Impacts of Beam Trawl Net (Al-Qerba) on
Tilapia Fish Population in Lake Manzalah, Egypt

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Abstract: Analysis of the length-frequency of Cichlid fish species caught by trawl nets (Al-Qerba) using (FiSAT) computer program revealed that the Von Bertalanffy's growth parameters were: L_∞ = 23.89 cm (asymptotic length); k = 1.2year^{-1} for *O. niloticus*; L_∞ = 19.19 cm; k = 0.96year^{-1} for *O. aureus*. The estimated fishing mortality rate of *O. niloticus* was found as 4.9 whereas that of *O. aureus* was 3.31. The upper limit of selection range (L_{75}) didn't exeed 11 cm for the both species. The estimated exploitation rates "E" were 0.72 and 0.66 in respective for the two species indicating overfishing. To save tilapia stock, fishing by beam trawling in Lake Manzalah should be forbidden due to its destructive impact on the fishing grounds, fish nests and ecosystem effects caused by recycling the dsorbed pollutants into water and controlling the submerged plants causing to deterioration of the lake water.

Key words: Tilapia · Fisheries · Trawling gears · Lake manzalah · Egypt

INTRODUCTION

Lake Manzalah is considered as one of the most important sources of inland fishery in Egypt where it yields about 38.02% of the northern Nile Delta lakes and is considered as the second major source of fish after Lake Burollus [1].

Four Cichlid species were identified in Lake Manzalah namely; *Oreochromis niloticus, Oreochromis aureus*, *Sarotherodon galilaeus* and *Tilapia zillii*. The first two species were more abundant than the other two species in most areas of the lake [2]. During the last few decades the lake has encountered numerous problems and extensive resource exploitation which has constrained its productivity resulting in the drastic decline of biodiversity in general and fisheries in particular.

Various aspects of the biology of Cichlid species have been studied in Egypt [4-9]. There is a considerable exploitation pressure on the different species of tilapia specially *O. niloticus* & *O. aureus*. Information on fishing mortality and exploitation rates exerted by the different fishing gears are essentially required to asses the current status of the fishery in view of the present exploitation regime and for sustainable management of the lake fishery.

MATERIALS AND METHODS

Trawling net or frame net (locally known as Al-Qerba, Picture 1) is one of the illegal and destructive fishing methods used in lake Manzalah. Frame net is made of a wooden triangular frame. The base of which is a sharp iron plate of 1.5 m long fixed with two "X" shaped wooden bars and each of 3 m long. A funnel shaped webbing of about 3 to 4 m long, with an average mesh size of 1.7 cm (± 0.219), is attached to it. The frame net is tied to one side of the fishing boat with strong ropes. Fishing by this method is mostly

Carried out at the eastern and the middle regions of the lake where the aquatic vegetation are spreading [2].

On trawling, the net is hold by fishermen and they push the wooden frame downwards. As the boat moves forward, the iron base sweeps the bottom of the lake and the plants present. Consequently , all fish present on the bottom fall back into the funnel of the net with mud, shells and plant remains. The net is then lifted on the boat and the catch is removed and washed while other remains are thrown away.

The length frequency data of both *O. niloticus* and *O. aureus* collected from the catch of trawling nets operating in Lake Manzalah (data collected by [2] were analyzed using the appropriate routines and subroutines

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Pic. 1: A First class boat operating with frame net (Al-Qerba), Lake Manzalah

of the "FiSAT" computer program [10]. An estimate of the asymptotic length (L_∞) and the growth coefficient (K) were obtained by the method of Wetherall [11]. The parameters were then used as seed values in ELEFAN I routine [12, 13] for estimating the best combination of L_∞ and K.

The instantaneous rate of total mortality (Z) was derived from the length converted catch curve method described by Pauly [14]. The instantaneous rate of natural mortality (M) was computed from the empirical equation of Pauly [12] considering the mean annual water temperature of the lake as 20.75°C [15]. The instantaneous rate of fishing mortality (F) was calculated as F= Z–M. The exploitation rate also was calculated as E = F/Z. The length at first capture "L_c" was determined from the catch curve according to Pauly [13, 14].

The relative yield per recruit (Y/R)' and relative biomass per recruit (B/R)' were estimated using the model of Beverton and Holt modified by Pauly and Soriano [16] and incorporated in the FISAT software package as follows; $(Y/R)' = E\ U^{M/K}\ [1 - (3U/1+m) + (3U^2/1+2m) - (U^3/1+3m)]$ $(B/R)' = (Y/R)' / F$.

RESULTS

Tilapia fish forms the majority of fish catch from lake Manzalah (53.38, 50.83 %) in years 2000 and 2001, respectively. It shows signs of a decline in the landed catch in the last few years as it contributed only by 42.59% in 2006, followed by the Catfish *Clarias gariepinus* (23.3 %) as recorded [1].

A total number of 2404 fish were collected from the trawl net catch. *O. niloticus* represented the majority (1741) by 72.42 % of that number. Their total lengths varied between 4.5 cm and 20.5 cm with a modal length at 10.5 cm. *O. aureus* was represented by 25.83 % where its modal length was also corresponding to 10.5 cm (Fig. 1). *Tilapia zillii* & *S. galilaeus* were poorly represented in the catch (1.7 % & 0.04 % respectively).

An estimate of the total mortality coefficient (Z) for *O. niloticus* was found to be $6.77y^{-1}$. Meanwhile, the natural mortality rate of *O. niloticus* (M) was found as $1.87y^{-1}$. The fishing mortality rate (F) was computed as $4.9y^{-1}$ (Table 1).
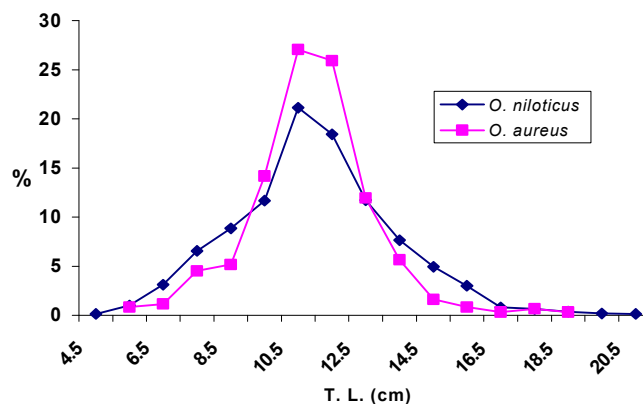

Fig. 1: Annual length frequency of O. niloticus & O. aureus caught by trawl net, Lake Manzalah

Table 1: Mortality and exploitation rates of *O. niloticus* and *O. aureus* caught by trawl net (frame net) in Lake Manzalah

Fishing Method	Species	L_8 (cm)	K	Z	$C.I._Z$	M	F	E
Trawl net	*O. niloticus*	23.89	1.2	6.77	6.127 - 7.407	1.87	4.9	0.72
	O. aureus	19.19	0.96	5.03	4.115 – 5.947	1.72	3.31	0.66

Note; $C.I._Z$ = Confidence interval of Z

Table 2: Probability of capture and Relative exploitation parameters corresponding to yield per recruit (Y/R)' and relative biomass per recruit (B/R)' for *O. niloticus* and *O. aureus* caught by trawl net , Lake Manzalah

Parameter	L_{25} (cm)	L_{50} (cm)	L_{75} (cm)	E_{10}	E_{50}	E_{max}
O. niloticus	8.62	9.46	10.39	0.516	0.332	0.604
O. aureus	9.13	10.02	10.89	0.656	0.371	0.794

The total mortality coefficient (Z) of *O. aureus* was estimated as $5.03y^{-1}$. While the natural mortality rate (M) of *O. aureus* was computed as $1.72y^{-1}$. Thus; its respective fishing mortality rate was calculated as $3.31y^{-1}$ (Table 1).

The exploitation rates (E) were found to be 0.72 for *O. niloticus* and 0.66 for *O. aureus*.

The length at first capture (L_c)at which 50% of the fish that become allowable to capture was estimated to be 9.46 cm and 10.02 cm for *O. niloticus* and *O. aureus* respectively. The selection range fluctuated between 8.62 cm and 10.39 cm total length for *O. niloticus* caught by trawl nets, while it ranged between 9.13 cm and 10.89 cm for *O. aureus* caught by the same net (Table, 2).

As shown at Table (2), the relative yield per recruit and relative biomass per recruit of *Oreochromis niloticus* and *O. aureus* were estimated. It was found that the maximum exploitation rate of *O. niloticus* was 0.60 caught by trawl net , while its value at 50% unexploited biomass was 0.33. The maximum rate of exploitation of *O. aureus* was 0.79.

The value of exploitation ($E_{0.1}$) where its slope corresponds to $1/10^{th}$ of the value at the origin of the yield per recruit curve was 0.52 for *O. niloticus* and 0.66 for *O. aureus* caught by the trawl net.

DISCUSSION

According to [16], both the total catch and tilapia catch of Lake Manzalah showed a decreasing trend (r = - 0.8739) at the last few years (2000-2006). This decrease may be due to many factors as reduction in lake's area, a progressive increase of eutrophication and pollution of lake water [18] as well as using illegal fishing gears in the lake [2]. A variety of factors are implicated including sea communication problems, reduction of the fresh water supply, over- fishing with a continuing increase of fishing effort units, contributes to fisheries decline [19].

Mortality (fishing and natural mortality) rates are important for understanding the rate of population decay [20]. The total mortality coefficients (Z) for *O. niloticus* and *O. aureus* as shown in (Table 1) and from the length converted catch curve (Figure 2, a&b) caught by trawl nets were higher than those estimated by El-Bokhty [21] for fish caught by seine net and higher than those estimated from trammel and basket trap catches indicating that the species are subjected to high exploitation levels [16].
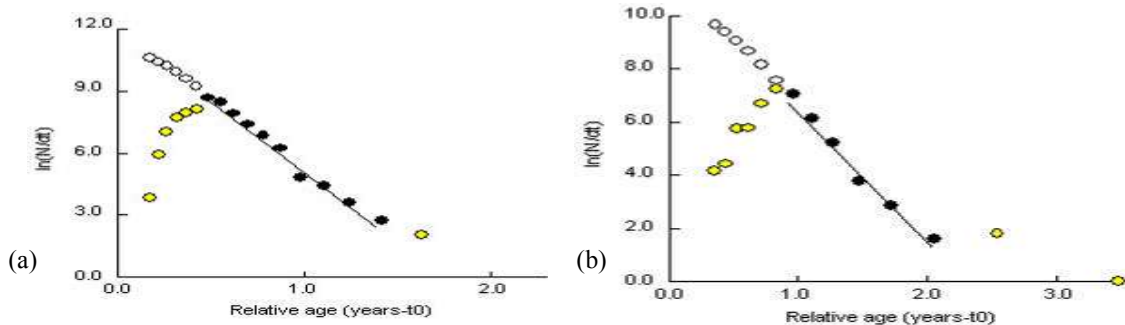
Fig. 2a: Length converted catch curve of *O. niloticus* caught by trawl nets, Lake Manzalah.
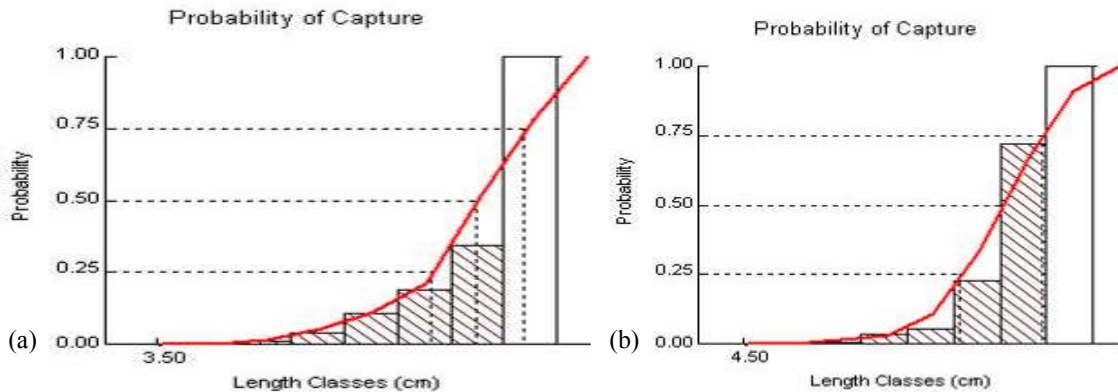Fig. 2b: Length converted catch curves of *O. aureus* caught by trawl nets, Lake Manzalah

Fig. 3a: Probability of length at first capture for *O. niloticus* caught by trawl nets, Lake Manzalah
Fig. 3b: Probability of length at first capture for *O. aureus* caught by trawl nets, Lake Manzalah
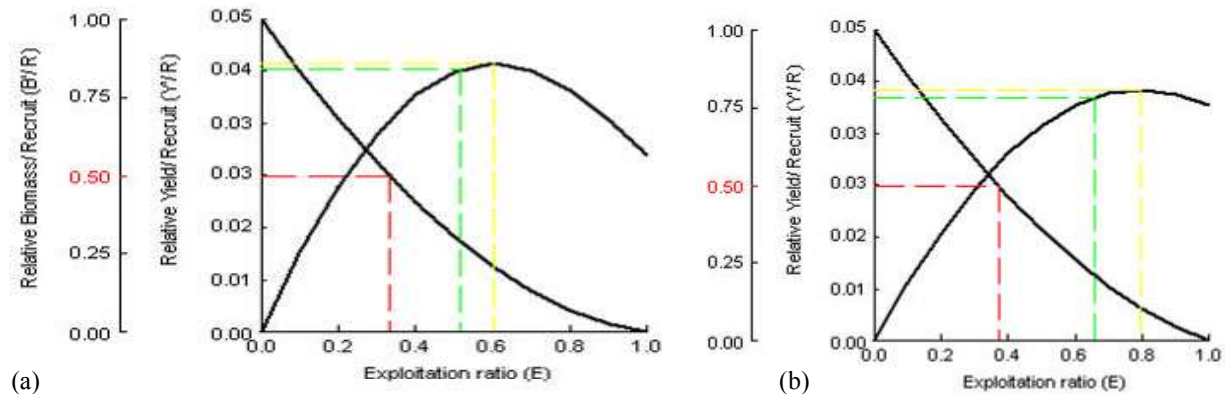

Fig. 4a: Relative yield per recruit (Y/R)' and biomass per recruit (B/R)' of *O. niloticus*, caught by trawl net, Lake Manzalah
Fig. 4b: Relative yield per recruit (Y/R)' and biomass per recruit (B/R)' of *O. aureus*, caught by trawl net, Lake Manzalah

Lengths at first capture (L_c) at which 50% of the fish become vulnerable to capture were estimated as 9.46 cm and 10.02 cm for *O. niloticus* and *O. aureus* respectively by trawl nets, (Figure 3, a&b). These low values can be attributed to the small mesh sizes of the trawl nets used in the lake as well as tilapia accomodation to stress and the high fishing pressure. Welcomme [22] explained that fish assemblages respond to fishing pressure (and other externally induced stress) by a decline in mean size. Some species, especially the larger are unable to accommodate to fishing pressure and disappear from the assemblages. Others, such as the Tilapia, are able to maintain their place in the assemblage by reducing their mean size. El-Zarka [5] reported that tilapia fish are caught at average length 11 cm. This sizes don't affect the breeding success of the fish because tilapia are known as sfractional spawners and reach its first maturity and spawns at this size and even at smaller lengths but fishing

large numbers from tilapia fish at such lengths may cause stock collapse on the long run as they will not be able to spawn. Hence, L_c values are recommended to be raised to 15 cm in total lengths by using wider mesh-sized nets for conservation of the stock and also to raise the sustainable yields of the different fish caught by trawl nets.

As obvious from Relative yield per recruit (Y/R)' and relative biomass per recruit (B/R)' Figures (4, a&b), the exploitation rates of *Oreochromis niloticus* was found more higher than *O. aureus*. These values should be reduced from 0.72 and 0.66 in respective to the former two species to the optimum value (0.5) through reducing the effort exerted by such nets and to correspond at least E_{10} value (0.51) for *O. niloticus* to reach an optimally exploited stock [24]. To get this, the mesh sizes of nets used in trwal nets should be increased in parallel with decreasing the effort exerted. The elastic increase in the overall fishing effort resulted in reducing the CPUE.

In combination with reduction of mesh sizes in the used gears have led to the over-fishing problem and decline of the fish catch of Lake Manzalah and decreasing the mean fish lengths. Fisheries management should aim at limiting gear types and mesh sizes which are difficult to be controlled in such lake without enforcing laws.

In conclusion, results indicated that the stock of *O. niloticus*, *O. aureus* in Lake Manzalah are biologically overexploited. For fishery management of this fishery resource, the fishing pressure and the present level of exploitation should be reduced to the optimum level (0.50%) and /or fishing by trawl nets should be prohibited due to its destructive impact on the fishing grounds and rapid deterioration of the aquatic environment. Using static or passive fishing gears such as trammel nets (with an inner layer) or gill nets of stretched mesh sizes of not less than 6 cm and basket traps of not less than 5 cm stretched mesh in such shallow muddy bottom lakes should be advantageous on the active or towed gears as trawl nets.

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