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REPRODUCTIVE STRATEGY AND FEEDING OF DUSSUMIER'S MULLET *Liza dussumieri* VALENCIENNES FROM SRI LANKA

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Introduction

Liza dussumieri Valenciennes, also known as *L. subviridis* (Valenciennes) is one of the grey mullet species abundant in the coastal waters, lagoons, back-waters and estuaries of the tropics (Fischer and Bianchi, 1984). In Negombo estuary, (7°10'N and 79°50'E) in the west coast of Sri Lanka, it is the most abundant grey mullet species in the commercial catches accounting for about 37% of the total grey mullet catch (Wijeyaratne, 1984). In spite of abundant literature on the biology and fishery of other grey mullet species (Pillay, 1972), reports on *L. dussumieri* appear to be very sparse. It is well known that an understanding of the biology and ecological requirements is essential for efficient management of fisheries and fish farming. This paper describes the re-, productive strategy, food and feeding of an estuarine popualtion of *L. dussumieri* from Sri Lanka.

Materials and Methods

From the commercial catch of Negombo estuary, 986 specimens of *L. dussumieri* were obtained for a period of two years between January 1982 and December 1983. The fish preserved in ice were brought to the laboratory at the University of Kelaniya and total length and weight were measured. The specimens were dissected open and maturity stage of gonads and sex were recorded. Gonads were removed and weighed to determine the gonadosomatic index. Mature ovaries were preserved in Gilson's fluid (Simpson, 1951) for one week and the diameter of oocytes were measured using an ocular micrometer. The fecundity was estimated by subsampling gravimetrically (Lagler, 1956). The gut was removed and length of intestine was measured. Stomach contents were scooped out, weighed and qualitatively analysed under an optical microscope. Quantitative analysis of food was carried out by the method described by Helawell and Abel (1971). Similarity among the diets of different size groups were determined using Schoener's (1970) formula.

Results and Discussion

Reproductive Biology :

Six developmental stages of gonads were identified in both sexes of *L. dussumieri* during the present study. These stages are described in the Table 1. The sex of virgin fish could not be distinguished since both ovaries and testes were similar to each othe in external appearance at this stage. These maturity stages have been observed in other grey mullets such as *Mugil curema* and *M. cephalus* in Texas, USA (Moore, 1794).

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Table I. Development stages of the gonads of *Liza dussumieri*.

Development stage	*Female*	*Male*
Virgin	Gonads are thread like and extends upto 1/4 of the body cavity. Ovaries and tests are undistinguishable at this stage.	
Developing	Ovaries extend upto 1/3 of the body cavity. Small oogonia are visible as granules.	Testes extend upto 1/3 of the body cavity. No granules are visible.
Developed	Ovaries extend upto 1/2 of the body cavity. Oocytes are larger than those of the developing stage.	Testes extend upto 1/2 of the body cavity.
Mature	Ovaries extend upto 2/3 of the body cavity. Eggs are round and some are translucent.	Testes extend upto 2/3 of the body cavity. They are creamy white in colour.
Spawning	Eggs are extruded from the ovary with slight pressure on the belly.	Milt is extruded from the testes with slight pressure on the belly.
Spent	Ovaries are empty with few small oocytes clumped in various places. Ovaries are shrinked and reddish in colour.	Testes are shrinked and reddish in colour.

Ova of two size groups representing developing oocytes and mature oogonia were present in the mature ovaries of *L. dussumieri* (Fig, 1). This indicates that this species is also a non-intemittant spawner as most other grey mullets (Timoshek and shilenkova, 1974; Grant and Spain 1975; Kuo and Nash, 1975; Rangaswamy, 1975). The diameter of mature oocytes ranged from 214 µm to 643 µm with a modal value of 500 µm.

The gonadosomatic indices (GSI) at different maturity stages are given in Table II. The weight of ovaries of some mature females was about 12% of the body weight while that of testes never exceeded 3% of the total body weight. GSI of mature females, although vary in a considerable range, did not change significantly with total length ($r=0.2051$, $n = 35$.)

Table II. Gonadosomatic indices of *L. dussumieri*

Gonadal development stage	Gonadosomatic Index	
	males	females
Virgin	0.06 – 0.25	
Developed	0.03 – 1.71	1.90 – 7.56
Mature	0.36 – 2.63	4.82 – 13.70
Spawning	0.56 – 2.41	11.15 – 12.53
Spent	1.77 – 1.83	0.05 – 2.36

Gonadosomatic indices and seasonal abundance of various maturity stages were used in the present study to determine the spawning period of *L. dussumieri*. Four peaks in the seasonal variation pattern of GSI were observed in January, May, July and September (Fig. 2). Mature fish were found throughout the year except in October (Fig. 1). This indicates that spawning of this species takes place almost throughout the year. However, since fish of the spawning stage were present in May and spent individuals from July to October it is possible that the main spawning period of this species extends from May to October.

Statistically significant correlation coefficients betweeen GSI and environmental parameters such as water temperature, salinity, dissolved oxygen content, pH and rainfall were not observed for *L. dussumieri* of Negombo lagoon. However, since the west coast of Sri Lanka where this lagoon is situated gets much rain from May to October due to south west monsoons, the main spawning season of *L. dussumieri* appears to coincide with the rainy season. Since spawning and spent individuals were found in the lagoon, *L. dussumieri* may be spawning in the lagoon itself or in coastal waters as observed for *M. saliens* (El Zarka, 1963).

The sex ratio of *L. dussumieri* was highly unbalanced in favour of the males who constituted about 84% of the population. The males out-numbered the females throughout the year (Fig. 2). It is possible that the males are more numerous in the population and/or are more active and get caught in the gears in higher numbers than the females. In smaller size groups, the males are more abundant and as they grow 1 : 1 sex ratio is attained (Fig 3) indicating an earlier maturity and a smaller longevity among the males. This is further evident by the smaller value for mean length at maturity of the males which is 21.7 cm as compared with 24.2 cm for the females (Fig. 3).

The absolute fecundity varied from 83600 to 401000 for the fish ranging in size from 15.5 cm to 32.5 cm. The relationships of fecundity with body weight and standard length, which are statistically, significant at 5% level, are as follows

$$F = 1157.6\ W + 146944$$

$$F_o = 438\ L^{2.23}$$

where F = absolute fecundity
W = body weight in g
L = standard length in cm

Statistically significant correlation between the relative fecundity, which ranged from 1500 to 3960 eggs per g of body weight, and standard length was not observed.

Food and Feeding :

The amount of plant matter and detritus in the diet was found to decrease significantly with size whereas that of animal matter significantly increased. However, a significant correlation between the relative gut length, which varied from 3.03 to 5.93, and total body length was not observed.

In the stomach contents of *L. dussumieri*, 21 genera of diatoms, 4 genera of green algae, 4 genera of blue green algae, 3 genera of dinoflagellates and 4 genera of foraminiferans were identified together with detritus, serpulid polychaetes, crustaceans, gastropod mollusks and small sand particles (Table III). According to Capanna *et al.* (1974), in grey mullets, these sand particles are selectively filtered through the complex pharyngo-branchial apparatus. These not only help to grind the food in the thick walled pyloric stomach (Thomson, 1966) but also serve as a source of vitamin B_{12} (Vallet *et al*, 1970) and organic food (Odum 1970) due to adsorbed micro-organisms.

Mean relative abundances of food items in the diet are shown in Fig. 4. Detritus was the most abundant item in 5-10 cm length group whereas in others it was, surpulid polychaetes. Having similarity indices of 65% and above (Fig. 5) the compositions of the diets among different size groups were more or less similar to each other. However, it is very unlikely that intranspecific competition for food will occur because the lagoons and esturies are among the most productive ecosystems in the biosphere (Odum, 1968). The seasonal variation of gastrosomatic index (Fig. 2) shows that the intensity of feeding is relatively low during the main spawning season as observed for several other species of grey mullets (Odum, 1970; Brulhet, 1975).

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Table III. Food items present in the stomach contents of *Liza dussumieri*

Food item	*Size group*				
	5 - 10 cm	10 - 15 cm	15 - 20 cm	20 - 25 cm	above 25 cm
Blue green algae					
Anabaena	—	—	+	+	—
Chroococcus	+	—	+	+	+
Lyngbia	+	+	+	+	+
Merismopedia	+	+	+	+	+
Green algae					
Chladophora	+	+	+	+	—
Mougotia	—	—	—	+	—
Scenedesmus	—	—	—	+	—
Spirogyra	—	+	—	—	—

Table III. Food items present in the stomach contents of *Liza dussumieri*

Food item	*size group*				
	5 - 10 cm	10 - 15 cm	15 - 20 cm	20 - 25 cm	above 25 cm
Diatoms					
Amphora	+	+	+	+	+
Achnanthes	+	–	+	–	–
Biddulphia	–	+	+	+	+
Campylosira	+	+	+	+	–
Coccoueis	+	+	+	+	+
Coscinodiscus	+	+	+	+	+
Cyclotella	+	+	+	+	+
ymatopleura	–	–	–	+	–
Cymbella	+	+	+	+	+
Amphorn	+	+	+	+	+
Aehnanthes	+	+	+	+	+
Biddulphia	+	+	+	+	+
Campylosira	+	+	+		+
Cocconeis	+	+	+	+	+
Coscinodiscus	+	+	+	+	+
Cyclotella	+	+	+	+	+
Cymatopleura	+	+	+	+	+
Cymbella	+	+	+	+	–
Diatoma	+	+	+	+	+
Diplonels	–	+	+	+	–
Dinoflagellates					
Ceratium	+	+	+	+	+
Gymnodiniun	+	+	+	+	+
Peridinium	+	+	+	+	+
Foraminiferans					
Palystomella	+	+	–	+	–
Textularia	–	–	+	–	–
Crustacean					
Copepods	–	+	+	–	–
Cladoceraus	+	–	–	+	–
Nauplii	+	+	+	+	+
Unidentified crustaceans	+	+	+	+	+
Mollusks	+	+	–	–	+
Annielids (Serpulid polychaetes)	+	+	+	+	+
Detritus	+	+	+	+	+
Sand particles	+	+	+	+	+

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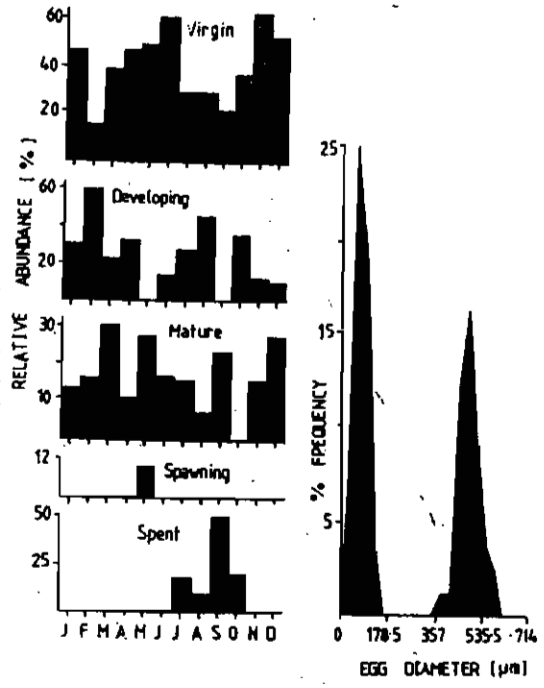

Fig. 1. Egg diameter distribution and seasonal abundance of different maturity stages.

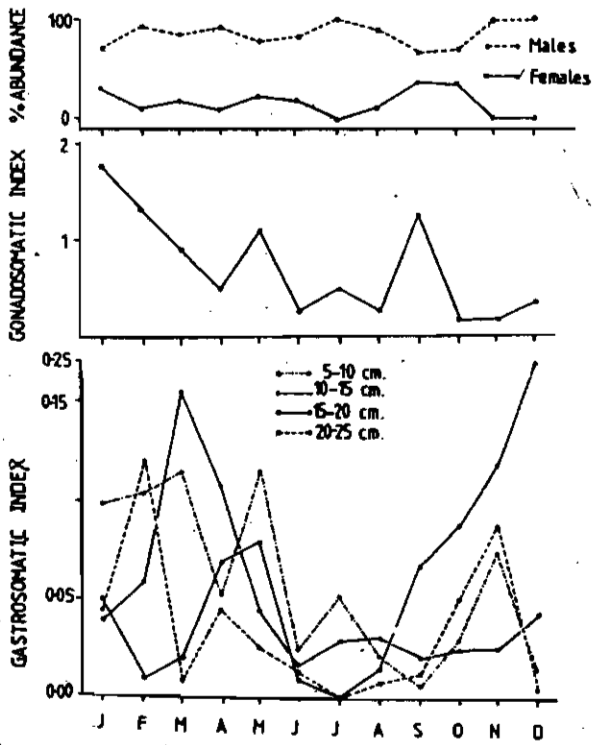

Fig. 2. Seasonal variation of gonadosomatic index, sex ratio and gastrosomatic index.

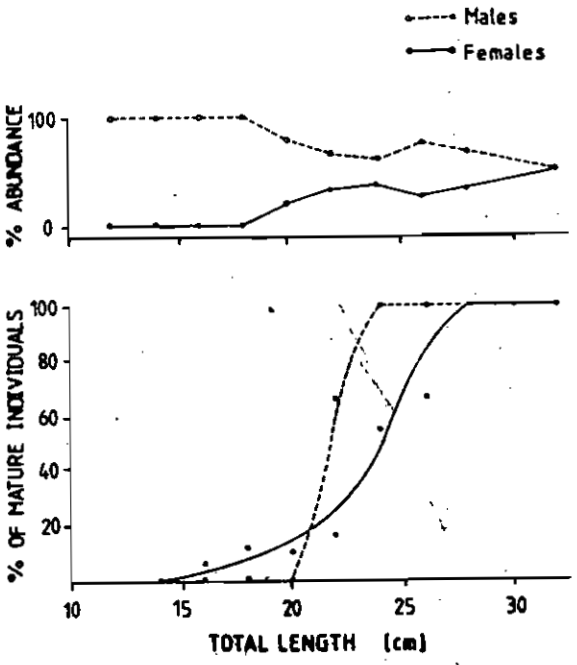

Fig. 3. Variation of sex ratio and the percentage of mature individuals with size.

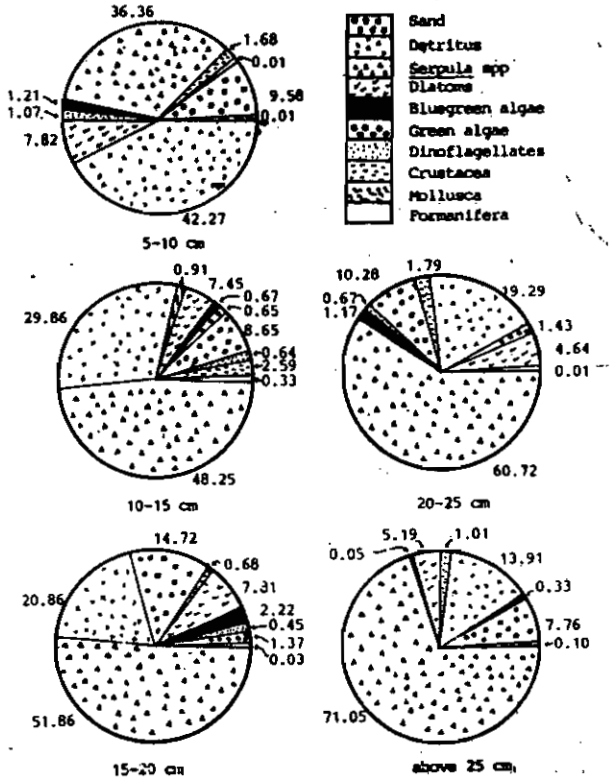

Fig. 4. Relative importance of different food items in the diets.

Fig. 5. Similarity indices among the diets of different size groups of *Liza dussumieri*

	5-10 cm	10-15 cm	15-20 cm	20-25 cm	above 25 cm
5-10 cm	100	89	77	73	65
10-15 cm	..	100	88	85	77
15-20 cm	..	..	100	90	80
20-25 cm	..	..	..	100	89
above 25 cm	..	..	..	..	100