protected, i.e., owning this bird as a pet is prohibited by law.

In terms of endemism, 18 species (33%) are found only in the Philippines. Most of these species were observed in areas with dense vegetation, particularly within or adjacent to the proposed eco trail. These birds prefer areas with vegetation cover and strands of fruiting trees. The Elegant Tit (*Pardaliparus elegans*), Blue-Headed Fantail (*Rhipidura cyaniceps*), Pygmy Flowerpecker (*Dicaeum pygmaeum*), and Grey-Backed Tailorbird (*Orthotomus derbianus*) are commonly seen foraging mixed-flock. We also recorded two species of endemic owls - the Luzon Boobook (*Ninox philippensis*) and the Philippine Scops-Owl (*Otus megalotis*) near the streams.

Migratory birds such as the Brown Shrike (*Lanius cristatus*), Barn Swallow (*Hirundo rustica*), Eastern Yellow Wagtail (*Motacilla tschutschensis*), Grey-streaked Flycatcher (*Muscicapa griseisticta*), Arctic Warbler (*Phylloscopus borealis*), and Chinese Sparrowhawk (*Accipiter soloensis*) were observed in open areas and grasslands within Arillo. They were seen perched on top of wires, tall grasses, on top of low bushes, and branches with unobstructed views. These birds migrate to the Philippines during wintering season in search of food. Other resident birds such as the Pied Buschat (*Saxicolo caprata*), Rufous-crowned Bee-eater (*Merops americanus*), and Long-tailed Shrike (*Lanius schach*) were also quite common in Arillo. Some were observed singly or in groups in grassy areas. For its relatively small size, it appears that Arillo Estate harbors birds of high conservation value.

Figure 11 shows photos of commonly observed species in Arillo. The complete list of bird species is found in Annex 1 - Table A1.

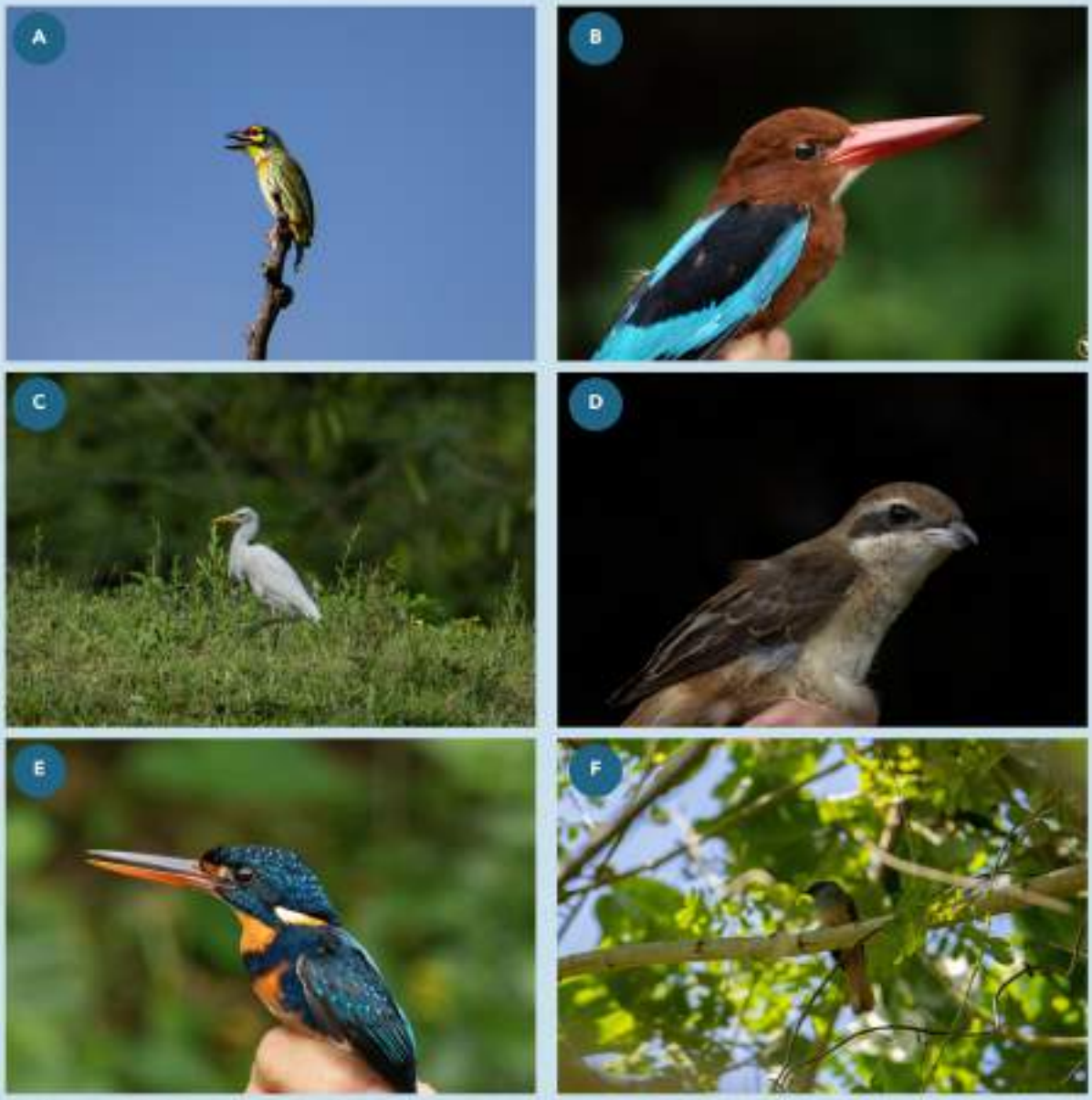


Figure 11. Photographs of birds recorded in Arillo. A) Coppersmith Barbet (*Psilopogon haemacephalus*), B) Brown Breasted Kingfisher (*Halcyon gularis*), C) Intermediate Egret (*Ardea intermedia*), D) Brown Shrike (*Lanius cristatus*), E) Indigo-banded Kingfisher (*Ceyx cyanopectus*), F) Blue-headed Fantail (*Rhipidura cyaniceps*).

Mammalia

There were four species of volant mammals or bats recorded. One of these was the Philippine endemic *Ptenochirus jagori* or the Greater Musky Fruit Bat (*Figure 12*). Males have a distinct odor described as "sweet musty cinnamon," which comes from the oils produced by glands under their fur (Heaney et al. 2010). It was the most abundant bat species observed during our sampling. The Greater Musky Fruit Bat prefers to feed on fruits of fig trees (*Ficus* spp.), which could explain the high encounter rates given the abundance of fig species within the area. Interestingly, these bats are capable of using their olfactory senses to distinguish between ripe and unripe fruits - showing a preference for the former (Luft et al. 2003).

Figure 12. Greater Musky Fruit Bat (*Ptenochirus jagori*) photographed in Arillo Estate.

Through interviews with our guides and during site scoping, we noted the presence of Long-tailed Macaques (*Macaca fascicularis*) within the estate. Given that the team was not able to trap or directly observe this species during the survey, it is noted as a general observation. Long-tailed Macaques are internationally recognized as Endangered species as per the IUCN Red List of Threatened Species (2022). These macaques are forest edge species, which means they are well adapted to fragmented or disturbed forest habitats within proximity to human settlements. The primary threats faced by Long-tailed Macaques are habitat loss and the illegal wildlife trade as they are heavily traded as pets, food, and used in biomedical research (Gumert et al. 2011).

Complete list of mammal species found in Annex 1 - Table A2.

Herpetofauna

A total of 15 species of herpetofauna were recorded during our survey. This included six species of frogs, six species of lizards and skinks, and three snakes.

Two Philippine endemic frog species were recorded within Arillo Estate, namely the Duméril's Wrinkled Ground Frog (*Platymantis dorsalis*) and the Luzon Swamp Frog

(*Limnonectes woodworthi*). The two were the dominant amphibian species recorded within habitats of the estate's eco trail. The whistle-like calls of Duméril's Wrinkled Ground Frog could be heard throughout the trail and coming from the river in the ravine below. As a ground-dwelling species, it is dependent on the moisture of leaf litter, which is maintained by the closed canopy overhead. The Luzon Swamp Frog on the other hand is a river-dependent species and can be further classified as a Luzon endemic. The presence of both adult and juvenile swamp frogs in the river flowing through Arillo suggests that this habitat is vital to the estate's population of Luzon Swamp Frogs.

We observed three endemic species of lizards, namely: the Philippine bent-toed gecko (*Cyrtodactylus philippinicus*), Northern Philippine Giant Forest Skink (*Pinoyscincus abdictus aquilonius;* unphotographed), and the Luzon Water Monitor (*Varanus marmoratus;* unphotographed). All three species were spotted in the closed canopy habitats adjacent to the eco trail. The Luzon Water Monitor was the only observed species listed as threatened (Other Threatened Species, OTS) as per the DENR Administrative Order 2019-09. This species has also been noted in other studies as capable of withstanding the bufotoxin of the Cane Toad (*Rhinella marina*), a harmful and prolific invasive alien species (Sy, 2023).

We recorded three snake species during our survey. We also received reports of viper, cobra, and rat snake sightings from our guides and guard staff on duty, but we were unable to verify the presence of these species with our own observations. One of our recorded species was the Barred Philippine False Coral Snake (*Hemibungarus calligaster*), a visually striking species named after its vibrant orange ventral scales. This fossorial (ground-dwelling) venomous species twists its body to flash its brightly colored ventral scales as a threat display towards possible predators. Another Philippine endemic, the Gervais' worm snake (*Calamaria gervaisii gervaisii*), is a much smaller non-venomous species that also prefers soil and leaf litter microhabitats. It is often mistaken for a worm due to its size. Lastly, we observed the endemic subspecies *Ahaetulla prasina preocularis* or the Philippine Vine Snake. This is a mildly venomous arboreal (tree-dwelling) species that was observed several meters above the ground in a thicket of bamboo by the eco trail. Vine snakes are widespread throughout Southeast Asia, but this individual is from a genetically distinct subspecies only found in the Philippines. As only the subspecies is endemic, it is not included in our endemic species count.

The herpetofauna species observed in Arillo Estate are all tolerant of certain degrees of habitat degradation. See Figure 13 for photos of endemic herpetofaunal species mentioned above. A complete list of herpetofaunal species can be found in Annex 1 - Table A3.

Herpetofauna

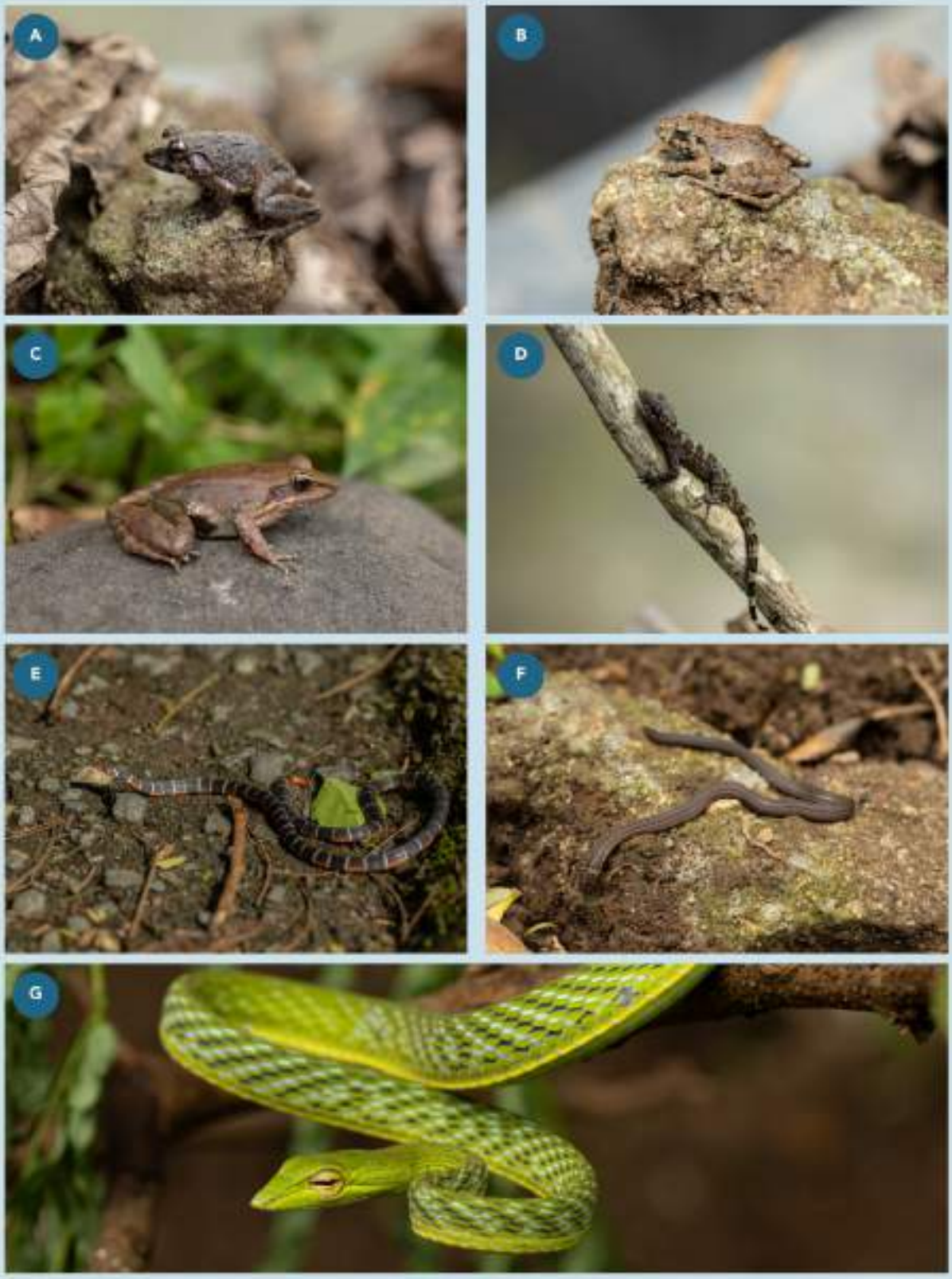


Figure 13. Endemic herpetofaunal species recorded within Arillo Estate. A) Female Duméril's Wrinkled Ground Frog (*Platymantis dorsalis*), B) Male Duméril's Wrinkled Ground Frog, C) Luzon Swamp Frog (*Limnonectes woodworthi*), D) Philippine Bent-toed Gecko (*Cyrtodactylus philippinicus*), E) Barred Philippine False Coral Snake (*Hemibungarus calligaster*), F) Gervais' Worm Snake (*Calamaria gervaisii gervaisii*), G) Philippine vine snake (*Ahaetulla prasina preocularis*).

Flora

A total of 43 tree species have been identified during the initial phase of our tree inventory. Four Philippine native species found in the Arillo estate are included in the IUCN Red List of Threatened Species (1998, 2019). These include the Endangered (EN) Narra (*Pterocarpus indicus*), Vulnerable (VU) Takip Asin (*Macaranga grandifolia*), VU Is-is (*Ficus ulmifolia*), and VU Bargas (*Eucalyptus deglupta*) (*Figure 14*). The DENR Administrative Order 2017-11 considered Narra as a vulnerable species due to its declining population in the wild. Narra timber ranks among the most valuable woods in the world and they are typically poached in the wild for their premium wood. Other species such as the Big-leaf Mahogany (*Swietenia macrophylla*) and Norfolk Pine (*Araucaria heterophylla*) are categorized as threatened in IUCN but are introduced (non-native) to the Philippines.

Most trees recorded in Arillo appear to be intentionally planted and cultivated for landscaping purposes. For instance, Bagras is the only Eucalyptus species found in the Philippines, and its natural distribution lies within Mindanao Island. Bagras trees that are recorded outside their natural range are most probably planted for their colorful barks flaking into thin, long strips, greenish blue, with yellow-greenish patches. Naturally occurring trees in the area consisted mostly of native figs (*Ficus* spp.) and Macaranga species within the riverine area.

In addition to the trees, we listed 14 understory species and 44 ground-cover vegetation species during the quadrat sampling. Two notable species were observed within the estate, the Philippine endemic Luya-luya (*Wurfbainia elegans*) and the Other Threatened Species (OTS) King Fern (*Angiopteris evecta*) (*Figure 15*). Naturally occurring understory and ground cover were mostly Hagikhik species (*Phrynium interruptum, P. pubinerve*) and Aroids (*Schismatoglottis plurivenia, Syngonium cf. podophyllum*). Within the open areas, native Clover species such as *Alysicarpus vaginalis, Oxalis corniculata*, and *Grona triflora* grew in between grasses (*Zoysia matrella, Paspalum conjugatum*) and assist in stabilizing the soil. The native species observed in the area, whether naturally occurring or planted, are generalist plants that are tolerant of disturbed habitats. A complete list of flora species can be found in Annex 2.

Figure 14. Threatened trees recorded in Arillo Estate. A) Takip Asin (*Macaranga grandifolia*), B) Narra (*Pterocarpus indicus*), C) Bagras (*Eucalyptus deglupta*).

Figure 15. Understory plants in Arillo Estate.
A) Luya luya (*Wurfbainia elegans*), B) King Fern (*Angiopteris evecta*)

HCV 2 Large Landscape Ecosystems and Ecosystem Mosaics

Arillo Estate does not qualify for the HCV 2 criteria of large landscape-level ecosystems and Intact Forest Landscapes (IFL). Field observations and initial analyses suggest variation in land cover types in the area - mixed vegetation (*Figure 16B*) and grasses (*Figure 16C*) being the dominant land cover classes. Crop cover (*Figure 16A*) was also observed within the area. Land cover classes in Arillo appear to be too fragmented and small to form landscape-level ecosystems (*Figure 16*) that can support viable populations of the great majority of naturally occurring species.

However, Arillo Estate's proximity to Taal Volcano Protected Landscape allows it to form an ecosystem mosaic with its neighboring key biodiversity area (*Figure 17*). The mosaic comprises patches of different natural habitats and anthropogenically altered habitats that can harbor a variety of species. Most of the species observed in Arillo are generalists that can survive in different environments, even degraded habitats but only to a certain extent. Protection and restoration of remaining habitats in Arillo are important to maintain the role they play as part of the bigger ecosystem mosaic.

We are currently validating and interpreting satellite images based on the generated orthomosaic image (*Figure 18*) to determine the extent of land cover classes in Arillo. The output will be presented in the final report.

HCV 2 Large Landscape Ecosystems and Ecosystem Mosaics

Figure 16. Crop cover (A), mixed vegetation, (B) and grass cover (C) as the predominant land cover classes in Arillo Estate.

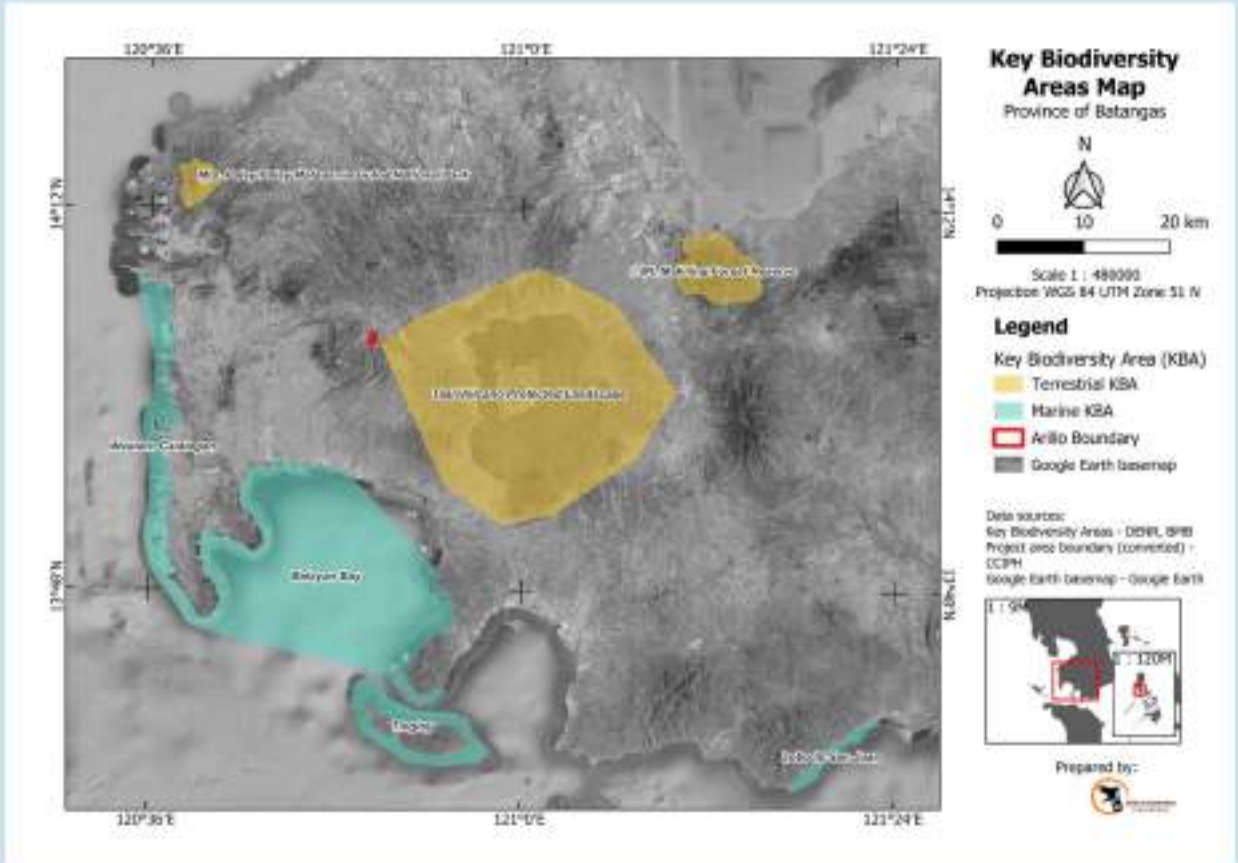


Figure 17. Location of Arillo Estate relative to nearest key biodiversity area

Figure 18. Arillo Orthomosaic Map

HCV 3 Rare, Threatened, and Endangered Habitats and Ecosystems

Freshwater Ecosystem

The river ecosystem in Arillo exhibited a generally narrow water body with relatively low water depths and low flow rates. The presence of boulders and cobbles overlaying gravel and pebbles in a fine-grained bed was observed. Riparian vegetation was also present (*Figure 19*).

The water is most likely classified as Class C based on the water quality guidelines by DENR DAO 2016-08 Water Quality Guidelines and General Effluent Standards of 2016. Analysis of all sampling points indicated that both pH and water temperature fall within the normal range (DAO 2016-08).

HCV 3 Rare, Threatened, and Endangered Habitats and Ecosystems

This suggests that the water body can be used (1) to support fish propagation and growth; (2) for recreational Water Class II activities such as fishing; and (3) for agriculture and irrigation. We also noted the presence of garbage and plastic containers that are littered along the river and the riverbank.

Figure 19. Photos of each sampling point for freshwater assessment. (A) site 1, (B) site 2, (C) site 3, (D) site 4, (E) site 5, (F) site 6.

Terrestrial Ecosystem

An initial analysis derived from the orthomosaic image and habitat data suggests that the ecosystems in Arillo Estate are predominantly grassland and mixed vegetation. In the 'anthropogenic grassland' or the old golf course area, cultivated turf grasses like Manila grass (*Zoysia matrella*) and Carabao grass (*Paspalum conjugatum*) coexist with the typical 'colonizers' of the open areas. Aside from the grasses, Clovers (*A. vaginalis, O. corniculata, G. triflora*), Amaranths (*Gomphrena celosioides, Alternanthera sessilis, Cyathula prostrata, Amaranthus viridis*), Mimosoids (*Mimosa pudica, Aeschynomene americana*), False Buttonweeds (*Spermacoce laevis*) and Tobacco grasses (*Elephantopus mollis*) dominate the large portion of the grassland. The edges of the grassland were encroached by the trailing daisy (*Sphagneticola trilobata*), which inhibits the growth of the grasses and other vegetation.

Mixed vegetation areas are mostly located within the river banks. The constant supply of fresh water supports the native tree species like Tibig (*Ficus nota*), Hagimit (*Ficus minahassae*), Binunga (*Macaranga tanarius*), Alim (*Melanolepis multiglandulosa*), and Takip Asin (*Macaranga grandifolia*). These trees form the canopy layer and encourage the growth of shade-tolerant species of King Ferns (Marratiaceae), Gingers (Zingiberaceae), and Arrowroots (Marantaceae). Wet ravines and stream embankments are naturally covered with Aroids (Araceae) such as *Schismatoglottis, Scindapsus, Syngonium,* and *Aglaonema* but several areas were cleared during the trail establishment and replaced by the exotic *S. trilobata*.

Terrestrial ecosystems in Arillo have already undergone massive anthropogenic disturbance. Analysis on detecting and locating where these changes occur is ongoing. We will generate maps from two time periods to illustrate the contemporary land cover and determine the extent of change. The results of this analysis will be included in the final report.

HCV 4 Ecosystem Services in Critical Situations

The presence of trees with extensive root systems and other ground cover vegetation in the area suggests the potential of the ecosystem to provide landslide mitigation services. These trees (e.g., Narra, Bitaog, Tuai) help keep the soil intact and redirect rainwater, thus reducing the risk of landslides (*Figure 20*). Additionally, based on the Geoportal landslide susceptibility data of the DENR Mine and Geosciences Bureau, certain areas of the Arillo estate are highly susceptible to landslides. However, additional research is needed to confirm the presence of this ecosystem service.

The presence of a closed tree canopy and river ecosystem contribute to ambient temperature conditions and provide an evaporative cooling effect that users can enjoy when underneath the canopy. This is referred to as local climate regulation, which is a service that extends beyond user comfort and plays a crucial role in enhancing biodiversity. Local climate regulation helps create microclimates that support a wider variety of plants and animals, contributing to ecosystems' overall health and resilience.

Figure 20. Photos showing the presence of dense tree cover and deep-rooted trees that could prevent landslides and regulate local climate

HCV 5 Community Needs

There are no communities residing within the assessment area that are dependent on natural resources. As such, we conclude that HCV 5, sites and resources essential for local communities, is absent within the estate.

HCV 6 Cultural Values

The patch of closed tree canopy provides a recreational service to users by serving as a green space (*Figure 21*). Due to the biophysical characteristics and qualities of the ecosystem, users can enjoy and utilize this environment through various recreational activities. Green spaces provide a serene and relaxing environment for users, as well as opportunities for outdoor recreation, such as forest bathing, leisure walks, and trekking. Our avifaunal survey results also support the potential for birdwatching within the area.

Figure 21. Photos showing some of the area's nature scenes ideal for recreational activities

4 Threats to High Conservation Values

Invasive Species

We observed several threats to biodiversity that compromise the presence of HCVs within Arillo Estate (Table 2). The introduction of non-native species is detrimental to the natural environment given their propensity to out-compete native fauna and flora for resources. The proliferation of invasive alien species (IAS) can lead to the displacement of native species and the disruption of the delicate balance of ecosystems. One such IAS, the Eurasian Tree Sparrow (*Passer montanus*) or locally known as the maya, is a very common and widespread bird. They thrive in human settlements but are rare or absent in forest areas. We observed this species within the open areas of the estate and in places where infrastructures were built.

Of the six amphibian species recorded, three were IAS (*Figure 22*). The presence of the Cane Toad (*Rhinella marina*) indicates high levels of habitat degradation. Introduced in the 1930s as a pest-control agent for sugar cane plantations, the absence of natural predators and an abundance of food sources has led to the uncontrolled spread of this species throughout the country. Very few animals can prey upon and withstand the powerful bufotoxin secreted by the Cane Toad. According to the IUCN Invasive Species Specialist Group, it is part of the top 100 of the world's worst invasive alien species (Lowe et al. 2000).

The introduction of non-native cultivated plants may also serve as a vector for the spread of IAS such as the Malaysian Narrowmouth Toad (*Kaloula pulchra*) and the Common Green Frog (*Hylarana erythraea*). The former was found nestled in a bromeliad plant, a non-native ornamental plant planted near the Arillo Estate Vistor's center. This is an area with a high concentration of non-native ornamental plants. Common Green Frogs were very abundant within the Water Hyacinth pond of Arillo. The introduction of non-native Water Hyacinths likely facilitated the spread of this species.

Figure 22. Amphibian species classified as IAS recorded within Arillo Estate. A) Cane Toad (*Rhinella marina*), B) Malaysian Narrowmouth Toad (*Kaloula pulchra*), C) Common Green Frog (*Hylarana erythrea*).

The introduction and spread of exotic species within the estate was both intentional and accidental. Many of the past introductions were intended for horticulture and recreation, but the lack of maintenance after the golf course ceased operation allowed the uncontrolled spread of the initial population. This also served as an opportunity for the noxious weeds to colonize the previously manicured lawns and prevent the establishment of native plant communities within the area. Further propagation of the exotic species within the eco trail increases the risk of invading the remaining patches of natural habitat within the area.

Bio-invasive tree species such as Mahogany (*Swietenia macrophylla*), Giant Ipil-Ipil (*Leucaena leucocephala*), Auri (*Acacia auriculiformis*) African Tulip (*Spathodea campanulata*), and Lapnis/Paper Mulberry (*Broussonetia papyrifera*) grow and reproduce faster than native species. These trees were introduced for their ornamental value. However, profuse fruiting and the masses of wind-dispersed seeds mean that only a few tree stands can begin a process of invasion.

Understory and groundcover IAS were also abundant and widespread throughout the estate (*Figure 23*). The trailing daisy (*Sphagneticola trilobata*) was observed to be encroaching on the edge of the grassland areas. The trailing daisy was also planted along the eco trail (*Figure 23F* and *Figure 23G*), possibly as an ornamental ground cover. The species can spread vegetatively and is difficult to eradicate. The IUCN Invasive Specialist Group identified this species among the top 100 of the world's most invasive alien species (Lowe et al. 2000). The Wandering Jew (*Tradescantia zebrina*) is another fairly common ornamental plant with a tendency to escape into shady, moist spots. It is reported as invasive in many areas in the Pacific (PIER, 2012). Together with the trailing daisies, this species was planted along the eco-trail. Once established, it can spread several hundred meters along the trail, and form thick carpets on moist rocks and shady areas along the riverbanks.

A close cousin of *S. trilobata* is the Wild Sunflower, *Tithonia diversifolia*. It is also an ornamental plant from the Asteraceae family that escaped cultivation and became invasive in disturbed areas within the estate.

Threats to High Conservation Values | Invasive Species

Aside from outcompeting native vegetation, allelopathic activity has been reported for this species (CABI Compendium, 2018), meaning the plant secretes biochemicals that affect the growth and survival of other species surrounding it. Another IAS to watch out for within Arillo is the *Dieffenbachia seguine*, which is a very popular ornamental plant. Further introduction of this species must stop as the leaves of this plant are highly toxic to humans and pets when ingested. The sap of *D. seguine* is also irritating to the skin (CABI Compendium, 2022).

Colonizers of disturbed areas like *Chromolaena odorata* and *Lantana camara* were considered among the world's worst weeds due to their efficient short and long-distance dispersal. Both weeds are poisonous to livestock and have caused large economic losses in several countries. They are host to numerous pests and diseases and are generally deleterious to biodiversity.

Napier grass and Tobacco grass are also frequent invaders of open areas. The Napier grass (*Cenchrus purpureus*) is a fast-growing species that colonizes new regions and forms dense thickets. Once established, it has the potential to modify ecosystem functions such as fire regimes, hydrological cycles, biophysical dynamics, nutrient cycles, and community composition (D'Antonio and Vitousek, 1992). Because of this species' propensity to resprout from small rhizomes left after disturbance, it can smother and outcompete any native vegetation within the area. This species of grass observed in Arillo is one of the most invasive grasses in the world. The Tobacco grass (*Elephantopus mollis*) is native to the tropics and has been widely introduced in Africa, Asia, and the Pacific. In other countries, the Tobacco grass is considered a pest plant threatening endangered native flora. This species is pioneering in disturbed areas and can quickly colonize pastures, plantations, forest edges, and roadsides. Just like the Napier grass, the Tobacco grass can smother its native flora competition.

Within the artificial ponds of Arillo estate is a freshwater weed, the Water Hyacinth (*Pontederia crassipes*), a water ornamental plant popularized due to its colorful flowers. The Water Hyacinth is considered one of the most troublesome aquatic plants in the world (Holm et al. 1997) because of its ability to spread rapidly in ponds, lakes, and rivers when conditions are suitable (Binggeli 2003). Once it spreads, it is very difficult to eradicate and will need long-term management to control. This species is known to have adverse effects on local biodiversity and water quality (Mironga et al. 2012; Binggeli 2003; Kumar and Rohatgi 1999).

Figure 23. Understorey and ground cover species classified as IAS recorded in Arillo Estate. A) *Dieffenbachia seguine*, B) Wild Sunflower (*Tithonia diversifolia*), C) Wandering Jew (*Tradescantia zebrina*), D) Kantutay (*Lantana camara*), E) Hagonoy (*Chromolaena odorata*), F) Trailing Daisy (*Sphagneticola trilobata*), G) Trailing Daisies planted along the eco trail

Artificial Ponds

The man-made ponds situated near the Arillo Visitor's Center are breeding grounds for invasive species. The smaller of the two ponds was infested with Water Hyacinths and Common Green Frogs. The second and larger pool of stagnant water appears green in color due to algal blooms that occur due to excess organic nutrients in the water. Based on the qualities we observed, we suspect these ponds are likely experiencing eutrophication. Waterbirds such as the Intermediate Egret (*Ardea intermedia*) were not observed within the vicinity of these ponds as these species prefer natural bodies of water where prey is abundant.

Trash and Dump Sites

The waste generated from the ongoing construction of the eco-trail may affect the environment. As mentioned in the freshwater sampling results, recently disposed of trash was also found throughout the eco-trail and river. Scattered wastes, particularly broken glass and plastics, create an unsightly dumpsite that mars the landscape and may also affect wildlife. Animals may mistakenly ingest or become entangled in plastic materials, causing injuries. Meanwhile, sharp shards of broken glass may pose a physical hazard to people and animals traversing the area, potentially causing cuts and infections if not properly managed.

Eco-trail Establishment

The eco trail construction raises serious concerns due to its unsustainable and destructive methods. The ongoing clearing of native vegetation and the dimensions and manner of trail establishment disrupt microhabitats essential for frogs and reptiles. Additionally, the planting of invasive flora, the excessive width of the trail, and the positioning of the trail on both sides of the river also threaten the natural environment.

Table 2. Summary of threats to biodiversity encountered in Arillo estate and affected HCVs.

Threats	HCV 1	HCV 2	HCV 3	HCV 4	HCV 5	HCV 6
Invasive Species	✓	✓	✓			
Artificial Ponds	✓	✓	✓	✓		
Trash and Dump Sites	✓	✓	✓	✓		
Eco Trail Establishment	✓	✓	✓	✓		✓

5 Key Recommendations and Next Steps

Recommendations

It is clear from our results that the river and closed canopy habitats of Arillo are vital to the local survival of numerous endemic and threatened species. The destruction of this habitat would bring about the loss of many species from the Estate. Given the negative impacts brought by the establishment of the eco trail, we recommend the application of the Rewilding Concept. Rewilding would involve both planting and enabling the spontaneous growth of indigenous trees and plants to mitigate the impacts of the eco-trail establishment. This concept advocates for the restoration of ecosystems into a managed state of wildness and to stray away from manicured landscapes. The revegetation of the riverbanks with native flora would also strengthen ecosystem services such as soil erosion control and landslide mitigation services within the area.

Initial list of proposed native flora to be planted in the Arillo:

- Aglaonema (*Aglaonema commutatum*)
- Hagikhik (*Phrynium interruptum, Phrynium pubinerve*)
- Mali-mali (*Leea manillensis*)
- Silver pothos (*Scindapsus pictus*)
- King fern (*Angiopteris evecta*)
- Fig trees (*Ficus* spp.)

We also advocate for the gradual removal of IAS, particularly exotic landscape plants that escaped cultivation, as well as invasive vines, grasses, and saplings. Both the removal of the invasive Trailing Daisy and Wandering Jew planted along the eco trail and the prevention of further introduction of IAS within the estate are critical. When replaced with native flora, there is a greater possibility for the ecosystem to heal. This would facilitate the return of native wildlife. It is not recommended that the trail be expanded any further as this would involve the destruction of native species and natural habitats.

A proper tree inventory requires the proper tools and equipment to document each tree. During a previously conducted tree inventory within Arillo, information was written on thin sheets of metal that were then nailed to trees using iron nails. Many of these tags and nails had rusted or had fallen off by the time we arrived for our survey. Piercing the bark with nails may potentially lead to the death of the tree as the physical damage could serve as a vector for the introduction of fungi, bacteria, and diseases. We recommend the use of aluminum tags attached to the trees with a material that can stretch as the tree grows such as springs or nylon. This is a less destructive, less unsightly, and more sturdy method of physically tagging trees.

A full biodiversity species inventory involves sampling during both wet and dry seasons. Conducting a second rapid biodiversity survey during the dry season may allow for more species to be accounted for within Arillo.

Next Steps

1. We were able to validate 11% of trees in Arillo. We will continue the validation and geotagging of trees in January 2024.

2. Species count indicated in this report is preliminary. The number of species may change after we complete tagging all trees in the estate.

3. While our field campaign on faunal survey was already completed, other faunal species sighted when we return for the tree tagging activities will be recorded as general observations and added to our species list.

4. Data analysis is still ongoing for HCV 2 and HCV 3. The results will be discussed in the final technical report.

5. List of proposed native plants for rewilding will be updated in the final report.

6. Recommendations identified in this report are preliminary. The HCV management and mitigation plan consisting of management recommendations will be included in the final report.

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7 Annex

Annex 1. List of Fauna species identified within the project area.

Table A1. Species list of avifaunal species found in the Arillo Estate.

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Acanthizidae	Golden-bellied Gerygone	*Gerygone sulphurea*	R	OWS	LC
Accipitridae	Chinese Sparrowhawk	*Accipiter soloensis*	M	OWS	LC
Alcedinidae	Brown-breasted Kingfisher	*Halcyon gularis*	R	OWS	LC
Alcedinidae	Collared Kingfisher	*Todiramphus chloris*	R	OWS	LC
Alcedinidae	Indigo-banded Kingfisher	*Ceyx cyanopectus*	E	CR	LC
Apodidae	Pygmy Swiftlet	*Collocalia troglodytes*	E	OWS	LC
Apodidae	Pacific Swift	*Apus pacificus*	R M	OWS	LC
Apodidae	House Swift	*Apus nipalensis*	R	OWS	LC
Ardeidae	Yellow Bittern	*Ixobrychus sinensis*	R	OWS	LC
Ardeidae	Intermediate Egret	*Ardea intermedia*	R, M	OWS	LC
Ardeidae	Little Egret	*Egretta garzetta*	R,M	OWS	LC
Artamidae	White-breasted Woodswallow	*Artamus leucorynchus*	R	OWS	LC
Campephagidae	Blackish Cuckooshrike	*Edolisoma coerulescens*	E	OWS	LC
Caprimulgidae	Philippine Nightjar	*Caprimulgus manillensis*	E	OWS	LC
Caprimulgidae	Savanna Nightjar	*Caprimulgus affinis*	R	OWS	LC
Cisticolidae	Grey-backed Tailorbird	*Orthotomus derbianus*	E	OWS	LC
Columbidae	Zebra Dove	*Geopelia striata*	R	OWS	LC
Columbidae	White-eared Brown Dove	*Phapitreron leucotis*	E	OWS	LC
Corvidae	Large-billed Crow	*Corvus macrorhynchos*	R	OWS	LC
Cuculidae	Philippine Coucal	*Centropus viridis*	E	OWS	LC
Cuculidae	Philippine Drongo-Cuckoo	*Surniculus velutinus*	E	OWS	LC
Cuculidae	Lesser Coucal	*Centropus bengalensis*	R	OWS	LC
Cuculidae	Plaintive Cuckoo	*Cacomantis merulinus*	R	OWS	LC

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Dicaeidae	Pygmy Flowerpecker	*Dicaeum pygmaeum*	E	OWS	LC
Dicruridae	Balicassiao	*Dicrurus balicassius*	E	OWS	LC
Hirundinidae	Pacific Swallow	*Hirundo tahitica*	R	OWS	LC
Hirundinidae	Barn Swallow	*Hirundo rustica*	M	OWS	LC
Hirundinidae	Striated Swallow	*Cecropis striolata*	R	OWS	LC
Laniidae	Brown Shrike	*Lanius cristatus*	M	OWS	LC
Laniidae	Long-tailed Shrike	*Lanius schach*	R	OWS	LC
Locustellidae	Striated Grassbird	*Megalurus palustris*	R	OWS	LC
Locustellidae	Tawny Grassbird	*Cincloramphus timoriensis*	R	OWS	LC
Megalaimidae	Coppersmith Barbet	*Psilopogon haemacephalus*	R	OWS	LC
Meropidae	Blue-tailed Bee-eater	*Merops philippinus*	R	OWS	LC
Meropidae	Rufous-crowned Bee-eater	*Merops americanus*	R	OWS	LC
Monarchidae	Black-naped Monarch	*Hypothymis azurea*	R	OWS	LC
Motacillidae	Eastern Yellow Wagtail	*Motacilla tschutschensis*	M	OWS	LC
Motacillidae	Paddyfield Pipit	*Anthus rufulus*	R	OWS	LC
Muscicapidae	Grey-streaked Flycatcher	*Muscicapa griseisticta*	M	OWS	LC
Muscicapidae	Mangrove Blue Flycatcher	*Cyornis rufigastra*	R	OWS	LC
Muscicapidae	Pied Bush Chat	*Saxicola caprata*	R	OWS	LC
Nectariniidae	Purple-throated Sunbird	*Leptocoma sperata*	E	OWS	LC
Nectariniidae	Olive-backed Sunbird	*Cinnyris jugularis*	R	OWS	LC
Oriolidae	Black-naped Oriole	*Oriolus chinensis*	R	OWS	LC
Paridae	Elegant Tit	*Pardaliparus elegans*	E	OWS	LC
Passeridae	Eurasian Tree Sparrow	*Passer montanus*	I	OWS	LC
Phylloscopidae	Arctic Warbler	*Phylloscopus borealis*	M	OWS	LC
Picidae	Philippine Pygmy Woodpecker	*Yungipicus maculatus*	E	OWS	LC
Pittidae	Hooded Pitta	*Pitta sordida*	R	OWS	LC
Psittaculidae	Philippine Hanging Parrot	*Loriculus philippensis*	E	CR	LC
Pycnonotidae	Philippine Bulbul	*Hypsipetes philippinus*	E	OWS	LC
Pycnonotidae	Yellow-vented Bulbul	*Pycnonotus goiavier*	R	OWS	LC
Rallidae	Barred Rail	*Hypotaenidia torquata*	R	OWS	LC
Rhipiduridae	Blue-headed Fantail	*Rhipidura cyaniceps*	E	OWS	LC

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Strigidae	Luzon Boobook	*Ninox philippensis*	E	OWS	LC
Strigidae	Philippine Scops Owl	*Otus megalotis*	E	OWS	LC
Sturnidae	Asian Glossy Starling	*Aplonis panayensis*	R	OWS	LC
Zosteropidae	Lowland White-eye	*Zosterops meyeni*	NE	OWS	LC

Endemism/Distribution: E = Philippine Endemic; R = Resident; M = Migratory; NE = Near Endemic; In = Introduced
DENR DAO: CR = Critically Endangered; OWS = Other Wildlife Species
IUCN: LC = Least Concern

Table A2. List of rare, threatened, or endemic mammal species found in the Arillo Estate.

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Order **Chiroptera**					
Hipposideridae	Common Rousette	*Rousettus amplexicaudatus*	N	OWS	LC
Pteropodidae	Lesser Dog-faced Fruit Bat	*Cynopterus brachyotis*	N	OWS	LC
Pteropodidae	Dagger-toothed Long-nosed Fruit Bat	*Macroglossus minimus*	N	OWS	LC
Pteropodidae	Greater musky Fruit bat	*Ptenorchirus jagori*	PE	OWS	LC
Order **Primates**					
Cercopithecidae	Long-tailed macaque	*Macaca fascicularis*	N	OWS	EN

Endemism/Distribution: PE = Philippine Endemic; N = Native; In = Introduced
DENR DAO: OWS = Other Wildlife Species
IUCN: EN = Endangered; LC = Least Concern

Table A3. List of rare, threatened, or endemic herpetofauna found in the Arillo Estate.

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Class **Amphibia** | Order **Anura**					
Bufonidae	Cane Toad	*Rhinella marina*	In	OWS	LC
Ceratobatrachidae	Duméril's Wrinkled Ground Frog	*Platymantis dorsalis*	PE	OWS	LC
Dicroglossidae	Luzon swamp frog	*Limnonectes woodworthi*	PE	OWS	LC
Microhylidae	Malaysian Narrowmouth Toad	*Kaloula pulchra*	In	OWS	LC
Ranidae	Common Green Frog	*Hylarana erythraea*	In	OWS	LC
Rhacophoridae	Asiatic Tree Frog	*Polypedates leucomystax*	N	OWS	LC
Class **Reptilia** | Order **Squamata** | Suborder **Sauria**					
Gekkonidae	Philippine bent-toed gecko	*Cyrtodactylus philippinicus*	PE	OWS	LC
Gekkonidae	Botel Gecko	*Gekko kikuchii*	N	OWS	LC

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Gekkonidae	Common House Gecko	*Hemidactylus frenatus*	N	OWS	LC
Scincidae	Many-lined sun skink	*Eutropis multifasciata*	N	OWS	LC
Scincidae	Northern Philippine Giant Forest Skink	*Pinoyscincus abdictus aquilonius*	PE	OWS	LC
Varanidae	Luzon Monitor Lizard	*Varanus marmoratus*	PE	OTS	LC
Class **Reptilia** | Order **Squamata** | Suborder **Serpentes**					
Colubridae	Philippine Vine Snake	*Ahaetulla prasina preocularis*	PE (subsp)	OWS	LC
Colubridae	Gervais' Worm Snake	*Calamaria gervaisii gervaisii*	PE	OWS	LC
Elapidae	Barred Philippine False Coral Snake	*Hemibungarus calligaster*	PE	OWS	LC

Endemism/Distribution: PE = Philippine Endemic; N = Native; In = Introduced
DENR DAO: OTS = Other Threatened Species, OWS = Other Wildlife Species
IUCN: LC = Least Concern

Annex 2. List of Flora species identified within the project area.

Table A4. Species list of flora species found in Arillo Estate.

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
CANOPY					
Anacardiaceae	Mangga	*Mangifera indica*	I	NA	DD
Araucariaceae	Araucaria	*Araucaria heterophylla*	I	NA	VU
Betulaceae		*Alnus japonica*	I	NA	LC
Bignoniaceae	African tulip	*Spathodea campanulata*	I	NA	LC
Calophyllaceae	Bitaog	*Calophyllum inophyllum L.*	N	OWS	LC
Cannabaceae	Celtis	*Celtis sp.*	N	OWS	-
Casuarinaceae	Agoho	Casuarina equisiitifolia	N	OWS	LC
Combretaceae	Talisay	*Terminalia catappa*	N	OWS	LC
Euphorbiaceae	Alim	*Melanolepis multiglandulosa*	N	OWS	LC
Euphorbiaceae	Binunga	*Macaranga tanarius*	N	OWS	LC
Euphorbiaceae	Takip-asin	*Macaranga grandifolia*	N	OWS	VU
Euphorbiaceae	Para rubber	*Hevea brasiliensis*	I	OWS	LC
Euphorbiaceae		*Mallotus sp.*	N	OWS	-
Euphorbiaceae		*Acalypha sp.*	N	OWS	-

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Fabaceae	Ayangili	*Acacia auriculiformis*	I	NA	LC
Fabaceae	Narra	*Pterocarpus indicus*	N	Vu	EN
Fabaceae	Ipil-ipil	*Leucaena leucocephala*	I	NA	CD
Fabaceae	Anii	*Erythrina subumbrans*	N	OWS	-
Fabaceae	Acacia	*Samanea saman*	I	NA	LC
Fabaceae	Madre de cacao	*Glinicidia sepium*	I	NA	LC
Fabaceae	Kupang	*Parkia timoriana (Parkia roxburghii)*	N	OWS	LC
Lamiaciae	Gmelina	*Gmelina arborea*	I	NA	LC
Lamiaciae	Teak	*Tectona grandis*	I	NA	En
Lauraceae	Bakan	*Litsea philippinensis*	N	OWS	-
Lythraceae	Banaba	*Lagerstroemia speciosa*	N	OWS	-
Meliaceae	Mahogany	*Swietenia macrophylla*	I	NA	VU
Meliaceae	Igyo	*Didymocheton gaudichaudianus = Dysoxylum gaudichaudianum*	N	OWS	-
Moraceae	Hauili	*Ficus septica*	N	OWS	LC
Moraceae	Is-is	*Ficus ulmifolia*	N	OWS	Vu
Moraceae	Lapnis	*Broussonetia papyrifera*	I	NA	LC
Moraceae	Nangka	*Artocarpus heterophyllus*	I	NA	-
Moraceae	Antipolo	*Artocarpus blancoi*	N	OWS	LC
Moraceae	Tibig	*Ficus nota*	N	OWS	LC
Moraceae	Hagimit	*Ficus minahassae*	N	OWS	LC
Moraceae	Fig tree	*Ficus sp.*	N	OWS	-
Moraceae	Salisi	*Ficus benjamina L.*	N	OWS	LC
Myrtaceae	Bayabas	*Psidium guajava*	I	NA	LC
Myrtaceae	Duhat	*Syzygium cumini*	N	OWS	-
Myrtaceae	Bagras	*Eucalyptus deglupta*	N	OWS	Vu
Phyllanthaceae		*Glochidion album*	N	OWS	-
Phyllanthaceae	Tuai	*Bischofia javanica*	N	OWS	LC
Pinaceae	Ornamental pine	*Pinus sp.*	N	OWS	-
Urticaceae	Lipang-kalabaw	*Dendrocnide meyeniana*	N	OWS	-

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
UNDERSTORY					
Araceae		*Dieffenbachia seguine*	I	NA	-
Asteraceae	Hagonoy	*Chromolaena odorata*	I	NA	-
Asteraceae		*Tithonia diversifolia*	I	NA	-
Arecaceae	Rattan	*Calamus sp.*	N	NA	-
Cannaceae	Saging-Saging	*Canna indica*	I	NA	-
Cyatheaceae	Tree fern	*Sphaeropteris sp.*	N	NA	-
Marantaceae		*Phrynium interruptum*	N	OWS	-
Marantaceae	Hagikhik	*Phrynium pubinerve*	N	OWS	-
Poaceae	Bukawe	*Cyrtochloa toppingii*	N	OWS	-
Rubiaceae		*Mycetia javanica*	N	OWS	-
Verbenaceae	Kantutay	*Lantana camara*	I	NA	-
Vitaceae	Mali-mali	*Leea manillensis*	N	OWS	-
Zingiberaceae	Tagbak	*Alpinia haenkei*	N	OWS	LC
Zingiberaceae	Luya-Luya	*Wurfbainia elegans*	E	OWS	-
GROUNDCOVER					
A canthaceae	Chinese violet	*Asystasia gangetica*	I	NA	-
Araceae	Gabi	*Colocasia esculenta*	N	OWS	LC
Amaranthaceae	Globe amaranth	*Gomphrena celosioides*	I	NA	-
Amaranthaceae	Joseph's coat	*Alternanthera sessilis*	N	OWS	LC
Amaranthaceae		*Cyathula prostrata*	N	OWS	-
Amaranthaceae	Kulitis	*Amaranthus viridis*	I	NA	-
Araceae		*Syngonium cf. podophyllum*	I	NA	-
Araceae		*Schismatoglottis plurivenia*	N	OWS	-
Araceae		*Schismatoglottis luzonensis*	N	OWS	-
Araceae	Silver pothos	*Scindapsus pictus*	N	OWS	-
Asteraceae		*Sphagneticola trilobata*	I	NA	-
Asteraceae		*Elephantopus mollis*	I	OWS	-
Asteraceae	Nodeweed	*Synedrella nodiflora*	I	NA	-
Asteraceae		*Cyanthillium cinereum*	N	OWS	-
Asteraceae		*Crassocephalum crepidioides*	I	NA	-
Asteraceae		*Pseudelephantopus spicatus*	I	NA	-
Athyriaceae	Fern	*Deparia sp.*	N	OWS	-

Family	Common Name	Scientific Name	Endemism/ Distribution	DENR DAO	IUCN
Commelinaceae		**Commelina diffusa**	**I**	**NA**	**LC**
Commelinaceae		*Tradescantia zebrina*	I	NA	-
Commelinaceae		*Pollia secundiflora*	N	OWS	-
Cucurbitaceae	Wild Ampalaya	*Momordica charantia*	I	NA	-
Cucurbitaceae		*Melothria pendula*	I	NA	-
Cyperaceae	Daat	*Scleria scrobiculata*	N	OWS	-
Fabaceae	Makahiya	*Mimosa pudica*	I	NA	LC
Fabaceae	Tick clover	*Grona triflora* = *Desmodium triflorum*	N	OWS	-
Fabaceae	One-leaf clover	*Alysicarpus vaginalis*	N	OWS	-
Fabaceae	Thornless mimosa	*Aeschynomene americana*	I	NA	-
Fabaceae		*Mimosa pudica*	I	NA	LC
Fabaceae	Giant Mimosa	*Mimosa diplotricha*	I	NA	-
Malvaceae		*Sida rhombifolia*	N	OWS	-
Oxalidaceae	Clover	*Oxalis corniculata*	N	OWS	-
Poaceae	Carabao grass	*Paspalum conjugatum*	I	NA	LC
Poaceae		**Zoysia matrella**	**N**	**OWS**	**-**
Poaceae		*Polytrias indica*	I	NA	LC
Poaceae	Napier	*Cenchrus purpureus*	I	NA	LC
Poaceae		*Urochloa sp.*	N	OWS	-
Rubiaceae	False Buttonweed	*Spermacoce laevis*	I	NA	LC
Solanaceae		*Solanum diphyllum*	I	NA	-
Solanaceae	Talong-talong	*Solanum torvum*	I	NA	-
Thelypteridaceae	Fern	*Christella dentata*	N	OWS	LC
Verbenaceae	Elephant grass	*Stachytarpheta jamaicensis*	I	NA	LC

Annex 3. Description of the Land cover classes

Land Cover Class / Term	Definition	Reference
Tree stand	Formation where trees with woody stem, regardless of size and economic utility or end-use, including the parts thereof such as stumps, tops and branches.	DENR Administrative Order No. 2021 - 11
Grass	A land cover pertaining to those found in rangelands and pasture land; also includes all grasses from wild lands to recreational areas, as well as, agricultural and silvi-pastural systems; here, we lumped what might be considered as land with shrubs.	FAO. 2001. Global Forest Resources Assessment 2000 Main Report. FAO Forestry Paper No. 140. Rome.
Crop	Land cover with arable and tillage land, and agro-forestry systems where vegetation falls below the thresholds used for defining forests.	The Intergovernmental Panel on Climate Change (IPCC). 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Institute for Global Environmental Strategies (IGES) for the IPCC. 590pp.
Bare	Considered as a type of land cover with few or no plants growing on it.	The Intergovernmental Panel on Climate Change (IPCC). 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Institute for Global Environmental Strategies (IGES) for the IPCC. 590pp.
Built-up / Settlement	This refers to any area that is populated by people grouped together as a community and any buildings or infrastructure therein.	The Intergovernmental Panel on Climate Change (IPCC). 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Institute for Global Environmental Strategies (IGES) for the IPCC. 590pp.
Water	This includes kinds of water bodies ranging from rivers, lakes to swamps.	FAO. 2001. Global Forest Resources Assessment 2000 Main Report. FAO Forestry Paper No. 140. Rome.

Annex 4. CCIPH HCVA Arillo Team composition

Name and Role	Relevant Expertise and Regional Experience
Adryon Rozz Javier Operations Head/ Socio economic Specialist	• Masters of Science in Biology (in progress) • 6 years of experience in projects related to reducing emissions from deforestation and degradation, voluntary GHG programs, assessment and monitoring forest and wildlife conditions, socio-economic assessments, and assessing drivers of land use change • Extensive operational experience with reputation risk management, compliance issues and social safeguards in engaging indigenous peoples for private sector engagement • Project manager for Ayala Corporation's Mindoro Forest and Biodiversity Conservation Program and leads the social and cultural components of HCV assessments.
Jennica Paula Masigan, MSc. Ecologist, HCVA Specialist	• Master of Science in Biology major in Conservation Biology • More than 10 years of professional experience on biodiversity conservation, knowledge management and wildlife population studies • Has led HCV field campaigns and participated in HCV assessments, including USAID-DENR B+Wiser Sites, Buguey Watershed, Puerto Princesa Subterranean River National Park, Mt. Nacolod Local Conservation Area, Energy Development Corporation sites, West Mt. Bulanjao, Ayala Corporation's Mindoro Forest and Biodiversity Conservation Program, and Unifrutti. • Currently working on the development of the HCVA framework for the Philippines with DENR
Rhiana Angelita Parr Biodiversity Research Associate, Project Coordinator	• Bachelor of Science in Biology • Three years of experience and research work involving Philippine terrestrial and marine biodiversity research • Currently working on the development of the HCVA framework for the Philippines with DENR
Dr. Oliver Coroza Geospatial Solutions Technology Team, Geospatial Assessment Lead	• Ph.D. in Environmental Planning • More than 30 years of experience in the application, teaching of cartographic modeling, and GIS for natural resources planning and management, land use and protected area planning, real estate management and facilities for urban application • Involved in geospatial technology applications to climate change policy, forest carbon, biodiversity conservation, ecosystem services mapping, and HCV mapping • Currently working on the development of the HCVA framework for the Philippines with DENR

Name and Role	Relevant Expertise and Regional Experience
For. Regina Aedrianne Felismino-Inovejas Geospatial Solutions Technology Team, Technical Associate	• Bachelor of Science in Forestry • CAAP Licensed Drone Pilot • Eight years professional experience in generating GIS digital data, thematic maps, and processing of satellite and aerial imageries. • Participated in conducting HCV assessments by leading the ground and aerial truth surveys, and producing spatial outputs. • Currently working on the development of the HCVA framework for the Philippines with DENR.
Czeskian Realo Geospatial Solutions Technology Team, Technical Associate	• Bachelor of Science in Geography • CAAP Licensed Drone Pilot • Facilitated the creation of disaster maps (hazard, vulnerability, exposure and risk maps) for the identified eco-disaster risks in the mountainous area of Tublay, Benguet • Trained Tublay's disaster risk response technical working group in basic and advanced GIS to maximize the use of their generated disaster maps for disaster risk response and management • Conducted aerial ground- truth survey using RPAS as a licensed drone pilot for land cover mapping in ALI sites such as Lio, Nuvali, Sicogon, Toril and Arillo; • Co-facilitated the SIBOL's Geospatial Training on Green Assessment for Ecosystem's Disaster Mapping and Aerial Ground truth survey to help improve DENR's management effectiveness of conservation areas and natural resources and crafted their respective training manuals • Assisted in SIBOL'S Green Recovery Planning in PPSRNP, CNCH, San Vicente and Roxas sites in Palawan in determining target area for spontaneous natural regeneration, assisted natural regeneration and assisted natural regeneration with enrichment program through remote sensing techniques.
Rey Dimacuha Geospatial Solutions Technology Team, Technical Associate	• Bachelor of Science in Geography • Contributed to data curation and geospatial analysis to determine area statistics, and cartographic results for the Green Restoration planning for Palawan sites devastated by Super Typhoon Odette.
Kristine Andaya Geospatial Solutions Technology Team, Remote Sensing Technologist	• Bachelor of Science in Geography • CAAP Licensed Drone Pilot • Eight years of professional experience in GIS and remote sensing • Participated in HCV assessment by conducting aerial ground truth surveys and producing land cover and change maps through satellite image processing. • Currently working on the development of the HCVA framework for the Philippines with DENR and the Green Restoration planning for Palawan sites devastated by Super Typhoon Odette.

Name and Role	Relevant Expertise and Regional Experience
Leila Cruz Geospatial Solutions Technology Team, Remote Sensing Associate	• Bachelor of Science in Geodetic Engineering student (Graduating 2024) • Working on remote sensing and GIS projects for 3 years since 2020. • Participated in HCV assessment by conducting aerial ground truth surveys and producing land cover and change maps through satellite image processing.
Dr. Mary Ann Bautista Botanist, Biodiversity Assessment Lead	• Ph.D. in Botany • Twelve years of experience in plant taxonomy, plant collection and identification, molecular techniques, genome analysis, and phylogenetic and morphological analysis • Involved in developing the Rewilding Framework of the Philippines • Currently working on the development of the HCVA framework for the Philippines with DENR
For. Jingky Dayaganon Natural Assets Solutions Associate, Forest Carbon Associate	• Bachelor of Science in Forestry • Five years of experience conducting tree carbon inventory and carbon stock assessment that involves establishing baseline and methodologies for carbon accounting of eligible projects • Experience in flora identification and mangrove inventories
Gina Mirasol Forest Carbon Associate	• Bachelor of Science in Forestry • Four years of experience conducting tree carbon inventory and carbon stock assessment that involves establishing baseline and methodologies for carbon accounting of eligible projects • Experience in flora identification • Currently underwent training on Basic GIS training
John Lister Bibar Avifaunal Sampling Lead	• Bachelor of Science in Information Technology • Five years experience in conducting biodiversity assessment as part of high conservation value areas (HCVA) projects • Specializes in avifaunal sampling
Russel Atienza Mammal Sampling Lead	• Bachelor of Science in Biology • Six years of experience in the field of ecology and conservation • Assisted in the management, coordination, and preparation of several Environmental Impact Assessment (EIA) and monitoring projects. • Experienced in conducting biodiversity surveys which include standard sampling protocols of different animal taxa (mist-netting of birds and bats, snap and live traps of small mammals, strip transect and pitfall trapping of amphibians and reptiles, line and point transect of birds), faunal species identification and classification

Name and Role	Relevant Expertise and Regional Experience
Clark Jerome Jasmin Technology Solutions Lead	• Masters of Science in Biology major in Conservation Biology (in progress) • Ten years of experience in developing technical reports, such as those identifying High Conservation Value Areas, developing biodiversity and forest monitoring plans, and geospatial analysis particularly in developing species distribution models. He specializes in optimizing the use of geospatial science and technologies to develop species distribution modeling for identifying conservation area priorities. • Currently involved in the development of the HCVA framework for the Philippines. • Exploring various technology solutions for biodiversity data capture, monitoring and patrolling of protected and conservation areas.
Louise Abigail De Layola Herpetofaunal Sampling Lead	• Master of Science in Biological Science (in progress) • Ten years of experience in conducting and managing projects involving ecological assessments using standard sampling protocols, protected area management planning, and capacity building on biodiversity surveys • Specializes in herpetology • Experienced in laboratory techniques (preservation and storage, bio and molecular techniques) • Involved in faunal invasive alien species research
Lawrence Empillo, MSc. Community Conservation Solutions Team Lead, Socioeconomic Assessment Lead	• Master of Science in Environmental Science and Ecosystem Management • Twelve years of experience in environmental studies, community organizing, preparation of biodiversity and socio-economic inventories, the social component of REDD+ projects, research on drivers of land use change, and HCV assessments • Experience in engagement with indigenous communities and other upland communities
Julie Ann Gelbolingo Research Associate for ground truthing	• Bachelor of Science in Forestry • Four years of experience conducting tree carbon inventory and carbon stock assessment that involves establishing baseline and methodologies for carbon accounting of eligible projects • Experience in flora identification
Victor Yayen Research Associate for ground truthing	• Bachelor of Science in environmental Science • Three years experience in research field works that involve tree inventory and carbon stock assessment, and study on drivers of land use change • Experience in community organizing
Mark Anthony Cantil Research Associate for ground truthing	• Bachelor of Science in Forestry • Two years of experience conducting tree carbon inventory and carbon stock assessment that involves establishing baseline for carbon accounting of eligible projects