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Brush park fishery targeting ornamental fish in Negombo estuary, Sri Lanka

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Abstract
The brush park fishery targeting ornamental fish species is a potential area for the fisheries development that have not been studied extensively in the past. Present study was carried out to determine the composition and yield of the ornamental fish species in Negombo estuary, Sri Lanka, through ornamental brush park fishery. The ornamental brush park fishery was investigated from July 2008 to March 2009 by selecting two study sites around Katunayaka fish landing sites. The ornamental fish species were identified and the yields of those fish species were monitored and standard lengths were measured. Nine ornamental fish species including two main species (*Monodactylus argenteus* and *Scatophagus argus*) were identified. The majority of *Scatophagus argus* (>6 cm in standard length) and *Monodactylus argenteus* (between 4-6 cm) caught were juveniles. A seasonal variation in total ornamental fish yield was observed. Total ornamental fish yield was decreased with the increasing salinity which was determined mainly by the monsoon rainfalls.

Keywords: Brush park fishery, ornamental fish, estuary, yield, sustainable

1. Introduction
In coastal fisheries, several local methods which are labour intensive requiring simple technology such as fish aggregating devices or traps are prevalent in many parts of the world [3]. One such low technology installation formed by using branches `of trees, bushes or soft vegetation stuck in to the muddy bottoms of lagoons, lakes or rivers, are brush parks [6]. Brush parks are a kind of fish aggregating device. These structures are designed to mimic the natural dry season habitat of the many species of fish and crustaceans that regularly use the floating vegetation and submerged branches associated with the banks of rivers and the shores of floodplain lakes for refuge, food and reproduction. Brush park fishing has been recorded in Ivory Coast Ghana, Togo, Madagascar, specific Mexican lagoons [6], Lagos lagoon in Nigeria [5] and in the rivers and lakes Cameroon, Sierra Leone, Cambodia, China and Ecuador [3].

The operation of brush parks in Negombo estuary has a long history. The first reference to brush parks in the estuary dated back to 1910. The average number of brush parks operating per year in the Negombo estuary is about 1800-2200 [2]. The fin fish and shell fish are the major resources of the Negombo estuary system and there is an expanding year round fishery for shrimps in the lagoon. Annual per unit area cropping rates from brush parks are very high and rival those of semi-intensive and even intensive aquaculture. Fin fish caught by brush parks contribute about 36% of the total catch in the Negombo estuary [8]. Furthermore, there is an ornamental fishery in the Negombo estuary apart from the food fish industry and majority of the ornamental fish species caught from the estuary comes from the brush park fishery. Specific species of these ornamental fish species are exported to countries like Thailand, Malaysia, United States of America and United Kingdom. These fish species are also used for the local ornamental fish industry to some extent. In Negombo, ten fish collecting centers are located around the estuary [2]. The major concern is given to two fish species, *Monodactylus argenteus* and *Scatophagus argus* in the ornamental fishery at Negombo estuary

The ornamental brush park fishery is one of the important aspects of the fishery in the estuary. However, studies on ornamental fishery in the estuary are considerably low. This research will provide information on the brush park fishery in the Negombo estuary and it will be useful for the managers to come up with strategies to conduct a sustainable fishery in the future.

The overall objective of the study was to determine the variation in brush park fishery targeting the ornamental fish and the composition and yield of the ornamental fish species in Negombo estuary

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2. Materials and Methods

2.1 Study Site
The Negombo estuary (7°6' - 7°12' N; 79°40' – 79° 53' E) is a shallow basin estuary with a total water surface area of 3502 ha and additional mangrove cover of 350 ha around the estuary in the intertidal land. Two study sites between Katunayake and Kurana coastal belt were selected on the eastern side of the estuary (Figure 01).

2.2 Methodology
To identify the ornamental fish species caught by brush parks in the Negombo estuary the fish species were collected from the fishermen and fishes were identified up to species level using a standard taxonomic guide [4].
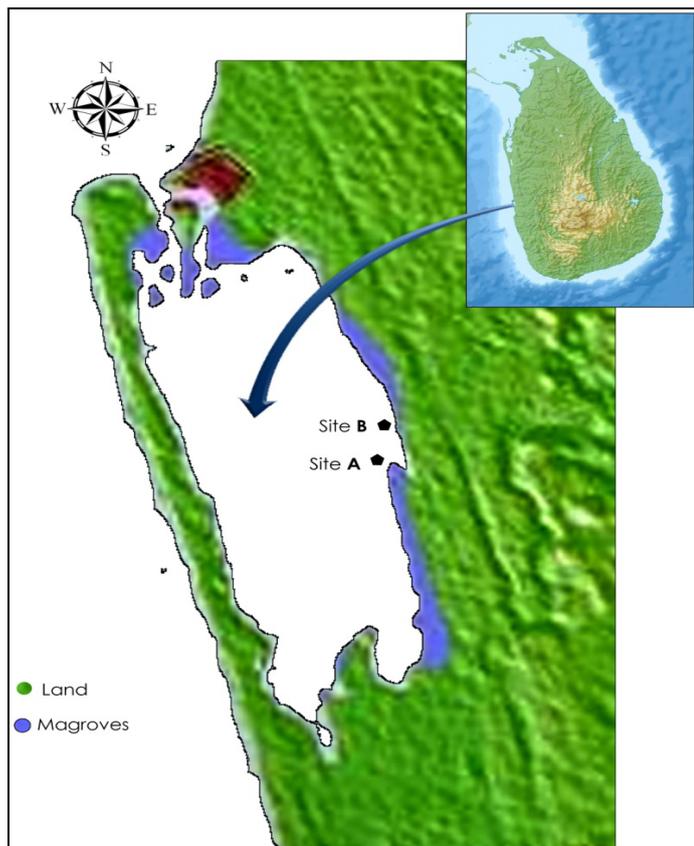

Fig 1: Map of the Negombo estuary;
A.   Katunayake south fish landing sites
B.   Katunayake North fish landing site
(**Source:** Amarasinghe, *et al*, 2002)

The data were collected once in two weeks from a total of 36 brush parks which were randomly selected from various fishing areas around the two selected fish landing sites, between July 2008 and March 2009. The available brush parks for harvesting were known from the fishermen and they were numbered randomly and a number was picked randomly to select a brush park.

The standard length of twenty individuals of *Monodactylus argenteus* and *Scatophagus argus* were measured for each brush park and recorded. To determine the fish yield of each ornamental fish species the number of individuals belonging to each species were counted separately for each brush park and recorded monthly. Salinity was also measured around the brush parks that were used to obtain data.

Chi square test was carried out to analyze the variation in total ornamental fish yield with the months sampled. For that the nine months sampled were divided into three time intervals based on the salinity variations, as July - September (mean salinity 4.43±0.32 ppt), October - December (mean salinity 4.96±0.33 ppt)and January - March (mean salinity 5.85± 0.34ppt)and the analysis was carried out. Histograms were drawn for the standard length of *Scatophagus argus* and *Monodactylus argenteus* for the three time intervals. Correlation analysis was carried out to find the relationship of total yield, yield of *Scatophagus argus* and *Monodactylus argentius* with the salinity.

3. Results
Nine species of ornamental fish species belonging to two orders and seven families were recorded (Table 01). The lowest average monthly fish yield of ornamental fish species was reported in March 2009 (63 individuals per brush parks) and the highest yield in October 2008 (251 individuals per brush park). Monthly average fish yield was about 136 individuals and it showed significant variations between months (Figure 02). Chi square test indicated that there is a significant difference in the fish yield between the time intervals July- September, October- December and January-March (Chi square value 594.94; p = 0.000).

The lowest mean yield for species was recorded for *Tetraodon fluviatilis* (five individuals per brush park) while the highest mean yield was recorded for *Scatophagus argus* with a mean value of 30 individuals per brush park (Figure 03). According to the correlation analysis the total yield ($r^2 = -0.824$), the yield of *Monodactylus argenteus* ($r^2 = -0.831$) and yield of *Scatophagus argus* ($r^2 = -0.841$) decreased with increasing salinity.
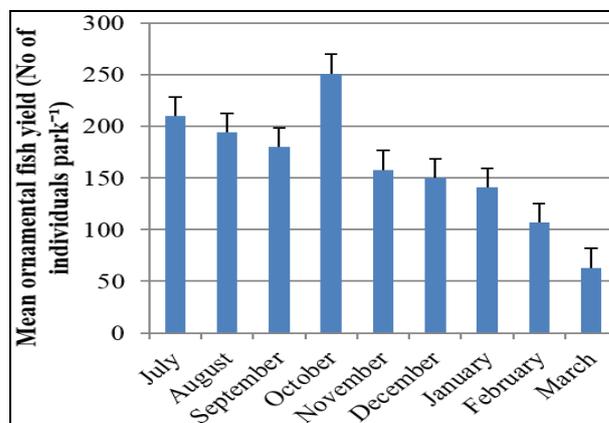

Fig 2: Mean monthly total ornamental fish yield from July 2008 to March 2009
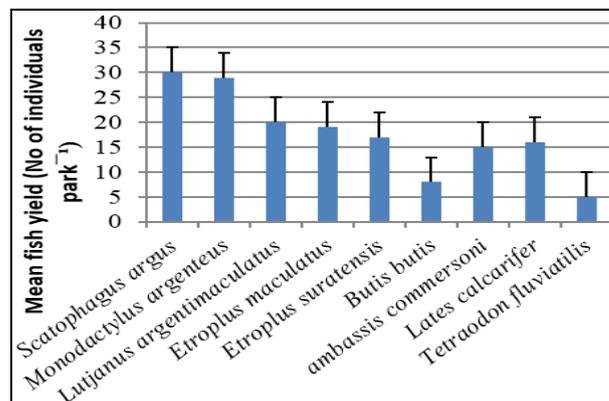

Fig 3: Mean yield of ornamental fish species from July 2008 to March 2009

The histogram for the standard length of *Scatophagus argus* shows that the majority of the individuals belong to the size class of 6 cm – 7.2 cm, 6 cm – 7.2 cm and 5.5 cm- 6 cm for July – September, October – December and January – March time periods respectively (Figure 04).

The histograms for the standard length of *Monodactylus argenteus* shows that the majority of the individuals belongs to the size class of 4 cm – 5 cm, 5 cm – 5.8 cm and 4.5 cm – 5.5 cm for July – September, October – December and January – March time periods respectively (Figure 05).
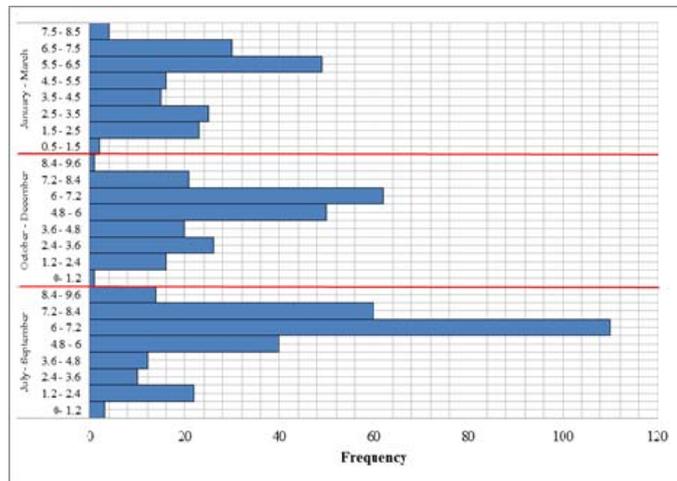

Fig 4: Histogram for standard length of *Scatophagus argus* for the three time intervals
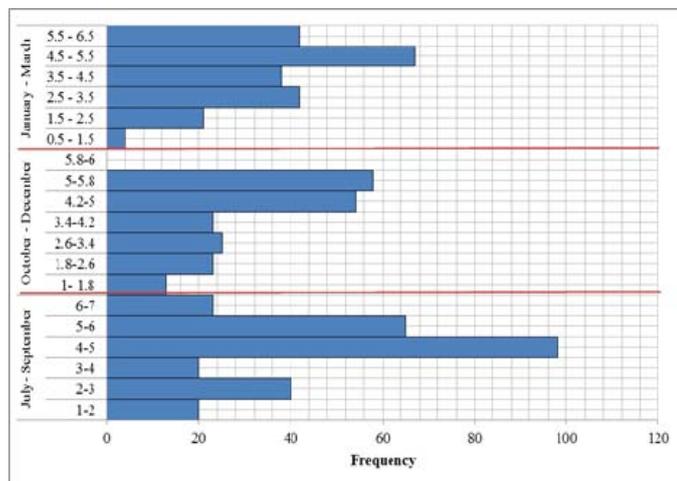

Fig 5: Histogram for standard length of *Monodactylus argenteus* for three time intervals

Table 1: List of ornamental fish species caught by the brush park fishery in Negombo estuary

Family	Scientific name	Common name
Monodactylidae	*Monodactylus argenteus*	Mono
Scatophagidae	*Scatophagus argus*	Scat
Lujanidae	*Lutjanus argentimaculatus*	Red Snapper
Cichlidae	*Etroplus maculatus*	Orange chromide
	Etroplus suratensis	Pearl Spot
Eleotrididae	*Butis butis*	Upside down sleeper
Centropomidae	*Ambassis commersoni*	Common glass fish
	Lates calcarifer	Barramundi
Tetraodontidae	*Tetraodon fluviatilis*	Common puffer

4. Discussion

Brush parks provide suitable habitats for many species. They provide substrate for the growth of periphyton, hence the nutrient levels are high [7] and also provide suitable hiding places for fish. Fish are attracted to brush parks depending on two major factors. Some fish are attracted for food and shelter while the others for reproduction purposes as well. However, in the Negombo estuary it is unlikely that any ornamental fish species except *Etroplus maculatus* and *Etroplus suratensis* reproduce within them. Even these two fish species might not reproduce withings the short soaking time (3-4 weeks) of brush parks.

All the nine ornamental fish species caught by brush parks are indigenous and common fish species which can be adapted to freshwater conditions [4]. The *Scatophagus argus* and *Monodactylus argenteus* are the two main ornamental fish species caught in this estuary. This may be due to their omnivorous food habit, where they eat more plant material than animal matter and also their tendency to hover around and under the floating and submerged objects. The diet of algae and other plant materials of *Etroplus* spp caught from the brush parks may attribute to their moderate yield. The lowest average yield was recorded for *Tetraodon fluviatilis* which is a carnivore that feeds on small prawns and fish fry. Less abundance of these food resources in brushparks may attribute to the lower yield of *Tetraodon fluviatilis*. All other species which showed lower yields were also carnivorous fish. Therefore, it indicates that the availability of food resources in a brush park is directly linked with the yield of fish species harvested. However, the type of mangrove species used to construct the brush park also has an effect on its fish yields. For example the yields are higher for *Scatophagus argus* and *Monodactylus argenteus* with the use of *Excoecaria agallocha* as the brush park material. This may be due to the chemical nature of the latex found in that mangrove species, and the higher decaying rate of these plant parts which may attract those two species to the brush parks.

The ornamental fish yield in the brush park fishery showed considerable seasonal variations whih may be attributed to the seasonal salinity variations in the estuary [1]. From January – March the salinity levels were higher (5.85 ± 0.34 ppt) thus giving lower yields of ornamental fish. The high salinity may have been resulted from lower rainfalls in the inter monsoon periods, lower fresh water inputs and high amount of sea water inflow to the estuary. Higher yields of fish were recorded when the salinity levels were relatively lower (4.96 ± 0.33 ppt during October-December and 4.43 ± 0.32 ppt during July – September). Lower salinities may have been resulted from the higher inflow of freshwater due to the Northeastern and Southwestern monsoon rainfalls.

When considering the standard length of the individuals of *Scatophagus argus* and *Monodactylus argenteus* caught by the brush parks, it is clear that the majority of them are juveniles (<10 cm and 4-6 cm in standard length respectively). However the heavy use of these two species does not appear to affect the abundance of that species [4]. But the overuse of juveniles may influence to destroy the future ornamental fishery of these two species as the removal of juveniles can lead to reduce the natural density of these two species.

It seems that low level of income, less knowledge of the fishing community and the higher demand of fish has forced them to apply more pressure on the estuary. Therefore, they tend to go for shorter harvesting time periods (14-21 days). Keeping the brush park for a longer period of time (30 days) before harvesting can yield higher amounts of fish. Further, using a higher density of the materials used for the construction of brush parks can provide higher yields as well.

However, an economic survey together with a social impact assessment should be carried out to make necessary sustainable management plans for the Negombo estuary.

5. Conclusion

The nine ornamental fish species caught including *Monodactylus argenteus* and *Scatophagus argus* are a good source of income for brush park fishermen and its' yield shows a seasonal variation with respect to salinity changes. Since a majority of fish caught is juveniles it may have a threat to the sustainability of this estuary.

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