

Has the Latest Fish Introduction in Lake Naivasha Improved Income of Fishermen? The Economics of Nile Tilapia (*Oreochromis niloticus*) in Lake Naivasha

James Last A. Keyombe^{1*}, Ruth M. Lewo², Edna Waithaka³, Alice Mutie³ and Priscilla Boera³

¹Kenya Marine and Fisheries Research Institute, Lake Turkana Station, PO Box 205-30500, Lodwar, Kenya

²Nakuru County Fisheries Department, Naivasha Sub-County, PO Box 135-20117, Naivasha, Kenya

³Kenya Marine and Fisheries Research Institute, Naivasha Station, PO Box 837-20117, Naivasha, Kenya

*Corresponding author: James Last A. Keyombe, Kenya Marine and Fisheries Research Institute, Lake Turkana Station, PO Box 205-30500, Lodwar, Kenya, Tel: +254 0735 102306; E-mail: katalitsa@yahoo.com

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Abstract

Data used in this study was collected daily between January 2011 and April 2016 from four fish landing beaches along the shores of Lake Naivasha; Central, Karagita, Kamere and Tarambete beaches. The results revealed that the total landings of Nile tilapia *Oreochromis niloticus* has been gradually increasing from a 0% in 2011 to 42.7% (206.923 tons) of the total landings between January and April 2016 (422.613 tons) with projections of it surpassing carp by December 2016. These findings corroborate regular field observations which indicate that fishermen are abandoning carp fisheries, opting for Nile tilapia due to its high demand and increased market returns. Between January and April 2016, Nile tilapia had an average price per kg of KShs 147.52 compared to carp's KShs 122.93. The study therefore concludes that the re-introduction of *O. niloticus* in 2011 has achieved its main objectives of food security and improving livelihoods since the fish has completely established itself and is now the key driver of Lake Naivasha fishery.

Keywords: *O. niloticus*; Lake Naivasha; Fishery; Species

Introduction

Nile tilapia *O. niloticus* is of great commercial importance often forming the basis of commercial fisheries in many African lakes [1]. In Lake Victoria for example *O. niloticus* is the third most important fishery and the most desired by the community [2]. This species was introduced in Lake Naivasha around 1967 but disappeared in 1971 due to reasons still unclear to date [3-4]. It was later reintroduced by the Government of Kenya through the Economic Stimulus Package (ESP) reintroduced the Nile Tilapia between 2010 and 2013 to boost the local fisheries in Lake Naivasha [5]. Previous studies in Lake Naivasha indicated that there could be an opportunity to support higher fish yields than the realized annual catches [5-7]. According to [8] the maximum sustainable yield (MSY) when the fish stocks are properly managed could exceed 400 metric tons per year. These therefore supported the need for the introduction of an additional fish species with effort being made to draw potential candidate species from African fauna and to link such action to improved enforcement and stock conservation regimes. Based on prospective feeding guilds and the actual food web, it was identified that the most convincing case was for a bottom feeder, given that it was the benthic *oligochaetes* and *chironomid* larvae which were the most under-utilised, and it was suggested that one of the species of Mormyrus should be considered [8]. Although the proposal for additional species was adopted by the riparian interests spearheaded by Lake Naivasha Riparian Association (LNRA) no official introductions were done then. However, in 2011 Nile tilapia was reintroduced and is now the most commercially important species in the lake [5]. This study assessed the economic

successes challenges of the reintroduction of *O. niloticus* in Lake Naivasha.

Materials and Methods

Data used for this study was collected routinely by Kenya Marine and Fisheries Research Institute and Nakuru County Government Fisheries Department between January 2011 and April 2016 from four landing beaches along the shores of Lake Naivasha; Central, Karagita, Kamere and Tarambete. Lake Naivasha (Figure 1), a shallow freshwater lake with a surface area of approximately 139 km² is situated in the Eastern arm of the Great Rift Valley, about 100 km north-west of Nairobi, Kenya [3,9]. It has an average depth of 3.35 m with the deepest area being 7 m [4] though these values vary with change in rainfall patterns. The lake was declared a Ramsar site in 1995 due to its unique flora and fauna [10]. It is the major source of fish for the surrounding communities, neighbouring towns and also provides fresh water for the numerous hotels, horticultural, floricultural and geothermal industries in the area. Apart from transient streams, the lake is fed by the perennial Malewa and Gilgil rivers with the former being the main one [10].

Results

Results indicate a significant increase in total landings of Nile tilapia in the first four months of 2016 (206.923 tons) compared to 70.307 tons landed between January and December 2015. However, a reverse of the observation was noted in carp fishery which had a significant drop in total catch in 2016 (214.289 tons) compared to 2015 (10,553.382 tons) as shown in Figures 2 and 3.

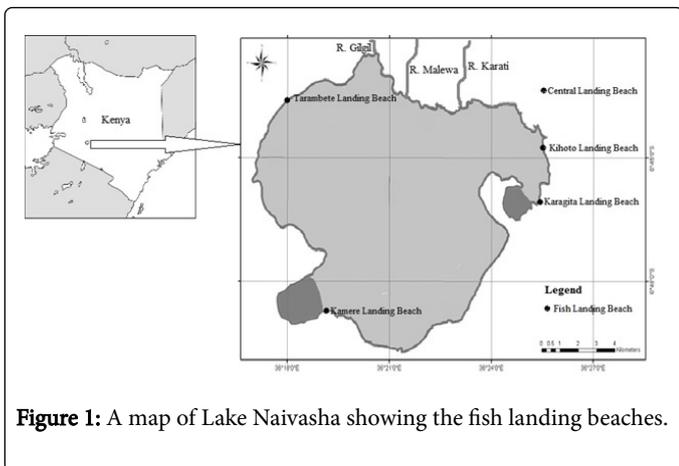


Figure 1: A map of Lake Naivasha showing the fish landing beaches.

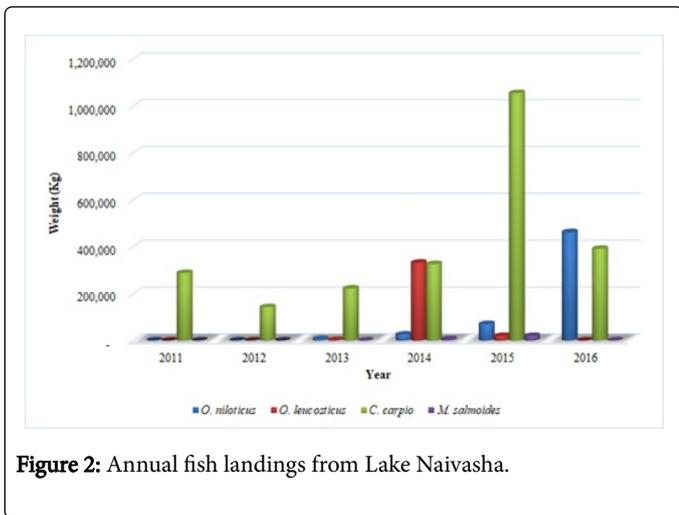


Figure 2: Annual fish landings from Lake Naivasha.

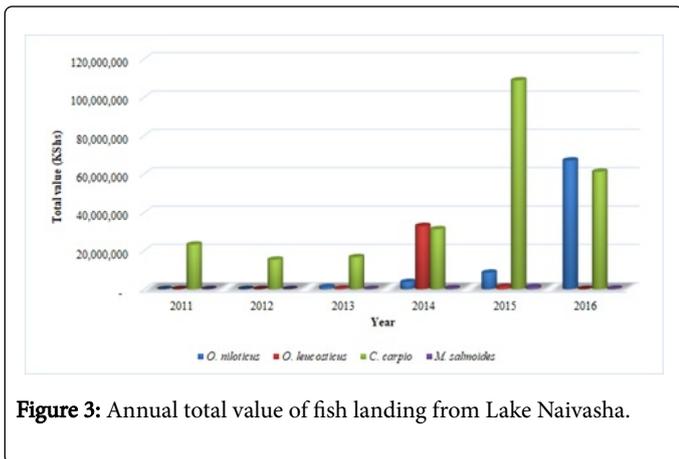


Figure 3: Annual total value of fish landing from Lake Naivasha.

Fishermen on Lake Naivasha landed a total of 206.923 tons of Nile tilapia between January and April 2016 valued at KShs 18,706,367.00, the highest value since the reintroduction of the fish in the lake. The total value of Nile tilapia between January and April 2016 (KShs 18,706,367.00) is higher than the combined value of the fish since reintroduction in 2011 to December 2015 (KShs 13,343,422.88) (Figure 4).

The average price per kilogram of Nile tilapia has been fluctuating since its reintroduction in 2011. Commercial value of Nile tilapia was

first recorded in 2012 where a kilogram of the fish had an average cost of KShs 102.34. In the year 2013, the price per kilogram averaged KShs 174.38.00, the highest value of the fish since reintroduction a situation attributed to its high demand. It should be noted that in the same year, a kilogram of carp was valued at KShs 74.90, its lowest between January 2011 and April 2016. Currently, the average price per kilogram of Nile tilapia is KShs 147.52 (Figure 5).

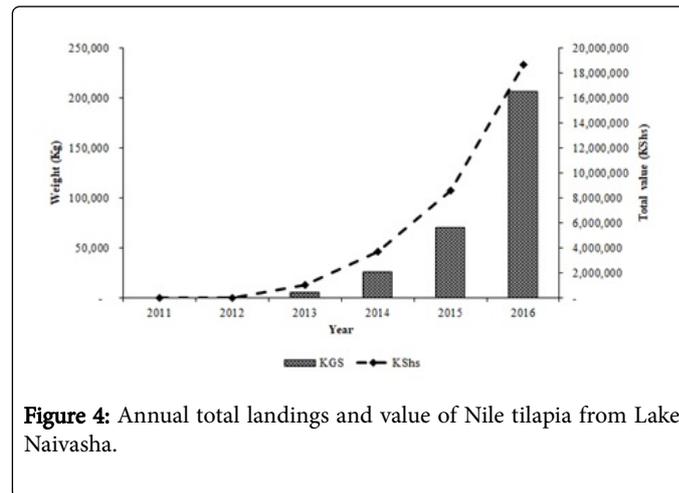


Figure 4: Annual total landings and value of Nile tilapia from Lake Naivasha.

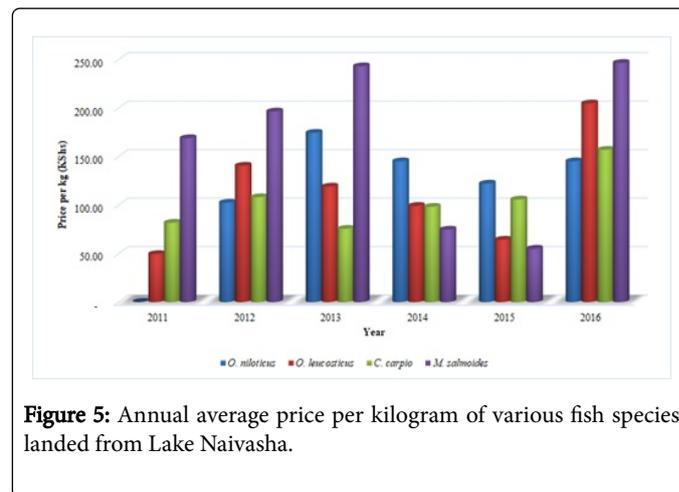


Figure 5: Annual average price per kilogram of various fish species landed from Lake Naivasha.

Discussion

Previously annual species composition of the fin-fish catch in Lake Naivasha for the period 1987-2000 was dominated by *Oreochromis leucostictus* 71.7%, *Coptodon zilli* 8.8% and *Micropterus salmoides* 19.5% [6]. From 2002 to 2006 there was a shift in composition with dominance of common carp, *Cyprinus carpio* 51%, *O. leucostictus* 21.9%, *M. salmoides* 13.2% and *C. zilli* 1.5% [7]. Between 2007 and 2008 the catches were dominated by *C. carpio*, 81.7%, *O. leucostictus* 9.7%, *M. salmoides* 8.3% and *C. zilli* 0.3% [7]. Currently the fishery is dominated by *O. niloticus*, *C. carpio*, *O. leucostictus* and African catfish *Clarias gariepinus* [5-9]. In 2015, the contributions were 83.4%, 7.3%, 6.0% and 19% and 1.7% for these species respectively [5-9]. “The notable decline in carp in the first four months of 2016 was attributed to overexploitation in the previous year which was occasioned by gillnets of 3.5” and below being deployed targeting the smaller sized *O. niloticus*, *O. leucostictus* and *C. zilli* [5-9]. This practice has rendered common carp as a by-catch of the tilapia fishery and hence resulted in

capture of immature fish. Since the reintroduction of *O. niloticus* in 2011, fishermen have been landing higher numbers of the fish in every subsequent year. This study indicates that the total landings of Nile tilapia between January and April 2016 have surpassed previous yearly total landings of the fish. Frequent field observations by Kenya Marine and Fisheries Research Institute indicates that fishermen are abandoning carp fisheries, opting for Nile tilapia due to its high demand and increased market returns translating to improved livelihoods and better nutritional status. The average price per kilogram of Nile tilapia has been fluctuating since its reintroduction in 2011. It should also be noted that in 2013, the closed fishing was 'abolished' by the county government of Nakuru. The county government of Nakuru also opened a new beach, Karagita, which subsequently increased the number of boats from 50 to approximately 178. The increase in demand of the fish could have led to the price per kilogram being significantly higher in 2013 [11].

Conclusion

From the foregoing it is clear that the re-introduction of the *O. niloticus* was a blessing to the fishery and the fishing community since the fish completely established itself and it now drives the fishery. Increase in catch will directly translate to improved livelihoods and increased food security.

Recommendations

In order to ensure sustainable utilization of the Nile tilapia fishery, fisheries managers and law enforcers should ensure compliance of the fisheries regulations by conducting regular Monitoring Control and Surveillance. They should also strive to work closely with the Beach Management Units (BMUs) and other fisheries stakeholder in order to have a more positive impact on community resource management. Kenya Marine and Fisheries Research Institute (KMFRI) and Kenya Fisheries Service (KFS) should provide guidelines on optimum fishing effort for Lake Naivasha. Nakuru County Government should thereafter compliment the actions of KMFRI and KFS by providing adequate funds for monitoring control and surveillance to ensure protection of fish critical habitats and serious legal sanctions taken against illegal fishers who are a major threat for Lake Naivasha fishery.

References

1. Britton JR, Harper DM (2008) Juvenile growth of two tilapia species in Lakes Naivasha and Baringo, Kenya. *Ecology of Freshwater Fish* 17: 481-488.
2. Njiru M, Ojuok JE, Okeyo-Owuor JB, Muchiri M, Ntiba MJ, et al. (2006) Some biological aspects and life history strategies of Nile tilapia, *Oreochromis niloticus* (L.) in Lake Victoria, Kenya. *African Journal of Ecology* 44: 30-37.
3. Harper DM, Mavuti KM (2004) Lake Naivasha, Kenya: Ecohydrology to guide the management of a tropical protected area. *Ecohydrology and Hydrobiology* 4: 287-305.
4. Hickley P, Muchiri M, Britton R, Boar R (2008) Economic gain versus ecological damage from the introduction of non-native freshwater fish: Case studies from Kenya. *The Open Fish Science Journal* 1: 36-46.
5. Keyombe JL, Malala JO, Waithaka E, Lewo RM, Obwanga BO (2017) Seasonal changes in length-weight relationship and condition factor of Nile tilapia, *Oreochromis niloticus* (Linnaeus, 1758) (Cichlidae) in Lake Naivasha, Kenya. *International Journal of Aquatic Biology* 5: 7-11.
6. Hickley P, Muchiri SM, Britton JR, Boar RR (2004) Discovery of carp (*Cyprinus carpio*) in the already stressed fishery of Lake Naivasha, Kenya. *Fish Management Ecology* 11: 139-142.
7. Ojuok J, Njiru M, Mugo J, Moraa G, Wakwabi E, et al. (2008) Increased dominance of common carp, *Cyprinus carpio* L: the boon or the bane of Lake Naivasha fisheries? *African Journal of Ecology* 46: 445-448
8. Muchiri SM, Hickley P (1991) The fishery of Lake Naivasha, Kenya. In: I.G. Cowx (Ed). *Catch Effort Sampling Strategies: Their application in freshwater fisheries management*. Fishing News Books, Blackwell Scientific Publications, Oxford. pp: 382-92.
9. Njiru J, Waithaka E, Aloo PA (2017) An Overview of the Current Status of Lake Naivasha Fishery: Challenges and Management Strategies. *The Open Fish Science Journal* 10: 1-11.
10. Harper DM, Morrison EHJ, Macharia MM, Mavuti KM, Upton C (2011) Lake Naivasha, Kenya: ecology, society and future. *Freshwater Biology* 4: 89-114.
11. Oyugi DO, Harper DM, Ntiba JM, Kisia SM, Britton JR (2011) Management implications of the response of two tilapiine cichlids to long-term changes in lake level, al biodiversity and exploitation in an equatorial lake. *AMBIO* 40: 469-478.