Uganda Journal of Agricultural Sciences, 1998, 3:33-38

ISSN 1026-0919

Fishing gear selectivity for *Lates niloticus* L. , *Oreochromis niloticus* L. and *Rastrineobola argentea* P. in Lakes Victoria, Kyoga and Nabugabo

R. Ogutu-Ohwayo, S.B. Wandera and J.R Kamanyi
Fisheries Research Institute, P. O. Box 343, Jinja, Uganda

Abstract

Catch effort data on which fisheries management regulations are sometimes based are not available for most lakes in Uganda. However, failure to regulate fishing gears and methods has been a major cause of collapse of fisheries in the country. Fisheries have been damaged by destructive and non-selective fishing gears and methods such as trawling and beach seining, by use of gill nets of mesh size which crop immature fish and by introduction of mechanised fishing. Selectivity of gears used to crop *Lates niloticus* L(Nile perch), *Oreochromis niloticus* L. (Nile tilapia) and *Rastrineobola argentea* Pellegrin (Mukene) which are currently the most important commercial species in Uganda were examined in order to recommend the most suitable types, sizes and methods that should be used in exploiting these fisheries. Gill nets of less than 127 mm mainly cropped immature Nile tilapia and Nile perch. To protect these fisheries, the minimum mesh size of gill nets should be set at 127 mm. Seine nets of 5 mm caught high proportions in immature Mukene while those of 10 mm caught mainly mature Mukene. When operated inshore, both sizes caught immature Nile perch and Nile tilapia as by-catch. To protect the Mukene fishery and avoid catching immature bye-catch, a minimum mesh size of the Mukene net should be10 mm operated as Lampara type net offshore, but since most fishermen have been using 5 mm seine nets for over five years the minimum size should not be allowed to drop below 5 mm pending further thorough investigations. Beach seining and trawling are destructive to fisheries and should be prohibited until data that may justify their use is available.

Key words: Fisheries management, gill nets, trawling, seining

Introduction

The concept of maximum sustainable yield on which fisheries management regulations are based may not be applicable on most lakes in Uganda because of poor or non-existence of catch effort data, and the open access policy on these lakes. However, historical data show that the collapse of important commercial fisheries on lakes and rivers in Uganda were caused by selective fishing, introduction and indiscriminate use of destructive fishing gears and introduction of mechanised fishing without having sufficient means of controlling it (Garrod, 1961, Cadwalladr, 1969; Jackson, 1971 and Ogutu-Ohwayo, 1990). The decline in stocks of *Oreochromis esculentus* Graham which formed the most important commercial fisheries on lakes Victoria and Kyoga was caused by shifts to smaller mesh gill nets which cropped immature fish (Fryer and Iles, 1972 and Ogutu-Ohwayo, 1990). From about 1930 to 1960, the fisheries of Lake Victoria had been managed by controlling the mesh size of gill nets. Gill nets of less than 127 mm (%) stretched mesh had been prohibited because they cropped immature *O.esculentus* which were at the time the most important commercial species. When the mesh size restrictions were removed, there was a shift to small meshes which cropped immature tilapia plus other large species and led to a collapse in the fishery. Similarly, *Labeo victorianus* Boulenger which formed the most important fishery on the rivers within the Lake Victoria basin was destroyed due to intensive gill netting of gravid individuals on breeding migrations (Cadwalladr, 1969).

In Lake Victoria, and indeed in other African lakes like Malawi and Tanganyika, mechanised bottom trawling altered the composition of small cichlid communities by selectively depleting the larger species (Turner, 1977). Similarly, introduction of commercial trawling in the Tanzania region of Lake Victoria led to disappearance of the large haplochromine species and a rapid fall in catch rates (Witte and Goudswaard, 1985). In Lake Tanganyika, mechanised fishing has resulted in a decline of clupeid populations (Roest, 1992).

One of the management problems on most African Great Lakes fisheries is that they are open access fisheries with no control of fishing effort. For instance, there is currently no control of fishing effort on lakes Victoria and Kyoga. Both are open access fisheries where any national has freedom to catch as much fish as he can as long as he can afford a fishing licence, which is inexpensive. The only fishing regulation on these lakes prohibits cropping Nile tilapia of less than 28 cm and Nile perch of less than 46 cm total length but does not specify the type and mesh sizes of nets to be used. Lakes Victoria and Kyoga are currently the most productive lakes contributing about 80% of Uganda's annual fish production. There is need to institute management measures that will promote sustainability of the fisheries of these lakes.

An effective regulation is one that can be enforced with a high degree of success. Since lakes Victoria and Kyoga are open access fisheries it would be difficult to limit the fishing effort by excluding some fishermen from the fishery. Furthermore, scientific data, the basis of which the fishing gears effort can be set is lacking. Settling mesh size limits, restricting the types of fishing gear, and controlling the methods of fishing would be more effective in managing the fishery than merely limiting the size of the fish caught. Mesh size limits can be enforced with some degree of success by prohibiting manufacture, importation, sale and use of specified gears and confiscating of illegal gear if found in use.

In this paper, the types of fishing gears used to exploit Nile perch, Nile Tilapia and Mukene and their selectivity are examined. We offer recommendations on the suitable types and sizes of gears to be used in exploiting these fisheries in lakes Victoria, Kyoga and Nabugabo.

Methodology

Selectivity of gill nets, seines and trawls of different codends were determined for Nile perch, Nile tilapia and Mukene. A fleet of gill nets of 76 mm to 25.4 mm stretched mesh increment by 25.4 mm were examined. The gill nets were mounted at 50% hanging ratio. They were set in the evening and retrieved the following day. Two mosquito seines; one of 10 mm mesh and another of 5 mm mesh were used to catch Mukene. The seines were operated either as seine nets inshore or as lampara lift net offshore. The trawl codends examined were of 19 mm, 50 mm, 75 mm and 127 mm stretched mesh. Bottom trawling was done using the research vessels *MV Ibis* and *MV Mputa*. Gill nets and trawls were used to examine mesh size selectivity for Nile perch and Tilapia. Species composition of fish caught in each fishing gear was recorded. Total length of the fish was measured in case of Nile perch and Nile tilapia but standard length was measured for Mukene. Length frequency distribution of fish caught in different types and sizes of fishing gears was analysed and compared with known sizes at first maturity for each species. The length frequency distribution of Mukene caught by artisinal fishermen during different months of the year was examined to establish when new cohorts were recruited into the fishery.

In fisheries management, the size limit of fish that should be cropped is normally set at at least the size at first maturity (i.e the size at which 50% of members of that species are mature(Beverton and Holt, 1957)). The logic behind this is that it allows 50% of the individuals to breed before they are cropped and hence sustain the stocks.

The size at first maturity of the Nile tilapia in lakes Victoria and Kyoga is around 23 cm total length for males and 25 cm for females. By 28.5 cm all fish are mature (Balirwa, J.S, pers. comm.). The sizes at first maturity for Nile perch is 50-55 cm TL for males and 90-100 cm for females (Ogutu-Ohwayo, 1988). The size at first maturity of Mukene is currently 42 mm and by 45 mm all the fish are mature (Wandera, 1993)

Results and discussions

The Impact of trawls and seines

The length frequency distribution Nile perch and Nile tilapia caught in trawl nets of different codend mesh sizes are illustrated in Figure 1. Codends of mesh sizes less than 127 mm catch large proportions of immature Nile perch and tilapia. If trawling were to be permitted on Lake Victoria, the minimum codend of the trawl net

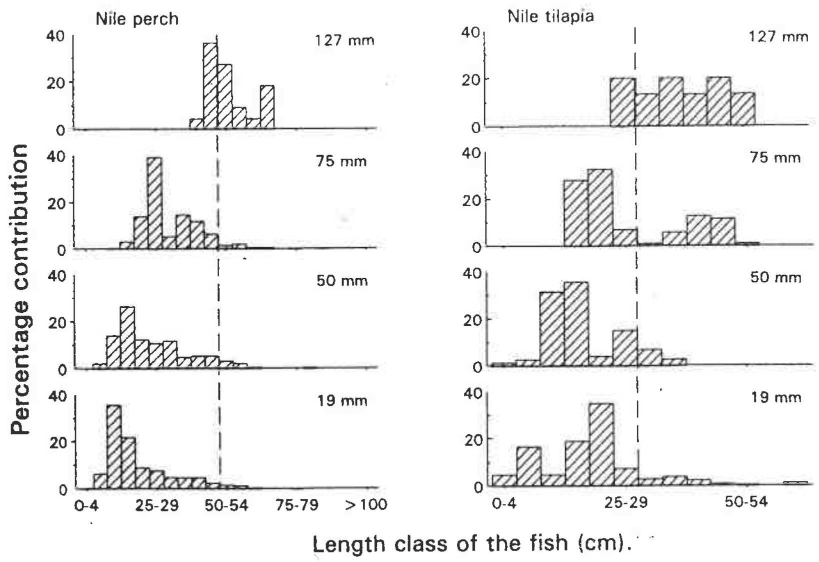


Figure 1. Length frequency distribution of Nile perch and Nile tilapia caught in trawl nets of different codend mesh sizes. The vertical dashed lines indicate the minimum sizes of fish that should be cropped.

should, as in the case of the gill net fishery discussed later, not be less than 127 mm.

Seines and trawls are operated as active gear. The dragging of these gears on the lake bottom especially near the lake's margins where tilapiines breed, destroys tilapia nests and disrupts courtship on breeding grounds of the tilapiines. Sweeping of the bottoms also destroys habitats of benthic organisms which affects important food of fishes. These gears are also not very selective such that smaller fish than would not normally be retained are caught due to blocking of the meshes by larger fish. Trawling also destroys nets of artisanal fishermen.

The impact of gill nets

The size distributions of Nile tilapia caught in gill nets of 89 mm to 178 mm and that on Nile perch caught in gill nets of stretched mesh 76 mm to 254 mm are illustrated in Figures 2 and 3. The length frequency distribution of Nile tilapia and Nile perch caught in each mesh size followed a normal distribution with each mesh size retaining a specific range of fish.

Since the size at fish maturity of the Nile tilapia in lakes Victoria and Kyoga is around 25 cm (TL), the minimum size of Nile tilapia that should be permitted should be 25 cm. However, fishing pressure on lakes Victoria and Kyoga is very high while the fecundity of the Nile tilapia is relatively low. It is, therefore logical to set the gill net limit for the Nile tilapia at 100% maturity to preserve enough spawners in the population. In lakes Victoria and Kyoga, 100% maturity in Nile tilapia is at 28.5 cm TL. This would require a minimum gill net mesh of 127 mm (Fig.2). This suggests that the minimum gill net mesh size limit in respect to Nile tilapia should be set at 127 mm.

The minimum mesh size suggested above for the Nile tilapia would crop immature Nile perch (Fig.3). However, biological and ecological considerations justify setting the minimum mesh at 127 mm. Nile perch is a predator which during certain stages of its development becomes detrimental to the fishery by feeding on other commercially important fishes (Ogutu-Ohwayo, 1985). Increasing fishing pressure on Nile perch of the size range which feeds on other commercially important fishes would be beneficial to the fishery. Further, the species has high capacity to replace itself. Each female produces millions of eggs at each breeding (Ogutu-Ohwayo, 1988).

Nile perch up to 50 cm feeds predominantly on invertebrates especially, the prawns *Caridina nilotica* and dragonfly nymphs. At this size, it plays a beneficial role because it converts the invertebrates into consumable commodity, fish. Nile perch shifts to a predominantly piscivorous diet comprising Mukene, juvenile Nile perch and Nile tilapia after about 50 cm and finally concentrates on the Nile tilapia after about 95 cm. Large Nile perch are, therefore, destructive to other commercially important fishes. Schindler et al. (1995) have predicted that enforcement of a 127 mm minimum mesh would reduce predation on other important fishes with little decrease on Nile perch yield. Use of mesh sizes which crop Nile perch of more than 50 cm might, therefore, be beneficial to the fishery by reducing predation pressure on the two other

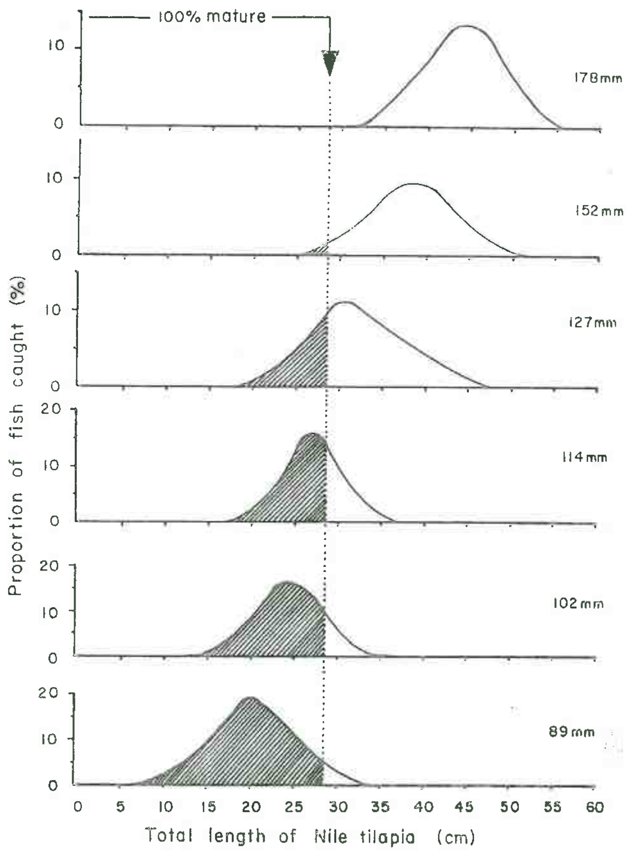


Figure 2. Smoothed curves of length frequency distribution of Nile tilapia caught in nets of 89 mm to 178 mm.

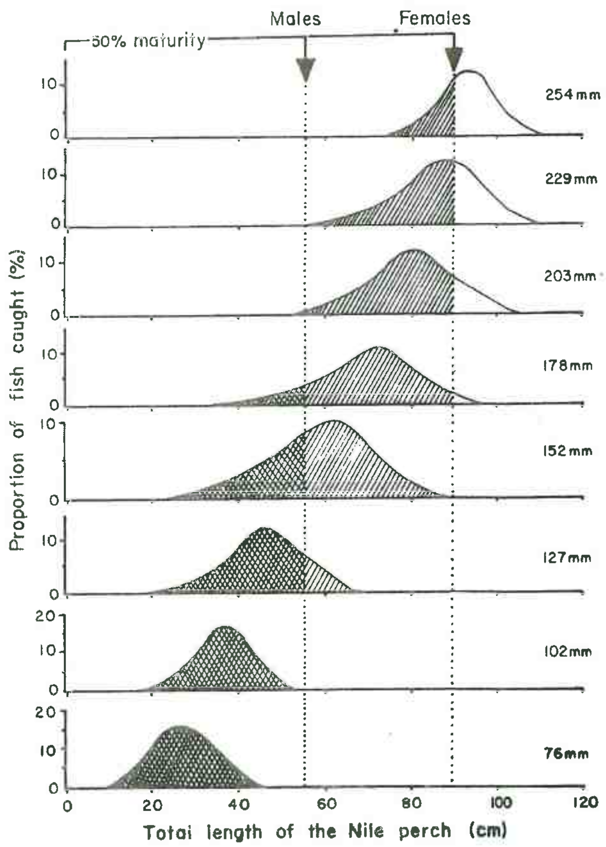


Figure 3. Smoothed curves of length frequency distribution of Nile perch caught in nets of 76 mm to 254 mm.

commercially important fish species on lakes Victoria, Kyoga and Nabugabo. The size range of Nile perch given above coincides with the mesh size limit suggested for the Nile tilapia. This further suggests that the minimum size of Nile perch permitted to be landed should be 50 cm and not 46 cm as in the Fish and Crocodiles Instrument of 1981.

The impact of mosquito seines

Up to 1988, Mukene in the Ugandan waters of Lake Victoria was exploited using a 10 mm mesh seine operated as a beach seine. In 1989, a smaller meshed net (5 mm) was introduced. This net was operated either as a Lampara net or a scoop net. This mesh size and fishing methods are currently in wide use in lakes Victoria and Kyoga. There is no fishing for Mukene on Lake Nabugabo although the species is abundant in the lake.

Length frequency distribution of Mukene retained by the 10 mm and the 5 mm mesh seine are illustrated in Figure 4. The 10 mm seine captured Mukene of more than 30 mm standard length and a mean of 48 mm. Using the 5 m seine, the mean length dropped to 36 mm, with specimens a small as 19 mm being retained.

While the 10 mm seine cropped mostly mature individuals, the 5 mm net captures a larger proportion of immature Mukene especially during the period when new cohorts are recruited into the fishery. The size structure of Mukene caught by artisanal fishermen on Lake victoria using 5 mm mesh Lampara net during the period January to December 1992 is shown in Figure 5. New cohorts were recruited into the fishery twice a year. First recruitment occurred in the months of April to May while the second one occurred in September. During these periods, the 5 mm mesh net caught high proportions of immature Mukene (Fig. 6). Mature individuals dominated the catches only during the months of January to March and July to August. Therefore, 5 mm nets are safe only for 5 months. Unfortunately two of these, January and August are peak breeding months for *R. argentea* (Wandera, 1992). This leaves only 3 safe fishing months if breeding individuals are to be saved.

The different types of fish taxa and the proportions caught in the mosquito seines operated as beach seine inshore and as a Lampara net offshore are illustrated in Fig. 7. The lampara net operated offshore captures mainly in target species *R. argentea* with negligible quantities of Nile perch and Nile tilapia. On the other hand, beach seine catches are composed of high proportions of juvenile Nile perch and Nile tilapia as bye-catch. These nets are therefore detrimental to the fishery when operated as beach seines inshore. Fishing for Mukene should, therefore, be done using the Lampara type lift net operated offshore. Also, over 70% of Mukene caught by the 5 mm seine net are immature (Fig. 4) and this is detrimental to the Mukene fishery. However, the 10 mm mesh net is no longer used on Lake Victoria. It is the 5 mm mesh which is now used. Prohibiting the 5 mm seines without providing a suitable alternative may have negative socio-economic consequences. Further research should be done to identify a suitable size of net for exploiting the Mukene fishery. As an interim measure and to avoid further deterioration in the Mukene fishery, mosquito seines of less than 5 mm should not be allowed in the fishery.

Recommendation

On the basis of the above observations 127 mm should be the minimum mesh size of gill net permitted on lakes

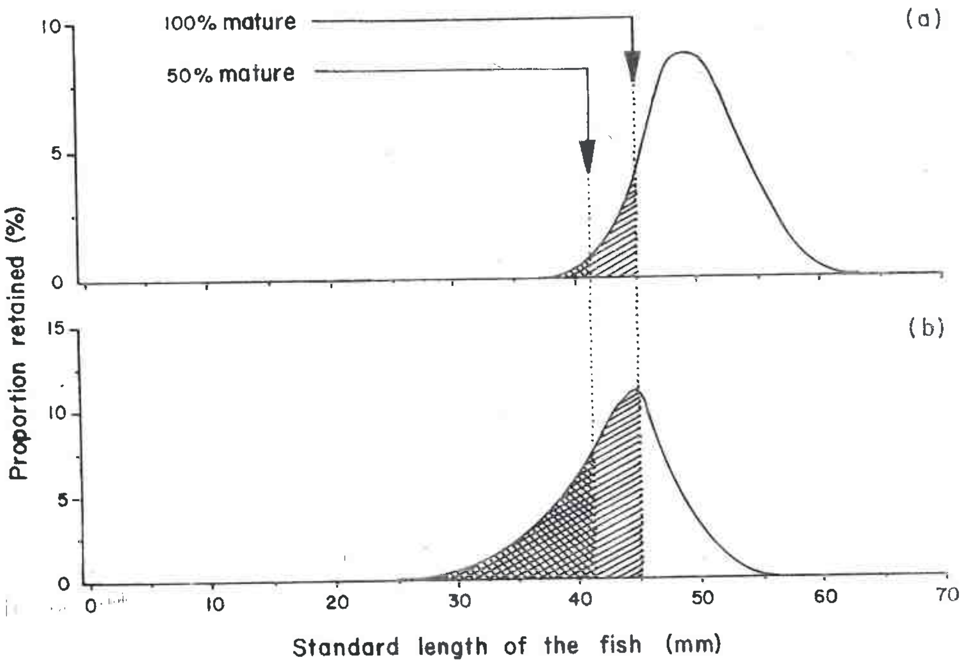


Figure 4. Length frequency distribution of Rastrineobola argentea retained by the 10 mm (a) and 5 mm (b) seines.

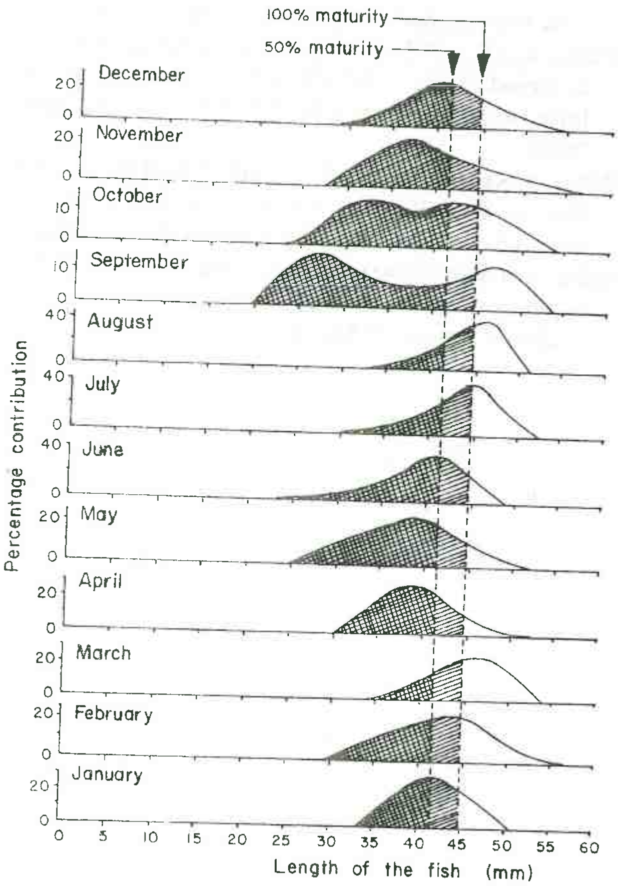
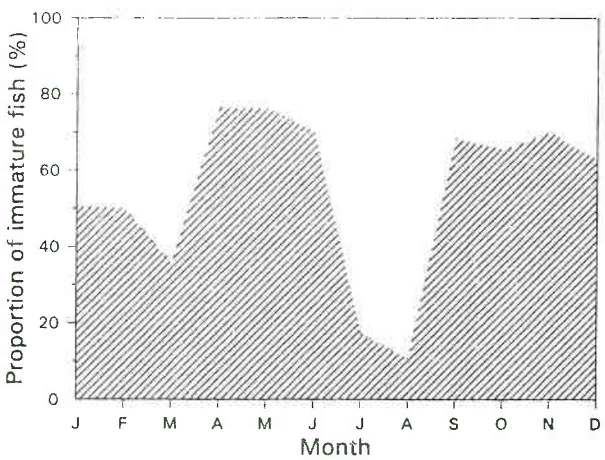


Figure 5. Length frequency distribution of Mukene retained by the 5 mm seines net during different months of 1992 in the northern area of Lake Victoria.



Figures 6. Immature Mukene appearing in commercial catches of the 5 mm seine during different months of the year. Data collected from the northern region of lake Victoria in 1992.

Victoria and Kyoga and Nabugabo. The minimum length of Nile tilapia should remain at 28 cm but that of Nile perch should be increased from 46 cm to 50 cm. The minimum mesh size limit of seine net for Mukene should have been 10 mm but since virtually all fishermen have already shifted to the 5 mm net, the minimum mesh size limit for Mukene should not be allowed to drop below the current 5 mm mesh pending further investigations.

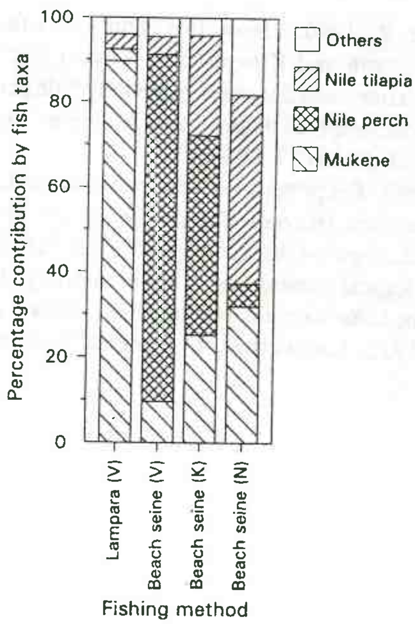


Figure 7. The catch composition of the 5 mm seine operated as beach seine and lampara net.

Acknowledgements

This work was supported by a grant from the International Development Research Centre IDRC, Ottawa, Canada and by the World Bank HARE Sub-Project No. 8.

References

Beverton, R.J.H. and Holt, S.J., 1957. On the dynamics of exploited fish populations. Ministry of Agriculture, Fisheries and Food. Fishery investigation series II Vol. XIX. Her Majesty's stationery office: London 533 pp.

Cadwalladr, D.A., 1969. A discussion of possible management measures to revive the *Labeo victorianus* fishery of Lake Victoria with special reference to Nzoia river, Kenya. Uganda Fisheries Department Occasional paper, 2:1-6.

Fryer, G and Iles, T.D., 1972. The cichlid fishes of the Great Lakes of Africa:Their biology and evolution. Oliver & Boyd. London. 641 pp.

Garrod, D.J., 1961. The rational exploitation of the *Tilapia esculenta* stock of the North Buvuma Island area, Lake Victoria, *East African Agricultural and Forestry Journal,* 27:69-76.

Jackson, P.B.N., 1971. African Great Lakes Fisheries: past present and future. *The African Journal of Tropical Hydrobiology and Fisheries,* 1:35-49.

Ogutu-Ohwayo, R.1985. The effects of predation by the Nile perch, *Lates niloticus* (Linne) introduced into Lake Kyoga (Uganda) in relation to the fisheries of Lake Kyoga and Lake Victoria. *FAO Fisheries Report No.335.* 18-41.

Ogutu-Ohwayo, R., 1988. Reproductive potential of the Nile perch. *Lates niloticus* L. and the establishment of the species in Lakes Kyoga and Victoria (East Africa). *Hydrobiologia.* 162: 193-200.

Ogutu-Ohwayo, R., 1990. The decline of the native fishes of lakes Victoria and Kyoga (East Africa) and the impact of the introduced species, especially Nile perch, *Lates niloticus*, and Nile tilapia, *Oreochromis niloticus*. *Environ. Biol. Fishes* 27:81-96.

Roest, F.C., 1992. The pelagic fisheries resources of Lake Tanganyika. *Mitt. Internat. Verein. Limnol.* 23:11-35.

Schindler, D.E., Ogutu-Ohwayo, R. and Kitchell, J.F., 1995. Ecological consequences of alternative gill net Fisheries for Lake Victoria. Mimoe. FIRI, Jinja. 17pp.

Turner, J.L., 1977. Some effects of demersal trawling in Lake Malawi. *Journal of Fish Biology* 10:161-271.

Wandera, S.B., 1992. A study of *Rastrineobola argentea* in Uganda Lakes. UNDP/FAO Regional Project for Inland Fisheries Planning RAF/87/099-TD/38/92 (En): 36-50.

Wandera, S.B., 1993. FAO-IFIP/UFFRO/KMFRI/TAFIRI Rastrineobola Research Project Scientific Terminal Report September 1992 - April 1993 (Mimeo) 12pp.

Witte, F and Goudswaard, P.C., 1985. Aspects of the haplochromine fishery in southern Lake Victoria. *FAO Fisheries Report,* 335:81-88.