BRACHYURAN DIVERSITY IN SUB LITTORAL ZONE OF TROPICAL ESTUARY, KARWAR, WEST COAST OF INDIA.

Shivakumar B. Haragi[1], Ulhas G. Naik[2] and J.L. Rathod[3]

1,2,3- Assistant Professor

Studies in Department of Marine Biology, Karnatak University Post Graduate Centre, Kodibag, Karwar – 581 303, Karnataka, India.

ABSTRACT

Kali estuary (14°50'21" N ; 74°09'05" E) being one of the productive ecosystem of Uttara Kannada, the maritime district of Karnataka located in the west coast of India is known for its verdant mangrove diversity. Totally 13 species of true mangrove were recorded belonging to 8 genera and 6 families. In addition to this, there is associated mangrove floras were also been recorded comprising 7 species (5-genera and 3-family). Among mangroves, family Rhizophoraceae represents 5 species and 3-genera where as in associated flora dominant family was Fabaceae. This mangrove ecosystem harbours diversified fin and shell fish but present study focused mainly on brachyuran crabs diversity. The 20 species of crabs belonging to 14 genera and 6 families have been recorded from sub littoral zone of the estuary. Dominant genera represented are *Ocypode* and *Sesarma*. But, *Scylla serrata* is the only commercial species found amidst the rich floral growth of *Rhizophora apiculata* and *Avicennia* sp. associated with soft mud. Some crab species are site specific with respect to mangrove flora. *Portunus sanguinolentus* and *P. pelagicus* were absent in this biotope. *Sesarma edwarsi* and *Varuna litterata* were observed during the rainy season especially when low salinity regime established (between 2 to 5 psu). Crab fishery, their landing and culture aspects along the estuary is also discussed briefly to give some information on their culture potentials. Conversion of mangrove area into shrimp farm, industrialization, sand mining and excavation of shell fossils are major threat to crab diversity in this area.

Keywords: Brachyuran, Mangrove, Estuary, Crab fishery and Diversity.

INTRODUCTION

India is one of the few countries of world bestowed with diverse marine ecosystem structuring estuary, lagoons and backwaters. Estuarine mangrove forests are among the most biologically productive ecosystem. Mangroves are the most conspicuous photosynthetic organisms along the coast contribute substantial amounts of food energy to coastal waters. The mangrove ecosystem provides an ideal nursery ground for many aquatic organisms and the root system of these plants also traps the rich nutrients laden soil, which prevent soil erosion. An estimated of 75% commercial fishes are caught; spend some time in mangrove area (Ilka and Marsha, 2002).. Kali estuary is a productive region of Western Ghats, represents rich mangrove diversity and harbors a plethora of organisms.

The group of brachyurans forms very conspicuous and bio-ecologically very important faunal constituents in estuarine forests and may belong to different species and even families. There are 6793 species of crabs in the world found in all the oceans. The smallest crab is Pea with only few mm wide and the largest in Japanese spider crab (Peter *et al*., 2008). Mangrove crabs are wonderful and colorful creation of nature. They are very active on mud flats in low tide and display a variety of behavioral pattern. Although mangrove crabs are omnivores that eat both plant and animal matter, their diet relies heavily particularly on mangrove leaves, they prefer the leaves of the *Rhizophora* and *Avicennia* (Soundarapandian et al., 2008). The crabs play a significant role in detritus formation, recycling of nutrients and overall dynamics of the ecosystems, (Funde *et al.,* 2009). Crabs form one of the most conspicuous animals in the mangrove forests, the dominant commercial genera in the Kali estuary region is *Scylla* and *Sesarama.* In India, the exports of mud crabs alone contribute to 1948 tons which earn revenue up to 46.2 Crore rupees. Live crabs exported during 2009-10 were 5492 tons which show as increasing trend when compare to 2008 -09 which is 3434 tons (MPEDA). All the edible crab meats are rich in vitamins, stimulate brain cells and are good for colds, asthma, eosinophil, primary complex, wheezing. All the brachyuran crabs are indirectly important as their larvae are consumed by many predators and omnivorous fishes and they play a vital role in the transfer of energy through the food chain.

Kali estuary is one of the hot spot regions of Western Ghat because of the future industrialization. Ample work has been done on mangroves, finfish and shell fish diversity (Andrade 2003; Desai 1994 andShivakumar 2009). The data available on the crabs of Kali estuary are sparse. In view of this the principal goal of the present investigation is to survey and to revise the data on mangrove associated brachyuran crabs of Kali estuary.

MATERIALS AND METHODS

Following four study stations were selected based on the rich mangrove diversity for survey of brachyurans and monthly physico-chemical analysis.

Table 1. Details of the study location of Kali estuary.

Station	Study area	Location	Extent (Hectare)	Sediment
Station 1.	**Devabag and Mavinhole creek**	**$14^0$50'41''N;$70^0$07'18''E**	**2.5 and 10.5**	**Sandy silt**
Station 2.	**Kanasgiri**	**$14^0$51'28''N:$74^0$09'08''E**	**2.6**	**Silty clay**
Station 3	**Sunkeri and Kadwad**	**$14^0$50'18''N:$74^0$10'03''E**	**18.5**	**Sandy silt & clay**
Station 4.	**Hankon**	**$14^0$52'53''N;$74^0$10'47''E**	**8.0**	**Sandy clay**

Present survey was undertaken for the period of one year (2009-10) in the Kali estuary covering around 12km stretch (Figure 1). Study stations were falls within the grid of different biotopes like estuary, backwater and freshwater regime etc. Monthly physico-chemical analysis such as temperature, salinity, dissolved oxygen and pH, was measured in-situ with hand held DO meter (HACH).

Methods of collection and preservation of Brachyuran crabs:

Crabs were surveyed and unidentified species were collected in the monthly intervals for the period of one year from March 2009 to Feb 2010 along with the physico-chemical analysis. Most of the observation and collections were made during low tides from the study area by hand picking. Crabs were preserved in 70% alcohol tinged with formalin for the laboratory studies. The species were identified following the method as described by Kakati (1980).

The density of crabs were subjected to statistical analysis calculated in terms of number of individuals or specimens (N), number of species (S), Margalef species richness (d), Shannon-Weiner index (H′) at each site. Bray Curtis similarity for species diversity for all the species belonging to brachyuran crabs determined analytically by PRIMER-v5.

RESULTS AND DISCUSSION

The physico-chemical analysis studied reveals that the water quality at the study sites is congenial to the ecological requirements of biota and the average data were represented in the Figure 2.

The study comprises the findings of distribution and diversity of mangrove and associated crabs in four different stations located in Kali estuary at Karwar. Aspects of the study covered were survey, taxonomy and diversity. Of the 15 species of true mangroves reported from Karnataka as many as 13 species were representing in this region. Most abundant mangroves are *Avicennia* (3 species), *Bruguiera* (2 sp.) *Rhizophora* (2 sp.) *Sonneratia* (2 sp.) and one species of each of *Aegiceras*, *Excoecaria*, *Lumnitzera* and *Kandelia* respectively (Nayak 2010). The mangrove species diversity was presented in the Table 1 along with the study stations. Among these *Rhizophora apiculata*, *Avicennia officinalis*, *Sonneratia alba* and *Excoecaria agallocha* are the most dominant species. All the recorded 13 species of mangrove along the Kali estuary were observed in the Devbagh and Mavinhole creek. The species like *Bruguiera cylindrica* was restricted to Devbag area only where as *Bruguiera gymnorrhiza* and *Lumnitzera recemosa* were found in both Devbagh and Kanasgiri area.

Brachyuran crab distribution in the mangrove zones with reference to four stations shows rich diversity (Table 2). The crab prefers sand mixed areas, but always found burrowing in muddy sand substratum. Sediment was predominantly sandy at Devbagh station with high salinity as this area located at closer proximity of estuary mouth where tidal influence is maximum. Kanasgiri, Sunkeri and Hankon were dominant in muddy bottom with rich organic matter. Devbagh and Kanasgiri were dominant representing areas of brachyuran. Devbagh represents 17 species where as Kanasgiri followed by 15 species. *Ocypode* family among the dominant group of brachyurans represents at Devbagh. The species like *S. proxima, P. elongates, Ebalia malefactrix* and *Neorhynchoplax demeloi* were restricted towards the estuary mouth which shows their high salinity preference. The Sunkeri and Hankon represent 12 and 10 species of crabs respectively. The Species like *Varuna litterata* and *Sesrma edvarsi* were recorded in the Hankon during low saline regime. *Uca* and *Dotilla* were recorded abundantly in all seasons in almost all the study area from inter tidal zone where the fringing mangrove distribution is established.

Sesarma and *Metapograpus* species are profuse in dense mangrove area where lush growth of pneumatophore zone where the tree of mangrove can grow up to 10 to 15 meters like *Sonneratia*, *Avicennia* and *Bruguiera*. *Metapograpus maculates* (*latifrons*) are also called as tree climbers and feeds on vegetation. Karwar coast is represented by 50 species of crabs belong to 38 genera representing 11 families including inter tidal and rocky shore (Kakti 1980). Based on the survey along the Kali estuary, 20 species of crabs belongs to the 14 genera and 6 families have been recorded during the study period. Study area was restricted up to Hankon 12 km from the estuary mouth were the average salinity lies is more than 10 psu during tidal influence. Beyond this region tidal influence is negligible. A dominant genus represented was *Ocypode* followed by *Sesarma*. *Ocypode* were most dominant forms after the post monsoon seasons which play a vital role in recycling the nutrients. Possible reason for the abundance is availability of maximum organic matter through the river runoff during monsoon seasons.

The results of various diversity indices calculated are given in Table 3 & 4. In line with the higher number of species and abundance in Kali estuary, the Shannon diversity (Loge) was more at Devbagh (2.7165) followed by Kanasgeri (2.2896) and Hankon (2.1055) but in Sunkeri area it comparatively very low (1.8570). The Margalef species richness showed clear difference between the four study areas registering high richness values at Devbagh (3.8618) and low at Sunkeri habitat (2.7976) this showed similar trend as it was found in diversity index pattern. However, the variation in taxonomic distinctness index was more at Devbagh habitat (0.9416) and less at Sunkeri (0.7796).

The similarity in species composition and abundance among stations of Kali estuary was in the range of 51.089 -71.308 (Table 4) with an average similarity percentage of 63.182. The dendrogram (Figure 3) drawn revealed clearly the separate grouping of study stations of Kali estuary. Stations 1 and 2 formed one cluster at a similarity percentage of 94.5 to which station 3 got linked at 87.5. These two groups ultimately got linked at a percentage similarity of 71. Crabs thrive well in the mangroves mainly due to a variety of microhabitats available in the form of various roots of mangrove plants (Khan *et al*., 2005). Species arboreal in nature particularly sesarmids abound in such habitats. Besides this, densed shaded portions of mangroves provide a good habitat to species intolerant to bright sun and dry air (Macnae, 1967). In the present study it was focused on to compare the diversity of crabs in the different habitats of Kali estuary, Karwar in the thick and sparse mangrove ecosystem. In the nut shell, the brachyuran crab diversity can be considered to reflect the well-being of the mangrove habitats. Keeping this in view, the present study was undertaken to ascertain the crab diversity in the lower reaches of the Kali estuary.

Out of twenty species observed over twelve months, *Scylla serrata* (mud crab) found in the all study area. Among these areas, Sunkeri recorded abundant of *Scylla serrata*. In Sunkeri area, *Scylla* is highly dominated along with the wide spread of muddy flats (Prasad, 1989). Some of the other Indian estuary were noticed the *Potrunus* species in the estuarine region (Roy and Nandi 2008). But with reference to this study area, *Portunus* species were not recorded in any of the seasons. This could be due to the low saline regime established in this biotope, which may be the factor responsible for the non availability of this species. Sunkeri and Kanasgiri of this estuary forms the major fishing ground of *Scylla serrata*, where there is high rate of fishing activities is being carried round the year by the fisherman communities like Bhoi, Paghis and Ambigs. These commercial shell fishes were mainly caught by the trap net and cast nets. Crab culturing or fattening are not being practiced in this region. Supply of wild (live) crabs weigh up to 500gm each and are exported to Chennai through Bangalore by local suppliers. Survey on fishing communities revealed that various communities are also involved in crab fishing for recreation, some portion of collected crabs used for domestic consumption and for local market.

Industrial development, sand mining, charcoal, timber industries, urban growth pressure, pollution problem and mainly conversion of mangrove area into aquaculture ponds along the estuary are greatly reduced mangrove acreage, which is the greatest cause for the depletion of biodiversity (Subramanian 2000). Since the Kali estuary known for its rich biodiversity, this area has been proposed for declaring as a heritage site to the Government of Karnataka as part of conservation measure. Wanting of planed ecotourism's and non polluting industries is the preferable economic hub along the estuary.

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Figure 1. Map showing locations of study stations

Fig. 2 Monthly variations (average) of physico-chemical analysis along study stations.

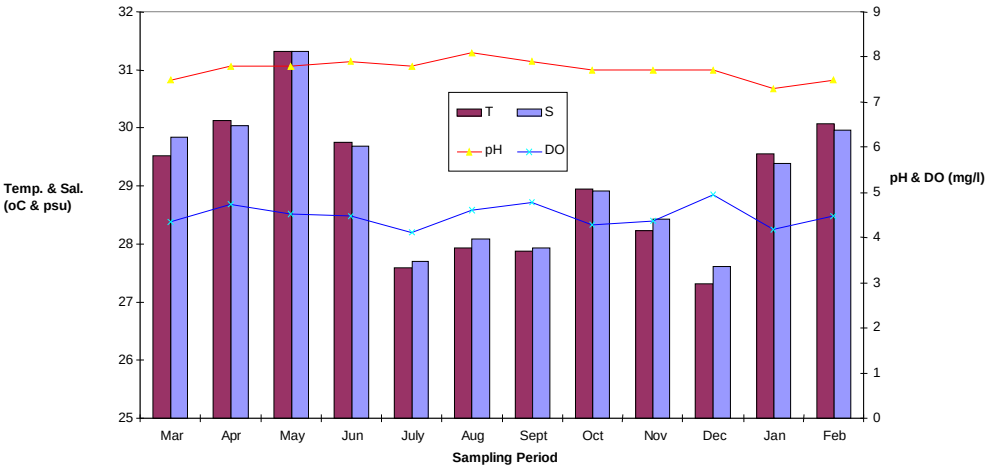

Table 1. Distribution of mangrove species at study stations, Kali estuary.

Mangrove species	Station 1	Station 2	Station 3	Station 4
Family Rhizophoraceae				
Rhizophora mucronata	+	+	+	+
Rhizophora apiculata	+	+	+	+
Bruguiera cylindrica	+	-	-	-
Bruguiera gymnorrhiza	+	+	-	-
Kandelia candel	+	+	+	+
Family Avicenniaceae				
Avecennia marina	+	+	+	+
Avicennia officinalis	+	+	+	+
Avicennia alba	+	-	-	-
FamilySonneratiaceae				
Sonneratia caseolaris	+	+	-	+
Sonneratia alba	+	+	+	-
FamilyAcanthaceae				
Acanthus illicifolius	+	+	+	+
FamilyCombretaceae				
Lumnitzera recemosa	+	+	-	-
Family Euphorbiaceae				
Excoecarea agallocha	+	+	+	+
Family Myrsinaceae				
Aegiceras carniculatum	+	+	+	-

Stn. 1: Devbagh & Mavinahole ; Stn. 2: Kanasgiri ; Stn. 3: Sunkeri & Kadwad ; Stn. 4: Hankon

Table 2. Occurrence of Brachyuran crabs at study stations, Kali estuary.

Brachyurans species	Station 1	Station 2	Station 3	Station 4
Family Ocypodidae				
Ocypode cordimonus	+	+	-	+
Ocypode ceratophthalmus	+	+	-	+
Uca annulipes	+	+	+	+
Dotilla myctiroides	+	+	+	-
Macropthalmus parvimanus	+	+	+	-
Scopimera proxima	+	-	-	-
Macropthalmus brevis	+	+	+	+
Family Grapsidae				
Metapograpus maculatus	+	+	+	-
Metapograpus messor	+	+	+	+
Varuna litterata	-	-	-	+
Pseudographus elongatus	+	-	-	-
Pseudographus intermedius	-	+	+	-
Sesarma quadratum	+	+	+	+
Sesarma lanatum	+	+	+	+
Sesarma edwarsi	-	-	-	+
Family Portunidae				
Scylla serrata	-	+	+	+
Thalamita crenata	+	+	+	-
Family Xanthidae				
Eurycarcinus orientalis	+	-	+	-
Family Leucosiidae				
Ebalia malefactrix	+	-	-	-
Family Hymenosomatidae				
Neorhynchoplax demeloi	+	+	-	-

Stn. 1: Devbagh & Mavinahole ; Stn. 2: Kanasgiri ; Stn. 3: Sunkeri & Kadwad ; Stn. 4: Hankon

Stations	S	N	d	J′	H′[loge]	1-lambda
Devbagh	17	63	3.8618	0.9588	2.7165	0.9416
Kanasgiri	14	69	3.0703	0.8676	2.2896	0.8785
Sunkeri	12	51	2.7976	0.7473	1.8570	0.7796
Hankon	11	27	3.0341	0.8780	2.1055	0.8746

Table 3. Diversity indices of brachyurans crabs in Kali estuary.

Table 4. Bray-Curtis similarity for brachyurans crabs collected from different stations of Kali estuary

	Station 1	Station 2	Station 3	Station 4
Station 1	0	0	0	0
Station 2	71.308	0	0	0
Station 3	58.438	76.646	0	0
Station 4	51.089	61.256	60.355	0

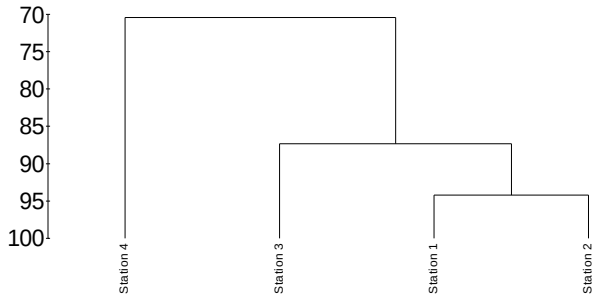

Figure 3. Dendogram of brachyuran crabs recorded in various stations of Kali estuary.