BIODIVERSITY OF FAUNA AND FAUNA AND ECO-TOURISM DEVELOPMENT ON MADADMA WATERSHED IN BALABAG, KIDAPAWAN, NORTH COTABATO

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ABSTRACT

Balabag is one of the 40 barangays of Kidapawan City. It has a total land area of 2,542 hectares, of which 842 hectares were used for agricultural and multiple purposes while 1,700 hectares were forest land. It has a population of 1,719 with 361 households; about 60% of the population were Indigenous People (IP), and 40% were non–IPs. This study aimed to assess the current conservation status of the endemic diverse species that surrounded the watersheds; gather and identify the priority needs of the community; promote the existing tourist destination; respect the "obo maneuver" culture and arts heritage; and enforce forestry laws, regulations, and other issuances in watershed management. Inventory, collection, and assessment with the participation of local assistants, foresters, and plant experts and conservation status using the IUCN Redlist were the methods used. Forty-eight different species of vascular plants were high in the Balabag secondary forest. In terms of flora, the study revealed that 14 species as edible, seven as medicinal, 11 could be utilized as firewood, one as raw material for handicraft-making, one as fuel, six as ornamental, four as food plants for animals, and four could be used as dyes, spices, and ropes. On the other hand, 23 fauna were recorded in the area: two species of birds, six mammals, seven amphibians, and eight reptiles. One species of threatened and endemic birds was noted, and one threatened species (Megaerops Wetmore) of mammal and Limnonectes magnus (Philippine Woodland Frog), a near-threatened species of amphibians, were also recorded.

Keywords: Biodiversity, watershed, IUCN Redlist, eco-tourism, Philippines

INTRODUCTION

The Philippines is a treasure trove of biodiversity on Earth, harboring more diversity of life than any other country on a per-hectare basis (DENRPAWB, 2006). It is one of the 17 megadiverse countries which host 70-80% of the world's biodiversity. However, Philippine biodiversity is alarmingly endangered, making it a biodiversity hotspot as well (Oliver & Heaney, 1996). The abundance, distribution, and degree of threat to which the country's resources are exposed call for a rapid and effective response to accelerate the coverage of conservation efforts.

Ecosystem diversity is a self-sustaining collection of organisms and habitats. Examples include forests, rivers, mangroves, marine ecosystems, and wetlands. One of the sources of this biodiversity is the forest and mountains, which provide aquifers, sources of the water that we drink, and the water that we drink coming from the watershed.

A watershed is an area of land that drains all streams and rainfall to a common outlet, such as the outflow of a reservoir, the mouth of a bay, or any point along a stream channel, including rivers or other bodies of water. There is a need to include a specific focus on water and sustainability as they apply to the protection of human health, the environment, all living organisms, and the many resources on which our lives depend.

Humans use rivers or streams for drinking water, irrigation, transportation, industry, and recreation. Therefore, there is a need to protect, preserve, manage, and restore our natural resources for the maximum social, environmental, and economic benefit of the people, ensuring sustainability.

Eco-tourism was originally driven by the need to sustain biodiversity, reduce poverty, and generate income for communities. To increase tourism expenditures, attract visitors, and provide them with a satisfying and memorable experience while doing so in a profitable manner and enhancing the well-being of residents in the destination is largely due to the quality of their environmental resources (Huybers & Bennette, 2003).

Dolnicar and Leisch (2008) stated that recognizing the natural environment represents the main resource for many tourism destinations, and tourists are increasingly interested in spending their vacations in unspoiled natural areas.

Barangay Balabag is located within the rainforest on the premises of Paniki Falls, specifically at Sitio Mawig in Kidapawan City. It is situated at the foot of Mt.

Apo National Park is located approximately 50 kilometers from Kidapawan City, accessible via a highly curved, steep, and rough feeder road that crosses the river nine times en route.

The area has an elevation of approximately 1600 masl, with a cool temperature of around 26°C. It is a mix of two distinct forest formations, ranging from lowland tropical rainforest to mid-mountain forests, with a

predominant presence of primary forests. As part of Mount Apo National Park, it is rich in diverse species of flora and fauna. Tribal groups, including the Bagobos, Manobos, and Klata, inhabit the adjacent lands to the forests. They are primarily farmers and beneficiaries of projects such as livestock dispersal. They cultivate tiger grass and earn a living by making soft brooms.

The entire area of Barangay Balabag is covered under a tenurial instrument – the Certificate of Ancestral Domain Title (CADT)- as proof of ownership by the tribe. From the 18th century, Kapitan Umpan was the 6th generation tribal leader of the barangay.

OBJECTIVES OF THE STUDY

The general objective of this research paper was to provide information on the biodiversity of fauna and flora in protected forests in Barangay Balabag in Cotabato Province and utilize the natural resources for present and future generations to enjoy. Thus, the specific objectives were formulated to:

1. assess and protect the current status of the watersheds;
2. gather the priority needs of the community for the development of the area.
3. identify priority projects that will also conserve the endemic species of flora and fauna;
4. promote/showcase the existing tourist destination in the area;
5. respect the "Obo maneuver" culture and arts heritage;
6. strictly enforce forestry laws, regulations, and other issuances in watershed management.

THEORETICAL FRAMEWORK

This study focused on the biodiversity of flora and fauna, eco-tourism development, and the strengthening of environmental conservation and protection in the watershed area, specifically in Madadma, Balabag, Kidapawan City, and Cotabato.

A number of watersheds in the country are classified as being in critical condition, as they are at risk of denudation while providing irrigation for agricultural crop production and water supply for domestic use (Posa et al., 2008). Thus, in the pursuit of sustainable development, watersheds need protection, conservation, and rehabilitation of degrading areas (Francisco & Rola, 2004). However, to sustain biodiversity, studies on flora and fauna are necessary; hence, eco-tourism development is required.

There must be regular biodiversity assessments, especially in protected areas such as watersheds. Local community members must be involved in this activity to increase their commitment to conserving the remaining economically important flora and fauna. Threatened species of both flora and fauna must be protected because they play vital roles in maintaining the

ecosystem and contributing to eco-tourism development.

Definition of Terms

1. Biodiversity refers to the existence of a wide range of different plant and animal species within an environment.
2. Critically Endangered refers to those animals or species whose continued existence is critical.
3. Ecotourism refers to the practice of traveling to beautiful natural places for pleasure in a manner that minimizes environmental harm.
4. Endemic means common in a particular area that is existing.
5. Extinct refers to the existence of a certain species.
6. Least Concern refers to those animals or species that are of less importance.
7. MADADMA stands for Manobo Apao Descendants' Ancestral Domain of Mt. Apo.
8. Near Threatened refers to animals or species that are threatened with extinction.
9. Rare means seldom occurring or found in an area.
10. Vulnerable refers to those physically harmed or damaged plants and animals.
11. Watersheds are those areas of land that drain all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel like the rivers or other bodies of water

METHOD

Locale of the Study

This study site is located within the rainforest on the premises of Paniki Falls, specifically at Sitio Mawig, Barangay Balabag, in Kidapawan City. It is situated at the foot of Mt. Apo National Park, approximately 50 kilometers away from Kidapawan City. Access is via a highly curved, steep, and rough feeder road that crosses the river nine times en route.

The area has an elevation of approximately 1600 masl, with a cool temperature of around 26˚C. It is a mix of two distinct forest formations, ranging from lowland tropical rainforest to mid-mountain forests, with a predominant presence of primary forests. As part of Mount Apo National Park, it is rich in diverse species of flora and fauna. Tribal groups, including the Bagobos, Manobos, and Klata, inhabit the adjacent lands to the forests. They are primarily farmers and beneficiaries of projects such as livestock dispersal. They cultivate tiger grass and earn a living by making soft brooms.

Research Design

This study employed observational and descriptive survey research methods. To gather data, a descriptive survey was used, which involved administering questionnaires. The study aimed to collect data to answer questions about the subject's status and to explore the causes of particular phenomena (Hammond, 2015).

Respondents and Sampling Procedure

The study population was the community in the area of Balabag, Kidapawan City. Participants from this community were selected using total population sampling, a type of purposive sampling technique where the entire population with a particular set of characteristics is examined (Arikunto, 2010, p. 183).

Research Instrumentation

The questionnaires were the primary instruments used to gather data in this study. The researcher employed survey questionnaires as the primary data collection tool.

Data Gathering Procedure

Prior Informed Consent (PIC) and Selection of Local Researchers. The research proposal was presented to the community as part of the requirements of EO 247 (Bioprospecting) and RA 9147 (Wildlife Resources Conservation and Protection Act). This was done to obtain the prior informed consent from the community. Approval from the barangay captain and municipal mayor of the study area was subsequently obtained. The research was also presented to the members of the Protected Area Management Board (PAMB).

Nominations and the selection of local researchers (Bagobo, Klata, and Manobo) were made in collaboration with stakeholders in Brgy. Balabag, Kidapawan City. Balabag, Kidapawan City. Balabag, Kidapawan City. Balabag, Kidapawan City. Balabag, Kidapawan City. Balabag, Kidapawan City. The local researchers were chosen based on their extensive indigenous knowledge of the floral and faunal resources in the study site. These local researchers were compensated and involved in the entire duration of the research project.

Flora. In order to qualify all plants, the "Modified Stripline-Transect line Method" was used. The method was adopted from the Forest Inventory Manual of Parks and Wildlife Bureau (PAWB) of the Department of Environment and Natural Resources (DENR), revised by the College of Forestry, Central Mindanao University. Two transect lines were established. The length of the transect lines varied depending on the size of the sampling site and the terrain present. This method was implemented to cover a wide range of situations. In the first sampling site, a 200m X 20m sampling area was established (4000m2 sampling size). This was done by laying a continuous 200m line/strip on the ground and measuring 10m on both sides of the strip. The transect was divided

into 10 sampling plots or stations. Hence, each sampling plot measured 20m X

20m. The second line measured 260m X 20 (5200m2) with 13 sampling stations.

Species Identification and Nomenclature. A census within the transect line was done in addition to opportunistic identification and collection. Species found in every sampling plot were noted. Quick characterization, description, and identification were done on-site. For each plant species in the survey area, the official common name and widely accepted scientific name were placed first on the checklist. Several field guides on floras available were used from which to select the most appropriate scientific name for plant species. The guides include those by Asis and Hernandez (1980), Brown (1921), de Guzman et al. (1986), Hutchinson (1967), Pancho (1983), Pancho and Gruezo (2006; 2009), Porter (1959), Remollo (2000), Rojo (1999), Salvoza (1963), Seeber (1979).

Determination of Economic Importance of Plants Identified. The economic importance of each identified species was determined using published literature and guides. Furthermore, a focused group discussion was conducted with local community members to understand how these plants are utilized and validate the various uses of plants identified in the area. The panel consisted of community members, including traditional folk healers, farmers, homemakers, and elders.

Fauna. Standard sampling techniques, as employed by the Haribon Foundation (Mallari & Tabaranza, 2001), were used in the study. The capture-mark-release technique was employed for most of the captured individuals, where samples were marked and released after processing. Some samples that required verification were preserved in 70% alcohol and brought to the laboratory for further identification. Direct observation and informal interviews with key informants were also done to supplement the data gathered.

Birds. Mist nets (10m x 2m with five pockets) were used primarily to sample birds. These were set up at least 0.5 to 3 meters above the ground to sample ground and understory dwellers, and sky nets as high as 15 meters above the ground were set up along strategic flight paths to catch canopy species. These were checked every two hours. The captured birds were processed immediately to reduce stress. Captured birds were taken from the entanglement and placed in cloth bags. All captured samples were photo-documented and identified. Notable characteristics and standard biometric measurements, including total length (TL), wing length (WL), bill length, tarsus length, tail length, and weight, were taken and recorded in the data sheets. A Guide to the Birds of the Philippines by Kennedy et al. (2000) was used as a reference for identification.

To supplement the identification of birds, a transect walk was done in the study area. This involved listing all birds seen and observed using binoculars

while walking along a 1 km line within the site. A parasitologist, a resident expert on birds in the area, accompanied the walk. The local names of the birds were listed and identified at the campsite using photographic guides.

Mammals. Systematic trapping and mist netting were used to sample small non-volant and volant mammals, respectively. Direct observation and interviews with the residents were also done to record large mammalian species. Mist nets were used to sample volant mammals, which were the same nets used to sample birds. The nets were left open at night to capture bats and other nocturnal species. Checks were made in the early evening, as insect-eating bats are active at this time and at intervals thereafter to prevent the bats from tearing the nets. A total of 102 net nights were operated in each study area.

Captured bats were photo-documented and identified. The age of the bat was estimated by observing the degree of ossification of the metacarpal phalange joints (Anthony, 1998). The juvenile bats were excluded from the biometric measurement. Adult bats‟s biometric measurements, namely total (TL), forearm (FAL), tail (TV), ear, hindfoot (HFL) length, and weight, were taken and recorded in the data sheets. Other characteristics like the absence or presence of a tail, white markings in the ear, tragus and antitragus of the ear, structure of the nose, interfemoral membrane, and other notable traits in each sample were also recorded. The condylocanine length (CCL), condylobasal length (CBL), and the maxillary toothrow of the skulls of preserved samples brought to the laboratory for verification were measured and recorded.

Small, non-volant mammals were captured using live traps. Trap lines, approximately one km in length, with 15 traps, were established around the area. Individual traps were placed in locations where captures were likely to occur, such as near holes and along fallen logs. The traps were baited with freshly cooked coconut meat mixed with peanut butter, and others were baited with live earthworms. All traps were checked every morning, and baits were changed at least once daily. A total of 250 trap nights were operated in each area.

All captured non-volant mammals were measured and recorded. Body measurements, including tail-to-vent length (TV), head-body length (HBL), total length (TL), and weight, were recorded in the data sheets.

Unless voucher specimens were needed for further identification, all samples were tagged and released. Taxonomic guides by Ingle and Heaney (1992), Heaney et al. (1998), and Heaney et al. (1999) were used in the identification of volant and non-volant mammals.

Herpetofauna (*Reptiles and Amphibians*). Amphibians and reptiles were captured by hand. Opportunistic catching was increased by searching a variety of habitats, i.e., forest floor, leaf litter piles, tree trunks and branches, tree holes, root tangles, water tributaries, and small ponds (Oliveros et al., 2004). Photographs of reptiles and amphibians were taken in the wild and/or after capture.

Standard measurements of captured animals were taken using a ruler. For amphibians, measurements were recorded for snout-vent length, hind limb length, eye diameter, head length, snout length, head breadth, and eye diameter. For reptiles, measurements included snout-vent length, tail length, total length, axilla-groin distance, eye diameter, head breadth, and snout length. Identification was carried out using the guide by Alcala (1986).

Conservation Status and Distribution. The International Union for the Conservation of Nature (IUCN) Red List (IUCN, 2010) served as a reference for the conservation and distribution status of the recorded fauna. The species were categorized as critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC), endemic, rare, and/or economically important species. Knowing the conservation status of each species in the area is of great importance for bio-monitoring and protection of biodiversity.

Gathering priority needs of the community. An interview-based approach using a semi-structured questionnaire in which questions related to the priority needs of the community were recorded using a voice recorder and with the help of an informant while making visits to the area for site viewing and observation.

Identify priority projects. An interactive discussion, conducted through meetings and discussions with various stakeholders, including traditional herbal healers, school teachers, social workers, and local people, was used to record the different priority projects identified.

Promote and showcase the tourist destinations. A focus group discussion on Marketing and utilizing IEC materials, as well as involving social media and online tools, was conducted to promote the community's tourist destinations.

Respect the "*Obo Manuvu*" culture and arts heritage. Community immersion, including interviews and focus group discussions, was conducted using a community-based approach.

Enforced forestry laws, regulations, and other issuances in watershed management. Concerned agencies like the DENR and LGU" S were invited to speak to the community to implement conservation mechanisms like the establishment of nurseries and planting seedlings in the vacant patches in the area as well as in their fields.

Statistical Treatment of Data

The community responses to the questionnaires were tallied, tabulated, and prepared in a manner suitable for use. Diversity Indices using Relative Abundance were measured using the formula:

P1=ni/N x 100

Where:

P1= relative abundance

n= number of individuals of I genera N= total number of individuals

of all genera
Species Richness- this refers to the number of species.
n= species richness

Species Diversity

Species diversity was measured using the Shannon-Weiner Index:
H=([(n1/N) inn (n1/N)]
Where
H= Shannon-Weiner Index
N= total number of individuals of the population sampled n= total number of individuals belonging to "I" genera Evenness €
Evenness was measured using the formula:
E=H/H maximum Where:
E=evenness
H= Shanno-Weiner Index
H maximum diversity of all species

RESULTS AND DISCUSSION

Participatory Inventory of Plants and Species Richness

Vascular Plants

With the local researchers (Blaan, Bagobo, Klata, and Manobo), an inventory of flora in the surveyed area revealed a total of 48 different species of vascular plants belonging to six genera and distributed across four families.

The MADADMA watershed in Balabag, part of Mt. Apo Natural Park, exhibits higher species richness, with 48 species recorded. Table 1 provides a summary of plant species per habitat.

Table 1. *Summary of plants per habit*

Habit	MADADMA Watershed Balabag
Tress	14
Shrubs	7
Herbs	7
Vines	1
Palms	1
Grasses	6
Sedges	4
Ferns	4
Total	48

Participatory Assessment of Economically Important Flora. The participatory inventory and assessment of economically important flora revealed that 14 species are edible plants, seven species are medicinal, 11 species are utilized for lumber or firewood, one species is used as a raw material for handicraft-making, one species is used as fuel, six species are ornamental, four species serve as food plants for animals, and four species are used for other purposes, including dye, spices, jewelry, and accessories, as well as ropes.

Table 2. *Lists of plants with their uses*

Scientific Name	Common Name	Family	Uses
SPECIES EDIBLE			
1. *Artrocarpus blancoi (Elmer) Merr.*	Antipolo	Moracea	food (starchy seeds)
2. *Melastoma malabaricum* L.	Malatungao	Melastomataceae	Food (seeds)
3. *Pangium edule* Reinw	Pangi	Flacourtiaceae	Food (spice)
4. *Schismatoglottis ltifolia miq.*	Pihau	Araceae	Food
5. *Hibiscus surattensis* Linn	Labuag (Kolabog)	Malvaceae	Food
6. *Spondias pinnata* (L.F.) Kurz.	Libas	Anacardiaceae	Food
7. *Hibiscus sabdariffa* Linn	Roselle Morado (red leaves)	Malvaceae	Food
8. *Spondia purpurea* Linn	Sineguelas (Sargilyas)	Anacardiaceae	Food
9. *Kolowratia elegans* Linn	Tagbak	Anacardiaceae	Food
10. *Nasturtium officinale* Linn	Watercress	Brassicaceae	Food
11. *Atuna racemosa* Rafini. ssp. *Racemosa*	Tabon-tabon	Chrysobalanaceae	Food
12. *Rubusf raxinifolius* Linn	Wild strawberry	Berberidaceae	Food

13. *Phyllanthus acidus* (L) Skeels	Karmay	Phyllanthaceae	Food
14. *Artocarpus nitidus* Trec ssp. *Nitidus*	Kubi	Moraceae	Food
MEDICINAL			
1. *Acanthus montanus*	Mountain thistle	Acanthaceae	Medicinal, perceived protection from bad spirits
2. *Blumea balsaniefera*	Sambong	Asteraceae	Medicinal
3. *Cananga odoratum* (Lamk.) Hook.f. & Thoms	Ilang-ilang	Annonaceae	Medicinal, industrial (perfume)
4. *Cassia alata*	Acapulco	*Fabaceae*	Medicinal
5. *Celtis luzonica* Warb.	Magabuyo	Ulamceae	Medicine, betel nut for chewing with tobacco, and calcium oxide (pug)
6. *Cinnamon mercadoii* Vidal	Kalingag	Lauraceae	Medicinal, condiment
7. *Cyperus kyllingia Endl.*	Busicad	Cyperaceae	Medicinal
FIREWOOD			
1. *Cratoxylum sumatranum* (Jack) Blume	Pag-uringon	Clusiaceae	Firewood
2. *Leucaena leucocephala* (Lam.) de Wit	Ipil-ipil	Fabaceae	Firewood
3. *Duabanga moluccana* Blume	Loktob	Lythraceae	Firewood
4. *Dysoxylum gaudichaudianum* (A. Juss.) Miq.	Igiu	Meliaceae	Firewood

5. *Dysoxylum excelsum* Blume	Kuling-babus	Meliaceae	Firewood
6. *Gymnostoma rumphianum* (Miq.) L.A.S. Johnson	Agoho del Monte	Casuarinaceae	Firewood
7. *Ficus magnoliifolia* Blume	Kanapai	Moraceae	Firewood
8. *Ficus minahassae* (Teijsm. & de Vr.) Miq.	Hagimit	Moraceae	Firewood
9. *Ficus odorata* (Blanco) Merr.	Parking	Moraceae	Firewood
10. *Vitex glabrata* R. Br.	Bongoog	Lamiaceae	Firewood
11. *Viticipremna philippinensis* (Turcz.) H.J.Lam	Lingo Lingo	Lamiaceae	Firewood
HANDICRAFT			
1. *Bauhinia integrifolia subsp. cumingiana* (Benth.) K.Larsen & S.S.Larsen	Agpoi	Fabaceae	For tying materials, rope making, and bag
FUEL			
1. *Sterculia crassieramea*	Malapapaya	Sterculiaceae	Fuel
ORNAMENTAL			
1. *Begonia soccinea* Hook	Begonia	Bigoniaceae	Ornamental
2. *Diplodiscus paniculatus* Turcz.	Balobo	Malvaceae	Ornamental
3. *Drynaria quercifolia* (L.) J. Sm.	Leaf Oak Fern	Polypodiaceae	Ornamental
4. *Ficus heteropleura* Blume	Upling buntotan	Moraceae	For ornamental
5. *Iresine herbstii* Hook	Blood leaf	Amaranthaceae	Ornamental
6. *Livistonia rotundifolia* (Lam.) Mart.	Anahaw	Dipterocarpaceae	Ornamental
FOOD PLANTS			
1. *Melastoma malabaricum* L.	Malatungao	Melastomataceae	Spices/food

2. *Pangium edule* Reinw	Pangi	Flacourtiaceae	Spices/food
3. *Peperomia ppellucid*	Olasiman ihalas	Portulacaceae	Spices/food
4. *Shorea assamica* Dyer.ssp. philippinensis (Brandis) Sym.	Manngasinuro	Elaeocarpaceae	Spices/food
OTHER PURPOSES			
1. *Coix lacryma jobi L*	Katigbi	Poaceae	Jewelries and accessories
2. *Saccharum spontaneum*	Tiger grass	Poaceae	Soft brooms
3. *Ficus ulmifolia* Lam.	Is-is	Moraceae	timber for furniture and heavy construction material
4. *Antidesma bonus* (L.) Spreng	Bignay	Euphorbiaceae	Wood, Dye, ropes, and cardboard

Fauna

Birds. A rapid survey recorded two species of birds from the area. The results revealed that the total number of species recorded was 9% of the total species recorded in the Philippines (Kennedy et al. 2000). There were 17 (33%) species endemic to the Philippines. Only Alcedo argentata was considered vulnerable by the IUCN red list (2010).

Balabag secondary forest, part of the Mt. Apo National Park, had the highest number of endemic species (13). However, only two species were sighted near the MADADMA watershed area.

Laiolo (2010) stated that species richness and diversity of birds may have been affected by vegetation structure and floristic composition. The rapid survey showed that most of the recorded birds were secondary forest dwellers.

High endemicity of birds was recorded in the Balabag secondary forest, which could be affected by the high elevation as well as its complex vegetation. According to Peterson et al. (2008), most of Mindanao"s endemic birds are concentrated at higher elevations. However, only two species were noted in the vicinity of the watershed.

Alcedo argentata, a threatened bird species, was captured in the area (Figure 1). According to BirdLife International (2008), it appears to be dependent on forested streams below 1000m and tolerates secondary, selectively logged forests, as well as streamside vegetation within forested areas.

Figure 1. *Alcedo argentata* (Silvery Kingfisher), a vulnerable species

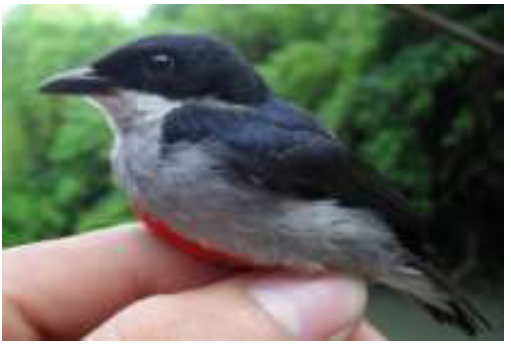

Figure 1-A. *Dicaeum australe* (Red- keeled flower pecker) is an endemic bird.

Mammals

A rapid survey of mammals recorded a total of 5 species, which belong to two families. The highest number was fruit bats (Pteropodidae), with three species, one belonging to the family Muridae, two to Rhinolophidae, and one to Vespertilionidae. There were five endemic species, with only one threatened species, Megaerops wetmorei (Figure 2).

Figure 2. *Megaerops Wetmore* (Mindanao Fruit Bat), a threatened species

The low capture of insect bats in the study might be due to the use of mist nets. According to Sedlock (2001), insect bats can echolocate and evade nets. Further studies should be done using harp traps to fully document the occurrence and diversity of microchiropterans in the area. On the other hand, the small non-volant mammals recorded were mostly associated with disturbed and agricultural lands. Three species (*Bullimus bagobus*) were the only murid recorded in Balabag. It is considered a strictly forest-dwelling species.

An ethnobiological survey recorded the presence of a medium-sized non-volant mammal, Paradoxurus hermaphroditus, in all survey areas. According to Heaney et al. (1998), this species was reported to be common in secondary forest areas near human communities. Locals considered this species a pest, as it feeds on their domesticated small chicks. Although widespread in the Philippines, this species is subject to excessive hunting, reducing its population.

Noteworthy was the presence of the threatened *M. Wetmore* in both conservation areas. According to Heaney et al. (1998), this species is known to inhabit primary and lightly disturbed lowland forests from 800 m to 1200 m. It is currently categorized as vulnerable by the IUCN Redlist (2010), which is threatened by habitat loss (Rosell-Ambal et al., 2008).

Amphibians. There were seven amphibian species restricted to the Mindanao faunal region. Some species were determined as threatened (*Limnonectes magnus*) and vulnerable (*Ansonia McGregor, Megophrys stejnegeri, Philautus acutirostris,* and *Rhacophorus bimaculatus*). Invasive species were also noted: *Hoplobatrachus rugulosus* (East Asian Bullfrog) and *Rhinella marina* (Giant Marine Toad).

Generally, amphibians prefer ground, riparian, and arboreal strata as

microhabitats, which are relatively prominent in montane forests, even at high elevations (Navas, 2006), and in humid lower-elevation forests. The presence of water bodies and moist locations in Balabag, such as small rivers, streams, and pools, may help explain the abundance of these organisms in the area. The presence of ground cover and litter in the terrestrial habitats serve as microhabitats that allow anurans to complete their life cycle. The presence of diverse species in the area can be attributed to these different microhabitats (Relox et al., 2010).

In addition, most of the vulnerable species, including *Ansonia McGregor*, *Megophrys stejnegeri, Philautus acutirostris,* and *Rhacophorus bimaculatus*, were found only in Balabag near the MADADMA watershed. A. McGregor is a species restricted to the Mindanao faunal region, where it inhabits cool mountain streams and rivers in lower montane and lowland forests. It is recorded from several protected areas in Mindanao, including Mount Malindang, Mount Apo, and the Mount Kitanglad Range Natural Park. Threats to this species include habitat destruction, deforestation, and improper use and disposal of pesticides and herbicides (Diesmos et al., 2004).

Megophrys stejnegeri is a species known from many parts of Mindanao, like Mount Malindang (Nuńeza et al., 2006) and in the southern and eastern islands of the Philippines. This species is relatively common, but the population may be decreasing due to the loss of lowland rainforest. This could be attributed to logging and the pollution of mountain streams and rivers due to agricultural effluents and mine tailings (Diesmos et al., 2004). Another species, *Philautus acutirostris,* is restricted to the Mindanao faunal region. It has also been recorded in Mt. Malindang (Nuńeza et al., 2006) and Mt. Hamiguitan (Relox et al., 2010). This species inhabits arboreal and occasionally terrestrial microhabitats in mossy and montane rainforests and disturbed areas adjacent to forests (Diesmos et al., 2004). *Rhacophorus bimaculatus* is locally common but patchily distributed. This species has been recorded from southern Luzon, Bohol, and Mindanao in the Philippines, where it is found in some protected areas, including Mt. Malindang and Mt. Apo National Parks (Diesmos et al., 2004).

Amphibian species worldwide appear to be experiencing population-level declines, at least in part due to the degradation and fragmentation of habitat and the intervening areas between habitat patches. Amphibians are frequently characterized as having limited dispersal abilities and strong site fidelity. In recent decades, amphibian populations have suffered widespread declines and extinctions (Pokhrel et al., 2011). The limited dispersal ability of amphibians and reptiles may further increase their vulnerability to climate change. Even slight changes in water levels in breeding ponds can trigger reproductive failure and, in a single year, can cause a severe drop in the population size of short-lived species. Persistent environmental changes can lead to the extinction of species.

Figure 3. *Limnonectes magnus* (Philippine Woodland Frog), a near-threatened species Vulnerable Species

A. *Ansonia mcgregori* (Mcgregor's Toad)

B. *Megophrys stejnegeri* (Midanao Horned Frog)

C. *Philautus acutirostris* (Pointed snouted tree frog)

D. *Rhacophorus bimaculatus* Asiatic tree frog)

Invasive species recorded

E.*Hoplobatrachus rugulosus* (East Asian Bullfrog)

F. *Rhinella marina* (Giant Marine Toad)

Reptiles. Eight species representing six families were recorded. Of these, four species were snakes, and four were lizards. All snakes and lizards were classified as of least concern. The figure below shows some endemic reptile species. *Tropidonophis dendrophiops* (Spotted Water Snake), *Oxyrhabdium modest* (Non-banded Philippine Burrowing Snake), *Boiga angulate* (Philippine Blunt-headed tree snake), *Rhabdophis auriculata* (White-lined Water Snake) and lizards

Cyrtodactylus annulatus (Small bent-toed gecko), *Gonocephalus semperi* (White-spotted Anglehead), *Sphenomorphus fasciatus* (Banded sphenomorphus), and *Tropidophorus misaminus* (Misamis waterside skink).

Some endemic reptile species

A. *Tropidonophis dendrophiops* (Spotted Water Snake)

B. Oxyrhabdium modestum (Non-banded Philippine Burrowing Snake)

C. *Boiga angulate* (Philippine Blunt-headed tree snake

D. *Rhabdophis auriculata* (White-lined Water Snake

E. *Cyrtodactylus annulatus* (Small bent-toed gecko)

F. *Gonocephalus semperi* (White-spotted Anglehead)

G. *Sphenomorphus fasciatus* (Banded sphenomorphus)

H. *Tropidophorus misaminus* (Misamis waterside skink)

The community's priority needs for the development of the area include projects that conserve endemic species of flora and fauna. Additionally, the community requires a room or function hall, as well as a cultural museum, where they can showcase their indigenous musical instruments, traditional clothing, and indigenous jewelry. A cafeteria, which serves as one of their primary sources of livelihood, is essential, where they can serve their homemade coffee to tourists and visitors. Additionally, cottages, bunkhouses, and a viewing deck

must be constructed to generate income for the community. Table 3 outlines the community's priority needs and identified projects.

Table 3. *Community Priority Needs/ Identified Projects*

Community Priority Needs	Identified Projects
1. Room/building Cultural Facility Area a. museum b. function room c. amenities multi-media	1. capability building and organizing a. Organic farming technology b. Marketing
2. Restroom/ dressing rooms/ mini coffee shop or cafeteria	a. Propagation of *Katigbi* b. Tiger grass and Botanical medicinal plants
3. Cottages and Bunk houses for tourist visitors	2. Skills Training a. Jewelry/Dressmaking sewing b. Quality enhancement of soft brooms/Herbal preparation and utilization/ coffee processing
3. View deck areas and facilities a. Railings b. Viewing deck	3. Production a. Indigenous Jewelry/accessories selling b. Coffee-making/ soft brooms

Promote / Showcase the Existing Tourist Destination in the area. Marketing and distributing leaflets, brochures, or any other IEC materials will help highlight the existing tourist destination to visitors and tourists who wish to explore the area.

Respect the "*Obo Manuvu*" Culture and Arts Heritage. A visitor or tourist who visits the community should have the courage to listen, encourage, congratulate, and be helpful to the indigenous people, as they are of great assistance if you are kind to them, especially when conducting research in the community area.

Strictly Enforce Forestry Laws, Regulations, and other Issuances in Watershed Management. Invited concerned agencies, such as DENR and LGUs, must advocate for the enforcement of forestry laws, regulations, and other issuances in watershed management, which enable improved environmental integrity and sustainability.

SUMMARY AND CONCLUSIONS

1. With the local researchers (B"laan, Bagobo, Klata, and Manobo), the inventory of flora in the survey showed a total of 48 different species of vascular plants belonging to 33 genera distributed in 7 families.
2. Species richness was relatively higher in the plots with mossy

bryophytes or the upper elevation than in the lower elevation and near the watershed area.

3. The participatory inventory and assessment of economically important flora revealed that 14 species are edible plants, seven species are medicinal, 11 species are utilized for lumber or firewood, one species is used as a raw material for handicraft-making, one species is used as fuel, six species are ornamental, four species serve as food plants for animals, and four species are used for other purposes, including dye, spices, jewelry, and accessories, as well as ropes.
4. Twenty-Two species of fauna were recorded in the Balabag secondary forest area, including two bird species, six mammal species, eight reptile species, and seven amphibian species.
5. One species of bird is endemic to the area, and one species, Alcedo argentata, was determined to be vulnerable. Five species of mammals are Philippine endemics, and one species, Megaerops Wetmore, was determined to be threatened. For amphibians, two were invasive, and one species was determined to be threatened (Limnonectes magnus) and vulnerable (Ansonia McGregor, Megophrys stejnegeri, Philautus acutirostris, and Rhacophorus bimaculatus). Eight reptile-endemic species were captured. All lizards and snakes were of least concern.
6. Marketing and distributing leaflets and brochures that specify the area's destination would at least help the community showcase the area for tourism.
7. Respecting the indigenous culture and traditions by listening and being helpful would at least ensure tourists are secure and comfortable in the area.
8. Distributing IEC materials, such as field guides and conservation promotion materials, to community members in the area would at least raise their awareness of environmental issues.

RECOMMENDATIONS

Based on the findings of this project, the following recommendations are offered:

1. The spirit of conservation of the remaining endangered, endemic, and economically important flora and fauna in the survey areas must be promoted to the community people. The community people must avail of IEC materials plus seminars. The spirit of conservation must be felt by the community people themselves so that they will be more supportive of the conservation programs to be implemented by concerned agencies or groups.
2. Local ordinances must be formulated to regulate the use of natural resources. Concerned agencies, such as the DENR and LGU,

must have the willpower to guard the forest against encroachment. Threatened species of both flora and fauna must be protected because they all play vital roles in maintaining the ecosystem.

3. Regular biodiversity assessments must be conducted, especially in the watershed area. Local community members should be involved in this activity to foster their commitment to conserving the remaining economically important flora and fauna.
4. Concerned agencies, such as the DENR and local government units (LGUs), may implement conservation mechanisms, including the establishment of nurseries and planting seedlings in vacant forest patches, as well as in their fields.
5. Because the inventory is not yet fully complete, further exploration in these areas is recommended. Continuous monitoring should be conducted, especially for threatened species, not only within the watershed area but also outside its premises.

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