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The Food Habit of *Epinephelus coioides* (Hamilton, 1822) in Khuzestan Coastal Waters (Persian Gulf)

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Abstract: During January 2000 to March 2001, a large number of *Epinephelus coioides* species was captured in main fishing areas of Khuzestan province namely, Busafe-Liphe and Bahrakan, North of Persian Gulf. The stomach contents of 394 individuals were analysed, in which 226 individuals had contained (trace-full) stomachs while 168 individuals had empty stomachs. The percentages of CV in males were more than in females. Seventy three percent of stomachs contained fish 11% crab; 8.8% shrimp; 3.9% squid; 1.7% gastropod and 0.4% bivalves. The intensity of feeding in monthly sampling periods and length groups did not show a clear trend. The results of Fp index showed 73% for fish; crab 11%; shrimp 8.8%; squid 3.9%; gastropod 1.7 and 0.4% for bivalvia. Similar pattern of feeding was observed using CN index. The main food items for *E. coioides* were fish followed by crabs and accidental food items were shrimp, squid, gastropods and bivalvia.

Key words: *Epinephelus coioides*, feeding, Persian Gulf

INTRODUCTION

According to Smith and Heemstra (1986) about 320 species of serranidae belonging to 48 genuses have been identified around the world. These species are mostly demersal and live in coral reefs and rocky substrates. *E. coioides* (Fig. 1) is dominant species of groupers in Persian Gulf and mainly is captured by the trap which is named locally Gargoor (Parsamanesh *et al*., 2000). In Khuzestan coastal waters total catch of groupers was 1417.789 tones/year in 2005 (Mohammadi *et al*., 2007).

Serranidae species are among the expensive fishes in Khuzestan province (South of Iran) (Anonymous, 2007) and cost about 6 US $/kg and in Hong kong ranging between 12 to 41 US $/kg (http://www.fmo. Org.hk/indexeng.html.).

In recent years in which more attention have been paid to its culture in Asian southeast countries because of its economical importance (Chen, 1979; Chae and Lim, 1991; Tucker, 1992; Baliao *et al*., 2000; Chan, 2000; Sadovy, 2000; Seng, 2000). The present study aim was food habit determination of *E. coioides*. Because of its important role in economy of Khuzestan fishery and also in Persian Gulf region countries this fish is a target species for marine culture. Previous studies on the biology and culture of groupers from Persian Gulf are those of Abdollah and Hussain (1975), Al-Hossaini (1996), Hossain and Higuchi (1980) in Kuwait waters and Dehghani and kamali (1996), Yazdi Pur and Mohammadi (2000) and Abbasi and Orian (2001) in Iran waters.

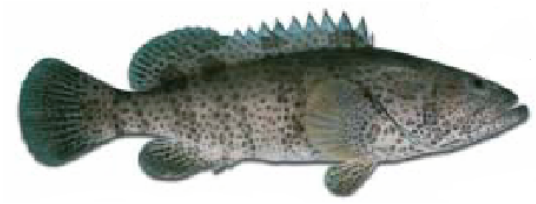

Fig. 1: *Epinephelus coioides* (Hamilton, 1822)

MATERIALS AND METHODS

The main fishing areas of *E. coioides* the north Persian Gulf are located in Busafe-Liphe and Bahrekan between 29° 44' to 07 ' N and 48° 45' to 49° 50' (Fig. 2).

Monthly water samples for analysis of environmental parameters (pH, salinity, temperature and dissolved oxygen) were collected from each station using a Nansen bottle sampler and analysed as per standard analytical

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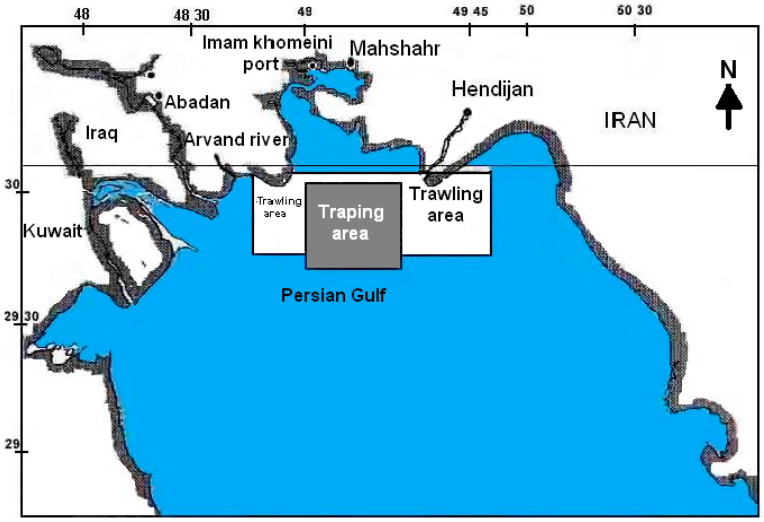

Fig. 2: Map showing study area

procedures (Clesceri *et al*., 1989). A total number of 394 individuals of *E. coioides* were captured during 2000 to 2001 using bottom trawl and Gargoor trap, transferred in icebox to the laboratory. In the laboratory, the total length, standard length, body weight and stomach content weight were measured. In Khuzestan coastal waters high fishing effort is during February and March in which climatic seasonal changes (cold to warm) is done was repeated during above mentioned months in 2001.

The qualitative and quantitative analysis of stomach contents were done and intensity of feeding (Hynes, 1950; Pillay, 1952; Somasekharan Nair, 1980) vacuity index (EuzeNi, 1987), Prey occurrence index (Euzen, 1987) were calculated. Calculations of different indices were as follows:

Vacuity index: The index of vacuity or index of emptiness (called the vacuity index CV); it is the percentage ratio between the number of empty stomachs (ES) and the total number of stomachs analysed (TS).

$$CV = ES \times 100/TS$$

This index gives an estimate of the voracity of the predator fish; the more voracious fish species, the lower percentage of empty stomachs. Because of possible regurgitation of prey that may produce more empty stomachs in samples than in population this index may not be very robust Therefore, some other indices were also used.

The intensity of feeding: The intensity of feeding was determined based on the degree of distention of stomach wall and amount of contained food in it and classified as gorged, full, 3/4full, 1/2full, 1/4full, trace and empty.

Prey occurrence index: The percentage frequency of occurrence of one prey item j, the prey occurrence index, Fp. This is the ratio of the number of stomachs containing the pry item j (Nsj) and number of stomachs that contained food (NS.),

$$Fp = Nsj \times 100/Ns$$

The different values of this index allow separation of the prey items into three categories:

- If F>50% the prey are dominant and characteristic of the predator diet.
- If 50%>F>10% the prey eaten are secondary and occur mainly if there is a lack of dominican prey.
- If F<10%, the prey are eaten accidentally.

Numerical diet composition index: Cn is the percentage ratio between the number of prey j (nj) and the total number of prey Np. Cn is called the numerical diet composition index:

$$Cn = nj \times 100/Np$$

The data was processed in Excel and SPSS ver.14 packages. Statistical analysis consisted of one way analysis of variance for means of vacuity stomachs in different months and seasons in each sex and used paired t-test differences for mean vacuity stomachs of male and female during survey. Also intensity of feeding of

E. coioides and environmental factors were compared. Independent t-test was used to compare the mean number of families consumed in each fishing zone (Busafe-Liphe and Bahrekan area).

RESULTS

Out of 394 individuals of *E. coioides* analysed, 168 had contained (trace-full) stomachs and 226 empty stomachs (Fig. 3). The results of CV index showed random monthly fluctuations in the values. The highest (90.47%) and lowest (20%) values were observed in June and July, respectively. There was no significant differences between means of vacuity stomachs of each sex in different months and seasons, but a significant difference ($p<0.05$) between means of vacuity stomachs of female and male during survey. Also there was not any mathematical relationship between Cv index and months.

The results of monthly intensity of feeding regarding sex and length groups are shown in Table 1 and 2.

The results showed that intensity of feeding was higher in females than in males. The highest and lowest

Table 1: Monthly fluctuations in intensity of feeding of *E. coioides* (Female)

	Intensity of feeding (%)						
Months	100	75	50	25	<25	Empty	Total No. of sample
January	-	66.66	-	11.11	-	22.22	9
February	-	14.28	-	-	85.71	7.00	
March	-	14.28	9.52	9.52	4.76	61.90	21
April	10.0	5.00	5.00	20.00	20.00	40.00	20
May	8.0	8.00	16.00	16.00	4.00	48.00	25
June	5.0	35.00	25.00	10.00	5.00	20.00	20
July	-	4.76	4.76	-	90.47	21.00	
August	-	16.66	33.33	-	5.55	44.44	18
September	-	4.34	21.73	4.34	8.69	60.86	23
October	7.14	-	28.57	14.28	7.14	42.85	14
November	-	5.71	8.57	8.57	2.85	74.28	35
December	7.69	3.84	15.38	7.69	11.53	53.84	26
January	-	13.33	-	33.33	6.66	46.44	15
February	1.25	16.25	16.25	8.75	2.50	55.00	80
March	14.28	-	-	28.57	7.14	50.00	14

Table 2: Monthly fluctuations in intensity of feeding in *E. coioides* (male)

	Intensity of feeding (%)					
Months	100	50	25	<25	Empty	Total No. of sample
April	-	-	-	-	100	4
May	-	-	33.33	-	66.66	3
September	6.25	-	12.50	-	81.25	16
November	-	-	-	33.33	66.66	3
December	-	-	-	-	100.00	2
January	-	8.34	33.33	-	58.33	12
February	-	16.66	-	-	83.33	6
Total	-	-	-	-	-	46

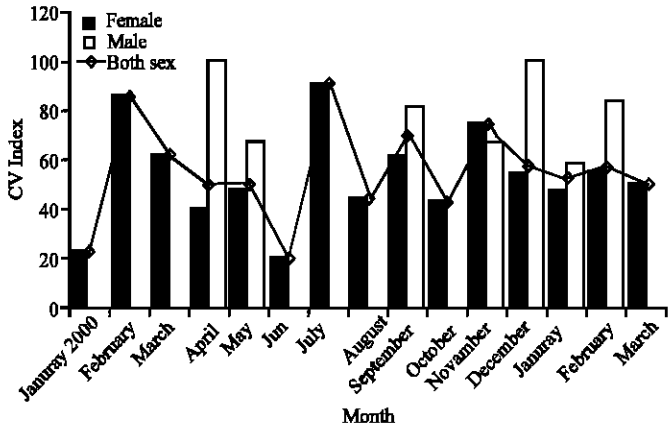

Fig. 3: Monthly fluctuation of CV index in *E. coiodes* (males and females) in the study area

Table 3: The comparison of mean values of environmental parameters and intensity of feeding

Months	**ES (%)	*CFS (%)	Temperature (°C)	O_2 (ppm)	Salinity (ppt)	pH
April	40.00	60.00	22.00	7.9	39.1	7.86
May	48.00	52.00	26.00	7.7	39.6	7.72
June	20.00	80.00	28.35	7.3	41.1	7.90
July	90.47	9.53	29.30	7.1	40.7	7.82
August	44.44	55.56	34.50	6.8	43.0	7.98
September	60.87	39.14	28.35	7.1	42.6	8.33
October	42.86	57.15	26.80	8.1	39.7	7.84
November	74.29	25.72	20.25	8.3	39.3	7.83
December	53.85	46.16	19.90	8.6	38.7	7.68
January	46.67	53.34	15.60	8.7	37.6	8.03
February	55.00	45.00	16.90	8.1	39.4	8.25
March	50.00	50.00	16.90	8.3	38.9	8.22

*: Percentage of contained food stomachs (Trace-Full), **: Percentage of empty stomachs

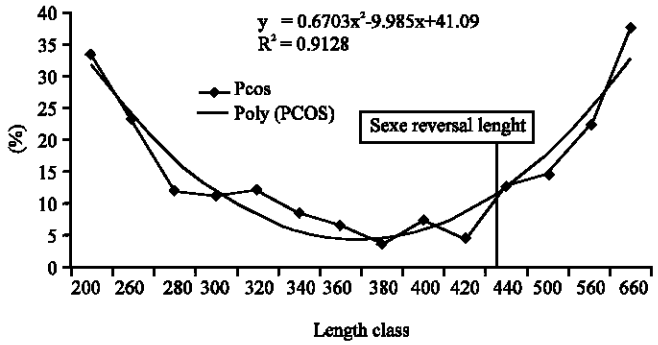

Fig. 4: Crustaceans observed in *E. coioides* stomachs. PCOS: Percentage of crustaceans observed in stomachs and Poly. (PCOS): Polynomial curve fitted

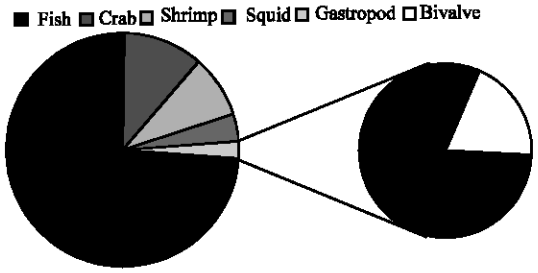

Fig. 5: Frequency of pray of occurrence

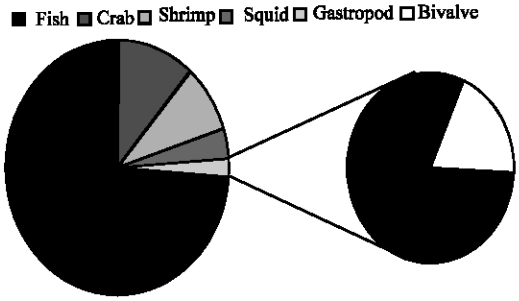

Fig. 6: Numerical diet composition index

values in females were 41.7 and 16.7% in January and February, respectively. Also all stomachs were empty in April and December. The highest and lowest values in males were 37.3 and 0.0% in May, November, April and December (empty stomachs), respectively. Figure 4 shows a polynomial relation (with high correlation), between crustaceans percentage consumed by *E. coioides* and its length class. It also shows that when fish grows in length feeding on crustaceans reduces and increases again when fish sex reverse occurs.

Comparing mean between values of environmental parameters and intensity of feeding (Table 3) did not indicate any significant correlation between them (pH, Water temp., Dissolved oxygen) and intensity of feeding. The values of FP index showed 73% (166 stomachs) for fish followed by crabs (11%), shrimps (8.8%), squids (3.9%), gastropods (1.7%) and bivalves (0.4%). The results showed that fish is the main food source for *E. coioides* followed by crabs and shrimps, as secondary food source and squids, gastropods and bivalves are accidental food sources (Fig. 5). Similar pattern of feeding of *E. coioides* was observed when using CN index (Fig. 6). It showed 75% for fish followed by crabs (11%); shrimps (7.8%) squids (3.5%), gastropods (1.5%) and bivalves (0.3%).

The main food items were *Liza* sp. *Thryssa* sp. *Leiognatus* sp. *Johnius belangeri*, *Otolithus ruber*, *Synodus* sp. *Platycephalus* sp. (fishes); *Metapeneaus*

affinis, *Parapenaeopsis stylifera* (shrimps); squids; gastropods and bivalves (Invertebrates). *Liza* sp. and *Thryssa* sp. were the dominant items in the stomach.

There was no significant difference between mean number of fish families consumed by *E. coioides* in two fishing zone area (Busafe-Liphe and Bahrekan)

DISCUSSION

Knowledge of feeding regimes of fish species is of great importance in understanding their ecological interaction (Alberto *et al*., 2003). Serranids having relatively big head and mouth with sharp teeth and usually attack and swallow their prey them very quickly (Koslow *et al*., 1988).

Many researchers have tried to standardize methods for analysing fish stomach contents (Obrebeski, 1976; Smith, 1976; Terry, 1976; Ellison, 1976; Kask and Sibert, 1976; Bowen and Windell, 1987; Hyslop, 1980; Levy and Yeaski, 1981; Ursin, 1981). In fact, the method chosen depends mainly on the aim of the study. In this study, numerical methods were used.

Groupers are unspecialized and opportunistic carnivores, feeding on a variety o f fishes and crustaceans during the day and at night (Thompson and Munro, 1978). Generally, feedings is most active at dawn and dusk (Randall, 1967).

According to the present study most of the stomach analysed were empty Abdollah and Hussain (1975) and Euzen (1987) made similar observation in *E. tauvina* held in cages in Kuwaiti waters. Dehghani and Kamali (1996) also made similar observation in the same species (Iran-Hormozgan province coastal waters) in Persian Gulf.

A large number of empty stomachs maybe related to regurgitation of prey during coming to surface or digested food in stomachs during captivity in traps.

In females the percentage of empty stomachs was almost the same in spawning months of April and May. In June, stomachs were found to be full, which could be attributed to increased feeding activity to meet the demand for more energy in spawning season. In male, higher percentage of empty stomachs was observed in January and February. The fluctuations in fullness of stomach did not show any correlation with temperature and fluctuations in CV, or between the months and seasons.

Based on numerical index, the most important food item was fish, followed by crustaceans and molluscs. Dehghani and Kamali (1996) and Abdollah and Hussian (1975) have also made similar observation for *E. coioides* in Hormozgan and Kuwait waters, respectively.

In Mediterranean waters Heemstera and Golani (1993) reported, this fish (*E. coioides*) feeds on small fishes and its second priority was crabs, shrimps and (in one case) squids that confirms results of present study. Also Shpigel (1989) reported same results about feeding of three species of genus *Cephalopholis*. These species occur in the shallow-water coral habitats of the Red Sea and feed on fishes and invertebrates. Of these, *C. argus* and *C. miniata* prefer selected fish species (95 and 86% of their diet, respectively), where as *C. hemistiktos* consumes more invertebrates (36%) and is less selective with respect to fish species. All three species employ various techniques to catch their prey and in situations where their elected food is absent they readily switch to substitute prey species.

Food habits of grouper in the Mediterranean coast of Spain were studied by Vicente and Francesc (2005). Their results were mostly similar to these study results. They reported that fishes (33.3%), Crustaceans (30/1%) and molluscs (36.6%) were the main preys consumed by *E. marginatus*, the main prey consumed by *E. costs* was fishes (97.1%) and molluscs (2.9%) were occasionally found inside their stomach.

The results indicate that fishes with smaller length group feed mainly on crustaceans. According to Parrish (1987), Serranids change their feeding habits with increase in age from crustivory to piscivory. The present study shows similar pattern of feeding habits in female, as in the other regions, However about male we had gaps and limited sample length (specially in large sizes), Present study showed that with increasing in length, increasing percentage of consumed crustaceans (on the contrary of female). So it is it shows different results with others. According to Wootton (1995), Abdel-Azis *et al*. (1993) and Parrish (1987) the presence of food items in the fish diet is related to availability of food, food selection and the age of fish.

Regarding to Nilsaz *et al*. (2006) and present study results Bahrakan and Busafe-Liphe area had very similar habitats and had same environmental factors. Also there is no any barrier between themes. Bahrakan and Busafe-Liphe area had like catch component (Mohammadi and Ansari, 2004). These results confirm our results which referred about same families consumed by *E. coioides*.

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