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Full Length Research Paper

Impacts of anthropogenic activities on fish habitat, breeding ground, and macrophytes of lake Lugo

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Data was collected from November, 2012 to June, 2014. Three sampling sites were Ankerkeha, river mouth; Zegeta which is an open water that represents lake mean depth. And areas at which remnants of vegetation are observed (Gedam sefer). At these three sites hysic-chemical parameters and stretched mesh sizes of 6cm, 8cm, 10cm, 12cm and 14cm were used to evaluate water quality and catch per unit efforts for fish stock. Echo sounder device was used to evaluate its depth. Fishing activities were aggregated at shore areas where the fingerlings are fed, grown up with different type of maternity cares of the different fish species found in the lake. In most cases, even if fishing activity is underway during night time it is not uncommon to see fishers encircled with narrow monofilament gillnet followed by chasing and dragging towards a certain point that initially pointed somewhere. Fishers catch by such type mainly *O. niloticus* with TL ranges from 12 cm to 16 cm with 13.5 cm mean length and ripened at 15.1 cm. This indicates that there is over fishing in lake Lugo. This needs an immediate management plan to cop up the existing fishing pressure and ecosystem degradation of important habitats through different anthropogenic activities.

Keywords: Anthropogenic activities, fish habitat, breeding ground, and macrophytes, lake Lugo

INTRODUCTION

Tropical fresh water ecosystems are among the biologically richest ecosystems on Earth, but are being rapidly degraded and destroyed by habitat conversion. These water bodies are also vulnerable to global warming (Williams et al., 2013; Tewksbury et al., 2008; Colwell et al., 2008) and other large-scale environmental changes (Laurance and Peres, 2006). But much uncertainty exists about the nature and magnitude of these anthropogenic impacts on tropical fresh water organisms. Land use and land cover dynamics are widespread, accelerating, and significant processes driven by human actions but also producing changes that impact humans (Agarwal *et. Al.*, 2002). These dynamics alter the availability of different biophysical resources including soil, vegetation, water, animal feed and others.

Objectives

• To know the existing situations of fishing activities and it's fish stock status of the lake

• To assess shoreline development, anthropogenic activities, catchment conditions and depth of a lake

• To characterize hysic-chemical parameters of the lake.

• To recommend good management options for sustainable utilization of the resource

MATERIALS AND METHODS

Study area

Data was collected from November, 2012 to June, 2014. Lake Lugo is characterized as a highland Ethiopian lake with an annual rainfall of 1173mm and a mean air temperature 0f 18.2^{o}c (National Meteorological Agency, 2002). Lake Lugo is a deep lake with maximum depth of 88 m and mean depth of 37.37m (Baxter and Golobitsh, 1970). It is a fresh water lake with a salinity of 0.828gL^{-1} (Zinabu *et.al*.,2002). Stratified sampling sites were selected based on its shoreline type, encroachment and considering total surface area of the lake. As a result

Figure 1: *Cyprinus carpio*, *O. niloticus* and *C. gariepinus* are fish species found in L. Lugo

Table 1: Physical characteristics of lake Lugo

Site	pH	Oxygen mg/l	T °c	TDS g/l
Gedamesefre	9.4	6.43	22.26	0.607
Ankerkeha	8.9	7	22.5	0.602
Zegeta	9	6.7	22.24	0.6065

Sites	Salinity	Cond	Sp.cond	S.disc in m	Depth m
Gedam sefre	0.46	930	0.88	40	12.55
Ankerkeha	0.45	920	0.87	33.5	22.25
Zegeta	0.46	930	0.88	3.55	34.5

Table 2: Chemical composition of lake Lugo

Site	phosphate	Amonia	Nitrite	Nitrate
Gedam sefer	0.675	0.19	0.006	0.858
Ankerkeha	0.18	0.1	0.014	0.968
Zegeta	0.11	0.315	0.012	0.924

Site	Total hardness	Silicate in 1ml	Sulphate	Turbidity	Alkalinity
Gedam sefer	287.5	9.7	4	5	450
Ankerkeha	260	9.1	1.5	4	460
Zegeta	290	7.6	37.5	2.5	441.5

Ankerkeha River mouth, Zegeta sampling site which is open water that represents lake mean depth. And areas at which remnants of vegetation are observed (Gedam sefer). At these three sites physico-chemical parameters and stretched mesh sizes of 6cm, 8cm, 10cm, 12cm and 14cm were used to evaluate water quality and catch per unit efforts for fish stock. Echo sounder device was used to evaluate its depth. Personal observation at every corner of the lake was made to evaluate every activities performed around the lake including fishing activities. Purposive sampling technique with fishers and inhabitants was made

RESULTS AND DISCUSSION

Lake Lugo is connected with the nearby lake known as Lake Ardibo through Ankerkeha River. Commercially important fish species that inhabit the lake are *Oreochromis niloticus* (Nile Tilapia) which was introduced by Bureau of agriculture. *Cyprinus carpio* (common carp) which was introduced from nearby lake Ardibo through irrigational schemes (Figure 1). And the last but not least is *Clarias gariepinus* (African catfish) which is the only indigenous fish species (Baxter and Golobitsh, 1970).

In the present study maximum depth of the lake found to be 77 m and with mean depth of 30 m from which it was 88m and 37.37m according to ((Baxter and Golobitsh, 1970). Ammonia (NH_3); this test Shows deep green color, it implies that the nitrogen compound drains directly from the surrounding farm land and homesteads to the lake. Alkalinity; this test shows deep blue color, means it is basic that indicates Hydroxides, Carbonates, bicarbonates sometimes silicates and phosphate drains towards the lake directly from the catchment areas (Table 1 and 2).

Table 3: Number, mean length, mean weight and fish composition per sampling sites

Sampling site	Wet season					Dry season		
	Gear code	Species	Number	Mean length (cm)	Mean weight (gm)	Number	Mean length (cm)	Mean weight (gm)
Ankerkeha	10cm	*C. carpio*				3	28.5	300.5
	8cm	*C. gariepinus*	1	38.2	397			
		C. carpio				1	23.5	167
	6cm	*O. niloticus*	5	15.2	63			
		C. carpio	38	17.5	72			
Zegeta	-	-	-	-	-	-	-	-
Gedam Sefer	12cm	*C. carpio*	1	12.6	28			
		C. gariepinus				1	59.2	1191
	10cm	*C. gariepinus*				2	43.8	500
		C. carpio				1	26.4	234.6
	8cm	*C. gariepinus*				1	41.6	436.1
	6cm	*O.niloticus*	1	16.2	72			
		C. carpio	4	16.45	61	2	17.5	67.5
		C. gariepinus				1	29	156.1
	Total		**50**		**3728**	**12**		**4221.3**

Mean secchi depth is 3.87m. During all sampling trips and sampling site with 6cm, 8cm, 10cm, 12cm and 14cm mesh size was used and caught 50 *C. carpio* of which 30.2cm highest length and 12.6cm smallest size with the mean size 20.13 cm STDEV 8.26 cm was recorded. *C. carpio* of which 30.2cm highest length and 12.6cm smallest size with the mean size 20.13 cm was recorded. *O. niloticus* specimens were caught of which 16.2 cm highest length and 15.2 mean length. *C. gariepinus* with 59.2 cm highest length and 29 cm smallest length with mean length of 34.5 cm. During the three sampling periods Zegeta site was none of catch (Table 3).

Fishing gears and activities of fishers

Fishers of the lake used gillnets made locally from nylon rope and imported from Sudan (Monofilament gillnets). In most cases fishers around the lake have ample experience in fishing activities using local made gillnet made from the nylon rope purchased from the shop by dismantling the single trade from the already fabricated twine nylon rope and prepared for making gillnet for fishing activities in lake Lugo. This practice is well adopted for several years back due to shortage of appropriate twine trade fabricated abroad and disseminated for fishers where fishing activity is commonly known water bodies in the country. But due to different reasons it could not be easy to get these twine trade in their nearby market. So fishers through time found the solution to have fishing gear which is not expensive. Therefore, fishers trained to make gillnet from locally available materials that is nylon rope that found every shop in their surroundings (Figure 2).

Fishers of the surrounding used heavy metal material which is coiled thick rope like material in order to make the gillnet heavy at the lead part (bottom) of the gillnet so that it could be easy to drag the bottom of the lake and able to collect all sized fish at some where they pointed out. Most of the fishing activity is taking place during night time that extends until early in the morning in most cases no later than 8:00 AM. But at a lesser extent there is same type of fishing activity that starts early in the morning until 11:00 AM, which is mainly handled by part-timer and beginner young fishers. Otherwise in most cases fishing gears and fishing boat made from locally available bamboo trees are piled up together and put at shore area of the lake till dark time of a day comes (Figure 3).

Fishing activities mainly aggregates at shore area of the lake where both fish species found in the lake breeds and the baby fishes are grown up particularly in areas where vegetation cover is available and the depth of the water is relatively low. Because attachment of the eggs maternity care and availability of feeding materials for the fry including insect larvae are high in such part of the water bodies. Hence, fishers do not want to set on gillnet over night at open water of the lake. Rather tend to fish at the shore area using small stretched mesh size gillnet, on top of this fishers drag the gillnet after circling and chasing (Figure 4). As a result their catch is under table sized mean length of 15.2cm and mean weight 63gm was registered for *O. niloticus* in fishers daily catch. *Cyprinus carpio* mean length and mean weight of fishers catch was 17.5 cm and 72 gm respectively (Figure 4).

Fishing activities were aggregated at shore areas where the fingerlings are fed, grown up with different type of maternity cares of the different fish species found in the lake. In most cases, even if fishing activity is underway during night time it is not uncommon to see fishers encircled with narrow monofilament gillnet followed by chasing and dragging towards a certain point that initially pointed somewhere. Fishers catch by such

Figure 2: Fishing gears of L. Lugo made from nylon rope locally with heavy lead in order to drag the ground

Figure 3: Fishing boat made from locally available bamboo trees are piled up with monofilaments and put at shore area of the lake

Figure 4: Fishing activities of L. Lugo mainly aggregates at shore area by encircled, chase, drag and trap system

type mainly *O. niloticus* with TL ranges from 12 cm to 16 cm with 13.5 cm mean length and ripened at 15.1 cm (Figure 6). Very surprisingly fishers encircled the small remnant vegetations with 4 cm stretched mesh sized monofilament gillnet (Figure 5).

Fish catch processing and post harvest handling is taking place at each landing sites of their proximate vicinity. Basically fishers are targeting for *O. niloticus*, but in some cases there are catches for *C. carpio* followed by *C. gariepinus*. The catches of *O. niloticus* filleted together with the caudal fins, so that two sides of filleted flesh could not be separated and orderly

Figure 5: Fishers encircled with small mesh sized monofilament gillnet targeting fingerling fishes

Figure 6: Fishers catch: mainly *O. niloticus* with TL ranges from 12 cm to 16 cm with 13.5 cm mean length and ripened at 15.1 cm with body weight of 68 gm

Figure 7: Post harvest handling of *O. niloticus* species prepared for transportation and sale in the nearby town Haiq and Dessie

arranged by thin nylon rope based on the affordability of their customers (Figure 7).

Huge amount of fish left over carcass is discarded every day at every landing sites of the lake. The most common fish left over carcass observed belongs to *O. niloticus* (Figure 8). Because the composition of fishers catch is *O. niloticus* and during processing only filleted not dissected fish species is *O.niloticus*. With a very

Figure 8: Fish offal totally discarded at every landing sites of L. Lugo

Figure 9: highly degraded ecosystem of the nearby catchment area, due to anthropogenic activities

small proportion, there is gut content offal for *C. carpio* discarded to the environment.

Ecosystem and habitat destruction

Catchment degradation

In the catchment area of the lake, crop cultivation is taking place at the sloppy sides of every hill without any form of soil and water conservation strategies applied to the area. Hence, heavy erosion is an ultimate goal for the bared soil (Figure 9). Therefore, during the present study the maximum depth of the lake is found 77 m with mean depth of 30 m, that reduced by 11 m from which it was 88 m with mean depth of 37.37 m (Baxter and Golobitsh, 1970).

Ankerkeha tributary river blockage starting from post rainy season mainly for irrigation purposes contributing the low inflow rate and ultimately results low lake level (Fig. 10). There are also different projects designed for pumping the lake for irrigation purposes, this will come up with shrinkage of the lake especially littoral regions which is the most productive site for fisheries of the lake.

Land use change shoreline habitat destruction such as crop cultivation for both perineal and annual crops is immense by land fill system of the shore areas of the lake, this is a direct negative anthropogenic activity impact of the most productive site of the lake regarding to fisheries. Since the lake is the deepest lake both reproduction and feeding activities has been mainly taking place at shore areas where vegetation cover is possibly grown up. But landfills to the shore area by transporting soil and gravel from somewhere else and

Figure 10: Tributary river (Ankerkeha) blocked during post rainy season diverted for irrigation at the upstream

Figure 11: Crop cultivation inside shore area of the lake by landfills process

Figure 12: Wetland encroachment by inhabitants and manusipality

cultivating crop is commonly practiced this condition adversely affects the production and productivity of lake fisheries (Figure 11).

Both the municipality and the inhabitants around the lake targeted wetlands of the lake through different intervention activities such as cultivating field crops like maize and settlement and lodge construction at just the edge of the lake (Figure 12). As a result wetlands are adversely encroached by the inhabitants and lose their proper functioning to sustain the production of the lake.

Heavy livestock grazing inside the lake and harvesting littoral vegetations for fodder and Pumping water from lake for irrigation purposes contribute great for the destruction of wetlands which are found around Lake Lugo (Figure 13). These wetlands are very important for Lake Ecosystem by serving as filter for sedimentation,

Figure 13: Lake water pumping projects at different wetland sites of Lake Lugo

trapping chemicals drained from upper catchment, serves as feed source for the whole lake system, serves as breeding and nursery grounds for different fish species of the lake.

CONCLUSION

The existing fishing activity types; encircling, chasing and dragging with small sized monofilament gillnet be locally made or imported from Egypt has contribute for over fishing occurrence in lake Lugo. The declined mean size and mean weight of fish species indicates the existence of over fishing. The length of *O. niloticus* 15.2 cm at maturity stage indicates that change in life history strategy that able to substitute themselves before being caught by fishers at early age of their life time. Ecosystem degradation is very immense (shore line vegetation loss, lake volume decrement and siltation).

RECOMMENDATIONS

- The existing fishing activity types; encircling, chasing and dragging with small sized monofilament gillnet be locally made or imported from Egypt has to be changed with selective appropriate fishing gear types
- Fishing activities has to be done far from shore vegetation cover areas, in order to safeguard the breeding and nursery grounds for better recruitment
- Verify the breeding seasons and grounds of the different fish species and implement closed seasons and grounds during the pick breeding seasons of a year
- Since the lake is deep lake, it is very important to develop shoreline for good breeding, nursery and buffer zone sites
- Soil and water conservation strategy has to be in place to overcome the problem of siltation water quality and depth change of the lake

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