

DIURNAL VARIATION IN THE FEEDING HABITS OF *DUSSUMIERIA ACUTA* VAL. FROM THE GULF OF MANNAR AND THE PALK BAY

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ABSTRACT

A distinct variation in the feeding intensity was noticed in *Dussumieria acuta* between the day and night. This was due to the diurnal variation in the feeding habits of this fish, feeding actively during day time and starving during the night. The study over a period of two years in 1969-70 and 1970-71 showed that in day samples only 6.05% fish during the first year and 2.57% fish during the second year were with empty stomachs, whereas in the night samples 98.33% during the first year and 98.16% during the second year were either with empty or with 'little' stomachs.

INTRODUCTION

A GREAT deal of work has been done on the food and feeding habits of fishes of almost all commercially important species from Indian waters, some in general and others in detail. The rainbow sardines of the genus *Dussumieria* (Family: Dussumieriidae) were not an exception to this. The feeding habits of these fishes have been studied by several earlier workers. The works of Tham-Ah-Kow (1950), Devanesan and Chacko (1944), Chacko (1949), Venkataraman (1960), Mahadevan and Chacko (1962), Srinivasa Rao (1964), Sekharan (1949), Vijayaraghavan (1951) and Kuthalingam (1961) are only a few among many. The species involved in these studies were *Dussumieria acuta* Val. and *D. hasseltii* Blkr. Nair (1973) reviewed the food and feeding habits of these two species. All these earlier studies were largely of the qualitative nature. During the course of his investigations on the biology of *Dussumieria acuta* Val., the present author noticed a significant difference in its feeding intensity between day and night samples and a detailed analysis revealed that this species exhibited diurnal variation in feeding habits.

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MATERIAL AND METHODS

The materials for the present study were collected at random from the commercial catches landed by shore seine, gill net and trawl net in the landing centres in and around Mandapam, on the Palk Bay and the Gulf of Mannar sides, during the period from April 1969 to March 1971. The stomach contents were analysed using volumetric points method (Pillay, 1952) and later the data was processed by the method of 'Index of Preponderance' as suggested by Natarajan and Jhingran (1961).

In the present study, since the exact time of capture of the fishes was not available, they were generally grouped into two major categories,

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namely day samples and night samples. The day samples comprised of those fishes caught during the day time between 6 a.m. and 6 p.m. and the night samples referred were those caught in the night, mostly in the early morning before the sunrise. A total number of 874 fish from day catch and 1373 fish from night catch were analysed for this study during the two year period.

samples was calculated and the results are presented in Tables 1 and 2. From the volume points allotted to each stomach, according to its degree of fullness, the average volume points were calculated for each month, dividing the total volume points attained for all the fishes in the month by the total number of fish examined in that month. The fishes with the empty stomachs were also incorporated in this

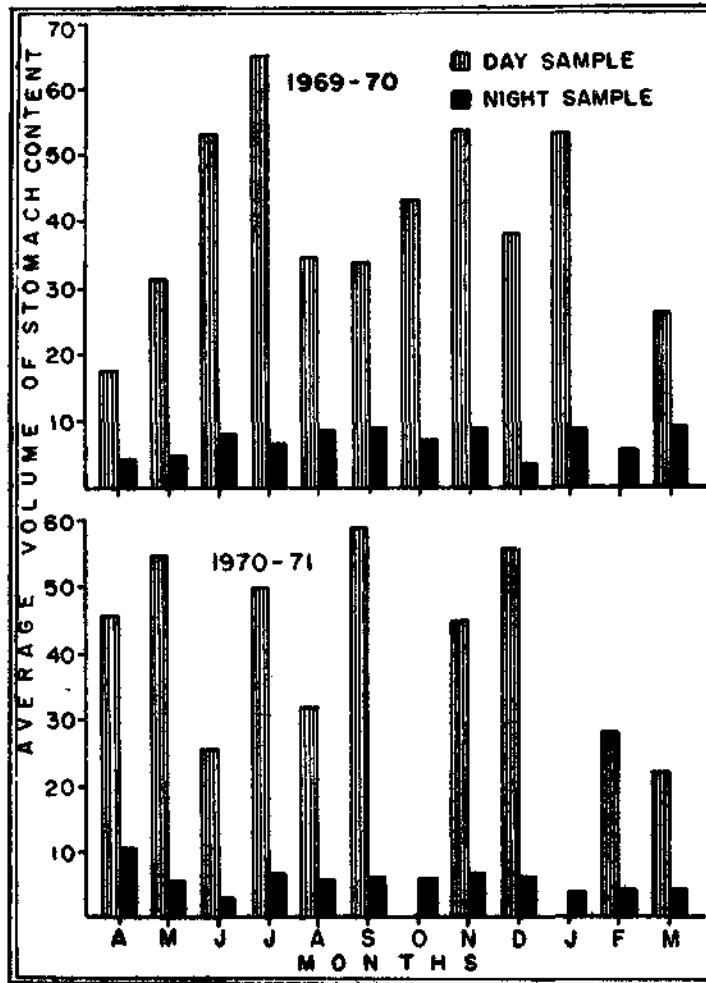


Fig. 1. Monthwise average volume points of stomach contents of *Dussumieria acuta* in day and night samples during 1969-70 and 1970-71.

RESULTS

The percentage occurrence of stomach in various degrees of fullness in day and night

calculation. The average volume points thus calculated for day and night samples in different months are presented in Fig. 1.

TABLE 1. *Percentage occurrence of the stomachs of Dussumieria acuta in various degrees of fullness in day and night samples (April 1969 to March 1970)*

Months	Time	Gorged	Full	‡ Full	‡ Full	‡ Full	'Little'	Empty	No. of fish
Apr.	Day	—	2.56	5.13	5.13	17.95	69.23	—	39
	Night	—	—	—	—	—	41.18	58.82	51
May	Day	8.80	7.20	9.60	8.80	22.40	34.40	8.80	125
	Night	—	—	—	—	—	47.83	52.17	23
June	Day	16.36	18.18	18.18	16.36	23.64	3.64	3.64	55
	Night	—	—	—	0.93	1.87	71.03	26.17	107
July	Day	23.08	38.46	15.38	—	15.38	7.69	—	13
	Night	—	—	—	—	0.79	63.49	35.72	126
Aug.	Day	8.33	8.33	16.67	—	33.33	33.33	—	12
	Night	—	—	—	—	3.08	76.92	20.00	65
Sep.	Day	4.65	16.28	13.95	6.98	18.60	37.21	2.33	43
	Night	—	—	—	—	2.22	82.22	15.56	45
Oct.	Day	6.06	21.21	15.15	15.15	15.15	21.21	6.06	33
	Night	—	—	—	—	—	57.14	40.82	49
Nov.	Day	17.14	22.86	8.57	22.86	17.14	8.57	2.86	35
	Night	—	—	—	—	4.76	57.14	35.71	42
Dec.	Day	—	2.38	—	—	—	16.67	16.67	18
	Night	—	27.78	5.55	22.22	11.11	32.79	67.21	61
Jan.	Day	—	39.13	21.74	8.70	26.09	4.35	—	23
	Night	—	—	—	—	—	83.05	16.95	59
Feb.	Day	—	—	—	No sample	—	—	—	nil
	Night	—	—	—	—	—	55.41	44.59	74
Mar.	Day	8.00	6.00	4.00	8.00	12.00	48.00	14.00	50
	Night	—	—	—	—	5.26	78.95	15.79	19
Total	Day	8.52	14.57	11.21	10.76	19.51	29.37	6.05	446
	Night	—	0.14	0.14	0.14	1.25	62.69	35.64	721

TABLE 2. *Percentage occurrence of the stomachs of Dussumieria acuta in various degrees of fullness in day and night samples (April 1970 to March 1971)*

Months	Time	Gorged	Full	‡ Full	‡ Full	‡ Full	'Little'	Empty	No. of fish
Apr.	Day	19.70	16.67	3.03	10.61	22.73	24.24	3.03	66
	Night	4.17	—	—	—	—	62.50	33.53	24
May	Day	9.52	22.62	26.19	21.42	11.90	8.33	—	84
	Night	—	—	—	—	—	56.15	43.75	16
June	Day	1.35	6.67	8.11	16.22	12.16	51.35	4.05	74
	Night	—	—	—	—	—	28.95	71.05	38
July	Day	17.65	23.53	11.76	—	17.65	29.41	—	17
	Night	—	—	—	—	1.43	62.86	35.71	70
Aug.	Day	6.67	6.67	13.33	6.67	26.67	40.00	—	15
	Night	—	1.18	—	—	1.18	51.76	45.87	85
Sep.	Day	13.33	40.00	13.33	6.67	6.67	20.00	—	15
	Night	—	—	—	—	2.56	56.41	41.03	39
Oct.	Day	—	—	—	—	No sample	—	—	nil
	Night	—	—	—	—	—	57.59	42.11	76
Nov.	Day	5.26	21.05	15.79	15.79	31.58	10.53	—	19
	Night	—	—	—	2.04	5.88	57.14	40.82	49
Dec.	Day	35.29	17.65	5.88	5.88	17.65	5.88	11.76	17
	Night	—	2.22	—	—	5.56	31.11	61.11	90
Jan.	Day	—	—	—	—	No sample	—	—	nil
	Night	—	—	—	—	—	37.35	62.65	83
Feb.	Day	4.62	4.62	12.31	9.23	23.07	41.53	4.62	65
	Night	—	—	—	—	—	41.38	58.62	58
Mar.	Day	—	—	—	10.71	30.36	42.86	3.57	56
	Night	—	—	—	—	—	41.67	58.33	24
Total	Day	8.88	13.08	12.85	12.85	19.39	30.14	2.80	428
	Night	0.15	0.46	—	0.15	1.23	47.55	50.46	652

During the year, April 1969 to March 1970 (Fig. 1), it may be noticed that the monthly average volume points of the night samples ranged from 3.28 in December to 8.95 in March and in the day samples from 17.77 points in April to 65.38 points in July. This shows that the monthly average were less than 'trace' condition (10 points) in night samples and above 30 points in day samples, except for April and March. No day samples were available in February. During the subsequent year, April 1970 to March 1971 (Fig. 1), the average volume in the night samples ranged from 2.89 in June to 10.41 in April, whereas in the day samples the points varied from 22.41 in March to 59.33 in September. In the night samples, except for April, the average volume was less than 7 and in the day samples except for June, February and March, was above 30 (no day samples in January and October). This shows that there is a clear variation in feeding intensity of *D. acuta* between day and night.

D. acuta caught in the night had their stomachs completely shrunken with thick walls and prominent internal folds and most of these contained no food items and were completely empty. The stomachs with a condition of feed 'little' contained traces of highly digested and macerated materials where the identity of food items had completely lost. Stomach with higher conditions of feed were only very rarely noticed. Contrary to this the fish caught in the day time had stomachs with various degrees of fullness. Only very few stomach were empty and those designated as 'little' had their walls showing the signs of a dilation by softening of the walls and smoothening of the internal folds. The food items present inside were fresh and clearly identifiable. This indicated that the fish had just commenced to feed. It may be emphasized that while the category 'little' in the night samples is the end point of the process of digestion, that of the day samples, especially in the morning hours, is the commencement of the feeding activity.

During the period, April 1969 to March 1971, samples from night catch were available in all the months. Except for February 1970, October 1970 and January 1971, day samples were available in all other months.

Throughout the period it was observed that the percentage of empty stomach was very less in day samples, whereas it was very high in night samples (Table 1). In the day samples during the first year the empty stomach ranged from a minimum of 2.33% in September 1969 to 16.67% in December 1969. In April, July and August 1969 and in January 1970 empty stomachs were completely absent in day samples. The percentage of empty stomachs in the day samples for the whole year was only 6.05% (Table 3). In the night samples, during this period, the empty stomachs ranged from a minimum of 15.56% in September 1969 to a maximum of 67.21% in December 1969 and empty stomachs were present in all the months without any exception (Table 1), and it gave a value of 35.64% for the year (Table 3). The

TABLE 3. Percentage occurrence of stomachs in three main categories of fullness showing the diurnal variation in feeding activity in *Dussumieria acuta* for the period April 1969 to March 1971

Years	Degrees of fullness	No. of Fish	Day		Night	
			Percentage	No. of Fish	Percentage	
1969-70	Empty	27	6.05	257	35.64	
	'Little'	131	29.37	452	62.69	
	½ full and above	288	64.58	12	1.67	
1970-71	Empty	12	2.57	330	50.61	
	'Little'	129	30.14	310	47.55	
	½ full and above	287	67.29	12	1.84	

percentage of 'little' stomachs in the day samples during this period was 29.37 (Table 3) which ranged from 3.64 in June 1969 to 69.23 in April 1969. In the night samples the percentage of 'little' stomach was 62.69 and ranged from 32.79 in December to 83.05 in January 1969.

During the subsequent year, April 1970 to March 1971, in the day samples the empty stomach ranged from a minimum of 3.03% in April 1970 to a maximum of 11.76% in December 1970, with a value of 2.57% for the year (Table 3). Empty stomachs were completely absent in May, August, September and November 1970. In the night samples, during this period, the empty stomachs ranged from a minimum of 33.33% in April 1970 to a maximum of 71.05% in June 1970 (Table 2), with a value of 50.61% for the whole year (Table 3). Empty stomachs were observed in all the months in night samples during this period. The percentage value of 'little' stomachs in day sample was 30.14 which ranged from 5.88% in December to 51.35% in June. In the night samples for the year 47.55% stomachs were in the category of 'little' (Table 3) which ranged from 28.95% in June 1970 to 62.86% in July 1970 (Table 2).

In general, in the day sample only 6.05% stomachs during the first year and 2.57% stomachs during the second year were empty, whereas the rest contained fresh food items in various degrees of fullness. In the night samples 98.33% stomachs during the first year and 98.16% during the second year were either empty or 'little' (Table 3). Since the 'little' stomachs of the night samples contained no fresh food components other than some pulpy digested materials, it was inferred that, in effect in the night samples, the fishes with both these categories of stomachs ('little' and empty) were not feeding in the night. It was observed that in the night samples only 1.67% fishes during the first year and 1.84% fishes during the second year had stomachs with various degrees of fullness. These low values revealed that feeding activity of *D. acuta* was negligibly low in the night and even if any occurred, could only be accidental.

The occurrence of such a diurnal variation in the feeding intensity of *D. acuta* suggests the possibility of illumination being linked with the

feeding habit of this fish. From the qualitative analysis of the stomach contents, it was evident that the fish fed mainly on crustaceans, especially *Lucifer*, alima, zoea, megalopa, etc. and other than crustaceans they mainly fed on 'fishes' of which *Stolephorus* sp. was the dominant one. They also ingested some plant materials (bits of seaweeds and seagrasses), but no diatoms were observed in the stomach. Such a composition of the diet suggests that the fish prefer some food items among the myriads of planktonic items around it and in order to pick-up them it make use of the day light illumination and thus has adopted a habit of day feeding.

DISCUSSION

Venkataraman (1960) observed a high percentage (53%) of empty stomachs in *D. hasseltii* of Calicut area. Tham-Ah-Kow (1950) also noticed the same feature in the specimens of the species caught from Singapore Strait. But these authors had not mentioned any specific reason for it. On the other hand, Mahadevan and Chacko (1962) had observed comparatively low percentage (15.75%) of empty stomachs in *D. hasseltii*. They also opined that the percentage of empty stomachs was low from September to April and high in the subsequent months, thus showing two stages of feeding. The maximum feeding they could observe was in March and in November-December. The trend of feeding had been interpreted by them as seasonal, rather than in accordance to the size of the fish and they also assumed that active feeding periods may be the after effect of spawning. In the present study on *D. acuta* also high percentage of empty stomachs were noticed. But a detailed analysis showed that this fish exhibited a diurnal variation in feeding habits, feeding during day time and starving during night. Since the majority of the commercial catch, from which specimens were collected, came from night fishing, the percentage of the empty stomach was high. When the

day catch was analysed it was seen that the percentage of empty stomach was very low. In the present study, as against the observations of Mahadevan and Chacko (1962), no specific

seasonal variation in feeding or any correlation with spawning was noticed. But the variation was in the feeding intensity between day and night and was not due to any other aspects.

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