STUDIES ON THE FOOD AND FEEDING RELATIONSHIPS OF THE HALFBEAK FISHES (HEMIRHAMPHIDAE) FROM THE GULF OF MANNAR AND PALK BAY

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Introduction

As a part of the investigations of the biology of the hemirhamphids in the Gulf of Mannar and Palk Bay from 1957–59, the contents of 2221 guts belonging to four species, *viz.*, *Hyporhamphus georgii* (C.V.), *H. quoyi* (C.V.), *Hemirhamphus marginatus* (Forsk.) and *H. far* (Forsk.) were examined. No detailed information on the food and feeding habits of the halfbeaks is available and the accounts given by Schlesinger (1909), Uchida (1930), Smith (1933), Devanesan (1933), Graham (1938), Suyehiro (1942), Gnanamuthu (1943), Chacko (1949), Tham Ah Kow (1950), Thompson (1957 and 1959), Vijayaraghavan (1957) and Kuthalingam (1958) relate mainly to observations confined to limited periods in a year and do not give a picture of the variations of the seasonal composition of the gut contents. The present study deals with the seasonal composition of the food items of four species of halfbeaks and its relation to the environmental biota and their stages of sexual maturity.

Material and Technique

General

The alimentary canal is simple and takes a straight course from the oesophagus to the anus in the hemirhamphids. The stomach and the pyloric caeca are absent. Such a type of alimentary tract is classified by Jacobshagen (1911) as the most primitive type under category 'A' of his classification.

Material and Methodology

The guts examined in this study were obtained from fish used for other biological studies, the fish having been obtained from the commercial catches. Immediately upon capture, or as soon as possible, the guts were dissected out and preserved separately in 5% sea-water formalin solution. Data on

size, sex and stage of sexual maturity were recorded for each fish. A summary of the collections is given in Table I.

TABLE I

Monthly average intensity of feeding (points) for the year 1957–59

(The number in brackets indicates the number of fish examined)

	Hypo. georgii		*Hypo. quoyi*		*Hemi. marginatus*		*Hemi. far*	
January ..	4·1	(73)	9·2	(38)	3·7	(107)	9·4	(30)
February ..	4·4	(48)	8·9	(45)	..	..	8·8	(45)
March ..	5·8	(246)	8·5	(45)	..	..	7·9	(46)
April ..	5·3	(226)	9·3	(45)	..	..	7·7	(50)
May ..	4·7	(164)	8·5	(49)	..	..	8·1	(35)
June ..	..	..	..	..	..	..	..	(5)
July ..	..	..	..	(3)	..	..	..	..
August ..	..	..	7·2	(25)	..	..	7·9	(20)
September ..	4·1	(31)	7·6	(21)	..	..	8·6	(25)
October ..	3·8	(81)	8·7	(23)	3·8	(39)	8·4	(39)
November ..	4·2	(83)	8·9	(20)	3·9	(170)	9·2	(36)
December ..	3·9	(90)	8·3	(27)	3·5	(171)	8·9	(20)

Food organisms were generally found uniformly distributed throughout the greater part of the alimentary tract and for this reason it was considered necessary to examine the contents of the whole digestive tract. Each gut was split open and all the contents were washed into a petri-dish and examined under a binocular microscope.

For a quantitative study of the gut contents the method followed by Hynes (1950) was adopted. Points were given to denote the intensity of feeding like 0, 3, 5 and 10 representing guts with no contents and guts with 3/10th, half and full contents respectively. The percentage composition of the various items of the gut contents were analysed by the numerical method. The contents of the adults in the different stages of sexual maturity were studied separately. For the purposes of the analysis of the gut contents the fish were grouped as :—

(i) Maturing (Stages II–IV),

(ii) Fully Ripe—Spawners (Stages V–VI),

(iii) Spent (Stage VII).

Length to the caudal fork (L.C.F.) of the fish has been used as the standard linear measurement.

Species-wise Analysis of the Gut Contents

(Table II)

I. Hyporhamphus georgii

1042 specimens of a size-range 155–275 mm. L.C.F. were examined. The analysis of the gut contents with reference to the different stages of sexual maturity indicated that the diet could be classified into three categories:—

(*i*) *Food of the maturing fish.*—The main diet during the maturing phase was *Cymodocea* and green algae. The diatoms—*Nitzschia*, *Coscinodiscus* and *Rhizosolenia* were common, *Climasphaenia* was relatively rare. Polychaete remains were also frequently observed. The miscellaneous items encountered mostly were crustacean appendages.

(ii) *Food of the spawners.*—The diet of the spawners was significantly different from the maturing group. The pteropod, *Creseis acicula* constituted about 80% of the diet. Molluscan larvae, mostly bivalves, were frequently observed in the guts and constituted about 5% of the diet. The remaining 15% of the diet was composed of miscellaneous items like the copepods—*Acartia*, *Oithona* and *Pseudodiaptomus*, decapod larvae and diatoms like *Gyrosigma*, *Guinardia flaccida*, *Rhabdonema*, *Chaetoceros* and *Bacteriastrum*.

(iii) *Food of the spent fish.*—The diet during this phase, as seen from Table II, showed the existence of two conditions. Condition 'A' with about 80% of *Acartia erythraea* and condition 'B' with about 80% of foraminifers. In both cases molluscan larvae constituted 5% of the diet. Copepods like *Acartia*, and *Oithona*, and decapod larvae were occasionally observed.

II. Hemirhamphus marginatus

The twenty samples comprising 487 specimens of a size-range of 216–253 mm. L.C.F. analysed constituted spawners and some spent fish. This species migrates into the Gulf of Mannar mainly for spawning.

37·9% of the guts had their contents completely digested forming a mucilaginous mass. The diet of the remaining 62·1% fish comprised of *Cymo-*

TABLE II

Percentage composition of the gut contents

		No. of guts analysed	*Cymodocea* spp.	Green algae	Diatoms	Foraminifers	Polychaete	*Acartia erythraea*	*Lucifer* spp.	*Creseis acicula*	Molluscan larvae	Miscellaneous items
			Percentage frequency									
Hyporhamphus georgii												
Maturing fish		.. 341	70	10	5	..	5	..	..	..	..	10
Spawners		.. 327	..	..	..	..	..	..	..	85	5	10
Spent fish	A	.. 374	..	..	..	..	..	80	..	..	5	15
	B	..	..	..	..	80	..	..	..	..	5	15
Hemirhamphus marginatus		.. 487	50	10	10	..	..	..	15	..	..	15
Hyporhamphus quoyi		.. 341	70	10	5	..	5	..	..	..	..	10
Hemirhamphus far		.. 351	70	10	5	..	5	..	..	..	..	10

docea, green algae (*Chaetomorpha* spp. and *Enteromorpha compressa*), *Lucifer* spp. and diatoms—*Coscinodiscus, Thallasothrix, Rhizosolenia, Pleurosigma* and *Gyrosigma*. Crustacean remains and hydroids (*Lytocarpus* sp.) were occasionally encountered. Polychaete remains found were in a semi-digested form and hence it was not possible to determine their identity. About 70% of guts examined contained sand grains.

III and IV. Hyporhamphus quoyi and *Hemirhamphus far*

The diet of these two species is observed to be remarkably similar. 42 samples comprising 285 individuals of *Hyporhamphus quoyi* and 351 individuals of *Hemirhamphus far* were examined. The specimens ranged from 57–249 mm. L.C.F. and 174–239 mm. L.C.F. respectively.

Cymodocea was the dominant food item of these fishes throughout the year. Algae, the most common forms being *Cladophora* sp. and *Chaetomorpha* spp., also constituted a fairly good proportion of the diet throughout the year. Diatoms like *Nitzschia* spp., *Coscinodiscus* spp., *Gyrosigma* spp. and *Pleurosigma* spp. were most common while *Licmophora abbreviata, Rhabdonema mirificum* and *Guinardia flaccida* were rare. Polychaetes (*Nereis* spp., and *Perinereis* spp.) were occasionally present in the gut contents throughout the year.

Discussion

Summing up it may be said that *Hyporhamphus georgii* is omnivorous in that it takes both vegetable and animal matter. It also seems to be highly selective in its feeding with a preference for vegetable matter at the time when the gonads are ripening and for zooplankton in the spawning and spent stages. Such apparent changes in the diet may be due to the absence of specific food items like *Cymodocea*, or may be due to changes in preference. The former condition, *i.e.*, non-availability of *Cymodocea* in the environment seemed to be untenable as *Cymodocea* is available in the environment throughout the year (Dr. R. P. Varma—Personal communication). Moreover, from the investigations on allied species concurrently carried out by the author in the same area, it was seen that *Hemirhamphus far* and *Hyporhamphus quoyi* feed chiefly on *Cymodocea* during this period (March–April). The latter condition appears to have more of physiological bearing in so far as the relationship of the maturity of the gonadial stages are concerned and seem, therefore, to be closer to the actual state of affairs. In this connection it may be mentioned that in the herring it was suggested that the change from a non-crustacean to a crustacean diet could be associated with the phases of the reproductive cycle (Hardy, 1924).

The spawners of *Hyporhamphus georgii* preferred *Creseis acicula*. These pteropods were at their peak of abundance in the plankton during this period, March–April (Prasad, 1956). The diet of spent individuals of *Hyporhamphus georgii* was mostly the copepod, *Acartia erythraea* which is abundantly present in this area during April–May (Krishna Kartha, 1959), and foraminifers. The switch-over in the diet from pteropod to copepod was probably due to the different pattern of distribution of the spawners and spent fish. The occurrence of *Creseis acicula* and foraminifers in the guts of *Hyporhamphus georgii* have also previously been reported by Devanesan (*op. cit.*) and Gnanamuthu (1943) respectively. Hence it may be concluded that *Hyporhamphus georgii* does not belong to the group of filter feeders but feeds selectively. Several authors like Petersen (1894), Dannevig (1897), Pearse (1915), Lebour (1919), Russel (1929) and Shelbourne (1953) have all emphasised the capacities of some fishes for selective feeding. Seasonal changes in the feeding habits have also been reported for the mackerel, *Scomber scomberus* during its spawning period (Bullen, 1912).

Hyporhamphus quoyi and *Hemirhamphus far* feed exclusively on seagrass and green algae, and occasionally on polychaetes (*Nereis* spp. and *Perinereis* spp.). The few zooplanktonic organisms observed were probably accidental inclusions only since a regular pattern of fluctuation in abundance of these organisms in the guts was not noticeable. A similar observation was made by Thomson (1959) on *Hemirhamphus ardelio*. This should be expected if they were not taken voluntarily by the fish but were only accidental inclusions. But Vijayaraghavan (1957) has observed in his studies on *Hemirhamphus far* from Madras Coast that it is a "typical surface feeder often browsing among seaweeds and algae and supplementing this vegetable diet with an equal amount of crustacea and other zooplankton". Both these species, namely *Hyporhamphus quoyi* and *Hemirhamphus far*, showed no differences in their feeding habits with regard to maturity-index.

It is interesting to note that there was no evidence of a cessation of feeding during spawning in any of these species as not a single fish with a completely empty gut was encountered during the whole period of study. Suyehiro (1935) working on the Japanese flying fish, *Cypselurus agoo*, Hatanaka (1956) on the Japanese saury, *Cololabis saira*, drew similar conclusions. However, a total cessation of feeding was reported in the Australian garfish, *Reporhamphus melano chir* by Ling (1958).

The above studies have shown that different types of feeding relationships are maintained by the different species. A shift in emphasis is noticed as regards certain food elements depending on the maturity conditions in

Hyporhamphus georgii rather than on the availability of food items. Hence hemirhamphids may be considered to be selective in their food habits.

Summary

In the present study the food and feeding habits of the halfbeaks, *Hyporhamphus georgii* (C.V.), *H. quoyi* (C.V.), *Hemirhamphus marginatus* (Forsk.) and *H. far* (Forsk.) were studied for a period of about three years. The gut contents were analysed by the Points and Numerical methods. The seasonal variations in the composition of the gut contents are discussed in relation to the environmental biota and maturity stages. These studies have revealed that different types of feeding relationships are maintained by the different species and that they do not belong to the group of filter feeders but feed selectively.

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