Natural diet of the crab *Menippe nodifrons* Stimpson, 1859 (Brachyura, Menippidae) in Paranapuã Beach, São Vicente (SP), Brazil

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Abstract

The crab *Menippe nodifrons* Stimpson, 1859 is a common intertidal brachyuran found in rock shore and the biological aspects of this species are poorly known. Information about of the natural diet of this crab leads to a better understanding of its ecological aspects and the relation with others coexistent species. The present study describes the natural diet of the crab *M. nodifrons* by the frequency of the main preys in stomach. The most common food items were polychaetes *Phragmatopoma caudata* (Kröyer Mörch, 1863), crustaceans mainly *Eriphia gonagra* (Fabricius, 1871), algae and mollusks, although sponges, echinoderms, cnidarians, bryozoans and fishes had been also ingested. The high feeding diversity allows the characterization of the omnivore habit for *M. nodifrons*, as well as its influence over other populations on the rock shore.

Key words: Brachyura, *Menippe*, diet, stomach, predation

Introduction

The crab *M. nodifrons* is a common brachyuran of Menippidae (Martin and Davis, 2001) found in the intertidal zone of rock shores, widely distributed in the Atlantic coast, and very abundant crab in Paranapuã beach, São Vicente (SP), Brazil (Melo, 1996; Negreiros-Fransozo *et al.*, 1998). This is an important commercial species, frequently captured by fishermen, tourists, and local communities to be used on culinary (Fausto-Filho, 1966; Oshiro, 1999; Oshiro *et al.*, 1999).

The feeding habit is a result of the diversity and frequency of food ingested to supply its nutritional requirements. Therefore, the knowledge about the food spectrum of a species is essential to understand its interactions with others organisms in an ecosystem (Williams, 1981).

Natural feeding activities of marine brachyuran have been well recorded to portunid crabs (Caine, 1974; Hill, 1976, 1979, 1980; Williams, 1982; Sukumaram and Neelakantan, 1997; Wu and Shin, 1998; Mantelatto and Christofoletti, 2001; Reigada and Negreiros-Fransozo, 2001). However, despite the ecological and economical importance of intertidal crabs of Menippidae, there are few studies about this species, with eminence to Vannini *et al.* (1989) about *Eriphia smithi* MacLeay, 1838, and there no are publications of a crab of this family from Brazilian coast. In such case, this is the first register on the literature to the feeding habit of *M. nodifrons,* describing its prey and the frequency that they are ingested by analyses of stomach contents.

Material and Methods

Parnapuã Beach (23°58'49"S – 46°22'43"W) is situated on the estuarine region of Santos-São Vicente, São Paulo State, Brazil, and to belong to State Park Xixová-Japuí, a Conservation Unit that is unavailable for tourists.

Diuturnal collects (two at daytime and two at nighttime during 48 h) were made during September/2003 to compare the feeding frequency between daytime and nighttime. Crabs were sampled monthly by hands during 2 hours at nocturnal low tide from September/2003 to January/2004. All specimens were kept at room temperature until they were transported to laboratory and stored at 0°C. Animals were measured (CW = carapace width), weighted, dissected and four stomach replenishment categories were established using a method modified from Wear and Haddon (1987): empty (0-25% of stomach fullness with food), partially filled (25-50%), half full (50-75%), and full (75-100%). Only gut contents from stomachs of categories half full and full were used to have no influence of the time of digestion of different preys (calcareous or organics), which were identified into major taxa.

Analysis of stomach contents was made at room temperature with a binocular dissecting microscope. The methods used were percentage points (PP) and frequency of occurrence (FO). The quantitative scoring method of PP (modified from Williams, 1981 and Wear and Haddon, 1987 by Mantelatto and Christofoletti, 2001) was based on point scores of the relative contribution of each prey category to the total volume of material in each stomach: a prey representing 0-10% of stomach contents was awarded 10 points; 10-20% of stomach contents was awarded 20 points; 20-30% was awarded 30 points; and so on until 90-100% was awarded 100 points. These points were multiplied by a value dependent on the degree of foregut stomach (half full : 0.75 and full : 1).

Frequency occurrence is a measure of the regularity of a food in the diet of crustaceans (Williams, 1981), and was defined as the number of stomachs contained the specific prey, divided by the number of crabs in the sample.

The *G* test (Sokal and Rohlf, 1995) was used to compare the frequency of the stomach replenishment categories between daytime and nighttime and the Spearman correlation to compare percentage points and percentage occurrence methods.

Results

A total of 265 specimens of *M. nodifrons* were collected during the study period with size ranged from 23.4 to 79.4mm of CW and weight from 4.4 to 180g. Of this total, 60.4% exhibited empty stomachs, 21.9% partially filled, 11.7% half full, and 6.0% full stomachs.

In the diuturnal analysis were examined 103 crabs (daytime = 63 individuals, nighttime = 40 individuals), which showed a significantly higher food ingestion during night (G test, $p<0.01$). The higher frequency of empty stomachs was observed at daytime (61.9%), while at nighttime the higher frequency of full (50%), and half full (22.5%) stomachs than daytime (Figure 1).

Analyses of stomachs contents was made in 43 specimens with full and half full stomach replenishment categories, and fragmented prey items were identified by remains of animals with hard parts and most plants (Table I, Figure 2). Elevated percentage of digested organic matter was observed and represents the principal item together sediment in the diet (Table I). Annelids, crustacean, algae and mollusks were the main recognizable prey with higher frequency (>35%) and volume (>8%) at stomach contents. Sponges, echinoderms, cnidarians, bryozoans and fishes were food items of minor occurrence (frequency <20% and volume <2%) (Table I). Two main recognizable prey are registered: annelids composed mainly by the polychaete *Phragmatopoma caudata* (Kröyer) Mörch, 1863, and crustaceans with the xanthid crab *Eriphia gonagra* (Fabricius, 1871) being the predominant prey. There was a significantly correlation ($r=0.84$, $p<0.05$) between the percentage points and percentage occurrence methods.

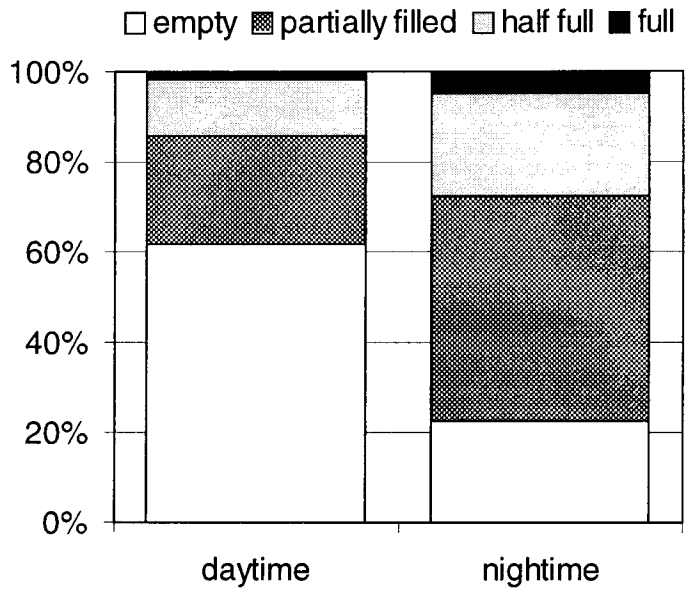

Figure 1: Feeding frequency based on diuturnal stomach replenishment variation of the crab *M. nodifrons* from São Vicente (SP), Brazil.

Table I: Principal prey items, discernment identification, percentage points (PP) and frequency occurrence (FO) from stomach contents of *M. nodifrons*, São Vicente (SP), Brazil.

Prey groups	Identification	PP (%)	FO (%)
Digested organic matter	-	21.9	93.0
Sediment	sand grain	18.6	90.7
Annelida	opercular paleae	17.3	48.8
Crustacea	antenna, appendages and carapace fragments	17.1	74.4
Algae	fragments of algae	10.6	37.2
Mollusca	gastropods and bivalves shell	8.5	76.7
Porifera	monaxon calcareous spicules from sponges	1.9	18.6
Echinodermata	skeletal ossicules of Ophiuroidea	1.5	14.0
Cnidaria	hydrozoans polyps	1.3	9.3
Bryozoa	pieces of calcareous colony	0.7	11.6
Pisces	otoliths	0.4	4.7
Unrecognizable tissue	-	0.2	20.9

Discussion

Diuturnal differences associated with personal observations in field of foraging behavior during the samples showed that this species have a nocturnal feeding activity. This behavior decrease the chance of predation during periods of higher light intensity, besides increase the opportunity of capture prey of same behavior (Caine, 1974; Hill, 1976; Reigada and Negreiros-Fransozo, 2001). Temperature and luminosity are factors that can influence foraging of crabs, as described for *Scylla serrata* (Forskäl, 1775) by Hill (1976, 1980).

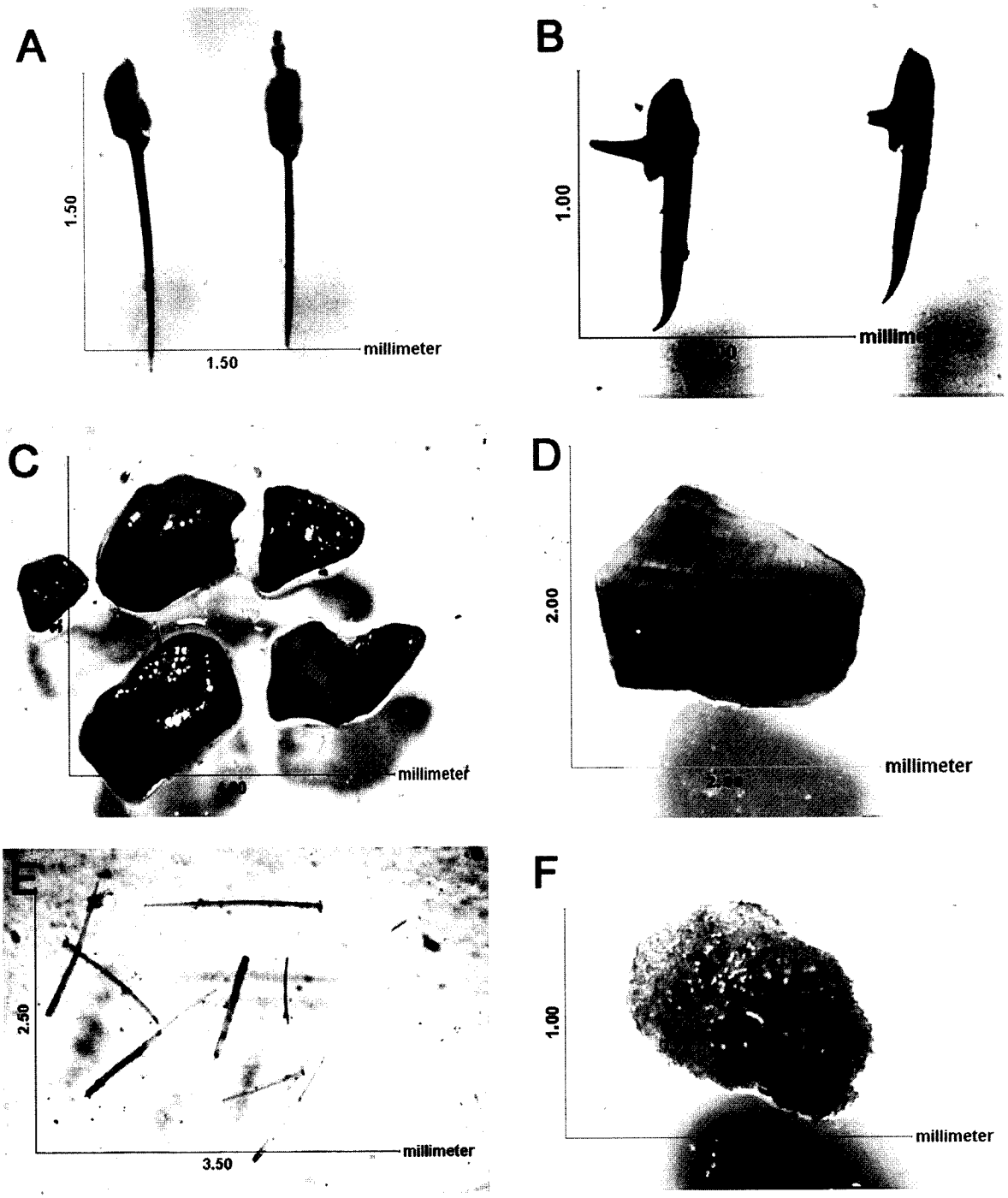

Figure 2 Principal fragments from stomach contents of the crab *M. nodifrons*, São Vicente (SP), Brazil (A, B = opercular paleae of polychaets; C = carapace fragments of the prey *E. gonagra*; D = mollusks shell fragment; E = monaxon spicules from sponges; F = skeletal ossicules of echinoderms).

The crabs *M. nodifrons* showed a diversified diet and can be classified as an opportunistic omnivore with higher nocturnal activity, as observed to a similar intertidal species, *E. smithi* by Vannini *et al.* (1989). Crustaceans and mollusks had elevated frequency in the stomachs that suggests a similar feeding preference to portunid crabs (Williams, 1981, 1982; Choy, 1986; Cannicci *et al.*, 1996; Mantelatto and Petracco, 1997 Sukumaram and Neelakantan, 1997; Wu and Shin, 1998; Mantelatto and Christofoletti, 2001), probably due to occupation of a similar habitat.

The foraging is directly related to prey selection by a physiological requirement and to food availability in the habitat. The principal prey items of *M. nodifrons,* the polychaetes *P. caudata*, algae, mollusks and crabs (mainly *E. gonagra*) have great abundance in the rock shore of Parnapuã Beach (personal observations), and this elevated available to predation agree with the opportunistic behavior demonstrated by *M. nodifrons.* The higher frequency of sediment may be due to its accidental ingestion during prey selection and ingestion, mainly associated with *P. caudata* colonies, and to help in the trituration process of calcareous prey, favoring fast digestion (Mantelatto and Christofoletti, 2001).

This crab has an elevated size in comparison with others intertidal organisms, and its high feeding diversity allows the characterization of the opportunistic omnivore habit for *M. nodifrons.* These results reflects the ecological importance of the crab *M. nodifrons* in the population dynamic of the sympatric species in a rock shore, and provide information to a better understanding of a trophic web dynamic in the intertidal regions and to the biotic relationships among such organisms.

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