A Study on the Diversity of Carangid Resources off Cochin, Kerala

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The Family Carangidae includes diverse marine fishes that are ecologically and economically important species such as the jacks, scads, trevallies, pampano, amberjacks and queenfishes. Most are either deep bodied neretic bottom feeders or more slender neretic planktivores. A few species such as the rainbow runner and pilot fish are pelagic, typically found in the open ocean. Carangids are found in all tropical and subtropical marine waters of the world, and some occur in temperate regions. In India, fishes of the Family Carangidae are widely distributed along both coasts of India. During 2008, an estimated 1.22 lakh t of carangids were landed, constituting 4.6% of 3.21 million t of marine fish production in India. Among the pelagic fishery resources, carangids constitute the fourth important resource and rank next to oil sardine, ribbonfishes and mackerel (CMFRI, 2008). Though there are scattered reports of carangids along both coasts, the carangid fishery off Cochin is not well documented. In this paper, carangid fishery off Cochin and taxonomy of the carangids is discussed, in the context of increasing importance given to biodiversity documentation and conservation.

Material and Methods

Landings of carangids were observed by all gears at Munambam, Cochin Fisheries Harbour, during the years 2003-07. A total of 463 fishes were collected from the landings of different gears such as trawls, purse seines and drift gillnets. The samples were selected at random from the landings in case of dominant species. Care was taken to collect as many rare and less represented species, as possible. The fishes collected were brought to the laboratory and tentatively identified. They were then subjected to detailed taxonomic studies. Meristic and morphometric studies followed Hubbs and Lagler (1941) with certain modifications. The counts and measurements were subjected to detailed analysis before the taxonomic placement of the fish was finalized. Catch statistics were also noted from the commercial landings. Morphometric and merisitic characters measured are defined in Table 1.

Table 1: Morphometric and meristic characters measured

Morphometric characters	
Total length (TL)	Length of the body from the tip of the snout to vertical through tip of the longest caudal fin lobe
Fork length (FL)	From the tip of snout to tip of shortest median caudal fin ray
Head length (HL)	From tip of snout to posterior margin of the fleshy opercular membrane
Eye diameter (ED)	Horizontal diameter of the bony orbit located (if necessary)
Inter-orbital width	Least distance measured across the top of the head between the bony orbits.
Body depth (BD1)	From origin of the first dorsal spine to dorsal point of insertion of the pelvic fin.
Body depth (BD2)	From dorsal tip to the origin of the anal fin.
Snout length	Least distance between tip of snout and bony orbit
Upper jaw length (UJL)	From tip of snout to posterior end of maxilla
Lower jaw length (LJL)	From tip of snout to posterior end of lower jaw
Base D1	Length of the base of the first dorsal fin
Base D2	Length of the base of the second dorsal fin
Base A1	Length of the base of the anal fin
Pectoral fin length (P1)	From dorsal point of origin of the spine to the tip of the longest ray
Pelvic fin length (P2)	From anterior point of origin of the spine to the tip of the longest ray
Straight lateral line (SLL)	Straight section of lateral line from junction with curved section to posterior point of last lateral line scute or scale on caudal base
Curved lateral line (CLL)	Chord of arc from first pored scale to junction with straight section of lateral line
Pre-dorsal I	Length from tip of snout to origin of first dorsal fin
Pre-dorsal II	Length from tip of snout to origin of second dorsal fin
Pre-pelvic	Length from tip of snout to anterior point of origin of pelvic fin
Pre-pectoral	Length from tip of snout to dorsal point of origin of pectoral fin
Pre-anal	Length from tip of snout to origin of anal fin
Meristic characters	
Dorsal fin count	Includes the fin spines and rays
Anal fin count	Includes anal spines and rays, if externally visible as well as the two detached spines
Pectoral fin count	Includes the spine counts as well as the ray counts
Pelvic fin count	Includes the spines as well as the rays
Gill raker count	For lateral gill rakers on the first arch, normally on the left side. The raker at the junction of the upper and lower limbs (epibranchial and ceratobranchial) is included in the lower limb count as the major part of the base of the raker is over the ceratobranchial. Rudimentary gill rakers, with the base width (lateral) of the raker equal to, or less than, the raker length, occur at the anterior ends of the upper and lower limbs and these are included in the counts
Straight lateral line	Scute count is the number of scutes in the straight lateral line. A scute is a modified lateral line scale that is enlarged, usually thickened and has its posterior margin terminated in a pointed spine or an apex with the angle of the angle formed by this margin being 110 or less.
Curved lateral line	Scale count is the number of pored scales in the curved lateral line

Results and Discussion

Fishery at Cochin

The fishery at Cochin was represented at a commercial level by horse mackerel, scads, leather jackets and other carangids. Landings of carangids are observed by all gears, but the most dominant gear in the fishery is trawl. A monthly analysis of the fishery, during 2007, has shown that more than 53% of the carangids were landed by the trawlers, especially the multi-day trawlers. The other contributing gears were multi-day mechanised vessels operating hooks and lines, purse seiners and a minor percent by drift netters (Fig.1). Landings remained almost constant during the period January–March after which landings increased steadily till September and later declined. Monthly percentage composition of carangids landed at Cochin fisheries harbour is given in Fig. 2. Landings of scads (*Alepes kleinii, Alepes djedaba* and *Alepes vari)* have increased from 36% in 2003 to 78% in 2005, followed by a decrease in 2006 and increase to 72% in 2007 (Fig. 3). Of these scads, the major constituents are *Alepes klenii* and *Alepes djedaba.* Leather jackets and horse mackerel were the other major groups landed. The size of the fishes landed were also bigger. *Caranx melampygus* was the largest sized carangid being landed in Cochin harbour along with *Alectis ciliaris* and *Alectis indicus.* Rare species like *Carangoides bajad* and *Carangoides orthogrammus* have been reported during this study.

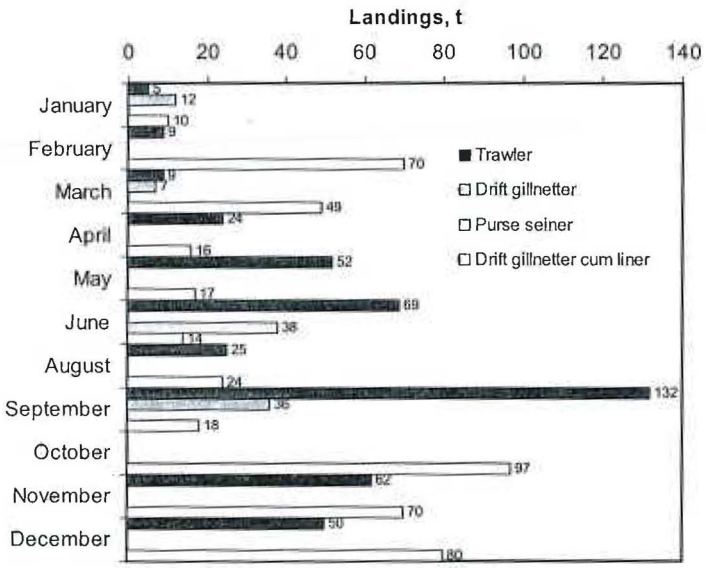

Fig. 1. Gear-wise landings of carangids

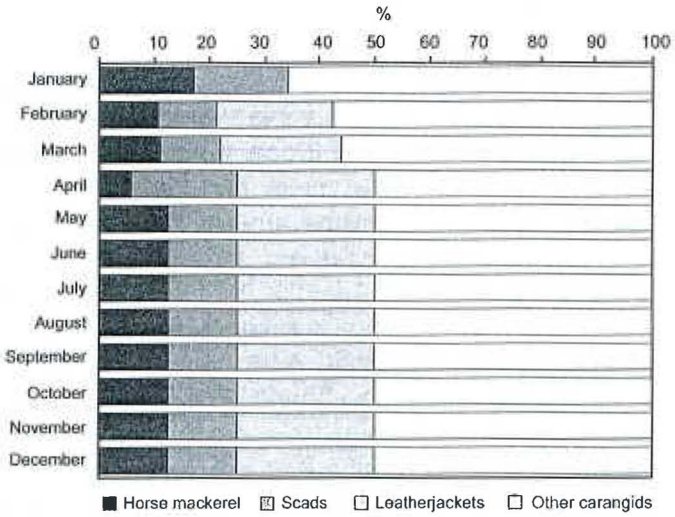

Fig. 2. Monthly percentage composition of carangids, landed at Cochin

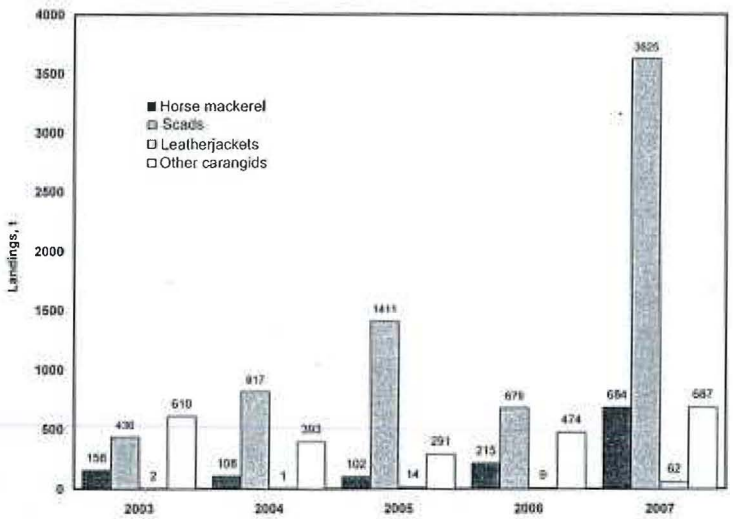

Fig. 3. Year-wise landings of carangids

Taxonomic revision

Carangids are well defined by a posteriorly elongated first proximal anal fin pterygiophore that typically results in a wide gap between the last two anal fin spines (Smith-Vaniz, 1984a). The family is named for the genus *Caranx*, first described by Lacépède in 1801. Previous descriptions of some carangid species, but assigned to other genera, include those

by Artedi (1738), Osbeck (1765), Linnaeus (1758), Forsskål (1775), and Bloch (1793). Linnaeus originally placed members of the carangid genera *Naucrates* and *Trachinotus* in the genus *Gasterosteus* (the sticklebacks), and in 1766 described the related cobia (*Rachycentron canadum*) as *Gasterosteus canadus*. Forsskål and Bloch assigned various carangids to the genus *Scomber* (the mackerels). Quoy and Gaimard (1824) described carangids captured during their voyage around the world, and Cuvier and Valenciennes (1833) did early work on Indo-Pacific species. Gunther (1859) in the Catalogue of the Acanthopterygian Fishes of the British Museum divided Family Carangidae into two subgroups – Carangina and Kurtina. Subgroup Carangina consist of 25 genera and subgroup Kurtina has 2 genera. The classification was based on the characters of the dorsal and anal fin; the subgroup Carangina having soft dorsal and anal of nearly equal extent, while subgroup Kurtina had only one dorsal fin, which was much shorter than the anal fin. Subgroup Carangina included genera *Trachurus, Carangichthys, Caranx, Argyreiosus, Micropteryx, Seriola, Seriolella, Seriolichthys, Nauclerus, Porthmeus, Temnodon, Chorinemus, Lichia, Trachynotus, Pammelas, Paropsis, Psettus, Platax, Zanclus, Psenes, Capros, Antigonia, Equula, Gazza* and *Lactarius.* Two genera included in the subgroup Kurtina were *Pempheris* and *Kurtus*. Many of the genera then included have been designated in different families. Descriptions of carangids in Hawaiian waters were included in works by Jordan and Everman (1903) and Fowler (1928). Bleeker (1852) and Berg (1940) list several carangid genera as belonging to the family Seriolidae, but that name is obsolete. Eschmeyer (2009) lists 122 generic names that have been ascribed to carangids at one time or another. A considerable amount of revision in nomenclature has occurred over the years. For example, Smith-Vaniz and Randall (1994) note that 16 junior names have been proposed for the white trevally (*Pseudocaranx dentex*). Carangids belong to the order Perciformes, suborder Percoidei, and superfamily Percoidea. The family is divided into four subfamilies (tribes), originally described by Starks (1911) and later recognized by Smith-Vaniz (1984a) as Trachinotini, Scomberoidini, Naucratini, and Carangini. Scomberoidini consists of 3 genera –*Oligoplites, Parona, Scomberoides* with 10 species; Naucratinae consists of 5 genera – *Campogramma, Elagatis, Naucrates, Seriola, Seriolina* with 13 species; Caranginae is the only subfamily with scutes present and includes genera - *Alectis, Atropus, Carangoides, Caranx, Chloroscombrus, Decapterus, Gnathonodon, Hemicaranx, Megalaspis, Parastromateus, Pseudocaranx, Selar, Selene, Trachurus* and *Uraspis* with 96 species. There are now about 32 genera and 140 species of carangids worldwide (Nelson, 1994).

Phylogenetic relationships within the suborder and family remain poorly defined (Laroche *et al.,* 1984). Johnson (1984) further notes that these five families share small, adherent cycloid scales, and lists three synapomorphies that suggest Carangidae, Coryphaenidae, Rachycentridae, and Echeneididae are united as a monophyletic group: lack of the bony stay posterior to the ultimate dorsal and anal pterygiophores found in nearly all other percoids, presence of two prenasal canal units, and a lamellar expansion along the anterior margin of the coracoid. The roosterfish *Nematistius* has sometimes been regarded as a member of Carangidae, but is now considered a sister group of the other four families listed above. Nelson (1994) placed the species *Parastromateus niger* in its own family, Apolectidae (Formionidae), but in 1994 followed Smith-Vaniz (1984b) and placed it in Carangidae. Gushiken (1988) described a hypothetical phylogenetic tree for the carangids. Presumed relationships were based on 25 characteristics that include gap between last two anal spines, upper jaw, detached or semidetached finlets, scutes, adipose eyelids, pharyngeal and premaxillary teeth, and a number of other muscular and skeletal features.

The first detailed study on Indian carangids was by Day (1878), who recorded 38 carangid species from Indian waters. Fowler (1927; 1928) briefly described and listed carangid fishes from the Ceylon and Bombay waters, while Munro (1955) recorded 36 species. Williams (1958) gave a detailed description of carangids of East African waters. Misra (1959) listed 24 carangid fishes and also proposed a key for the identification of the species in the Museum of the Zoological Survey of India. Jones and Kumaran (1980) recorded three more species of carangid from Indian waters. Smith (1967) did a series of taxonomical studies on carangid species; Talwar (1969) described *Carangoides malabaricus* and *Carangoides coeruleopinnatus*, Luther (1971) recorded *Ulua mandibularis* for the first time in Indian seas. Sreenivasan (1975; 1978) recorded eight carangid species from Indian waters. Venkataramani *et al.* (1995) has recorded twenty nine species from Porto Novo waters of which three were new records, two from Bay of Bengal and one from Indian waters. Thus most of the work from Indian waters is in the form of new records or as brief descriptions on limited samples.

Species collected at Cochin

A total of 45 species of carangids belonging to 19 genera, were identified from the landings of different gears such as trawls, purse seines and drift gillnets, at Munambam, Cochin Fisheries Harbour, during the years 2003-07 (Table 2). Of the different genera landed, *Carangoides*

Table 2: Carangid species identified from the landings of different gears, at Munambam and Cochin Fisheries Harbour

Order:	**Perciformes**	
Family:	**Carangidae**	
1.	*Alectis ciliaris (Bloch, 1787)*	African pompano
2.	*Alectis indicus* (Rüppell, 1830)	Indian threadfish
3.	*Alepes djedaba* (Forsskål, 1775)	Shrimp scad
4.	*Alepes kleinii* (Bloch, 1793)	Banded scad
5.	*Alepes vari (Cuvier, 1833)*	Herring scad
6.	*Atropus atropos* (Bloch & Schneider, 1801)	Cleft belly trevally
7.	*Atule mate* (Cuvier, 1833)	Yellowtail scad
8.	*Carangoides armatus* (Rüppell, 1830)	Longfin trevally
9.	*Carangoides bajad* (Forsskal, 1775)	Orangespotted trevally
10.	*Carangoides coeruleopinnatus* (Rüppell, 1830)	Coastal trevally
11.	*Carangoides ferdau* (Forsskål, 1775)	Blue trevally
12.	*Carangoides malabaricus* (Bloch & Schneider, 1801)	Malabar trevally
13.	*Carangoides oblongus* (Cuvier, 1833)	Coachwhip trevally
14.	*Carangoides orthogrammus* (Jordan & Gilbert, 1882)	Island trevally
15.	*Carangoides praeustus* (Bennett, 1830)	Brownback trevally
16.	*Caranx heberi* (Bennett, 1830)	Blacktip trevally
17.	*Caranx ignobilis* (Forsskal, 1775)	Giant trevally
18.	*Caranx lugubris* Poey, 1860	Black jack
19.	*Caranx melampygus* Cuvier, 1833	Bluefin trevally
20.	*Caranx papuensis* Alleyne & MacLeay, 1877	Brassy trevally
21.	*Caranx sexfaciatus* Quoy & Gaimard, 1825	Bigeye trevally
22.	*Decapterus kurroides* Bleeker, 1855	Redtail scad
23.	*Decapterus macarellus* (Cuvier, 1833)	Mackeral scad
24.	*Decapterus macrosoma* Bleeker, 1851	Shortfin scad
25.	*Decapterus russelli* (Rüppell, 1830)	Indian scad
26.	*Elagatis bipinnulata* (Quoy & Gaimard, 1825)	Rainbow runner
27.	*Gnathanodon speciosus* (Forsskål, 1775)	Golden trevally
28.	*Megalapsis cordyla* (Linnaeus, 1758)	Torpedo scad
29.	*Naucrates ductor* (Linnaeus, 1758)	Pilot fish
30.	*Parastromateus niger* (Bloch, 1795)	Black pomfret
31.	*Scomberoides commersonnianus* Lacepède, 1801	Talang queenfish
32.	*Scomberoides lysan* (Forsskål, 1775)	Double spotted queenfish
33.	*Scomberoides tol* (Cuvier, 1832)	Needle scaled queenfish
34.	*Selar crumenophthalmus* (Bloch, 1793)	Bigeye scad
35.	*Selaroides leptolepis* (Cuvier, 1833)	Yellow stripe scad
36.	*Seriola rivoliana* Valenciennes, 1833	Longfin yellowtail
37.	*Seriolina nigrofasciata* (Rüppell, 1829)	Black banded trevally
38.	*Trachinotus blochii* (Lacepède, 1801)	Snubnose pompano
39.	*Trachinotus mookalee* Cuvier, 1832	Indian pompano
40.	*Uraspis helvola* (Forster, 1801)	White tongue jack
41.	*Uraspis secunda* (Poey, 1860)	Cotton mouth jack.
42.	*Uraspis uraspis* (Günther, 1860)	White mouth jack

was the most diverse with nine species followed by *Caranx* with seven species. *Decapterus* was the third diverse group with four species. Fishes of the other genera were recorded in only few numbers. Results of the Univariate methods for diversity indices showed that Shannon diversity (H') was 3.3, Simpson's species richness index (D) was 0.05, Margalef's index was 18.74 and Pielou's eveness index was 0.78.

Conclusion

Around 12 species contribute to the commercial fishery at Cochin harbour. Many species of carangids which are landed in small numbers go unnoticed as they do not have much commercial value. A study of this nature throws some light on the species which would otherwise go unnoticed. Conservation oriented studies requires that correct identity of the species constituting the fishery are known and information on the rare and less occurring species are available. For this, taxonomical identification of the species using detailed meristic and morphometric characters and analysis of the data is done. Confirmation of such identified specimen may be done with genetic markers. Thorough revision of the taxonomic history of the group is also essential as publications do not always confirm the synonymies of the names. Information on the taxonomic history will facilitate placing of the fish in the correct hierarchical position and thus help in throwing light on the associated biological characters. Hence, it is suggested that taxonomical studies of this nature be taken up for all commercial and non-commercial groups of Indian fishes, in order to have a better understanding of conservation status of the fish.

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