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Status of fisheries in Lake Pulangui, Maramag, Bukidnon, Philippines

Arturo G. Gracia Jr.
Department of Natural Sciences and Mathematics, College of Arts and Sciences, Surigao del Sur State University-Main Campus, Tandag City, Surigao del Sur, Philippines
artzgracia@gmail.com

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Abstract

This study was conducted to assess the status of fisheries and productivity in Lake Pulangui in Bukidnon. Twelve percent (40) of the total fishermen in different age brackets were considered as respondents/key-informants to gather information on the lake's status. Results revealed that there was a gradual decreased in the total number of fishermen (n=326) in this study as compared to the retrieved data from the years 2011 (n=379) and 2005 (n=390). Gill-nets, cast-nets, and fish-pots were the commonly used fishing gears. However, 6 illegal fishing gears were occasionally reported in the area. On the other hand, the average Catch Per Unit Effort (CPUE) is 6 kilograms indicating that the lake has a fish production of 713,940kilograms in a year which is 35.76% lesser as compared to the year 2011. Among the species recorded, Oreochromis niloticus and Cyprinus carpio were commonly harvested and sold with a price of USD 0.50-1.20/kg. The average kilogram of fish sold per day/person is 3 kilograms with a price of USD 0.70/kg, thus, revealing the total annual revenue of USD 249,879. The results indicate that there was a significant decrease in fish production due to the alteration of the lake's physical property.

Keywords: Fish harvest, Catch per unit effort (CPUE), fishing gears.

Introduction

The fisheries and aquaculture serve as important sources of major provisions such as food and nutrition[1]. It also provides livelihood and generates income for millions of people across the world, especially for large numbers of people in the less developed coastal countries[2,3]. However, the fisheries and aquaculture worldwide are in a constantly diminishing state[4]. With the prevailing extreme poverty in the fishing communities, resource management officers and implementers are often caught in a predicament between prioritizing the livelihood or protecting the natural resources of the fishery-dependent communities[5]. In the Philippines, fisheries are deemed as major source of livelihood on par with agriculture with an estimated total aquatic resources area of 414,926,334 ha[6]. Among these aquatic resources are inland resources like lakes. Though it represents only a fragment of a bigger portion in the aquatic resources which is well-represented by marine resources, these inland resources provide provisions for fisherfolks living in a place enclosed by mountains and other land formations.

This is evident with the statement of Gam et al.[7] that lake creates an important habitat to aquatic wildlife and offers food resource to various and diverse group of aquatic life. The Philippines have more than 80 lakes with a total area of more than 200,000 ha[8]. Among these lakes, is a 1,985 ha Lake Pulangui, a man-made lake established by the National Power Corporation (NAPOCOR) along the Pulangui River to serve as a reservoir for a hydroelectric generation[9]. The lake is considered as one of the major lakes in the country along with Laguna de Bay, Lake Lanao, Lake Taal, Lake Mainit, Lake Naujan, Buluan Lake, Pantabangan Lake, Lake Bato, and Lake Buhi. This is in view of the lakes surface areas and economic support it provides to the neighboring community[10]. Upon the completion of this massive man-made lake in the late 1900s, it has started to serve its purpose as a power supply and at the same time, a source of livelihood for the local people who live along the vicinity of the lake. With a capacity to hold 67 million cubic meters of water, the lake serves as a large reservoir and became the habitat for various economically-important aquatic organisms[11]. However, due to rapid industrialization, human malpractices, and fluctuation of extreme climate conditions (*el niño* and *la niña*) which is also in consonance with the report of Camacho[12], an apparent change on the lake's physical attribute had manifested that could affect the productivity and fisheries in the lake. This viewpoint on the effects of physical alteration on the productivity of the lake is not totally addressed, yet, it is a vital information for making an intervention program to address such phenomenon. Thus, this study was conducted to provide information on the status of Lake Pulangui with the integration of any available historical data; and determine the extent of effects of its current status to the fisheries and productivity in the area.

Methodology

Study Site and Duration: The study was conducted at Brgy. Dologon, Maramag, Bukidnon where most of the registered fishermen live (Figure-1). The community is situated at 7°01'60.00" North and 124°29'59.99" East. This study was carried from the months of March to May in the year 2014.

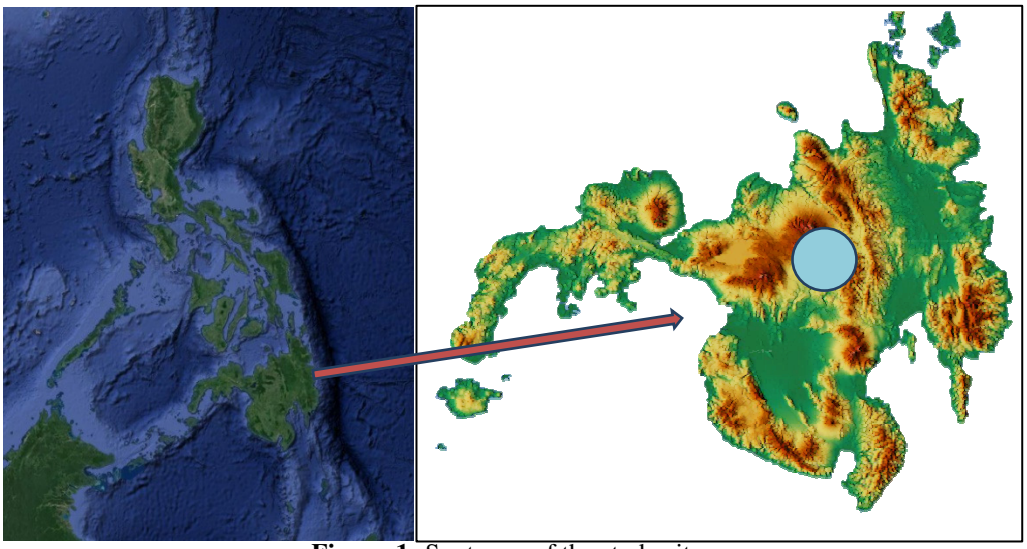

Figure-1: Spot map of the study site.

Selection of Key Informants and Respondents and Data Gathering: A total of 40 respondents were considered for this study through random sampling. The total respondents represent 12% of the total population of the registered fishermen including the fishermen from the neighboring community. Also, for this study, the respondents were considered as the key-informants as well. A standardized questionnaire was given to the respondents for them to fillin the necessary information needed for this undertaking. After answering, the respondents were asked for a semi-constructive interview wherein the whole session of the interview was recorded with approval from the Key-informant.

Evaluation of fish species captured and reported: An ocular visit in the lake was also performed during the time of fishing activity around 4:00 AM to 8:00 AM. The captured species of the fishermen were documented. The biological characteristics of the fish were also noted. This was to serve as bases for the scientific process of species identification. The FishBase.com, a database for fish fauna across the world was utilized as a guide for identification. Some samples were sent also to experts for further verification of the species.

Data processing and statistical analysis: After the sampling period, the data acquired from the questionnaires and from the recordings from the interviews were transcribed and processed. Data were then arranged accordingly. Statistical analysis used for this study simply follow the basic application of statistics, the central tendency.

Results and discussion

Profile of the fishermen: Based on the retrieved data, there were about 326 fishermen fishing in the lake. Eighty-seven (87) of which are full-time fishermen (fishing is their only source of income), and 239 are part-time fishermen (composed of fishermen that goes fishing for their consumption, and if they have excess captures, that is the only time they sell the extra). As compared to the retrieved data from the previous studies[9,13,14] there was an apparent decrease on the total and full-time number of fishermen from 2005 to 2014; the data on the year 1990 were excluded in the comparison since there were no existing data that represents the total number of full-time fishermen during that time, and the presented total number only represents the part-time fishermen unlike the other years (Table-1). The gradual decrease in the number of fishermen indicates that the lake gradually losses its purpose to some of the fishermen, thus, leading the other fishermen to seek a new work where they can earn more. This is in parallel with the statement of the fishermen who quit fishing due to the unsustainable profit they earned from fishing in the lake, the statement is stated below.

"… Lately, I don't usually go fishing - because unlike before, we have lesser catch nowadays. If I go fishing, I usually do it for consumption, if a little bit fortunate, we sell the extra catch for a little income". (note: the statement is translated in non-verbatim)

Further, the statements stated above were the common answers of the respondents who were full-time fishermen in the past but nowadays were considered part-time fishermen.

Fishing gears used: Eleven fishing gears (Table-2) were noted and among these gears, gill-nets and cast-nets were the commonly used by the fishermen (Figure-2). The average dimension of the gill-nets used was 15-30 meters wide by 2.5-4.0 meters length with mesh sizes numbers 5 (2.5cmx2.5cm) to 6 (3.0cmx3.0cm). In addition, the dimension of the commonly used cast-nets is 11x2.5 meter with the same mesh sizes as above. The fish pots or *bubo* were also the common gears of the fishermen for capturing *M. rosenbergii* (Ulang). On the other hand, six of the fishing gears (gill-net #4, mosquito-net, electric-fishing, chemical poisoning, drag-net, and *tikbong*) were banned by the local government and considered illegal. This is in pursuant to provisions of Sections 4, 7, and 34 of the

Presidential Decree No. 704, as amended, otherwise known as the Fisheries Decree of 1975 for the conservation of the fishery resources[15]. However, even though there is an ordinance implemented by the local government about the illegal use of such gears for fishing, some of the fishermen tend to perform these ways secretly for more captures. In connection, the reasons why such fishing gears were banned, this is to maintain the balance of fish production and cycle in the area. The use of gill nets and cast-nets with mesh number 4 was prohibited due to its small holes (2.0cmx2.0cm) which may capture the juvenile fish, does, may affect the cycle of fishes in the lake. Whereas the use of *tikbong* where it strikes the water forcefully will destroy the physiological balance of fish especially the juvenile ones. The person who will be caught guilty in using mesh size #4 is sanctioned of either a penalty of USD 10-80 or imprisonment of 6 months to 4 years according to the above law. While those who caught using other illegal gears are given a penalty and their fishing materials will be confiscated.

Table-1: Total number of fishermen from 3 different fisherfolks around Lake Pulangui from different years.

Total number of fishermen in Lake Pulangui from 1990-2014					
Year	1990	2005	2011	2013	2014
	Quimpang[13]	Repolidon[14]	Quimpang and Gregorio[9]	Repolidon[14]	(current)
Full-time	*	*	142	128	87
Part-time	205	*	237	*	239
Total	205	396	379	128	326

Note: 1. an asterisk indicates that there is no specified data. 2. The year being shown above the author's name is the actual year the data was recorded. While the year shown after the author's name is the date of publication.

Table-2: Assessment on the Fishing gears used by the fishermen from 1990-2014.

Fishing gears	Year				Remarks
	1990	2011	2013	2014	
Gill nets (pukot)**					
#4*	/	/	/	/	Illegal
#5***	/	/	/	/	Accepted
#6***	/	/	/	/	Accepted
#7**			/	/	Accepted
Harpoon (pana)*	/	/		/	Accepted
Hook and line (bingwit)*	/	/		/	Accepted
Hand lift net (sikpaw)	/	/			Accepted
Cast net (laya)***	/	/		/	Accepted
Fish pot (bubo)***	/	/			Accepted
Mosquito net (mosketro)	/	/			Illegal
Electric fishing (kuryente)*	/	/		/	Illegal
Chemical poisoning (hilo)*	/	/		/	Illegal
Palangre/pasol	/	/			
Taiwanese trap			/		
Drag net*			/	/	Illegal
Screen trap			/		
Tikbong**				/	Illegal

Note: i. Fishing gears with a triple asterisk (***) at the upper right are the commonly used gears. ii. Fishing gears with a double asterisk (**) at the upper right are the occasionally used gears. iii. Fishing gears with one asterisk (*) at the upper right are the rarely used gears, iv. Fishing gears with no asterisk are not observed in the area.

Figure-2: Showing some of the fishing gears and fishermen in Lake Pulangui A: gill-net; B: fish-pot; C: cast-net; D: tikbong; E: fishermen establishing the fish-pots; F: fishermen using gill-net; G: a group of fishermen fishing; H: group fishermen after fishing; I: fishermen using cast-net.

Faunal Species in the Lake: Based on the observation from the captures of the fishermen and from the data acquired from the 40 respondents, Lake Pulangui houses 12 faunal species. This is composed of 8 fish species (*Anabas testudineus*, *Clarias gariepinus*, *Cyprinus carpio*, Oreochromi niloticus, *Ophicephalus striatus*, *Pterygoplichthys disjunctivus*, *Puntius binotatus*, and *Trichogaster trichopterus*), 2 gastropods (*Vivipara* sp. and *Pomacea canaliculata*), 1 bivalve (*Taiwan Clam*), and 1 species of crustacean (*Macrobrachium rosenbergii*) (Table-3 and Figure-3). Among these species, only *P. disjunctivus* (Janitor fish), *P. canaliculata* (Golden Apple Snail), and Taiwan clam were considered by the inhabitants as Non-Economically Important Species (NEIS).

According to the local people, the total species in these days are much lower as compared to the total species observed in the years 1970-1990. Some species like *Hipposcarus* sp. (Mol-mol) was said to be present in the area but according to some locals, it is now extinct in the lake. The absence of the reported extinct species in the lake was validated every field visit. Every fisherman who happened to be fishing during the time of visit were asked if they happened to capture the above-mentioned species, but even a single individual was never observed. In addition, the fishermen further stated that the abundance of fish nowadays was much lower as compared to the past years, in which the supposed common fishes such as *A. testudineus* (Puyo), *C. gariepinus* (Hito), *O. striatus* (Halo-an), *P. binotatus* (Paitan), and *T. trichopterus* (Gurame) were now rarely caught. During the survey, the most abundant fish species observed was *O. niloticus* (Tilapia).

According to the Lake Warden, this species was purposely propagated through dispersing its fingerlings in the lake by the Bureau of Fisheries and Aquatic Resources (BFAR) with approximately 2 million fingerlings per year for the fishermen to sustain their livelihood. Though the purpose is to save the productivity of lake on the post-harvest of Tilapia, on the other side of it, this could also be a reason for the gradual decrease on the population of the native species in the actual habitat. Paller et al.[16] reported that Tilapias are considered as invasive species that compete with the available food and space in any habitat they are in, and prey on the eggs of the native species. With this, it can be derived that letting this species propagated in a natural habitat could result in the displacement of the native species and affects its population because of high competition on the ecological resources.

Table-3: Faunal species in Lake Pulangui as observed from the captures of the fishermen and based on the data acquired from the 40 respondents.

Faunal Species	Population trend	Remarks
Fish		
Anabas testudineus (Puyo)	Decreasing	EIS
Clarias gariepinus (Hito)	Decreasing	EIS
Cyprinus carpio (Carp)	Decreasing	EIS
Oreochromi niloticus (Tilapia)	Stable	EIS
Ophicephalus striatus (Halo-an)	Decreasing	EIS
Pterygoplichthys disjunctivus (Janitor fish)	Increasing	NEIS
Puntius binotatus (Paitan)	Decreasing	EIS
Trichogaster trichopterus (gurame)	Decreasing	EIS
Gastropods	-	-
Vivipara sp. (ege)	Stable	EIS
Pomacea canaliculata (kuhol)	Stable	NEIS
Crustacean	-	-
Macrobrachium rosenbergii (Ulang)	Stable	EIS
Mollusc	-	-
Taiwan Clam	-	NEIS
Legend: EIS = Economic Important Species NEIS = Non-Economic Important Species		

Figure-3: Species observed in Lake Pulangui. A: Taiwan clam, B: *Vivipara* sp. C: *Cyprinus Carpio*, D: Oreochromis niloticus, E: *Macrobrachium rosenbergii*, F: *Pterygoplichthys disjunctivus*.

On the other hand, the decrease in the abundance of economically important fish species was highly attributed to the high rate of sedimentation in the lake. The sedimentation is a manifestation of the clearing of vegetation in the vicinity of the lake as well as to the vicinities of its tributary streams and creeks. This is consonance with Galarpe et al.[17] who reported that there was evident deforestation in the Lake's tributary streams which causes flashfloods that could lead to high sedimentation rate. The accumulation of sediments for a long period of time has gradually changed the physical property of the lake. Islets are continuously formed overtime, where in fact, the supposedly vast area of water has now formed massive patches of land in between (Figure-4). According to the Lake Warden, out of the lake's total area, only 15% of it is covered by water and the rest were converted into islets. This percent of water level only rise-up to its maximum percentage (35%) if there is a strong rain that will fill-up the lake through flooding. This significant reduction on the total area of the lake limits the growth of the population of the fish for it has now a limited resource to offer as compared before. Another problem that was considered that affects the productivity is the booming population of the Janitor fish. Just like *O. niloticus* (Tilapia), this species poses a threat to other species for it has been reported as well to feed on the native fish eggs, thus, disrupting the reproduction of other fish species.

Post-Harvest: Out of the 40 respondents' catches/day that ranges from 2-10 kilograms per person, an average Catch Per Unit Effort (CPUE) of 6 kilograms was determined. The reason why there was a large scale of catch range was due to the fact that the fishermen do not spend the same range of time for fishing, and the variation of fishing gear used also contributed. Some fishermen spent 4-5 hours; some spent 8 hours, however, most of the time they only spent 2-3 hours fishing with catches range from 2-7 kilograms with fishing gears used either gill-nets or cast-nets. With an average CPUE of 6 kilograms, the lake has an annual fish production of 713,940 kg. However, the CPUE and the annual fish production was 35.76% lesser as compared to the report of Quimpang and Gregorio[9] wherein the survey was conducted in the year 2011 and reported an average CPUE of 9 kilograms with the annual fish production of 1,111,301 kg (Table-4). Further, the decreased on the catches nowadays was highly attributed to the physical condition of the lake which has very low water level (15%) which is caused primarily of

sedimentation that has accumulated through the years. The formation of islets due to sedimentation and overpopulation of macrophytes which were also observed could be fatal because it alters the topographic and organic matter balance of the lake that will eventually affect the entire ecological balance of the aquatic ecosystem. According to Birthwell[18] that a high level of sedimentation could kill the fishes instantly. This is in accordance with the statement of Ward[19] that if the suspended sediment in any of the water bodies exceeds the normal range which is usually 200-300 mg/L, it can cause fish death especially if it lasts for many days.

Table-4: Assessment of Catch Per Unit Effort (CPUE) and Annual Fish Production in Lake Pulangui from two different years.

Indicator	Year	
	2011	2014
Average Catch Per Unit Effort (CPUE)	9	6
Annual Fish Production	1,111,301	713,940

Among the species, *C. carpio* (Carp), *O. niloticus* (Tilapia), and *M. rosenbergii* (Ulang) were the commonly harvested and sold in different price brackets. The species *O. niloticus* (Tilapia) is usually sold with a price of USD 0.70-1.20/kg (during the conduct of the study, the conversion of Philippine peso to U.S Dollar was 1 USD is equal to 50 PHP) but if this fish will be bought in bulk, the price could be lower down to USD 0.50. Just like *O. niloticus* (Tilapia), *C. carpio* (Carps) and *M. rosenbergii* (Ulang) were sold at a price of USD 0.70-1.20/kg. Based on the gathered data, the average kilogram sold ranges from 3 to 5 kg/person at the usual price of USD 0.70/kg. In addition, some of the local also harvested and sold *Vivipara* sp. with a price of USD 0.30/salmon (sardines can with a capacity of 500mL). Considering that all the 326 fishermen sold 3 kilogramsper person, the lake has an annual estimated revenue of USD 249,879/year.

Conclusion

The current status of the fishery in Lake is comparatively lower than the previous years. The reduced activity on fisheries and fall down of lake's productivity are a manifestation of various ecological factors that are primarily caused by the alteration of the lake's physical attributes that leads to the lesser fishing grounds. Biotic factors also play a role for its change in productivity through the presence of invasive species such as Janitor fish that competes with other species. While the excessive harvest of fish by using the illegal fishing gears also leads to the disruption of the reproduction of the economically important species leading to the decrease of its population.

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Figure-4: A: Panoramic view of Lake Pulangui showing the fragmented areas of the lake: scene was captured at Rockstar Resort, Brgy, Tubigon, Maramag, Bukidnon; 1B: Panoramic view of the eastern side of Lake Pulangui on the Dologon portion showing the area with water: scene was captured near the Dologon Cemetery, Dologon, Maramag, Bukidnon.

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