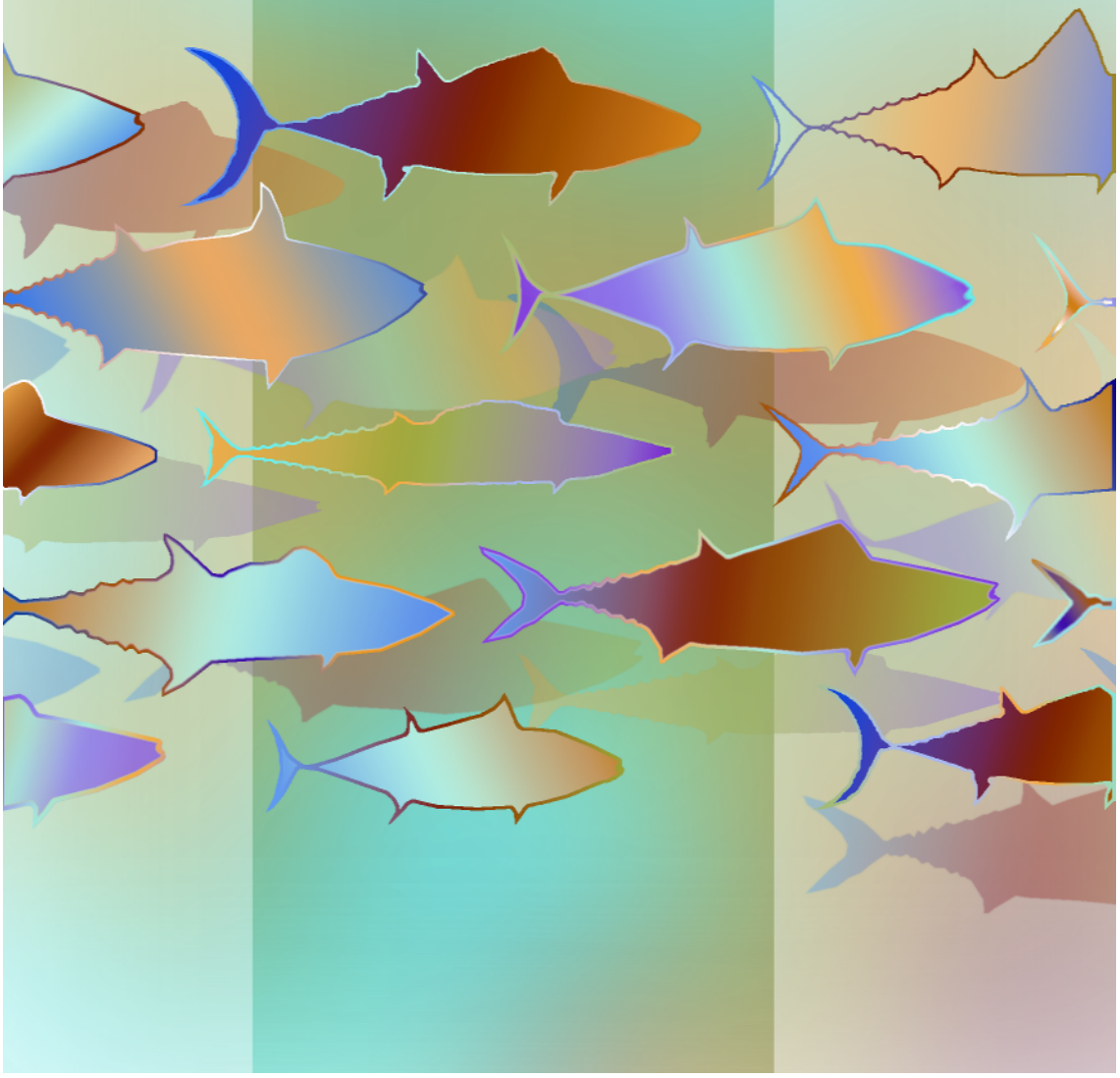
Status of Exploited Marine Fishery Resources of India



STATUS OF EXPLOITED MARINE FISHERY RESOURCES OF INDIA

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Catfishes

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1. Introduction

Among a wide variety of coastal demersal fish species, the marine catfishes assume prime dominance, by virtue of their abundance in the coastal grounds, vulnerability, migration and behavior. Compared to many other demersal fishes, catfishes are within the affordable range of poor/middle class fish eaters. They have a wide distributional range in the Indo-Pacific region, all along the Indian coastal waters upto the middle shelf with preferential concentration on muddy grounds of 30-70 m depths. They migrate both vertically (diurnal migration) and horizontally (seasonal) in small schools to large shoals in response to seasonal climatic / hydrographic variations, drift pattern, biology and reproductive behaviour of the species. Although the young ones live at the bottom, the adults frequently visit column/surface water and move in shoals along the prevailing drifts of the southwest and southeast monsoon, and become amenable to a variety of fishing gears.

Catfishes are utilized as fresh/frozen/processed (cured, dried) form in the internal and export markets. The air bladder yields isinglass while the liver oil is a good source for vitamin A. Marine catfishes are known as Khago or Khagi (Gujarati); Shingala (Marathi); Etta, Koori (Malayalam) Keluthi, Keluru (Tamil); Kantia, Jella (Telugu); Thella Jella (Oriya) and Kanta, Tengra (Bengali).

Marine catfishes belonging to the family Tachysuridae are grouped under three genera Tachysurus (= Arius), Osteogeneiosus and Batrachocephalus in Indian waters with 21 species under the former genus and one species each in the latter two genera.

Of the 23 species recorded from the Indian waters, 11 appear in the commercial fisheries with characteristic species abundance and seasonal variation in different regions. The genus Batrachocephalus, represented by a single species B. mino, has only rare occurrence in the Gulf of Mannar and Palk Bay. Its rarity calls for inclusion of this species under threatened or endangered category. The species diversity in the commercial fisheries has dwindled since the nineties to 4-6 species along the southeast coast and 2-4 species in southwest region of India. A drastic decline in their production in the above regions was also noteworthy.

2. Production trends

Till the beginning of mechanisation in the fisheries sector, the resource was exploited by various artisanal gears from shallow grounds during fair weather. The annual average catch of catfish was 21,139 t (2.8% of the total marine fish landings of the country) during 1956-66. The resource was mainly exploited by gill nets, hooks & line, boat seines, shore seines and other artisanal gears. Several species constituted the fishery, with the peak landings in post and premonsoon months, and the production showed steady increase over the years. When mechanised fishing (trawlers) gained strength in 1966-75, the catfish landings also made concurrent progress with annual average of 29,527 t (1966-70) and 57,776 t (1971-75). The introduction of purse seine in 1976-80 period and its popularisation in 1980-85, along the southwest coast has helped to keep the annual average landings to the tune of 57,860 t (1980-85). The harvest was at its peak during 1971-85 by a multitude of competing fishers, which include artisanal, mechanised and motorised small-scale fishers and the industrial sector. The resource is chiefly exploited by mechanised trawlers (37%) followed by out-board gill nets and hooks & line (24%), mechanised gillnetters (18%), mechanised hooks & line (8%) non-mechanised gear (7%), dol net (4 %)and purse seine (2%) during 1996-2000 (Fig.1). The period of abundance of catfish is January-June off the Maharashtra coast, April-September off Karnataka and Kerala, July-September in the Gulf of Mannar and March-June and December-January off the Andhra coast. Indiscriminate exploitation of juvenile and sub-adult populations by bottom trawlers and capture of brooders/spawners by purse seiners has resulted in poor recruitment, spawning stock decline and infrequent shoreward migrations. Ultimately the production gradually declined in 1986-90, though several innovative gears contributed towards the coastal

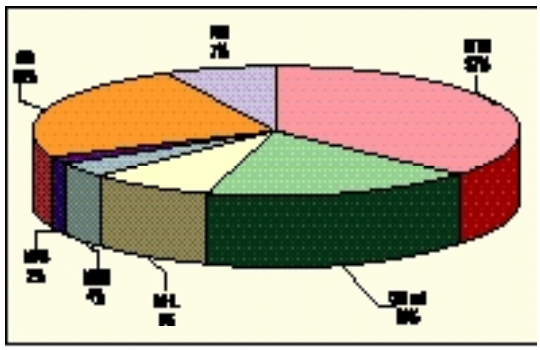

Fig.1. Gearwise all India catfish landing during 1996-2000

fisheries in this period, with an annual average catch of 51,244t. The landings further declined to 40,008 t in 1991-95 inspite of modernisation of harvesting technology, extended fishing to deeper ground upto 80-100 m depth and species replacements. The average annual landings during 1996-2000 was 46,849 t out of which the production from northwest and northeast coasts alone accounted for 84% (Fig.2).

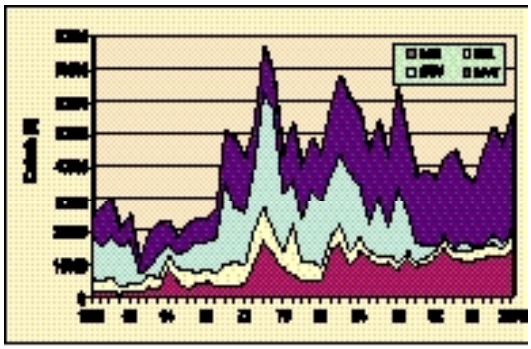

Fig. 2. Regionwise annual catfish landings during 1968-2000

The west coast landed 70% of the total catfish catch and the east coast 30%. Until 1980, the southwest coast was the dominant catfish producing region (56.2% of the total catfish landing of the west coast); whereas during 1981 -1985 period, the northwest coast produced 72.5% and in 1991-95 this region landed more than 95 % of the catfish catch of west coast. Thus, the depletion of the catfish stock is well manifested in the southwest region, comprising Karnataka, Kerala and Goa where the landings declined from 24,702 t (1971-75) to 437 t (1996-2000). The landing in the northwest region (Maharashtra and Gujarat) registered a continuously increasing trend from an annual average of 7,360 t (1956-66) to 26,269 t (1986-90) and further up to 30,188 t (1996-2000). In the northwest region the trawl net landed 38% of the total catfish catch, followed by gill net (25%), purse seine (16%), dol net (8%), hooks & line (7%) and non mechanised gear (7%). The trawlers contributed 37% of the total catfish catch of southwest region, gillnetters 23%, purse seine 19%, hooks & line 12% and non-mechanised gear 6%.

Species composition

The catfish landings in Gujarat showed a progressive increase from 1,843 t (1967) to 26,658 t in 1998. Tachysurus dussumieri (45%), T. tenuispinis (16%), T. caelatus (12%), T. thalassinus (12%) and Osteogeneiosus militaris (8%) were the most common species. The production in Maharashtra showed a steady and progressive increase with the peak in 1988 (21,086 t) and there after the landings fluctuated between 7,461 t (1995) and 15,279 t (1994). Of the several species occurring in the fishery, T. dussumieri (25%), O. militaris (22%), T. thalassinus (19%) and T. tenuispinis (14%) were the dominant. At Goa, till 1989 the production increased gradually and reached 5,317 t and thereafter declined to 9 t in 2000. The rise in landings is linked directly to purse seine impact (1976-90) and exploitation of shoaling species likeT. tenuispinis (Fig. 3), T. dussumieri and T. serratus.

The annual landing of 3,193 t (1956) has increased progressively and reached a peak of 10,253 t (1982) in Karnataka. The landing declined thereafter until 1988

and recorded a steep fall to 107 t in 1992. The catch was mainly composed of T.tenuispinis, (53%), T.dussumieri (31%), T.serratus, (10%) and T.thalassinus (6%) during 1979 -88. Thereafter (1992-94) the former 2 species declined (T. dussumieri 11% and T.serratus, 5%), while T.thalassinus continued to contribute to the fishery forming 65% of the total catfish catch.

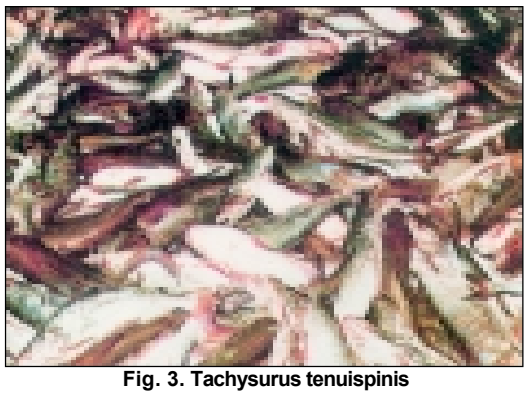

Fig. 3. Tachysurus tenuispinis

In Kerala, the landings showed a fluctuating progress with the peak of 33,528 t in 1974 and this trend continued until 1983 (15,344 t) and thereafter declined with wide fluctuation upto 1988. The catch decreased steeply from 1989 and reached a meagre 49 t in 1993. The species composition here during 1984-88 was T. thalassinus (40%), T. tenuispinis (30%), T. serratus (18%) and T. dussumieri (12%); whereas in 1991-95 the composition showed the dominance of T. thalassinus (65%) and T. serratus (19%). The specieswise landing from Cochin and Calicut clearly illustrates the stock depletion of T. tenuispinis and T. dussumieri.

Along the southeast region, the landings progressively increased upto 1975 (8,190 t) and thereafter declined to 2,129 t in 1986-90; whereas in the northeast region the production increased steadily and reached a peak in 1981-85 (13,283 t) and thereafter remained steady. In 1981-95 period, the northeast region contributed to about 81% of the total catfish catch of east coast. During 1991-95, the gillnetters followed by non-mechanised gear (24%), trawl net (20%), and hooks and line (17%) landed the bulk of the catch (38%) from the northeast. In the southeast region, the mechanised trawlers landed 47% of the total catch; the non-mechanised gear caught 38% followed by gillnetters (12%).

Catfish production from Tamil Nadu registered a general increase until 1982., 3,396 t in 1956-65 to 8,055 t in 1971-75, with fluctuation and declined thereafter (7,031 t in 1976-80 to 1,907 t in 1986-90). Although many species are available, the dominant among them are T. thalassinus (30%), T. caelatus (18%), T. dussumieri (4%), T. serratus (3%) and O. militaris (2%). Catfish catch at Pondicherry showed a declining trend 184 t (1965-75) to 81 t (1976-85) and it further declined thereafter (except a sudden hike in 1986 - 1,043 t). The landing showed a general increasing trend from 2,542 t (1956-65) to 8,574 t (1971-75) till 1981-85 and thereafter slowly declined with minor fluctuations along Andhra coast. The major species contributed to the fishery are T. thalassinus (67%) and T. tenuispinis (32%) during 1960-75 period; whereas the latter species declined to less than 10% of the total catfish catch in 1990. The landings in Orissa registered a fluctuating trend with general increase, the peak landing was in 1981 (6,084 t) and it formed 12.5% of the total marine fish

catch of the state in 1981-85. Of the several species occurring, T. thalassinus, T. dussumieri, T. tenuispinis, T. sona , T. caelatus and O. militaris are the major species contributing to the fishery. In West Bengal, the catch showed a peak of 9,075 t in 1982 and thereafter it was stable and formed about 17% of the total marine fish catch of the state in 1986-90. The dominant species are T. thalassinus, T. jella, T. caelatus and O. militaris. Large quantities of T. jella young fish landing was reported from the bag net operation in the Hoogly- Matlah area. The changing production scenario during 1986-90 and 1996-2000 at various maritime states is presented in Figure 4.

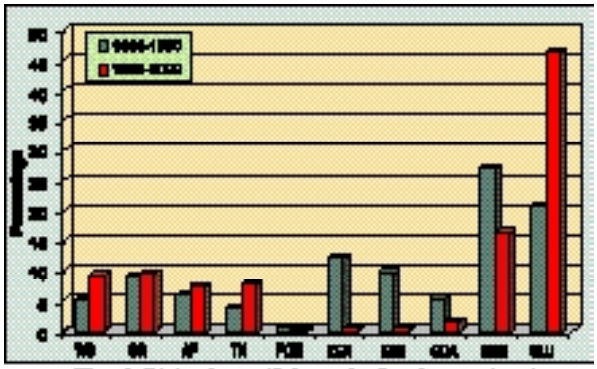

Fig. 4. Stolephorus catfish production (percentage) during 1986-90 and 1996-2000

Impact of Fishing

Trawl net: The introduction of trawl net in the fifties and its large-scale popularisation in subsequent decades altogether changed the fishing pattern and production trends in many of the maritime states. In the shrimp targeted but non-selective gear the catfish was one of the important items among the by-catch. Invariably the trawl catch composed of bottom living juvenile and sub-adult, and medium size column moving 1-2 year old fish. Often the juveniles and sub-adults of 7-20 cm formed the bulk (numerical) of the landings at most of the centres along southwest and southeast coasts. The landings of T. thalassinus by trawl net consisted of less than one year old and immature (7-20 cm) fish to the tune of 80% at Mangalore (1988-91) and 83% at Visakhapatnam (1986-93). 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) often from a trawling depth within 30 m. This type of juvenile fishery from the nursery grounds has caused both recruitment and growth over fishing 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. The destructive overfishing of T. tenuispinis by bottom trawling along Andhra coast has been reported earlier.

Purse seine: The introduction of purse seine into the commercial fishing in 1979 and its intensification in the eighties along Goa, Karnataka and later in Kerala has paved the way for rapid proliferation of the gear (400 units in Mangalore alone) with a concurrent high production of 10,253 t of catfish in 1982. Invariably the purse seine catch consisted of gestating males/shoaling female spawners of T. tenuispinis, T. dussumieri and T. serratus, during September-November , December - March and July - September respectively . During 1979-87 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 2,768 t per year (assuming 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 3,320 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 from Mangalore during 1982-92 showed that the total disappearance of both T. tenuispinis and T. dussumieri from this part of the coast since 1988 and 1992 respectively as a consequence of mass destruction of egg/embryos by purse seine.

3. Biology

The characteristic reproduction, shoaling behaviour and migration of many species of marine catfishes have made them easy target for over-exploitation. Species such as T. tenuispinis, T. dussumieri and T. serratus although demersal denizens of coastal habitats, exhibit shoaling behaviour and vertical and horizontal migration especially during their adult/breeding/spawning phases of life history. All these species have low fecundity ranging from 25 - 190 ova and with a single spawning in a year. The breeding period lasts for 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). They are easily vulnerable to purse seines in this period. All species exhibit parental care with the male carrying the brood (25-120 eggs) in the oro-buccal cavity for 1 to 2 months time until the juveniles (4-7 cm) are released. After spawning the brooding males segregate into shoals and 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 both the preys, benthic fauna and the predator catfishes and immature demersal fish juveniles/sub-adults. The characteristic shoreward breeding migration, the low fecundity, oral incubation and the shallow nursery grounds are the biological and behavioural characteristics detrimental to their survival when threatened by fishing mortality.

The predominantly demersal marine catfishes exhibit diurnal vertical and horizontal migrations towards and parallel to the coast during monsoon. The seasonal yield trends and the bumper landings at various fish landing centres from Ratnagiri to Chennai throw considerable light on the probable season and the course of such migration of the major shoaling species like T. tenuispinis, T. dussumieri and T. serratus. Analyses of data 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 during August- September and thereafter the trend is reverse during the northeast monsoon (November -January). The shoreward migration of shoals is mostly evident during breeding season and the migration parallel to the coast is reported from below 17º N at west and 15º N along east coast. The mass harvest of brooders/ spawners 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 southeast sectors as evidenced by a continuously declining production trend since the late eighties and in the nineties. Since the stocks of the northern sectors (Northwest and Northeast) remain isolated the breeding stocks are not threatened by mass exploitation and hence continue to contribute to the fishery. The southbound drift and concurrent movement of catfish, bullseye and ribbonfish shoals are reported to approach the coast around 17^0N and move down. The movement could be traced upto Chennai in the east and a reverse movement during northeast monsoon. The circulation pattern clearly shows that the monsoon current flow is strong from 17º N downwards during southwest monsoon and in the north bound northeast monsoon (November-January) the drift weakens and partly moves away from the coast at around 17º N in the west coast. The movement of the above resource also follows the same pattern. However, to prove this hypothesis, further investigation is needed by conducting tagging and recovery, release of drift bottles and racial studies on migratory species.

4. Stock assessment

During the project investigation period, the vital biological and population parameters of major exploited species like Tachysurus thalassinus, T. tenuispinis, T. dussumieri, T. serratus and Osteogeneiosus militaris from centres such as Veraval, Calicut, Cochin, Mandapam and Visakhapatnam were estimated and the results revealed that the present level of exploitation of T. tenuispinis and T thalassinus, is slightly high above the MSY and hence proposed a 25% reduction in fishing pressure, especially by non-selective gears. The general recommendation based on the results are that all the species of the genus Tachysurus were subjected to heavy fishing pressure, and therefore indicated that the fishing pressure be brought down to the existing level of C (index of size at first capture) or the present level of C is to be increased considerably at the existing level of fishing in order to get the MSY. The studies also recommended strengthening of hooks and line and drift gill net fishing and trawling in the grounds beyond 50 m.

5. Management

A critical analyses of the data on the fishery, biology and behaviour of tachysurid catfishes in the last 4 decades provide valuable hints on research inputs for assessing and evaluating the stock characteristics and for developing suitable management strategies.

The dwindling production and poor recruitment along the southwest and southeast region now demand management interventions such as banning coastal bottom

trawling, controlling purse seining of gestating/spawning stocks, etc. Since all such measures are detrimental to the economic objective of the industry there would be strong protest. Therefore, the priority should first be decided between short term economic gains or an affirmed policy of achieving a sustainable yield that takes care of the resource from overexploitation. In the interest of both, it is therefore, necessary to formulate suitable management strategies for each region or maritime state depending on the magnitude of the problem.

The regionwise production data clearly show that the higher input of mechanisation (trawling and purse seining) was responsible for sudden increase in landings in 1970-85 periods. Simultaneously this fishing has also caused damages to shoaling species like T.tenuispinis, and T.dussumieri by way of growth overfishing (trawl net impact) and recruitment overfishing (purse seine impact). As the spawning stock migrations are pronounced in the southwest region, the effect of overfishing is felt at an alarming magnitude mainly in this area.

Because of the oceanographic isolation of northern stocks from southern stocks it would be worthwhile to propose different management strategies for the northern and southern regions. The non- mechanised / motorised sector fishing by drift/gill nets and hooks and line should be encouraged and promoted all along the distributional range of this resource. 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 out board mini trawlers as well have to be regulated. These regulations will reduce growth overfishing and therefore, gradually help to rebuild the stock. The control or ban on this bottom trawling operation will also reduce benthic fauna devastation and degradation of the feeding habitat of the resources that are exploited.

The exploitation of spawning stock and gestating males by purse seine should be banned totally all along the distributional range; with the help of the skilled fishermen who can detect the catfish shoals and avoid fishing them during breeding season. The implementation of this regulation, of course has to be initiated with the beneficiary fisher societies participation. As the spawning of T. tenuispinis, T. dussumieri and T. serratus mostly take place in the coastal habitat of Kerala - Karnataka, this regulation should be effectively implemented in the southern sector, where their shoreward migrations are intense.

It is often reported that stocks of catfishes occur in areas beyond 50 m depth in exploitable concentration (Fig. 5). But the existence of such stock in deeper grounds is restricted to certain seasons/periods of time,

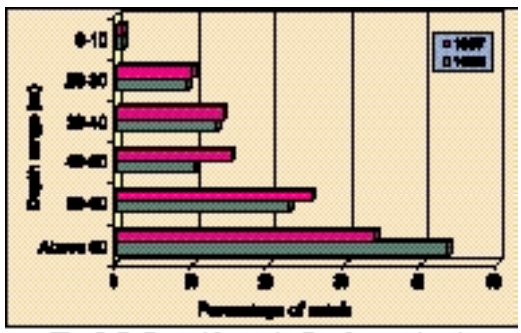

Fig. 5 Bathymetric production (percentage) of catfish during 1997 and 1998.

depending on the feeding biology and behaviour of the species and the prevailing oceanographic conditions. However, the present commercial catch data (1992-94) revealed that more than 90% of the total catfish catch is realised from less then 50 m depth zone inspite of the extension of fishing into deeper grounds upto 100 m. Therefore, to make fishing regulations more economical, it would be worthwhile to harvest them during the shoreward migration phase by selective gears avoiding recruitment or growth overfishing, rather than resorting 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 the regions where shoreward migration are scanty or infrequent.

Current production of about 36,000 t from the northern regions could be further improved by responsible fishing by employing non-selective gears (Hooks and line, gill nets) and midwater trawling in 30-100 m, for a sustainable yield from the potential available in this part. Although the resource is overexploited from the southern regions, the production scenario of the northern region offers scope for sustaining the production through willing co-operation of all stakeholders and responsible fishers. Unbridled entry should also be restricted at most vulnerable hot spots through input controls or through seasonal ban/closure of fishery.

The Government of Karnataka was advised from time to time (1989-92) regarding the negative impact of purse seining on the stocks of marine catfishes. The vulnerability of this resources to "recruitment overfishing", especially during September - November and December - February; and the mitigative measures to control destructive fishing by purse seines have been brought to the notice of the respective state governments sufficiently in advance. Similarly the adverse impact of the bottom trawling in the fishing grounds of less than 30 m depth, the consequent environmental damage and the destruction of juvenile fishes caught as by-catch (catfish being one among them) which might cause growth overfishing have also been highlighted in many publications of the Central Marine Fisheries Research Institute issued from time to time.

6. Suggested reading

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