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Rapid biological assessment of Basaw Lake, Penablanca Cagayan, Northern Philippines: Basis for sustainable ecotourism development

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Abstract

Basaw Lake, with geographic location of 17° 36' 12.2" to 09.9" latitude and 121° 49' 21.1" to 50' 37.9" longitude, with surface area of 15.6ha is being eyed as the next eco-tourism site of Penablanca, Cagayan, Northern Philippines. This study was undertaken to assess the biological status of Basaw Lake. Rapid biodiversity assessment using transects, maps, and quadrat methods were used. Findings revealed a total of 21 faunal species fish (6), shellfish (8), shrimp (1), crab (1), turtle (1) and birds (4) on site. Collected mollusks were classified into families *Planorbidae*, *Ampullariiddae*, *Cyclophoridae*, and *Thiaridae*. Fishes were classified into families *Anabantidai*, *Cichlidae*, *Clariidae*, *Gobiidae* and *Opichthydae*. Families of collected crustaceans were *Palaemonidae* and *Potamidae* while birds were *Anatidae*, *Meropidae*, *Apodidae*, and *Accipitridae*. There were also a total of 15 floral species- trees (13), palm (1), and aquatic plant (1). Trees were classified into families *Dipteroceae*, *Ebinacea*, *Rubiaceae*, *Myrcinaceae*, *Euphorbiaceae*, *Clusiaceae*, and *Araliacea*; Palm under *Malvaceae* and aquatic plant under *Nelumbonaceae*. Zooplankton findings showed 17 species belonging to 15 genera, 11 families and 5 orders. Order includes *Phyllopoda* (4), *Calanoida* (3), *Cyclopoida* (4), *Monogononta* (4), and *Bdellodea* (2). Intensive survey should be continuously conducted to document all the species present including endemics within the area as basis for sustainable ecotourism development.

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Introduction

Of the total water sources in the world, the lakes only covers 0.013% with average renewal time of lake water at 17 years (Shiklomanov *et al.,* 2002). In the Philippines, there are a total of more than 100 known lakes (Guerrero III, 1999).

Technically, a lake is a body of still or slow-moving water that collects in an inland basin of other depression of considerable size. A lake is considered as a lentic ecosystem, having both photic and aphotic zones (Hansson, 2005). Lake is even categorized as part of inland wetland ecosystem (NWAP, 2013). The lakes are inhabited by organisms which provide suitable condition for the maintenance and performance of life activities because of each dense plankton population. It provides an ample food for aquatic faunas. These include turtles, frogs, fishes, shellfish and many more. Animal diversity in lake is somewhat less than that of a plant.

Lake seems to differ primarily in size and depth; scientific study has disclosed countless other points of difference. Many of these differences are critical determinants of the presence, absence and abundance of fishes.

On the human side, the Tourism sector is one of the world's fastest growing industries. In its most basic sense, tourism can be defined as "travel outside one's normal home and workplace, the activities undertaken during the stay, and the facilities created to cater for tourist needs" (Dowling & Fennell, 2003). The world has seen an "increase in international tourist arrivals from 525 million in 1995 to 1.4 billion in 2018" (UNWTO, 2019). The Philippine tourism industry is of no exception and is considered one of the fastest growing sectors in the country. It generates employment and local revenues thereby helping the local people and community in general.

In a report presented by the Department of Tourism-Region 02 in 2011, the nature tourism of the Province of Cagayan is also growing with Penablanca's Callao Cave noted leading the way. However, the current ecological status of Callao Cave shows continuous degradation. Walls of stalactites and stalagmites in the Callao Cave area are broken, stolen or full of unscrupulous writings and vandals. Garbage becomes common in the area (Cabauatan *et al.,* 2014). If mismanagement continuous along the way and environmental protection is not incorporated on this tourist site, the local tourism industry of Penablanca, Cagayan will diminish. To avoid dependence to just one eco-tourism site, and to continuously enhance and improve the local tourism industry, there is a need to look at alternative tourism sites in the locality. The Basaw Lake of Cabasan, Penablanca, Cagayan offer a good eco-tourism potential. It is located adjacent to the Penablanca Protected Landscape and Seascape. If given the chance to be developed in a sustainable, eco-friendly manner, this can give a boast to local tourism benefiting the local community, the municipality of Penablanca as well as the entire province of Cagayan. Not much known to public, it is home and haven of the Philippine wild ducks (Cagauauan and Palangya, 2012). It is a natural lake which also caters different fishes and different floras. Surrounded by mountains, the lake also offers good panoramic views for nature photographers. It also offers potential for local boating, and mountaineering in the vicinity area.

Basaw lake is not relatively known bodies of water in the province. The lake provides sufficient water to the organisms as well as source of foods for the growth and survival of aquatic organisms. However, with the presence of human activities such as fishing and hunting, it gives us assumption that there is a rapid reduction of aquatic life in the lake since these living species cannot reproduce, grow, and survive despite top condition characteristics of water habitat. It is therefore imperative to conduct a study on the macro-faunal and floral assessment of Basaw Lake in Cabasan, Peñablanca Cagayan to determine its carrying capacity prior to sustainable development of its eco-tourism potential and biodiversity conservation.

This study was undertaken to assess the biological status of Basaw Lake, through:

1. the taxonomic inventory of aquatic macro- fauna;
2. taxonomic inventory of aquatic macro- flora; and
3. the taxonomic inventory of zooplanktons

Materials and methods

Study Site Description

Basaw Lake is located in the Northeastern side of the municipality of Peñablanca, Cagayan, Northern Philippines and lies between 17° 36' 12.2" to 17° 36' 09.9" latitude and 121° 49' 21.1" to 121° 50' 37.9" longitude. The study site could be reached through hiking and horseback riding for about 30 to 45 minutes from the Barangay proper of Cabasan. The distance of the study site is approximately 2.14 kilometers. The following information entails the important detail of Basaw lake.

Table 1. Important Information and Features of Basaw Lake.

Location:	Cabasan, Penablanca, Cagayan
Latitude:	17° 36' 12.2" – 09.0"
Longitude:	121° 49' 21.1" – 50' 37.9"
Mean Water Surface Area:	15.6ha
Approximate Perimeter:	1430 m
Type of Lake:	Spring Lake (water source is a spring)
No. of Inlets:	5 tributaries (2 active tributaries all year round)
Transportation Means:	The project site could be travelled for 25 to 35 minutes away from Tuguegarao City. The study site could be reached through hiking and horseback riding for about 30 to 45 minutes from the Barangay proper of Cabasan.
Trekking Distance:	The distance of the study site is approximated to be 2.14 kilometers.
Important Features of the Lake:	(a) The lake also served as a sanctuary of different migratory species of wild ducks and other faunas that are dependent on the aquatic resources of the lake. (b) Basaw Lake is surrounded by Limestone Mountain on the West, lust forest on the South and East, and lowlands on the North dominated by shrub trees species. (c) Considered as bird sanctuary for Philippine wild duck (*papan*) by Conservation International with population count density of approximately 1000 or more during peak season.
Water Source:	Potable drinking water is available (from a spring)
Population:	1
Human Settlement:	1

Materials and Equipments

The following materials were used in the study: fish nets, fish hooks, shovel, dredger, pail, preserving bottles, syringe, gloves and masks.

Preservation of specimen included 70% ethyl alcohol and 10% formaldehyde solution, and magnesium sulfate was used as a relaxant.

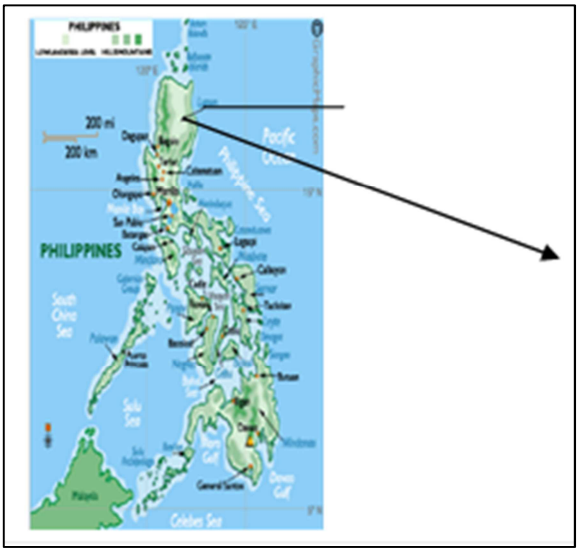

Fig. 1. Location of Basaw Lake, Northern Philippines.

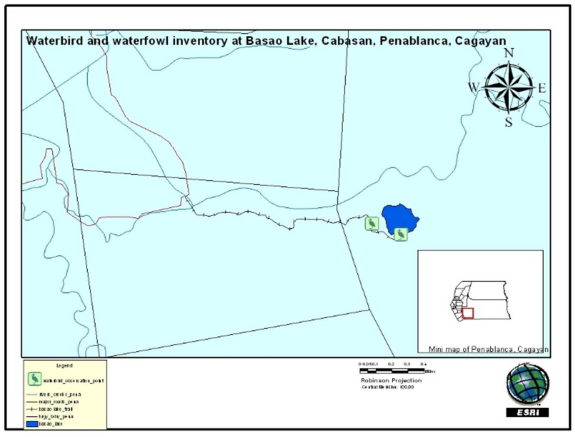

Fig. 2. GIS-based trekking location of Basaw lake.

Collection of Aquatic Macro-Fauna

Species observation and collection of aquatic macro-fauna was done twice a month using appropriate materials for the collection of fishes, crustaceans and reptile. Manual picking was utilized for the collection of gastropods since this was the common practice in harvesting shells on the edge and bottom of the lake respectively.

Preservation of the Aquatic Macro-Fauna

Preservation of Fishes

Fluid preservation was utilized in preserving the collected species. Relaxant was prepared by dissolving 50 mg of magnesium sulfate for every 1000ml of lake water. The relax species were transferred to 10% formaldehyde solution for three days which after it was washed with soapy water and thoroughly rinsed with tap water and was placed on the preserving bottles with 70% ethyl alcohol for permanent storage.

Preservation of Shellfish

Adequate preservation began when the specimens were collected. Live snails for shell studies were preserved in 70% ethyl alcohol. The shell specimens were cleaned and air dried. Some shells were heavily encrusted with mineral deposits and algae which may obscure details of the sculpture and color. These were dipped in a dilute solution of oxalic acid, and gently scrub with a fine brush. The shells were rinsed frequently in tap water during the cleaning process to prevent etching by the acid. After the shells were rinsed, they were air-dried in cardboard traced; the bodies of the large snails were pulled out from the shell. The opercula were glued to cotton plugs and replaced within the aperture.

Preservation of Crustaceans

Relaxant was prepared by dissolving 50 mg of magnesium sulfate for every 1000ml of lake water. The specimens collected were placed in the plastic bags with the relaxant to ease their appendages. The relax specimen were then transferred to 10% formalin in lake water for preliminary preservation. After two days of preservation, specimens were washed with tap water and were washed with tap water and were preserved in 70% of ethyl alcohol for permanent storage.

Preservation of the Zooplanktons

The collected samples were immediately preserved in 5% formaldehyde to avoid grazing of the zooplanktons.

Identification, Classification, Authentication and Documentation of the Macro-Fauna and Flora

The specimen collected included fishes, gastropods, crustaceans, reptiles and zooplanktons were sorted according to species. After that, the specimens collected were morphologically characterized.

After the characterization, the collected specimens were scientifically classified down to its scientific names at the National Museum Manila (Botanical, Concology, Ichthyology and Malocology Division). Pictures of the specimen were taken for documentation and proper identification. Standard herbarium technique was done using the methods of Aguilar (2000).

Statistical Analysis

All data were tabulated and analyzed using descriptive statistics including means, standard deviation, rank and percentages.

Results and Discussion

Collection, Classification and Identification of Macro-Fauna in Basaw Lake

Result of the collection showed that there were 21 species of aquatic macro-fauna in Basaw Lake which included some species of mollusks, bony fishes, crustaceans, reptile and birds. Collected aquatic macro-fauna were classified and identified using the taxonomic key for aquatic fishes, reptiles and gastropods. Some specimens were brought to the Manila National Museum for verification.

Table 2 revealed that there were eight (8) mollusks, six (6) bony fishes, two (2) crustaceans, and one (1) reptile that were classified and identified as follows:

Table 2. Faunal Species Collected at Basaw Lake.

Animal Group	Scientific Name	Local Name
Class Gastropoda	*Indoplanorbis exustus* (Deshayes, 1834)	"Kusikus"
	Pomoce canaliculata (Lamatck, 1819)	"Bisukul"
	Cyclophorus sp. (Deshayes, 1834)	"Bisukul"
	Lymnaea auricularеia	"Ararayan"
	Thiara tuberculata (Muller, 1774)	"Agurung"
	Melanoides maculate (Bruguire,1789)	"Agurung"
	Melanoides toruloso(Bruguire,1789)	"Suso"
	Angulyagra oxytropis (Benson 1836)	"Lidag"

Animal Group	Scientific Name	Local Name
Class Osteichthyes	*Tricogaster Pectoralis*	Bubble Nest "Gourami"
	Trichogaster trichopterus	Spotted "Gourami"
	Tilapia nilotica	"Tilapia"
	Clarias batrachus	"Hito"
	Gobius sp.	"Bia"
	Opichthys striatus	"Dalag"
Class Crustacea	*Macrobarchium sp.*	"Hipon"
	Potamon sp.	"Agama"
Class Reptilia	*Cyclemis ambionensis*	"Pagong"

Table 3 shows the summary of frequency and percentage abundance of birds in Basaw Lake for the period November 2011 to January 2012. Four species were spotted in the area as follows *Anas luzonica, Merops philipinus, Aeroramus fuciphagus* and *Pandionhaleaetus* (Cagauauan & Palangya, 1998).

Table 3. Frequency and Abundance (%) of Birds in Basaw Lake from November-January.

Species	Total	Abundance (%)
Anatidae (Anas): Anas luzonica	2,326	89.46
Meropidae (Merops): Merops philippinus	197	7.58
Apodidae (Aerodramus): Aerodramus fuciphagus	76	2.92
Accipitridae (Pandion): Pandionhaleaetus	1	0.04
Total	2,600	100.00

All bird species are resident birds except for *P. haleautus* which is migratory. The presence of this bird in the area indicates the importance of Basaw Lake as area of refuel and habitat for this species.

Identification and Classification of Zooplanktons

The zooplankton taxonomic groups (rotifiers, copepod and cladoceras) were identified above. Results of the study revealed that there were 17 species of zooplanktons that were identified and classified. This study revealed that the most frequently occurring and abundant zooplanktons belong to Copepods, which includes eight (8) species followed by Rotifiers with six (6) species belonging in different groups. The least number of species and classified belong to the Cladocera which includes three (3) species.

Table 4. Summary of Identified Zooplanktons.

Classes	Family	Scientific Name
Cladocera	Daphinidae	*Ceriodaphnia rigaudu*
	Daphinidae	Richard
	Daphinidae	*C. lacustris* Birge
	Cycopidae	*C. quadrangular* Mull
	Cycopidae	*Mesocyclops oithonoides*
	Cycopidae	Sars
		Eucyclops agilis Koch
		Cyclops strenuous Fischer
Copepoda	Diaptomidae	*Sinodiaptomus*
	Diaptomidae	*chaffanjoni*
	Calanidae	*Eiodiaptomus japonicas*
	Tomonidae	*Calanus helgolandicus*
	Canthocamtid	Claus
	Ergalisaidae	*Eurytemora pacifica*
	Branchionidae	Poppe
	Branchionidae	*Canthocamptus staphylinus*
		Ascomorphella sp.
		Brachionus bakeri Lant
		Keratellahiemalis Mull
Rotifera	Dicranophidae	*Dicranophorus forcipatus*
	Synchaetidae	*Ploesoma triacanthum*
	Trichocercidae	*Limnocaea genuine*

Collection, Classification and Identification of Aquatic Macro-Flora in Basaw Lake

Table 5 shows that there are eleven (11) species of plants found in Basaw lake, consisting of family *Ebinecea* (1 specie), family *Rubiacea* (2 species), family *Myrcinacea* (1 specie), family *Euphorbiacea* (1 specie), family *Clusiaceae* (1 specie), family Nelumbonaceae (1 specie), family *Malvaceae* (1 specie) and two identified species.

Table 5. Classification and Identification of Different Flora Collected in Basaw Lake.

Family	Scientific Name	Common Name
Ebinacea	*Garcinia venolusa*	Gatasan
Rubiaceae	*Palaquium pinnatinervia*	Wisak
Rubiaceae	*Psychotria luconiensis*	Katagpo
Myrcinaceae	*Ardisia pyramidallis*	Mala Adelfa, Aunasin
Euphorbiaceae	*Mallutus philippinensis*	Banato
Clusiaceae	*Cratoxylum sumatranum*	Paguringon
Araliacea	*Polyscias modosa*	Malapapaya
		Maragatas
Nelumbonaceae	*Nelombo lutea*	Lotus
Malvaceae	*Sterculia cordata var. montana*	Uwas
		Payongpayong

Conclusions and recommendations

The lake consist of a rich biological diversity with a total 21 faunal species which includes fishes (6), crustaceans (2), reptile (1), mollusks (8), birds (4), (17) zooplanktons and 11 floral species which will help in the balance of nature and serve as a source of food and income for the people on the community.

One of the main targets of the policy-maker should be the protection and sustainable usage of Basaw Lake to retain its integrity and beauty. Conservation of the lake including all habitat types to protect many valuable populations particularly the edible and endemic species should be given priority.

Intensive survey should be continuously conducted to document all the species present to include invertebrates and others especially endemics within the area.

Moreover, it is highly recommended that there should be a longer duration of the same study to document the entire existing living organism within the area including planktons found in the lake.

Holistic approaches should be done to assess the carrying capacity (land) and assimilative capacity (water) of the Basaw Environment that will match with its eco-tourism potential.

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