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Conservation Needs and Management Strategies for Migratory Marine Catfish Resources

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Abstract

The Marine catfishes are one of the most vulnerable resources for irrational harvest during their migratory and breeding phase. With the advent of mass harvesting gear like purse seine and trawlers, there has been a continuous onslaught on this resource during the periods of South bound or North bound migrations parallel to the coast. The damage is further aggravated when their spawning shoals are exploited from the surface often causing large scale destruction of parents and egg / embryos, leading to recruitment overfishing. Their production showed a continuously declining trend all along Indian coast, preferably along the SW and SE, since 1980's from 67,666 t (1982) to 37,518 t (1995). The paper gives the possible migratory direction and seasons of the resource. It is attempted to correlate the surface drift with the seasonal migrations. Various management practices are proposed to conserve the threatened group and suggested possible lines of exploitation of the non migratory species from distant waters, in the middle shelf and estimated their potential.

Introduction

The marine catfishes of the family Tachysuridae are widely distributed in the coastal waters and form a substantial demersal fishery resource of the country. The all India catfish production showed a continuously declining trend with the peak in 1982 (67,666 t) and the dip in 1992 (36,165 t). The annual average catfish catch in the pre-mechanised era was less than 20,000 t. The large mechanisation in 1971- 1980 witnessed a hike in the landings to the tune of 51,271 t followed by the purse seine fishing in Karnataka and Kerala thereby landings showed further progress to 57,860 t in 1981-1985 period. Thereafter the landings slowly declined to 40,008 t in 1991-1995. But the estimated revalidated potential is around 123,000 t from the EEZ, of which less than 50 m depth zone holds 60,000 t and above 50 m , 63,000 t (Anon., 1991). Menon *et al.*, (1996) estimated the potential from the 50 - 100 m as around 40,000 t and 57,000 t from 0-50 m depth, based on the experimental bottom trawling (1985-1994) data from FORV SAGAR SAMPADA. On the contrary the earlier estimate of potential yield of catfishes was 310,000 t (George *et al.*, 1977). The potential estimates made during different periods of time together with declining landing trends call for the implementation of suitable management strategies all along the coast , preferably in the Southwest and Southeast regions for sustaining the catfish fishery for the future.

The catfish fishery of the country for the last 5 decades has been critically analysed and evaluated to study the whole gamut of the over exploitation problem for developing management options to protect and conserve the threatened species from further degradation.

Materials and Methods

Regionwise and gearwise catfish landing and effort data collected by the NMLRDC and species composition as well as biology, behavior and population characteristics data of dominant species from selected centers are utilised for the study. Standard management tools were made use of in suggesting conservation and management measures along the whole range of its distribution.

Results and Discussion

All India catch

Till the beginning of mechanisation the resource was exploited by various types of artisanal gears, from shallow grounds and during fair weather. During 1956 - 1966, the annual average catfish catch was 21,139 t forming about 2.8 % of the total marine fish landings of the country. Several species constitute the fishery. The peak landings were in post and pre-monsoon months and the annual production then showed steady increase over the years. When mechanised fishing gained strength in 1966-1970 and 1971- 1975, preferably by trawlers, the catfish landings also made concurrent progress with annual average catches of 29,527 t and 57.776 t respectively. The introduction of purse seine in 1976-1980 period and its intense operation during 1980-1985, along the Southwest coast has helped to increase the annual average landings to the tune of 45,767 t and 57,860 t respectively. The catfish harvest was at its peak during the period 1971 - 1985 by a multitude of competing users. The resource was chiefly exploited by mechanised trawlers (33%) followed by mechanised gill net (21%), non-mechanised gear (14 %), purse seine (11%) hooks and line (10%) and dol net (5%). Indiscriminate exploitation of juvenile and sub-adult populations by bottom trawlers and brooders / spawners by purse seiners has caused considerable damage to this highly vulnerable resource. With the result the recruitment got weakened, spawning stock declined and shoreward migrations of shoals were infrequent. Ultimately the production declined in 1986-1990, though several innovative

gears contributed towards catfish fisheries in this period, with an annual average catch of 51,244 t. The landings further declined in 1991- 1995 period with an annual average of 40,008 t inspite of extended fishing to deeper grounds upto 80 -100 m depth and species replacements.

Regionwise catch

West coast : The West coast landed 69.7% of the total catfish catch and the East coast 30.3%. The trend was almost same during pre-mechanised and mechanised periods. The average annual production from the West coast (1956-95) is 30,180 t which is shared at the rate of 57.8% by Northwest and 42.2% by Southwest region. Till 1980 the Southwest was the dominant catfish producing region (56.2% of the total catfish landing of the West coast); whereas during 1981-1995 period, the Northwest produced 72.5% of the catfish catch of West coast. The situation is further pronounced during 1991-1995 when the Northwest region landed more than 95% of the catfish catch of West coast. Thus the data clearly indicate that the depletion of the catfish stock is well manifested in the Southwest region, comprising Karnataka and Kerala. The landing in the Northwest region (Goa, Maharashtra and Gujarat) registered a continuously increasing trend from an annual average of 7360 t (1956-1966) to 26,269 t (1986-1990). But in the Southwest region the landings increased steadily till 1975, with an annual average (1971-1975) peak of 24,702 t and thereafter the catches declined to 1212 t in 1991-1995 (Fig. 1). The fishing pattern during 1991-1995 in the Northwest region recorded that the trawl net landed 38% of the total catfish catch, followed by gill net (25%), purse seine (16%), dol net (8%), hooks and line (7%) and non-mechanised gear (7%). In the Southwest region trawlers contribute 37% of the total catfish catch, gill netters landed 23%, purse seine 19%, hooks and line 12% and non-mechanised gear 6%.

East coast : The annual average (1956-1995) production from the East coast is 13,137 t, which is shared by Northeast (64.6%) and Southeast (35.4%). Along the Southeast the landing progressively increased upto 1975 (annual average of 8,190 t) and thereafter declined to 2129 t in 1986-1990 period, whereas in the Northeast region the production increased steadily and reached a peak in 1981-1985 (average catch of 13,283 t) and maintained a steady state thereafter. In the 1981-95 period this region contributed about 81% of the total catfish catch of East coast. The data from the East coast also clearly showed that the catfish population decline was pronounced in Southeast coast (Fig. 1). The fishing methods and their contribution in the Northeast coast during 1991-1995 showed that the bulk of the catch (38%) was landed by gill netters followed by non-mechanised gear (24%), trawl net (20%), and hooks and line (17%). Whereas in the Southeast region the mechanised trawlers landed 47 % of the total catch ; the non-mechanised gear caught 38 % followed by gill netters 12%.

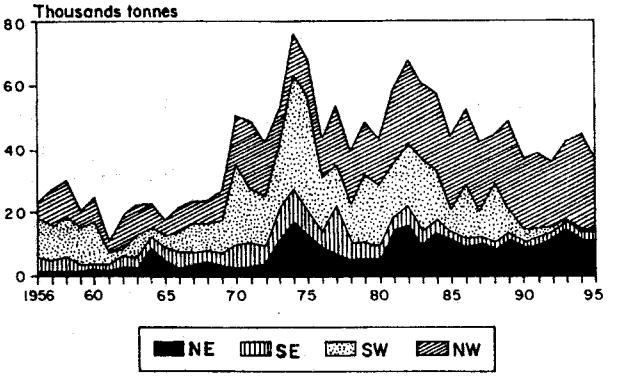

Fig.1. Regionwise catfish catch

Impact assessment of fishing gear

Trawl net: During the pre-mechanised period the catfish fishery was sustained by indigenous crafts plying many traditional non-mechanised gears like hooks and line , gill net and boat seine and the production showed a gradual but steady improvement, with many species contributing to the fishery. The introduction of trawl net in fifties and its extensive operation in sixties and seventies altogether changed the fishing pattern and production trends along most of the maritime states. This shrimp targeted but non selective gear landed juvenile and sub-adult, and medium size column moving 1-2 year old demersals in large quantities. Often the juvenile and sub-adults of 7-20 cm formed the bulk (numerical) of the catfish landing at most of the centers along Southwest and Southeast coasts. Continuous bottom dragging has depleted the nursery grounds causing growth overfishing of *T. thalassinus,* and *T. tenuispinis.* The impact of bottom trawler has caused damage not only to the ground fishes sustainability but also to the bottom habitat and the biota (epi- and in fauna) which form the prey for exploited demersal resources (Lakshmi and Rao, 1992; Menon, 1996). The landings of *T.thalassinus* by trawlnet consisted of less than one year old and immature (7-20 cm) fish to the tune of 80% at Mangalore (1988-1991) and 83% at Visakhapatnam (1986-1993). Similarly about 70% of the trawl catch of T. tenuispinis consisted of juveniles/ sub-adults (13.5 -23 cm) at Mandapam (1988-91) and 88% at Mangalore (1983-89). The trawling depth was invariably within 40 m. This type of juvenile fishery from the nursery grounds has caused both recruitment and growth overfishing, preferably of *T. thalassinus* and *T. tenuispinis.* The coastal trawling along Mangalore during 1983-93 clearly showed almost complete disappearance of T. tenuispinis from the fishery.

Purse seine : The introduction of purse seine into the commercial fisheries in 1979 first along Goa and Karnataka, later in Kerala has accelerated the growth of coastal pelagics and few shoaling demersals production. The purse seine catch invariably includes gestating males / female spawners of *T. tenuispinis, T. dussumieri* and *T. serratus,* during the periods

September-November , December - March and July - September respectively (Table 1). In 1979-87 period the gestating males (*T. tenuispinis* and *T. dussumieri*) alone formed 64 % of the catfish catch by purse seine. The estimate of annual destruction of egg / embryos / larvae of *T. tenuispinis* during the above period is about 8.2 million (13.4 t) by purse seine. If allowed to grow and contribute to the fishery (by age 2 years and above) it would have yielded 2768 t per year (after allowing a margin of 10% natural mortality). Similarly the estimated annual fishing mortality of eggs/embryos/larvae of *T. dussumieri* by purse seine in the above period is 1.6 million (5 t). The loss by way of this fishing mortality of egg / larvae is equivalent to 3320 t of exploitable fish (4-5 years old and above) after allowing a 10% natural mortality. The wanton destruction of catfish brooders with eggs / embryo by purse seine has been reported from Karnataka since 1980 and the vulnerable species were *T. tenuispinis, T. dussumieri* and *T. serratus*. The purse seine catch per unit effort data of Mangalore during 1982- 92 clearly indicate the total disappearance of both *T. tenuispinis* and *T. dussumieri* from this part of the coast since 1988 and 1992 respectively.

Biology and behavior characters

The characteristic reproduction, shoaling behavior and migration of many species of marine catfishes made them easy target for overexploitation. Species like *T. tenuispinis, T. dussumieri* and *T. serratus,* although demersal denizens of coastal habitats, exhibit shoaling behavior and vertical or horizontal migration especially during their adult / breeding / spawning phases of life history. These species are easily vulnerable to mass harvest by purse seine during this phase. All these species have low fecundity ranging from 25 - 190 ova and with a single spawning in a year. The breeding period lasts around 5 months with peak in 1-2 months (September - November for *T. tenuispinis,* December - January for *T. dussumieri* and July - August for *T. serratus*). All the species exhibit parental care with the male parent carrying the brood (25-120 eggs) in the oro-buccal cavity for 1 to 2 months time until the juvenile (4-7 cm) is released. After spawning the shoals of brooding males move along the surface and prefer shallow water. The newly released juveniles of all species of tachysurids live in the shallow muddy grounds feeding on the bottom epi- and in fauna. The incessant bottom trawling in these grounds frequently harvested large quantities of juvenile / sub- adult catfishes. The characteristics shoreward breeding migration, the low fecundity, oral incubation and the shallow nursery grounds are the biological and behavioral characteristics detrimental to their survival when threatened by fishing mortality.

Migration

The predominantly demersal marine catfishes exhibit diurnal vertical migration and horizontal migration towards the coast and parallel to the coast during monsoon (James *et al.,* 1989) . The seasonal yield trends, bumper landings at various fish landing centers from Ratnagiri along west coast to Madras in the east coast throws considerable light on the probable season and course of migration of the major shoaling species *T. tenuispinis, T. dussumieri,* and *T. serratus.* Analyses of data from all such reports revealed a south bound coastal migration starting from Ratnagiri during Southwest monsoon, concurrent with the surface drift pattern in the Arabian sea and north bound migration in the Bay of Bengal upto 15o N in August- September and thereafter the reversal trend in Northeast monsoon (November -January). The coastward migration of shoals is mostly evident during breeding season and the migration parallel to the coast is reported from below 17o N at both west and east coast . The mass harvest of brooders / spawners has, therefore, often takes place from this part of the coast. This has resulted in recruitment overfishing and depletion of stocks of *T. tenuispinis* and *T. dussumieri,* in Southwest and South east sectors as evidenced by a continuously declining production trend since late eighties and nineties. Whereas the stocks of the Northern sectors (Northwest and Northeast) remain isolated and hence continue to contribute to the fishery. The south bound drift and concurrent movement of catfish, bulls eye and

Table 1. Statewise average catfish catch t (Tonnes)

	WB&OR	WB	OR	AP	TN	PO	KE	KA	GO	MH	GU
1956-65	174			2542	3396		5801	1866		4319	3041
%	0.8			12.1	16.1		27.4	8.8		20.4	14.4
1966-70	254			3146	4803	144	8025	3968	100	6423	2641
%	0.9			10.6	16.3	0.5	27.2	13.4	0.3	21.8	8.9
1971-75	1198			8574	8055	135	22278	2424	462	11115	3522
%	2.1			14.8	13.9	0.2	38.5	4.2	0.8	19.2	6.1
1976-80		387	1665	4242	7031	100	11016	5509	1021	9601	5162
%		6.5	9	7.5	7.2	0.1	17.7	10.4	3	20.2	18.4
1981-85		3748	5190	4345	4142	59	10238	6029	1727	11677	10679
%		6.5	9	7.5	7.2	0.1	17.7	10.4	3	20.2	18.4
1986-90		4546	4489	2933	1907	222	6010	4868	2471	13419	10379
%		8.9	8.8	5.7	3.7	0.4	11.7	9.5	4.8	26.2	20.3
1991-95		4697	4697	2933	2502	35	835	377	707	10851	12705
%		11.7	10.9	7.3	6.3	0.1	2.1	0.9	1.8	27.2	31.7

WB & OR - West Bengal & Orissa, WB - West Bengal, Or - Orissa, AP - Andhra Pradesh, TN - Tamilnadu, PO - Pondicherry, KE - Kerala, KA - Karnataka, GO - Goa, MA - Maharashtra, GU - Gujarat.

Table 2. Purseseine landing of catfish brooders/eggs/embroys

Year/month		Area	Catch of brooders (t)	egg/ larvae
T. tenuispinis				
1980	September	Mangalore	204.9	16.0 t
1980	October	Mangalore	241.5	14.0 t
	October	Gangoli	82.0	7.6 t
1982	September	Karwar	136.1	3.9 t
1982	October	Karwar		2.3 t
1982	September	Mangalore	10.2	0.13 million
1982	October	Mangalore	475.6	5.9 million
1983	October	Mangalore	331.0	1.7 million
1984	September	Mangalore	9.0	0.05 million
1986	September	Gangoli	1094.0	2.5 million
T. dussumieri				
1983	March	Mangalore	21.0	1.65 lakhs
1984	January	Mangalore	68.7	
1986	Feb.-Mar.	Mangalore	849.0	5.7 million
1987	February	Malpe	25.4	0.38 million
T. serratus				
1996	October	Cochin	4.5	280 Kg.

ribbonfish shoals are reported to approach the coast around 17o N and move down (Rao *et al.*, 1982, James *et al.*, 1983, Vijayakumarn and Naik 1988). The movement could be traced upto Madras in the east and a reverse movement in Northeast monsoon.

Management

A critical analyses of the data on the fishery, biology and behavior of tachysurid catfishes in the last 5 decades emerges valuable research outputs for assessing and evaluating the stock characteristics and for developing suitable management options. The earlier assessment of of its potential at 310,000 t (George *et al.*, 1977) has been revalidated to 123,000 t (Anon., 1987) for the coastal waters upto 100 m depth (the distributional area in the Indian EEZ). Subsequently Menon *et al.*, 1996 estimated the potential based on the experimental bottom trawling by *FORV SAGAR SAMPADA* at 57,000 t from less than 50 m depth and about 40,000 t from 50 - 100 m depth belt. All these reports together with stock assessment studies emerges a continuously declining potential for this resource. In the pre mechanised period the fishery contributed an annual average catch of about 20,000 t with the southern sector yielding 36% (S.W.) 16% (S.E) of the total catfish catch. In the mechanised (predominantly trawl) period (1966 - 1980) the production increased considerably with an annual mean of 44,300 t; of which the southern sector contributed 40% (S.W.) and 16% (S.E) of the catfish catch. The production has further improved in the purse seine period of 1979 - 1985 and the annual yield was around 58,000 t and the share of southern sector was 28% (S.W) and 7% (S.E), Thereafter the yield declined gradually and in 1990 -1995 the annual average was around 40,000 t with the southern sector contribution of 3% (S.W.) and 6% (S.E) of the catfish landings.

The region wise production scenario clearly show that the input of mechanisation (trawling and purse seining) was responsible for sudden increase in landings in 1970 - 1985 period. Simultaneously this fishing has also caused damages to shoaling species like *T. tenuispinis* and *T. dussumieri* by way of growth overfishing (trawlnet impact) and recruitment overfishing (purse seine impact). For example the recruitment of *T. tenuispinis* at Cochin (ages 2 and 3) which was fairly strong till 1984, declined thereafter and the species itself disappeared from the fishery after 1989. Similarly the recruitment of *T. dussumieri* (at ages 3 and 4) continued only upto 1987 through in negligible numbers in the second part of eighties, thereafter this species also disappeared from the fisheries since 1989 at Cochin. As the spawning stock migrations are pronounced in the southwest region, the effect of overfishing is felt at a alarming magnitude in this region.

The characteristic reproductive biology, shoaling behavior and coastward migration made them vulnerable for many fishing gears. Earlier studies revealed that many commercially important species are under heavy fishing pressure (Krishnamoorthy, 1978; Anon. 1987; Menon *et al.*, 1992; Bensam and Menon 1994). Accordingly they suggested regulatory measures (species specific / gear specific / region specific) for implementation by the concerned maritime states. But often the regulatory measures were not implemented due to several socio- economic / political reasons.

The inshore catfish fishery is facing challenging threats not only on their sustainability but also existence of some of the more vulnerable species like *T. tenuispinis* and *T. dussumieri.* Because of the oceanographic isolation of northern stocks from southern stocks it would be worthwhile to propose different management strategies for the two regions. The non-mechanised / motorized sector fishing by drift / gill nets and hooks and line should be encouraged and promoted all along the distributional range of this resource (Menon *et al.*, 1989). This socially equitable proposition will help to sustain the resource harvest. Mechanised bottom trawling should be controlled, or banned in the coastal sector upto 30 m depth all along the coast and the unbridled entry of OB mini trawlers should be regulated. These regulations will reduce growth overfishing and therefore, gradually help to enhance the stock. The control or ban on these bottom trawler operation will also reduce benthic fauna devastation and the exploitable resources feeding habitat degradation (Lakshmi and Rao, 1992; Bensam and Menon, 1994; Menon, 1996).

The catch and landing of spawning stock and gestating males by purse seine should be banned totally all along the distributional range; this could be easily achieved since the skilled fishermen can detect the catfish shoals and avoid fishing them during breeding season. The implementation of this regulation, of course with the beneficiary fisher societies participation, will reduced the egg/ larval destruction and hence

improve and strengthen recruitment (James *et al.,* 1989). As the spawning of *T. tenuispinis , T. dussumieri* and *T. serratus* mostly takesplace in the coastal habitat of Kerala - Karnataka, this regulation should be effectively implemented in the southern sector, where their coastward migrations are intense.

It is often reported that stocks of catfishes occur in areas beyond 50 m depth in exploitable concentration (Joseph and John ,1987; James *et al.,* 1989; James and Pillai, 1990, Menon, *et al.,* 1996). But the existence of such stock in deeper grounds is restricted to certain seasons / periods of time, depending on the biology and behavior of the species and the prevailing oceanographic conditions (Rao *et al.,* 1977). However, the present commercial catch data (1992-1994) revealed that morethan 90% of the total catfish catch is realised from less than 50 m depth inspite of extension of fishing into deeper grounds upto 100 m. Periodically / seasonally they migrate to coastal grounds for feeding / breeding, where they become vulnerable to fishing gears. Therefore, to make fishing operations more economical, it would be worthwhile to harvest them during the incoming migration phase by selective gears without causing recruitment or growth overfishing, rather than to resort to a more costly fishing in the deep. However, the resource could be judiciously harvested from the fishing grounds beyond 30 m depth by High Speed Demersal Trawl (HSDT) or midwater trawl net along regions where shoreward migrations are scanty or infrequent.

Current production of about 36,000 t from the northern region (NW and NE) could be further improved by responsible fishing by non selective gears (Hooks and line, gill nets) and by midwater trawling in 30 - 100 m for a sustainable yield from the potential available in this part (more than 80% of the current total catfish potential from the Indian EEZ.

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