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Scope for the Exploitation and Management of Non Conventional Fish Resources of Distant Waters of Indian EEZ

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Abstract

As the coastal marine fish production faces challenging problems with regard to the sustainability, resources conservation and management, there is an imperative need to find ways and means to rationally manage the coastal resource exploitation as well as to exploit the potentially hitherto under exploited or unexploited non conventional resources from the distant waters of the Indian EEZ. The exploratory surveys conducted so far brought out a base line picture on the fishery potentials in the deeper waters and charted the extent of productive fishing grounds, fish concentration pockets and distribution and abundance in space and time. The paper throws more light on the management of epi-, meso and bathy pelagic resources, and their possible exploitation strategies by various pelagic/ or midwater and deepwater trawling, high seas drift netting and longlining. The abundant occurrence of potentially rich myctophid and gonostomatids in the DSL and their role in the oceanic food chain, forage of major pelagics and their possible utilisation as food fishes have also been discussed in this paper and emphasized suitable management options for economic exploitation and utilisation.

Introduction

Fish and fisheries play a vital role in the economic development of maritime nations, though not necessarily as a significant foreign exchange earner, certainly as a source of food and employment. India contributes little over 3 % of the world fish production. Our percapita annual fish consumption of around 4 kg is far short of nutritional requirement of 11 kg/ yr. Indian marine fish harvest mostly centers around coastal waters up to 80 m depth and about 90 % of the catch comes from upto 50 m. The production from this sector has even surpassed the potential and stagnated over the last few years. The stock assessment studies conducted on more than 45 species of exploited finfishes and shellfishes have shown that the present effort expended is close to or crossed the level of MSY and further increase in effort in the coastal sector would be detrimental to sustainable yield. The impact of mechanised trawling and purse seining has also caused resource depletion through recruitment and growth sustainable resources exploitation from this sector is still possible through regulatory management strategies for different species and for different regions. In addition to this, there is ample scope for increasing production, by extending fishing to deeper waters of the EEZ which holds a potential of 1.7 million t of underexploited and virtually unexploited finfishes and shellfishes. Another viable option to enhance production is through technically sound and economically feasible brackishwater aquaculture and mariculture in the coastal sector.

It is generally argued that the deep sea fishing industry in India has not been able to take off even after the declaration of the EEZ two decades ago, due to lack of adequate data on deep-sea fishery resources and their stock potentials, the knowledge regarding the right type of vessels and gears and the optimum numbers required for exploitation, inadequate infrastructure facilities for berthing, resource handling, transportation, distribution, processing and packaging of fish products, consumer reluctance and poor marketability , lack of financial resources to support the deep sea venture , limited R and D etc. (Dutt,1994). Therefore, to remove this apprehension concerted efforts are needed on the part of industry, Government, financial institutions, and R and D institutions to install thrust on exploitation of the deep sea resources and thereby to increase production to meet domestic per capita requirement and exports.

Various exploratory fishing / acoustic surveys conducted by Government agencies in the Indian EEZ during different periods of time since 1965 (INP / IFP, CIFNET, PFP, EFP / FSI, CMFRI / DOD,) revealed the existence of many finfishes / shellfishes in the deep sea fishing grounds of the shelf and slope and oceanic province (Ommen 1980; Joseph, 1986, Sudersan *et al.*, 1988, Bande *et al.*, 1990; James and Pillai 1990; Ferozkhan *et al.*, 1996,) . Attempts were also made to estimate their abundance in space and time. Inspite of this the Indian Deep sea fishing Industry is reluctant to venture into this promising sector in the absence of a clear deep sea fishing policy and lack of adequate incentives.

Materials and Methods

Fishing results from survey vessels of FSI ,IFP and DOD are made use of for interpreting results and developing management strategies.

Results and Discussion

Exploitable resources in outer shelf and upper slope waters

Most of the demersals of the outer shelf and slope waters such as bulls eye, drift fish, black ruff etc. form schools or shoals and vertically ascend and descend in the column with the DSL for feeding. They become vulnerable to bottom trawling during day and midwater / pelagic trawling during night. These resources, though dwell in the deeper grounds, also migrate to shallower grounds during monsoon / post monsoon due to oceanographic reasons. There they become susceptible to commercial fisheries. The extension of commercial fishing to deeper grounds in middle and outer shelf during the last few years have yielded good quantities of bulls eye during monsoon (70 - 80 m) and post monsoon (35 -75m).

Bull's eye

The popularly known 'Bulls eye', *Priacanthus* spp, is a common food fish in South east Asian countries. In 1984 Thailand and Hongkong caught 33,000 t from South China Sea. In the Indian EEZ this predominantly demersal fish are widely distributed all along the shelf and slope waters (50 - 400 m), but exhibit diurnal ascends and descends following the rich sources of food in the DSL. They feed voraceacely at night on the pelagic shrimp, *Leptochela* sp from the DSL. Experimental fishing by FSI vessels and FORV *Sagar Sampada* have shown that they are vulnerable to bottom trawling during day and pelagic / midwater trawling 3during night. They are abundant along the Southwest coast at 50 - 100 m during monsoon and 100 - 150 m in pre -monsoon (Sulochanan and Johan, 1988). Vijayakumar and Naik (1988) reported Southward shallow water migrations in March - June for breeding and northwest in September - November. The FORV *Sagar Sampada* results unfolded density packets of *Priacanthus* sp (1500 - 4900 kg / hr of trawling) along the SW coast at 74 - 120 m depth. Their estimated potential from the EEZ is 79,000 t, of which SW holds 73 % and NW 21 % t (Bande *et al.*, 1990). Although the resource has yet to capture Indian markets, its meat is rich in Protein (20.4 %) and Fat (1.6%) and equal or more in nutritive value compared with other common coastal demersals (CIFT, 1990).

Indian drift fish

The Indian drift fish, *Ariomma indica* is a common species under the family Nomidae. It is widely distributed in the outer shelf and upper slope upto 500 m depth with particular dominance in 100 - 200 m along the west coast, 50 - 100 m along the South east coast and below 50 m in North east coast. It forms large shoals and generally follow the DSL macrozooplankton and micronekton for feeding and hence found in epi-pelagic realm at night and demersal during day. Results of FSI surveys showed that it forms 5.1 %, 7.4 % and 2.3 % of the total trawl catch along SW, SE and NE coast respectively (Joseph and Johan, 1987). *FORV Sagar Sampada* trawling results indicated high catch rates of 1 to 7.5 t / hr from off NE coast (62- 68 m) in February (James and Pillai, 1990). Of late, due to the extension of commercial fishing to deeper grounds, it occurs commonly in the trawl landing along Andhra - Orissa region and occasionally from Karnataka and Kerala. Although a non- conventional resource, it finds a domestic market by virtue of its white and soft meat and high edible quality with protein (17.5 %) and fat (17.6%) (CIFT, 1990).

The black ruff

Centrolophus niger or the Black ruff is a demersal denizen of deep water upto 500 m with particular dominance in 200 - 500 m along the SW coast. It forms large shoals and concentrate in 8 - 13 N lat. Joseph (1986) reported that it formed 69 % of the trawl catch from 200 - 500 m off Karnataka during January - February . From off Quilon (200 - 400 m) charter vessels caught large quantities (up to 3 t / hr. of trawling) of black ruff together with drift fish and green eye . The nutritive quality of it equals any other quality demersals with high protein (14.9 %) and fat (5.8 %). However the appearance , colour , small size (7- 18 cm) and loose texture of muscle are deterrents to its acceptability in domestic markets. To make it acceptable for domestic consumption and export markets, value added products like canned fillets, surimi etc. could be prepared out of this fish.

The green eye

The sporadic appearance of large shoals of the green eye, *Chlorophthalums* spp (15-23 cm) in depths of 300 - 400 m offers scope for their commercial harvest by trawlers. Survey results of FSI and *FORV Sagar Sampada* indicated high landings of green high upto 4.5 t / hr. of trawling from the Quilon Bank. Fishes like *Psenopsis cyanea, Neoepinnula orientalis, Bathygadus* sp etc. are also caught along with green eye in good quantities during the various fishing surveys. Ferozkhan *et al.*, 1996 estimated their potential at 5 t/km2 in the area 8 -11N lat. and 75-76 °E long.

Exploitable pelagic and mesopelagic resources

The fishing fleets of Taiwan, South Korea and Japan have been fishing in all the oceans for over 30 years and China, which is the latest entrant. All these Asian countries continuously increased their fleet strength. Their success indicates that distant water fishing is a viable source of long term profitable earning. The exploratory fishing results of FSI, DOD and other industrial surveys are positive indicators for commercializing high seas longlining purseseining and pelagic trawling (Sudersan *et al.*, 1988). Therefore Indian industry should enter the Oceanic fishing at first in a moderate way until the project becomes economically feasible.

Although our commercial fishery has not made any success so far in pelagic or midwater trawling, experimental operations of pelagic trawl from *MT MUREANA* yielded catch rates of 402 kg / hr in depths upto 360 m off the NW coast (Bapat *et al.*, 1982). However, to prove the economic viability of oceanic fishing India should conduct industrial fishing surveys especially in areas already found suitable by the exploratory surveys. Of course the commitment is more risky and capital intensive compared to coastal fishing. As many oceanic pelagics like tunas, billfishes, sharks, dolphin fishes, oceanic breams, snake mackerel etc are highly disperse and shoaling species exhibit frequent transoceanic migration in and out of potential fishing areas, there is always an uncertainty in landings. However, sophisticated modern fish detection technology coupled with remote sensing are at rescue for the ocean fishing industry.

Myctophids

Myctophids (lantern fish) hve wide distribution from Artic to Antarctic waters. They exhibit diurnal vertical migration from surface down to 200 m at night; and from 400 - 1000 m during day; some show size stratification with depth, and in some cases adults and juveniles occupy different depth strata. Their Global biomass is estimated to be 950 million tons. Although their density in the oceans is generally low, there are reports of occurrence of relatively large stocks in sub-tropical and tropical waters in the Arabian sea, West Africa and South America. Total resource in the INDIAN ocean is roughly estimated to be 351 million tons. The pelagic trawl survey conducted by *R/V Dr. Fridtjof Nansen* in the Western and Northern Arabian sea recorded catch rates upto of 20,000 Kg/hr (Gjosaeter, 1975). Recently the U.S. GLOBEC study estimated a potential of 100 million tonnes of MYCTOPHIDS (particularly of *Benthosema pterotum*) in the Arabian sea.

Out of 340 species under 50 genera of myctophids catalogued from the world oceans only 240 species (30 genera)are currently recognised; 83 species (21 genera) occur in the Western Indian Ocean. In the FORV Sagar Sampada midwater / pelagic trawl operations 13 species have been caught from depth ranges of 40 - 400 m in shelf and oceanic areas of Indian EEZ. The IKMT collections of FORV SAGAR SAMPADA (1985-86) from the DSL revealed that the myctophids form about 31 % of the total fish catch of the gear. The common genera caught by the gear were *Diaphus, Lampanyctus, Diogenichthys, Hygophum, Symbolophorus, Bolinichthys, Benthosema* and *Myctophum.* The maximum density was recorded in the depth 20 - 90 m during night and 200 - 500 m during day (Mini Raman and James. 1990) The results of midwater trawling conducted along the equatorial region (3 °S to 3 °N ; 76 - 86 °E) in the depth range of 40 - 200 m yielded a variety of mesopelagic fishes of which myctophid constituted 61.3 % and the most dominant species were *Diaphus effulgenes, Triphotoros nigrescens, Symblpphorus rafinus, Lampanyctus pusillus* and *Bolinichthys photothorax* (Jayaprakash, 1996).

Although abundant and widespread, myctophids received attention only now as a possible source of cheap protein (15.3%) potentially exploitable in commercial quantities. They are potentially important for fish oil and fish meal. Proximate composition of the fish meal prepared out of lanternfishes is similar to high quality capelin meal. Results of biochemical experiments in the Soviet Union do not preclude the use of the southern hemisphere myctophid, *Gymnoscopelus nicholsi,* for human consumption. More over in Japan, some species are caught and consumed locally. Oil extraction efficiency of *Lampanyctodes hectoris* is 110 liters /ton. The proximate composition and mineral contents of myctophids collected by FORV Sagar Sampada are: Calorie 174.9; Sodium 366.5; Potassium 401.4; calcium 445.0 and Iron 10.7 (CIFT, 1990).

Light fishes

The small mesopelagic and bathypelagic, gonostomatids exhibit dial vertical migrations, and some are found in the upper 50 m at night, They occur down to 2000 m and their density and species composition vary significantly with depth. The group includes about 20 genera. The common genera *Vincigurrea* (30 -50 cm) is abundant in the DSL of Indian EEZ. It feeds on zooplankton and itself forms prey for major pelagics (Menon et.al.,1996). The resource is economically important as its vertically moving schools attract many oceanic pelagics like tunas, bill fishes and demersals like bulls eye, drift fishes etc.

Management

The occurrence of fishable concentrations of deep sea resources together with stagnating coastal production were the immediate need to recognize the deep sea fishing as a priority area for developing the industry. Accordingly Government has approved projects for importing larger ocean going fishing vessels and joint venture and charter programs for increasing the marine fish production. But none of the programs yielded tangible results owing to one set of problems leading to another set of problems. In addition to this, of late, there are considerable resistance from the traditional motorised and small scale sector as they themselves improved their capabilities for fishing in comparatively deeper areas, where the joint venture/ charter vessels invariably concentrate. Although the Government has nominated committees to study the whole gamut of the problem and to come out with socially and economically feasible strategy to evolve a national deep sea fisheries policy. The National Policy thus evolved ia also challenged by different sectors of resource users and it would be difficult to implement many programs envisaged under the policy owing to the vastness of Indian EEZ and the cost involved behind it.

All resources survey conducted so far in the deeper areas of Indian EEZ revealed that the often abundant and exploitable non-traditional demersal resources are within 100 - 500 m depth in the shelf and inner slope area. Some resources even exhibit migration to more shallow grounds seasonally, besides diurnal vertical migrations. The next group is the major pelagic finfishes and cephalopods and mesopelagics and bathy pelagics. They are widely distributed in the high seas, surface down to 1000 m or so. These two groups of resources, although both are considered as deep sea resources, need different exploitation and management strategies.

By increasing and enhancing the capability of our coastal fleet and with appropriate deck and fishing gear facilities it would be possible to harvest many non-conventional finfish or shellfish resources from the shelf / upper slope grounds, provided our fishers are given training in modern fish finding equipments, gear operation and allied activities in deep sea. This sector also needs financial support subsidies for energy cost and promotional efforts from Government for accepting and updating the deep sea fishing technology, currently vested with the Government Institutions or remain at experimental stages within the country, and marketing the catch in domestic and export markets.

The medium size vessels (17.5 - 28 m OAL) now chiefly targeted for deep sea shrimps would be deployed to harvest the potential ground fish / shell fish resources from this sector., wherein the old shall be replaced by new ones with more sophisticated fish finding and echo integrator equipment for quicker and easier exploitation of ground/column moving fish shoals. Concurrently further monitoring and research inputs are essential for collecting more reliable production particulars in space and time. Such data could be utilised for charting the various exploitable resources within this sector. Confidently our small scale fishing industry can venture into this sector with the backing of present scientific data base, upgraded craft- gear capability, multi gear use and above all with the wholehearted commitment and support of our skilled and adventurous fishers.

The high seas and oceanic fishery in the distant parts of the oceanic realm of Indian EEZ needs greater and capital intensive support and expertise to exploit the highly dispersed larger epi-pelagics of commercial importance. Similarly the exploitation and utilisation of oceanic mesopelagics, bathypelagics as direct source of fish protein, require technology development and upgradation in harvest and post- harvest areas ; besides shore infrastructure for berthing, handling, storing and processing facilities are deterrents to development in this sector.

However, available data on major oceanic pelagics and their spatial and seasonal abundance offers scope for commercial venture of a higher magnitude in terms of infrastructure / technology / cost. Fishing by high seas / oceanic gill netting, longlining and purse seining, subject to international conservation obligations, should be encouraged to catch tunas, bill fishes, pelagic sharks, dolphin fishes, flying fishes and squids with specific Total Allowable Catch (TAC) for each resource, to be fixed by the government from time to time. In this context it is necessary to attract national /multinational entrepreneurs with requisite capacity to join the industry with investment, in view of risks involved in un guaranteed production / market and management skills. Entrepreneurs capable to charter large oceanic fishing vessels (30 - 60 m OAL) and with an efficient management network in exploitation, utilisation and marketing fronts are required for developing this industry. For which a clear National Policy with greater transparency to ensure prompt and effective implementation of the charter/joint venture/ foreign collaboration is imperative. To enhance the consumer acceptability and marketability, the non conventional resources should be utilised for the preparation of value added products.

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