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Food and Feeding of *Siganus lineatus* from Waters around Northern Sri Lanka

K. CHITRAVADIVELU

Department of Zoology, University of Jaffna, Thirunelvely, Jaffna, Sri Lanka

AND

A. SIVAPALAN

Department of Botany, University of Jaffna, Thirunelvely, Jaffna, Sri Lanka

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Abstract: *Siganus lineatus* (Cuvier and Valenciennes), is a marine fish which inhabits coastal areas and brackish water bodies in Sri Lanka. This is found in the tropical parts of the Indian and Pacific oceans. Stomach contents of fish ranging from 2.4 cm to 25.5 cm in standard length, collected from twelve stations along the Northern coast, Thondaimannar and Jaffna lagoons were examined. Analysis of stomach contents revealed that *S. lineatus* is purely a herbivore feeding on twelve genera of diatoms, four genera of blue-green algae, six genera of green algae, nine genera of red algae, a brown alga *Dictyota* and an angiosperm - *Thalassia*, of which the diatoms predominated. The major components were *Licmophora*, *Gomphonema*, *Navicula*, *Oscillatoria*, *Cladophora*, *Chaetomorpha*, *Gracilaria* and *Laurencia*. *Thalassia* predominated all the other genera except the diatoms. When the variation in the feeding habits with the size of the fish was analysed by placing the fish in 3 cm length classes, no significant difference in the food was found. The analysis of stomach fullness of the specimens collected during day and night indicated preference to feed during night. An apparent indication of stomach fullness with increase in size of fish has been detected. *Siganus lineatus* is herbivorous in nature.

1. Introduction

Members of the Siganidae, or rabbit fishes, are good food fishes, having flesh which is firm and flaky. They are well liked locally for eating. These economically important group of fishes have gained popularity in recent times because of their suitability for culturing and have been the subject of a number of mariculture studies.^{1,3,14} These are small or moderate sized fishes found in the tropical parts of the Indian and Pacific oceans.^{1,2,9} They are found in the coastal areas and brackish water bodies in Sri Lanka.¹¹

Five species, namely *Siganus lineatus* (Cuvier and Valenciennes) *Siganus javus* (Linnaeus), *Siganus oramin* (= *S. canaliculatus*) (Bloch and Schneider), *Siganus stellatus* (Forsk.) and *Siganus virgatus* (Valenciennes) have been recorded along the Northern coasts of Sri Lanka, and in the Thondaimannar and Jaffna lagoons. *Siganus lineatus* is the dominant species in these areas.

Siganus lineatus, commonly referred to as the Golden-line spine foot has an oval and compressed body. The body is light grey, darkest above, with about 12 parallel longitudinal yellow lines as wide as interspaces and broken below into spots. The caudal fin is slaty-grey with a large brown spot slightly larger than the eye-ball, just anterior to the caudal peduncle, changing to bright yellow on death.

S. lineatus frequents coral reefs and rocky localities feeding in shoals. It has a small terminal mouth with a single row of close-set incisor-like teeth on each jaw and feeds by scraping algae from rocks and corals and browsing on seaweeds.

The present paper is a part of a detailed investigation on the biology of *S. lineatus*. In this paper the food and feeding habits of *S. lineatus* are presented. The results of this investigation would have practical value to mariculturists of *S. lineatus*.

2. Materials and Methods

Materials for the investigation were obtained from Thondaimannar lagoon (80°7'E. to 80° 28' E. long. and 9° 34' N. to 9° 49'N. lat.), Jaffna lagoon, (79° 53' E. to 80°38' E. long. and 9° 26' N. to 9° 46' N. lat.) and Northern coastal areas extending from Thalayaddy to Punakari, both during day and night (Figure 1). Samples were obtained from twelve locations during the period February 1981 to November 1982 using traps, cast nets, set nets, torch and 'sirahu' valai.¹²

The samples were immediately preserved in 4% formalin and brought to the laboratory for detail analyses. Their standard and total lengths were measured to the nearest millimeter using a fish measuring board. After opening the visceral cavity, the gut was removed and its length from the oesophagus to the anus was measured by placing the relaxed alimentary canal on a millimeter ruler. The stomach of each fish was cut longitudinally. The fullness of the stomachs was assessed and categorised as (i) empty (ii) trace to 25% fullness (iii) 25-50% fullness and (iv) more than 50% to total fullness.¹⁰ The content of each stomach was emptied carefully into a specimen tube and diluted four times its volume with formalin. The mixture was shaken until it was as homogeneous as possible. 0.2 ml of the mixture was taken with a suction tube and transferred to a glass slide, covered with a cover slip and examined under a microscope. Each food item was identified and its bulk assessed by the eye taking into account the size of the individual organism as well as their abundance and categorised as either (i) main - those items which formed the bulk of the stomach contents or (ii) considerable - those which still occurring in fair amounts not constituting the bulk of the stomach contents or (iii) rare - those items present in small amounts. Each category was given a number of points - 3 for main, 2 for considerable and 1 for rare.

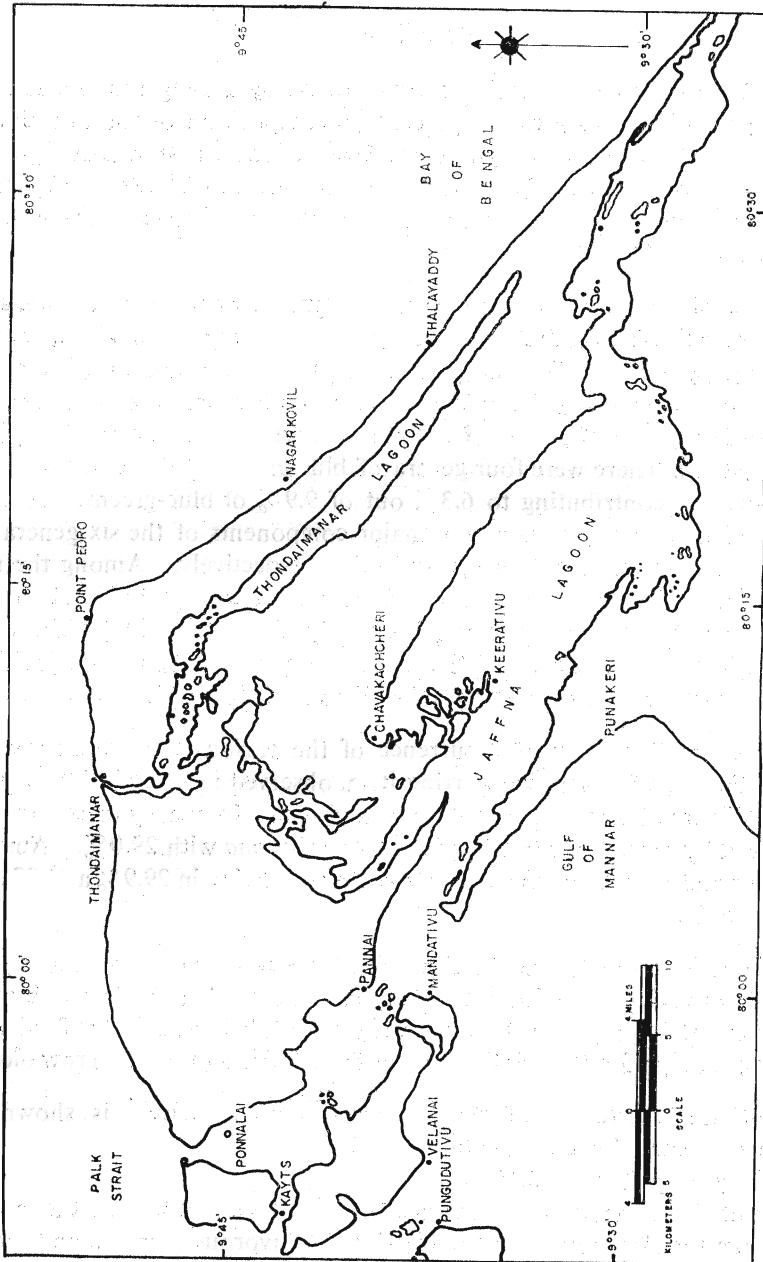


Figure: 1 Map of northern Sri Lanka, (O) Showing location of collecting stations.

This evaluation is essentially an estimate of bulk and the points represents absolute values and not relative ones.^{5,6,8,13}

3. Results

All points awarded to each food item are summarised by adding the results and scaled down to percentages, to give the percentage composition of food of all the specimens examined.¹³ The percentage composition of food is shown in Figure 2 and the frequency of occurrence of each food item is shown in Figure 3. Figure 4 gives the variation in this relative degree of stomach fullness of specimens collected during day and night.

The results of the stomach contents analysis reveal that *S. lineatus* is purely a herbivore feeding on diatoms, blue-greens, green algae, red algae, brown algae and an angiosperm, totalling 33 genera. Of the twelve genera of diatoms observed, species of *Licmophora*, *Navicula*, and *Gomphonema* were the major forms. *Licmophora* contributes to 11.2% out of the diatoms which account for 32.9% in composition (Figure 2). There were four genera of blue-greens of which *Oscillatoria* was the dominant one contributing to 6.3% out of 9.9% of blue-greens. Species of *Cladophora* and *Chaetomorpha* were the major components of the six genera of green algae observed, accounting to 9.7% and 8.1% respectively. Among the red algae *Gracilaria* and *Laurencia* predominated contributing to 5.1% and 4.6% respectively. Brown algae was represented by only *Dictyota* (4.3%). *Thalassia* was the only angiosperm observed and this amounting to 16.6% in composition predominated all the other genera except the diatoms (Figure 2).

The analysis of frequency of occurrence of the various food items reveals that *Thalassia* is the most frequently occurring item, observed in 45.3% of the specimens examined (Figure 3). *Licmophora* comes second with a frequency of occurrence of 37.6%, followed by *Navicula* with 30.8% and *Gomphonema* with 29.0%. Among others *Cladophora* and *Chaetomorpha* are noteworthy occurring in 29.9% and 22.2% respectively (Figure 3).

When the variation in the food habits with the size of the fish was analysed by placing the fish ranging from 2.4 cm to 25.5 cm in 3 cm length classes, by the analysis of variance at 5% significant level, no significant difference in the food was found, indicating no significant variation in the food habit as the fish grow old.

The variation of the length of the gut with standard length is shown in Figure 5 and is expressed by the equation: —

$$y = 4.60 x - 8.15$$

The total length of the alimentary canal varies between 4.3 and 4.6 times the length of the fish and fits the description of the classical herbivorous stomach and intestine.⁴

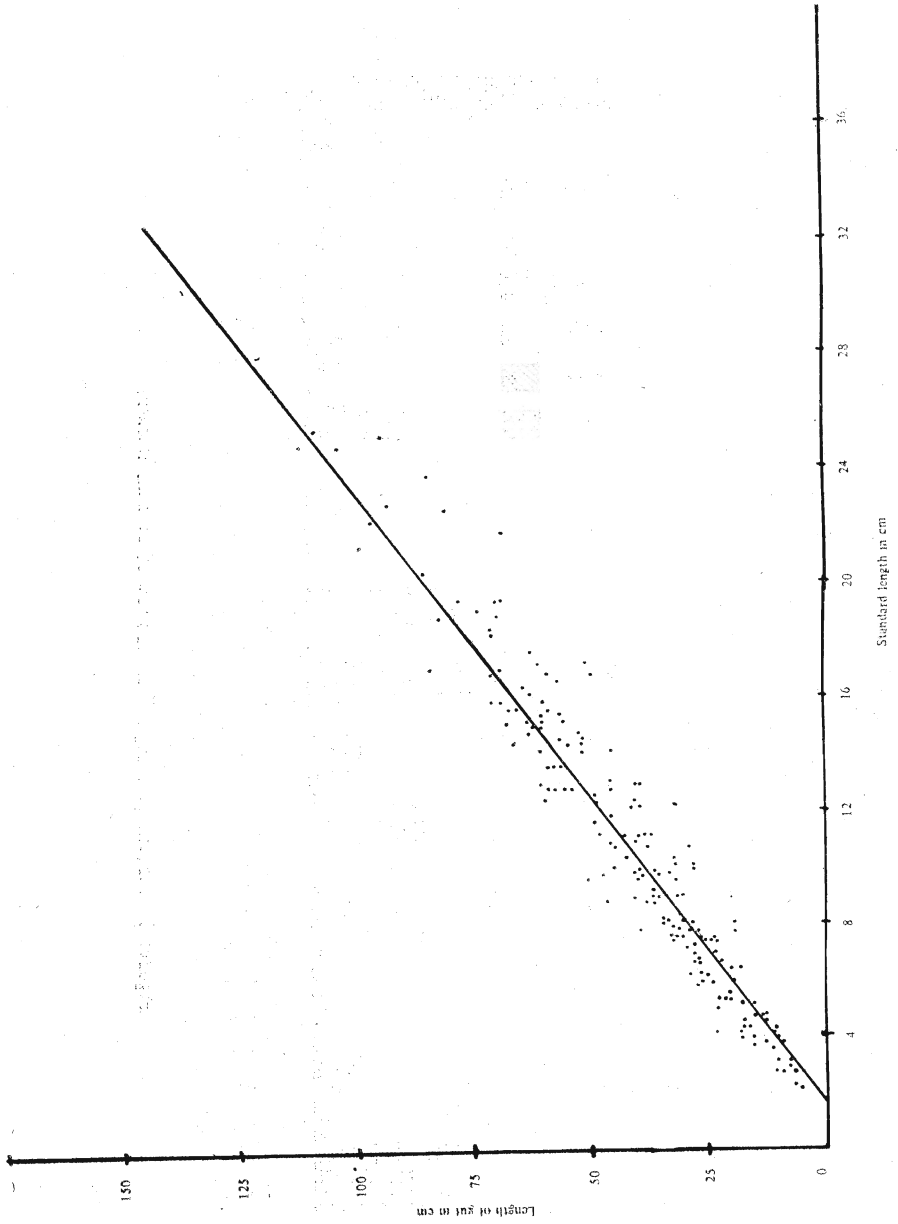


Figure: 5 Variation of the length of gut with standard length in *Siganus lineatus*.

The variation in the relative degree of stomach fullness with length is given in Table 1. From a total of 141 specimens examined, 24 (17.0%) had empty stomachs. The percentage of empty stomachs in the 21 - 50mm length group is 37.5% while in the 141 - 170 mm group it is 4.5%. In the length groups from 21 - 200 mm, there is a gradual increase in percentage of stomachs with 25 - 100% fullness. Data recorded for individuals in length groups 171 - 200 mm, 201 - 230 mm and 231 - 270 mm were less representative than those for other length groups, since fewer specimens, 08, 05 and 08 respectively, were available for analysis. However, there is an apparent indication of increase in stomach fullness with increase in size of fish.

Collections were made during day and night. Out of the 141 specimens analysed, 80 (56.7%) were collected in the nights (Table 1). 15 (24.5%) of the 61 specimens collected during daytime were with empty stomachs and only 09 (11.3%) among those collected in the nights (Figure 4). 62.5% of the specimens with empty stomachs were those collected during day time. 29 (76.3%) of the fish with more than 50% to total fullness were from those collected during night time. The overall picture of stomach fullness does indicate a preference of *S. lineatus* for feeding during night (Table 1 and Figure 4). This is in conformity with the observations reported by Drew.⁴

4. Discussion

The percentage composition of food of all specimens examined derived by summing up points awarded is essentially an approximate volumetric method while frequency of occurrence indicates what organisms are being fed upon, but it gives no information on quantities and does not take into consideration the accumulation of food organisms resistant to digestion.¹³ Both the methods have been adopted in the present investigation.

It is important to couple food studies with the determination of the types and abundance of food present in the environment. However, in the present investigation due to the large area covered in the collection of *S. lineatus*, only contents of stomachs were considered.

Cymbella and *Biddulphia* among diatoms, *Rivularia* among blue-greens *Valoniopsis* and *Ulva* among green algae, *Leveillea*, *Hypnea*, *Gelidium* and *Poly-siphonia* among red algae with a frequency of occurrence of 0.8% and percentage composition of 0.1 to 0.4 contributed very little to the diet of *S. lineatus*.

The percentage of occurrence of various food items and composition of stomach contents indicate that among macroscopic algae, *Thalassia*, *Cladophora* and *Chaetomorpha* constitute the major part of the overall diet. These are all attached forms found in the shallow coastal waters and lagoons which are generally inhabited by *S. lineatus*.

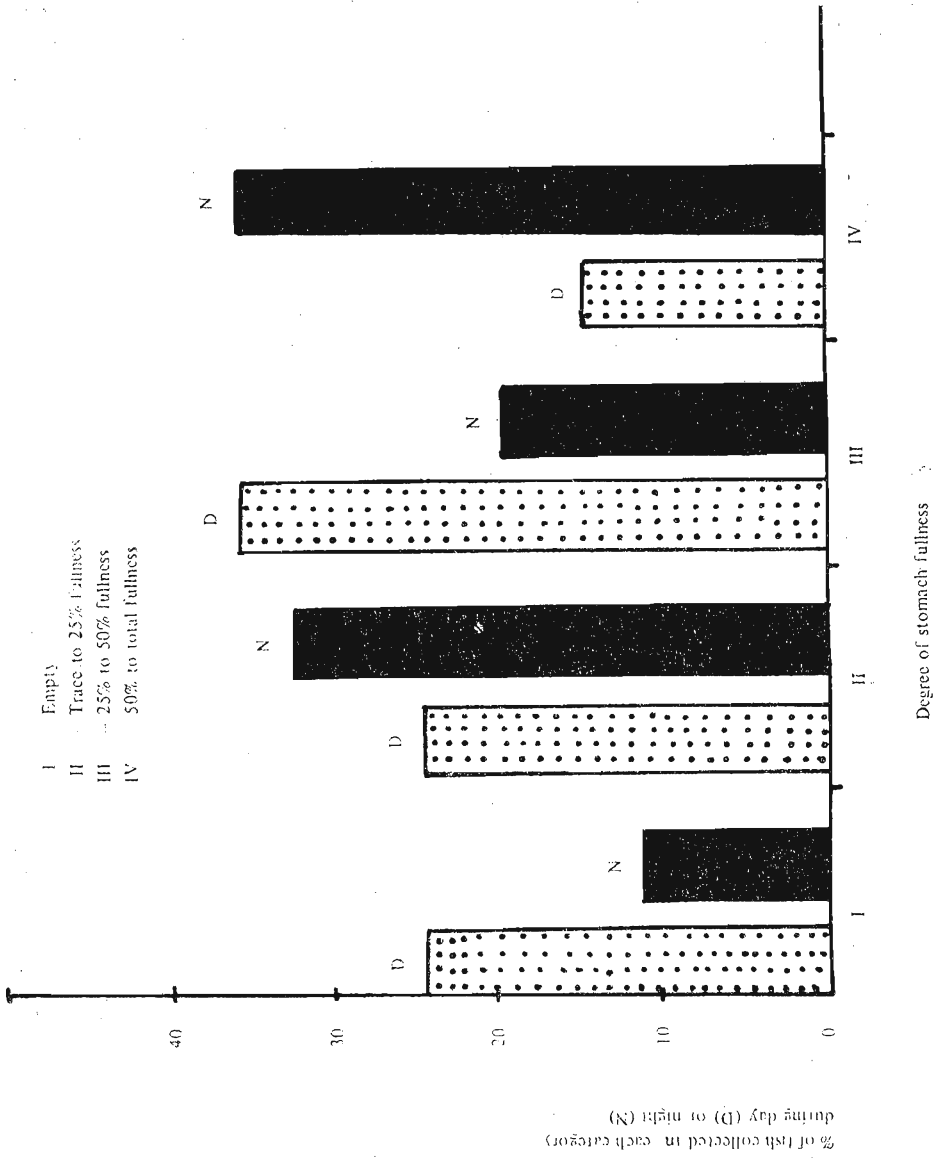


Figure: 4 Variation in degree of stomach fullness in *Sigamius lineatus* collected during day and night.

TABLE 1. Variation in relative degree of stomach fullness of different sizes of *Siganus lineatus* collected during Day (O) and (N) Night

Range of Standard length in mm	21-50	51-80	81-110	111-140	141-170	171-200	201-230	231-270	Total								
No. of specimens	14	19	41	24	22	08	05	08	141								
Degree of fullness of stomach	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %								
D	04	01	06	01	01	—	01	01	15								
N	01	03	02	03	—	—	—	—	09								
D&N	05	37.5	04	21.0	08	19.5	04	16.7	01	4.5	—	01	20.0	01	12.5	24	
D	04	00	02	03	03	04	00	00	02	15							
N	02	06	10	01	05	01	00	01	26								
D&N	06	42.8	06	31.6	12	29.3	04	16.7	09	40.9	01	12.5	00	00	03	37.5	41
D	02	03	06	07	02	01	00	01	22								
N	00	01	07	02	04	02	00	00	16								
D&N	02	14.2	04	21.0	13	31.7	09	37.5	06	27.3	03	37.5	00	00	01	12.5	38
D	00	01	03	04	00	00	01	00	09								
N	01	04	05	03	06	04	03	03	29								
D&N	01	7.3	05	26.4	08	19.5	07	29.1	06	27.3	04	50.0	04	80.0	03	37.5	38
Total	D		61		N		80										

Lam⁷ has reported that often large amounts of sponge were found in the stomach and intestine of *S. lineatus* and claimed that siganids are potentially omnivorous even though they may be primarily herbivorous in nature. Drew⁴ has also observed some sponges in the stomachs of *S. lineatus*. In this context, three exceptional stomach contents may be mentioned here. Nematodes were found in two specimens of standard lengths 2.7 cm and 15.7 cm, collected in May 1983. Spicules apparently of some sponges were found in two specimens of standard lengths 13.7 cm and 7.7 cm collected in February 1982. *Sertularia sp.* was recorded in one specimen of 4.9 cm collected in July 1982.

Except these, there are no other evidences from the present study to indicate the omnivorous potential of *S. lineatus*. However, the present investigation does indicate that *S. lineatus* is primarily herbivorous in nature.

Acknowledgements

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