The fisheries of Lake Victoria

Harvesting biomass at the expense of biodiversity

Richard Ogutu-Ohwayo

Principle: Introduced species can stimulate fisheries but eliminate native biodiversity, with unknown long-term ecosystem effects.

Experience: Chronic overfishing in Lake Victoria followed by a shift to single-species fishery.

Most important lesson learned: Poverty can be a powerful stimulus to overfishing, so that a crisis is necessary before action is taken.

Best practices: 1) Proposed protected areas and refugia, 2) research on genetic structure of populations.

Lake Victoria in East Africa is the second largest freshwater body in the world, and is shared by Kenya, Uganda and Tanzania. Its watershed extends to Rwanda and Burundi also.

Most of the fisheries in Kenya, Uganda and Tanzania are in Lake Victoria. In Uganda, the fishing industry employs between 500,000 and one million people. Fish is currently the second most important Ugandan export commodity (after coffee). These lakes are in one of the poorest regions of the world, and fish provide employment and food.

Lake Victoria and two other African Great Lakes (Malawi and Tanganyika) once had very high fish species diversity. They represented a spectacular example of rapid speciation, best demonstrated by the haplochromine group of fishes. There used to be over 500 species of haplochromines in Lake Victoria alone, more than 99% of which were endemic.

A history of the fishery

The lakes originally had a multi-species fishery in which two tilapiine species, (*Oreochromis esculentus* and *O. variabilis)*, were the most important. Overall, there was equity in access to the resources. Fishing was dominated by men, while fish processing and marketing were done by women. Fishing craft were small, restricting fishing to shallow inshore areas.

Pressure on the fisheries started to increase with the introduction of more efficient gill nets in 1905 and the expansion of markets following extension of the railway. Catch of the important *O. esculentus* decreased, even with increasing effort. A 1928 survey showed that *O. esculentus* was over-fished and recommended gill net mesh size restriction, effected in 1931. A lake-wide institution, the Lake Victoria Fisheries Service (LVFS), was set up to manage the fishery, and a fisheries research organization, the East African Freshwater Fisheries Organization (EAFFRO) was formed.

There were however, no limits put on fishing effort, and catches of *O. esculentus* continued to fall. Fishermen shifted to smaller mesh nets, and the mesh size limit was repealed. Fishing pressure continued to increase and catch rates decreased, due to the open access policy and the dependency of lakeside communities on the fisheries. Finally the fishery collapsed. *O. esculentus* became an endangered species in the Victoria and Kyoga lake basins. The LVFS was disbanded in 1960 and its role transferred to the individual national fisheries departments of Kenya, Uganda and Tanzania. There was no longer a regional mechanism to manage or coordinate management of this shared resource. Stocks of *Labeo victorianus*, which formed the most important fishery along the rivers of the Victoria and Kyoga Lake basins, were also depleted due to intensive exploitation of gravid females during migration. *L. victorianus* became endangered in the Lake Victoria basin.

As the larger species became scarce, fishermen shifted to smaller species. A fish stock assessment in 1967 determined the magnitude of haplochromine fish stocks and options for processing and marketing. This survey showed at least 650,000 metric tones of fish of which 80% were haplochromines. Trawling started in the Tanzanian waters of Lake Victoria, and it was not long before catch rates started declining rapidly.

One of the most significant events in the fisheries of Lake Victoria was introduction of new fish species. *Lates niloticus* (Nile perch) and four tilapiine species were introduced in the 1950s and early 1960s. Nile perch was introduced to feed on haplochromines and convert them into a larger fish of higher commercial value. The tilapiine species were introduced to augment stocks of native tilapiines which had declined due to over-fishing. Stocks of the introduced species increased rapidly between 1971 and 1983, accompanied by a decline and in some cases total disappearance of some of the native species. About 200 out of an estimated 300+ species of haplochromines are believed to have disappeared as a result of forming the main diet of Nile perch.

Nevertheless, overall fish catches increased five fold between 1975 and 1990, making Lake Victoria the single most important source of freshwater fish in the world. This increase of fish catches led to establishment of processing plants for Nile perch, mainly for export, and stimulated fishing. This rapid increase in fishing effort is now a major threat to the perch fishery, and there are indications that the maximum sustainable yield (MSY) has been exceeded

Effects on ecosystems

When haplochromines were abundant, there was high trophic diversity of fishes. Feeding by the different trophic groups played an important role in the flow of energy in the lake. During the mid-1980s, major ecosystem changes started manifesting themselves in Lake Victoria. Algal blooms and mass fish kills became frequent. The concentration of phosphorus in the lake doubled between 1960 and 1990 while that of silicon decreased by a factor of 10. Algal species composition changed from dominance of diatoms to nitrogen fixing bacteria. Phytoplankton production doubled and algal biomass increased four to five times, causing a decrease in water transparency. Changes in biotic communities also occurred among invertebrates.

The depletion of the complex haplochromine community and the changes in zooplankton reduced grazing pressure, leaving much of the organic matter unconsumed. Decomposition of this organic matter depleted the water column of oxygen and led to anoxia, driving haplochromines to shallower waters where they fell easy prey to Nile perch. Water hyacinth (*Eichhornia crassipes*) invaded Lake Kyoga in 1988 and Lake Victoria in 1989. Water hyacinth occupied the shallow, sheltered bays, which are breeding, nursery and feeding grounds for fish.

Efforts to manage for biodiversity

The riparian states of Lake Victoria are now implementing measures for conservation and sustainable use of biodiversity as stipulated in Article 6 of the CBD. Some of the key areas of intervention include: Biodiversity identification and monitoring (*Article 7*); *In-situ* conservation *(Article 8*); *Ex-situ* conservation; *(Article 9)*; Sustainable use *(Article 10)*; Public education *(Article 13)*; and Exchange of information *(Article 17)*. Some examples of key efforts follow.

The first plan to conserve the biodiversity of threatened species of Lake Victoria cichlids was to breed them in North American aquaria and zoos with the hope of reintroducing them. However, there is no hope of completely removing Nile perch from Lake Victoria and the other lakes. Besides, this would be economically undesirable because of the large economic benefits that had been realized from Nile perch catches. There is also a limit to the number of species which can be protected by this approach. This method is therefore of limited value. A related option is to conserve some of the threatened food fishes through fish farming. Technologies are being developed to introduce *O. esculentus* and *L. victorianus* into local aquaculture. Because some aquatic flora and fauna will be lost despite protection, representative samples are being kept as preserved or live specimens in museums and aquaria.

A more promising way of addressing biodiversity concerns is to identify and conserve the diversity of ecosystems. Generally, lakes which are protected from human encroachment, such as Lake Agu (among the Kyoga satellite lakes), are very valuable in biodiversity conservation. Almost all the native non-cichlids which occurred in the main lakes Victoria and

Kyoga before the Nile perch upsurge have been encountered in satellite lakes. Those with the highest biodiversity values have been recommended as protected areas.

Refugia that take advantage of natural fish tendencies are also useful. Nile perch cannot survive under low oxygen conditions such as those in papyrus swamps. Papyrus swamps and fringing wetlands have been observed to provide refuge from Nile perch. They also serve as barriers to movement of Nile perch between adjacent water bodies. It has therefore been recommended that papyrus swamps and vegetation along and between affected lakes should not be cleared. One of the wetlands in the Victoria lake basin (the Nabugabo wetlands) is also being developed into a Ramsar site whose role will include conservation of some of the fish species lost from Lake Victoria, such as *O. esculentus*.

The genetic variability of native and introduced species has been used to guide conservation efforts. Results of research suggest that conserving genetic diversity of *L. victorianus* and *O. esculentus* will require protecting many individual populations. Some of the satellite lakes within the Victoria and Kyoga Lake basins contain the only populations of native tilapiines which have not been contaminated by *O. niloticus*. It has been recommended that measures should be undertaken to safeguard against entry *O. niloticus* into these lakes.

Changes in fishing patterns have also been considered. Recovery or improvement in stocks of endangered species would depend upon reduction in Nile perch stocks. Selective exploitation of Nile perch, especially at the time when it feeds heavily on other fishes, could reduce predation pressure on those fishes and help improving their stocks. However, the economic importance of Nile perch makes this an unlikely option.