FOOD AND FEEDING HABITS OF THE TWO SPECIES OF *CHIROCENTRUS* FROM MANDAPAM*

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ABSTRACT

The two species of *Chirocentrus*, *C. nudus* and *C. dorab*, examined from the Palk bay and Gulf of Mannar, appear to be diurnal predators preying mostly on fishes, depending for predation perhaps on vision. They seem to ingest the prey as a whole, swallowing its head first. When young, they feed mainly on the postlarvae and juveniles of *Stolephorous* and *Sardinella* and on *Acetes*, but, as adult' they change over to adult sardines and other clupeoids. Though both the species belong to the same trophic level, *C. nudus* seems to avoid competition by feeding on relatively larger-sized prey, which they are able to do with the help of their larger mouth and stronger teeth.

INTRODUCTION

The available information on the food and feeding habits of *Chirocentrus* from the Indian seas is the brief mentions by Chacko (1949), Devanesen and Chidambaram (1953), Venkataraman (1961), Basheeruddin and Nayar (1962) and Rabindranath (1966), all reportedly relating to *C. dorab*, but in all probability relating to a mixture of both the species, namely, *C. dorab* and *C. nudus*, since both of them occur along the Indian coast with the latter more dominant in the catches (*see* Luther 1968). Therefore the food and feeding habits of the two species from the Palk Bay and Gulf of Mannar around the Rameswaram island were studied separately, and the results, together with a short description of the alimentary system of *Chirocentrus*, are given in this account.

MATERIAL AND METHODS

Samples from drift-net catches from the Palk Bay and Gulf of Mannar were examined once a week from July 1964 to June 1967. As relatively larger fish were more common in these catches, small-sized fish were examined from samples collected from the shore-seine catches around the Rameswaram Island during July 1967-June 1968. The drift-net samples were night catches

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and the shore-seine samples were day catches. Stomach contents of 5121 *C. nudus* ranging in fork length from 85 mm to 790 mm were examined. Out of them, 4076 fish, ranging between 180 mm and 790 mm length, were from drift nets and the rest, ranging in length from 85 mm to 350 mm, were from shore seines. Stomach contents of 1694 *C. dorab*, ranging from 127 mm to 664 mm fork length, were examined. Out of these, 1435 fish, ranging between 227 mm and 664 mm length, were from drift nets and the rest, ranging in length from 127 mm to 364 mm, were from shore seines.

The stomach contents were examined in fresh condition. The intensity of feeding was determined for individual fish based on the distention of the stomach and the amount of food contained therein (Pillay 1952). The intensity of feeding was classified, by eye estimation, as 'gorged', 'full', '¾ full', '½ full', '¼ full', 'a little' and 'empty'. The first four conditions were taken as indicators of "active" feeding and the last three conditions as "poor" feeding. The food components were identified up to generic or even specific level, wherever possible, and the occurrence of each category was recorded.

The examination of the data has shown that there was no significant variation in the quality of prey or in the intensity of feeding among the different seasons or among the different maturity stages of the fish. However, there were some evident variations between the fish caught during night and those caught during day and also between those caught from Gulf of Mannar and those caught from the Palk bay. Hence the data for night and day catches, separately for the two localities, were segregated and analysed by the Occurrence method.

Food Habits of C. nudus

The wide gape of mouth; the jaws bearing sharp, curved caniniform teeth; the thick, short gill rakers; and the simple, short alimentary canal all illustrate the predaceous nature of both the species of *Chirocentrus*.

Fishes were the main food of *C. nudus* (Table 1). Cephalopods of the genera *Sepia, Sepioteuthis* and *Loligo* were met with occasionally in fish caught in drift net, and shrimp *Acetes* was met with frequently in fish caught in shore seine catches. Species of *Sardinella* ranked first in importance, with *Stolephorus* and leiognathids ranking next, in fish caught in drift nets. However, *C. nudus* was found to consume a variety of other fishes, too, such as *Dussumieria, Thryssa, Sphyraena, Trichiurus, Lethrinus, Atherina, Hilsa, Pellona, Anodotostoma*, carangids, hemirhamphids, grey mullets and even young ones of *Chirocentrus*.

Though fishes formed the main food item of *C. nudus* also from the shore seine catches, the fishes here were mainly postlarvae and early juveniles. This difference in the size of prey in fish from the two types of gear might be

TABLE 1. *Food components in percentage of* C. nudus *from the Palk Bay and the Gulf of Mannar in night catches by drift net, and day catches by shore seines.*

Year	Size range (mm)	No. of fish	*Sardinella*	*Stolephorus*	*Leiognathus*	*Sphyraena*	Other fishes	*Acetes*	Cephalopods	Partly digested matter
Palk Bay: Night catches										
1964-65	256-770	795	40.6	9.1	0.3	—	2.0	—	0.3	47.7
1965-66	187-735	941	43.2	4.4	1.2	—	3.2	—	3.2	44.8
1966-67	200-757	823	39.2	3.8	2.1	—	5.1	—	—	49.8
Gulf of Mannar: Night catches										
1964-65	294-705	313	53.0	—	1.5	—	6.1	—	—	39.4
1965-66	202-790	725	36.1	1.3	1.6	—	5.7	—	0.8	54.9
1966-67	180-695	479	38.2	—	1.3	—	13.2	—	—	46.1
Palk Bay: Day catches										
1967-68	85-350	569	19.2	26.0	—	11.6	7.3	22.7	—	12.9
Gulf of Mannar: Day catches										
1967-68	85-320	476	14.0	32.4	—	8.6	4.1	30.1	—	10.8

due to the difference in the size of *C. nudus* caught in the two gears (Table 1). Further, *Stolephorus* formed the chief item consumed by fish obtained from shore seine. The other main items of food were *Acetes, Sardinella* and *Sphyraena.* Postlarvae of fish such as *Elops, Megalops, Saurida, Sillago, Therapon, Atherina* and carangids, were also at imes observed.

Food in relation to size of fish: Though the individual stomachs indicated that fish formed the main food of individuals examined in the length range mentioned earlier, fish between 85 and 350 mm length were found to feed on postlarvae and early juvenile fishes, mainly of *Stolephorus, Sardinella* and *Sphyraena,* and on the small shrimp *Acetes.* Stomachs of fish below 350 mm length examined from drift net catches had either partly digested food or were empty. Hence no comparison could be made of the food components of small-sized fish caught during day and night. But large-sized *C. nudus* appeared to feed on large-sized fishes, the size of the prey increasing with the size of the predator. Though fishes up to 200-300 mm standard length were observed in the stomachs of large-sized fish, 60-140 mm were the common size of prey in *C. nudus* exceeding 350 mm fork length.

Feeding habits and feeding grounds: *C. nudus* caught at night in drift net usually had in their stomachs either 1-4 fish of the same species, or varying amounts of partly digested material, mostly fish. Small-sized *C. nudus* occurring in the shore seine catches (day), however, were found usually to contain more than one category of food item, presumably because these items had occurred in an assemblage. Irrespective of size of the prey, the stomach contents of an individual usually were in the same state of digestion, perhaps indicating that *C. nudus* feeds at intervals of time. The fish appeared to ingest the prey as a whole starting with its head, for the heads of the fish, with very few exceptions, were found toward the blind end of the pouch-like stomach. Medium-sized *Trichiurus* when eaten was found in the stomach in a folded condition with both its head and tail toward the oesophagus. This method of ingestion, namely, swallowing the head of the prey first, seems to be an adaptive behaviour of the predator in order to prevent the prey's fin spines' possible interference while swallowing.

About 70% of stomachs of the fish examined from drift net catches (night) were empty (Table 2), whereas only 20% of them from shore seines (day) were in this condition. This difference in the occurrence of empty stomachs in fish caught during night and day indicates a low feeding activity of the fish during night. To examine this aspect further, a comparison was made

TABLE 2. *Condition of feeding (% occurrence) of* C. nudus *in the Palk Bay and the Gulf of Mannar in the night catches by drift net, and in the day catches by shore seine.*

	Size range (mm)	No. of fish	Gorged	Full	¾ full	½ full	¼ full	Little	Empty
Palk Bay: Night catches									
1964-65	256-770	795	—	10.2	2.4	18.9	2.9	3.1	62.5
1965-66	187-735	941	—	8.3	0.1	17.3	0.9	—	73.4
1966-67	200-757	823	—	7.5	—	20.2	—	1.0	71.3
Gulf of Mannar: Night catches									
1964-65	294-705	313	—	5.8	1.6	8.6	2.9	1.9	79.2
1965-66	202-790	725	—	4.8	—	11.4	—	—	83.7
1966-67	180-695	479	—	3.1	—	11.1	1.3	0.4	84.1
Palk Bay: Day catches									
1967-68	85-350	569	8.0	10.7	7.8	30.4	16.2	11.1	15.8
Gulf of Mannar: Day catches									
1967-68	85-320	476	5.0	7.8	5.9	22.7	19.5	14.5	24.6

of the proportions of fish in poor feeding activity in samples obtained during night and day. This gave a test statistic (d) (Bailey 1959) of 16.83 (> 1.96) indicating a significant difference between the two proportions. The feeding intensity of fish would naturally be lower during night than during day. Occurrence of semidigested matter to the extent of about 50% in fish caught at night and only about 10% in those caught during day also would point to the same possibility. Also, whereas fish with gorged stomach were present in day catches they were absent in night catches. However, fish with ½ full stomach were common both in night and in day catches, forming 15.8% and 26.9% respectively. Actively fed fish formed 7.7% in the night catches and 24% in day catches. These figures, besides pointing out the higher feeding activity during day time, would indicate that the fish feeds only moderately at a time.

Incidence of empty stomachs was higher in Gulf of Mannar than in the Palk Bay, in both night and day catches. Similarly, poorly fed fish were more in the Gulf of Mannar than in the other locality. This variation in the feeding intensity between the two localities was statistically tested by comparing the proportion of fish in poor feeding condition from the two localities for the night and day catches separately. The test statistic (d) obtained were 9.2 (> 1.92) for night samples, and 5.0 (> 1.96 for day samples, indicating significant difference. Thus the feeding intensity of the fish seems to be significantly higher in Palk Bay than in Gulf of Mannar, indicating the probability of Palk Bay's forming a more important feeding ground for *C. nudus*.

Food Habits of C. dorab

C. dorab seems to have a food habit almost similar to *C. nudus*, the difference being only in the relative proportion of certain food items consumed (Table 3). Large-sized fish examined from drift net catches were found to have consumed mainly fishes, the chief item being sardines. In this species, unlike in *C. nudus*, *Sardinella albella* and *S. gibbosa* were the most common sardines met with, and, as in *C. nudus*, *Stolephorus* and *Leiognathus* were the next in importance, But, unlike in *C. nudus*, in this only small-sized fish of fewer groups, such as *Dussumieria*, *Thryssa*, *Atherina* and carangids, were met with. Further, the occurrence of cephalopods, *Sepia*, *Sepioteuthis* and *Loligo*, as also of Leiognathids, was found to be slightly higher in *C. dorab*. The small-sized *C. dorab* examined from shore seines were having post-larval fishes and *Acetes* as in the case of *C. nudus*. However, the proportion of *Acetes* consumed was higher in this species than in *C. nudus*. But for this there appears to be very little variation in food between the small-sized fishes of the species.

Food in relation to the size of fish: Similarly as in *C. nudus*, larger-sized fish *C. dorab* fed on larger sized food organisms, and fish in 132-364 mm length

TABLE 3. *Food components in percentage of* C. dorab *from the Palk Bay and the Gulf of Mannar in night catches by drift net, and day catches by shore seine.*

Year	Size range (mm)	No. of fish	*Sardinella*	*Stolephorus*	*Leiognathus*	*Sphyraena*	Other fishes	*Acetes*	Cephalopods	Partly digested matter
Palk Bay: Night catches										
1964-65	290-590	77	36.7	3.3	6.7	—	3.3	—	10.0	40.1
1965-66	227-633	255	36.0	11.2	5.6	—	3.4	—	4.5	38.2
1966-67	255-610	142	45.6	8.7	4.4	—	4.4	—	2.2	34.7
Gulf of Mannar: Night catches										
1964-65	306-628	267	44.9	3.4	5.2	—	3.4	—	3.4	39.7
1965-66	257-664	375	32.6	4.4	4.4	—	4.4	—	4.4	55.6
1966-67	282-660	319	43.4	3.3	3.3	—	3.3	—	10.0	36.7
Palk Bay: Day catches										
1967-68	132-364	102	17.9	25.6	—	6.5	3.6	36.9	—	10.1
Gulf of Mannar: Day catches										
1967-68	127-348	157	14.5	24.3	—	7.2	3.4	40.4	—	10.2

range fed on postlarvae and early juveniles of fishes and on *Acetes*. As the stomach of the small fish examined from drift net catches were either empty or with partly digested food no comparison was possible between the foods of the small sized fish from the two types of gear.

Feeding habits and feeding grounds: The ranges in the numbers of food items of *C. dorab* in the night catches and the day catches, as well as the position of the prey in the stomach, were almost the same as observed in the other species. In the night catches by drift net, about 75% of the fish had empty stomach and about 42% had partly digested food (Table 4). But in the day catches by shore seine, only 24% of fish had empty stomach and 10% had digested food. These show a lower feeding activity of the fish during night. As in the case of *C. nudus*, the general condition of feeding was better in fish caught in the Palk Bay than in the Gulf of Mannar. This is borne out by the occurrence of fish in active state of feeding of about 32% from drift net catches and 56% from the shore seines in the Palk Bay as compared to 20% from the drift net catches and 40% from shore seines in the Gulf of Mannar, indicating that Palk Bay was the main feeding ground for *C. dorab* also.

TABLE 4. *Condition of feeding (% occurrence) of* C. dorab *in the Palk Bay and the Gulf of Mannar in the night catches by drift net, in the day catches by shore seine.*

	Size range (mm)	No. of fish	Gorged	Full	¾ full	½ full	¼ full	Little	Empty
Palk Bay: Night catches									
1964-65	290-590	77	—	9.1	1.3	26.0	—	2.6	61.0
1965-66	227-635	255	—	7.1	—	26.3	—	—	66.7
1966-67	255-610	142	—	5.6	—	22.5	2.8	—	69.0
Gulf of Mannar: Night catches									
1964-65	306-628	267	—	1.9	1.1	16.1	1.9	0.7	78.3
1965-66	257-664	375	—	5.9	0.5	14.4	0.8	—	78.4
1966-67	282-660	319	—	3.4	—	15.4	—	—	81.2
Palk Bay: Day catches									
1967-68	132-364	102	4.8	4.0	6.9	40.2	13.7	11.3	18.6
Gulf of Mannar: Day catches									
1967-68	127-348	157	4.0	4.2	5.1	26.8	18.5	13.4	28.2

REMARKS

In a general account of the food and feeding habits of the fishes of the Gulf of Mannar, Chacko (1949) described *C. dorab* as a carnivorous fish actively predaceous at surface and mid water. From the examination of 199 fish of 32-59 cm length, he found its food as comprising *Sardinella gibbosa*, *Engraulis* sp., *Stelephorus* sp., *Dussumieria hasselti* and *Trichiurus savala*. Devanesan and Chidambaram (1953) reported *C. dorab* as feeding on other small pelagic fish such as sardines (*Dussumieria*, *Sardinella gibbosa*, etc.) silver bellies (*Leiognathus* and *Gazza*), young ribbon fishes, prawns and young eels (Leptocephali). During the course of his studies on the food and feeding relationships of the inshore fishes off Calicut, Venkataraman (1961) found *Stolephorus heterolobus* and *S. commersonii* besides fragments of prawns. Basheerudin and Nayar (1962) found the juvenile *Chirocentrus* of the coastal waters of Madras feeding on *Stolephorus* sp., juvenile *Lactrius lactarius*, young ones of other fishes and also small dorabs. Rabindranath (1966), while dealing with the biology and seasonal distribution of the pelagic food fishes of Travancore coast, described the food of *C. dorab* of 36.5-59.0 cm length range, as comprising mainly anchovies and occasionally young ones of *Saurus indicus* and large sized *Loligo*. He also observed about 44% of *C. dorab* to be with empty stomach.

The present observations have shown that in the Palk Bay and the Gulf of Mannar the younger ones of these two species feed mainly on postlarvae and

juveniles of *Stolephorus* and *Sardinella* as well as on *Acetes* and, on their growing larger, they take mainly to sardines apart from a number of other fishes and cephalopods. Thus both the species of *Chirocentrus* may be considered to be chiefly piscivorous, feeding mainly on clupeoids. And both the species appear to forage at the same trophic level and compete for the same food item, though *C. nudus*, with its larger gape of mouth, stronger teeth and pharyngeal armature, and a more voluminous stomach, is able to feed on fishes of larger size.

Predaceous fish, according to several authors (as quoted by Popova 1967), may be divided into two groups on the basis of their method of finding and procuring food: diurnal and nocturnal predators. In the former group it is vision that plays the main role in capturing prey, whereas in the latter group it is the senses of smell, touch and the lateral line organs. If so, *Chirocentrus* can be regarded as diurnal predators depending mainly on vision to catch their prey, since it was in the fish caught during day time that greater feeding activity was evident.

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