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The Feasibility of Developing the Victoria Reservoir into a Sustainable Fishery

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ABSTRACT. The capture fishery at the Victoria reservoir, which was a subsidiary enterprise under state patronage was under the control of the Ministry of Fisheries since the reservoir was commissioned in 1984. The present situation is characterised by financial constraints and absence of organized management, with no in – depth knowledge about the eco – system itself. The main cause for this is the change in Government policy which took effect from July 1990. The present on – going studies have monitored the temporal changes in the mean monthly catch, and the breeding success of the exotics. Results obtained during this study reveal that in addition to hydro – power there is the potentiality of developing the Victoria reservoir into a sustainable enterprise. It is apparent that the absence of appropriate knowledge on fish populations by exploiters could jeopardise the fish yield of this reservoir.

INTRODUCTION

The short history of reservoir fisheries in Sri Lanka has shown that the main goal has been to enhance fish production in large perennial irrigation tanks and reservoirs. This has been achieved by the introduction of exotic species. In fact, the reservoir fishery became successful only after introduction of the cichlid *Oreochromis mossambicus* from Singapore in 1952, which has established itself in all our inland water bodies, and has now become the mainstay of Sri Lanka's inland fishery.

Victoria, one of the newly built highland reservoirs is the largest hydro – power reservoir in the country. Since its impoundment, the Government of Sri Lanka, stocked this reservoir with African cichlids and Indian and Chinese carps, with the object of establishing a fishery as a source of protein supply to the rural communities in the area.

A number of villagers suitably trained were authorized to operate in the reservoir and were provided with fibre-glass crafts and gill-nets on a subsidised scheme. The mesh size of the nets was specified and the fishermen were under the direct control of the Ministry of Fisheries. This scheme came to a halt in July 1990, when state patronage for inland fisheries was withdrawn.

The status of the commercial fishery of this reservoir has been investigated during the initial phase of its establishment (Silva, 1991; Edirisinghe *et. al.*, 1990; De Silva and De Silva, 1991 and Nathanael, 1991a). The present investigation, carried out over a two-year period helps to highlight the necessary strategies for building up this fishery from the present state of disarray. This study is of particular significance since it has been carried out prior to and after the withdrawal of state patronage.

MATERIALS AND METHODS

The Victoria reservoir (7^0 15'-7^0 19'N and 80^0 39'-80^0 48'E) has been created by inundating some large cocoa and coffee estates with rich soils, in the Dumbara valley. This reservoir, with its morphology (*i.e.* banks and shoreline) and hydrology (*i.e.* water level fluctuation, retention time *etc.*) is characterised by a typical intermediate lotic-lentic type of eco-system.

During the study period (August 1990 to August 1992) catch statistics have been maintained at least thrice a month on the gill-net fishery of the reservoir (Nathanael, 1991a). Data was collected for 20-25% of the total fishing operations in the reservoir with the assistance of individual fishermen and market entrepreneurs. Comparisons were made between the size (total length) of *Oreochromis mossambicus* in May 1990 (prior to withdrawal of state patronage) and a year later (May 1991) after withdrawal.

The number of mature females (females at the spawning stage) among the exotic fish species was noted for a one month period. This was expressed as a percentage of the total number of individuals examined in each case. Selected samples of mature females within the most frequently occurring size range in the commercial catch were weighed and their fecundity (number of ripe eggs per individual) was

determined. Data pertaining to inflow, outflow, water level fluctuation and rainfall, were obtained from the dam site.

RESULTS AND DISCUSSION

Figure 1 shows that overall inland fish production has increased steadily from 1956 to 1989. The peak production of 39,700 tons reached in 1989 dropped to 23,800 tons in 1991, since the withdrawal of state patronage. Obviously, as in the Victoria reservoir during this period there would have been over-exploitation, and fish of the smaller size category would have been harvested.

Breeding potential of exotics

The fish population at the Victoria reservoir is made up of exotic cichlids (*O. mossambicus, O. niloticus, T. rendalli*) exotic cyprinids (*Cyprinus carpio, Labeo rohita*) and indigenous species (*Barbus sarana, Tor khudree, Ompok bimaculatus, Anguilla nebulosa, Glossogobius giuris* and *Clarias* spp). While the cichlids spawn throughout the year with prominent peaks the exotic cyprinids migrate to the inflows of the reservoir for spawning. It appears that during the period of this observation these exotic cyprinids have been caught in the process of migration (Table 1a) and probably accounts for the large number of mature females.

Table 1b summarises data on fecundity for the different exotic species. The exotic cyprinids exhibit the highest fecundity (55,281 - 521,920) which is a very promising trend. Although the fecundity of the cichlids is much lower, numerically they are the dominant population in the commercial catch. They exhibit parental care over their offspring. On the other hand the mortality of exotic cyprinid fry would be very high owing to the absence of this phenomenon.

The present study shows that the exotic fishes in the reservoir have the potential to maintain natural self-sustaining populations if stocked in adequate numbers. The authors have recorded elsewhere (Nathanael and Silva, in press) that two of the non-cichlid exotic species in this reservoir, the common carp (*Cyprinus carpio*) and rohu (*Labeo rohita*) are an exploitable resource. Common carp fingerlings

Table 1a. Percentage of mature females (i.e. females at the spawning stage) among the exotic fish species examined during the period April 15th to May 15th 1992.

Type	Species	No. of fish examined	No. of mature females	%
Cyprinids	*Cyprinus carpio*	188	60	31.91
	Labeo rohita	47	11	23.40
Cichlids	*Oreochromis mossambicus*	635	52	8.19
	Oreochromis niloticus	612	7	1.14
	Tilapia rendalli	7	0	–

Table 1b. Fecundity of exotic fish species within the most frequently occurring size range in the commercial catch at the Victoria reservoir.

Species	Size range (cm)	Weight of ovaries (g)	Fecundity
Cyprinus carpio	38 – 40	73.94 – 195.38	55,281 – 147,903
Labeo rohita	62 – 64	263.46 – 419.55	234,743 – 521,920
O. mossambicus	18 – 20	1.82 – 5.07	337 – 474
O. niloticus	25 – 27	5.01 – 6.67	786 – 1,086
*T.rendalli**	20 – 22	6.35 – 6.97	2,020 – 3,322

* Mature specimens obtained after May 15th 1992.

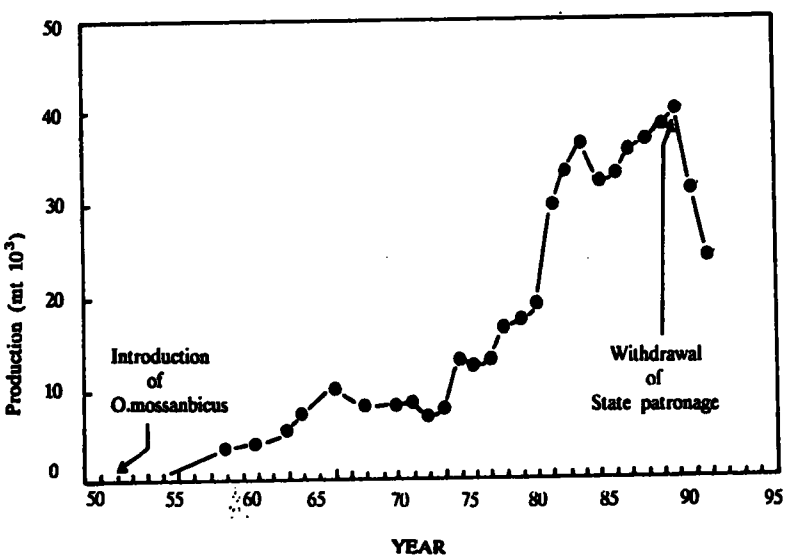

Figure 1. Inland fish production in Sri Lanka.

have been caught in the inflows of the reservoir during this period, confirming our previous inference (Nathanael and Silva, in press) that they appear to breed naturally in the vicinity of the reservoir. It now appears that rohu too may be having this potentiality. The high fecundity and increase in the number of rohu caught lately (April, May 1992) in the commercial catches despite the absence of stocking suggest this possibility.

Predator pressure

Four carnivorous indigenous fish species *Ompok bimaculatus* (butter cat fish), *Anguilla nebulosa* (eel), *Glossogobius giuris* (bar-eyed goby) and *Clarias* species (cat fish) have been identified as the potential predators in the reservoir. Table 2 shows their percentage composition in the commercial catch.

Table 2. Percentage composition (by number) of potential predatory fish species in the commercial catch. (August 1990 – January 1991).

Species	Aug	Sep	Oct	Nov	Dec	Jan
Ompok bimaculatus	2.09	0.27	0.43	0.51	2.75	0.41
Anguilla nebulosa	0.51	0.27	0.72	0.00	0.33	0.95
Glossogobius giuris	0.00	0.27	0.00	0.17	0.00	0.00
Clarias species	0.00	0.00	0.00	0.00	0.09	0.00
Total	2.60	0.81	1.15	0.68	3.17	1.36

The main avian predators of fry and fingerlings in this reservoir are cormorants, shags, white egrets and kingfishers. Predation is highest during high water level when shoals of fish fingerlings come to the littoral waters to feed. However, they do not appear to be a serious threat, high enough to jeopardise the colonization success of these species.

Gear selection

Gear selection is a vital factor for the control and efficient management of the fishery of this reservoir. Figure 2 illustrates the size range distribution of *Oreochromis mossambicus* before and after withdrawal of state patronage. It will be seen that the size range caught after withdrawal of state patronage (May 1991) in the interest of immediate profits has been the small size group.

According to De Silva (1988), there is a possibility that gill-nets may limit the catch efficiency of carps in reservoirs. If this is so, alternative methods of catching these fish should be developed.

Resource availability

The availability of feeding and breeding resources is also important for the survivorship of fish species. This reservoir appears to have an ample amount of detritus which serves as food for bottom dwelling fish. Many species of blue-green algae, desmids and diatoms are present, which would also serve as food for planktivorous fish species. However, the sparse dispersal of benthic organisms in the littoral zone coupled with the periodic availability of macrophytes and grasses could be a limiting factor for the growth of fish fry, macrophyte-eating fish and smaller fish species. The steep slopes that characterise the shoreline reduce the littoral zone, which in turn restricts the availability of soft substrates needed for nest building of exotic cichlids.

Morphometry

The morphometry of reservoirs influences fish production (Amarasinghe and Upasena, 1985). Since little is known of the bottom

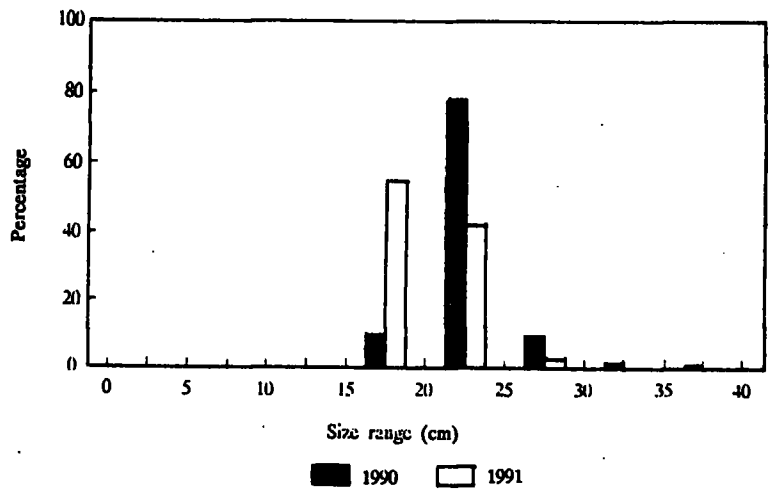

Figure 2. The size range distribution of *Oreochromis mossambicus* in the commercial catches in May 1990 (prior to withdrawal of state patronage) and a year later (May 1991) after withdrawal.

topography and substratum, it is necessary to prepare a bathymetric map for the reservoir. Other morphometric characteristics such as water depth, fluctuation of water level and irregularity of the shoreline are also important.

Overall management

The importance of managing our highland reservoirs as a biological resource on sound, ecological principles has been highlighted elsewhere (Nathanael, 1991b).

The drastic fluctuation in water level (Figure 3) in this reservoir obviously affects the fishery. However, up to date there has been no co-ordination whatsoever between the authorities concerned to regulate the inflow and outflow of water not only according to hydro-power and irrigation demands but also according to the fishing activity (Figure 3). This is a serious drawback, which needs immediate consideration.

Finally, it is felt that well planned scientific management is the key for achieving good productivity. This type of fishery obviously needs to be well funded since the fishermen need to be provided with welfare facilities and fishing gear at a subsidised rate. Stocking the reservoir periodically with fingerlings of exotic fish species is also important. This requires an in-depth understanding of the present environmental situation and an integration of the multi-purpose goals of this reservoir, so that a co-ordinated development could be achieved.

The ultimate success would of course depend on the competence and dedication of the administrative and research personnel to exploit this biological resource as a commercially feasible enterprise on an environmentally sustainable basis.

CONCLUSIONS

The present study indicates that there is potentiality to tap the Victoria reservoir as a biological resource by implementing appropriate management strategies on commercial fishes. This would contribute to the economic and social needs of the nation. Despite the barrier created by cultural and religious beliefs, it is hoped that with a better

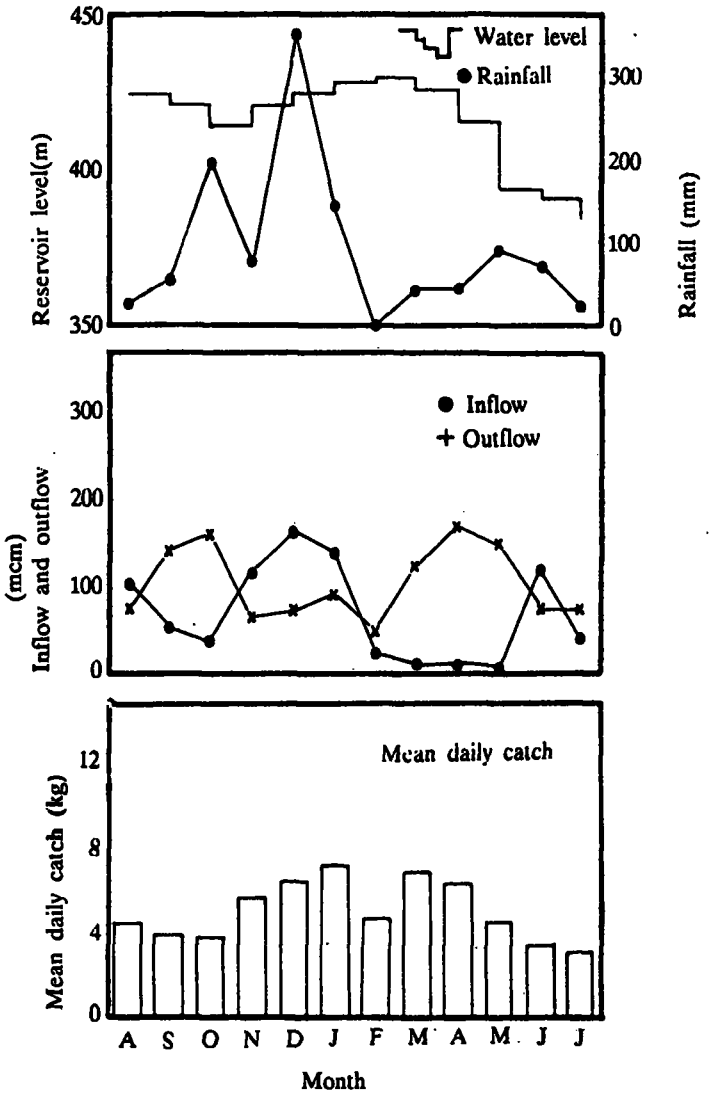

Figure 3. Water level fluctuation, rainfall, inflow, outflow and the mean daily catch in the Victoria reservoir during the period August 1990 to July 1991.

understanding of the economic and nutritional benefits, this fishery would be developed and established to produce self-sustaining populations of fish which would depend on natural recruitment in the near future.

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