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CONTENTS

INCREASE IN FISH PRODUCTION ACHIEVED BY STOCKING EXOTIC SPECIES (LAKE KYOGA, UGANDA)

by

J. STONEMAN AND J. F. ROGERS

THE LAKE KYOGA complex lies towards the north of Uganda, at an altitude of 3,400 feet, between 1° and 2° north of the Equator. The lake is extremely elongate and digitate, shallow (1 metre–7 metres), and almost all the coast-line is swampy, with many papyrus beds. Floating islands of sud are a feature. At its eastern extremity, it breaks up into many swampy, isolated lakes. The Nile from its source at Jinja enters Lake Kyoga on its southern side, and leaves the lake at its western extremity, and winds on through to Lake Albert and the Sudan. The Kyoga/Salisbury/Kwania complex covers 2,354 sq. km. of water.

Geologically, the lake is a series of flooded river valleys, probably resulting from the uplifting of the western edge of the basin in the Pliocene and the Pleistocene ages aud the endemic fish fauna is very similar to that of Lake Victoria, although Kyoga has not developed the species flocks of *Haplochromis* which characterise the larger lake. The Victoria fauna extends down-stream of Lake Kyoga to the Murchison Falls on the Nile, which forms an almost complete barrier between Kyoga and the typical nilotic fauna of the Nile below Murchison and Lake Albert.

Worthington's survey of Lake Kyoga in 1928 brings out the characteristics of the Kyoga fish population extremely well. Economic fish production from Kyoga was first studied scientifically by Rhodes, who was the first professional fisheries officer to be posted to the region (1947). At that time various primitive fishing methods were still in use by the Bukenyi tribe, who lived almost entirely by fishing, building houses on the floating islands and employing basket traps, simple locally-made hooks and primitive seine-nets built from papyrus stems. Descriptions of the region by Rhodes appear in the Fisheries Department's Annual Reports, 1947–50. Following Rhodes' work, gill-netting and long-lining became the standard fishing methods, gill-netting being made possible by the virtual eradication of crocodiles between 1945 and 1955. Species of economic importance were the endemic *Tilapia* (*esculenta* and *variabilis*) Cat fishes (*Bagrus, Clarias*) and the Lungfish (*Protopterus*).

The *Tilapia* were very much smaller individualy than specimens of the same species found in Lake Victoria, and 2½-inch to 3½-inch gill-nets were commonly employed.

In 1950, the Fisheries Department carried out a number of introductions of *Tilapia nilotica, T. zillii* and *T. leucosticta* into cattle dams in various parts of Teso, one of the districts bordering Lake Kyoga. These fish were obtained from Lake Albert. These introductions were remarkably successful, and it was, therefore, decided to stock the same Albertine species of *Tilapia* into the main lake. In 1954/55, several thousands of these species were stocked at Lalle Port, Bugondo, and Masindi Port. At the same time, consideration was being given to stocking the predatory Nile Perch (*Lates*) into Lake Victoria. Due to the inter-territorial nature of the lake, international agreement was difficult to secure, and, therefore, partly as an experiment to shed light on this question, and also because it was considered that such a stocking would be advantageous in its own right, Nile Perch from Lake Albert were stocked in Lake Kyoga. Fish of 10–40 lb.

were caught by angling at the bottom of the Murchison Falls, and were carried to the top in 44-gallon drums of water, where they were released some little way from the brink of the fall, but after one trial, this method was abandoned. Thereafter, small Perch of up to 10 inches long were caught in and around Butiaba, Lake Albert, and were released at Masindi Port and Jinja below the Owen Falls Dam. Details of these stockings are given in Table I.

TABLE I (*a*)—NILE PERCH STOCKINGS TO LAKE KYOGA

Date	Number	Origin	Stocked at	Remarks
February, 1954	7	River Nile below Murchison Falls.	Above Murchison Falls	12–14 inches. Angling-caught.
September, 1955	47	Butiaba, Lake Albert	Jinja below Owen Falls Dam.	9–18 inches. Seined and trapped.
October, 1955	100	Butiaba	Masindi Port . .	9–18 inches. Seined and trapped.
April, 1956 . .	41	Butiaba	Jinja below Owen Falls Dam.	9–18 inches. Seined and trapped.

TABLE I (*b*)—TILAPIA STOCKINGS INTO LAKE KYOGA

Date	Number	Origin	Stocked at	Remarks
July, 1955 . .	n.a.	Kidetok Dam . .	Lalle Port	Mostly *T. zillii.*
September, 1956	650	Kidetok Dam . .	Lalle Port	*T. zillii, nilotica, leucosticta.*
January, 1957 . .	97	Butiaba	Lwampanga . .	*T. zillii.*

TABLE II—RECORDED EARLY RECOVERIES OF LATES AND EXOTIC TILAPIA

Date	Number of *Lates*	Number of Exotic *Tilapia*	Place
May, 1956 . .	1	—	Namasagali (specimen not formally identified).
July, 1958 . .	1	—	Nabieso.
February, 1959	1	—	Lake Kwania.
April, 1959 . .	1	—	Lwampanga.
May, 1959 . .	1	—	Akokoro.
By the end of 1959 some hundreds of reeoveries were recorded.			
December, 1956	—	201	Labori area.
1957	—	Many hundreds from Muntu, Kidera, Odapakole and Mukora.	

TABLE III—LAKE KYOGA

Date	Total landings of wet fish	Landings of *T. esculenta* and *variabilis*	Landings of *Lates*	Landings of *T. nilotica, zillii* and *leucosticta*
	Tons	*Tons*	*Tons*	*Tons*
1963	16,551	6,002	Not recorded	742
1964	18,261	5,929	657	589
1965	18,027	3,597	4,374	517
1966	19,577	2,590	7,422	947
1967	25,905	2,172	1,300	5,017
1968	32,580	1,617	17,725	7,644
1969	48,945	2,158	26,920	13,171

First catches of the introduced *Tilapia* and of the Nile Perch are shown in Table II. Since that time, catches of these species have increased considerably. Table III shows total production of Lake Kyoga for the years 1963–1969, production of Nile Perch, the introduced *Tilapia* and the endemic *Tilapia* for the same years. Inspection of the Table will show that much of the increase in fish landings is accountable to the introduced fish. As a management technique, the introduction has obviously been extremely successful, and has vindicated the experiment. It will be seen that production from Lake Kyoga at 214 kg. per hectare per annum is amongst the highest in the world for tropical freshwater lakes, without any artificial feeding or fertilisation. The reasons for this remarkable productivity are fairly clear. The shallowness of the lake allows sunlight to penetrate through most of the water, and photosynthetic activity can occur throughout the water body. This shallowness also prevents the development of prolonged stratification, and the lake is well oxygenated at all times. The lake receives the drainage from a very large area of country — 56,125 sq. km. — and this must in itself result in a very high in-flow of nutrients.

The success of the introductions has been reflected in the modification and re-direction of the fishermen's methods to exploit the introduced species. In the open water of the main lake, large-mesh gill-nets (7 to 9 inches stretched mesh) are in widespread use for catching large *Tilapia nilotica* and small Nile Perch. Large Nile Perch are mostly taken on long-lines baited with live fish, *Clarias* and *Protopterus* being the most popular bait fish. It is of interest to note that fishermen always bait their long-lines with live fish; lines baited with dead fish or pieces of fish do not take Nile Perch. The demand for live bait is such that a small *Protopterus* will sell for Shs. 1, and, over the past few years, a trade in supplying small live *Protopterus* and *Clarias* from the swampy areas to the major landings on the main lake has developed. The drop in landings of the endemic species of *Tilapia* in recent years may well be explained by the changes in gill-net mesh sizes; in areas where smaller mesh gill-nets are still fished, landings have not varied to the same extent.

One endemic species where the catch per unit effort has dropped is *Bagrus docmac*. In 1961, 223 tons of this species were landed; in 1968, 4·5 tons were landed. Prior to the introductions of *Lates*, *Bagrus* was an important fish predator, and, since the establishment of a large Nile Perch population, it has presumably been unable to compete. Gill-nets now fished for *Tilapia nilotica* and Nile Perch, would also take *Bagrus*, if they were present. *Protopterus* was formerly taken from all areas of the lake, but nowadays catches are restricted to the swampy areas only.

From infrequent and cursory examination of Nile Perch stomach contents, fish (mainly cichlids) are the major food, particularly as regards the larger Nile Perch. Smaller Nile Perch stomachs contain a considerable proportion of insects, *Odonata* larvae being the most common. It is also interesting to note that some of the stomachs from small Nile Perch contain large amounts of macrophytic vegetable matter.

In the past few years, there has been a steady increase in fishing effort; more canoes, many of larger and better design, have been introduced, and the number of nets/long-lines per canoe has also increased. Despite the increases in fishing effort and fish landed, the average weight of Nile Perch and *Tilapia nilotica* in the catch has increased. In 1968 the average weight of Nile Perch landed was 2·41 kg. and *Tilapia nilotica* 0·89 kg. In 1969, Nile Perch was 7·7 kg. and *Tilapia nilotica* 1·4 kg. Although production per unit area is already at a high level, there are no signs that the lake cannot be even more intensely exploited in the future.

There has never been a complete biological study of Lake Kyoga, and, in view of the remarkable expansion of production in recent years, and the importance of the lake to the national economy, this gap should be closed as a priority measure.

Finally, it is now clear that the introduced fish are far more efficient at utilising the available resources than were the indigenous species. It is now rather amusing to read the many gloomy prognostications of a number of experts at the time of the introductions.

This emphasises a most important function of fisheries management officers. The startling increases in production from Lake Kyoga have barely kept pace with demand and consumption. Had the introductions not been made when they were, there would now be a shortage of approximately 40,000 tons of fish per year to the Ugandan consumer. The problems that this would pose, in terms of foreign exchange, etc., would be extremely grave. It is, therefore, clear that officers charged with development of fisheries must be sufficiently far-sighted, technically competent and resolute enough to value the pessimistic utterances of self-styled experts, often based on insufficient data, at their true worth. It must be realised that scientific assumptions and surveys can only help the management officer to make his decision, and he must be capable of evaluating such evidence at its true worth in the whole context of his multifarious duties and responsibilities.

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