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Dietary ecology of the *Portunus segnis* (Forskal, 1775) in the coastal waters of Hormozgan Province, Iran

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Abstract

In this study, the feeding habits of blue swimming crab (*Portunus segnis*) in the Northeast Persian Gulf were investigated. A total of 722 specimens were collected using bottom trawl. The samples were transferred to the laboratory in order to further analysis after freezing. All individuals were dissected and their stomach was removed. The results showed the vacancy index of stomach (CV) was 34.5. This finding indicated that this species is a gluttonous crab. Also the analysis of their feeding habits showed that this species is carnivorous. The main items included crustaceans, fishes and mollusks. Their diet varied seasonally. Crustaceans were more important in summer whereas fishes and mollusks were more important during autumn and winter, respectively. The crustaceans included shrimps and other crabs. The dominant mollusks were the bivalves such as common name *Marcina hiantina*, *Circentia callipyga*, *Tellina* sp., *Cardita bicolor* and gastropods *Cerithium erythraeonese*, *Atys* sp. There were significant differences in feed items occurrence frequency between sexes.

Keywords: *Portunus segnis*, Feeding habits, Persian Gulf

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Introduction

Decapods crustacean form a major component of commercial fisheries in the Indo-Pacific region. The crab fishery is dominated by a few members of a single family, the Portunidae. They include four species of mud crab (Genus *Scylla*, De Haan, 1833), the blue swimming crab (*Portunus pelagicus* (Linnaeus, 1758)) and the gazami crab (*P. trituberculatus* (Miers, 1876)) (Lai *et al*., 2010). The blue swimming crab, *P. segnis* (Forskål,1775), previously named as *P. pelagicus* (Linnaeus, 1758) in the northern Persian Gulf (Lai *et al*., 2010) . Different groups of decapods crustacean exist in the Persian Gulf and Oman Sea which are caught during shrimp fishery season. Portunid crabs, especially Portonus segnis, are the most commercially important of all true crabs in coastal waters of Hormozgan province (Safaie *et al.*,2013).

The blue swimming crab *P. segnis* is distributed from the eastern Mediterranean area to east of Africa in the Indian Ocean, and to Pakistan, Red Sea and Persian Gulf (Joelle and Lai, 2010). This crab also lives in a wide range of inshore and continental shelf areas, including sandy, muddy or algal and sea grass habitats, from the intertidal zone to at least 50 m depth (Williams, 1982; Edgar, 1990).

analysis of the feeding habits of specific species can be useful for determining the status of the food web, as existence of a species in an ecosystem depends on the availability of prey (Behzadi *et al*.,2018).

Investigation on the feeding habit of brachyuran crab is important because of their influence on the distribution and abundance of prey populations (Kitching *et al.,* 1959; Muntz *et al.,* 1965; Seed, 1980). Feeding habits of the blue swimmer crab have been investigated by Sukumaran and Neelkantan (1997). They found that the stomach content of *P. pelagicus* (the previous name of *P. segnis*) consist of crustaceans, mollusk, fishes and detritus. The major prey items ingested by *P. pelagicus* along the coast of Dare Salaam (Chande and Mgaya, 2004) were mollusks, crustaceans, fish bones and unidentified food digested feed items. Sahoo *et al.* (2010) reported that swimmer blue crab fed ~~of~~ shrimps, mollusks, fishes, sea grasses, mixed materials and unidentified materials, and Pazooki *et al.* (2012) concluded in Bushehr water, *P. segnis* consume crustaceans, mollusks, fishes, seaweeds, benthos, mixed and unidentified organisms. The present study has been undertaken to investigate the feeding habits of *P. segnis* in coast of the north-east area of the Persian Gulf and to have a seasonal comparison on feed items and includes comparison of feeding behavior between males and females.

Materials and methods

The crabs caught by using shrimp bottom trawl in the coastal waters of the north-east area of the Persian Gulf (Fig. 1). Samples were caught and collected monthly from June 2011 to May 2012. Specimens were placed in the ice at the

time of catch and then frozen samples transferred to the laboratory.

Crabs were dissected and opened from dorsal part, while the stomachs removed carefully. The fullness of the stomach estimated according to the degree of fullness (about 0, 25, 50, 75 and 100%) (Sukumaran and Neelkantan, 1997). The collected stomachs preserved in 70° ethanol. The stomach contents were completely separated. The organisms were identified by using different references such as Choe (1992), Choe and Lee (1994), Choi *et al.* (2002), Min (2004).

Data analyses were carried out using the Vacuity Index: number of empty stomachs/number of stomachs examined (Hyslop, 1980) and the prevalence of occurrence: b/n×100. b: is the number of crabs that their stomach contained prey.n: is the number of crabs samples (Williams, 1981).

All data were analyzed using SPSS V.18 and since the data could not be normalized, non-parametric Mann Whitney U - test has been used instead of that.

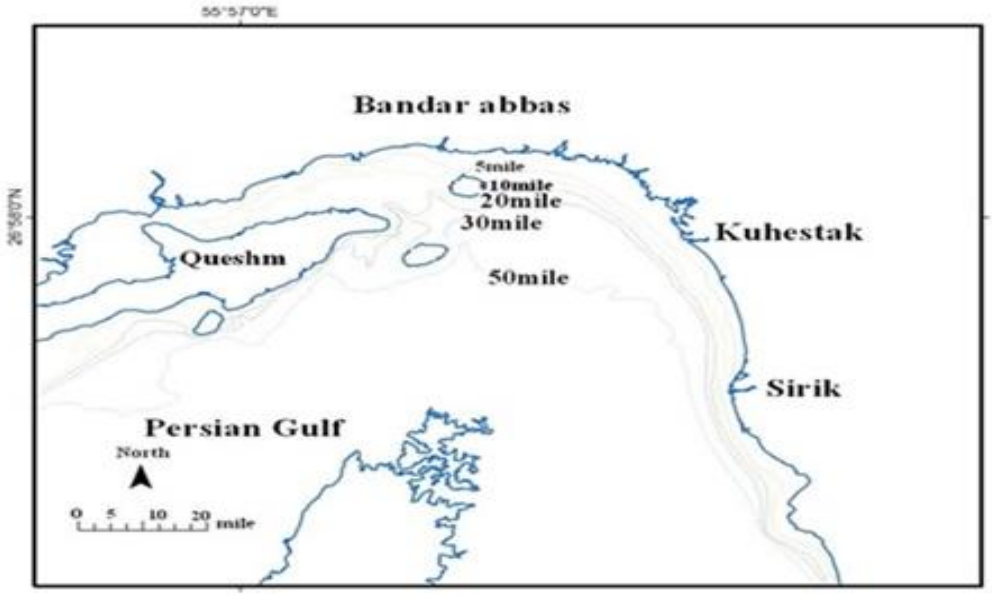

Figure 1: Map of the study area.

Results

A total of 722 *P. segnis* individuals were collected (including 418 males and 304 females) during four seasons. 249 (34.4%) empty stomachs were found from all samples. The frequency of crabs with empty stomachs changed throughout the year, the most crab samples with empty stomach were found during winter time.

There was no significant differences ($p<0.05$) on the Genus Vacuity Index during sampling period, while there was a significant difference in the vacuity index between the seasons ($p>0.05$) except in summer and autumn ($p<0.05$) (Figs. 2 and 3).

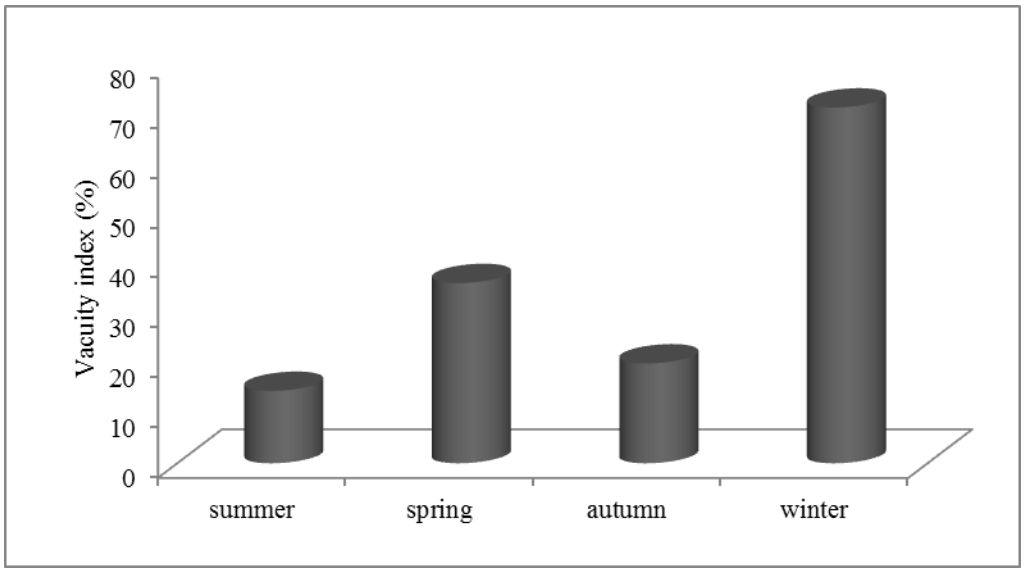

Figure 2: Vacuity index of *Portunus segnis* in different seasons in the north-east area of the Persian Gulf.

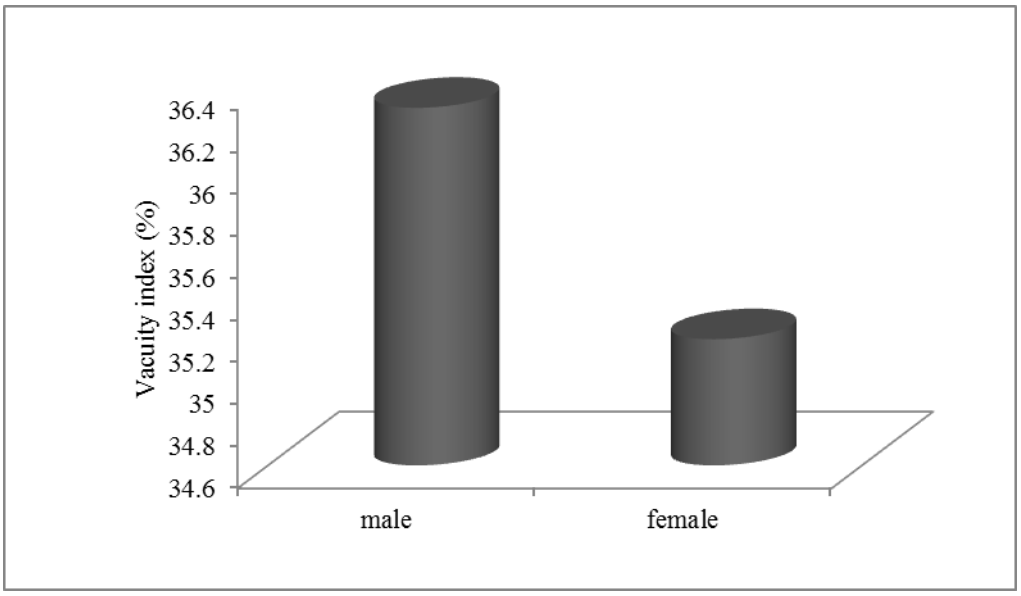

Figure 3: Vacuity index of *Portunus segnis* by sex Iin the north-east area of the Persian Gulf.

The analysis of the stomach contents of *P. segnis* in this study showed the crustaceans, fishes, mollusks, sea grasses, foraminifera, mixed and unidentified materials, sands particles and pieces of net were the major groups. Analysis of monthly variation in feed habits of crabs showed crustaceans were the most important feed items for *P. segnis* of which were found in 45.8% of the stomachs. Fishes (44.4%) and mollusks (22.4%) were formed the second and third—favorite feed items, respectively. The mollusks consisted of bivalves (*Marcia hiantina*, *Circenita calipyga*, *Cardita bicolor*, *Tellina* sp.) and gastropods (*Cerithium erythraeonese* and *Atys* sp.). The ~~food~~ feed items were found consist of mixed (4%); foraminifera (1.9%) and sea grasses (1.5%), respectively. Furthermore, sands particles and pieces of net have been observed in the stomachs contents (Fig. 4). There was

no significant difference in the sea grass diet in 4 seasons (p>0.05), while significant differences were found in fish residuals were found in stomach contents in 4 different seasons (p<0.05) (Fig. 4 and Table 1). There were significant differences between mixed and crustaceans items in stomach of males and females (p<0.05) (Table 2).

Table 1: Percentage of major feed items in *Portunus segnis* stomach in different seasons in the north-east area of the Persian Gulf.

Seasons diets	Winter (%)	Spring (%)	Summer (%)	Autumn (%)
Fishes	5.0	35.9	45.2	75.0
Crustaceans	30.0	42.2	75.6	36.5
Mollusks	45.0	31.3	12.5	31.8
Sea grasses	2.5	4.7	1.2	0.7
Foraminifera	7.5	4.7	0.0	2.0
Unidentified	2.5	17.2	4.2	4.7
Mixed	5.0	0.0	7.7	2.7

Table 2: Number and percentage of different feed items in males and females *Portunus segnis.*

	Male		Female	
	No	%	No	%
Fishes	123	50.4	89	48.9
Crustaceans	130	53.7	80	42.3
Mollusks	50	20.1	57	32.4
Sea grasses	6	2.5	1	1.1
Foraminifera	5	2.0	4	3.2
Unidentified	15	6.1	12	8.0
Mixed	15	6.1	4	2.1

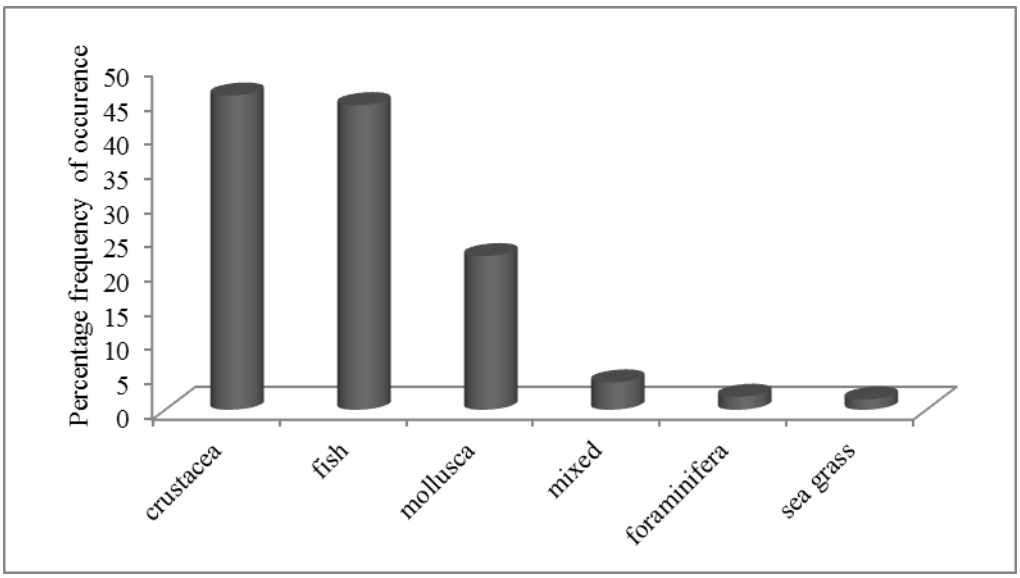

Figure 4: Frequency of stomach contents (%) in *Portunus segnis*.

Discussion

Investigation on the feeding habit of brachyuran crab is important because of their influence on the distribution and abundance of prey populations (Kitching *et al.*, 1959; Muntz *et al.*, 1965; Seed, 1980).

Feed items were found in the decapod`s stomachs identified and analyzed, but because of digestion proceeding, the feed items are very fine and the identification of undigested feed residual is difficult (Choy, 1986; Chande and Mgaya, 2004). The increase in number of empty stomachs was probably due to decreasing availability of metabolic necessities and decreasing nutritional needs in winter time compare to the other seasons (Singer, 1985). Feeding intensity is positively related to degree and index of fullness and negatively related to the percentage of empty stomachs (Bowman and Bowman, 1980). The low values of the vacuity index throughout the summer time indicated that feeding intensity is high. This crab was gluttonous entirely. This result was similar to result of Pazooki *et al.* (2012).

Sukumaran and Neelkantan (1997) found that the stomach content of *P. pelagicus* consists of crustacean, mollusks, fish and detritus. Sahoo *et al.* (2010) reported that swimmer blue crab used shrimps, mollusks, fishes, and sea grasses, mixed and unidentified materials. The major prey items ingested by *P. pelagicus* along the Coast of Dares Salam (Chande and Mgaya, 2004) were mollusks, crustaceans, fishes and unidentified feed items. Pazooki *et al.* (2012) concluded that in south-western area of the Persian Gulf, *P. segnis* consumed crustaceans, mollusks, fishes, seaweeds, benthos, mixed and unidentified items. The results from Willner and Collins (2013) study on the freshwater crab *Trichodactylus borellianus* is considerably different from our results. They concluded that this crab species consumed several plant and animal items, including amoebas, rotifers, oligochaetes, copepods, cladocerans, and insect larvae. Moreover, this species consumes filamentous and unicellular algae, diatoms, fungi, and macrophytic remains.

In present study, crustaceans, mollusks, fishes, sea grasses, foraminifera, mixed and unidentified items were dominated in the *P. segnis* feed regime. Thus, the basic diets of *P. segnis* in the eastern area of the Persian Gulf are similar to those reported–by other researchers in other areas,, except a small amount of foraminifera was also consumed. Cannicci *et al.* (1996) reported that foraminifera were one of the food feed items of *Thalamita crenata*. Mantelatto and Petracco (1997) reported that foraminifera were founding in the stomach contents of *Hepatus padibandus*. The seasonal variability of diet in this crab may be due to change of relative abundance of prey species. It is doubtful the blue swimmer crabs be able to consume live swimming fish ~~for~~ as feed item (Williams, 1982). Residues of corpse dead fish and waste products abundantly threw away by fishermen during shrimp fishing season (Wassenberg and Hill, 1987). This is conformity with our observation during shrimp fishing season (autumn) fish occurrence percentage was dominant and it declined in spring and winter. Our investigation showed there was significant difference in feed items

between two sexes. This result is antithetical with found of Chande and Mgaya (2004) and Williams (1981) about *P. pelagicus*. The results of this investigation showed female crabs consumed the more mollusks ~~as~~ compared with males, and may be because mollusks have more good nutritional effects on female crab's ova or their maturation. Choy (1986) reported males *Liocarcinus puber* consumed the more mollusks compared with females because they have more powerful chelipeds than females. Sukumaran and Neelkantan (1997) showed that males prefer crustaceans and mollusks but females prefer fishes and crustaceans. The sand particles were found in the stomach content is due to chelipeds movement which allows sand particles to enter crabs ` mouth. The grains of sand particles may serve at least two purposes: as material to grind particles such as crustacean shell or legs and as nutritional elements since these grains are often covered by organic materials like bacteria or microalgae (Ray and Marshall, 1974; Petchen - Finenko, 1987). The pieces of net in stomach of crab may be due to struggle when they try to come out of net. Kapiris and Thessalou-Legaki (2011) observed plastic and sand particles in the contents of blue-red shrimp stomachs *Aristeus antennatus*.

Foraminifera were recorded more in the stomachs containing sand. It seems that there is no real feeding on these creatures (Cannicci *et al.*, 1996). Sands particles in the stomachs may be arising of sweeping activity of crabs (Aurioles-Gamboa and Perez-Flores, 1997). This study showed the origin feed items of *P. segnis* were crustaceans, fishes and mollusks while sea grasses, foraminifera, unidentified and mixed materials were causal feed items.

Our investigation showed that *P. segnis* is mostly carnivorous. Williams (1981), Wu and Shin (1998), Potter and De lestang (2000), Chande and Mgaya (2004), reported the blue swimmer crab is carnivorous also while Patel *et al.* (1979), Sukumaran and Neelakantan (1997) proclamation this crab is omnivorous. Prasad and Tampi (1953) observed this crab is mostly scavenger and cannibal. Pazooki *et al.* (2012) reported that *P. segnis* in south-western area of the Persian Gulf water is omnivorous.

As a conclusion *P. segnis* consume a variety of organisms in their habitant.

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