Management
of
Scombroid Fisheries

Editors

N.G.K. Pillai
N.G. Menon
P.P. Pillai
U. Ganga

ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
Post Box No. 1603, Tatapuram P.O.
Kochi-682 014, India

Management of scombroid resources of India

N.G.K.Pillai, P.P.Pillai, T.M.Yohannan and C.Muthiah

Central Marine Fisheries Research Institute, Kochi

ABSTRACT

Scombroids consisting of mackerels, seerfishes and tunas are an economically important pelagic fishes whose average landings during the 90s was 2.81 lakh t forming 11.7 % of the total marine fish production in India. Their demand in the domestic and export markets is on the rise and the group assumes topical importance in a situation where most of the coastal fishery resources are exploited to the near optimum level. Resource potential, status of exploitation and management and conservation issues regarding the scombroid resource in the coastal fishery sector are presented and discussed.

INTRODUCTION

Scombroids which hold great potential for economic exploitation in the small scale and oceanic fishing sectors assume topical importance in a situation where most of the coastal fishery resources are being harvested to the near optimum level. They consist of 49 species belonging to 15 genera, which include the mackerels, Spanish mackerels, tunas and billfishes. Mackerels and tunas support a very important commercial and recreational fishery as well as a substantial artisanal fishery throughout the tropical and temperate regions of the world. World catches of scombroids have oscillated between 4.9 and 6.1 million t during the last two decades. Catches in temperate waters dominate over tropical catches with more than half of the world catch being harvested from the north-west Pacific, north-east Atlantic and south-east Pacific oceans. Many species of tunas and mackerels are the target of far seas fisheries mainly by Japanese, Taiwanese, Republic of Korean, French and Spanish fishing fleets. The principal fishing methods for these surface and sub-surface shoaling fishes are purse seining, ring seining, long lining, drift netting, hooks and line, pole and line fishing with live baits and trolling. The artisanal fisheries deploy a wide variety of gears including bag gill nets, drift nets, beach seines, hooks and line and hand lines.

Scombroids are economically important pelagic resources in India and their demand in the domestic and export markets is on the increase. The estimated annual landings of scombroids consisting of mackerels, seer fishes, bonitos and tunas averaged 2.81 lakh t during the period 1991 - '99 forming 11.7% of the total marine fish landings. Of these, the mackerels (*Rastrelliger* spp.) contributed 60.7% (1991) to 74.5% (1993), seerfishes (*Scomberomorus* spp., *Acanthocybium* sp.) 10.5% (1996) to 20.2% (1998) and tunas (*Euthynnus* sp., *Auxis* spp., *Katsuwonus* sp., *Thunnus* spp., *Sarda* sp.) 13.0% (1993) to 19.6% (1962) of the average annual total scombroid landings during this period. The annual catcheable potential yield of scombroids has been estimated at 7.58 lakh t. On an average 1.7 lakh t of Indian mackerel are being caught from Indian waters, whereas the average catches of tunas and seerfishes amount to 0.4 lakh t and 0.42 lakh t respectively. During 1990s the Indian mackerel was the most important fish species in the fishery along the Indian coast. The catches of tunas and seerfishes, though much less, were economically important due to their high market demand because of the high quality of their meat. These fishes are mostly marketed in fresh or frozen condition while the rest is canned, smoked or salted. Resource potential, status of exploitation, management and conservation of scombroid fish resources in the small scale sector is briefly discussed.

Mackerels

Status of the fishery

The Indian mackerel *Rastrelliger kanagurta* is widely distributed along both the coasts of India with high concentration along the south-west coast. *R.brachysoma* occurring in the Andaman seas contributes very little to the fishery, while *R.faughni* has been reported to occur very rarely along the south-east coast of India. Nearly 90% of the world production of *R.kanagurta* is contributed by India with about 77% contributed by the west coast and 23% by the east coast.

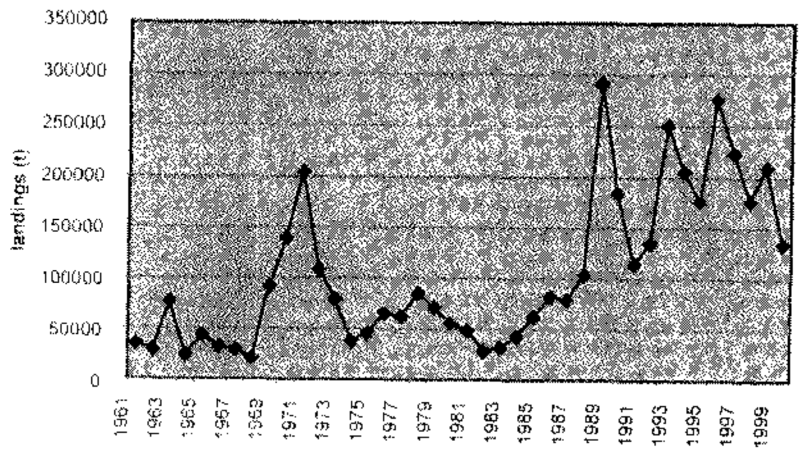

Fig.1. All India mackerel landings (1961-2000)

The Indian mackerel, *Rastrelliger kanagurta* is one of the most important marine fish resources of the country whose annual production during 1985 – '99 period varied from 0.79 lakh t (1987) to 2.91 lakh t (1989). During the last four decades catches have steadily improved with a quantum jump in the 90s (Fig. 1). During the 60s the average annual catch was 50,000 t, which increased to 81,000 t in 70s and 95,000 t in 90s which was mainly due to intensification of the exploitation. Large seines are the major gear employed in the fishery with purse seines and ring seines accounting for 62.3% of the overall production followed by gill nets (18.8%) and trawl (6.4%) and rest by other gears.

The surface waters of the upwelling areas of the west coast become rich grounds for the exploitation of this resource by the end of monsoon season (July – October). Ring seines operated from large plank built boats propelled by powerful outboard engines in Kerala and the purse seines operated from mechanised boats in Karnataka, Goa and Maharastra bring the bulk of the catch. Recently, trawl nets are also bringing in good catches in summer while gill nets land small quantities. Along the east coast where large seines are not operated, gill nets and trawls are the major gears.

Along the west coast the effective spawning of mackerel takes place during April – July period with peak recruitment to the fishery during August-September period (Devanesan and John, 1940). Along the south-west coast, the catchability of the species is very high because of their habit of forming large shoals in the surface waters during the monsoon period to feed on the abundant plankton resulted from the upwelling process and they are heavily exploited at an age of around 4 months. Along the east coast where environmental phenomenon like upwelling are not so pronounced, there is no large-scale surface fishery and exploitation is mainly by drift gill nets and trawl with the peak recruitment to the fishery being at the age of one year.

As noted by Yohannan and Abdurahiman (1998) the recent increase in monsoon fishery of mackerel along the south-west coast with faster motorised boats, larger seines with smaller meshes and harbour facilities have resulted in the intensive exploitation of new recruits. Spreading to deeper areas with downwelling since November reduced their vulnerability to exploitation but presently with the popularisation of deep water trawls even this natural refuge is being violated. They have also cautioned that the heavy exploitation of juveniles of size around 15 cm weighing about 35 g and the fast increasing fleet of ring seine units during monsoon months can further deteriorate the condition of stocks already subjected to growth overfishing.

Conservation needs and management

As mackerel is plankton feeder and their juveniles are important prey species of carnivores, the overexploitation of the juveniles can affect the resource and the ecosystem. The optimum age at first capture of the species is fixed at 0.5 years, however, at present 35% of the mackerel caught along the west coast are below this age. Thus growth overfishing is a major problem in the mackerel fishery of the south-west coast of India. The meshes of the large seines are below 20 mm and the regulation of the mesh size of these gears to a minimum of 40 mm can control growth overfishing and improve the maximum sustainable yield (MSY). The spawning period of mackerel is during April-July, which coincides with the summer fishery by trawls and gill nets which catches mainly the spawners, and can result in recruitment overfishing. Exploitation during this period has to be regulated to protect the spawning stock.

Yohannan *et al.* (1999) has proposed a method of successional fishing aimed at conserving juveniles and spawners occurring in inshore waters which are subject to relatively high fishing pressure. Accordingly different gears will be used in space and time according to the biological characteristics of fishes, for protecting their spawning stock and juvenile stages. With regard to mackerel fishery, during the spawning period (May- July) all gears except large meshed (>80 mm) drift gill nets and hooks and line should be controlled. After July, gill nets of mesh size >40 mm may be encouraged to catch post spawners, while protecting recruits. Mesh size of purse and ring seines should be made at least 40 mm and all kinds of trawling, including mini trawling in coastal waters during May –September should be banned.

As the mackerel fishery is vital for the sustenance of the traditional fishing community of the southwest coast, they should be made aware of the ecological and economical basis for the management of the mackerel fishery and also involved in taking management decisions.

Seerfishes

Seerfishes are valued table fishes enjoying high market demand. Out of the 21 species known under the genera *Scomberomorus*, *Acanthocybium* and *Grammatorcynus* from the world oceans, only the following five species are known to occur in the Indian waters, of which, *S. commerson* is the most abundant species in the small-scale fisheries sector.

Species	Common name	Maximum	
		Fork length(cm)	Weight (kg)
S.commerson	King seer	200	40
S.guttatus	Spotted seer	76	19
S.lineolatus	Streaked seer	80	21
S.koreanus	Korean seer	150	15
A.solandri	Wahoo	210	83

Mechanised/motorized boats and trawlers, dugout canoes and plank built, FRP boats, outrigger canoes and catamarans are the common crafts for seerfish fishery in the inshore waters. While all the small and medium trawl boats are mechanized, the small plank built boats and catamarans were motorized with outboard engines in recent times. A variety of gears are used for the capture of seerfish, of which, drift gill nets (surface and bottom set) with mesh sizes varying from 25 to 205 mm and hooks and line are the important gears. They are also caught by various other gears like shore seines, boat seines, longlines and surface trolling. Purse seines along the west coast also land them as incidental catches. In recent years, trawl net is emerging as the dominant gear for juvenile seerfish exploitation in many of the maritime states. Trawls and shore seines are non-selective and usually catch small size groups while gill nets with mesh size of 120-170 mm and hooks and line have been found very efficient in seerfish exploitation. In the traditional sector, gill nets contribute 65.1% to the all-India seerfish catch, the hooks and line 6.9%, the mechanised trawlers 1.5% and the rest by other gears like trolls and shore seines. Along the east coast the fishing season is from June to September and on the south-west coast from September to November.

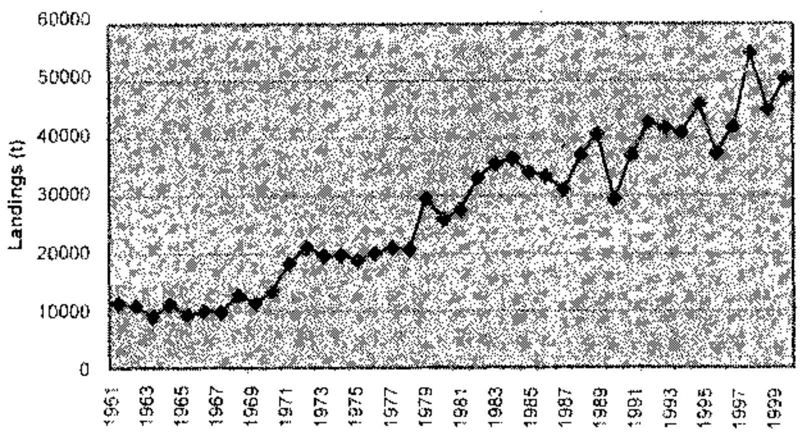

Fig.2. All India seerfish landings (1961-2000)

Seerfish production in India exhibited an increasing trend during the past five decades from the 1950s to the 1990s but with marked year-to-year fluctuations (Fig.2). The annual catch varied from 4,505 t (1953) to 54,867 t (1998). The average annual catch during the five decadal periods varied from 7,278 t in 1950-'59 to 41,575 t in 1990-'99 contributing 1.5% and 1.75 % respectively to the total marine fish catch. The state-wise contribution to the total seerfish fishery in India is given below:

State	%
Gujarat	25.8
Maharastra	16.1
Tamilnadu	13.6
Kerala	13.1
Andhra Pradesh	12.7
Karnataka	6.7
Orissa	5.3
Goa	2.2
West Bengal	1.9
Andaman & Nicobar	0.7
Pondicherry	0.3

Scomberomorus commerson dominates the catches with a contribution of 64% followed by *S.guttatus* (33.3%) and *S.lineolatus* (2.7%). Stray catches of *Acanthocybium solandri* are also observed. *S.commerson* and *S.guttatus* show a latitudinal difference in distribution with *S.commerson* dominating in the southern areas and *S.guttatus* in the northern regions.

Conservation needs and management

Along the south-west coast the fishing season is from September to January. The mesh size of the major gear (drift gill net) varies from 8-20 cm and mesh sizes below 10 cm catches juveniles of seerfishes. The size at first maturity of *S. commerson* is 75 cm (Devaraj *et al.*, 1983) while at present they are heavily fished before attaining this size, especially by bottom trawls and small meshed gill nets. Fishes of size below the optimum size of 80 cm contribute 64% of the seerfish catches in Kerala, 91% in Tamilnadu and 78% in Karnataka. The seerfish resources of Indian waters are not very abundant to allow the exploitation of the size groups below the size at first maturity and as observed by Yohannan *et al.* (1992) such an exploitation pattern may affect spawning stock and recruitment process. They have therefore suggested that the exploitation by small meshed gillnets (*podivalai*) along the south-east coast must be discouraged to ensure good spawning stock and also improve catches along the south east coast. Hence, drift gill nets with a mesh size of 10 cm and above only will be ideal for their exploitation from the coastal waters. As suggested by Devaraj *et al.*(1997) capture of juveniles which form a bycatch in the trawl fishery, especially during April-May should be discouraged while operation of hooks and line and bottom set large meshed gill netting for the exploitation of seerfishes should be encouraged.

Planktivorous fishes, especially their juvenile stages, are the major prey species of seerfishes and their overexploitation will also have negative effect on the abundance of seerfishes which must be avoided.

Tunas

The commonly occurring tuna species in the small scale fisheries are:

Species	Common name	Maximum	
		Fork length(cm)	Weight (kg)
Euthynnus affinis	Kawakawa	100	10.0
Auxis thazard	Frigate tuna	50	2.2
Auxis rochei	Bullet tuna	40	1.2
Thunnus tonggol	Longtail tuna	130	43.0
Thunnus albacares	Yellowfin tuna	150	65.0
Thunnus obesus	Bigeye tuna	210	85.0
Sarda orientalis	Oriental bonito	100	6.0
Katsuwonus pelamis	Skipjack tuna	85	13.0

Along the mainland, little tunny (*E. affinis*) is the major component of the tuna catch followed by frigate tuna (*A. thazard*) and bullet tuna (*A.rochei*) while recently, an increasing trend is seen in the catch of the yellowfin tuna (*T. albacares*) also. Skipjack (*Katsuwonus pelamis*) is the major species caught in Lakshadweep islands.

The crafts used for tuna fishery in the small-scale sector are small mechanised and non-mechanised boats and canoes while the main gears are drift gillnets, hooks & line, shore seines, purse seines and surface trolls. In the mechanised sector the drift gillnet contribute 54% of the total tuna catch followed by pole and line (27%), purse seines (17%) and other gears (2%). In the non-mechanised sector, drift gillnets contribute 76% and the rest by indigenous gears. In Lakshadweep, pole and line (live-bait fishery), troll lines and hand lines are the common gears.

Tuna landings in India showed an increasing trend with annual fluctuations (Fig.3). The average all India catch during the 11-year period from 1987-'97 was 40,323 t and it formed 15% of the average total scombroid fish catch. On an average, the west coast contributed 68%, east coast 14% and Lakshadweep and Andaman Islands 18%. The average annual statewise catch during 1987-'96 in different states was Kerala (16,197 t), Gujarat (4,542 t), Andhra Pradesh (1,213 t), Pondicherry (143 t), Orissa (123 t) and West Bengal (22 t). The most productive season for tuna fishery is during pre-monsoon and post-monsoon months along the south-west and south-east coasts and during post-monsoon months along the Karnataka, Goa, Maharashtra and Gujarat coasts. In the Lakshadweep, December-April is found to be most productive.

The tuna fishery is not an organized fishery, still the exploitation of tunas from the traditional fishing grounds has reached the optimum level or

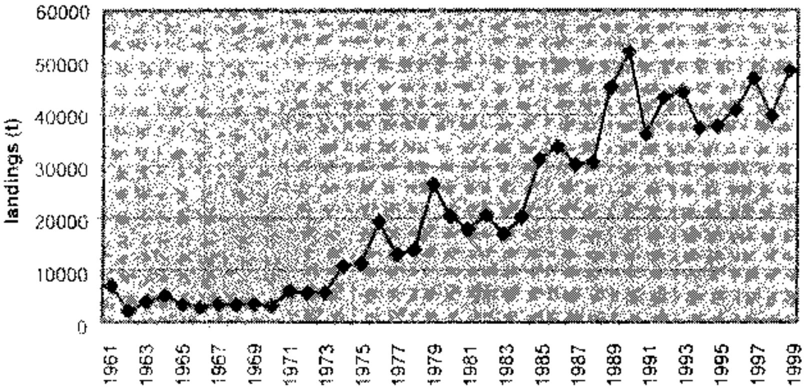

Fig.3. All India tuna landings (1961-2000)

is nearing it. While the exploitation of little tunny *E.affinis* has gone beyond the MSY level, there is scope for increasing the catch of some other species, especially frigate tuna and the longtail tuna (James *et al.*, 1992; James and Pillai, 1994). Exploitation of the skipjack tuna in Lakshadweep is not considered to affect the stocks seriously due to the fishery being mainly artisanal and depending on the migratory stock (Yohannan *et al.*,1993).

Growth and population parameters of the dominant tuna species *viz.*, *E.affinis*, *A.thazard*, *A.rochei*, *T. tonggol* and *K. pelamis* have been studied and their stocks assessed (James *et al.*, 1992). They estimated the potential yield of tunas in the Indian EEZ at 265,000 t and during 2000 the total tuna production has reached a level of about 50,000 t in the small scale fishery sector. James and Pillai (1994) reported that the tuna stocks in the traditional grounds are exploited to the maximum level and further enhancement of catch is possible only by the expansion of the area of operation into oceanic waters, introduction of multiday purse seiners, longliners, high sea gill netters and intensification of trolling and pole and line operations.

Conservation needs and management

At present exploitation is restricted only to a few of the coastal species of tunas and the strains of exploitation are evident on the resources of *E. affinis*. It is therefore desirable that fishing is extended to deeper waters to catch other species as well. Introduction of medium-sized fishing crafts for longlining, pole and line and gill net fishery may be encouraged for the effective exploitation of tuna resources from the continental shelf waters. Seasonal conversion of shrimp trawlers as tuna gill-netters / monofilament longliners for better and effective redistribution of fishing effort and development of sub-surface fishery (deep gill-netting) to catch tunas and seerfishes must also be considered as options.

As in the case of seerfishes, prey-predator relationship also plays a major role in the abundance of tuna resources available for exploitation and over exploitation of the prey species of tunas limit their abundance.

Tuna resources of the coastal area and the high seas should be treated separately for evolving strategies for tuna fishing operations and management of the fishery.

RESEARCH STRATEGIES FOR SCOMBROID FISHES

Reliable and strong database of the fishery, biology and fishery environment are the pre-requisites for evolving exploitation and management strategies for scombroids. The database on the neritic and oceanic scombroid resources should be established and strengthened through inter-institutional and regional / international linkages.

The present sampling design needs restructuring taking into consideration the shifting pattern of the fishery from the traditional sector to motorized/mechanized sector and stay-over fishing in recent years. For estimating production with desirable precision the existing sampling fraction should be enhanced to the tune of 5% instead of the present 2.5%.

The suitability of the existing production models to assess the status of the tropical migratory /straddling stocks should be critically evaluated and if necessary suitable models may be developed. Length frequency analysis (LFSA) is employed in most of the production models and a strong database on length frequency distribution especially of seerfishes and tunas are of paramount importance. Required manpower and financial assistance should be allotted to collect adequate data on the above lines on target species from all major landing centers including the UT of Lakshadweep and the Andaman and Nicobar islands.

As environmental parameters influence the distribution and fluctuations of scombroid fishes, specific studies to analyse the linkage between environmental parameters and availability and abundance of scombroids in the commercial fishery should be given prime importance.

Application of remote sensing technology in the scombroid fishery, particularly tuna fishery will result in economizing fishing operation. This needs development of suitable algorithm to analyse satellite imageries, which require elaborate sea truth data. Concept of Large Marine Ecosystem (LME) is relevant in this connection. Installation of FADs around the island ecosystems to understand their aggregation dynamics and increase tuna catches is desirable.

Telemetric tagging programme for understanding biology and migratory pattern of oceanic tunas may also be taken up in collaboration with international bodies such as Indian Ocean Tuna Commission (IOTC).

International cooperation and participation in FAO sponsored workshops/working group meetings/expert consultations would further enhance the quality of research and developmental programmes on the migratory stocks of tunas.

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