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TRENDS IN CATFISH CATCHES AT VISAKHAPATNAM SHOWING DISAPPEARANCE OF *ARIUS TENUISPINIS**

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ABSTRACT

Average annual catfish landings at Visakhapatnam during 1970-'78 was 43.65 tonnes forming 7.79% of inshore marine fish landings. The hook and line (61.2%) catch consisting mostly of *Arius thalassinus* and the bottomset gillnet (34.7%) catching mostly *A. tenuispinis* were the predominant indigenous gear. With the expansion of mechanised trawling and the advent of bottomset gillnets in 1972 (first introduced for catching prawns primarily), there has been a steady decline in the inshore catfish landings at Visakhapatnam to 17 tonnes by 1980-81. Catch statistics of Government of India trawlers during the period 1961-1965, showed that *A. tenuispinis* (60.7%) and *A. thalassinus* (38.2%) together constituted about 21% of the trawl landings in the northeast coast of India (between Kakinada and False Point). The decline in the 80s of the catfish component in the trawl landings as well as inshore landings was primarily due to the increasing scarcity of the formerly dominant *A. tenuispinis*, from the fishing grounds of North Andhra Coast. The species disappeared totally from the landings by 1984. Earlier estimations of mortality rates and yield per recruitment of *A. tenuispinis* showed that overfishing was greatly responsible for its disappearance. In the present study the damage done to the fishery is found to be largely due to the destruction of the feeding grounds of the fish off Visakhapatnam, rather than overfishing.

INTRODUCTION

THE MARINE catfishes represented by the genus *Arius* (Wheeler and Baddokwaya, 1981) (= *Tachysurus*) constitute an important component of the demersal fisheries along the east and west coasts of India, consequent upon the introduction of mechanised fishing. With an estimated annual average landings of 52 tonnes over a five year period from 1977—1982, the catfishes constituted about 4% of the total estimated 'all fish' landings only along the Indian Coast (Krishnamoorthy, 1987) as compared to the average catch of 21,000 t during 1956-75 (Table 1) constituting 2.85% of the total marine fish catch. In the beginning of trawling operations along the northeast coast, the catfishes were so important as to constitute 21% of the trawl landings with an estimated specieswise split-up of 38.2% of *A. thalassinus* and 60.7% of *A. tenuispinis* (Sekharan *et al.*, 1973). Although *A. thalassinus* is the single species that supports the catfish fisheries (domination of other species with limited distributional ranges, varies from region to region) all along the coastline of India, *A. tenuispinis* is equally ubiquitous and found to be more abundant along the coasts of West Bengal, Orissa, Andhra and North Tamil Nadu, than in the other maritime States (Krishnamoorthy, 1987). The once dominant *A. tenuispinis* in the trawl landings at Visakhapatnam has almost disappeared from the landings in which, one has to search carefully

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with a keen eye to pick out a stray specimen, once in a while. It is nowhere so alarming as at Visakhapatnam.

In the present study, while showing the decreasing trend of catfish fishery in general and that of *A. tenuispinis* in particular, based on catch statistics available from different sources, an analysis of the possible cause or causes for the almost total disappearance of *A. tenuispinis* at Visakhapatnam, is made. Krishnamoorthy (1987) in a general way pointed out that, while there is an increasing trend in the catfish catches in all other States, to be common all along the Indian Coast. It is only a question of degree at different places. Mukundan (1987) was of the opinion that more efficient fishing with mechanised boats using nets of small sized mesh, exerted extreme pressure in limited areas and caused enough harm to the catfish fishery, which is compounded by the low fecundity of the fish. These opinions highlight the harm done to the catfish fishery in a general way by the introduction of mechanised fishing, but do not help much in understanding the present near total disappearance of *A. tenuispinis* from the fishing grounds off Visakhapatnam. The purpose of

TABLE 1. *Composition of catfish catches in relation to the total marine fish landings in different States* (*Source* : Virabhadra Rao, 1973)

State	Average marine catch in tonnes (Percentage in All India catch) 1951-1965	Average catfish catch in tonnes/ Total marine fish landings 1956—1965	Percentage of catfish in total catch of the State
Kerala ..	2,17,392 (31.47)	5,801/2,60,601	2.23
Maharashtra ..	1,54,722 (22.4)	4,319/1,49,723	2.89
Tamil Nadu ..	1,02,981 (14.91)	3,396/1,10,543	3.07
Gujarat ..	89,106 (12.9)	3,014/ 97,668	3.09
Karnataka ..	56,851 (8.23)	1,866/ 59,459	3.14
Andhra ..	52,293 (7.57)	2,542/ 53,492	4.75
West Bengal and Orissa ..	8,292 (1.2)	174/ 9,054	1.92
Goa ..	3,938 (0.5)	..	..
South Andamans and Laccadives ..	582 (0.08)	..	..
All India average ..		21,112/7,40,540	2.85

he estimated landings in Andhra and Tamil Nadu, were characterised by the decreasing trends. It shows that the declining trend is common between Andhra and Tamil Nadu Coasts. Recent observations and personal communications from V. N. Bande, revealed the declining trend of *A. tenuispinis* at Cochin also. Thus, the decline of *A. tenuispinis* appears the present study is to take into account the manner of decline over several years since the introduction of new types of gear, like bottom trawls and bottomset gillnets for the capture of *A. tenuispinis* ; and analyse how the different factors affecting the population could have influenced their near total disappearance, since 1984, of the once dominant

TABLE 2. *Statewise catches of catfishes (in tonnes) Percentage contribution of each State to the annual*

Year		West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondicherry	Kerala	Karnataka
1969	..		191* (0.71)	3088 (11.48)	4026 (14.97)	139 (0.52)	6245 (22.31)	3857 (14.34)
1970	..		446 (0.88)	2346 (4.63)	7158 (14.13)	148 (0.29)	16380 (32.35)	9220 (18.21)
1971	..		315 (0.65)	2724 (5.58)	7219 (14.78)	360 (0.74)	15189 (31.09)	1331 (2.72)
1972	..		525 (1.24)	3651 (8.60)	5353 (12.61)	72 (0.17)	12636 (29.77)	3184 (7.50)
1973	..		534 (1.01)	10780 (20.48)	9861 (18.73)	122 (0.23)	17438 (33.13)	2372 (4.51)
1974	..		132 (1.62)	15890 (20.85)	10322 (13.55)	65 (0.09)	33526 (44.00)	2011 (2.64)
1975	..		3383 (4.85)	9824 (14.10)	7469 (10.72)	55 (0.08)	33603 (48.22)	3222 (4.62)
1976	..	785 (1.80)	1988 (4.57)	6131 (14.08)	5033 (11.56)	66 (0.15)	12743 (29.27)	4279 (9.83)
1977	..	134 (0.25)	1035 (1.93)	5662 (10.58)	15205 (28.42)	137 (0.26)	7947 (14.85)	5162 (9.65)
1978	..	151 (0.39)	1794 (4.57)	3281 (8.36)	5252 (13.39)	168 (0.43)	9125 (23.26)	2831 (7.22)
1979	..	140 (0.29)	1308 (2.68)	3799 (7.78)	5617 (11.51)	51 (0.11)	11328 (23.21)	9920 (20.32)
1980	..	723 (1.65)	2198 (5.03)	2338 (5.35)	4047 (9.25)	78 (0.18)	13936 (31.86)	5354 (12.24)
1981	..	4449 (7.49)	6084 (10.24)	4250 (7.16)	3792 (6.39)	102 (0.17)	9562 (16.10)	7503 (12.63)
1982	..	9075 (13.41)	3995 (5.90)	3182 (4.70)	6048 (8.94)	20 (0.03)	9532 (14.09)	10253 (15.15
1983	..	1501 (2.47)	4528 (7.46)	3606 (5.94)	4620 (7.61)	64 (0.11)	15344 (25.29)	7273 (11.99)
1984	..	2211 (3.86)	5993 (10.45)	5480 (9.55)	4197 (7.32)	68 (0.12)	11582 (20.19)	3722 (6.49)
Total	..	54718 (6.51)		86032 (10.23)	105219 (12.51)	1715 (0.21)	236116 (28.07)	81494 (9.69)
Average	..	3419.88		5377	6576.19	107.19	14757.25	5093.38

* For the years 1969-75 only, the available catch statistics are combined for the two States of West Bengal and Orissa.

catfish catches are given in parenthesis (Source.: *CMFRI, MFIS, T & E Ser., Nos.* 22, 41, 52 *and* 67)

Goa	Maharashtra	Gujarat	Andaman & Nicobar	Lakshadweep	Total catfish catch **	Total marine fish landings
115 (0.43)	6776 (25.19)	2453 (9.12)	13 (0.05)	..	26903 (2.95)	913630
85 (0.17)	10817 (21.36)	4021 (7.93)	10 (0.02)	..	50631 (4.67)	1085607
84 (0.17)	18052 (36.95)	3570 (7.31)	14 (0.03)	..	48858 (4.21)	1161389
281 (0.66)	12821 (30.21)	3905 (9.20)	15 (0.04)	..	42443 (4.33)	980049
230 (0.44)	9226 (17.53)	2071 (3.93)	8 (0.02)	..	52642 (4.31)	1220240
348 (0.46)	7240 (9.50)	5548 (7.28)	14 (0.02)	..	76196 (6.26)	1217797
1367 (1.96)	8236 (11.82)	2514 (3.61)	15 (0.02)	1 (0.0002)	69689 (4.89)	1422693
834 (1.92)	9522 (21.87)	2140 (4.92)	19 (0.04)	..	43540 (3.22)	1352855
918 (1.72)	8318 (15.55)	8958 (16.74)	28 (0.05)	..	53504 (4.25)	1259782
1356 (3.46)	11081 (28.25)	4159 (10.60)	33 (0.08)	..	39231 (2.80)	1403607
846 (1.73)	10433 (21.37)	5320 (10.90)	55 (0.11)	..	48817 (3.52)	1388380
1151 (2.63)	8653 (19.78)	5235 (11.97)	32 (0.07)	..	43745 (3.50)	1249837
2211 (3.72)	11045 (18.60)	10370 (17.46)	22 (0.14)	..	59390 (4.31)	1378457
1941 (2.87)	10919 (16.14)	12662 (18.71)	37 (0.06)	..	67664 (4.76)	1420624
1522 (2.51)	12008 (19.79)	10176 (16.77)	34 (0.06)	..	60676 (3.94)	1544396
1272 (2.22)	13418 (23.39)	9313 (16.23)	121 (0.22)	..	57377 (3.53)	1627661
14561 (1.73)	168565 (20.04)	92415 (10.99)	470 (0.06)	1	841306 (4.08)	2062,7004
910.06	10535.31	5775.94	29.38	..	52581.6	..

** Percentage in total marine fish catch.

A. tenuispinis. It may throw light on the possible ways in which the future of *A. tenuispinis* may be effected as there are indications of its decline in other parts of the Indian Coast, except probably off Mangalore.

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Catfish Catch Trends in Andhra, Tamil Nadu and Kerala

State-wise statistics of the catfish landings in relation to the total marine fish landings are available from different publications of Central Marine Fisheries Research Institute, Cochin.

The catfish component of the total marine fish landings was reported to be 2.43% for the period 1961-65 (Virabhadra Rao, 1973). However, the State-wise distribution of the catfish landings in relation to the total marine fish landings was available for 10 years only (1956-65) (Table 1). For these ten years the catfishes constituted 2.85% of the total catches at the all India level and 4.75% in Andhra Coast, which is the highest of all the States followed by Karnataka (3.14%), Gujarat (3.09%) and Tamil Nadu (3.07%), the rest being below 3%. These catfish landings are due mainly to the artisanal fishery. It shows the richness of catfish in the inshore fishing grounds off Andhra Coast, which ranks sixth in the order of the total marine fish landings (1951-65) of each State.

The next phase of 16 years from 1969-84 (Table 2) reflects the influence of mechanised fishing, when the demersal fisheries exploitation came into existence in all the States. During this period, the all India marine fish landings as well as catfish landings reached greater heights, but the latter declined in course of time.

The percentage composition of catfishes in the total marine fish landings was initially low at 2.95% in 1969 (Table 2), but during the period 1970-82, it was maintained at a higher level of 3.5% to 6.25% (except in 1978 when it was 2.8%). The percentage composition on average was 4.08%. During the years 1973-75 in Andhra and 1974-75 in Kerala, the catfish catches were unusually high. Both the States touched very high values in 1974 (highest for Andhra) resulting in the highest percentage composition of catfishes (6.26%) in the total marine fish landings in that year. In general, there was an increase in the catfish landings of all the states during 1969-84 as compared to 1956-65. The increase was mainly due to introduction of more and more mechanised fishing. In Kerala there was 15 fold increase in catfish landings, while in Maharashtra it was 7 fold increase, followed by Tamil Nadu, Gujarat, Karnataka and Andhra Pradesh depending on the magnitude of mechanisation of fishing in the different States. According to one estimate made on the basis of information collected from different sources, the total number of mechanised boats in operation by 1985 was 15,000 as against 5,000 in 1967. The increase in total catches was not commensurate with the degree of mechanisation. On the other hand, catfish catches have been on the decline, particularly on the east coast (Andhra and Tamil Nadu) and south-west coast (Kerala), where the success of mechanisation with regard to catfishes was restricted to the initial stages (1973-75). Thus, the phenomenon of adverse effect of severity of fishing appears to be common for the three maritime States. This adverse effect is further highly accentuated off Visakhapatnam.

Depth-wise Distribution on the West and East Coasts

Data on the total catfish landings, along with catch-rates and depth-wise distribution by all the Government of India Exploratory Fisheries Project vessels, are available at the different centres for the year 1979 (Anon., 1979). These figures show that the total landings of all the vessels was 171.0 t. The catch was analysed according to the effort put in by the vessels within 40 m depth and beyond 40 m depth, which was 5,866.42 and 5,029.35 hours respectively. The catch per unit effort (CPUE) shows that the grounds beyond 40 m depth were more productive of catfishes with 22.40 kg/hr as compared to 14.85 kg/hr within the 40 m depth. In the grounds beyond 40 m depth, the catch rates were very high at Goa, Cochin, Bombay, Mangalore, Visakhapatnam and Calcutta in that order, with a catch rate of more than 10 kg/hr. In the grounds below 40 m depth also, the same order of importance of the different centres is seen, excepting Bombay.

In this connection, Sekharan *et al.* (1973) have shown that along the east coast between Kakinada and False Point, the catfish catches were more abundant in the inshore regions (<50 m) during February-April and October-December, while in the deeper regions (>50 m) the abundance was during July-September only. According to them, about 21% of the total landings along the northeast coast would be composed of catfish with the expected species wise split up of 38.2% of *A. thalassinus* and 60.7% of *A. tenuispinis*. It is remarkable that *A. tenuispinis* has lost its ground since 1980, while *A. thalassinus* has become the dominant species in the catches of the small mechanised boats (Table 3). Gearwise catch statistics of the two species would reveal the relationship between gear and behaviour of the two species.

Inshore Catches in the Artisanal Fishery at Lawson's Bay

Fishing is traditionally carried out by four types of fishing gear at Lawson's Bay namely, the shoreseines, boatseines, gillnets and hooks and lines. In addition to these a fifth type of gear, namely bottomset gillnet was introduced since 1972, mainly for catching prawns.

Gear-wise and species-wise catch statistics during the period 1970-86 are given by Srinivasa Rao and Lakshmi (1988) to show the relative importance of each gear to catch catfish and also the relative importance of each species in each gear. Since the fishing methods by the different types of gear have evolved to take the best advantage of the behaviour of the fishes, the species-wise and gear-wise catch statistics give an idea about the predominant availability pattern of the different species, in relation to the gear.

Till the introduction of bottomset gillnets catfishes were caught mainly by hooks and lines (90-100%). *A. thalassinus* (49.05%) was the dominant species in the gear followed by *A. dussumieri* (41.2%) and *A. tenuispinis* (9.8%) during the years 1970 and 1971. Subsequent to the introduction of bottomset gillnets in 1972, the catfish catches by the gear constituted on an average about 29% of the total catfish catches during the period 1972-78, while the contribution of hooks and lines got reduced to 65% with boatseines (4.2%) and gillnets (1.7%) trailing far behind. The dominant species in the catfish catches of bottomset gillnets was *A. tenuispinis* (61%) followed by *A. thalassinus* (30%) and other catfishes (9%).

The above account shows that the availability of catfishes for capture by hooks and lines and bottomset gillnets is behaviour oriented, while their presence in the catches of boatseines and gillnets is incidental. The operations of the shoreseines are very near

the shore (within a distance of 1.6 km) rarely with any catfish component in their catches.

The manner of capture by hooks and lines involves baiting at intermediate levels in the water column. It shows that *A. thalassinus* is carnivorous and frequents the intermediate levels of the water column and that *A. tenuispinis* is less so. On the other hand, the bottomset gillnets are strictly confined to the bottom as they are mainly meant for capturing prawns. Predominance of *A. tenuispinis* in this gear shows that the species is strictly demersal. Menon and Muthiah (1987) showed that *A. thalassinus* lives upto 4.0 years attaining an average length of 52.2 cm, while *A. tenuispinis* lives upto 3.5 years attaining an average length of 44.0 cm. These observations are based on trawl catches. Menon and Bande (1987) stated that *A. thalassinus* which grows to more than 80.0 cm has a wider distribution extending upto Australia, China and Japan, beyond the Indo-Pacific and never forms large shoals although the young ones are strictly demersal. It appears to be more oceanic in its distribution. On the other hand, *A. tenuispinis* which is confined to the coasts of India, appears in large shoals and attains a maximum size of 60.0 cm only. This contrasting behavioural pattern is responsible for the difference in their relative dominance in the catches of hooks and lines and bottomset gillnets. The availability of *A. tenuispinis* with incubating eggs, in large shoals in the purse seine catches

TABLE 3. *Composition of catfish catches in the mechanised trawlers at Visakhapatnam* (*Source :* Appanna Sastry & Kasim (1987) and CMFRI Annual Reports 1983-1988

Year	Catfish catch (in tonnes)			% in total marine fish	C.P.U.E. (kg)
	A. thalassinus	*A. tenuispinis*	Total		
1979 ..	..	..	375.0	6.3	9.90
1980 ..	95.90 (48.7%)	101.10 (51.3%)	197.0	2.5	5.60
1981 ..	94.00 (62.7%)	56.00 (37.3%)	150.0	2.5	4.73
1982 ..	88.80 (87.8%)	28.20 (12.2%)	217.0	3.5	7.60
1983-'84 ..	135.07 (96.0%)	5.63 (4.0%)	140.7	..	..
1984-'85 ..	110.07 (96.3%)	4.30 (3.7%)	114.3	..	3.60
1985-'86 ..	62.38 (89.5%)	7.32 (10.5%)	69.7	..	2.60
1986-'87 ..	115.81 (97.4%)	3.09* (2.6%)	118.9	1.8	5.60
1987-'88 ..	133.81 (94.5%)	7.79* (5.5%)	141.6	..	8.8-12.0

* Catfish of other categories, presumably *A. dussumieri* (vide text)

off Mangalore (Silas *et al.*, 1980) appears to be due to upwelling of low oxygen waters during September and October (Sankaranarayanan and Jayaraman, 1972). Otherwise, the species is strictly demersal and shoaling; seldom moving individually to bite a bait. The vast deference in their behavioural pattern, despite being demersal, is largely responsible for the adverse effect of mechanised fishing on *A. tenuispinis* population off Visakhapatnam.

Catch Trends off Visakhapatnam

Srinivasa Rao and Lakshmi (1988) have given the catch statistics of artisanal fishery of catfish catches at Lawson's Bay, Visakhapatnam from 1970-86 with catch per unit (C/U) in kg.

The C/U figures for hooks and lines (1970-82) ranged from 0.48 to 1.45 kg, whereas the figures for bottomset gillnets ranged from 0.5 to 6.7 kg during the period 1972-82. The bottomset gillnets are mainly meant for catching prawns. Since C/U is an index of abundance, it shows the erratic nature of the bottomset gillnet catches of catfishes, which are constituted mainly by the shoaling *A. tenuispinis*. The catch rate of the high catches of 25.7 t of *A tenuispinis* in 1973 resulting from 8,936 fishing. units was rather low (C/U = 2.9 kg). It shows that the number of units put into operation were far too many. In subsequent years upto 1976 the catch rates were high, but the catches were low, indicating the decreasing trend of the number of units put into operation until 1978, when 10,373 units were put into operation with low C/U (0.27 kg). From 1977-82 the number of units put into operation ranged from 4,510 to 10,373 (Appanna Sastry and Kasim, 1987). After the bumper catch of *A. tenuispinis* (32.0 t) in 1981, there was a sudden drop (1.2 t) in 1982 and ever since there was scant representation of *A. tenuispinis* in the bottomset gillnet catches. In 1985-86, there were some landings of *A. tenuispinis* with the lowest catch rate of 0.04 kg. This by itself is an indication of the rapid disappearance of *A. tenuispinis* in the bottomset gillnet catches from 1984 onwards.

In the trawl landings of small mechanised boats operated at Visakhapatnam (Annual Reports, CMFRI, 1983-84, 1984-85 and 1985-86) the annual landings of *A. tenuispinis* were reported to have ranged from 4.3 to 7.3 t. These were mostly of *A. dussumeiri* which resemble *A. tenuispinis* very closely in the younger stages. It is difficult to distinguish the two, unless one has a keen eye for the distinctive character of antorbital knobs in the case of *A. dussumieri*. These knobs are less pronounced in fishes less than 20-25 cm size. Market studies during the years 1983-87 have also revealed the availability of *A. thalassinus* (30-40 cm) being much more than that of *A. dussumieri* (40-50 cm). Once in a way, stray specimens of *A. tenuispinis* were observed in the market samples. The CPUE of catfishes in mechanised trawlers has fallen from 9.9 kg in 1979 to 2.6 kg in 1985-86 with the disappearance of *A. tenuispinis* from the trawl catches (Appanna Sastry and Kasim, 1987; Annual Reports of CMFRI, 1983-88). Since 1986 the catch rates showed an increase (Table 3), because of the increasing predominance of *A. thalassinus* over the years from 1980-88. Although catch statistics is not available for 1989-90, it is mentioned in the Annual Report of CMFRI that *A. thalassinus* constituted 99.7% of the fish landings by the large trawlers, while *A. tenuispinis* (0.24%) and *A. dussumieri* (0.06%) were negligible.

The occasional appearance of 'other catfishes' in the landings of bottomset gillnets, gillnets and boatseines is due to apparently the appearance of large shoals of *A. dussumieri* which are of a sporadic nature.

Impact of Mechanised Fishing on *A. tenuispinis* Populations

After the introduction of mechanised fishing in the Visakhapatnam fishing grounds in the

late 1960s, it was found that the contribution of catfish to the trawl catches was about 20% (Mojumdar, 1969, 1977; Sekharan, 1973). In the catch composition *A. tenuispinis* was predominant (61.7%) followed by *A. thalassinus* (38.3%) with scarce representation of *A. dussumieri*. The composition of the two species was reversed drastically by 1983 with *A. thalassinus* (90-96%) becoming dominant and *A. tenuispinis* disappearing completely (Table 3). It only shows how timely were the warnings given by Krishnamoorthy (1978) and Dan (1981).

Krishnamoorthy (1978) analysed catch trends of catfishes *Tachysurus* (=*Arius*) *thalassinus* and *T. tenuispinis*, based on the catch and effort statistics of exploratory trawling over the period 1966-76 by the Government of India trawlers based at Visakhapatnam. He showed that catfishes contributed to 23-30% of the total trawl catches during 1966-70 and later during 1971-76, it dwindled down to 10-16%, with the exception of 1974, when it spurted to 24% over the period of six years. This spurt is also reflected in the Statewise analysis of catfish catches (Table 2). He also reported that of the two species *A. tenuispinis* was the major contributor during 1966-76, with a decreasing trend in the catch rates (kg/hr of trawling) coupled with an observed fall in the mean lengths. He believed that the decline in the catch rate may be attributed to fishery independent factors, such as natural mortality rate and warned that 'if, in future, a decline is also noticed in the total catches, then urgent management policies may have to be thought of against possible dangers of depletion that appear presently to threaten the stocks of *A. tenuispinis* in the region currently being exploited'. It was a timely warning that was unheeded, because of the insatiety for prawns by the private entrepreneurs.

Dan (1981) went a step further and made estimations of mortality rates and yield per recruitment of *A. tenuispinis*, using mean size and age composition data available for the period 1964-76. He estimated that the average instantaneous total mortality rate (Z) for a period of 9 years was 1.0 by the 'mean size' method, while in the 'numerical' method the Z value ranged from 0.90 to 1.96 with corresponding annual mortality rates of 0.5963 and 0.8596. He also found, that the yield per recruit (Y_w/R) was highest for 0.3 of instantaneous fishing mortality rate (F) and cautioned that any value of F above 0.3 is going to lead to overfishing. According to him, the fish attains sizes of 18, 30 and 40 cm respectively at the end of I, II and IV years. The fishery at Visakhapatnam appears to be supported mainly by immature groups with a modal length of 22 cm (Anon., 1979). The maximum Y_w/R of 10.74 kg/hr was obtained in 1967, when F was at its optimum (0.29). In the subsequent years, with increase in F, which has reached a maximum of 0.96 in 1974, the catch rate fell down to low values of 3.57 kg/hr in 1973 and 1975. He also mentioned that the higher rate in fishing mortality was probably due to the introduction of bottomset gillnets in 1972 and subsequently, after the prawn catches have also fallen, the intensity of operation of this net was drastically reduced from 1974 onwards. A warning was given by him that 'any further attempt to step-up the catch from the stock has to be excercised with caution'.

The warning signals given by Krishnamoorthy (1978) and Dan (1981) based on catch and effort statistics were timely, but the policy of the mechanised trawlers was to catch prawns mainly, so long as the economics of the fishing operation is not drastically effected. Fishing is still going on at the same rate by about 200 small sized mechanised trawlers which cover largely an area of 30 × 30 sq. km off Visakhapatnam. Thus, the almost total disappearance of *A. tenuispinis* in the trawl catches around Visakhapatnam has become a matter of biolo-

gical interest rather than an economic grievance. *A. tenuispinis* seems to have met with different degrees of the same fate all along the east coast and southwest coast of India. They are still reported to be abundantly available off Karnataka Coast. It is rather puzzling why the disappearance of *A. tenuispinis* is so drastic off Visakhapatnam and not elsewhere. The factors responsible for such a drastic are analysed under discussion.

Discussion

An analysis of the different influences operating on the fishery might reveal the actual cause or causes for the virtual extermination of *A. tenuispinis* from the fishing grounds off Visakhapatnam. Such an analysis should take into account the fact that despite trawling at several places along the Indian Coast, nowhere else the adverse effect on *A. tenuispinis* is so accentuated as at Visakhapatnam. It shows that mere trawling alone could not have affected the fishery. Some other factors peculiar to the continental shelf off Visakhapatnam should also be responsible for this decline of *A. tenuispinis*.

In the comprehensive survey made by Sekharan (1973) on the relative distribution of the two species of catfishes off the northeast coas of India, a major difference was observed between the two species. He was doubtful whether or not the difference is due to biological factors or due to sampling error. According to his analysis of data over the entire coastline, in the two southernmost (16° 40′ N and 17° 10′ N) and the three northernmost (20° 10′N-21° 10′N) zones, *A. thalassinus* was the dominant species ; whereas in the middle zones (17° 40′N-19° 40′N, the region between Visakhapatnam and Gopalpur) *A. tenuispinis* was the dominant species. Moreover, two periods of abundance of *A. tenuispinis* (February-July and October-December) were observed, which were apparent only in the middle zone (17° 40′-18° 40′N, Visakhapatnam to Kalingapatnam), but not in the grounds further north. In a more restricted area north and south of Visakhapatnam (17° 40′-18° 10′N) as per the data from the small motor vessels Champa and Sea-horse, the peak season for the catfish catches was February to May and that was influenced more by the relative abundance of *A. tenuispinis* than by that of *A. thalassinus*. Thus, in the early stages of trawling operations (1964-67) on a pilot scale, by the Government of India vessels, the predominance of *A. tenuispinis* off Visakhapatnam, with February-May as the peak season, shows that the differences in the distribution of the two species are of a biological nature.

For the aggregation of shoals of immature *A. tenuispinis* (Anon., 1979) on the fishing grounds within a radius of 20 miles around Visakhapatnam during February-May, availability of food appears to be the most important factor.

There is very little information about the food and feeding habits of catfishes. Srinivasa Rao (1967) studied the feeding habits of *Pseudarius jella* (= *A. tenuispinis*) obtained from the Government of India trawlers, which used to fish mostly north of 18° 10′ N. The catch was composed of small to medium size fish (10.6 to 28.5 cm) which were found to feed on cephalopods (30.0%), crabs (28.6%), teleosts (10.7%), prawn (9.1%) and squilla (4.5%). Mojumdar and Dan (1979) found that crustaceans formed 37% of the food composition, while polychaetes formed 26% followed by molluscs (6.5%), teleosts (6.3%) and ophiuroids (4.2%). These samples were also from the Government of India trawlers, but from areas closer to Visakhapatnam than those examined by Srinivasa Rao (1967). More recently, Sastry (1982) made a detailed study of the samples drawn from the catches of the private small sized

mechanised boats which operated within a radius of 20 miles around Visakhapatnam. He found that according to index of preponderance which takes volume and frequency of occurrence into account (Natarajan and Jhingran, 1961), polychaetes (69) formed the main food of *A. tenuispinis* followed by prawns (3.4) and other miscellaneous items. The Annual Reports of CMFRI for the years 1979 and 1981-82, also corroborate the observation that the major food component of *A. tenuispinis* was formed by polychaetes.

Besides being a shoaling fish, *A. tenuispinis* is a strictly demersal fish unlike *A. thalassinus*, caught mostly in the trawl net and bottomset gillnets. When shoals of *A. tenuispinis* appeared in large numbers, these two types of gear reaped a good harvest for a short period from 1972-77. After that, a general decline in the catches took place as observed by Krishnamoorthy (1978) and Dan (1981) and the decline was attributed by both to overfishing. But there was again an unprecedented spurt in the catches of *A. tenuispinis* by the bottomset gillnet catches of 1981 (Srinivasa Rao and Lakshmi, 1988). If overfishing was the real case for the decline of *A. tenuispinis* as suspected by Krishnamoorthy (1978) and Dan (1981), such a spurt could have dealt the death blow to the fishery constituted by juveniles. If the decline of *A. tenuispinis* is entirely due to overfishing then replacement by stocks from adjoining areas can always take place. Since such a replacement has not taken place so far (by 1988) the real cause for the decline of the species off Visakhapatnam alone lies elsewhere. It could be lack of food, which is a major determinant, in the aggregation of shoaling fish, which move from place to place in search of food and settle on the grounds where food is available in plenty. If *A. tenuispinis* is attracted by polychaetes on the fishing grounds off Visakhapatnam earlier, the lack of that food might act as a deterrent for aggregations of *A. tenuispinis* settling on these grounds. The reason for such a drastic change in the biological characteristics must be of an enormous magnitude that could upset nature's balance on a large scale for such a long period. Again, it must be due to human intervention and not a natural cause, because *A. tenuispinis* is the only fish affected and not other fishes and that too off Visakhapatnam only. It must be such a cause as to so powerfully deprive the fishing grounds of polychaete abundance which was attracting *A. tenuispinis* earlier.

Narrowing down the search for a man made cause other than overfishing, it is not necessary to seek far. Human intervention on a large scale has taken place with the introduction of hundreds of mechanised trawlers whose operations are confined to a radius of 20 miles around Visakhapatnam. These trawlers dragging their otter boards day after day on the fishing grounds could have exerted such a pressure on the sea floor as to make it hard and render the substratum uninhabitable for polychaetes and other benthic fish forage. The sea floor in the vicinity of Visakhapatnam is silty clay (Subba Rao, 1964). In the recent years a moderate estimate of the number of trawlers operating daily from Visakhapatnam is about 200 small trawls (Dan, 1981) and about 80 big trawlers. It is these incessant operations of the small trawlers, which seemed to have caused the hardening of the sea floor. The combined width of the two otter boards is roughly 15 cm. Such a heavy equipment dragged on the sea floor by 200 trawlers at the rate of 6 hours per day (or may be 8 hours) moving at a speed of 5 km per hour can rove over an area of about 10,000 sq. km in 20 years. It is more than what the sea floor off Visakhapatnam could stand. No wonder, that the heavy otter boards operating on the narrow fishing grounds off Visakhapatnam subjected the grounds to irrepairable damage by way of depriving the polychaete settlements, which formed the natural food (nearly 70) of *A. tenuispinis*. It is understandable

that when the preferred food is not available, the fish desert the area. Since it is more accentuated at Visakhapatnam, it resulted in the virtual disappearance of *A. tenuispinis* from the local fishery. To a smaller or larger degree, similar damage is possible elsewhere along the Indian Coast. Wherever the substratum is muddy or slushy or where the trawling operations are of low magnitude, the damage may be less severe and that may be the reason why *A. tenuispinis* is still available in considerable abundance off Mangalore.

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