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Edna Waithaka
Kenya Marine and Fisheries
Research Institute P.O. Box 837,
Naivasha, Kenya.

James Mugo
Kenya Marine and Fisheries
Research Institute P.O. Box 837,
Naivasha, Kenya.

Beatrice Obegi
Kenya Marine and Fisheries
Research Institute P.O. Box 837,
Naivasha, Kenya.

James Last
Kenya Marine and Fisheries
Research Institute P.O. Box 837,
Naivasha, Kenya.

Correspondence
Edna Waithaka
Kenya Marine and Fisheries
Research Institute P.O. Box 837,
Naivasha, Kenya.

Socio-economics of the re-introduced *Oreochromis niloticus* in Lake Naivasha (Kenya)

Edna Waithaka, James Mugo, Beatrice Obegi, James Last

Abstract

A study conducted in June and July 2014 by a team of Kenya Marine and Fisheries Research Institute staff to assess the socio-economics of the re-introduced species (*O. niloticus*) on the fishing community of Lake Naivasha. The study conducted semi structured interviews with fishers and fish traders at the four landing beaches along the shores of Lake Naivasha. The study revealed that fishing in Lake Naivasha is male youth dominated, within the age groups of 30 to 40 years old. It also revealed that *O. niloticus* is the most preferred fish recording 88% of the total fish landed in the Landing beaches of Lake Naivasha. Most fishermen confirmed to having changed their fishing habits to prolonged fishing hours (day and night), changing their fishing gear sizes from 3 inches to 4-6 inch mesh sizes and landing *O. niloticus* of total length (TL) 26-30cm followed by 31-35cm and 36-40cm. Most fishers were of the opinion that the restocking programme be intensified while the closed season be lifted citing lack of alternative livelihoods and income sources. The study recommended that fisheries managers develop suitable and viable methodologies for the sustainable management of this lake. To sustain the socio-economic status that has been realized.

Keywords: Restocking, *O. niloticus*, preferences, alternative livelihoods, sustainability

1. Introduction

Lake Naivasha is a Ramsar wetland of International importance situated in the Eastern Rift valley of Kenya. It lies in a closed basin at an altitude of 1890m above sea level. It is an endorheic lake with an area of about 140km² and mean depth varying between 4-6m.

Lake Naivasha fishery is based on fish species that were introduced between 1925 and 1970 for different purposes. The Largemouth bass (*Micropterus salmoides*) was introduced to support the sport fishery on the lake while *Tilapia nigra*, a mouth brooding cichlid, was introduced for the purpose of providing food for Black bass (Elder and Garrod, 1971) [2]. The initial introductions of the two species were successful for about two decades although in the late 1940s and early 1950s the lake experienced lower water levels leading to their disappearance. Black bass and other new species (i.e. *Tilapia zillii* and *Oreochromis leucostictus*) were later re-introduced in 1956 (Garrod and Elder, 1961) [3]. In 1965, *O. niloticus* was introduced in the lake but the species survived only up to 1969. Another re-introduction was done in 2011 which is now being landed in commercial catches.

Other fish species introduced in the lake were *Gambusia* sp., *Poecilia reticulata* and *Lebistes reticulata* (Guppy) mainly for the purpose of controlling mosquitoes. Specimens of *Salmo gairdneri* (Rainbow trout) and *Barbus amphigramma* (Palcidinosus) have been caught from the lake having probably strayed in from River Malewa (Harper, 1984). A crayfish was introduced in the lake in 1970 as food for Black bass. The most recent species to be noted in the lake is common carp, (*Cyprinus carpio* L.) This species was first recorded in 2001 and is believed to have escaped from the dams in the catchment during the El-Nino period.

Most of the fish species in Lake Naivasha, especially tilapiines, Black bass and Common carp are of commercial importance. Before the introduction of the closed seasons the major fish species in the commercial landings was *O. leucostictus*. However, after the closures common carp, initially accounted for about 0.5 % of total fish landed between January and May 2003, became the major fish species landed accounting for over 95 % of the total fish landed.

Present in the Lake today are *O.leucostictus* (Trewavas), *Tilapia zillii* (Gervais), *Micropterus salmoides* (Largemouth bass), *Barbus amphigramma* Blgr, *Cyprinus Carpio* L., *Clarias gariepinus*, *Clarias allaudi* and *O. niloticus* which has established itself and increased the economic benefits derived by the fishers from this fishery.

Therefore the main objective of our study was to assess the socio-economics of the re-introduced *O. niloticus* on the fishing community of Lake Naivasha.

Materials and methods

The study was conducted between June and July 2014 by a team of Kenya Marine and Fisheries Research Institute staff. Semi structured interviews were conducted between fishers

and fish traders at the five landing beaches along the shores of Lake Naivasha; Kamere, Tarambete, Karagita, Kihoto and Central landing beaches (Figure 1). A total of 15 questions were asked and the questions covered aspects of personal information, species preferences, fishing patterns, fish markets, fishers perceptions on restocking and closed fishing season etc.

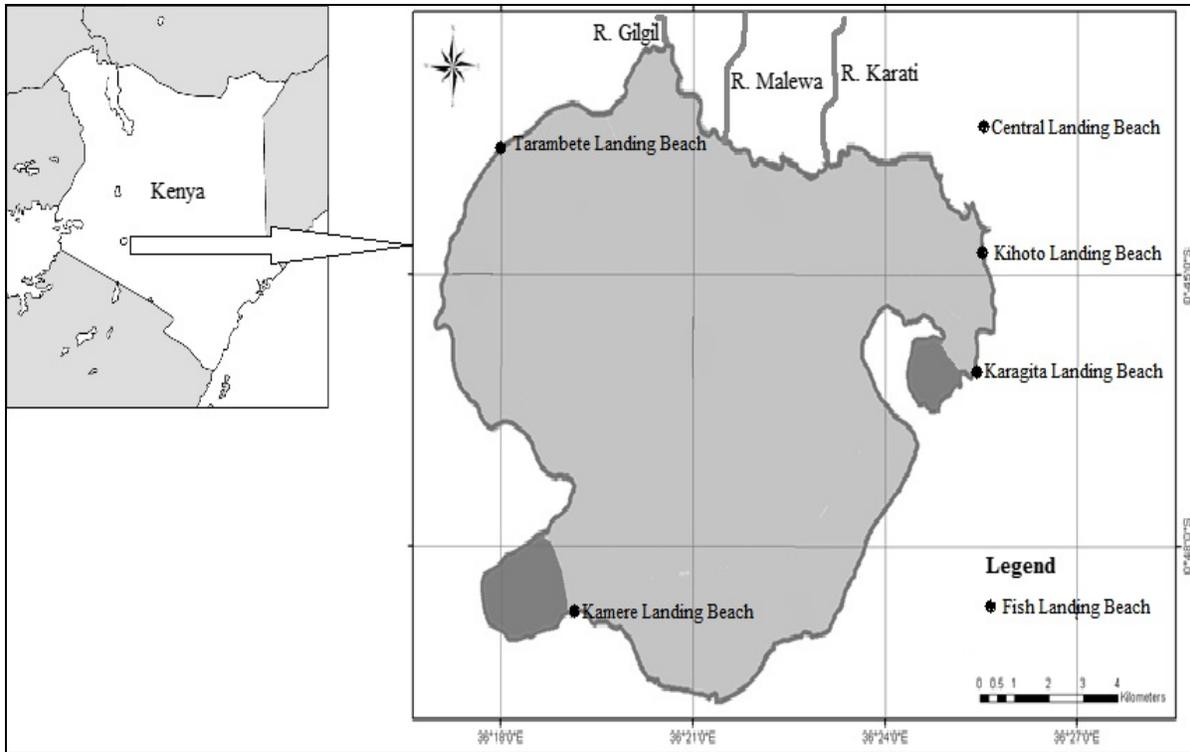


Fig 1: Fish landing beaches on Lake Naivasha

Results

A total of 131 fishers and fish traders were interviewed out of the existing 200 fishers and fish traders in Lake Naivasha; 21 in Kamere, 37 in Tarambete, 33 at the central landing beach, 26 in Kihoto landing beach and 14 in Karagita Landing beach. Each fisher and fish trader located at the landing beach at the time of the survey was interviewed (Figure 2).

25%. However it was noted that the participation of women prominently owning boats has become increasingly common with 5 women recorded as boat owners (Figure 3) this expresses the socio economic benefit of the increased fish catches due to restocking done recently in 2011. Socially for women to own boats is a demonstration of total economic empowerment in the fishing market.

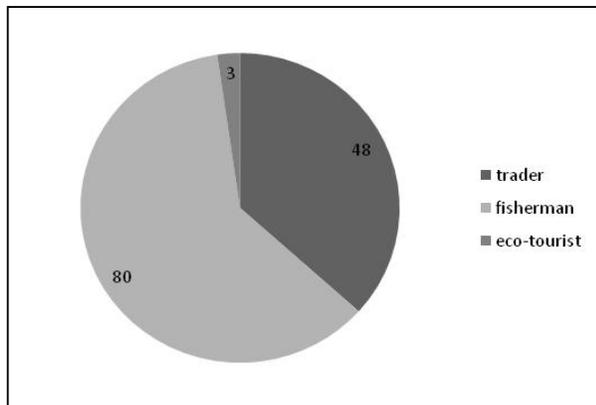


Fig 2: Number of respondents interviewed in Lake Naivasha

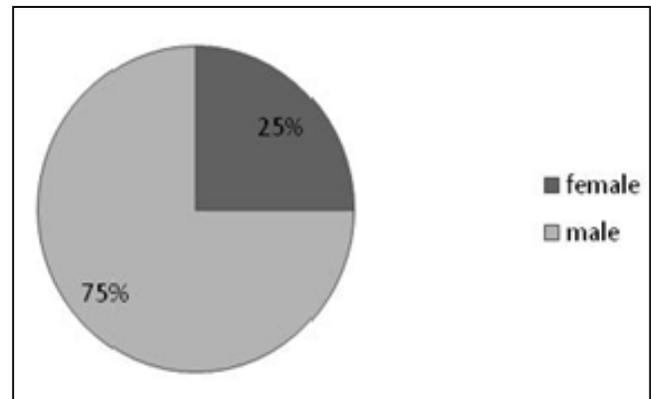


Fig 3: Gender distribution of respondents in Lake Naivasha

It was established that fishing in Lake Naivasha is mainly male youth dominated with a gender distribution of male respondents at 75% followed by the females respondents at

The study interviewed 80 fishers, 48 fish traders and 3 ecotourists, the distribution of respondents interviewed is shown in Figure 4 below.

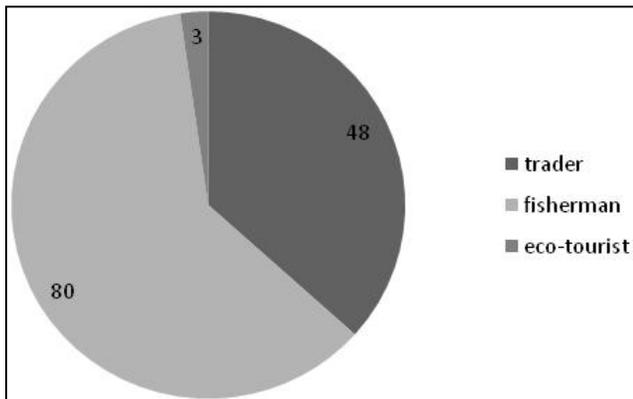


Fig 4: Occupation of respondents in Lake Naivasha

Gender and age distribution

Fishing in Lake Naivasha is male dominated with 75% of the respondents being male and 25% being female. The results also indicate that the number of women owning boats has become increasingly prominent.

The age distribution of the fishers ranged from 19 to 65 years with the age class of 30 to 40 years dominating the fishery (Figure 5). Almost all the fishers interviewed are in the economically active age of 21-50 years.

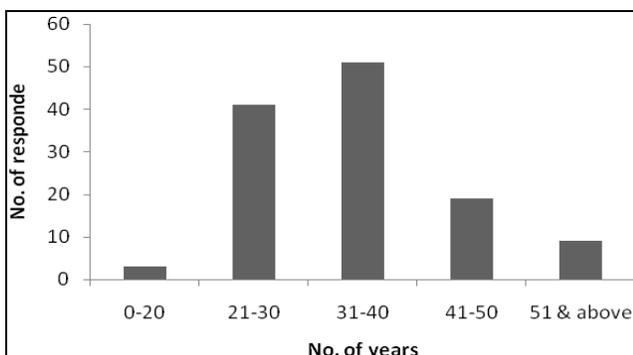


Fig 5: Age distribution of the respondents in Lake Naivasha

Education and experience

The study found that a large number of the respondents have been in the industry for less than ten years. The fishers have generally attained different levels of primary and secondary education and lacked specialized training, which greatly limits their alternative livelihood opportunities (Figure 6). It is evident from figure 5 that very few fishers 13 have attained tertiary level of education. The respondents also confirmed that the fishers operate on the basis of indigenous knowledge in response to the changing trends in fisheries.

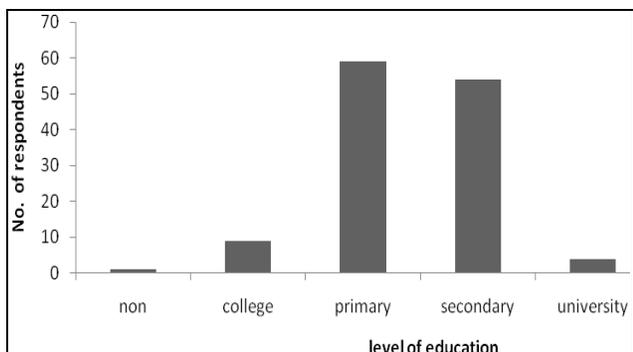


Fig 6: Level of education of the respondents in Lake Naivasha

Knowledge on the fisheries of the Lake

The level of understanding of the types of fishes found in Lake Naivasha by the fishermen and traders was investigated. The results have shown that most of the respondents were able to identify and name at least five of the different species in different languages. Some of the most common species mentioned were Nile tilapia, Black bass, Common Carp, Mud fish, *Barbus amphigramma* and Cray fish. However very few could establish the different three tilapines found in the lake. In addition, the study established that 82% of respondents were aware of new species while 18 % were not aware. In particular, the presence of Nile tilapia which was larger than the other tilapiines and the cat fish was reported as most preferred.

Landings

Tilapia was the most landed fish accounting for 88% of all the fish landed in all the landing beaches followed by the common carp that accounted for 12% of all the fish landed as shown in Table 1 below.

Table 1: Weight of fish landed in all beaches

species	March	April	May
<i>O. leucostictus</i>	9801	28763	69747
<i>O. niloticus</i>	229.5	974	878
<i>M. salmoides</i>	204.1	331	127
<i>C. gariepinus</i>	0	0	398
<i>M. carp</i>	678.5	144	234
<i>C. carp L.</i>	14576	15886	19017

In addition, tilapia is the most preferred fish from the lake because of its superior taste and reduced muscular bones, ready market, high demand and highly competitive prices (Figure 7).

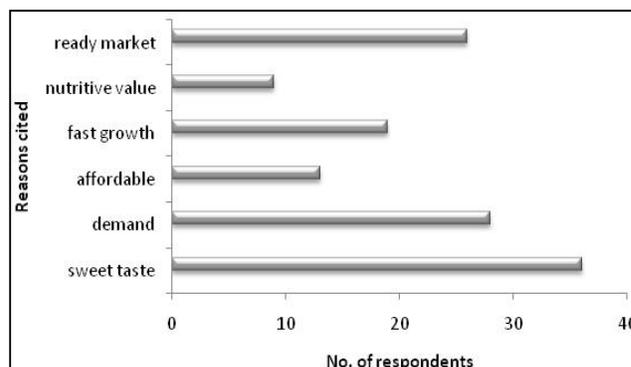


Fig 7: Preference level of *O. niloticus* in Lake Naivasha.

Fishing patterns

About 95% of the respondents indicated that the re-introduction of *O. niloticus* had changed the fishing pattern of the fishermen to longer fishing hours. The change in fishing patterns was attributed to increased fish catches landing which is associated with faster growth, increased use of larger mesh size nets (4 - 6 inches) to catch the large tilapines. Fishing at night was preferred in order to maximise catches, since no regulations were observed. However this behaviour could lead to overfishing and depletion of the species.

The study found that the average sizes of the most landed *O. niloticus* ranged from 26-30 cm total length (TL) being the most landed, followed closely by 31-35 cm, 36-40 cm, more than 40cm, 21-25cm and 15-20cm TL respectively (Figure 8)

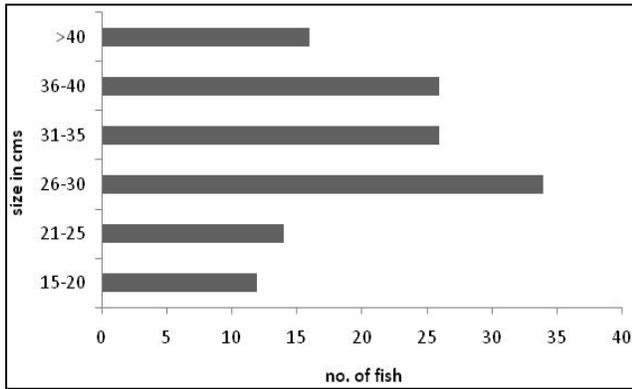


Fig 8: Size composition of *O. niloticus* landed by fishers in Lake Naivasha

Fish marketing

The fish landed from the lake is marketed in and outside Naivasha town. Naivasha town and Nairobi City being the main market for the fish landed absorbing 73% of all the fish landed. Approximately 40% of the fish is sold in Naivasha town and 33% is sold in Nairobi City. The remaining 27% is sold in Nakuru and other towns (Fig. 9). The price of *O. niloticus* in the 5 landing beaches between 2 dollars

and 2.9 dollars per kilogram, earning the handlers around the lake huge profits hence translating into economic and status improvement for the people.

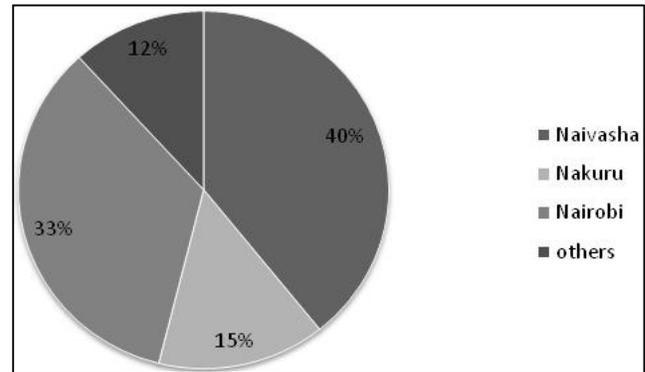


Fig 9: Markets for fish from Lake Naivasha

The observed variations of pricing of fish from one landing beach to another was mostly attributed to the marketing factors notably the middlemen, total catch, the number of fish traders, proximity to markets and the species of fish (table 2).

Table 2: Fish prices in various landing beaches in Lake Naivasha. In Usd \$

	Central	Kamere	Tarambete	Kihoto	Karagita	Average
<20cm	0.39	0.28	0.22	0.17	0.22	0.25
21-30cm	0.56	0.56	0.56	0.39	0.67	0.55
31-40cm	1.46	1.4	1.29	0.67	1.4	1.25
41-50cm	2.47	2.47	1.96	1.68	2.25	2.17

The average prices of fish in the landing beaches of Lake Naivasha were found to vary from one species to another as shown below (Table 3)

Table 3: Average price of various fish species in landing beaches of Lake Naivasha

	Price per kg March-April 2014 \$		
	<i>O. niloticus</i>	<i>O. leucostictus</i>	<i>C. Carpio</i>
March	2.8	1.2	1.1
April	2.3	1.2	1.1
May	2.1	1.4	1.01

Perceptions on restocking implementation of closed season

Fishers perception on the need for restocking the lake with *O. niloticus* was investigated and results indicate that 100% (n=131) of the sampled respondents argued that the lake should be restocked. They argued that restocking will lead to increased fish stocks in the lake which translates to increased harvest and increased income (Fig. 10)

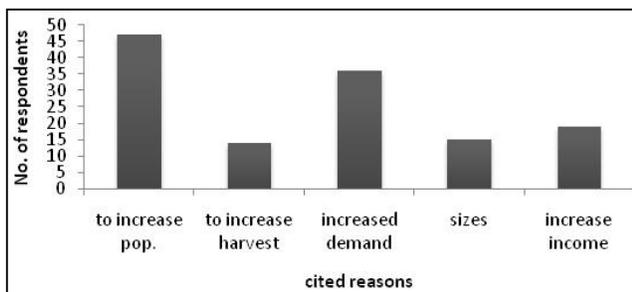


Fig 10: Respondents views on *O. niloticus* restocking in Lake Naivasha

A majority of the respondents (about 79%) are against the closed season with only 21% supporting it. Those against closure claimed that they do not have alternative livelihoods during the period of closure besides the lake has plenty of fish (Figure 11).

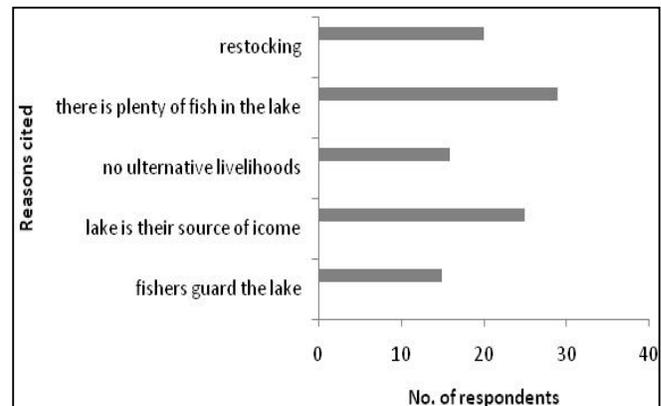


Fig 11: Respondents views on closed fishing seasons

Discussion

Results from the above survey indicate that the re-introduction of *O. niloticus* in Lake Naivasha in February 2011 has impacted positively on the entire fishing community; notably through decreasing incidences of poverty and malnutrition. The re-introduction of *O. niloticus* has seen commercial fish landings increase from 168.3 metric tones to 324.1 metric tones caught “between” September 2013 – May 2014 an increase by 48%.

The re-introduction of *O. niloticus* has also seen a change in the fishery production and catch composition trend with most fishers preferring to target and harvest *tilapines* which have ready markets in Nairobi and Nakuru towns. Already catch data suggests that the fish has a higher market value per Kg compared to the *C. carpio* L. which previously was the mainstream fishery of Lake Naivasha for instance the fishermen have changed their fishing habits and are engaging in prolonged fishing hours (day and night). The fishermen have also changed their gear size from 3 inches to 4-6 inch mesh sizes targeting the tilapines especially *O. niloticus*. This according to them translates to increased catch hence increased incomes and improved livelihoods for the fishermen communities who have always considered fish an important source of food and income for their families.

The re-introduced *O. niloticus* has attracted many fish traders on to the lake. Increase in the number of fish traders has also been attributed to the ready market for fish resulting from increased demand for the fish, better and competitive prices resulting in higher profits, and superior taste. Trading in fish from Lake Naivasha was previously dominated by females, however today both men and women of average age 35years carry out the trade.

Fresh fish traders in Naivasha get their supplies directly from the fishers. Fish traders in Lake Naivasha fall into two categories, local trader who sells their fish in the local market and residential estates, the other category are the long distance traders who sell their fish in distant towns away from Naivasha as shown by the study e.g. Nairobi, Nakuru, Thika, Narok, and Kinangop among others.

With the lifting of the closed fishing season which was a management measure implemented in the year 2011 to enable recovery of the fish stocks the management should provide a clear restocking programme to ensure sustainability of the fishery and a clear monitoring and surveillance programme.

Conclusions and Recommendations

Fisheries management should come up with a clear restocking programme that would ensure sustainable stocks are available in the lake to meet the growing market demands. It should also develop a serious monitoring and surveillance programme to stem illegal and unlicensed fishing which is ever increasing. It should come up with alternative livelihood programmes that will reduce fishing pressure in the lake and absorb the ever increasing number of new entrants in the fishing industry in the face of changing climate.

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