

Changing Trends in the Fishery of the Victoria Reservoir

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ABSTRACT. *To optimize the use of the Victoria reservoir as a resource for fish production, changing trends in the fishery were monitored over a five year period, starting in 1989 when fishing officially commenced in this reservoir.*

The annual fish production of 193 metric tons in 1989 declined by 59.1% in 1994 with a corresponding decline in the catch per unit effort (CPUE) from 8.2 to 4.2 kg per craft. The landing size of the principal marketable species Oreochromis mossambicus decreased significantly ($p < 0.05$) during the same period. Two of the stocked species, Oreochromis niloticus and Cyprinus carpio established themselves in the reservoir while Oreochromis mossambicus, the mainstay of the fishery, declined progressively. Although the number of fibre-glass boats operated has not changed much since 1990, the number of fishing days has declined following the decline in yield. Illicit fishing using wooden canoes and small meshed gill nets and cast nets increased significantly. Withdrawal of state patronage in July 1990 resulted in de-stabilizing regular stocking, the training of fishermen and withdrawing subsidies on fishing gear and crafts.

The principal factor responsible for the declining trend of this fishery was over-exploitation caused by unwarranted human activities due to the absence of supervisory control following the cessation of state patronage. It is evident that a suitable management strategy needs to be implemented for the sustainable utilization of this resource.

INTRODUCTION

The inland fishery of Sri Lanka is essentially a capture fishery of African cichlids and carps (Chinese and Indian) mainly confined to irrigation tanks and reservoirs in the lowland dry zone. Sri Lanka introduced about 16 exotic species as food fish during different stages since 1950 (De Silva, 1988).

Of these species, the African cichlid *Oreochromis mossambicus* has colonized most of the available habitats and ranks as the mainstay of the inland fishery.

The Sri Lankan government made a substantial allocation from its annual budget to develop inland fisheries with a view of providing protein for the rural communities. However, in 1990, the government declared the cessation of state patronage for inland fisheries which led to the withdrawal of the above mentioned support for this sub-sector.

Victoria, one of the largest hydro-power reservoirs (2,270 ha) in Sri Lanka has been created by damming the longest river in the country, the Mahaweli. In this investigation, an attempt is made to monitor the trend of a number of variables of the fishery in this reservoir over a five year period with a view to suggest means of optimizing the use of this resource for fish production.

MATERIALS AND METHODS

Study site

Victoria is the deepest ($D_{\max} = 102$ m) hydro-power reservoir constructed under the Accelerated Mahaweli Programme. This reservoir was commissioned in 1984 inundating some large cocoa and coffee estates with rich soils.

The Victoria reservoir has been colonized by several indigenous riverine fish which have no significant commercial value. In order to utilize this reservoir as a productive fisheries resource, the Ministry of Fisheries introduced a stocking programme in mid 1980's. A total of 165,240 fingerlings of the African cichlid *Oreochromis niloticus*, 191,00 fingerlings of the Common carp *Cyprinus carpio*, 163,010 fingerlings of Indian carp (*Cirrhinus mrigala* and *Labeo rohita*) and 46,475 fingerlings of Chinese carp (*Ctenopharyngodon idella* and *Aristichthys nobilis*) were stocked in the reservoir during the period 1984-1989. Fishing officially commenced in 1989.

The fishermen were registered and provided with outrigger fibre-glass canoes and fishing gear on a 90% subsidy. In addition, these fishermen were briefly trained on the exploitation and management of this fishery using a permissible mesh size of gill nets specified as 3 1/2 inches and above.

Furthermore, a Fishermen's co-operative society was established in 1989 under state patronage to look after the welfare of the fishermen.

Method

Several aspects of the fishery of the Victoria reservoir (eg. number of crafts operating, catch per craft, relative abundance of species, the standard and total lengths of the cichlid species and the method of fishing) were examined fortnightly at three major landing sites from 1989 to 1994. The significance of the differences in mean total length during the study period for the three cichlid species was tested using a regression analysis.

RESULTS AND DISCUSSION

Changing trends in fish yield, species composition, the mean landing size of the cichlids and in fishing practices were monitored during the period 1989 to 1994.

Fish yield

The declining trend of the annual fish yields and cichlid yields of the Victoria reservoir between 1989 to 1994 is shown in Figure 1. The estimated yield of the Victoria reservoir in 1989 was 193 metric tons ($85.02 \text{ kg ha}^{-1} \text{ yr}^{-1}$). This amount declined by 29.5% in 1990 and the decrease was 59.1% in 1994. The percentage of cichlids in the annual fish yield showed a 21.7% decline from 1990 to 1994. The decline in fish yield corresponded to the increase in producer price from Rs. 10.00 per kg in 1989 to Rs. 25.00 in 1994, with a corresponding increase in market price from Rs. 20.00 per kg in 1989 to Rs. 50.00 in 1994.

Under government patronage illegal fishing using wooden canoes and small meshed nets below 3 1/2 inches was prohibited, and fisheries regulations were enforced by the continuous supervision of fisheries inspectors. The decline in inland fish production after 1990 could be attributed mainly to the withdrawal of government patronage and the absence of supervisory and regulatory measures during this time. Decline in fish yields observed in the Victoria reservoir has also been caused by illegal fishing using gill-nets and cast nets below 3 1/2 inches and over-exploitation due to the absence of supervisory

control. Other factors, such as the natural decline of a virgin reservoir following eutrophication and the restriction in migration of indigenous species following the construction of the dam may also have contributed towards this decline.

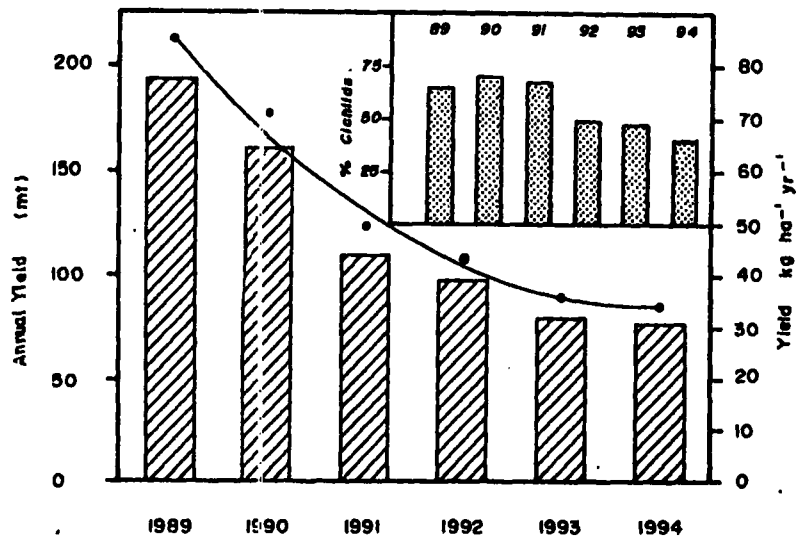


Figure 1. Annual fish production and percentage of cichlids in the annual fish yield of the Victoria reservoir during the period 1989-1994.

Different aspects of the fishery of many lowland reservoirs in Sri Lanka have been reported by several authors (Sirisena and De Silva, 1989; Enderlain and Wickstom 1991; Pet, 1995; Amarasinghe, 1987 and Schiemer, 1983). The average fish production of nineteen lowland reservoirs in Sri Lanka has been estimated to be 258 kg ha⁻¹ yr⁻¹ (De Silva, 1988), which is about three times as high as that of the Victoria reservoir. Factors such as drastic fluctuations in water level, greater depth, and inherent basin morphology could probably be attributed to the lower productivity of the Victoria reservoir.

The average fish yield in tropical lakes and reservoirs has been estimated to be about 80 kg ha⁻¹ yr⁻¹ (Oglesby, 1985) which is very close to the value obtained in 1989 for the Victoria reservoir (85.02 kg ha⁻¹ yr⁻¹). This indicates that there is a nple scope for the development of this fishery into a productive resource.

Species composition

Three species of African cichlids (*Oreochromis mossambicus*, *Oreochromis niloticus* and *Tilapia rendalli*), two species of carp (the common carp *Cyprinus carpio* and the Indian carp *Labeo rohita*) and three indigenous species (*Barbus sarana*, *Ompok bimaculatus* and *Tor khudree*) were the main constituent species in the commercial fishery. Other species such as *Catla catla* (which could have been accidentally introduced), and *Aristichthys nobilis* as well as indigenous species such as *Anguilla nebulosa*, *Glossogobius giuris*, *Channa marulius* and *Clarias* spp appeared only occasionally, while the endemic *Labeo fisheri* gradually disappeared from the catches.

With respect to fish species, the trend observed for cichlids is shown in Table 1. The percentage yield of *O. mossambicus*, the mainstay of the fishery declined from 61.4% to 23.4% between 1989 and 1994. In fact this appears to be the major cause for the decline of this fishery.

The decline of this species could be attributed to illegal fishing practices where a major part of the juvenile population was eliminated by laying small meshed gill nets and cast nets and also by catching a wide spectrum of size ranges by chasing these fish into gill nets of different mesh sizes using the water beating technique. In contrast, the yield of *O. niloticus* increased by 16.8% from 1989 to 1993, while *T. rendalli* appeared in relatively higher percentages in 1990 and 1991 compared to later years.

Of the carps, the percentage weight of *Cyprinus carpio* increased by 31.0% whereas the Indian carp (*Labeo rohita*) has declined progressively since 1993. It is interesting to note that the bottom-dwelling *Cyprinus carpio* has established a self-sustaining breeding population in this reservoir during the study period despite the absence of stocking.

Table 1. Catch composition in the Victoria reservoir from 1989 to 1994 as a percentage weight of the total production.

Species	1989	1990	1991	1992	1993	1994
Cichlid spp.						
<i>O. mossambicus</i>	61.4	58.7	50.2	31.2	26.3	23.4
<i>O. niloticus</i>	4.3	7.5	11.4	18.3	21.1	22.4
<i>T. rendalli</i>	2.2	3.0	4.8	1.2	0.7	1.7
Carp spp.						
<i>C. carpio</i>	12.8	15.3	20.5	35.9	39.1	43.8
<i>L. rohita</i>	8.2	5.2	6.1	8.0	9.4	5.6
Indigenous spp.						
<i>B. sarana</i>	5.6	5.1	2.9	1.6	1.4	0.9
<i>T. khudree</i>	2.4	2.1	2.4	2.4	1.0	1.2
<i>O. himaculatus</i>	2.3	2.2	1.0	0.8	0.6	0.6
Other species	0.8	0.9	0.7	0.6	0.4	0.4

In general, there is a decreasing trend in the percentage yields of the indigenous species over the period under investigation. The indigenous species of Sri Lanka are essentially riverine or marsh dwelling, which need to migrate to streams and rivers during the spawning season. Hazards encountered during such spawning migrations could be a factor for the observed decline. Lack of food during acute draw down especially for carnivorous species, competition with exotics and destruction of specific habitats needed for survival are also some possible contributory factors which could be responsible for this decline.

Mean landing size

The variation of mean total lengths of the three cichlid species in the commercial fishery of the Victoria reservoir is shown in Figure 2. The mean total lengths of *O. mossambicus* in 1993 and 1994 are significantly lower ($p < 0.05$) than those of the previous years. The reverse is true for *O. niloticus* where the mean landing size in 1993 and 1994 are significantly higher ($p < 0.05$) than previous years due to the increase in large sized *O. niloticus* in the catches from the inflow areas. Unlike the other two species, the mean total length of

T. rendalli did not show a significant difference during the period under investigation.

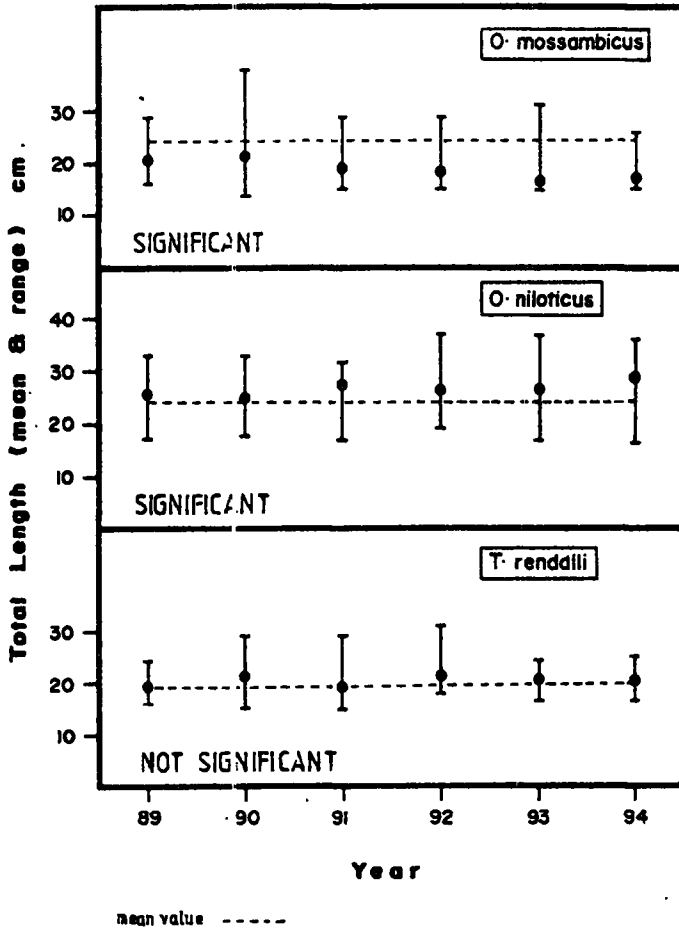


Figure 2. Variation in the mean total length of the three cichlid species in the commercial catches of the Victoria reservoir.

Fishing practices

The number of fibre-glass canoes that operated in the reservoir did not change much from 1990 to 1994 (Table 2) but the number of wooden canoes increased from 30 to 123 during this time. During the same period, the number of fishermen registered at the Fishermen's co-operative society increased from 56 to 125.

Table 2. The number of fibre-glass canoes (NFC) and wooden canoes (NWC) operated, and the average number of fishing days (ANF) and catch per unit effort (CPUE) in the Victoria reservoir from 1989 to 1994.

YEAR	NFC	NWC	ANF	CPUE
1989	28	30	275	8.2
1990	46	40	275	7.4
1991	48	70	270	6.3
1992	53	123	270	5.5
1993	53	123	200	4.8
1994	53	100	180	4.2

In addition to the registered fishermen who are members of the co-operative society, there are the unorganized fishermen who are not members of the Fishermen's co-operative society. The unorganized fishermen's main fishing method is by using a cast net. In addition, they use small meshed nets (less than 3 1/2 inches), the hook and line as well as wooden canoes. After withdrawal of state patronage, the registered fishermen joined the illegal fishermen in using unauthorised fishing practices. It was difficult to quantify the exact increase in exploitation rate due to the vastness of the reservoir area and also the variable times of the day during which these activities took place.

However, large illicit catches ranging from 40 to 60 kg per person, comprising mainly of small sized cichlids have been observed on numerous occasions.

As a result of the decline in fish catches, the average number of fishing days decreased from 275 to 180 and the average CPUE decreased from 8.2 kg per craft in 1989 to 4.2 kg per craft in 1994 indicating a marked decline in the yield (Table 2). In 1994, only 10% of the total registered fishermen were engaged in full time fishing.

CONCLUSIONS

It is evident that the fish yields of the Victoria reservoir have significantly declined following the withdrawal of state patronage in July 1990, due to unwarranted human interferences and lack of supervisory and regulatory measures. Reduction in mean landing size and the noteworthy decline of *Oreochromis mossambicus*, the mainstay of the fishery, with the spread of illegal fishing practices highlight the urgent need for action in respect of management. The productivity of this resource could be increased by the introduction of a suitable management strategy geared towards rational utilization of the fishery with strict enforcement of fisheries regulations.

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