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FOOD RESOURCE PARTITIONING AMONG THE FISHES CO-EXISTING IN BRUSH PARKS, AN ARTIFICIAL HABITAT IN A LAGOON IN SRI LANKA

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Introduction :

Fish communities in tropical regions are found to be highly complex with many species co-existing in the same environment. This high diversity is considered to be maintained by localized environmental disturbances (Connell, 1978) and preference for different microhabitats and food items (Lowe-McConnel, 1975; Costa and Fernando, 1967).

Although a number of studies on the ecological segregation among the members of fish communities in tropical freshwater environments have been carried out (Lowe-McConnel, 1975; Saul, 1975; De Silva *et al.*, 1977; Connell, 1978; Moyle and Senanayake, 1984) resource partitioning among fish species in brackishwater habitats have received very little attention. In the present study, similarities in the diets of twelve fish species co-occurring in brush parks in the Negombo lagoon were examined with the objective of evaluating the degree of food resource partitioning existing among them. These are specialized man made habitats consisting of circular piles of mangrove wood placed in shallow areas of the lagoon less than 1.5m in depth. These provide shelter for fish and also act as substrates for epifauna and epiflora. Fish aggregated in brush parks are generally harvested one month after implantation (Senanayake, 1981). During the harvesting procedure, the brush park is encircled by a net supported by 12 - 14 mangrove poles. The mesh size of the net is 1.875 cm. The brush wood is then cast out over the net. When all brush wood is removed, the bottom line of the net is slowly drawn in and the trapped fish in this bag of netting are scooped up with a hand net. The gear is considered as the most non-selective type of gear operated in the lagoon. Recent studies have shown that brush parks account for about 29.41% of the total fish catch of the Negombo lagoon (Wijeyaratne, 1984).

Materials and Methods :

The present study was carried out on fish collected from the Negombo lagoon in west coast of Sri Lanka. The samples were obtained from the collections made from brush parks during March - August 1982. Although this gear is operated throughout the year, intensity of its use during this period was higher than in other months. The specimens collected for this study were fairly evenly distributed over the collection period. Sampling was done randomly so that individuals of all size groups were included in the samples in same proportions as they were present in the population. Since the objective of this study was only to determine the extent of food resource partitioning among the fishes co-existing in brush parks, the size of the samples of each species was not selected according to their relative abundance in the commercial catch. More than 75 individuals of each species were used in the

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study. The size range of the fish analysed is given in Table I. The fish, immediately preserved in ice were brought to the laboratory at the University of Kelaniya for further analysis. They were then dissected and the stomach contents were identified as far as possible using an optical microscope. The method described by Helawell and Abel (1971) was used in the quantitative analysis of stomach contents. The food niche overlap among the different species was calculated using the similarity index described by Schoener (1970).

Results and discussion :

Twelve species of fin fish collected from the brush parks were used in the present study. They were *Acanthopagrus latus, Ambassis commersoni, Callyodon ghobban, Epinepheles tauvina, Etroplus suratensis, Liza tade, Lutianus fulviflamma, Lutianus waigiensis, Monodactylus argenteus, Pelates quadrilineatus, Siganus javus* and *Siganus vermiculatus*. Of these, *E. suratensis, E. tauvina, L. tade, Lutianus* spp and *Siganus* spp are highly important as food fishes. The juveniles of *M. argenteus* are commercially valuable as aquarium fish.

The food items present in the stomach contents of the fish species analysed are listed in Table II. The relative importance of the food items is shown in Figs. 1 and 2. *A. latus, A. commersoni, E. tauvina* and *Lutianus* spp. were found to be strictly carnivorous. *C. ghobban, E. suratensis, M. argenteus, L. tade, P. quadrilineatus* and *S. javus* were observed to have an omnivorous feeding habit while the other species, *S. vermiculatus* was observed to be herbivorous.

As indicated by Moyle and Senanayake (1984), the similarity indices having values less than 33% were considered to indicate a low overlap while the values above 67% were considered to indicate a high overlap. The similarity indices of the diets among the different species studied are shown in Fig. 3. The maximum overlap in the diets was observed between *A. latus* and *A. commersoni*. Both these species were observed to feed on small shrimps and nauplii larvae. It was noted that the similarity indices of the diets between *A. latus* and other species are very similar to the values obtained between *A. commersoni* and other species. A very high overlap in the diets of *A. latus* and *A. commersoni* with those of *L. fulviflamma, L. waigiensis* and *P. quadrilineatus* was also noted. Like *A. latus* and *A. commersoni*, the two lutianids, namely *L. fulviflamma* and *L. waigiensis* were also carnivorous, feeding on crustaceans and small fish. Therefore, a high overlap between the diets of these two lutianids was also observed. Although *P. quadrilineatus* was found to be an omnivore (Table 1), major portion of its diet composed of crustaceans (Fig. 2) resulting in a fairly high dietary overlap with *A. latus, A. commersoni, L. fulviflamma* and *L. waigiensis* whose major food items were also crustaceans.

High dietary overlap was also noted for *C. ghobban* with *M. argenteus* and *S. javus*. These three species were found to be omnivores, feeding on algae, detritus and crustaceans. Diatoms formed the major food item of all three species (Figs. 1 and 2). The diets of the two siganids namely *S. javus* and *S. vermiculatus* also show a high similarity (Fig. 3.). The major food item of these two was diatoms with detritus accounting for a considerable portion (Fig. 2). Although *S. javus* could be considered as an omnivore, the amount of animal matter in the diet was very small as in *E. suratensis*.

The diet of the five carnivores namely *A. latus, A. commersoni, E. tauvina, L. fulviflamma* and *L. waigiensis* did not show any

larity with those of *L. tade* and *S. iiculatus* (Fig. 3). The latter species herbivorous while *L. tade* although ivorous feeds mainly on poly-tes resulting in a zero overlap with the of the above five carnivorous species ch feed on crustaceans and fish. The ary overlap of *L. tade* with other omni-ous species too was very low because major food item consisted of benthic chaetes mainly *Serpula* spp.

The diet of *E. suratensis* show moderate lap with those of *S. vermiculatus*, *S.* , *C. ghobban* and *M. argenteus* (Fig. 3). latter three species although omnivorous ly fed on plant matter and therefore ed a moderate dietary overlap with *urantensis*. *S. vermiculatus* mainly feeds iatoms while the major food item of *E. ensis* was found to be green algae this resulted in a moderate overlap he diets between these two species. diet of *E. suratensis* show a very small lap with that of *P. quadrilineatus* which ugh an omnivore mainly feeds on aceans.

The diet of *E. tauvina* shows little or similarity to those of herbivorous omnivorous fish species while with of other four carnivorous species overlap was moderate. The reason his is that *E. tauvina* mainly feeds on fish while the diet of other four carni-consists mainly of crustaceans.

M. argenteus shows very little dietary ap with the five carnivores. This vorous species mainly feeds on diatoms. mount of sand particles in the stomach nts was fairly high in this species. particles were also observed in the mullet *L. tade* and the theraponid *uadrilineatus*. In grey mullets, sand les are considered to be useful in the ing of food particles in their thick d pyloric stomachs which act like gizzards (Thomson, 1966). As in grey mullets, sand particles may be useful in the grinding of food items in the stomachs of *M. argenteus* and *P. quadrilineatus*.

Although the diet of *C. ghobban*, *E. suratensis*, *L. tade*, *M. argenteus*, *S. javus* and *S. vermiculatus* consisted of almost same food items (Table II), relative importance of these varied considerably (Figs. 1 and 2) resulting in a low or moderate dietary overlap among most of them.

About 19% of the values shown in Fig. 3 are in the high overlap range (above 67) while 21% and 60% are respectively in the moderate (33 -67) and low (less than 33) overlap ranges. This indicates that in this special habitat in Negombo lagoon. although fish live together in mixed schools, most of them show a low or moderate dietary overlap. Therefore, a certain amount of ecological segregation is evident among most of the co-occurring species in this special habitat. Ecological segregation has already been well demonstrated for fish communities in freshwater streams in tropical regions (Moyle and Senanayake, 1984) This is considered to be very useful in such environments because it helps to minimize interspecific competition. The brackish-water environments such as lagoons and estuaries are considered to be highly productive ecosystems in the biosphere (Odum, 1971) and it is very unlikely that food become limiting in such habitats. Therefore, even among the few species with high dietary overlap, interspecific competition for food may possibly not occur in these environments. However, it is necessary to carry out detailed studies on the productivity of Negombo lagoon for definite conclusions. In addition, since it is well known that food habits of at least some species of fish vary with the life history stage, further studies on the diets of different size groups, carried out preferably over a period of one year, would be useful.

The present study shows that ecological segregation and resource partitioning can occur at least to some extent among the co-existing fish species in brush parks. Therefore these artificial habitats created in Negombo lagoon as a system of specialized fishing can act as favourable habitats for different species of important food fishes and thus appear to play an important role in brackishwater fisheries. The results of the present investigation may be utilized to select suitable species combinations for brackishwater polyculture programmes which will be very useful to further the increase of inland fish production in Sri Lanka.

Summary :

The diets of twelve fish species collected from the brush parks in Negombo lagoon were examined to evaluate degree of food resource partitioning among them. Five species namely *Acanthopagrus latus*, *Ambassis commersoni*, *Epinepheles tauvina*, *Lutianus fulviflamma* and *L. waigiensis* were found to be strictly carnivorous while *Siganus vermiculatus* was observed to be herbivorous. The other six species namely *Callyodon ghobban*, *Etroplus suratensis*, *Monodactylus argenteus*, *Liza tade*, *Pelates quadrilineatus* and *Siganus javus* were observed to have an omnivorous feeding habit. It was evident that food resource partitioning and ecological segregation occur at least to some extent among these co-existing fish species in this brackishwater environment.

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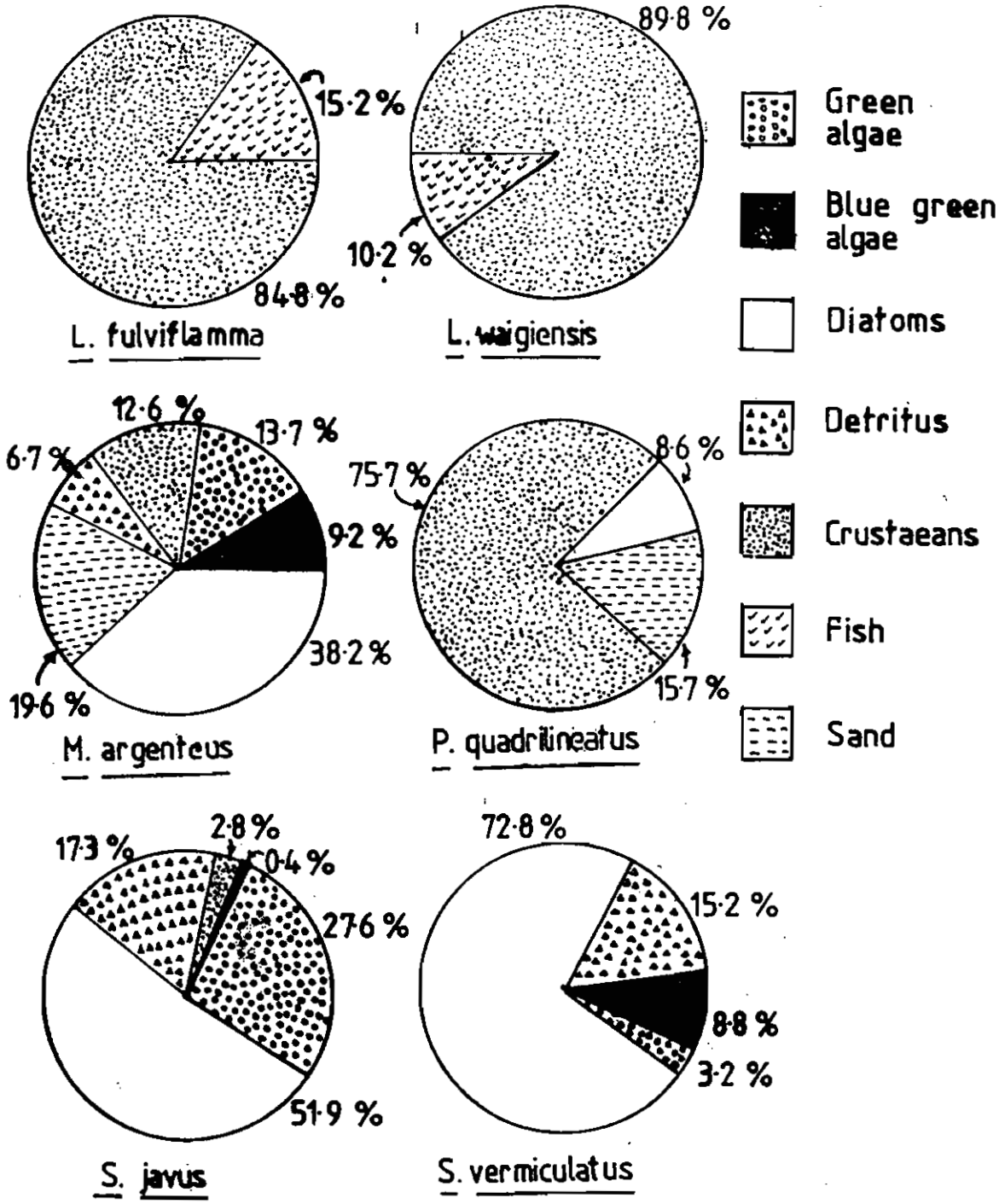

Fig: 1. Relative importance of the food items in the stomach contents of Lutianus fulviflamma, Lutianus waigiensis, Monodactylus argenteus, Pelates quadrilineatus, Siganus javus and Siganus vermiculatus.

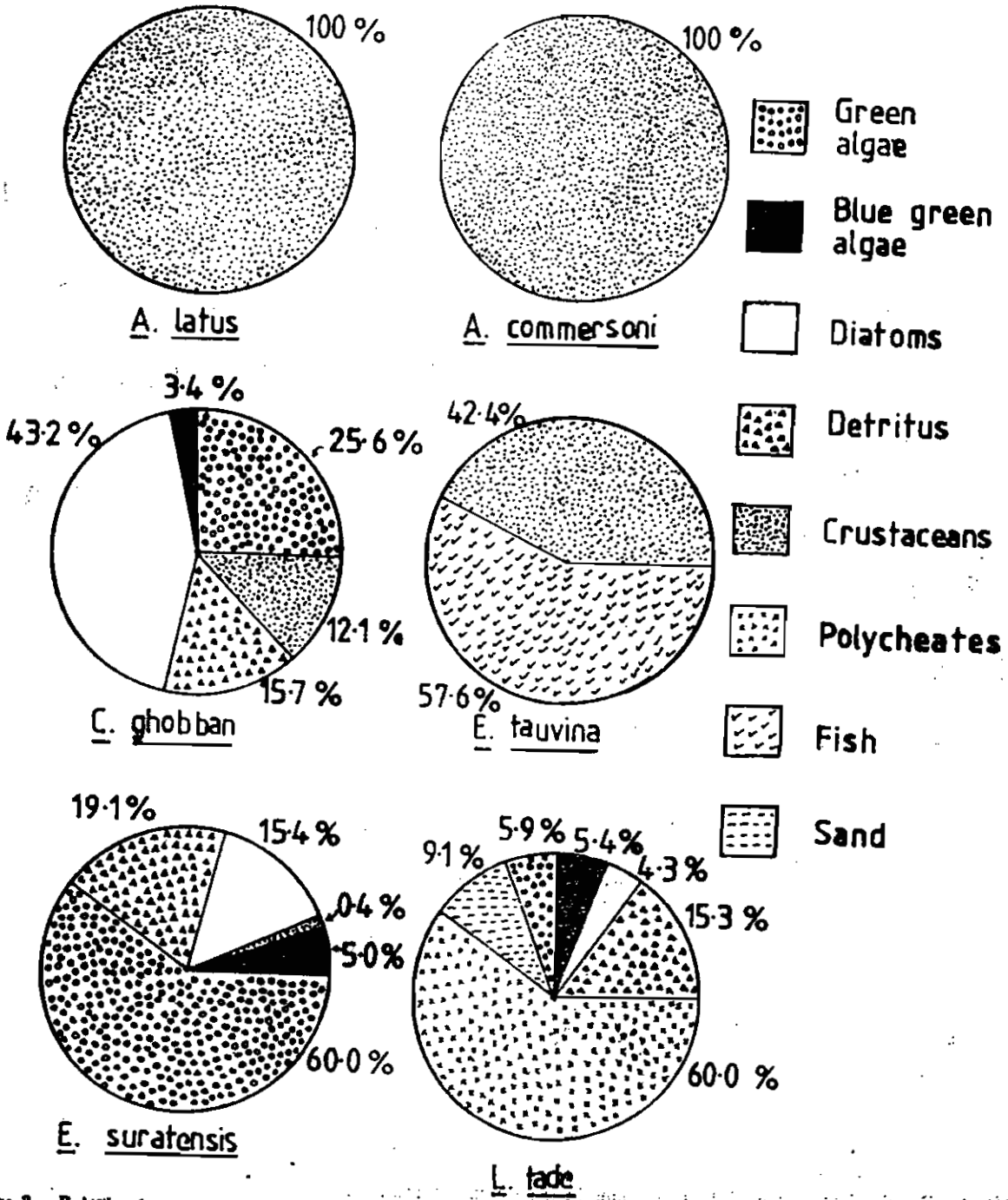

Fig. 2. Relative importance of the food items in the stomach contents of Acanthopagrus latus, Ambassis commersoni, Caliyodon ghobban, Epinephelus tauvina, Etroplus suratensis, and Liza tade.

TABLE 1

Total length of the fish species used in present investigation.

Species	Total length (cm)
Acanthopagrus latus ...	... 12.0 — 25.0
Ambassis commersoni ...	... 7.0 — 13.0
Callyodon ghobban ...	... 12.0 — 20.0
Epinephelus tauvina ...	... 9.0 — 33.0
Etroplus suratensis ...	... 5.0 — 16.0
Liza tade	... 7.0 — 32.0
Lutianus fulviflamma ...	... 10.0 — 17.0
Lutianus waigiensis ...	... 13.0 — 19.0
Monodactylus argenteus ...	... 7.0 — 11.0
Pelates quadrilineatus ...	... 10.0 — 14.0
Siganus javus	.. 7.0 — 10.0
Siganus vermiculatus ...	. 7.0 — 9 0

TABLE II

FOOD ITEMS OF THE FISH SPECIES ANALYSED

	A. latus	*A. communsoni*	*C. ghobban*	*E. tauvina*	*E. suratensis*	*L. tade*	*L. fulviflamma*	*L. waigiensis*	*M. argenteus*	*P. quadrilineatus*	*S. javus*	*S. vermiculatus*
Green algae												
Chlorella			+		+	+			+		+	+
Cladophora			+		+	+					+	+
Blue green algae												
Anabaena					+	+			+		+	+
Chroococcus			+		+	+			+		+	
Lyngbia					+	+					+	+
Diatoms												
Melosira			+		+	+			+		+	+
Navicula			+		+	+			+	+	+	+
Nitzchia			+		+	+			+		+	
Pinnularia					+	+			+	+	+	+
Pleurosigma					+	+					+	+
Detritus ...			+		+	+			+		+	+
Crustacea												
Copepods			+		+				+	+	+	
Nauplii	+	+								+		
Shrimps	+	+		+			+	+				
Crabs ...				+			+	+				
Polychaetes						+						
Fish ...				+			+	+				
Sand particles						+			+	+		

Fig. 3

PERCENTAGE OVERLAP AMONG THE DIETS OF THE SPECIES OF FISH STUDIED

	A. commersoni	*C. ghobban*	*E. auvina*	*E. suratensis*	*L. tade*	*L. fulviflamma*	*L. waigiensis*	*M. argenteus*	*P. quadrilineatus*	*S. javus*	*S. vermiculatus*
A. latus	100	12.1	42.4	0	0	84.8	89.8	12.6	75.7	2.8	0
A. commersoni	—	12.1	42.4	0	0	84.8	89.8	12.6	75.7	2.8	0
C. ghobban	—	—	12.1	60.2	28.9	12.1	12.1	74.1	43.1	87.7	65.0
E. tauvina	—	—	—	0	0	57.6	5.36	12.6	42.1	2.8	0
E. suratensis	—	—	—	—	30.9	0	0	41.3	8.6	60.7	39.3
L. tade	—	—	—	—	—	0	0	31.4	13.4	25.9	28.1
L. fulviflamma	—	—	—	—	—	—	95.0	12.6	75.7	2.8	0
L. waigiensis	—	—	—	—	—	—	—	12.6	75.7	2.9	0
M. argenteus	—	—	—	—	—	—	—	—	39.1	61.8	56.9
P. quadrilineatus	—	—	—	—	—	—	—	—	—	11.4	8.6
S. javus	—	—	—	—	—	—	—	—	—	—	70.7