The inventory of estuarine and marine decapods of Karnataka State of India has been prepared. This list has 42 species of shrimps/prawns, 112 species of brachyuran crabs, 14 species of hermit crabs and nine species of lobsters, collected from eight estuaries and coastal/ offshore waters of Karnataka State. The status of the exploitation of the important species in the inventory and the need for their conservation are highlighted in this paper. The study also brings out the first records of the decapods from the coast. The finding of the present study will serve as a baseline information to know the temporal changes taking place in decapod diversity of south-west coast of India as a whole and of Karnataka State in particular as a result of the technological developments in fisheries and other anthropological activities in estuarine marine ecosystems.

Introduction

For conservation and management of an ecosystem, one of the basic tools that is commonly used by managers is inventories. Inventories can be maps, lists, point source information, or numbers describing or monitoring some aspects of animals, plants or ecosystems through space or time. For management and conservation of an ecosystem, an enormous array of inventories over components of biodiversity is essential. The inventories of various components act as a baseline information to know the temporal changes in the ecosystem consequent to changes in species abundance and their diversity. Decapod crustaceans, comprising numerous edible species of shrimps, lobsters and crabs and inhabiting different ecosystems, form a significant portion of aquatic food resources of the world. Conservation of these resources is important from commercial as well as ecological point of view. India has ever remained one of the major contributors of marine crustacean production to the world. Among crustaceans, shrimps are the most commercially exploited group and they hold premier rank by virtue of their importance as an esteemed food of gourmets and because of their high export value. As in the case of most countries of tropical region, the shrimp fishery of India is also in the nature of multi-species composition. The common species supporting the shrimp fisheries of India belong to two major categories namely the "penaeids" and "carideans". The penaeid shrimps form the backbone of the seafood industry of the country as a major foreign exchange earner as well as a source of livelihood of millions of fish workers (Nandakumar and Maheswarudu, 2003). Almost all the shrimps and lobsters are having...
commercial value as human food. Crabs, especially true crabs, or 'brachyuran crabs' form a major constituent of the decapod fauna in terms of their species diversity. Apart from edibility value, most of the species of this group play a key role as a major link between primary and secondary producers. The burrowing members are of immense use in the recycling of organic matter in the ecosystem (Ajbalkhan et al., 2005).

Decapod crustaceans form a major food item for most of the demersal fishes. India is endowed with a rich fauna of edible crustaceans, several of them supporting commercial fisheries since times immemorial. At present, as many as 150 crustacean species mostly form a regular part of the commercial catches and an occasional part at some centres. Decapod crustaceans are commercially the most important crustaceans forming a part of faunistic record of Indian decapod crustaceans, constituting as many as 117 species of shrimps and prawns. 17 species of lobsters and 12 species of edible crabs inhabit marine and contiguous estuarine area that comes under the domain of commercial fishing (Suseelan, 1996).

Estuaries and backwaters have an important role in the survival of many crustaceans. They provide a permanent habitat for many of them, while many others utilise these areas as their nursery and breeding grounds. About 70 species of shrimps and prawns are known to occur in the estuarine systems of India. Of these, 28 are penaeid shrimps, four are serrastaeid shrimps and 25 are caridean prawns (Suseelan, 1996). While a good account of brachyuran fauna was given by Chapgar from Bombay (Mumbai) waters as early as 1957, in recent years, as compared to the records available from the east coast of India, published information from the west coast is very meagre. Chapgar (1957) reported 81 species of crabs along Bombay coast. According to the recent reports (Venkataramanan and Wafer, 2005), total carcinological fauna of west coast waters of India consists of 254 species of crabs, belonging to 120 genera under 24 families.

Due to the technological developments in the marine fishery sector, the exploitation of the fishery is being continuously extended to deeper grounds. As a result, non-conventional crustaceans are being added to the inventory of decapod crustaceans every year (Dineshbabu et al., 2001). Due to heavy fishing pressure along the coast, many species are facing drastic stock depletion, since several of them are targeted species and few are caught as by-catch. For the estimation of biodiversity changes occurring due to these anthropogenic changes, a database of baseline information is essential and this baseline will help in future management and conservation of these resources. While biology, distribution and management of commercially important species of marine waters off Karnataka coast are well studied and documented, information regarding non-edible species, especially 'true crabs' and 'hermit crabs' is not available in a documented form. Wide distribution of brachyuran crabs in the various ecological systems, such as sandy beaches, rocky foreshores, mud flats, marshes and mangrove swamps etc., make comprehensive study of the group very difficult. Even though studies of non-edible crabs were carried out by students and faculty of various universities, there is no authentic published report available on the species diversity of brachyuran crabs from waters off Karnataka coast, so is the case with hermit crabs also.

**Study Area and Methodology**

Marine shrimps, crabs and lobsters were collected from commercial catches of marine and estuarine waters of Karnataka during the period 2001-2007. In 2006, intensive survey for preparing an inventory was carried out in eight important estuaries, from Kali estuary in the north to Netravathi-Gurupur estuary system in the south (Fig. 1), five islands, Kurumgad island in the north and St. Mary's island in the south and ten inter-tidal areas representing the entire coastline of Karnataka. Estuarine collections were carried out by cast netting and drag netting. Collections out of gillnet and other entangling nets were not carried out. For the estimation of biodiversity changes occurring due to these anthropogenic changes, a database of baseline information is essential and this baseline will help in future management and conservation of these resources. While biology, distribution and management of commercially important species of marine waters off Karnataka coast are well studied and documented, information regarding non-edible species, especially 'true crabs' and 'hermit crabs' is not available in a documented form. Wide distribution of brachyuran crabs in the various ecological systems, such as sandy beaches, rocky foreshores, mud flats, marshes and mangrove swamps etc., make comprehensive study of the group very difficult. Even though studies of non-edible crabs were carried out by students and faculty of various universities, there is no authentic published report available on the species diversity of brachyuran crabs from waters off Karnataka coast, so is the case with hermit crabs also.

**List of decapod crustaceans collected from estuaries of Karnataka**

| Shrimps (4 families and 19 species) |
| Family 1: Alphediaceae |
| *Alphius malabaricus* |

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Fishing Chimes

Alphius palaudicola
Alphius rapax

Family 2: Atydae

Family 3: Palaeomonidae

Macrobrachium equidens
Macrobrachium rosenbergii
Macrobrachium idella
Macrobrachium lamerei
Macrobrachium malcolmsonii
Leadnites celebensis

Family 4: Penaeidae

Metapenaeus affinis
Metapenaeus dobsoni
Metapenaeus monoceros
Penaeus canaliculatus
Penneropenaeus indicus
Penneropenaeus murguensis
Penaeus monodon
Penaeus semisulcatus

Family 5: Majidae

Family 6: Ocypodidae

Family 7: Portunidae

Asterias alcocki
Parapenaeus fissuroides indicus

Alphius palaudicola crenata
Potamides cingulatus feriatus, Charybdis lucifera, Portunus serrata, Scylla tranquebarica, Thalamita matuta, Munida multidentata, Dilocardia barbata, Hymenocera tenuicrustata, Hermit crabs

Crabs (9 families and 35 species)

Family 1: Eriphiidae

Family 2: Grapsidae

Sesarma tetragonum, Metopograpsus maculates, Varuna littorata, Pseudograpsus elongates, Pseudograpsus intermedius, Sesarma quadratum, Sesarma edwarsi, Sesarma lanatum, Pericon planissimum, Grapsus tonicuscrustus

Family 3: Hymenosomatidae

Neorhynchoplax demeloi, Eleneina cristatipes

Family 4: Leucosidae

Philyra globosa, Philyra corallicala

Family 5: Majidae

Meneelitus monoceros

Family 6: Ocypodidae

Gelasimus marionis, Gelasimus annulipes
Gelasimus dussumieri, Macrophthalmus latreillei, Macrophthalmus depressus, Macrophthalmus cintrus, Uca annulipes

Family 7: Portunidae

Charybdis riversandersoni, Charybdis ferratus, Charybdis lucifera, Portunus pelagicus, Portunus sanguinolentus, Scylla serrata, Scylla tranquebarica, Thalamita crenata

Family 8: Potamidae

Potamides cingulatus

Family 9: Xanthidae

Pilumnus longicornis, Atergatis floridus
Atergatis roseus

(1 family and one species)

Family 1: Diogenidae Cibenerius padavensis

Shrimps: Shrimp resources of Karnataka are a well studied group since all the species belonging to this group are commercially important. A total of 33 species of shrimps, belonging 8 families were collected from coastal and marine zones of Karnataka. Penaeidae was the largest family with 16 species and all the species belonging to the family were collected from within 50 m depth zone and these are commercially very important. Metapenaeus dobsoni, M. monoceros, M. affinis, Fenneropenaeus (Penaeus) indicus, F. murguensis, Penaeus monodon, P. canaliculatus, P. semisulcatus, Parapenaeopsis stylifera, Trachysalambria (Trachypenaeus) curviostris and T. sedelli form regular part of the shrimp fishery, whereas others were found seasonally and some times in stray numbers. Parapenaeus fissuroides indicus is the first record from Indian coast (Fig.3).

Solenocera family along Karnataka coast is represented by species from mid-shelf (Solenocera chaprai and S. pectinata) and from deep-sea (S. hextili). S. chaprai is a commercially very important species which was caught in huge numbers from a depth of 60 to 100 m off Mangalore and Malpe. Other deep-sea varieties belong to Aristidae, Pandalidae and Sicyonidae families. Out of these, Aristidae is commercially the most important family. Aristaeus alcocki, known as ‘red-rings’ and belonging to Aristidae were caught in good numbers from a depth of 150 to 500 m off Mangalore-Kundapur. From the same fishing ground, 6 species belonging to Pandalidae family were also caught, of which Heterocarpus gibbosus was found in good numbers and all others represented in stray numbers. ‘Jawala shrimps’ (Acetes spp) belonging to Sergestidae family were found distributed along the coast and they seasonally formed a good fishery and most importantly these shrimps form major food items of most of the carnivorous fishes and other marine fauna. Rhynchocinetes durbanensis, shrimps belonging to Rhynchocinetidae family, were collected from Netrani island and these were the first record of the species from the coast (Fig.4). Commercially, this very important ornamental species is having heavy demand all over the world.

Brachyuran crabs: Among decapod macro-fauna, brachyuran crabs or true crabs are the most abundant in terms of species diversity. 105 species of true crabs belonging to 18 families were collected from Karnataka coast. Among others collected were those of Portunidae and Xanthidae, the biggest families with 19 and 17 species respectively. From a commercial angle, Portunidae is the most important family for the reason that it mostly consists of edible species. Portunidae is represented by 19 species, out of which Portunus pelagicus, P. sanguinolentus and Charybdis feriatus are the major species forming a commercial fishery. C. lucifera is also considered as edible species. Scylla serrata and S. tranquebarica which belong to the estuarine ecosystem also occur in coastal waters of Mangalore. C. smithi which is caught from deeper waters also is an edible species, landed occasionally. P. gracillimanus was identified in the catches from west coast of India (Fig.5) and this as the first record of its occurrence in the west coast. Even though many of the crabs are non-edible, these crabs are caught as by-catch by trawlers and are used for making fish meal. From catches of commercial trawlers, 9 species of coral reef related crabs (7 species from Xanthidae family and 2 from Carapidae family) were collected. This is indicative of the presence of a submerged coral reef off Karnataka coast. As far as zonal distribution is concerned, Portunid crabs Portunus pelagicus, P. sanguinolentus, Charybdis lucifera, C. feriatus, C. annulata, Scylla serrata, S. tranquebarica, Grapsid crabs Grapsus albinolaeus and G. tenticrusatus, Parthenopon crab Ashtoret (Matuta) lunaris, Ocypod crab Uca (Celucu) annulipes and Xanthid crab, Leptodius exactus had been found to have a wide distribution throughout the coast.

Lobsters: Nine species of lobsters belonging to 3 families were collected from Karnataka coast. While coastal species like Panulirus homarus, P. polyphemus, P. versicolor and Thenus orientalis could be collected in few numbers, deep-sea species, Puerulus sewelli and Nephirops swartii (Fig.6), caught from deep waters (beyond 150m) off Mangalore coast, were found in good numbers. P. polyphemus and P. versicolor were found on the coral reef around Netrani island and other coastal species were collected from trawl collections. Until late 1970s, while there were reports that good number of P. homarus were caught from Mangalore coast, during the period of survey the catches of this species were in few numbers. In the case of T. orientalis also there was alarming reduction in the distribution and now the species is recorded as a rare occurrence.
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Hermit crabs: Fourteen species of hermit crabs were collected from the marine regime of Karnataka waters. Out of these, 13 belonged to Diogenidae family and one belonged to Paguridae family. Four more species of these crabs also were collected from inter-tidal area and one (Clibanarius aequabilis) was collected from Devgadh island.

List of species collected from marine zone along Karnataka coast.

Shrimps (8 families and 33 species)
Family 1: Alpheidae
Alphius malabaricus; Alphius paludicolophus
Family 2: Aristaeidae
Aristeus alicockii
Family 3: Pandalidae
Heterocarpoides levicarinus; Heterocarpus gibbosus; Heterocarpus sibogae; Heterocarpus woodmasoni Plesionika spinipes Plesionika markia
Family 4: Penaeidae
Fenneropenaeus indica; Penaeus monodon
Family 5: Pandalidae
Metapenaeus affinis
Family 6: Grapsidae
Carpilius maculatus
Family 7: Hymenosomatidae
Philyra scabriuscula; Leucisca squalina
Family 8: Leucosidae
Leucosia sima
Family 9: Majidae
Ophryopsulamia cervicornis
Family 10: Menippidae
Menippa raphinthil
Family 11: Ocypodidae
Uca annulipes
Family 12: Parthenopidae
Matuta planipes; Galene bispinosa
Family 13: Pinnoweridae
Pinnoweres placuca
Family 14: Plagusidae
Plagiusa tuberculata
Family 15: Portunidae
Scylla serrata; Scylla tranquebarica
Family 16: Raninidae
Ranina ranina
Family 17: Trapizidae
Tetralia caven	ma
Family 18: Xanthidae
Etrsus levimanus; Leptodius exaratus
Zoysmyne anaeus; Plodius arauolus
Phymoidus monticulous; Phymoidus ungulatus; Phymoidus nitidus; Chlorodiella nigra; Psephoaliuma speciosa; Atergatis subjacent; Atergatis integerimanus; Menippe rumphi; Ozius rugulosus; Ozius tuberculous; Epixanthus frontalis; Pilumnus vespertilio; Eurycarcinus orientalis

III. Hermit crabs
(2 families and 14 species)

Family 1: Diogenidae
Paguristes incomitatus; Clibanarius infraspinatus; Clibanarius paddavensis; Clibanarius aequabilis; Clibanarius arethusa; Diogenes Diogenes; Diogenus affinis; Diogenes planimanus; Diogenes vilaceus; Diogenes miles; Diogenus avarus; Dardanas setifer; Troglopagus manaarenis
Family 2: Paguridae
Pagurus kulkami

IV. Lobsters (3 families and 9 species)

Family: 1. Nephropidae
Nephrops stewarti
Family: 2. Palinuridae
Panulirus homarus; Panulirus polyphagus; Panulirus versicolor
Panulirus ornatus; Panulirus penicillatus
Panulirus longipes; Puerulus sewelli
Family: 3. Scyllaridae
Thenus orientalis

Shrimps of Peneaeidae family, except Parapenaeus, Parapenaeopsis and Tachysalambria genera need estuaries and low saline coastal waters for the growth and survival in their larval and juvenile stages. Changes in the estuarine ecosystem were found to influence the recruitment of this species to the adult fishery. Protection to the stock of commercially important decapods, especially shrimps.
Applications are invited for consideration to grant permission by CAA to import SPF brood stock of *L. vannamei* and seed production from shrimp hatcheries in the country to those who fulfill the following criteria:

i) Hatcheries should already have been registered under the provisions of Coastal Aquaculture Authority Act, 2005.

ii) Hatcheries should be having the required bio-security facilities viz. fencing, tyre baths, footwash, handwash, etc., and separate implements for each section.

iii) There should be a PCR Laboratory with the required kits and reagents having a qualified laboratory technician.

iv) ETS should be functional in the hatcheries.

Applications may be sent to the CAA in the prescribed format for import of brood stock from the approved list of suppliers available in the website of CAA (www.caa.gov.in). A processing fee of Rs. 5,000/- (Rupees five thousand only) per annum to be paid through demand draft drawn from any nationalized bank in favour of the Coastal Aquaculture Authority payable at Chennai shall accompany the application. Approval of the facility for rearing SPF *L. vannamei* shall be granted by CAA only after due inspection of the facility. After the approval of the CAA, the hatchery operators are required to obtain the Sanitary Import Permit (SIP) from the Department of Animal Husbandry, Dairying and Fisheries before importing the brood stock. All imports of SPF *L. vannamei* brood stock shall have to undergo strict quarantine procedures at the quarantine facility located at the Rajiv Gandhi Centre for Aquaculture (RGOA) facility at Neelankarai, Chennai to be operated by MPEDA and in accordance with the guidelines brought out in the Notification of DAHDF, available in the website of CAA.

Applications shall be scrutinized and processed by the CAA during the month of March 2011 to enable the selected hatcheries to commence seed production of SPF *L. vannamei* from April 2011 onwards for meeting the requirement of *L. vannamei* seed for the financial year 2011-12.

Member Secretary