Feeding habits and stomach contents of Silver Sillago, *Sillago sihama,* in the northern Persian Gulf

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Abstract

The study investigated the stomach content of *Sillago sihama* in Hormuzgan Province waters located in the northern Persian Gulf from October 2009 to March 2010. The stomach analysis was carried out using frequency of occurrence and numeric methods. Diatoms, blue- green algae and dinoflagellates constituted main food of plant origin. Diatoms were found to be the most preferable food of plant origin where it occurred in more than 60.8% of food item by number and 59.5% by occurrence. Crustacean including crabs and their larvae, shrimps, copepods, eggs and larval forms comprised the maximum part of the food of animal origin. It was concluded that *Sillago sihama* in the Coastal waters of Hormuzgan Province is planktonivorous and feeding on a wide range of food of planktonic and benthic organisms.

Keywords: *Sillago sihama*, Feeding, Stomach contents, FP, Persian Gulf

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Introduction

Feeding ecology is an important aspect of the life-history strategy of a species to understand the functional role of the fish within their ecosystems (Blaber, 1997; Cruz-Escalona et al., 2000; Hajisamae et al., 2003; Abdel-Aziz and Gharib, 2007). Without knowledge of the food requirements, feeding behavior pattern, and predator - prey relationships, is not possible to understand the predicted changes that might result from any natural or anthropogenic intervention (Hajisamae et al., 2006). *Sillago sihama* (Family: Sillaginidae), are commercially and recreationally important estuarine and near shore species of the Indo-west Pacific region (Battaglene, 1996).

Numerous researches have been conducted about food and feeding ecology of many fish species and seasonal change in feeding habits: (Hynes, 1950; Hyslop, 1980; Hyndes et al., 1997; Hajisamae et al. (2003, 2004, 2006); Shamsan and Ansari (2008, 2010); Rao and Rao, 2002; Serajuddin and Ali, 2005). In addition Mohammed et al., 2003 and Kuronuma et al., (1972; 1986) have studied about fishes of Kuwait and food habits of *Sillago sihama* in the Persian Gulf.

The aim of this study was to investigate the type of food eaten by *S.sihama*. Such studies could be important in the rational management of this species.

Materials and methods

Fish samples were collected seasonally from artisanal fishermen at several landing sites in each of two regions of the Persian Gulf- Bandar Abbas and Qeshm, during the period October 2009 to March 2010 (Fig. 1).

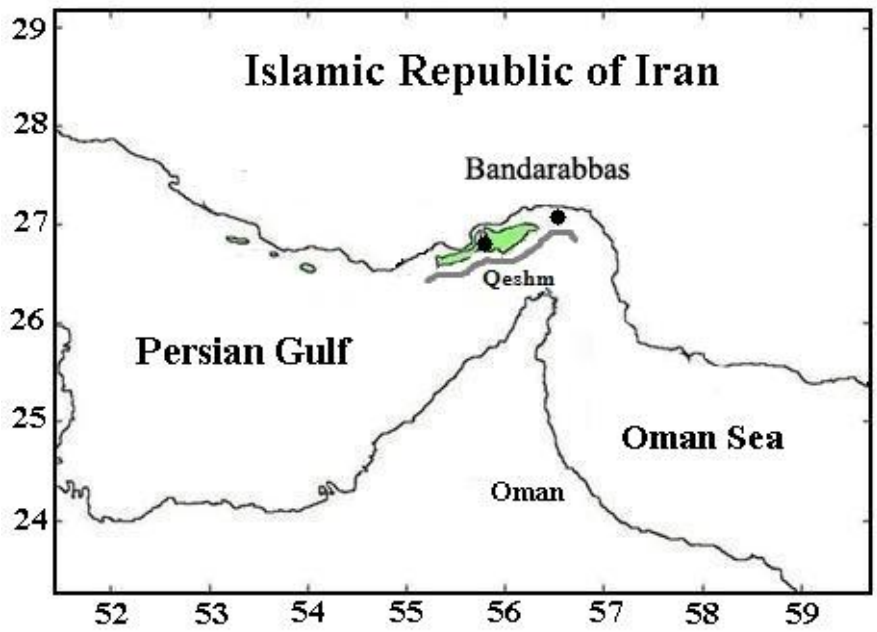

Figure 1: Location of the sampling sites (●) in the Persian Gulf.

The specimens were properly cleaned in the laboratory and total lengths (TL to the nearest cm), weights (W to the nearest g) and degree of stomach fullness were recorded. Fish were classified into three size groups (5.00–10.90, 11.00–16.90 and 17.00–23.90 cm) and the seasonal variations in the mean weight of stomach content calculated.

Specimens were dissected and their stomach removed and preserved in 10% formalin solution and examined under the microscope. The zooplankton and phytoplankton were identified and the number of the individuals was counted.

Analysis was done using frequency of occurrence and numerical methods as described by Hyslop (1980). In the numerical method, the number of each food item was expressed as the percentage of the total number of food items found in the stomach. In the frequency of occurrence method, the occurrence of food items was expressed as the percentage of the total number of stomach containing food. The degree of stomach fullness is divided into 3 classes ranging from empty, semifull to full. Mean relative weight of content was calculated as described by Hyslop (1980) as follow:

$$\text{Mean weight of content} = \frac{\text{Total stomach contents weight}}{\text{Total fish weight}} \times 100$$

Results

In this study, 300 specimens of *Sillago sihama* were examined. The length range for adult males was 15.40-20.90 cm and for females, 5.60-23.70 cm. Bacillariophyceae (diatoms), Cyanophyceae (blue-green algae) and Dinophyceae (dinoflagellata) constitute main food of plant origin. The major food items found in the stomach of *S.sihama* are shown in Table 1. In occurrence method, diatoms were found to be the most preferable food of plant origin where it occurred in more than 59.52% of the examined fish. Copepods and animal derivatives as a groups contribute about 8.86% of the examined fish while molluscs, Blue green algae and foraminifera were the least (1.27%).

Regarding seasonal occurrence of different food items in the stomach of *S. sihama*, Fig. 2 shows that, a high percentage of occurrence of diatoms were recorded during autumn, winter and spring (76.20, 68.40 and 35.71%, respectively), while the highest percentage of dinoflagellates occurred during winter (18.41%). Blue-green algae constituted the highest percentage in spring comprised about 7.14% of the total examined stomachs, While crabs attainted its highest occurrence during summer (66.67%), shrimps was detected during summer season (33.33%), Animal derivatives (eggs, scales, insect and crustaceans appendages, etc.) during autumn season constituting 19.05% of the examined stomachs, foraminifera occurred during winter (2.63%) and nematodes were recorded during spring (7.60%). The rest food of animal origin (molluscs and copepods) attained the highest percent during spring season (Fig. 2).

Table 1: Seasonal composition of food in the stomach of *S.sihama* in the Coastal waters of Hormuzgan Province- northern Persian Gulf

Food categories	Percent composition									
	Spring		Summer		Autumn		Winter		%food items	
	NM (%)	**FO (%)**	**NM (%)**	**FO (%)**	**NM (%)**	**FO (%)**	**NM (%)**	**FO (%)**	**NM (%)**	**FO (%)**
Diatoms										
Surirella sp.	-	-	-	-	0.32	-	6.90	7.89	6.33	3.80
Gyrosigma sp.	-	-	-	-	52.29	38.10	-	-	3.73	10.13
Amphora sp.	1.85	7.14	-	-	5.52	23.81	1.40	2.63	1.70	8.86
Pleurosigma sp.	-	-	-	-	29.22	14.29	-	-	2.09	3.80
Cymbella sp.	-	-	-	-	-	-	1.19	13.16	1.09	6.33
Navicula sp.	-	-	-	-	-	-	28.07	23.68	25.67	11.39
Cerataulina sp.	-	-	-	-	-	-	1.52	2.63	1.40	1.27
Pinularia sp.	-	-	-	-	-	-	0.38	-	0.35	-
Cymatopleura sp.	-	-	-	-	-	-	0.13	2.63	0.11	1.27
Hemidiscus sp.	-	-	-	-	-	-	3.05	2.63	2.79	1.27
Coscinodiscus sp.	44.44	28.57	-	-	-	-	15.84	7.89	15.04	8.86
Rhizosolenia sp.	-	-	-	-	-	-	0.05	2.63	0.05	1.27
Peridinium sp.	-	-	-	-	-	-	0.50	2.63	0.46	1.27
Total	46.29	35.71	-	-	87.35	76.2	59.03	68.4	60.81	59.52
blue green algae										
Oscillatoria sp.	1.85	7.14	-	-	-	-	-	-	0.02	1.27
Dinoflagellata										
Alexanderium sp.	-	-	-	-	-	-	0.02	2.63	0.02	1.27
Polykrikas sp.	-	-	-	-	-	-	2.53	5.26	2.32	2.53
Dinophysis sp.	-	-	-	-	-	-	0.05	-	0.05	-
Prorocentrum sp.	-	-	-	-	-	-	1.50	7.89	1.37	3.80
Pyrocyst sp.	-	-	-	-	-	-	0.50	2.63	0.46	1.27
Total	-	-	-	-	-	-	4.60	18.41	4.22	8.87
bivalves	1.85	7.14	-	-	-	-	-	-	0.02	1.27
Copepods	35.20	28.57	-	-	-	-	35.79	7.89	33.17	8.86
Shrimps	-	-	33.33	33.33	-	-	-	-	0.04	2.53
Crabs	-	-	66.67	66.67	-	-	-	-	0.09	5.06
Nematodes	1.85	7.14	-	-	0.97	4.76	-	-	0.09	2.53
Foraminifera	-	-	-	-	-	-	0.50	2.63	0.46	1.27
Animal derivatives	12.96	14.29	-	-	11.68	19.05	0.05	2.63	1.04	8.86

NM= Numerical method FO= frequency occurrence method

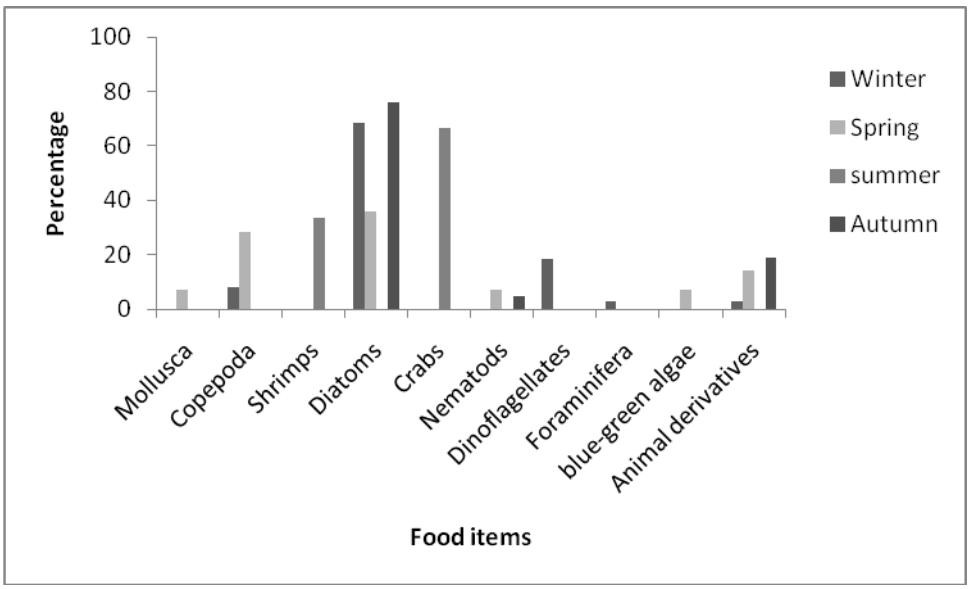

Figure 2: Seasonal occurrence of food items of *S.sihama* in the northern Persian Gulf

In the numerical methods, copepods and diatoms formed the most important diet (33.17 and 60.81%, respectively). Seasonal variation of different food items showed that, diatoms formed the most important food items of plant origin during the three seasons as shown in Fig. 3. Animal derivatives were the preferable food of animal origin during autumn, winter and spring, whereas copepods were the most important animal food origin during winter (35.79%).

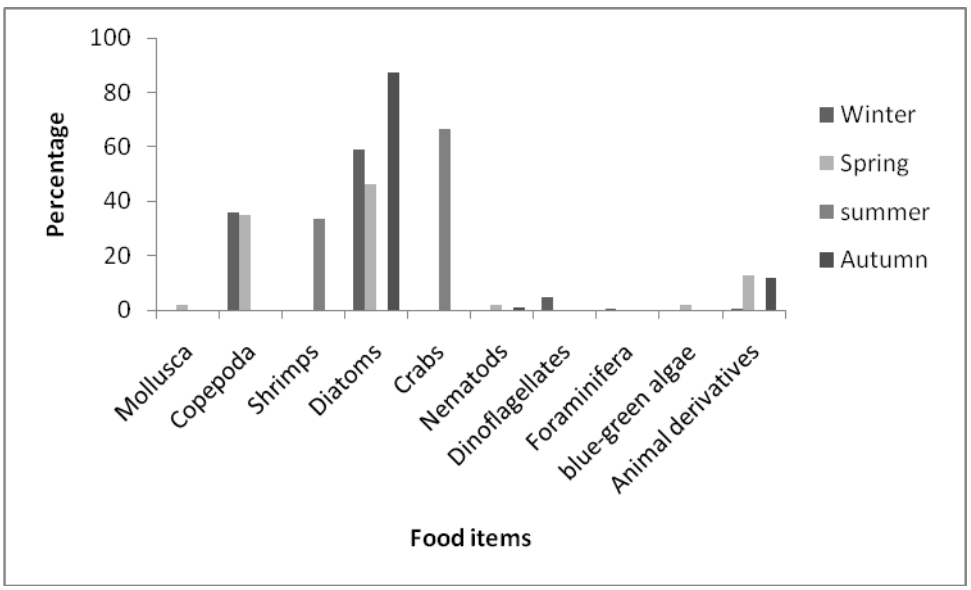

Figure 3: Seasonal percentage of food items of *S.sihama* in the northern Persian Gulf

Generally, results of the two methods of analysis emphasized the importance of plant as a major food resource in the stomach of *S. sihama*.

Regarding the seasonal variation in the feeding intensity as an index of the stomach fullness, it could be stated that, the maximum number of empty stomach was recorded during summer season (53.30%) as shown in Table 2.

The result of the seasonal variations in the mean weight of content in collected fish samples are shown in Table 3.The mean weight of content showed that, winter attained the highest mean weight of content whereas the lowest was recorded during summer.

Table 2: Percentages of seasonal variation in gut fullness of *S.sihama*

State of stomach	Spring	Summer	Autumn	Winter
Full	19.20	23.30	23.90	56.60
Semi-full	53.80	23.30	47.80	16.60
Empty	26.9 0	53.30	28.20	26.60

Table 3: Percentages of Mean weight of content of *S.sihama*

Season	Mean weight of content ± SD
Spring	0.98±31.60
Summer	0.63±22.00
Autumn	0.81±24.60
Winter	1.12±23.80

The stomach contents also varied with size. The *S.sihama* was grouped into three size groups. The smallest size was 5.00–10.90 cm, medium size 11.00–16.90 cm and the largest size was 17.00–23.90 cm in total length. The food items in relation to size are shown in figures 4 and 5. Food items were absent in the stomach of small size groups (5.00–10.90 cm). There were no differences in food habits of the medium and large size groups as copepods, diatoms and dinoflagellates were present in their stomachs, irrespective of size. It was, however, observed that diatoms were the most consumed food item in the medium size groups (11.00–16.90 cm), accounting for 83.30% by occurrence and 94.7% by number, while it accounted for 40.5% by occurrence and 39.90% by number in large size group (17.00–23.90 cm).

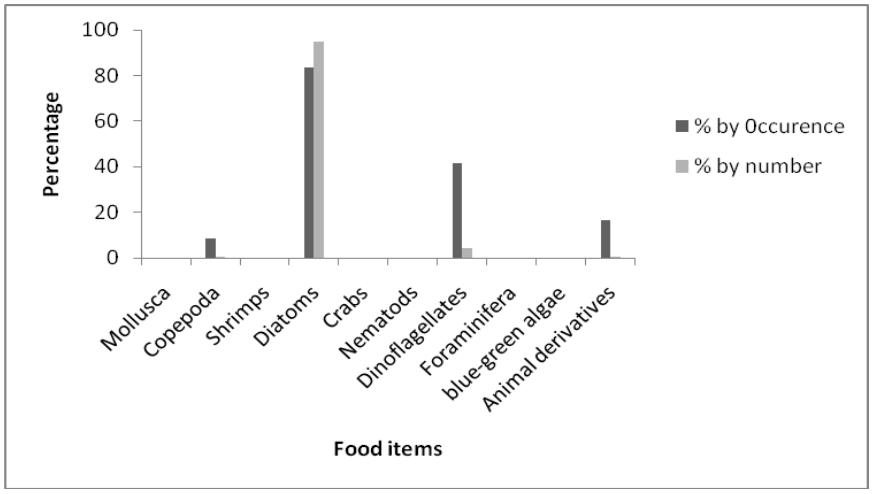

Figure 4: Food items in medium sized (11.00–16.90 cm) *S. sihama*

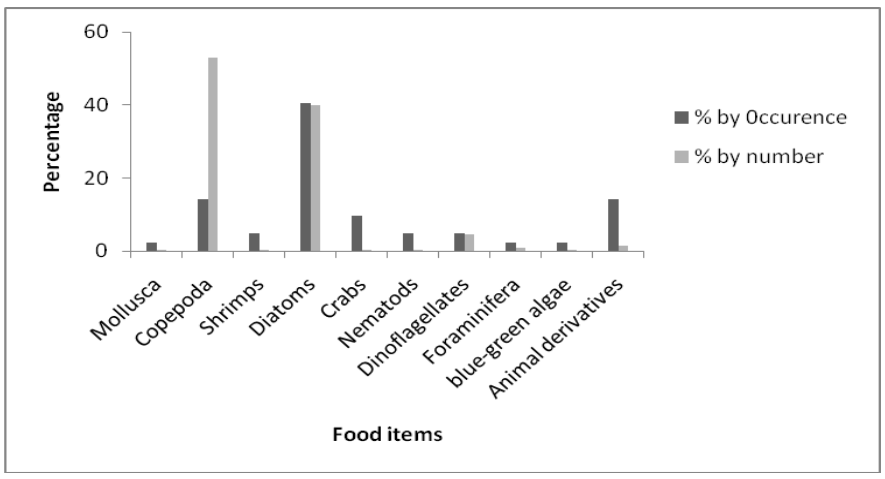

Figure 5: Food items in large sized (17.00–23.90 cm) *S. sihama*

Discussion

In the current study, the feeding activity of the *Sillago sihama* in the northern Persian Gulf was strongly reduced during the summer months. The maximum number of empty stomach was recorded during summer (53.30%).The feeding activity of *S. sihama* fluctuated with season (Shamsan and Ansari, 2008). the abdominal cavity is fully occupied by the ripe gonads and so stomachs were always empty during summer (Kariman et al., 2009). In accordance with a previous study (Shamsan and Ansari, 2008) in the warm months, there seemed to be a decrease in the feeding activity, probably due to an increased spawning activity by these fish.

Also, it has been registered similar patterns in the feeding activity and spawning activity of this species (Gowda et al., 1988; Jayasankar, 1991; Reddy and Neelakantaan, 1991). Analysis of stomach contents of *S.sihama* during the study showed the presence of 3 groups of blue green algae, dinoflagellata and diatoms were the most preferable food of plant origin where it occurred in more than 59.52% of the examined fish. Crustacean including crabs and their larvae, shrimps, copepods, eggs and larval forms comprised the maximum part of the food of animal origin in *S. sihama*. The study of Shamsan and Ansari (2008) pointed out that the crustaceans are the most important food item than any food items in the stomach of *S. sihama* in Zuari Estuary of India. This is in agreement with findings by Gowda et al. (1988) in *S. sihama*. To lesser extents molluscs, nematods, and other organisms (miscellaneous) also occurred in the stomach of *S. sihama*. Copepods and crabs were dominant in spring and summer, respectively. This is perhaps due to the abundant of copepods and crabs during this period.

It is important to emphasize that the effect of seasonality should always be considered in the studies on feeding of fish, because the temporal changes of biotic and a biotic factors alters the structure of the food web along the year and, as a consequence, the fish often shows seasonal diet shifts (Kariman et al., 2009). In our study, *S. sihama* can be classified as planktonivorous, feeding on a wide range of food of planktonic and benthic organisms. The omnivores feeding habit of *S. sihama* have been reported by Radhakrishnan (1957) and Gowda et al. (1988), because of the occurrence phytoplankton in the stomach which agrees with the present study. While According to Shamsan and Ansari (2008), Gunn and milward (1985), Mohammed et al. (2003), Hajisamae et al. (2006), Weerts et al. (1997) and Reddy (1991), studying the food and feeding habit of *S. sihama* classified the fish as carnivorous. Contradictory results in feeding habits may be caused by either the life history pattern of food organisms or the feeding activity of the fishes themselves.

Analysis of stomach contents of *S. sihama* in this study showed good relation with the ambient plankton where most species found in the stomach of this fish were previously recorded. Results of the two methods of analysis emphasized the importance of plant as a major food resource in the stomach of *S. sihama*, which is inconsistent with the study of Shamsan and Ansari (2008). The recorded seasonal variations in the mean weight of content in collected fish samples revealed that, winter attained the highest mean weight of content while the lowest value was observed during summer. These results coincide with that of variation in stomach fullness in this study. Changes in mean weight of stomach contents through the year indicate differences in feeding intensity (Man and Hodgkiss, 1977; Kariman et al., 2009) that have accordance with our research in the coastal waters of Hormuzgan Province. Dominant of planktonic food is replaced by benthic food items in large size groups (copepods, crabs, shrimps, molluscs, nematods and animal derivatives), and is consistent with

the study of Shamsan and Ansari (2008) who showed that *Sillago sihama* is planktonivorous.

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