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Feeding habits of Yellowfin Seabream (*Acanthopagrus latus*) in the northern region of the Persian Gulf

I. Sourinejad[1]*, S. Nikkhah Khaje Ataei[1], E. Kamrani[1], M. Ghodrati Shojaei[2]

1-Dept. of Fisheries, Faculty of Marine and Atmospheric Sciences and Technologies, University of Hormozgan, Bandar Abbas, Iran
2-Dept. of Marine Biology, Faculty of Marine Sciences, University of Tarbiat Modares, Noor, Iran

** Corresponding author's E-mail: sourinejad@hormozgan.ac.ir*

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ABSTRACT

Feeding habits of Yellowfin Seabream (*Acanthopagrus latus*) was investigated in coastal waters of the Northern Persian Gulf. This investigation was conducted by monthly sampling of thirty fish from September 2011 through August 2012. Fish size ranged from 17.98 ± 2.07 to 32.31 ± 6.52 cm in total length and from 134.01 ± 45.62 to 720.46 ± 292.58 g in weight. The highest value of gastro-somatic index was obtained in September (5.22 ± 0.04) and the lowest in December (1.61 ± 0.03) with annual average of 2.50 ± 0.60. The result of gastro-somatic index revealed that the highest feeding activity of *A. latus* was during autumn. The highest level of vacuity index was observed in summer (34.95 ± 4.71) and the lowest in autumn (25.88 ± 2.71) indicating that the highest number of empty stomachs was in summer. Annual average of vacuity index was 30.14 ± 5.72 exhibiting that A. latus was comparatively gluttonous in the Northern Persian Gulf. Bivalves and shrimps were the major food items found in the stomach of *A. latus* showing food preference indices of 45.86% and 30.67%, respectively. Other food items included crabs (12.66%), aquatic plants (4.05%), animal derivatives (4.52%) and gastropods (2.23%). According to the results, animal derivatives, aquatic plants and gastropods were eaten accidentally and were not the food items of A. latus in coastal waters of Hormozgan. The average relative length of gut was 1.41 ± 0.15 showing that *A. latus* was omnivorous in this region.

Keywords: *Acanthopagrus latus*, Feeding habits, Gastro-somatic index, Persian Gulf

INTRODUCTION

The quality and quantity of food directly affect fish growth while indirectly affect its maturation and mortality (Wootton, 1990). Studies on feeding habits give information on the quality and quantity of food consumed by fish. Observations on fish prey preferences and feeding habits are mainly based on analyses of stomach contents. Stomach contents analysis can yield incidental but immediately valuable information since predators are often better sampling devices than most commercial fishing gears. Feeding habits studies of fish are helpful in identifying some of the higher-level trophic relations in an ecosystem and are required for estimating fish production (Pauly and Christensen, 2000). In addition, knowledge of the feeding behavior of marine fishes is essential for fish stock assessment, ecosystem modeling and to assess the role of marine fishes within ecosystem (Salavatian *et al.*, 2011). Diet composition data also play a key role for the research on resource partitioning and within and between-species competition (Harmelin-Vivien et al., 1989), prey selection (Stergiou and Fourtouni, 1991), predator-prey size relationships (Scharf *et al.*, 2000), distribution of feeding habits with latitude (Pauly, 2000) and habitat selection (Labropoulou *et al.*, 1999). Yellowfin Seabream (*Acanthopagrus latus*) is a commercially and ecologically important species that is widely distributed throughout the Indo-West Pacific region (Xia *et al.*, 2008). Like many other sparids, this fish is a protandrous hermaphrodite and usually inhabits relatively a wide

biogeographic range but is specially found in warm shallow and coastal waters, often entering river mouths and estuaries (Li and Ou, 2000; Xia et al., 2008). Various studies have been carried out about feeding habits of fish species. However, there is no considerable published information regarding feeding habits of marine fishes from the Northern Persian Gulf. Among the Persian Gulf fishes in Iranian waters, investigation of feeding habit of *Platycephalus indicus* (Hashemi and Taghavi Motlagh, 2013), *Saurida tumbil* (Vahabnezhad *et al.,* 2013), *Chirocentrus nudus* (Khodadadi *et al.,* 2012), *Argyrosomus hololepidotus* (Shekari and Hashemi, 2012), *Sillago sihama* (Taghavi Motlagh *et al.,* 2012), Sawtooth Barracuda, *Sphyraena putnamae* (Mohammadizadeh *et al.,* 2010) and *Epinephelus coioides* (Mohammadi *et al.,* 2007) are the most recent ones. The present study was, therefore, carried out to gain knowledge of the feeding habits and natural diet composition of Yellowfin Seabream (*Acanthopagrus latus*) in the Iranian waters of the Persian Gulf at Hormozgan Province. In terms of management, such studies are essential for evaluating the ecological role of the Yellowfin Seabream as well as understanding its position in the Persian Gulf food chains. The results also aimed at understanding the biology of predator and prey species as well as their usefulness for stock analyses. The findings can also be applied in aquaculture development.

MATERIALS AND METHODS

Sampling and biometry

Fish specimens were collected monthly from September 2011 through August 2012. Thirty fish per month were randomly sampled from Bandar Abbas landing sites in northern part of the Persian Gulf (Fig. 1).

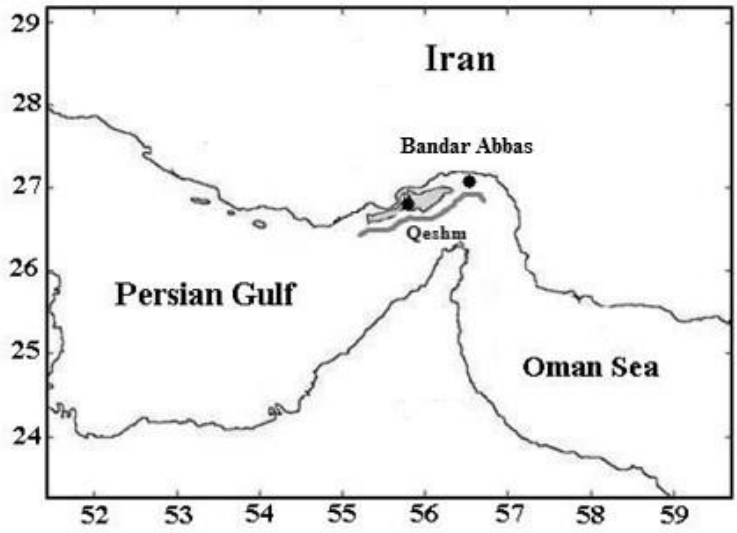

Fig 1. Location of sample collection of *A. latus* in the Persian Gulf.

Totally, 360 fish were sampled and then assessed biometrically. The total length and the fork length of the sampled fish were measured to the nearest 0.1 cm and the total weights to the nearest 0.1 g.

Gastro-Somatic Index (GaSI)

The specimens were properly cleaned in the laboratory, dissected and the stomachs were removed. The total weight of the stomach with its contents was measured to the nearest 0.01 g. GaSi, based on monthly and seasonal calculation was obtained as described by Biswas (1993): GaSI= (Total weight of stomach/Body weight) × 100.

Vacuity Index (VI)

Vacuity Index or the stomach emptiness index determines the amount of the fish appetite for food and was calculated using the following equation (Euzen, 1987):

VI= (The number of empty stomachs/total number of the stomachs examined) × 100.

The interpretation of the obtained VI is determined under the following conditions (Euzen, 1987). If, 0≤VI<20, the logical conclusion is that the fish is gluttonous, 20≤VI<40, the fish is comparatively gluttonous, 40≤VI<60, fish is middle alimentary, 60≤VI<80, fish is comparatively hypoalimentative, 80≤VI<100, fish is hypoalimentative.

Food Preference index (FP)

After dissecting the stomachs, all the food items in them were identified. To analyze the composition of the stomach and determine the food preference index, percentage frequency of occurrence was obtained through the following equation described by Chrisfi *et al.*, 2007:

FP= (number of stomachs with a specific food item/the number of non empty stomachs) × 100.

The different values of this index, allow separation of the prey items into three categories: If FP >50%, the prey eaten is dominant and the main diet. If 50%> FP >10%, the prey eaten is secondary and occur mainly if there is a lack of dominant prey. If F<10%, the prey is eaten accidentally and not the food of predator at all (Euzen, 1987).

Relative Length of Gut (RLG)

Relative length of gut was measured to the nearest 0.1 cm as described by Euzen (1987) through the following equation:

RLG= Length of gut/total body length

If the amount of RLG is less than 1, the fish is carnivorous and if it is more than 1, the species tends to be herbivorous and the medium values indicate that they are omnivorous species.

RESULTS

In this study, 360 specimens of *A. latus* were examined. According to the results, fish size ranged from 17.98 ± 2.07 cm (in September) to 32.31 ± 6.52 cm (in January) in total length and from 134.01 ± 45.62 g (in September) to 720.46 ± 292.58 g (in January) in weight (Table 1).

Table 1. Biometric results of *A. latus* specimens in the Persian Gulf from September 2011 through August 2012 (Mean ± SD) (N = 360).

Month	Total length (cm)	Total weight (g)	Month	Total length (cm)	Total weight (g)
September	17.98 ± 2.07	134.01 ± 45.62	March	31.00 ± 2.90	603.13 ± 138.53
October	25.94 ± 4.85	361.94 ± 157.76	April	27.49 ± 5.18	407.54 ± 221.15
November	22.21 ± 6.17	263.67 ± 200.23	May	25.14 ± 3.59	304.49 ± 118.85
December	30.40 ± 4.72	608.25 ± 270.02	June	26.26 ± 5.69	398.81 ± 250.68
January	32.31 ± 6.52	720.46 ± 292.58	July	26.45 ± 2.17	377.63 ± 75.35
February	30.23 ± 3.32	510.54 ± 169.55	August	21.08 ± 2.06	232.23 ± 65.32

Table 2. The average GaSI in examined A. latus from September 2011 through August 2012 (N = 360).

Season	**autumn**			**winter**			**spring**			**summer**		
GaSI	3.70 ± 1.36			2.32 ± 0.74			2.13 ± 0.30			1.88 ± 0.02		
Month	September	October	November	December	January	February	March	April	May	June	July	August
GaSI	5.22 ± 0.04	2.60 ± 0.29	3.30 ± 0.18	1.61 ± 0.03	2.26 ± 0.03	3.09 ± 0.03	1.87 ± 0.04	2.05 ± 0.04	2.47 ± 0.04	1.90 ± 0.36	1.88 ± 0.02	1.85 ± 0.04

Table 3. The average vacuity index in examined A. latus from September 2011 through August 2012 (N = 360)

Season	**autumn**			**winter**			**spring**			**summer**		
VI	25.88 ± 2.71			28.63 ± 8.54			31.11 ± 6.93			34.95 ± 4.71		
Month	September	October	November	December	January	February	March	April	May	June	July	August
VI	28.12	22.85	26.66	25.80	38.23	21.87	33.33	23.33	36.66	35.48	30.00	39.39

Table 4. The average FP index in examined A. latus from September 2011 through August 2012 (N = 360).

Prey / **season**	**bivalves**	**shrimps**	**crabs**	**Aquatic plants**	**Animal derivatives**	**Gastropods**
autumn	48.48	31.81	10.72	-	8.99	-
winter	37.70	31.14	12.31	9.75	9.10	-
spring	49.05	32.96	11.54	6.45	-	-
summer	48.21	26.78	16.07	-	-	8.94

GaSI values are presented in Table 2. This index had the highest value in September (5.22 ± 0.04) and the lowest in December (1.61 ± 0.03). The maximum value of GaSI was found in autumn and its minimu sumer. The annual average of GaSI was 2.50 ± 0.60.
Table 3 contains the results of VI. The annual average of this index was 30.14 ± 5.72. The highest level of VI was observed in August (39.39) and summer (34.95 ± 4.71). The lowest level of VI was found in autumn (25.88 ± 2.71). According to the results of food preference index, bivalves and shrimps were the major food items found in the stomach of *A. latus*. The FP index (%) was 45.86 for bivalves and 30.67 for shrimps in the whole period. Other food items included crabs (12.66%), aquatic plants (4.05%), animal derivatives (4.52%) and gastropods (2.23%).
Seasonal occurrence of different food items in the stomach of *A. latus* is shown in Table 4. High percentage occurrence of bivalves was recorded during all seasons i.e. autumn, winter, spring and summer (48.48%, 37.70%, 49.05% and 48.21%, respectively). Animal derivatives (eggs, scales, insect and crustaceans appendages, etc.) in the stomach in autumn and winter constituted 8.99% and 9.10%, of the food items respectively. Aquatic plants also constituted 9.75% and 6.45% of the food items in winter and spring, respectively. The average relative length of gut was 1.41 ± 0.15 indicating that *A. latus* exhibits omnivorous feeding behavior in coastal waters of Hormozgan in the Persian Gulf.

DISCUSSION

According to the results, the maximum value of gastrosomatic index was found in autumn and the minimum in summer. Gastrosomatic index in autumn was higher than the annual average while was lower than the annual average in summer. Calculation of gastrosomatic index is a useful and efficient way of comparing the status of food consumption. The present results showed that the heaviest stomachs and subsequently, the highest feeding activity of *A. latus* occur in autumn. The results also showed that the feeding activity is reduced during the summer. Vacuity index estimates the veracity of the predator fish. The higher the voracity of fish species, the lower the percentage of empty stomachs. The annual average of vacuity index was found to be 30.14 ± 5.72. Since this value is between 20 and 40, So *A. latus* is classified as comparatively gluttonous in coastal waters of Hormozgan, North Persian Gulf (Euzen, 1987). The highest level of vacuity index and also, the maximum numbers of empty stomachs were observed in summer, while the minimum in autumn. Changes in the number of empty and full stomachs during the year indicate differences in feeding intensity. Feeding intensity is negatively related to the percentage of empty stomachs (Shalloof and Khalifa, 2009). In the present study, the highest feeding intensity and also the lowest percentage of empty stomachs were found in autumn. However, the results of GaSI and VI both indicate that the highest feeding activity of *A. latus* occur in autumn. Cabral and Murta (2002) and Santic *et al.* (2005) have stated that feeding intensity through the analysis of empty stomachs is well correlated with seasons. Feeding intensity in fish is synchronized with their spawning seasons (Dadzie *et al.,* 2000; Salavatian *et al.,* 2011). Most aquatic animals generally do not feed during the reproductive season, or their feeding habits are greatly decreased. The fact indicates that there is a close relationship between the reproductive season and feeding activity. Available reports suggest that the higher occurrence of empty stomachs during the spawning season of fishes is due to the decreased feeding activity since the mature gonads take up more space in the peritoneal cavity, compressing the stomach and making feeding more difficult (Dadzie *et al.,* 2000).
This study also revealed that feeding activity is at its peak before the spawning season. Furthermore, the stomachs were found to be less empty in autumn which could be related to the increased feeding activity to meet the demand for more energy in spawning season. This fact notes that the feeding habit in *A. latus* has a close relation with its reproduction. Spawning of *A. latus* in the Persian Gulf takes place from January through March with spawning peak in March (Nikkhah Khaje Ataei *et al.,* 2013). Gonadosomatic index in this species begins to increase gradually from September through February and then reaches strikingly to its peak in March. It can be concluded that the feeding activity increases during the early stages of maturity to provide the energy for final maturation and spawning. Hence, feeding decreases in spawning season. This result is in line with those of some other marine species including *Pampus argenteus* and *Sillago sihama*

(Dadzie *et al.,* 2000; Shalloof and Khalifa, 2009). In silver pomfret (*Pampus argenteus*), feeding was intensive during the early stages of maturity and decreased as the gonads mature (Dadzie *et al.,* 2000). In Indian waters, Pati (1980) stated that in mature fish of silver pomfret, the space inside the body cavity was reduced because of the growth of the reproductive organs pushing the digestive tract toward the dorsal side. On *Sillago sihama*, the abdominal cavity was fully occupied by the ripe gonads in summer and led to empty stomachs (Shalloof and Khalifa, 2009; Taghavi Motlagh *et al.,* 2012).

Feeding intensity decreases during the winter months when the temperature drops. This assumption broadly agrees with the thermophilous fish growth model from seas of medium geographic latitudes with lowest growth rate in winter and higher spawning rates in summer. This is due either to a temperature-dependent physiological process (Santic *et al.,* 2005), a strong temperature-dependent regulation of food intake (Temming and Hermann, 2001), or lesser abundance of prey and the lowered metabolism, which probably reduce predation during the winter (Santic *et al.,* 2005). In contrast, the monthly variations in GaSI and VI revealed a low feeding intensity during high temperature season (summer) and a higher feeding intensity during the period of low temperature (autumn and winter). These findings strengthen the evidence that in the Persian Gulf, feeding intensity in *A. latus* is likely related to the reproductive cycle rather than the seasonal climatic changes. Based on the results of VI, some of the stomachs were empty. Euzen (1987) reported similar observations in Epinephelus tauvina in Kuwaiti waters. Mohammadi *et al.* (2007) also made similar observation in *Epinephelus coioides* in the Persian Gulf. Empty stomachs maybe either related to regurgitation of prey during coming to surface or rapid digestion of food that takes place in the tropical waters as the metabolic rate is high (Kalita and Jayabalan, 2000). Considering the results of FP, the annual average of food preference index (%) was obtained 45.86 for bivalves, 30.67 for shrimps and 12.66 for crabs. According to Euzen (1987), since these values of FP are between 10 and 50, bivalves, shrimps and crabs are the secondary food items of *A. latus* in coastal waters of Hormozgan. However, in comparison to other preys, bivalves and shrimps were the major food items found in the stomach. Animal derivatives, aquatic plants and gastropods also occurred with FP indices of lower than 10, revealing that these items are eaten accidentally and not the food items of this predator. Nasir (2000) reported that bivalves, crabs, shrimps, amphipods, aquatic plants and aquatic insects were the food items in the stomach of *A. latus* in Khor Al-Zubair in the Northwestern Persian Gulf. The diet of most fishes will change based on a number of factors, either intrinsic (e.g. size, behavior, taxonomy) or extrinsic (e.g. biotope, region) (Pauly *et al.,* 1998). However, the food preference of predatory fishes is very complex and is influenced by many factors. The age of fish, prey accessibility and mobility, prey abundance, prey energy content, prey size selection and seasonal changes are among these factors (Stergiou and Fourtouni, 1991). It seems that the mollusks and crustaceans are available enough to *A. latus* in Hormozgan waters to constitute the most important preys of this species. Based on the seasonal analysis of stomach contents, benthic organisms including bivalves, shrimps and crabs composed the major food items in all seasons. Some small differences were observed in stomach contents in different seasons. Animal derivatives were only found in autumn and winter, aquatic plants in winter and spring and also gastropods in summer. Noteworthy, the effect of seasonality should always be considered in the studies on feeding of fish, because the temporal changes of biotic and abiotic factors alter the structure of the food chain along the year; consequently, fish often shows seasonal diet shifts (Shalloof and Khalifa, 2009). Seasonal fluctuations in diet composition of fishes elsewhere have been attributed to the influence of the monsoons, when peak occurrences of certain food organisms are observed (Pati, 1980) and seasonal fluctuations in water temperature when food organisms peak in summer and reach a minimum in winter (Dadzie *et al.,* 2000; Santic *et al.,* 2005). In this study, the average relative length of gut in *A. latus* was measured to be 1.41 ± 0.15. Since this value is not less than 1 and also, not much greater than 1, *A. latus* could be considered omnivorous. Furthermore, the presence of food items in the stomach with both animal (bivalves, shrimps and crabs) and plant origins (aquatic plants) may confirm this inference. In conclusion, this research

revealed that the highest feeding activity of *A. latus* occurs in autumn in coastal waters of Hormozgan. The fish is comparatively gluttonous and bivalves and shrimps are the major food itemfound in the stomach of this omnivorous species at least in this region.

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عادات غذایی ماهی شانک زرد باله (*Acanthopagrus latus*) در ناحیه شمالی خلیج فارس

الف. سوری نژاد[1*]، ش. نیکخواه خواجه عطایی[1]، الف. کامرانی[1]، م. قدرتی شجاعی[2]

۱- گروه شیلات، دانشکده علوم و فنون دریایی و جوی، دانشگاه هرمزگان، بندر عباس، ایران
۲- گروه زیست شناسی دریا، دانشکده علوم دریایی، دانشگاه تربیت مدرس، نور، ایران

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چکیده

عادات تغذیه ای ماهی شانک زرد باله (*Acanthopagrus latus*) در آب های ساحلی ناحیه شمالی خلیج فارس مورد بررسی قرار گرفت. این پژوهش با نمونه برداری ماهانه ۳۰ قطعه ماهی از مهر ماه ۱۳۹۰ تا شهریور ماه ۱۳۹۱ انجام شد. طول کل ماهیان از ۲/۰۷ ±۱۷/۹۸ تا ۶/۵۲ ±۳۲/۳۱ سانتیمتر و وزن ماهیان از ۴۵/۶۲ ±۱۳۴/۰۱ تا ۲۹۲/۵۸ ±۷۲۰/۴۶ گرم متغیر بود. بیشترین مقدار شاخص گاستروسوماتیک در ماه مهر (۰/۰۴ ±۵/۲۲) و کمترین مقدار در ماه دی (۰/۰۳ ±۱/۶۱) با میانگین سالانه (۰/۶۰ ±۲/۵۰) به دست آمد. نتایج شاخص گاستروسوماتیک نشان داد که بیشترین فعالیت تغذیه ای ماهی شانک زرد باله در فصل پاییز می‌باشد. بیشترین مقدار شاخص خالی بودن معده در تابستان (۴/۷۱ ±۳۴/۹۵) و کمترین در پاییز (۲/۷۱ ±۲۵/۸۸) مشاهده شد که مبین بیشترین تعداد معده های خالی در تابستان است. مقدار میانگین سالانه شاخص خالی بودن معده ۵/۷۲ ± ۳۰/۱۴ به دست آمد که نشان می دهد این ماهی در ناحیه شمالی خلیج فارس در گروه آبزیان نسبتاً پرخور قرار می گیرد. دوکفه ای ها و میگوها مواد غذای اصلی یافت شده در معده ماهی شانک زرد باله با شاخص ترجیح غذایی به ترتیب ۴۵/۸۶ درصد و ۳۰/۶۷ درصد بودند. دیگر مواد غذایی شامل خرچنگ ها (۱۲/۶۶ درصد)، گیاهان آبزی (۴/۰۵ درصد)، بقایای جانوران (۴/۵۲ درصد) و شکم پایان (۲/۲۳ درصد) بودند. بر اساس نتایج، بقایای جانوران، گیاهان آبزی و شکم پایان غذای تصادفی بوده و غذای اصلی ماهی شانک زرد باله در آب های ساحلی هرمزگان محسوب نمی شوند. میانگین شاخص طول نسبی روده ۰/۱۵ ± ۱/۴۱ محاسبه شد که نشان می دهد ماهی شانک زرد باله در این منطقه همه چیزخوار است.

*مولف مسئول