FEEDING HABITS OF *HEMIRAMPHUS ARCHIPELAGICUS* COLLETTE AND PARIN, 1978 (FAMILY:HEMIRAMPHIDAE) FROM KARACHI COAST, PAKISTAN

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ABSTRACT

Feeding habits of *Hemiramphus archipelagicus* (Hemiramphidae), Collette and Parin, 1978 in Karachi coast, Pakistan were studied based on the analysis of stomach contents. Monthly samples were taken from September, 2009 to December, 2009 from Karachi Fish Harbour. Stomach contents of 333 fishes (male n = 200 , female n = 133) were examined. Eleven food categories were identified: Polychaeta , Mollusca, Bivalvia, Crustacea, Amphipoda, Brachyura, Cirripedia, Pisces , Unidentified animal materials , Unidentified plant materials and Unidentified materials. The results showed that *H. archipelagicus* is an omnivorous predator and its diet depends upon the availability of local prey species, especially in intertidal areas. The proportions of food items in the diet composition of the *H. archipelagicus* in the category of 145-185 mm and 195-235 mm length were to be found roughly equal.

Keywords: *Hemiramphus archipelagicus*, feeding habits, stomach contents, Karachi Fish Harbour, Karachi coast.

INTRODUCTION

The family Hemiramphidae (Gill, 1859) is divided into two subfamilies:Hemiramphinae (Gill, 1859) and Zenarchopterinae (Fowler, 1934), each containing about half the known species. Halfbeaks are known from the Atlantic, Indian and Pacific Oceans. They are surface dwelling omnivores of algae, zooplankton and small fishes typically found in water with a depth of 0 to > 5.0 m. The genus *Hyporamphus* (Gill, 1859) belongs to the subfamily Hemiramphinae (Gill, 1859) which is marine. The genus *Hyporamphus* (Gill, 1859) contains 36 species worldwide, out of which some are present in Arabian Sea also. Garfish or halfbeaks, of the family Hemirhamphidae, have generally been described as herbivores, feeding mainly on the fronds of zosteracean seagrass (Thompson, 1957, 1959; Talwar, 1962; Collette, 1974). A more complex feeding pattern has emerged for the southern sea garfish *Hyporhamphus melanochir* (Valenciennes) which 'switches' from seagrass fronds during daylight to emergent benthic crustaceans, mainly amphipods, at night (Robertson and Klumpp, 1983). These authors propose feeds preferentially on small crustaceans when these are available in the water column. The digestive system in hemirhamphids consists of a straight tubular alimentary canal without stomach or appendages (Suyehiro, 1942) and the ratio of gut-to-body length is only 0.5 (Robertson and Klumpp, 1983) which is a typical of a herbivore. Knowledge of dietary habits is essential for studies of nutritional requirements, interactions with other organisms and for its culture (Santos and Borges, 2001). The study of the feeding behavior of marine fish is necessary for fish stock assessment and ecosystem modeling. Some major modules and methods like multi-species virtual population analysis (Sparre,1991; Bulgakova *et al*.,2001) and the ECOPATH II Ecosystem model (Christensen and Pauly, 1992) use the information on the dietary composition of fish. Information on the feeding habits of marine fish, such as the predatory-prey relationship is useful in order to assess the role of marine fish in the ecosystem (Bachok *et al*., 2004).Morever, data on the diet composition are useful in the creation of trophic models as a tool to understand complex coastal ecosystems (Lopez-Peralta and Arcila, 2002). Diet analysis is also necessary to demonstrate the trophic overlap among species within a community . This is essential in determining the intensity of the interspecfic interaction in marine fish communities as well (Morte *et al*., 2001). A wide variety of methods can be used such as measuring the weight or volume of items (gravimetric and volumetric methods, respectively) and counting individual food items (occurrence method, numerical method, various subjective methods such as the points method) . These methods require a visual identification of the prey items and not all are equally useful for all food types. Numerical counts, are not suitable where plants are among the principal food components because plants, unlike most animal prey, are not consumed as individual items. Application of different methods can lead to very different ideas about a species' diet and even the same method applied by different authors can lead to inconsistent results. Furthermore, no one method of stomach analysis gives a complete dietary picture. In fisheries research gut contents are standard tasks and data obtained are the back bone of many models used in fish population The importance of food types in the diet differs depending on the nature of the habitat. Please insert what is planned to investigate?

MATERIALS AND METHODS

Specimens of *H archipelagicus.* were monthly collected from September, 2009 to December, 2009 from Karachi Fish Harbour of Karachi. All specimens were captured during the early morning and early afternoon in a nylon gill net of mesh size 60 mm set. The net was fished for 1 to 2 of 24 to 25 m of water. All captured specimens were immediately preserved in 10% formalin. Fish were taken to the laboratory for processing and stomach content analysis. The preserved specimens were dry before analysis. The total length (in mm) were measured an a measuring board while the weight (in gm) was determined using a blance. The stomach contents were emptied into a petri dish and examine under a binocular microscope. Stomach fullness was categorized as follows: class 0, empty or containing only traces of food; class 1, medium fullness; and class 2, full or nearly full (fully distended stomach). All stomachs were subsequently opened and the contents were washed with 10% formalin into a Petri dish and examined under a binocular microscope. Only stomachs belonging to classes 0 and 2 were used in the study of diet. Because of the progress of digestion, most food ingested had been broken into small fragments and, for this reason, was difficult to identify at the species level. Thus, food items were classified into major categories ranging from the level of phylum to species according to criteria established in a preliminary, short-term laboratory test as follows. They were subsequently fed with only one food item also collected in the same area, i.e. Polychaeta, Bryozoa, Mollusca, Crustacea (Cirripedia, Isopoda, Amphipoda, Macrura, Brachyura), Ascidiacea, Pisces, and Algae. The stomach contents were excerised after 24 h to determine their shape, color and other characteristic after partial digestion.The diet of *H. archipelagicus* was carried out using the frequency of occurrence method and numerical methods.The frequency of occurrence method was calculated for each food item by dividing the number of fishes with stomachs containing the specific food item by the total number of stomachs.

Table 1. Summary of main food categories found in stomach contents of *Hemirhamphus archipelagicus.*

Food category	Observations of fragment
Annelida	
Polychaeta	Jaws, bristle, more rarely body wall and tissues
Mollusca	
Bivalvia	Pieces of shell and tissues
Other mollusca	
Crustacea	
Cirripedia	Pieces of carapace and tissues
Amphipoda	Pieces of carapace, antenna, appendage and tissues
Brachyura	Pieces of carapace, appendage and tissues
Other crustacean	
Pisces	Pieces of fin and scale
Plant materials	Pieces of algae

Frequency of occurrence = 100 x The number of stomach with prey I / The number of stomach with food items

The numerical method was calculated the number of each prey item in all non empty stomachs, expressed as the percentage of total number of food items in all stomach in a simple.

Numerical abundance=100 x The number of prey / The number of all identifiable food.

Prey diversity in the diet, which is a measure of trophic niche breadth (Scrimgeour and Winterbourn, 1987), was calculated using the Shannon Weaver index ($H^/$):

$$H^/ = -\sum pi\ lnpi,$$

Where pi is the proportion of individuals of its prey type (Shannon and Weaver, 1949). This index has adequate sensitivity for detecting changes in species diversity and provides a general indication of the relative magnitude of trophic specialization (Berg, 1979).

Table 2. The number (n), mean Total length (TL) and weight (w) of *Hemirhamphus archipelagicus* by length class.

Length class (mm)	**N**	**Fish Length ±SD mm**	**Fish weight ±SD gm**
145-185	215	165±8.874	14 ±1.659
195-235	118	195±13.60	16±3.6477

Table 3. Variation in empty stomachs by size of *Hemirhamphus archipelagicus* from Karachi coast.

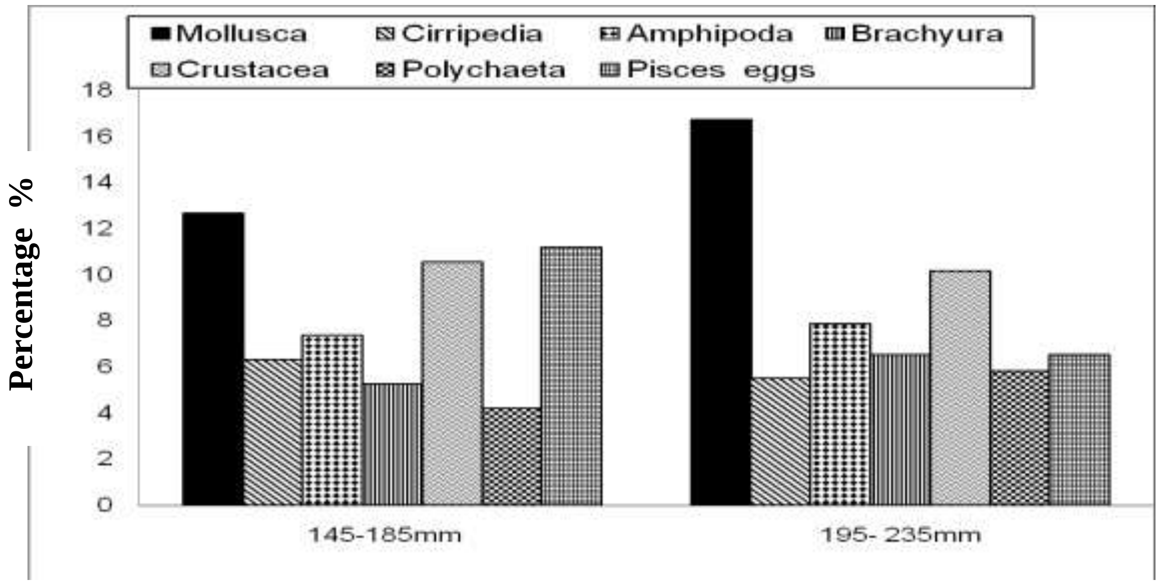
Size / Standard length ‘mm’	**Number examined**	**Number with empty stomach**	**% empty stomach**
145-185	215	115	53.48
195-235	118	33	27.96

Table 4. The stomach contents of *Hemirhamphus archipelagicus.*

Food Items	**Numerical method**		**Occurrence method**	
	Number	**%**	**Number**	**%**
Polychaeta	60	5.17	25	5.31
Mollusca	175	15.08	50	10.63
Bivalvia	140	12.06	45	9.57
Crustacea	120	10.34	60	12.76
Amphipoda	89	7.67	30	6.38
Brachyura	70	6.03	35	7.44
Cirripedia	68	5.86	25	5.31
Pisces eggs	98	8.44	48	10.21
Unidentified animal materials	170	14.65	80	17.02
Unidentified plant materials	60	5.17	32	6.80
Unidentified materials	110	9.48	40	8.51

Table 5. Dietary breadth of *Hemirhamphus archipelagicus* expressed in terms of the Shannon–Weaver index ($H^{/}$) and number of prey items in stomachs of specimens,classified according to sampling season and size group (n, number of digestive tracks).

Size classes of fish	**n**	**Number of prey items**	**$H^{/}$**
145-185mm	215	473	2.274
195-235mm	118	687	2.302



Size range of *Hemirhamphus archipelagicus*

Fig. 1. Stomach contents *Hemirhamphus archipelagicus.*

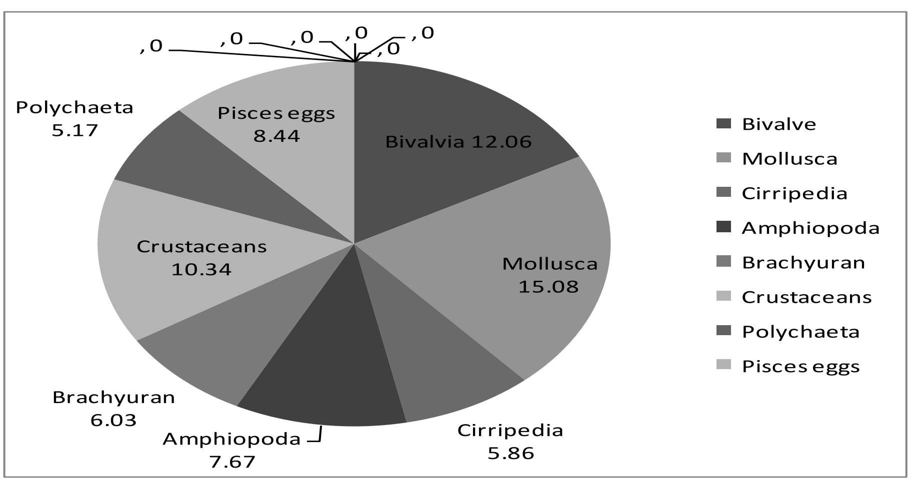


Fig. 2. Percentage of food components of *Hemirhamphus archipelagicus* by Numerical method.

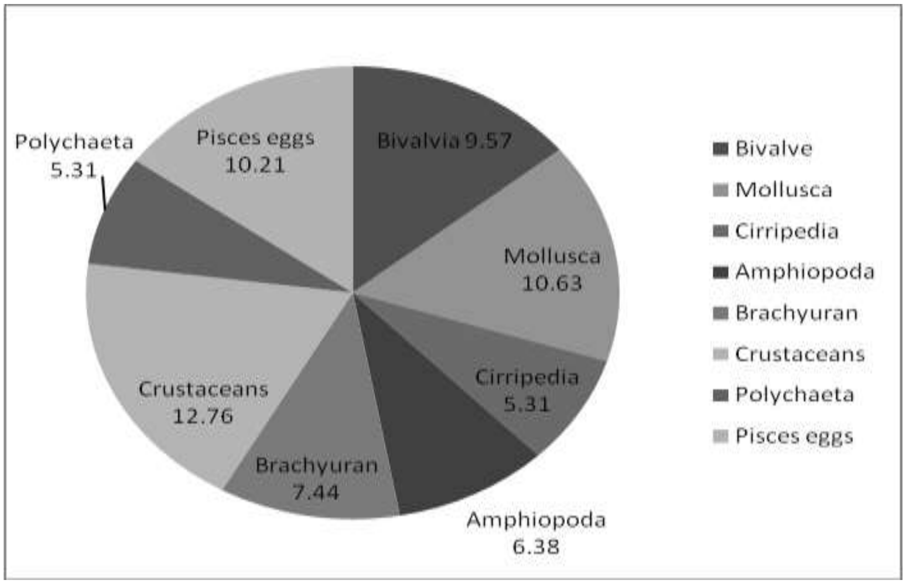


Fig. 3. Percentage of food components of *Hemirhamphus archipelagicus* by Occurrence method.

RESULTS

A total of 333 specimens of *Hemirhamphus archipelagicus* were collected, for which 199 (54.22%) had stomachs within classes 1 and 2 and which contained identifiable contents for analysis. *H. archipelagicus* fishes of two length size classes 165±8.874 and 195±13.60 corresponding to mean weight 14 ±1.659 and 16±3.6477 respectively of which examined , 148 were found to be empty. The number mean length and weight of *H. archipelagicus* samples are given in (Table 2).Stomach contents were classified into 11 categories: Polychaeta , Mollusca, Bivalvia, Crustacea, Amphipoda, Brachyura, Cirripedia, Pisces , Unidentified animal materials , Unidentified plant materials , and Unidentified materials . Mollusca , such as Bivalvia, were recognized from pieces of shell and tissues. Crustacea , such as Amphipoda and Brachyura , were recognized from tissue fragments. Polychaeta , small pisces with eggs. (Table 1). Mollusca are made up of the most important food items by numerical method (15.08%), while Crustaceans formed the most frequently consumed food items by occurrence method (12.76%). Bivalvia constituted 12.06% and 9.57% by numerical and occurrence methods respectively. Pisces eggs constituted 8.44% and 10.21% by numerical and occurrence methods. Amphipoda constituted 7.67% and 6.38% by numerical and occurrence methods respectively while Brachyura constituted 6.03% and 7.44% by numerical and occurrence methods. The least consumed food items in the stomach of *H. archipelagicus* from the Karachi coast were the Cirripedia constituted 5.86% and 5.31% by numerical and occurrence methods and Polychaeta constituted 5.17% and 5.31% by numerical and occurrence methods (Table 4). Mollusca and Bivalvia were the dominant food groups. Crustaceans were the next most important group. Pisces eggs and Amphipoda comprised the most important food item and Brachyura were the next dominant food item. Mollusca were present in higher percentage throughout the year. At that time, the diet consisted chiefly of Bivalvia such as and Crustacea such as Pisces eggs. According to the Shannon wiener Index, prey diversity of the 145- 185mm length class were the lowest ($H^{/ =}$ 2.27, 2.302 for the length classes of 145-185mm and 195- 235mm, respectively).

DISCUSSION

Garfish and half – beaks are presumed to be mid water and surface feeding fish (Lagler *et al* ., 1977) and have been observed taking sea grass leaves which are detatched and floating near the water surface (Carr and Adams, 1973). The relative importance of the main food categories was similar as determined using either the points method or the frequency of occurrence method. Based on the results of these analyses, we conclude that *H. archipelagicus* was able to feed on a wide range of available prey in the intertidal areas, confirming its opportunistic and omnivorous feeding character. Observations suggest that *H.archipelagicus* collected in Karachi coast was predominantly Polychaeta, Mollusca, and Crustacea were the preferred prey items. The ingestion of each food item was probably dependent on their availability in the feeding area, as can be seen in reports of the feeding habits. They also used small bivalves, Amphipoda or Polychaeta and in the diet of *H.archipelagicus* reflect changes in the availability of food 3 indicates that Crustacea) and Mollusca) items were consumed throughout the year. Of these food items, Crustaceans were more important. Some studies reported that fishes preyed differently throughout the year and suggested that this reflected their need to accumulate energy for growth and reproduction. Bivalvia and Crustacea from shallow waters represent an abundant resource to fulfill these needs. Nevertheless, all main food categories did not show any significant seasonal variance. Bivalvia was a frequent dietary component of *H. archipelagicus* , but it is difficult to predict whether *H. archipelagicus* will be able to establish themselves in sufficiently large numbers to pose a threat to the intertidal molluscan fauna. It is interesting to consider the effects of incursion by these invaders with their predator–prey relationship. Some small changes in feeding habits are often superimposed on the more general pattern. For instance insects may become abundant on the water surface at some times during the year and then often taken by *H. archipelagicus* during the day. Natantian and brachyuran larvae are also seasonally abundant in the water column (Robertson and Howard, 1978) . Gut-fullness data suggests that the period of maximum food consumption was during flood tides, irrespective of night or day. Rising tides probably float many detached eelgrass leaves out of eelgrass meadows, and thus make this food source more available to mid-water and surface feeding *H. archipelagicus* during the day. Amphipods rise into the water column on flood tides at night and their numbers decrease on falling tides (Robertson and Howard,1978), thus favouring more intensive feeding during nocturnal rising tides. It Moreover, their omnivorous feeding habits increase the probability of survival and minimize their dependency on a particular food item. In contrast, although *H. archipelagicus* be at a disadvantage in competition for food because of their poor swimming ability, there are few competitors and predators and, conversely, abundant prey species.

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(*Accepted for publication December 2012*)