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Freshwater Fishes of Tikub Lake, Tiaong, Quezon, Philippines

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ABSTRACT

Freshwater fish survey was conducted in Tikub Lake, a landlocked crater lake with an area of 48.34 hectares nestled at the foot of Mt. Malepunyo which is shared and bordered by Barangay Ayusan I and Barangay San Pedro in Tiaong, Quezon, Philippines. A total of 221 individuals comprising 9 species from 7 families were found in Tikub Lake, three of which are native and six are introduced. Diversity index was 1.87. A native, *Giuris margaritacea* and an introduced, *Poecilia sphenops* are the two most abundant species in the lake with relative abundance of 29.41% and 26.24% respectively. Although the study revealed that Tikub Lake hosts diverse community of fish, this is due to different introduced species as the lake is being utilized for aquaculture. Other uses of the lake include subsistence fishery, and to limited extent recreation and tourism. Just like any other lake ecosystems of the country, Tikub Lake experiences pressures due to different human activities both in the aquatic and terrestrial realms such as cutting of trees as wood fuel, excessive extraction of resources, and the ever

increasing human population as evidenced by the presence of informal settlers. A sound community-based management strategy is a prerequisite to achieving environmental sustainability.

Keywords **-** aquatic ecosystem, freshwater fishes, introduced, translocated

INTRODUCTION

The Philippines is one of the seventeen mega diverse countries recognized by the UNEP World Conservation Monitoring Centre and at the same time a biodiversity hotspot (Heaney et al. 2004). It hosts about 3,010 fish species with only 343 (10%) occurring in freshwater, of which 83 are endemic 206 are native, 44 are introduced in the country, and 42 are of uncertain status (Froese and Pauly 2011).

BFAR (2000) listed 241 lakes but, only the status of freshwater fishes in major lakes had been studied with smaller lakes being left out. The ASEAN Centre for Biodiversity in their 2010 ASEAN Biodiversity Outlook reported that the Philippines has the gravest threat from population pressure and infrastructure development, and it is for this reason that assessment of freshwater ecosystems is necessary for we do not know what we might be losing.

This study was conducted in Tikub Lake (13°57'45.81"N 121°18'22.95"E at the center), a near-perfect circular caldera lake in Tiaong, Quezon, Philippines situated at the slope of Mt. Malepunyo, one of the three peaks of Mt. Malarayat Mountain Range.

OBJECTIVES OF THE STUDY

The study mainly aimed to conduct a survey of aquatic resources, specifically freshwater fishes since there has been no published literature pertaining to the richness of this isolated lake. The study also intends to determine whether the lake harbors species unknown to science since the lake is still unexplored. This study is the first attempt to document the freshwater fishes thriving in Tikub Lake.

MATERIALS AND METHODS

Sampling Points

Ten sampling points were assigned for Tikub Lake, six of which were located near the shore whereas the four other sites on the open water; two near fish cages, one at the center, and one on the western portion about 85 meters away from the shore (Figure 1).

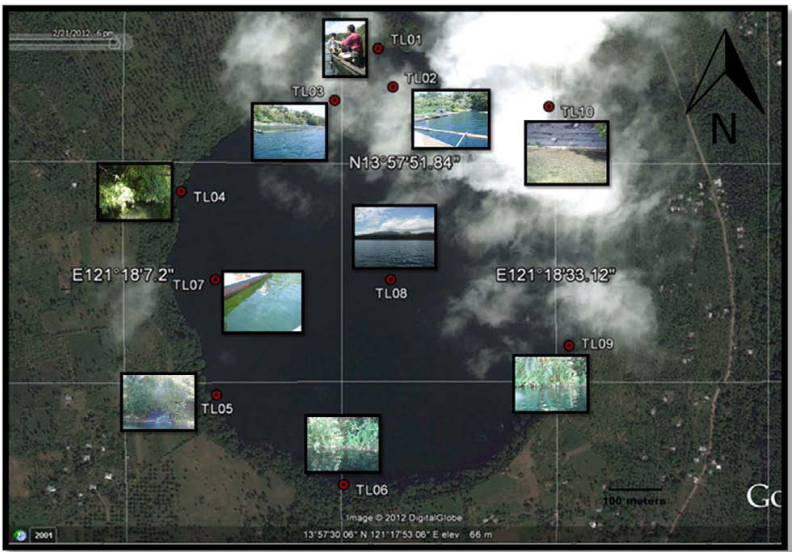

Fig. 1. Sampling points for Tikub Lake, Tiaong, Quezon (Satellite image modified after Google Earth).

Fish Sampling

Multiple sampling techniques were used in the study that included both passive and active gears. Beach seine was employed in portion of the lake with shoreline; traps (bubo) and gill net was placed near the shore, and the hook-and-line method was employed near the shore and on the open water. Fish collection was done between 10 in the morning and 3 in the afternoon. Species caught using different collection schemes were counted and included in the study.

Fixation and Preservation of Freshwater Fishes

Specimens smaller than 100 mm in Standard Length (SL) were placed directly in 70% ethyl alcohol and replaced with freshly prepared alcohol a week after for permanent storage. Specimens larger than 100 mm were immersed in full strength formalin (37% aqueous solution) for 3-4 hours before transferring to 10% formalin (diluted 1:9 part of water v/v) for a week. To allow the entry of formalin, a slit was made on the right side of specimen or injected directly on the fish. Fish samples were brought to the laboratory for accurate identification. After a week of fixation, specimens were washed and soaked in tap water with daily water change. Photo documentation, morphometric and meristic characterizations were done while the specimens were soaked in tap water for 5-7 days. The specimens were then subjected to alcohol series (20%, 50%, and 70% ethyl alcohol) for about 5-7 days each. Finally, specimens were sorted per species and summarized per sampling site then placed in freshly prepared 70% ethyl alcohol for permanent storage.

Documentation and Identification of Freshwater Fishes

Taxonomic works such as those of Kottelat et al. (1993), Kottelat et al. (1996), Rainboth (1996), and Kottelat (2001) were used for identification. References such as those of Herre (1927b 1953) and Conlu (1986) were also used since they are the only existing materials containing comprehensive listings of Philippine freshwater fishes.

Data Analyses

Different biological indices were determined which include the number of species present in the lake (species richness, D); Biodiversity Index using the Shannon Index formula, $H' = -\sum [(p_i/N)\, l_n\, (p_i/N)]$ where p is the proportion of individuals found in the ith species and l_n is the natural logarithm to determine how diverse the ecosystem in terms of species composition; Pielou's Evenness Index with the formula, $e = H'/\log S$ where S = total number of species to determine how even the distribution species relative to other species in the ecosystem; Simpson's Dominance Index using the formula $c = \sum [n_i\, (n_i\text{-}1)/\, N(N\text{-}2)]$ where n_i is the number of individuals in the *i*th species and N is the total number of individuals was used to determine species dominance since the formula weighs towards the

most dominant species. Fish species density was also calculated using the formula d = number of individual species/ 10 m^2.

RESULTS AND DISCUSSION

Fish composition

Nine species from seven families of freshwater fishes were caught in Tikub Lake (Table 1). These include three native species: *Giuris margaritacea* (snakehead gudgeon), *Chanos chanos* (milkfish), and *Clarias batrachus* (walking catfish) and six introduced species: *Cyprinus carpio carpio* (common carp), *Gambusia affinis* (mosquito fish), *Oreochromis niloticus niloticus* (Nile tilapia), *O. niloticus x O. hornorum* (red tilapia), *Poecilia sphenops* (wild molly), and *Rhinogobius giurinus* (barcheek goby).

Table 1. Checklist of fish fauna from Tikub Lake, Tiaong, Quezon

Family	Scientific Name	Author/Year	English Name	Local Name	Status
Recorded species					
Chanidae	*Chanos chanos*	(Forsskål 1775)	milkfish	bangus	Native
Cichlidae	*Oreochromis niloticus niloticus* (Linnaeus 1758)		Nile tilapia	tilapia	Introduced
	O. mossambicus x *O.hornorum**		red tilapia	tilapyang pula	Introduced
Clariidae	*Clarias batrachus*	(Linnaeus 1758)	walking catfish	hito	Native
Cyprinidae	*Cyprinus carpio carpio*	Linnaeus 1758	common carp	karpa	Introduced
Eleotridae	*Giuris margaritacea*	(Bleeker 1854)	snakehead gudgeon	bakuli	Native
Gobiidae	*Rhinogobius giurinus*	(Rutter 1897)	barcheek goby	tunghod	Introduced
Poeciliidae	*Gambusia affinis*	(Baird and Girard 1853)	mosquitofish	guno	Introduced
	Poecilia sphenops	Valenciennes 1846	wild molly	guno	Introduced
Reported species					
Channidae	*Channa striata*	(Bloch 1793)	snakehead murrel	dalag	Introduced

Cichlidae	*Amatitlania nigrofasciata*	(Günther 1867)	convict cichlid	tilapyang convict	Introduced
Centrarchidae	*Micropterus salmoides*	(Lacepède 1802)	largemouth black bass	black mask	Introduced
Terapontidae	*Leiopotherapon plumbeus*	(Kner 1864)	tiger perch	ayungin	Endemic

* developed by Garcia and Sedjro in 1987 (Watanabe et al. 2006)

According to local residents, snakehead gudgeon (*Giuris margaritacea*) known locally as '*bakuli*' which is a native species of the Philippines is the most common catch in the open water. This study was able to confirm the provided information wherein this species is the most dominant species which comprised 65 individuals or 29.41% of the total catch. Nile tilapia on the other hand, is the most common species being cultured in the lake. It comprises the largest bulk of reap from the fish cages. Milkfish was first cultured in the lake on September 5 2011, wherein the local People's Organization, Samahan ng Bantay Lawa ng Tikub attempted to raise the fish which they successfully grow and harvested only after 4 months of culture on January 7 2012. Harvests were of varying sizes that ranged from 2 to 4 fish per kilogram. Walking catfish (*Clarias batrachus*) was also caught during the survey which, according to local residents, was once abundant in the lake but now rarely caught by fishermen through spear fishing and occasionally through electrofishing as confessed by one fisherman we interviewed.

Common carp (*Cyprinus carpio carpio*), a non-indigenous species was accidentally introduced in the lake wherein it was mixed with tilapia fry most fish cage owners imported from Bay, Laguna. Red tilapia was introduced in the lake as well but was not able to establish.

Reported species

Leiopotherapon plumbeus, locally known as Ayungin was once abundant in the lake but due to sulfur upwelling or *Kanuba incidence* where the latest occurred on December 23 2008 the entire population of which was totally wiped out. Some participants of perception mapping activity conducted in relation to this study say otherwise where they claimed that they can still catch the species singly once in a while but, during the duration of this study (Table 1), not a single specimen was caught. *L. plumbeus*, although a Philippine endemic just like the native *Giuris margaritacea* may have been translocated in the lake, most probably from Laguna de Bay where the fish cage owners buy their fingerlings. This is also

true in the case of *G. affinis*, *P. sphenops* and *Rhinogobius giurinus* which are very abundant introduced species in Laguna de Bay (*personal observation*).

Dalag, scientifically known as *Channa striata*, another introduced species was also once abundant in the lake but suffered the same fate of ayungin not due to sulfur upwelling but, to overharvesting since the lake can be easily circumnavigated by spear fishers in less than 4 hours, in addition to numerous placing of gill nets in this small lake. Other reported introduced species (Table 2) previously cultured in the lake includes largemouth black bass (*Micropterus salmoides*) and the convict cichlid (*Amatitlania nigrofasciata*).

Table 2. Non-indigenous fish species recorded and reported in Tikub Lake, Tiaong, Quezon

Scientific Name	Introduction Pathway	Year of Introduction in the Philippines
Channa striata	Aquaculture	Introduced by Malays and Hindu pre or during the Spanish Era (Herre 1927b) but possible that its geographic range includes the Philippines.
*Clarias batrachus**	Aquaculture	Recorded as introduced to the Philippines from Thailand in 1972 (Juliano, Guererro and Ronquillo 1989, Guerrero 1997, Cagauan 2007) which were actually an addition to the native stock since Jordan and Richardson (1910) and the survey of Herre (1927a) in Naujan Lake already recorded the existence of this species in Philippine freshwaters. Recorded by Herre (1953) in different parts of the Philippines prior to the recorded date of introduction.
Cyprinus carpio carpio	Aquaculture	Introduced in the Philippines from Hongkong with conflicting year: 1915 (Juliano, Guererro and Ronquillo 1989, Guererro 1997) and 1910 (Cagauan 2007).
Oreochromis niloticus niloticus	Aquaculture	Introduced to the Philippines from Thailand in 1970 and 1972 (Juliano, Guererro and Ronquillo 1989), Israel in 1972 (Guererro 1997, Cagauan 2007), Israel in 1973 (Juliano, Guererro and Ronquillo 1989).

Gambusia affinis	Mosquito control	Introduced to the Philippines in 1913 from Honolulu, Hawaii, USA by Alvin Seale in 1913 (Seale 1917).
Poecilia sphenops	Possible through aquarium trade	No record of introduction.
Rhinogobius giurinus	Possible through aquarium trade	No record of introduction.
Micropterus salmoides	Sport fishing	Introduced from San Francisco, California, USA by Alvin Seale in 1907 (Seale 1910).
Amatitlania nigrofasciata	Possible through aquarium trade	Listed as introduced in the Philippines in Fish Base (Froese and Pauly 2011), no record of year of introduction.

*We consider in this paper that the native geographic range of *C. batrachus* includes the Philippines

Biological Indices

Tikub Lake has species richness of 9 which pertains to fish species collected in the lake. Species diversity (1.87) is high considering that in the natural ecosystem, diversity index ranges from 1.5 to 3.5 wherein the value above 3.0 indicates a stable habitat while value under 1.0 indicates highly disturbed environment (Magurran 2004). Pielou's evenness index, species dominance and species density was computed at 0.21, 0.18 and 3/10 m^2, respectively.

Relative abundance of fish species caught in Tikub Lake is presented in Figure 2 wherein result showed that *G. margaritacea* and *P. sphenops* are the two most abundant species in the lake. Relative abundance is important to determine what species are common and what species are rare in a community.

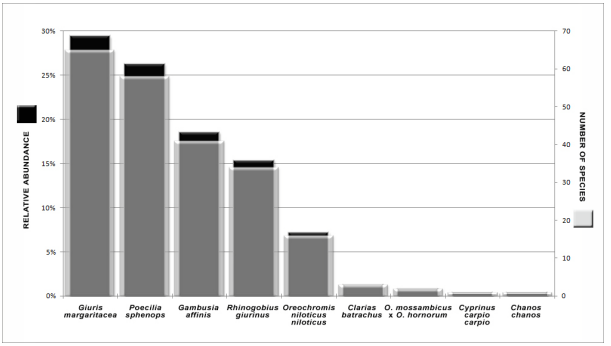

Fig. 2. Relative abundance of freshwater fishes of Tikub Lake

CONCLUSIONS

Tikub Lake as shown in the study does not harbor species new to science and instead the lake is home to numerous non-native species which have been introduced through aquaculture. The proliferation of introduced species may be partially responsible for the decline of other native species translocated in the lake; other factors responsible include *Kanuba incidence* or sulfur upwelling, and over harvesting of aquatic resources. Fish cage operation, introduction of invasive alien species, and over harvesting are among the gravest threat to the lake. Fish cage operation is being allowed to augment the economic status of people living in the surrounding area without really understanding the long term effect of such activity. The community is not aware of the consequences and the extent of damage aquaculture can bring to the environment since they only see the lake as area for aquaculture production and as a place where they get their catch for daily living. However, the importance of the lake as an integral component of a larger picture (landscape) is often taken for granted.

Finally, with the limited literature pertaining to small lakes of the Philippines, this study can be used as a basis for similar future study.

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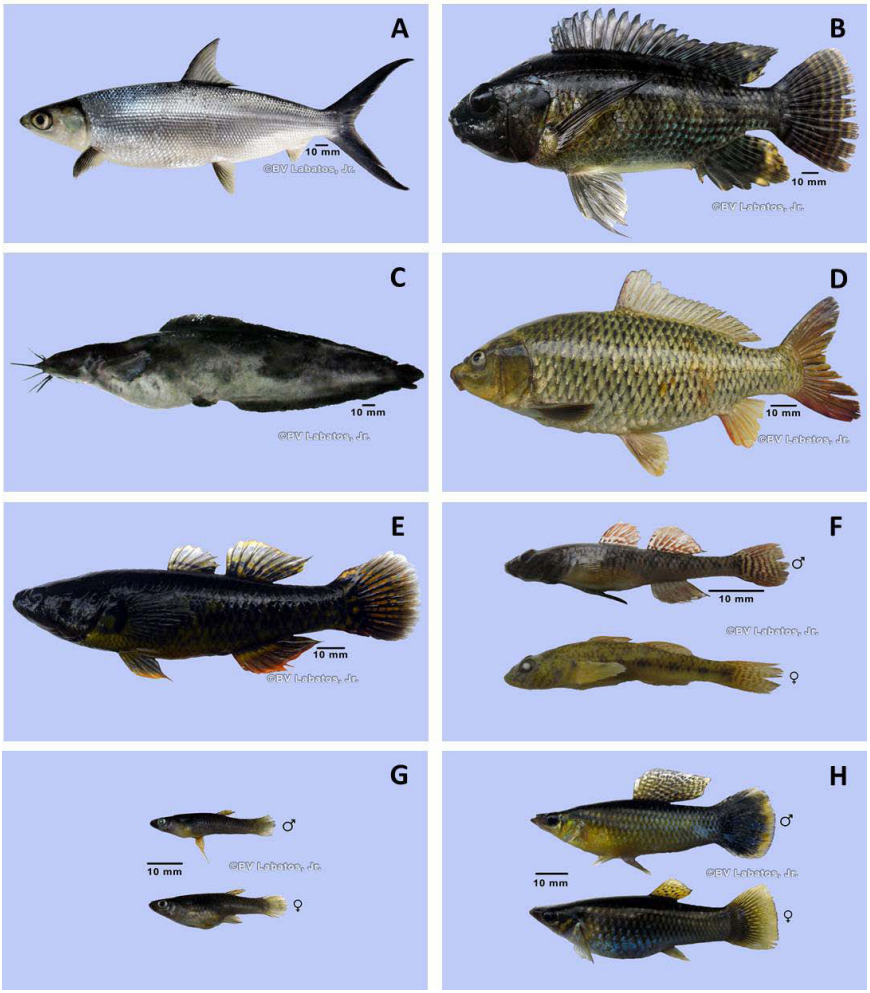

Plate 1. Freshwater fishes documented from Tikub Lake, Tiaong, Quezon: A. Milkfish, *Chanos chanos* (Forsskål 1775); B. Nile tilapia, *Oreochromis niloticus niloticus* (Linnaeus 1758); C. walking catfish, *Clarias batrachus* (Linnaeus 1758); D. common carp, *Cyprinus carpio carpio* Linnaeus 1758; E. snakehead gudgeon, *Giuris margaritacea* (Bleeker 1854); F. barcheek goby, *Rhinogobius giurinus* (Rutter 1897); G. mosquitofish, *Gambusia affinis* (Baird and Girard 1853); and, H. wild molly, *Poecilia sphenops* Valenciennes 1846.