Indian Journal of Geo Marine Sciences
Vol. 48 (05), May 2019, pp. 622-627

Identification of fishing grounds for emerging non-conventional crustacean fishery resources off south-west coast of India

K. Yogesh Kumar,* A. P. Dineshbabu, Sujitha Thomas, & Shailaja Salian
ICAR-Central Marine Fisheries Research Institute, Research Centre Mangalore, P.B. No. 244, Mangalore, Karnataka, India
*[E-mail: yogeshkk58@gmail.com]

Received 10 November 2017; revised 03 May 2018

Trawling operations, extended wide and far, have resulted in the emergence of many non-conventional fishery resources. Apart from regular commercial crustacean resources of shrimps, crabs and lobsters, crucifix crab, *C. feriatus*, *C. smithii* and *C lucifera* are forming bulk catch in regular trawl fishery recently. The south-west coast of India contributes one-third of country's stomatopod production in which *Oratosquilla nepa* contributes the maximum. Extension of fishing grounds has resulted in exploitation of larger-sized stomatopods *Harpiosquilla harpax,* which is edible. Present study aims at understanding the spatio-temporal distribution of these non-conventional resources, through GIS-based resource mapping which is indicative of their distribution and abundance. The study showed that there is good potential for commercial exploitation of non-conventional resources which can form a part of the commercial fishery in coming years to enrich the seafood availability and to provide new avenues for fishermen for maximising their returns from the fishery.

[Keywords: Non-conventional crustaceans; Distribution; Trawl fishery; Resource mapping; GIS]

Introduction

India is supporting an estimated total of 8% of the globally documented species and is experiencing increasing pressure on its bio-resource and ecosystem services due to high demand of food[1]. In view of increasing population, the food from land is so limited that it may not be able to satisfy even the basic requirement. Crustaceans are highly valuable commodities by virtue of their pivotal role in the seafood industry of the world. Among crustaceans, shrimps and lobsters are the most preferred variety from the period of introduction of trawls and are being exploited to its maximum potential. Among crabs, out of about 640 species of marine crabs so far recorded from Indian waters only 15 species are edible[1]. Along south-west coast of India, crabs are caught by trawlers operating single day (SDT) and those operate multiday (MDT). Generally, SDT operates within 30 to 50 m depth from the shore and MDT trawls beyond 150 m depth on regular basis[2]. Brachyuran crabs and stomatopods are two major species forming the bulk of the catch from Indian coast; but most of the studies on crabs are restricted to commercial species only[3]. As far as traditional crab varieties are concerned, *Portunus pelagicus* and *Portunus sangionolentus* are the two species for which studies are done in detail[4,5,6]. Off late, the portunid crab *Charybdis feriatus,* which is widely distributed in the Indo-Pacific region, started forming a fishery along west coast of India. Fishery and biology of this species along south-west coast[7] and north-west coast of India[8] were studied and documented. *Charybdis smithii* which is a deep-water crab, occurs in commercially exploitable quantities in many regions of Indian Exclusive Economic Zone (EEZ), which was reported by many workers through exploratory surveys[9,10] that had predicted its potential for forming a commercial fishery in future. Along the east coast of India, *C. lucifera* is a preferred edible species[11], whereas along south-west coast of India it is discarded as trash due to lack of awareness of their edible status and their nutritional values. *C. lucifera* is found to be highly nutritious with protein, carbohydrates, minerals and unsaturated fatty acids, and is found to support components of hormones, enzymes and enzyme activators in human food system[11]. Stomatopods are the dominant constituent in SDT which is dominated by single species *Oratosquilla nepa*[12]. With the extension of the fishing ground, bigger species, *Harpiosqilla harpax* which have an average length of about 20 cm were found to be caught by trawlers. The species is reported to be forming an important constituent of commercial fisheries in south-east Asian countries and is one of the edible species. Rao *et al.,* (2015)[14] conducted studies on the meat content of *H. hapax* from the east coast of India and confirmed that meat yield of *H. harpax* is significantly higher and it holds good scope of commercial exploitation. This can be a probable export item to south-east Asian countries if exploited in good quantity. Among the non-conventional crustaceans studied in the present study, *Charybdis feriata* has already become a part of commercial fishery. As a result of technological interventions in trawling operations, *C. lucifera, C. smithii* and *H. harpax* are found to have great potential of forming a fishery along south-west coast. The information on the availability of the species in space and time can bring out new options for harnessing more protein from the sea as well as to increase the income of fishermen. Based on the indicative maps developed from the study, species-based exploratory surveys can be charted out to derive exploitation strategies for these non-conventional resources.

Materials and Methods

For the study, the crab catch from SDT and MTD were observed. Weekly samples of *C. feriatus*, *C. smithii* and *H. harpax* were collected at random from the landings of MTD at Mangalore fishing harbour and *C. lucifera* collections were done from STD operated along Karnataka and Goa. The study was carried out during January 2015 to December 2016.

Data for the study was collected using a commercial trawler used as a sampling boat during 2015-2016. The L_{OA} (overall length) of the trawler was 15.85 m with 350 hp engine, engaged in trawling of 8 to 13 days in a trip. Specially designed logbooks were prepared and the crew members of the sampling boats were trained in data collection. Onboard information collected and recorded included the date of operation, depth of shooting, time of shooting, shooting longitude, shooting latitude, hauling depth, hauling time, hauling latitude, hauling longitude, total catch (kg) total discard (kg) and number of hauls/day etc. The sample of the catch was brought to the laboratory to identify the species up to species level and to assess biological information (Dineshbabu et al, 2016). The crew in the sampling vessel were trained for onboard data collection using a log sheet. Along with fishing information, an unsorted portion of the discarded catch was collected as sample for analysis. The samples of *C. feriatus*, *C smithii*, and *H. harpax* were preserved in ice and stored in fish-hold for identification and biological data collection in the laboratory[15]. Data on *C. lucifera* were collected from SDT centres in Mangalore, Malpe, Gangoli and Karwar. The spatial data collected were used as an input for the GIS study; Arc GIS software was used for the spatial thematic shapefiles. Hauls from 419 fishing days of fishing operation were analysed. Species composition of the catch including discards-at-sea in each haul was recorded. For spatiotemporal distribution mapping and smooth handling of data, two software were used, ArcGIS and Visual Basic6. Visual Basic was populated with data on catch, fishing effort, geographic coordinates, water depths, etc. Thematic shape files/feature classes were prepared by sending queries into these tables of database created. The output of the queries was used for analysis on spatial distribution and abundance of species.

Results

Study area

Mapping of the fishing ground operated by the sampling boat showed that the trawler from Mangalore operated off Ratnagiri in the north and off Calicut in the south. (Fig.1). The depth of operation

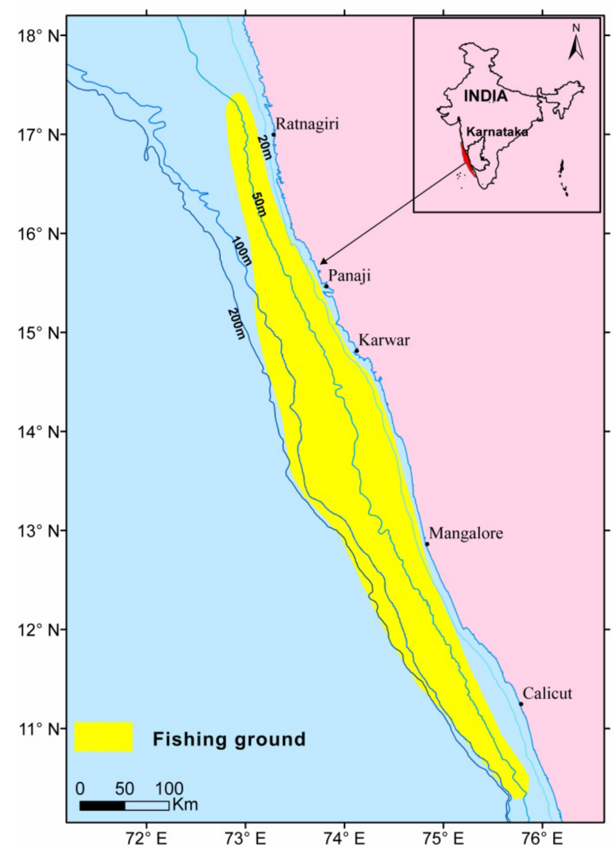

Fig. 1 — Map showing fishing ground studied for non-conventional crustacean resources.

extend upto 200m depth and lat. long of 10^0 16.678′ N to 17^0 25.373′ N and 72^0 47.901′ E to 75^0 53.939′ E. The fishery operations of 2015 and 2016 were mapped and it was understood that there is a definite pattern of fishing operational route followed in different months and this route is repeated in following year also.

Availability and distribution

Charybdis feriatus: It is a commercial species and very documented. During the study, the species was found throughout the trawl season and the highest catch was seen during pre-monsoon season from February to May. In May 2015, the estimated landing of the species in Mangalore fisheries harbour was about 200 t. Species distribution maps were made with the data available from the sampling boat operated during this period. GPS readings show the availability of species in the 11^0 25.575′ N to 15^0 41.23′ N and 73^0 22.879′ E to 74^0 52.645′ E. Annual average landing for the species during 2015-2016 was estimated at 715 t. Even though juvenile crabs were seen distributed in coastal waters, the commercial sized crabs were found distributed beyond 30 m depth zone and a wide distribution of species was seen within 30 and 50 m depth zone (Fig. 2). In the southern part of the fishing ground studied, the species was found distributed at a depth of 100 m and generally it can be assumed that the species have a depth preference of 30 to 100 m. Figure 2 gives the mapping of pooled data for the study period, which is a summation of the monthly maps derived from the study, GIS provided the monthly and seasonal mapping facilities, with which seasonal trend of distribution the species can be drawn for deriving further information on the species.

Charybdis lucifera: It is a widely distributed species, very close to the shore and the distribution generally extends up to 30 m depth (Fig. 3) in the GPS location of 12^0 28.771′ N to 15^0 36.921′ N and 73^0 34.369′ E to 74^0 45.464′ E. Since SDT data was used for distribution studies, these crabs were seen in the fishery from October to May, during entire SDT operating period. Monthly landing ranged from 1 to 6 t; and during pre-monsoon season (January to May), the catch was comparatively high, with an average monthly landing above 4 t. Annual average landing for the species during 2015-2016 was estimated at 45 t. The study showed that there is a regular fishery for the species throughout the

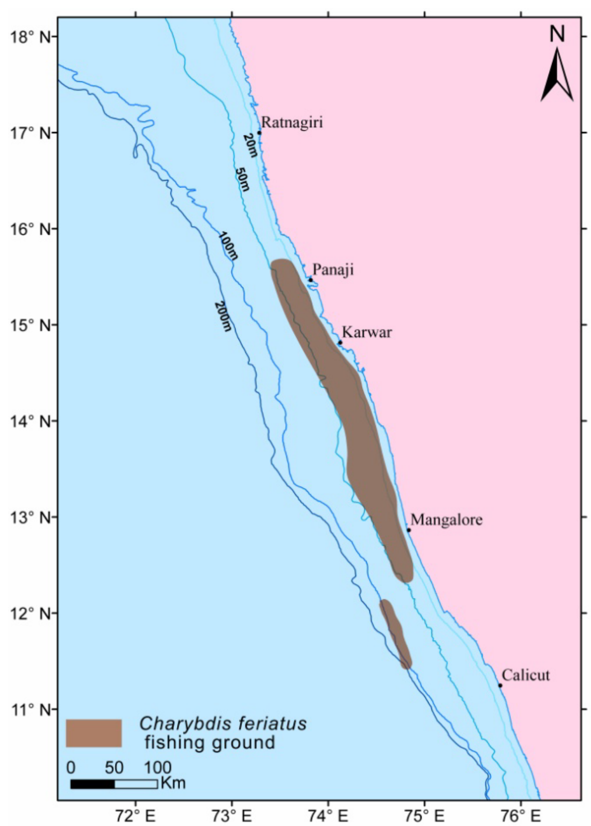

Fig. 2 — Map showing species distribution of crab *Charybdis feriatus.*

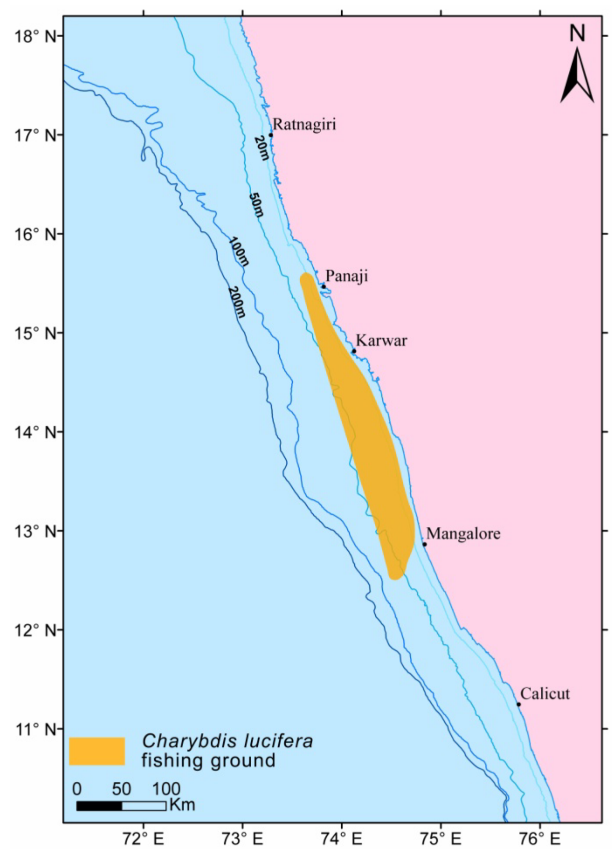

Fig. 3 — Map showing the distribution of crab *Charybdis lucifera.*

trawling period, which is a very promising sign for commercial exploitation of the species.

Charybdis smithii: Deepwater brachyuran crab, *C. smithii* inhabits the shelf edge and does not show a regular appearance in the fishery. *C. smithii* was caught from a depth range of more than 100 m and are caught in huge quantity as pelagic or semi-pelagic shoals (Fig. 4). They are distributed in the lat. long of 10^0 17.447′ N to 17^0 5.236′ N and 72^0 44.185′ E to 75^0 51.629′ E. Species was found in the catch in January to March, August and October in both the years. Monthly catch ranged from 2 t in (October 2015) to 20t (October 2016). Annual average landing for the species during 2015-2016 was estimated at 52 t.

Harpiosqiulla harpax: Stomatopods traditionally formed the bycatch from single day trawlers, which is almost entirely constituted by single species *Oratosquilla nepa*. During the study, big sized stomatopods of *Harpiosqilla* and *Lysiosquilla* genera were also observed in the catches of MDT along with *O. nepa*. Among this *H. harpax* showed regularity in distribution in both years and the species was available in good numbers in the fishery from March to May in the region of lat. long 12^0 22.336′ N to 16^0 26.687′ N and 73^0 5.128′ E to 74^0 45.539′ E. The distribution was found between 30 and 70 m with very wide distribution in the per-monsoon months (Fig. 5). During post-monsoon months, the species were not recorded in the sampling data. Annual average landing for the species during 2015-2016 was estimated at 4 t.

Discussion

The study showed that *Charybdis feriatus* already have an established fishery along Indian coast. Nutritive value of the species and its taste is well appreciated and accepted. Apart from *C. feriatus*, *C. Smithii, C. lucifera* and *H. harpax* are found to be emerging non-conventional crustacean resources along the south-west coast of India. It was understood that there is a need for awareness regarding the availability and nutritional qualities of these species. Nutritive value of *C. smithii* is found to be comparable with most of the other commercially exploited crabs and the protein content of meat varied from 59.8 to 71.1%[10]. The present study showed that there is a possibility for exploitation of the species in large quantity during March and May. *C. lucifera* is a delicacy along the east coast of India but

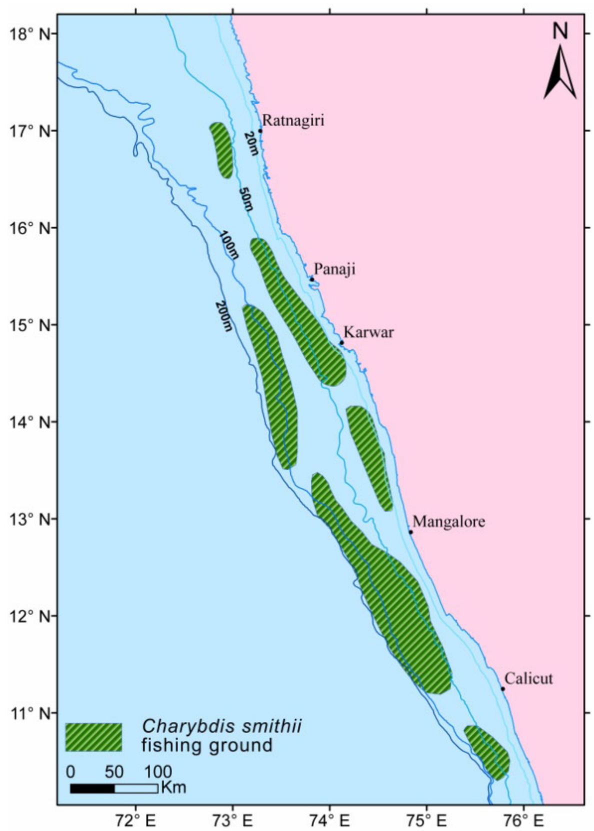

Fig. 4 — Map showing s distribution of crab *Charybdis smithii.*

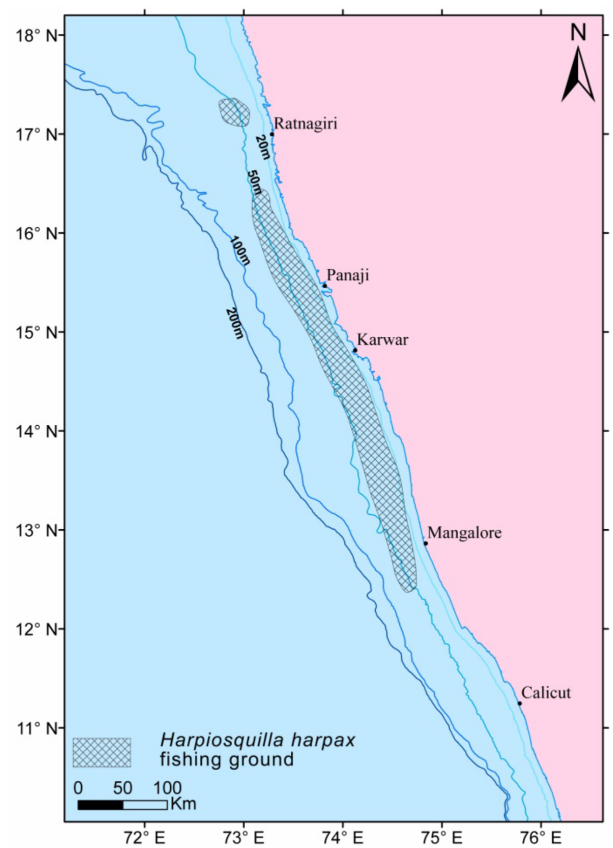

Fig. 5 — Map showing Species distribution of stomatopod, *Harpiosquilla harpax* .

Table 1 — Seasonal occurrence of the species recorded in the sampling trawler used for the spatial study.

Sl. No	Species	Months of occurrence/fishery
1	*Charybdis feriatus*	Throughout trawling period
2	*Charybdis lucifera*	Throughout trawling period
3	*Charybdis smithii*	January, February, March, August, October
4	*Harpiosquilla harpax*	March, April, May

along west coast these species do not have commercial value Studies on meat content of *C. lucifera* showed that it contained well balanced composition of amino acids and is recommended as one of the healthiest crustacean sea foods[11]. Apart from the edible value, the importance of these crabs as the source of food additives is highlighted by the studies by Ambati *et al.* (2014)[16]. The present study showed that *C. lucifera,* was found to occur regularly in the trawl catches throughout the trawling period and the distribution is found to be in the fishing grounds close to the shore. This information will help in rational exploitation of the species on a commercial scale. Stomatopods are considered as the major contributors for food of benthic fishes and shellfishes[17] and their role as human food is not much known from India. Stomatopod fishery in India is dominated by single species, *Oratosquilla nepa,* which is very small in size and has low meat content[12]. Species belonging to Harpiosquillidae are larger-sized species[18], and ever since the trawl fishery in Indian waters extended beyond 30 m depth zone, species like *H. harpax* started showing their presence in Indian trawl fishery. *H. harpax* is reported as serving an important role in commercial fisheries in south-east Asian countries[13] and the fishery potential of the species in India would open up a good opportunity for the export market of the species in near future.

Conclusion

The information on the availability of the species in space and time opens up new options for increasing marine fisheries production. The study shows that non-conventional crustacean resources caught by trawlers can be utilized as an excellent source of proteins if scientific exploitation and post-harvest strategies are ready in place. There is a need for awareness regarding the nutritive importance of the species to bring these resources into commercial fishery. The distribution maps prepared based on the sampling boat may not be giving an exhaustive picture of the distribution and biomass of the species; however, these maps will help to chart out species-based exploratory surveys to estimate the standing stock and exploitable biomass of each species in space and time to derive the exploitation strategies for these non-conventional resources.

Acknowledgement

The authors are thankful to Dr. A. Gopalakrishnan, Director, C.M.F.R. Institute, Kochi and Dr. Prathibha Rohit, Scientist-in Charge, C.M.F.R.I, Mangalore, for the facilities provided for the study and their constant encouragement. The first author is thankful to Department of Biosciences, Mangalore University for permitting to register for PhD. The co-operation and help provided by the fishing community from Mangalore fisheries harbour are acknowledged

References

1 Varadharajan, D., Soundarapandian, P. & Pushparajan, N., The global science of crab biodiversity from Puducherry coast, south-east coast of India. *Arthropods*, 2(1) (2013) 26-35

2 Dineshbabu, A. P., Radhakrishnan, E. V., Thomas Sujitha, Maheswarudu, G., Manojkumar, P. P., Kizhakudan, Shoba Joe, Pillai, Lakshmi S., Chakraborty Rekha, D., Josileen Jose, Sarada, P T., Sawant, Paramita Banerjee, Philipose, K.K., Deshmukh, V.D., Jayasankar, J., Ghosh, Shubhadeep, Koya, Mohammed, Purushottama, G. B. & Dash, Gyanaranjan., Appraisal of trawl fisheries of India with special reference on the changing trends in bycatch utilization. J. *Mar. Biol. Ass. India.*, 55 (2) (2013) 69-78

3 Manisseri Mary, K. & Radhakrishnan, E.V., *Marine Crabs.* In: *Status of Exploited Marine Fishery Resources of India,* CMFRI, Cochin, 2003, pp.188-194

4 Sukumaran, K.K. & Neelakantan, B. Marine crab fishery of Karnataka. *Seafood Export J.,* 27 (12) (1996) 5-14

5 Dineshbabu A .P., Sridhara, B. & Muniyappa, V., "Fishery, growth and stock assessment of Portunus sanguinolentus (Herbst) from south Karnataka coast, India. J. Mar. Biol. Ass. India., 49 (2) (2007) 141-147

6 Dineshbabu, A.P., Sridhara, B. & Muniyappa, Y. Biology and exploitation of the blue swimmer crab, *Portunus pelagicus* (Linnaeus, 1758), from south Karnataka coast, India, India. *Indian J. Fish*., 55(3) (2008) 215-220

7 Dineshbabu, A.P., Biology and exploitation of the crucifix crab, *Charybdis (Charybdis) feriata* (Linnaeus, 1758) (Brachyura: Portunidae) from Karnataka coast, India. *Indian J. Fish.,* 58(1) (2011) 25-29

8 Dash Gyanaranjan, and Dash Swatipriyanka Sen and Koya Mohammed, and Sreenath, K.R. and Thangavelu, R. and Mojjada Suresh Kumar, and Zala, M.S. Analysis of fishery and stock of the portunid crab, *Charybdis feriata* (Linnaeus, 1758) from Veraval waters, north-west coast of India. *Indian J. of Fish.*, 61 (4) (2014) 1-9

9 Silas, E. G. Exploratory fishing by Varuna, R.V. *Bulletin of the Central Marine Fisheries Research Institute*, No. 12, 1969, pp.1-86

10 Balasubramanian, C.P. & Suseelan, C. Distribution and population structure of deep water crab *Charybdis smithii (Decapoda: Portunidae)* in the Arabian Sea and Bay of Bengal, *Bull. Mar. Sci.,* 68 (3) (2001) 435-449

11 Kumari A.S.I., Shankar A.M., Jaganathan, K. & Soundarapandian, P. Determinations of minerals in marine crab *Charybdis lucifera* (FABRICIUS, 1798). *International Letters of Natural Sciences*, Vol. **45**(2015) 1-8

12 Shanbhogue, S.L., Studies on stomatopod crustacea from the seas around India. In: *Recent Advances in Marine Biology* Today and Tomorrow Printers and Publishers, New Delhi, 1986, pp. 515-567

13 Yan, Y., Yuying, Z., Guirong, W., Xiongbo, H., Chunxu, Z. & Huosheng, L. Seasonal Feeding Habits, Reproduction, and Distribution of *Harpiosquilla Harpax* (Stomatopoda: Harpiosquillidae) in the Beibu Gulf, South China Sea, *Journal of Crustacean Biology*, **35** (6) (2015) 776-784

14 Rao P Yedukondala., Rajendra Prasad, D., Rukmini Sirisha, I., Sreenivasa Rao, M. & Teja, G. Meat yield studies in *Harpiosquilla harpax* (de Haan, 1844) and *Oratosquilla anomala* (Tweedie, 1935) (Crustacea: Stomatopoda) represented in the shrimp trawl net by-catches off Visakhapatnam, east coast of India, *European Journal of Experimental Biology*, **5**(5) (2015) 6-11

15 Dineshbabu, A. P., Thomas Sujitha, & Dinesh, A.C., *Handbook on Application of GIS as a Decision Support Tool in Marine Fisheries, CMFRI Spl Publn.,* No. 121. ICAR-Central Marine Fisheries Research Institute, Kochi, 2016, pp. 1-104

16 Ambati, R.R., Phang, S.M., Ravi, S. & Aswathanarayana, R.G., Astaxanthin: Sources, Extraction, Stability, Biological Activities and Its Commercial Applications. A Review. *Marine Drugs*,12 (2014) 128-152

17 Menon, N.G., Impact of bottom trawling on exploited resources. In: Menon, N.G., Pillai. C.S.C. (Eds.). *Marine Biodiversity Conservation and Management*, Central Marine Fisheries Research Institute Cochin, 1996, pp. 97-82

18 Liu, R. & Wang, Y. On two new species of the Squilidae and Harpiosquillidae (Crustacea Stomatopoda) from the South China Sea. *Oceanologia et Limnologia Sinica* 29(1998) 588–596