

Asian Fisheries Society, Selangor, Malaysia
Available online at www.asianfisheriessociety.org

An Appraisal of the Marine Fisheries of Orissa, India

S. SIVAKAMI* and SOMY KURIAKOSE

Central Marine Fisheries Research Institute (CMFRI), Kochi, Kerala, PIN-682 018, India.

Abstract

This paper presents the trend of marine fish landings of Orissa during the period 1975-2006. The marine fish landings of Orissa indicated a general increasing trend from 16,804 t in 1975 to 1,01,500 t during 2005 contributing to an average of 2.6% of the all India marine fish landings. Demersal fishery resources including crustaceans and molluscs dominated the landings ranging between 6575 t during 1977 to 56,556 t during 2005. The pelagic fishes contributed to 8497 t during 1977 to 44472 t during 2005. A total of six types of mechanized and motorized gear each and seven types of non-motorized gears were operated off Orissa during 2005 & 2006. The total effort both in units and Actual Fishing Hours (AFH) was greater during 2005 (5.91 Lakh units & 35 Lakh AFH) than during 2006 (5.49 Lakh units & 31 Lakh AFH). While motorized gears expended more effort in terms of units, mechanized gears had put in more AFH during both the years. Gear wise, all the resources were landed more by mechanized gears followed by motorized gears and non-motorized gears. Resource wise, pelagic fishes were contributed mainly by carangids (21%), ribbon fishes (19.5%) and other clupeids (13.5%). The major contributors of demersal resources were croakers (35%), pomfrets (17%), catfishes (16%), and silver bellies (5.4%). Crustacean resources were dominated by penaeid prawns (78%) followed by non-penaeid prawns (11.6%) and crabs (9.25%). Seasonally, all major resources were landed more during October to December and January to March period.

Introduction

The state of Orissa (lat. 17.75° N & 22.5° N; Long 81.5° E & 87.6° E) has a coast line of 480 km and a continental shelf area of 25000 km². The state has six maritime districts namely Balasore (80 Km), Bhadrak (50 Km), Kendrapara (68 Km), Jagatsinghpur (67 Km), Puri (155 Km) and Ganjam (60 Km) (Fig. 1). The marine fishery of Orissa assumes importance both in relation to domestic market and export earning. The coastal and offshore waters off Orissa form a rich abode of many a quality pelagic and demersal resources. According to [Reuben et al. \(1989\)](#), in order of richness of bottom trawl fishery resources along the northeast coast of India, Orissa ranks first followed by Andhra Pradesh and West Bengal. Though the fishery potential of Orissa had been assessed through several exploratory surveys ([Sheriff 1961](#); [Krishnamoorthy 1976](#); [Sekharan 1973](#); [Sekharan et al. 1973](#); [Joseph et al. 1976](#); [Appa Rao 1978](#); [Appa Rao and](#)

*Corresponding Author.

Email : sivakamipillai@yahoo.com

Krishnamoorthi 1983; Reuben et al. 1989; Menon et al. 1996) the trend of marine fish landings through commercial landings had been less attempted (Dharmaraja & Philipose 1977; Scaria et al. 1987; CMFRI 1995). This paper is an attempt on the appraisal of marine fisheries of Orissa based on commercial landings with particular emphasis on the current exploitation and future potential.

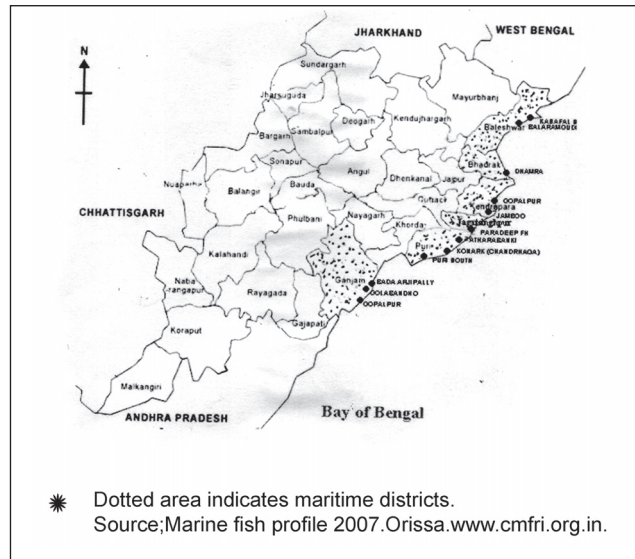


Figure 1. Major fish landing centres in Orissa*.

Materials and Methods

The catch and effort data on marine fisheries of Orissa are obtained from FRA Division of CMFRI, Kochi. Gear-wise landing data for the period between 2005 and 2006 are analyzed with special reference to seasonal abundance of major groups landed in mechanized trawlers and motorized gill netters. Catch per hour is reckoned for evaluating seasonal abundance.

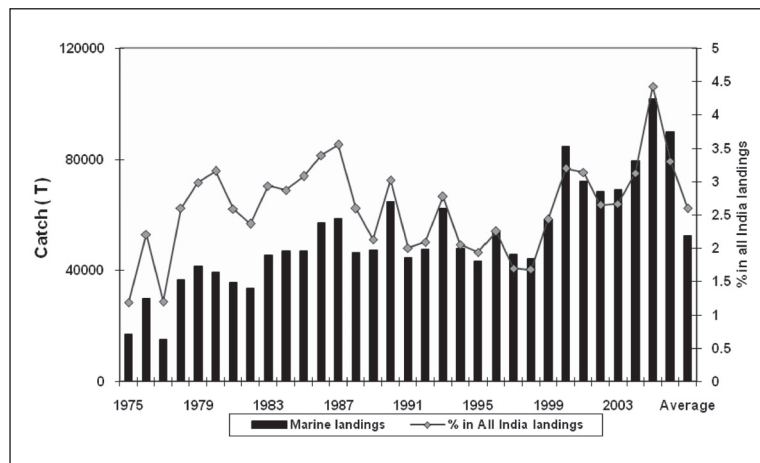


Figure 2a. Marine fish landings off Orissa & its % in All India marine landings during 1975 to 2006

Results and Discussion

Exploitation (Fig. 2a,b)

The marine fish landings in Orissa during 1975 to 2006 indicated a general increasing trend from 16804 t during 1975 to 101500 t during 2005 (Fig.2a). The landings of Orissa formed 1.18% of the all India marine landings during 1975 to 4.42% during 2005, the average being 2.60%.

The demersal resources including crustaceans and molluscs dominated the total landings ranging between 6575 t during 1977 and 56556 t during 2005 (Fig.2b).

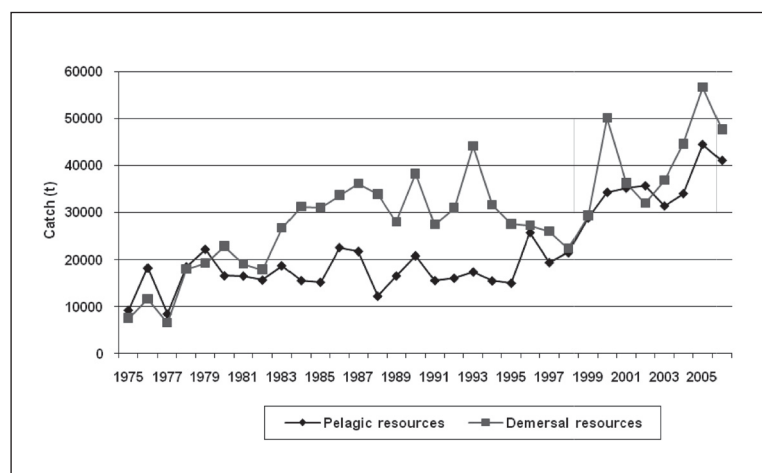


Figure 2b. Pelagic and demersal resources landed off Orissa during 1975 to 2006

The pelagic resources ranged between 8497 t during 1977 and 44472 t during 2005.

According to [Scariah et al. \(1987\)](#), the pelagic fish landings off Orissa indicated a declining trend from 18245 t during 1976 to 15600 t in 1984, with a corresponding decline in effort input by the non-mechanized units from 29823 units in 1976 to 17553 units in 1984. The present study shows that during the same period, the demersal resources indicated an increase in landing from 11578 t in 1976 to 31173 t in 1984. This may be because of the increase in contribution by the mechanized sector from 1980 onwards when mechanization started gathering momentum in Orissa. From 1985 to 2006 also, the contribution of demersal resources was on the higher side ranging between 31070 t in 1985 and 56556 t in 2005 when compared to their pelagic counterpart and this may also be due to the wider continental shelf off Orissa in addition to multiday trawl operation by the mechanized trawlers. Likewise, during 1993 to 98 period, the demersal finfish landings had declined from 38740 t to 18608 t with a corresponding decline in mechanized trawler units operation from 1,12,000 t to 38000 t and that of mechanized gill netters from 1,18,000 t to 68,000 t ([Srinath et al., 2003](#)). But the pelagic

resources indicated a fluctuating pattern ranging from 15037 t during 1995 to 21488 t during 1998, which may be attributed to the increased motorized units operation from 10000 m to 2,82,000 m (Srinath et al. 2003).

Fishery during 2005 and 2006: With a view to analyse the recent trend in landings, the catch and effort data during 2005 and 2006 were studied in detail.

Fishing crafts and gears: Orissa state has a total of 57 landing centers spread over 641 fishing villages. According a latest estimate off Orissa, there are a total of 3577 mechanized, 4719 motorized, and 15,444 non-motorized fishing crafts operated by a total of 74,980 active fisher folk (CMFRI, 2007a).

Effort expended during 2005 and 2006: A total of 19 types of gears were operated off Orissa under the mechanized, motorized, and nonmotorized categories (Table 1).

Table 1. Particulars of crafts & gears operated off Orissa during 2005 & 2006

Crafts	Gears
Mechanised	Single day Trawlers(MTN), MultiDay Trawlers(MDTN), Mechanised Gill Netters(MGN), Mechanised Drift Netters(MDN), Mechanised Drift Gil Netters(MDGN), Mechanised Hooks & Line (MHL)
Motorised	Out Board Gill Netters(OBGN), Outboard Drift Netters(OBDN), OutBoard Bottom Set Gill Netters(OBBGN), Out Board Hooks & Line(OBHL), Out Board Ring Netters (OBRN), OutBoard Ring Seine(OBRS)
Non motorised	Non Motorised Gill Netters(NMGN), Non motorised Hooks & Line(NMHL), Non Motorised Shore Seine(NMSS), Non Motorised Boat Seine(NMBS), Non Motorised Drift Netters(NMDN), Non Motorised Bottom Set Gill Netters(NMBGN), Non Motorised Ring Netters(NMRN)

Particulars regarding unit effort and actual fishing hours (AFH) expended off Orissa during 2005 and 2006 are presented in Fig. 3a & b.

Effort in units (Fig.3a): During 2005, a total of 0.69 lakhs mechanized units were operated followed by 2.80 lakh units of motorized gears and 2.42 lakh units of non-motorized gears. The total units expended amounted to 5.91 lakhs units. During 2006, mechanized, motorized, and non-motorized gears operated 0.56 lakhs, 2.95 lakhs and 1.98 lakh units, respectively, the total effort input being 5.49 lakh units (Fig. 3a).

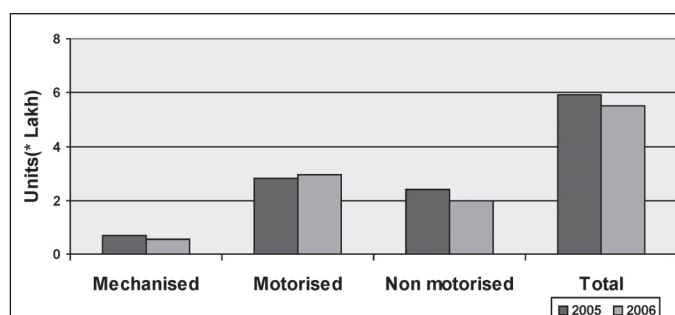


Figure 3 a. Effort (units) expended off Orissa during 2005 & 2006

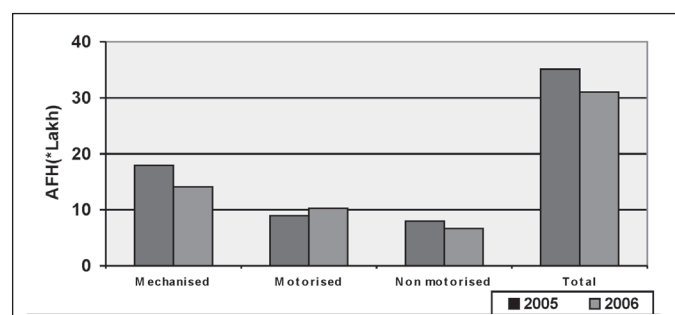


Figure 3b. Actual fishing Hours expended off Orissa during 2005 & 2006

Effort in AFH (Fig. 3b): During 2005, the mechanized gears expended an effort of 18.03 lakhs followed by 8.96 lakhs hrs by motorized gears and 8.03 lakhs hrs by non-motorized gears.

During 2006, the mechanized gears had put in an effort of 13.9 lakh hrs while motorized gears expended 10.34 lakh hrs. The effort expended by non-motorized gears was 6.71 lakh hrs (Fig.3b). The total fishing hours expended during 2005 & 2006 amounted to 35 lakhs and 31 lakhs, respectively.

It may be noticed that the total effort both in units and AFH expended is more during 2005 than during 2006. However, among the different groups of gears, motorized gears were found to have put in more effort in units while mechanized gears had expended more fishing hours during both the years that may be attributed to the operation of multiday trawlers by mechanized units.

Fishery Particulars regarding the landings of various resources off Orissa for the years 2005 & 2006 are given in Table 2.

Table 2. Major fishery resources landed off Orissa during 2005 & 2006

Resources/Years	2005		2006	
	Catch (t)	%	Catch(t)	%
Pelagic fishes	43791	43.14	41081	45.86
Demersal fishes	38750	38.18	34017	37.97
Crustaceans	17293	17.04	13094	14.62
Molluscs	1194	1.18	514	0.57
Miscellaneous	472	0.47	880	0.98
Total	101500		89586	

During 2005, pelagic fishes contributed to a total of 43791 t (43%) while demersal fishes formed 38750 t (38%). Crustacean resources brought a landing of 17293 t (17%) with molluscs (1194 t; 1.2%) and miscellaneous items (472 t; 0.47%) contributing to the rest of the catches. The total catch amounted to 101500 t.

During 2006, the total catch of 89586 t was contributed by the pelagic fishes (41081 t; 45.86%), demersal fishes (34017 t; 38%), crustaceans (13094 t; 14.62%), molluscs (514 t; 0.57%) and miscellaneous items (880 t; 1%).

Gearwise landings: Average catch and percentage of resources landed in mechanized, motorized and non-motorized gears during 2005 & 2006 are given in Fig 4.

Pelagic fishes were contributed maximum by mechanized gears (24,171 t; 57%) followed by motorized gears (12757 t; 30%) and non-motorized gears (5508 t; 13%). Demersal fishes also were landed the maximum in mechanized gears (27145 t; 74.6%) followed by motorized gears (7463 t; 20.5%) and non-motorized gears (1776 t; 5%). Crustacean resources were landed the maximum in mechanized gears 14098 t; 93%) followed by motorized gears (594 t; 4%) non-motorized gears (503 t; 3%). Molluscan resources also were landed the maximum by mechanized gears (840 t; 98%) with lesser representation in motorized gears (7 t; 0.75%) and non-motorized gears (6 t; 0.61%).

An evaluation of gear wise landings during 2005 and 2006 show that both pelagic and demersal resources were landed more in mechanized gears contributing to 57% and 75%, respectively. During 2005 and 2006, the mechanized trawlers operated 27422 and 21115 units and 1432131 and 1122201 AFH while the mechanized gill netters operated 40976 and 31239 units and 369018 and 253269 AFH (CMFRI, 2007b). While the contribution of demersal resources in mechanized gears can be attributed more to

operations of mechanized trawlers, the increased landings of pelagic resources also by mechanized gears may be due to the operation of mechanized gill netters.

Resource wise landings:

Pelagic resources: Average percent composition of pelagic, demersal, and crustaceans resources landed during 2005 & 2006 are depicted in Fig. 5a-c.

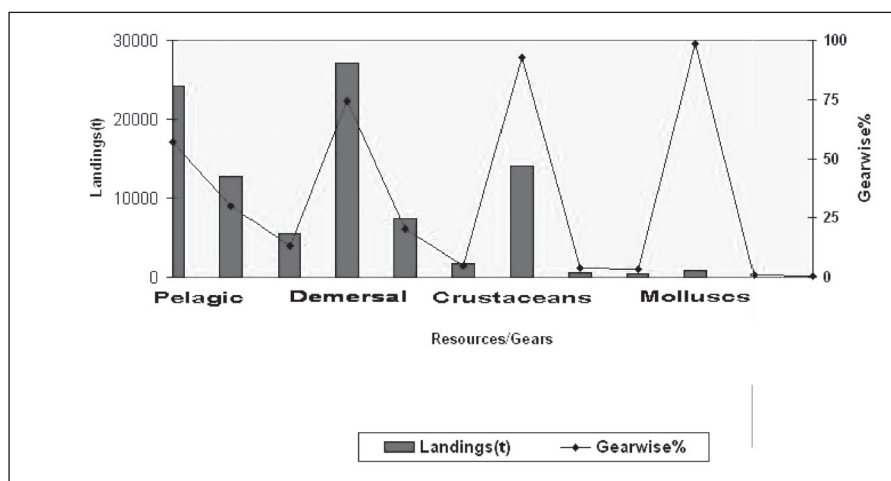


Figure 4. Gearwise landings (t) of major resources off Orissa during 2005 & 2006 (Average)

Among pelagic fishes, carangids (20.58%), ribbon fishes (19.54%) and other clupeids (13.47%), were the major resources landed followed by other sardines (9.23%), *Stoleph-orus* spp., (6.6%), Indian mackerel (6.64%), *Setipinna* spp (5.71%) and Seer fishes (5.2%) Fig.5a.

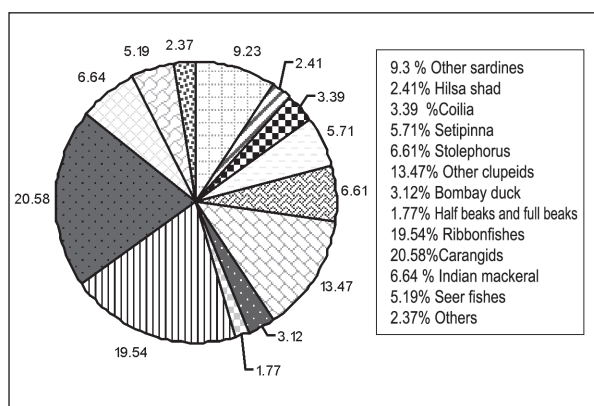


Figure 5a. Average % composition of pelagic resources landed off Orissa during 2005 & 2006

Among demersals, croakers (35%), pomfrets (17%), catfishes (16%), silver bellies (5.36%), goat fishes (4.66%) and flat fishes (4.22%) were the major groups landed (Fig.5b). Among crustaceans, penaeid (78.2%), non penaeid prawn (11.64%), crabs(9) and stomatopods were the major groups landed(Fig.5c)

Major species landed :

Among pelagic fishes, major carangids represented in the landings were *Megalaspis cordyla*, *Caranx ignobilis*, *C.malabaricus*, *Decapterus russelli*, *D macrosoma* and *Selar crumenophthalmus*. Major ribbon fish species landed were *Trichiurus lepturus*, *Lepturacanthus savala*, *Eupleurogrammus intermedius* and *E.muticus*. Lesser sardines were represented more by *Sardinella gibbosa*, *S.fimbriata* and *S.brachysoma* (CMFRI. 2007).

Among demersal fishes, catfishes were represented by species such as *Tachysurus thalassinus*, *T.tenuispinis*, and *T.jella* while the dominant croakers landed were *Otolithoides biauritus*, *Protonibea diacanthus*, *Johnius carutta*, *Otolithus argenteus* and *O.ruber*.

Among crustaceans penaeid prawns were represented by *Parapeneopsis stylifera*, *Metapenaeus dobsoni*, *M.monoceros*, *M.affinis*, *Solenocera crassicornis*, *S.choprai* and *S.indica*, *S.hextii*, and *Fenneropenaeus indicus*. Molluscan resources were chiefly represented by cephalopods.

Resource wise landings in the present study shows that pelagic groups like ribbon fishes and carangids and demersal groups such as croakers, catfishes, and pomfrets were the major groups landed. Exploratory surveys along Orissa coast had indicated that resources such as carangids and catfishes yielded high catch rates of 500 kg/hr at 19°26'N, 85°09'E at 90 m depth and 1500 Kg/hr off 19°19'N, 85°15'E (at 62 m depth) (Menon et al. 1996). Vijayakumar and Naik (1991) had reported of high abundance of catfishes along north east coast within 51-100 m depth. Sivakami et al. (1996) had

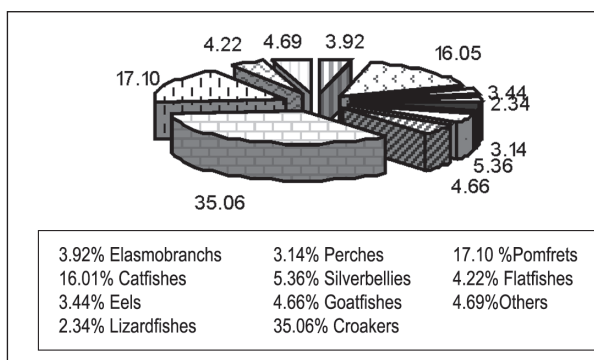


Figure 5b. Average % composition of demersal resources landed off Orissa during 2005 & 2006

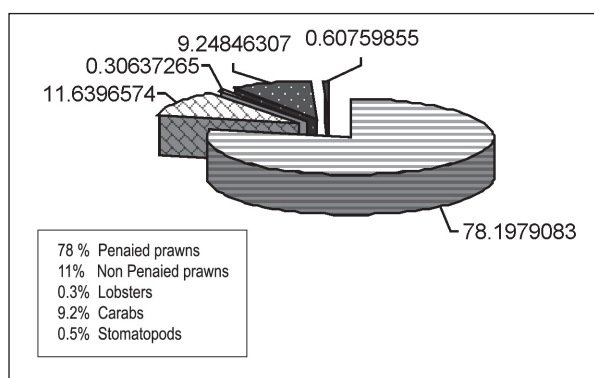


Figure 5c. Average % contribution of crustacean resources off Orissa during 2005 & 2006

reported that Orissa coast is a potential zone for carangids. Nair et al. (1996) had obtained a catch rate of 493 kg/hr of ribbon fishes from 100 m depth off south Orissa coast. Off Andhra-Orissa coast, mackerel was abundant in the 51-100 m depth with a catch rate of 109 Kg/hr (Anon, 1987). Reuben et al. (1989) had noticed very rich grounds for mackerel off 19° N, 80°E, 20°N, 87°E and 20°N, 88°E and for sciaenids at 19° N, 84°E areas. They had also observed that non demersal groups like mackerel and carangids were exploited by the traditional sector much below their potential leaving scope for harvesting the surplus stocks from waters beyond 40 m depth. Thus, it may be concluded that the shelf waters off Orissa have a rich potential of both pelagic and demersal fishes probably by virtue of a wider continental shelf of trawlable muddy/sandy bottom with the coast of Orissa characterized by several estuarine systems of higher productivity.

According to Whitehead (1973) and Rao (1973), the distribution of Oil sardine (*Sardinella longiceps* Val.) along the east coast of India is mainly off Tamil Nadu and Andhra Pradesh where they form stray catches. Antony Raja (1969) includes the coast of Orissa for the occurrence of oil sardine “under verification”. Ramasomayajulu and Dhana Raju (1985) have confirmed its occurrence in this region and Scariah et al. (1987) had reported of a landing of 539 t of oil sardine off Orissa coast during 1984. Pillai et al. (2003) had observed that in the north eastern states of West Bengal and Orissa, a new fishery for oil sardine has emerged from a position of no landings. In the present study, oil sardine formed 86 t and 196 t during 2005 and 2006 contributing to an average of 0.35% of the pelagic fish landing off Orissa thereby confirming their distribution off Orissa coast. They were landed in outboard gill net, ringnet, non-motorized gillnets & trawl net.

Seasonal abundance: Catch rate (Kg/hr) of dominant groups of various resources landed during 2005 & 2006 in mechanized trawlers and motorized gill netters is depicted in Fig. 6a-1.

Pelagic fishes:

Mechanized trawlers:

Ribbon fishes: During 2005, ribbon fishes had the peak landings during January (7.03 Kg/hr), March (14.35 Kg/hr), November (9 Kg/hr) and December (9 Kg/hr). In addition during 2006, peak landings were observed during January (6.04 Kg/hr), November (10 Kg/hr) and December (17.63 Kg/hr) (Fig.6a).

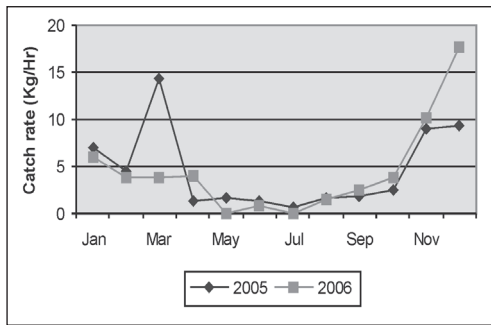


Figure 6a. Seasonal abundance (C/hr) of Ribbon fishes landed off Orissa in mechanised trawlers during 2005 & 2006

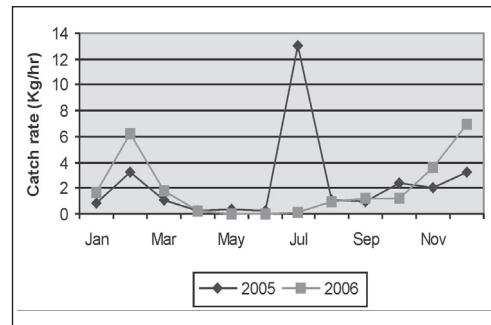


Figure 6b. Seasonal abundance (C/hr) of Carangids landed off Orissa in mechanised trawlers during 2005 & 2006

Carangids: Carangids were landed the maximum during July 2005 (13 Kg/hr) and during February (6.28 kg/hr) and December (7 Kg/hr) during 2006 (Fig.6b).

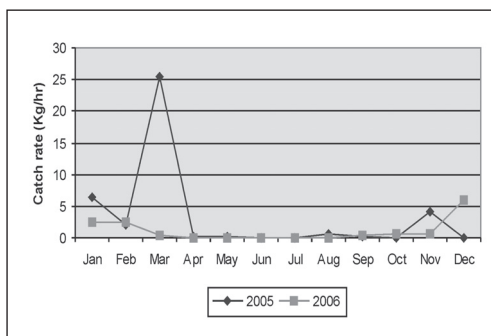


Figure 6c. Seasonal abundance of mackerel landed in mechanised trawlers off Orissa during 2005 & 2006

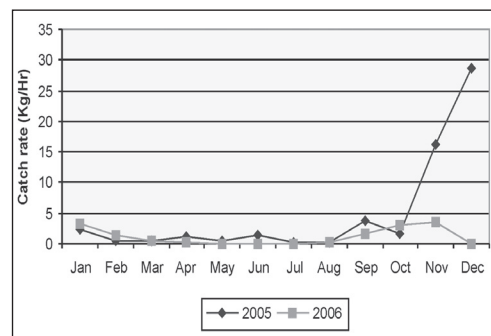


Figure 6d. Seasonal abundance (C/Hr) of Ribbon fishes landed off Orissa in motorised gill netters during 2005 & 2006

Mackerel: Indian mackerel were landed the maximum during January (6.36 Kg/hr), March (25.48 Kg/hr) and November (4.13 Kg/hr) during 2005 while during 2006, catch rates were generally less with peaks during January (2.55 Kg/hr), February (2.5 Kg/hr) and December (6 Kg/hr) (Fig.6c).

Motorized gill netters:

Ribbon fishes: During 2005, ribbon fishes were landed the maximum during November (16.11 Kg/hr) and December (28.67 Kg/hr) while during 2006, peak landings were noticed during January (3.18 Kg/hr) and November (3.61 Kg/hr) (Fig.6d).

Carangids: During 2005, carangids were landed the maximum during January (7 Kg/hr), March (31.31 Kg/hr), April (12.6 Kg/hr) June (7.32 Kg/hr), August (20.35 Kg/hr)

October (20.2 Kg/hr) November (20.2 Kg/hr) and December (13.4 Kg/hr). During 2006, peak landings were noticed during January (6.52 Kg/hr), February (12.92 Kg/hr) and June (5.24 Kg/hr) (Fig.6e).

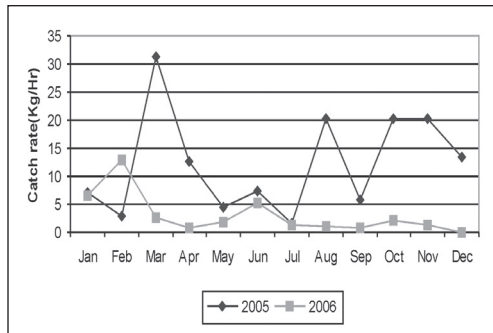


figure 6e. Seasonal abundance (C/Hr) of Carangids landed in motorised gill netters off Orissa during 2005 & 2006

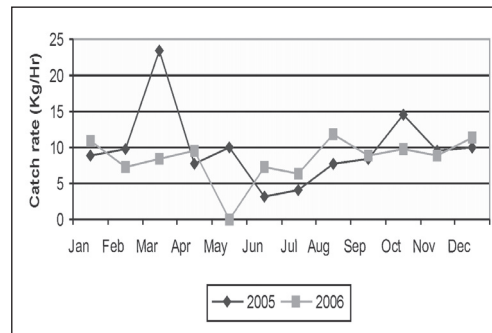


Figure 6f. Seasonal abundance of Croakers landed in mechanised trawlers off Orissa during 2005 & 2006

Demersal fishes:

Mechanized trawlers: Croakers: In mechanized trawlers, croakers generally brought good catch rates particularly during March (23.51 Kg/hr) and during October 2005 (14.45 Kg/hr) and during August (11.81 Kg/hr) and December 2006 (11.42 Kg/hr) (Fig.6f).

Catfishes: Catfish landings were generally less in mechanized gears with peak only during November 2006 (18.66 Kg/hr) (Fig.6g).

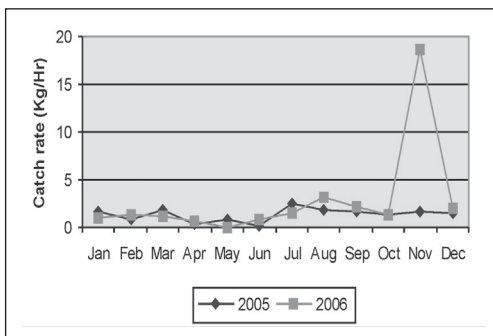


Figure 6g. Seasonal abundance (C/Hr) of catfishes landed off Orissa in mechanised trawlers during 2005 & 2006

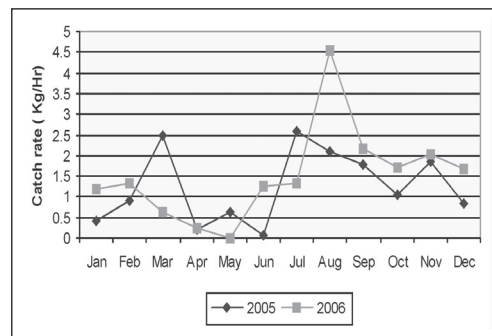


Figure 6h. Seasonal abundance (C/Hr) of Pomfrets landed in mechanised trawlers off Orissa during 2005 & 2006

Pomfrets: Pomfret landings in mechanized trawlers were high during March (2.5 Kg/hr), July (2.6 Kg/hr) and during November 2005(1.84 Kg/hr). During 2006, good catch

rates were obtained during August (4.54 Kg/hr), September (2.16 Kg/hr) and November (2 Kg/hr) (Fig.6 h).

Motorized gill netters:

Croakers: Compared to mechanized trawlers, landings of croakers in motorized gill netters was less with peak during March (9.06 Kg/hr), August (6.47 Kg/hr) and October (12 Kg/hr) during 2005. During 2006, peak catch rates were obtained during February (2.42 Kg/hr), June (2.11 kg/hr) and July (4.76 Kg/hr) (Fig. 6i).

Catfishes: Catfish landings in motorized gill netters indicated a peak during January (7.8 Kg/hr), March (5.51 Kg/hr), June (6.1 Kg/hr), August (6.01 Kg/hr) and October (5.5 Kg/hr) (Fig.6j).

Pomfrets: Pomfrets brought good landings only during March (24.83 Kg/hr), May (9.8 Kg/hr) August (8.09 Kg/hr), September (9.53 Kg/hr) and October 2005 (25.6 Kg/hr) (Fig. 6k).

Crustaceans:

Mechanized trawlers:

Penaeid prawns: Penaeid prawns in mechanized trawlers was generally good with peak during January (9.21 Kg/hr), July (16.93 Kg/hr), October (11.31 kg/hr) November (9.81 Kg/hr) and December (8.04 Kg/hr) during 2005. During 2006, peak landings were obtained during January (7.74 Kg/hr), April (6.58 Kg/hr), June (10.48 Kg/hr), November (11.42 Kg/hr) and December (14.05 Kg/hr) (Fig.6 l). In motorized gears the catch of penaeid prawns was negligible.

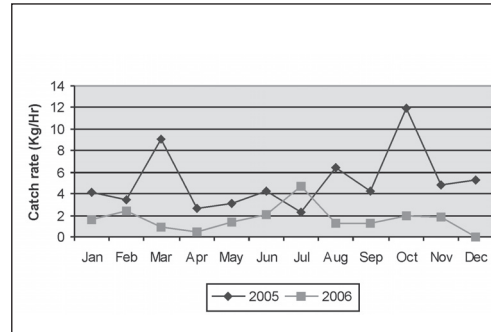


Figure 6i. Seasonal abundance of Croakers landed in motorised gill netters off Orissa during 2005 & 2006.

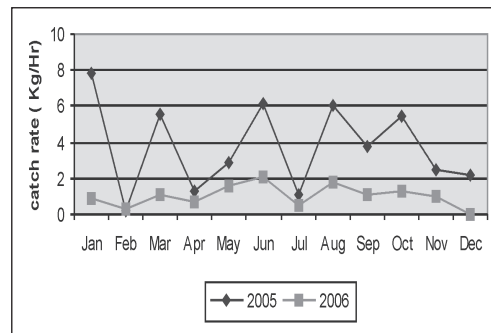


Figure 6j. Seasonal abundance of Catfishes (C/Hr) off Orissa in motorised gill netters during 2005 & 2006

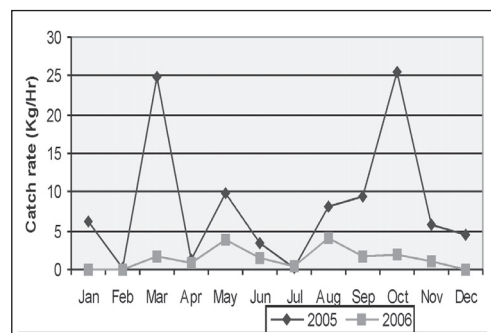


Figure 6k. Seasonal abundance of Pomfrets landed off Orissa in motorised gill netters during 200 & 2006

Seasonally, major resources such as ribbon fish, mackerel, croakers & catfish had brought higher catch rates during October to December & January to March period, while other resources such as carangids were landed more during February, April, June, and August. Penaeid prawns also brought good landings

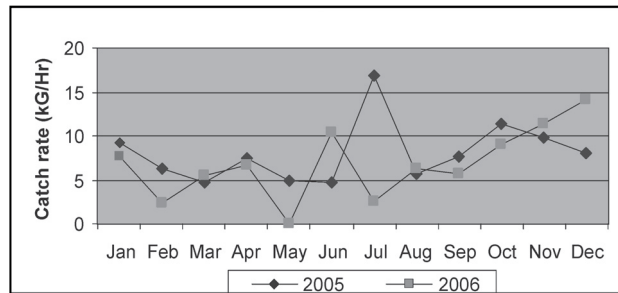


Figure 61. Seasonal abundance (C/Hr) of penaeid prawns landed in mechanised trawlers off Orissa during 2005 & 2006

during January, July & October to December. Sekharan et al (1973) have found that catfishes are dominant in > 30 m depth during March-June. Scariah et al (1987) have observed that during 1875 to 84, off Orissa coast the highest landings was during fourth quarter (October to December) followed by first quarter (January to March), when planktivorous fishes such as sardines, pomfrets, etc contributed to more than 33%. According to Sankaranarayanan & Reddy (1968), there is evidence of upwelling in the North Western Bay of Bengal in January. Mathew et al (1996) have observed higher concentration of zooplankton in North West Bay of Bengal off Chilka Lake & Paradeep area during January and that the most productive period was during the North East monsoon (October to January) followed by premonsoon (February to May). The above authors have concluded that the fresh water influx and the high nutrient load towards the head of the Bay (Qasim 1977) coupled with the south westerly current and the prevailing wind pattern along with the effect of upwelling would have caused a piling up of standing crop in the coastal waters between 18° N & 20° N. It is therefore logical to believe that the peak landings of planktivorous fishes off Orissa during the north east monsoon season during October to December have a bearing on the proliferation of zooplankton population because plankton production is funneled either by pelagic or demersal groups into fish production (Sheldon et al. 1975).

Acknowledgements:

The authors wish to express their gratitude to Prof. (Dr). Mohan Joseph Modayil, Director, CMFRI, Kochi for suggesting this topic and necessary improvements made and to Dr.E.Vivekanandan, Head, Demersal Fisheries Division, CMFRI, Kochi, for the encouragements. Thanks are also due to Dr.M.Srinath, Head, FRA Division for providing the catch and effort data. The help rendered by Smt.P. K. Seetha, Senior Technical Assistant in preparing the manuscript is duly acknowledged.

References

- Anon. 1987. Demersal fishery survey along Andhra Pradesh-Orissa Coast during September-December 1986. Fishing Chimes 7(4): 11.
- Antony Raja, B. T. 1969. The Indian Oil sardine. Bulletin of the Central Marine Fisheries Research Institute 16: 1-128.
- Appa Rao, T. 1978. Relative abundance of Sciaenids along Andhra- Orissa coasts. Indian Journal of Fisheries 23(1&2): 201-212.
- Appa Rao, T. and B. Krishnamoorthy. 1983. Diurnal variation in the catches of demersal fishes in the north west region of Bay of Bengal during 1959-60. Indian Journal of Fisheries. 29 (1 & 2): 134-143.
- CMFRI. 1995. Marine Fish Landings in India during 1985-1993. Marine Fish Information Services T & E Series 136: 1-30.
- CMFRI. 2007a. Marine fish profile, 2007. Orissa, www.cmfri.org.in.
- CMFRI.2007b. Project Reports, Demersal Fisheries Division, CMFRI, Kochi. Dharmaraja, S.K.and V.Philipose. 1977. Trends in the yield of major exploited fisheries off east coast of India. Indian Journal of Fisheries 22 (1&2) (1975): 187-197.
- ICM, 2003. Final report of the ICM Case Study in Orissa. Integrated Coastal Management. February-June, 2003.
- Joseph, K.M.,N.Radhakrishnan, Antony Joseph and K.P.Philip , 1976. Results of demersal fishery resources survey along the east coast of India, 1959-74. Bulletin Exploratory Fisheries Project .5: 53pp.
- Krishnamoorthy, B. 1976. An assessment of the demersal fishery resources off the Andhra-Orissa coast based on exploratory trawling. Indian Journal of Fisheries 21(2): 557-565.
- Mathew, K.J.,K.N.Kurup, T.S.Naomi,G.Antony and Solomon. 1996. Zooplankton abundance in the continental shelf waters of the north-east coast of India. Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada, (ed. V.K. Pillai, S.A.H.Abidi, V. Ravindran, K.K. Balachandran and V.V. Agadi, (Department of Ocean Development)) New Delhi, pp . 262.
- Menon, N.G. , N.G.K. Pillai, S. Lazarus and P. Nammalwar. 1996. Finfish resources in the northeastern region in the Indian EEZ. Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada, (ed. V.K. Pillai, S.A.H. Abidi, V. Ravindran, K.K. Balachandran and V.V. Agadi, (Department of Ocean Development)) New Delhi, pp . 295-304.
- Nair, P.N., Radhakrishnan, Alexander Kuraian, C. Muthiah, S. Lazarus, R. Thiagarajan, M. Zaffer Khan and Prathibha Rohit. 1996. Occurrence of ribbon fishes in the Indian EEZ . Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada (ed.V.K.Pillai, S.A.H.Abidi, V.Ravindran, K.K.Balachandran & V.V.Agadi, (Department of Ocean Development) New Delhi), pp . 429-436.
- Pillai, N.G.K., U. Ganga and A.A. Jayaprakash. 2003. Indian Oil Sardine. In: Status of Exploited Marine Fishery Resources of India. Central Marine Fisheries Research Institute, Kochi., India. pp. 19.
- Qasim, S. Z. 1977. Biological productivity of the Indian Ocean. Indian Journal of Marine Sciences (2): 122-137.
- Rao, K. Virabhadra. 1973. Distribution pattern of the major exploited marine fishery resources of India. Proceedings of the Symposium on Living Resources of the Seas around India. CMFRI Special. Publication pp. 18-101.
- Ramasomayajulu, K. and K. Dhana Raju. 1985. A confirmation of the occurrence of oil sardine *Sardinella longiceps* Val. along the Orissa coast. Indian Journal of Fisheries. 32(4): 495-496.
- Reuben, S., G.S. Rao, G. Luther, T. Appa Rao, K. Radhakrishna, Y. Appanna Sasthry and G. Radhakrishnan. 1989. An Assessment of the bottom trawl fishery resources of the North East coast of India. CMFRI Bulletin, No. 44 (Part I): pp 59-77.
- Sankaranarayanan, V. N. & C.V. G. Reddy. 1968. Nutrients of the northwestern Bay of Bengal. Proceedings of the Symposium on the Indian Ocean. Bulletin of the National. Institute for the Promotion of Science, India. 38: 148-163.

- Scariah, K.S., V.Philipose, S.D. Dan, P. Karunakaran Nair and G. Subbaraman. 1987. An appraisal of the marine fisheries in Orissa. CMFRI Special. Publication 31: pp 1-36. Sekharan, K. V. 1973. On the catfish resources of coast of Andhra Pradesh, Orissa and West Bengal. Proceedings of the Symposium on Living Resources of the Seas around India. Special Publication, CMFRI, Kochi-682 018, India, pp 517-536.
- Sekharan, K. V., M.S. Muthu, K. Venkatasubba Rao, V. Ramamohana Rao, P. Mojumdar and S. Reuben. 1973. Exploratory trawling on continental shelf along the northwest part of Bay of Bengal. Proceedings of the Symposium on Living Resources of the Seas around India. Special. Publication, CMFRI, Kochi-682 018, India, pp. 280-337.
- Sheldon, W., Sutcliffe Jr. W. H. and M. A. Paranjape. 1975. Structure of pelagic food chain and relationship between plankton and fish production. *Journal of the Fisheries Research Board of Canada*. 34: 2344-2353.
- Sheriff, A. T. 1961. A survey of the off shore demersal fisheries of Andhra-Orissa 1960. In: *Souvenir Fisheries of Gujarat*. pp: 46-54.
- Sivakami, S., P.N. Radhakrishnan Nair, A. A. Jayaprakash, Mohammed Kasim, T. M. Yohannan, M. Sivadas, K. P. Said Koya, and P. K. Seetha. 1996. Distribution and abundance of carangids along the EEZ of India. Proceedings of the Second Workshop on Scientific results of FORV Sagar Sampada (ed. V.K.Pillai, S.A.H.Abidi, V.Ravindran, K.K.Balachandran & V.V.Agadi, (Department of Ocean Development) New Delhi), pp 347-362.
- Srinath, M.Somy Kuriakose, K.G.Mini, M.R.Beena and S.K.Augustine, 2003. Trends in landings. In: *Status of Exploited Marine fishery resources of India* (Eds): Mohan Joseph . M. and A.a Jayaprakash . Central Marine Fisheries Research Insititute, Kochi. India, pp.283.
- Vijayakumaran, K. & S.K.Naik. 1991. Demersal finfish resources of the inter-continental shelf of the EEZ. In: *Proceedings Of the National Workshop on fishery resources and Data of Fish from Indus*. (FSI, Bombay) pp.71-79
- Whitehead, P. J.P. 1973. A synopsis of the Clupeoid fishes of India. *Journal of the Marine Biological Association of India*. 14(1) 160-256.