

Natural diet of the deep water crab *Charybdis smithii* McLeay (Brachyura : Portunidae) of the seas around India

C. P. BALASUBRAMANIAN¹ AND C. SUSEELAN

Central Marine Fisheries Research Institute, Cochin - 682 014, India

ABSTRACT

Natural diet of potentially commercial deep-water crab *Charybdis smithii* comprised a wide variety of invertebrates and myctophid fishes. Pelagic juveniles and subadults of this crab were found to feed actively than benthic adults. The diet of juveniles were mainly composed of pelagic shrimps (20 % by volume) and crabs (17 %). The stomach contents of subadult crabs were dominated by teleost fishes and decapod crustaceans (64 %) whereas in adults, crabs were the major food (42 %). Pronounced cannibalistic tendency was observed in this species especially among juveniles.

Introduction

The deep-water crab, *Charybdis smithii* occurs in commercially exploitable quantities in several regions of Indian Exclusive Economic Zone (EEZ). The possibility of exploiting this species on commercial scale has been pointed out by several workers (Silas, 1969; Mohamed and Suseelan, 1973; Sulochanan *et al.*, 1991). Nevertheless information on many aspects of its biology and ecology are still scarce. In this paper, we report the natural diet of this crab at different life stages as well as at different habitat.

Materials and methods

Crabs for the present study were obtained from the cruises of the Fishery

Oceanographic Research Vessel (FORV) *Sagar Sampada* in the Indian EEZ and contiguous waters (Lat. 05°00'N to 23°00'N and Long. 65°00'E to 77°30'E on the west coast, Lat. 05°00'N to 21°30'N and Long. 77°30' E to 95°30'E on the east coast). Three types of trawls, namely Isaacs-Kidd mid water trawl (IKMT) (Isaac and Kidd, 1953), pelagic trawl (for juveniles and subadults in the pelagic realm) and bottom trawl (Panicker, 1990) (for adults in the benthic realm) were used for sampling.

A total of 283 crabs obtained from the trawl collections were used for the study. Based on carapace width, three groups namely, juveniles (<20 mm CW), subadults (21-45 mm CW) and adults (>45 mm CW) were segregated.

1. Present address : Puri Research Centre of Central Institute of Brackishwater Aquaculture, Puri - 752 002, India.

The food content present in the foregut only was used for the present study for easier identification of various food components. The intensity of feeding was determined based on the degree of distension of stomach wall, amount of food contained in it and classified as full, half-full and empty (Hynes, 1950). The food contents were identified into various taxonomic groups and the relative abundance of each of the groups was estimated by the frequency of occurrence method and the volumetric methods as suggested by Williams (1981) for the study of food and feeding habits of portunid crabs.

As characteristic of brachyurans, most of the food items were found in highly crushed form and hence only the hard structures that could be recognised were relied for qualitative evaluation. The major items recognised included foraminiferans, molluscs, arthropods and pisces. Foraminiferans were identified from entire shell, molluscs from hinge of shells, cuttle fish from bone, arthropods from pigmented remains of exoskeleton, appendages, carapace etc. and pisces from remains of bones, eyeballs, scales and otoliths. Many stomachs contained food remains that were highly pulverised or digested and such items were included under amorphous material.

Results

Pelagic habitat : A total of 187 crabs obtained from pelagic realm by IKMT and pelagic trawl collections were used for this study. Of these, 108 crabs were juveniles and the rest subadults. In juveniles, 98 % of stomachs examined contained food in various degrees of fullness. Among those which contained food, about 80 % were full and the rest were half-full. Figure 1A shows the percentage frequency of occurrence of

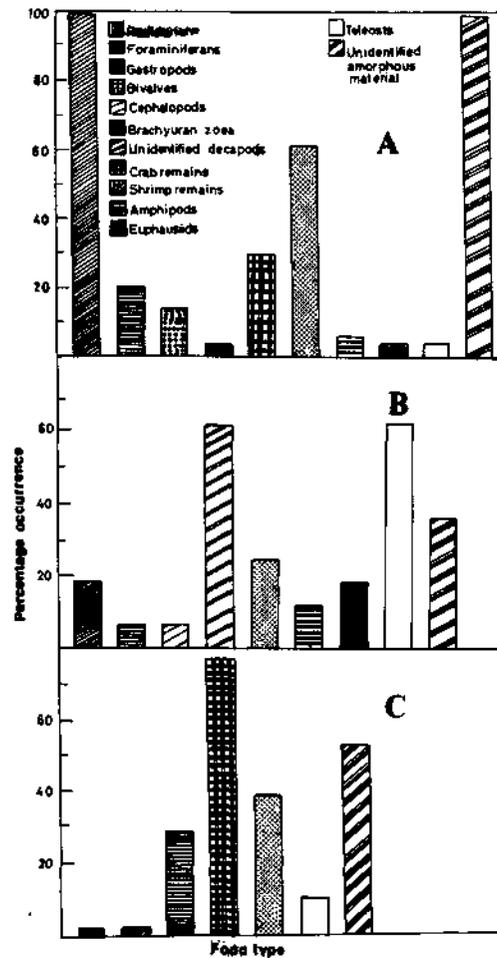


Fig. 1. Percentage frequency of occurrence of dietary composition for (A) juveniles, (B) subadults and (C) adults.

different food items in the foregut of juvenile crabs. Foraminiferans, shrimps and crabs were the common food items in the foregut of juveniles, the most frequently occurring prey being foraminiferans (95%). However, decapod crustaceans represented by shrimps (*Sergestes* spp.) and crabs (*Charybdis smithii*) made the highest contribution in terms of volume.

About 20 % of foregut was filled with shrimps and 17 % with crabs (Fig. 2A). Other items occasionally met within the stomach included small bivalves, euphausiids, hyperiid amphipods and brachyuran zoea.

Of the 179 subadult crabs, 62 contained food and 69 % had their stomach full. Teleost fishes and decapod crustaceans other than shrimps formed the most frequently occurring items of food (Fig. 1B). Fig. 2B presents the percentage contribution of different food items in terms of total volume of food in the subadults.

Bottom habitat: A total of 96 adult crabs trawled by bottom trawl were examined out of which only 40 % contained food in the foregut, thereby indicating relatively lesser feeding activity than juveniles and subadult crabs obtained from the pelagic habitat. Fig. 1C

shows the frequency of occurrence of various food types in the foregut of adult crabs. Crustaceans, gastropod molluscs and teleost fishes were the most frequently occurring food items. Among crustaceans, crabs were found to be a regular item and they were present in 78 % of the stomachs.

Fig. 2C presents the percentage contribution of different food types to the total volume of food of adult crabs.

Discussion

The present observations indicate that crabs obtained from the pelagic habitat feed more actively than the benthic crabs. Losse (1969) also reported the voracious feeding habit of this crab in the pelagic habitat. Juvenile crabs obtained exclusively from the pelagic environment showed a high feeding intensity than the adult crabs from the benthic habitat. Jewett and Feder (1983) have also made similar observation in the juveniles of tanner crab, *Chionoecetes bairdi*. They assumed that small crabs might be expected to feed more intensively than larger crabs as moulting frequency among smaller crabs is greater and hence require a greater amount of energy.

The most common food items consumed include decapod crustaceans and fishes as in the case of most other portunid crabs (Elner, 1981; Joel and Sanjeevaraj, 1986; Sukumaran and Neelakantan, 1996). Nevertheless, qualitative study of food of different life stages showed notable variations in the type of food eaten by crabs at different stages of growth. The most preferred food items in the juvenile stages are pelagic shrimps, crabs and foraminiferans

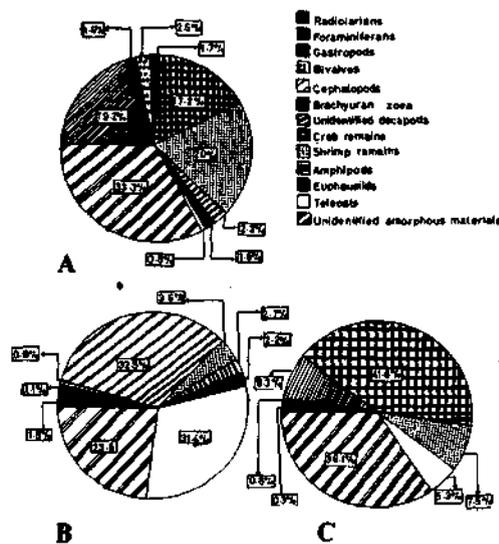


Fig. 2. Estimated percentage contribution of the different food items to the total volume of observed crab diet. (A) juveniles, (B) subadults and (C) adults.

whereas in subadult crabs the same are teleost fishes (myctophids) and brachyuran crabs. The high percentage of pelagic shrimps and myctophids in the diet of juvenile and subadult crabs respectively may be due to the abundance of such organisms in that habitat. The existence of dense concentration of pelagic shrimps and myctophids in the deep scattering layers of the coast of India has been well established (Mini Raman and James, 1990; Suseelan and Nair, 1990). It can be concluded that the preponderance of same food groups in the stomach reflects the relative abundance of the same in the habitat as suggested by Ennis (1973) for the lobster *Homarus americanus*. Cannibalistic tendency of *C. smithii* is evident from the occurrence of the same species in the stomach of juveniles as well as adult stages. In the stomach of juvenile crabs fragments of this species accounted for a major portion of food eaten. In the case of adult crabs, however, this species was relatively less in the stomach, although brachyuran remains formed one of the major items of food consumed at the bottom. From this it may be inferred that cannibalistic tendency of *C. smithii* is more pronounced among juveniles. Cannibalism is reported to be a very common feature among brachyuran crabs both in nature and laboratory conditions as already reported by Jewett and Feder (1983); Elner (1981) and Paul (1981).

Acknowledgment

We are deeply indebted to Dr P. S. B. R. James, former Director of Central Marine Fisheries Research Institute, Cochin for providing facilities and encouragement. Financial support from the Department of Ocean Development,

Government of India is gratefully acknowledged.

References

- Elner, R. W. 1981. Diet of the green crab *Carcinus maenas* from Port Herbert, Southwestern Nova Scotia. *J. Shellfish Res.*, **14** : 89-94.
- Ennis, G. P. 1973. Food, feeding and condition of lobsters, *Homarus americanus*, throughout the seasonal cycle in Bonavista Bay, Newfoundland. *J. Fish. Res. Bd. Canada*, **34** : 2203-2207.
- Hynes, H. B. N. 1950. The food of freshwater stickle backs (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of methods used in studies of the food of fishes. *J. Anim. Ecol.*, **19** : 36-58.
- Isaacs, J. D. and L. W. Kidd 1953. Isaacs-kidd midwater trawl. *Final Report. Scripps Inst. Oceanogr.*, Ref. 53-3, p. 1-18.
- Jewett, S. C. and H. M. Feder 1983. Food of the tanner crab *Chionoecetes bairdi* near Kodaik Island, Alaska. *J. Crustacean Biol.*, **3**(2) : 196-207.
- Joel, D. R. and P. J. Sanjeevaraj 1986. Food and feeding of the two species of *Scylla* (de Haan) (Portunidae : Brachyura). *J. mar. biol. Ass. India*, **28**(1&2) : 178-183.
- Losse, G. F. 1969. Notes on the portunid crab *Charybdis edwardsi* Leene and Buitendijk 1949 from the Western Indian Ocean. *J. Nat. Hist.*, **3** : 145-152.
- Mini Raman and P. S. B. R. James 1990. Distribution and abundance of Lantern fishes of the family Myctophidae in the EEZ of India. In: *Proc. First Workshop Scient. Resul. FORV Sagar Sampada*, 5-7, June, 1989, Cochin, India, K. J. Mathew (Ed.), Cochin, CMFRI, 1990, p. 285-290.

- Mohamed, K. H. and C. Suseelan 1973. Deep-sea prawn resources of the southwest coast of India. *Proc. Symp. Living Res. Seas around India. Spl. Publ. Cent. Mar. Fish. Res. Inst., India*, p. 614-633.
- Panicker, P. A. 1990. FORV *Sagar Sampada* and development of demersal trawls for Indian EEZ – a status paper on prospects and constraints. *Proc. First Workshop Scient. Result. FORV Sagar Sampada*, 5-7, June, 1989, Cochin, India, K. J. Mathew (Ed.), Cochin, CMFRI, 1990, p. 427-434.
- Paul, R. G. K. 1981. Natural diet, feeding and predatory activity of the crabs *Callinectes arcuatus* and *Callinectes toxotes*. *Mar. Ecol. Prog. Ser.*, **27** : 143-154.
- Silas, E. G. 1969. Exploratory fishing by R. V. *Varuna*. *Bull. Cent. Mar. Fish. Inst.*, No. 12, p. 1-86.
- Sulochanan, P., K. N. V. Nair and D. Sudarsan 1991. Deep-sea crustacean resources of the Indian Exclusive Economic Zone. *Proc. Nat. Workshop Fish. Resour. Data Fish Indus.*, p. 98-107.
- Sukumaran, K. K. and B. Neelakantan 1996. Food and feeding of *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* along Karnataka coast. *Indian J. Mar. Sci.*, **26**(1) : 35-38.
- Suseelan, C. and K. R. Manmadan Nair 1990. Quantitative distribution of pelagic shrimps in the Deep Scattering Layers of the Indian EEZ. *Proc. First Workshop Scient. Result. FORV Sagar Sampada*, 5-7 June 1989, Cochin, India, K. J. Mathew (Ed.), Cochin, CMFRI, 1990, p. 361-370.
- Williams, M. J. 1981. Methods for analysis of natural diet in portunid crabs (Crustacea; Decapoda: Portunidae). *J. Exp. Mar. Biol. Ecol.*, **52** : 103-111.