

## HOOKS AND LINE FISHERY IN NORTH KERALA WITH PARTICULAR REFERENCE TO CATFISH RESOURCES \*

N. GOPINATHA MENON, V. N. BANDE AND K. BALACHANDRAN  
*Central Marine Fisheries Research Institute, Cochin-682 031*

### ABSTRACT

The paper deals with the hooks and line fishery along North Kerala during 1979-1985. Marine cat-fishes were traditionally harvested from this area by non-mechanised gears, such as hooks and line, drift net and boat-seines till early sixties. The operations by hooks and line yielded a steady catch. The catfishes alone contributed about 90% in the hooks and line landings. The dominant species in the landings were *Tachysurus tenuispinis*, *T. dussumieri* and *T. thalassinus* from the depth ranges of 40-70 m and *T. serratus* from 10-30 m. *T. tenuispinis* is vulnerable to the gear at the age of 3 years and above and *T. dussumieri*, *T. thalassinus* and *T. serratus* at the ages 4, 2 and 6 years and above respectively. Introduction of trawlers and purse seiners initially contributed to a sudden hike in its production. But exploitation of juveniles and eggs/embryos carrying male brooders on large-scale, ultimately resulted in low recruitment. As brooders are not susceptible to fishery by hooks and line, it is suggested to intensify the catfish fishing by this gear.

### INTRODUCTION

THE HOOKS and line fleet is highly mobile and exhibits marked seasonal fluctuations in fishing strategy. The liners appear to respond to seasonal fluctuations in landings which are usually related to changes in the availability of fish in the area ; it is more so in the case of migratory catfishes. The environment, bottom texture of fishing grounds and their faunistic abundance also affect the strategy of fishing. Along North Kerala Coast, hooks and line was one of the major non-mechanised gear used for exploitation of several groups of large size quality fishes. As marine catfishes of family tachysuridae form an important component in the ground fish resources along these waters, they are represented as a major group in the hooks and line catches. Other fishes frequently caught in this gear, include sharks, seerfishes,

barracuda and species which occur infrequently in the landings are *Belone* sp., *Rachycentron* sp., *Chorinemus* spp., other carangids, etc.

\* Presented at the 'Symposium on Tropical Marine Living Resources' held by the Marine Biological Association of India at Cochin from January 12 to 16, 1988.

Upto a depth of 70 m catfishes are mainly harvested by hooks and line and account for 58.2% of the total catfish catch. They are also caught by drift net (19.7%), boat seine (7.8%) and trawl net (14.3%). Though purse seine is widely used in both south and north of the presently studied fishing grounds, this gear has not been introduced in the fishing fleet of North Kerala. This is mainly because of the regional social conflicts and the anticipated negative impact of this gear on other common non-mechanised gears, such as boat seines, drift nets and hooks and lines. Even though the gear is very effective for mass harvest, which may help the fishing industry, it very often encircles large schools of gestating catfishes or spawners of oil sardine and mackerel, leading to calamitous destruction of eggs/embryos or spawners as the case may be, and warranting the need for implementation of

managerial measures to conserve these resources (Silas *et al.*, 1980 ; James *et al.*, 1987). Though this gear is not in operation in North Kerala, its impact is very often felt here too, because of the highly migratory behaviour of these resources.

Since the hooks and line harvest the bulk of the catfishes and the catch is composed of all sizes and age classes except juveniles, brooders and spawners, this gear is more effective biologically and less harmful to the stock and future recruitment. In North Kerala *Tachysurus tenuispinis*, *T. dussumieri*, *T. thalassinus* and *T. serratus* are the species of catfishes of economic importance and all of them are caught by hooks and line.

This account is an attempt to study the hooks and line fishery along North Kerala coastal waters with particular emphasis on catfish resources. Much of the recent literatures on the subject deals with catfish resources of various regions along the west coast of India and all those reports emphasised the large scale harvest of gestating and spawning catfishes during breeding months and stressed the need for proper managerial measures for a more judicious exploitation of this resource (Silas *et al.*, 1980 ; Anon, 1987 ; James *et al.*, 1987). It is also found that the mass destruction of eggs embryos will have deleterious effect on the recruitment not only at fishing grounds off southwest coast, but also elsewhere ; as the catfish undertake long migrations along the coast from south to north and *vice versa*, mostly influenced by monsoon drifts, upwelling, etc. (Rao *et al.*, 1977 ; James *et al.*, 1987). This study on the hooks and line fishery for catfishes for a period of nine years suggests the suitability and effectiveness of the gear for a judicious harvest of catfishes. It is also attempted to suggest the possible lines of modifications to the gear to achieve the maximum production taking into account the behaviour of the different species available in the environ-

ment and the probable season of their abundance in different depth ranges.

The authors are grateful to Dr P.S.B.R. James, Director, Central Marine Fisheries Research Institute and Shri C. Mukundan, C.M.F.R.I. for their guidance and encouragements.

#### DATA BASE AND FISHING GROUNDS

The data base for this investigation is the hooks and line landings from the fishing grounds off Calicut, between 10 and 70 meters during 1977-1985. Information on the length frequency, age composition and maturity stages of two of the principle species *viz.* *T. tenuispinis* and *T. dussumieri* were also collected for a period of seven years from 1979 to 1985. Hooks and lines were operated from non-mechanised country crafts by 4 crews per boat. Each unit had on an average 2000 hooks of varying sizes with hook numbers 9 to 23. The hooks were baited with trash fishes before shooting the line. The catch per unit of effort (CPUE) considered in this study is the yield in kg per 1000 hooks. As catfishes are opportunistic scavengers, they bite any food organisms available in the environment. After the introduction of out-board motors (OBM) in 1980, gradually the liners were also mechanised with OBM. However, the operations continued without any appreciable change in the gear, duration of fishing, labour input or the areas of fishing. The catch trend also remained unchanged despite mechanisation. The only change noticed was that the catches were brought ashore immediately after the harvest. After the landings the mechanised OBM liners were redeployed as carrier boats for boat seines or trawlers.

Depending on favourable climatic conditions, the fishing operations were extended upto 100 m. During the peak period of monsoon major activity was restricted in very shallow grounds

of 10-20 m along rocky patches. The fishing grounds are muddy at depth ranges 30-50 m and support rich bottom fauna.

#### HOOKS AND LINE FISHERY

Commercially, marine catfishes are harvested by hooks and line, driftnet, boat seine (Pattankolli vala) and trawl net. Hooks and lines alone exploit more than 58.2% of the total catfish catch. All fish landings by this gear from 1977-1985 showed a peak catch of 493 t in 1980 and the lowest of 224.4 t in 1985 with an annual mean of 334.1 t. The bulk component of this gear is catfishes. The landings of catfishes in the gear also showed fluctuations with a crest in 1980 at 478.6 t and a trough in 1985 at 205.8 t. The mean annual catfish catch was 306.3 t. The variation in catfish yields perfectly coincided with the fluctuations in the total catch by hooks and line. The percentage contribution of catfishes in the all fish total, hooks and line landings varied from 84.3% in 1977 to 97.1% in 1980, with a mean of 91.7% (Table 1).

TABLE 1. Hooks and line fishing effort, total fish catch, catfish catch and the percentage at Calicut

Year	Total fish catch (kg)	Catfish catch (kg)	(%)	Effort (in 1000' of hooks)
1977	290,233	244,644	84.3	3,068
1978	321,882	273,737	85.0	3,812
1979	375,569	344,509	91.7	4,094
1980	493,010	478,553	97.1	4,540
1981	381,515	349,896	91.5	4,132
1982	296,350	272,594	92.0	3,792
1983	341,254	325,621	95.4	3,280
1984	282,491	261,433	92.5	2,844
1985	224,398	205,794	91.7	2,826
Average	334,078	306,309	91.7	

Other important groups of fishes, which usually appear in the hooks and line fishing are sharks, seerfishes, barracuda, garfish and

black kingfish. The average (1979-1985) percentage composition of the component species of the fishery is given Fig. 1. Some of the species were highly seasonal in their occurrence.

The contribution of catfishes by the hooks and line varied from 50.9% in 1977 to 83% in 1984 with an annual average of 58.2% in the total catfish catch. Of the four species of catfishes occurring in the hooks and line *T. tenuispinis* was the most dominant species contributing on an average 48.7% in the total catfish catch of the gear. The next abundant species was *T. dussumieri* (28.5%) followed by *T. thalassinus* (20.5%); whereas the contribution by *T. serratus* was negligible (2.3%).

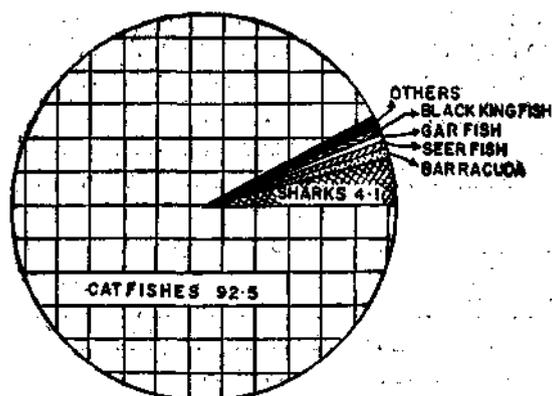


Fig. 1. Percentage contribution of catfishes and other fishes in the hooks and line landings at Calicut during 1977-1985 (Mean).

*T. thalassinus* is fairly well represented in the landings throughout from 1977-1985. The annual catch during this period varied from 98.3 t (1980) to 21.2 t (1982) showing a general decline in the annual yield with a mean of 62.7 t. In general the yield was at its peak during 1978-1980. The percentage contribution by this species in the total catfish catch of the gear fluctuated from 7.8% in 1982 to 31.5% in 1978. Though the yield showed a downward trend, the variations between years were not very sharp. Mostly this species remains at the bottom or in lower segment of the column during the early part of its life

history (till the attainment of size at first maturity *i.e.* 26-28 cm). The larger individuals, however ascend the column for feeding and breeding. When compared with other species they mostly remain in the lower strata of the water column and as such are less affected by the influence of southward or northward drifts of the respective monsoons. This fact is further emphasised by the predominance of *T. thalassinus* along the east coast even when the once abundant *T. tenuispinis* has totally disappeared from those fishing grounds (Anon., 1985, 1986). The size range of *T. thalassinus* ranged from 23 to 56 cm and the most dominant size classes in the commercial fishery were 36 to 48 cm (2 and 3 year old). The non-availability of larger size classes in the fishery is mainly due to their seaward migration from the coastal waters. Present data as well as the past information from other centres show that species such as *T. tenuispinis*, *T. dussumieri* and *T. serratus* usually exhibit horizontal migrations towards north or south along the shelf. This phenomenon has not been reported in *T. thalassinus* during any season or at any phase of its life history. This is the main reason for the little fluctuations in the yield of the species with almost a steady catch throughout the period of study.

The landings of *T. dussumieri* showed fairly wide annual fluctuations with prominent crest (158.3 t) in 1980 and trough (33.1 t) in 1983. The percentage contribution of *T. dussumieri* in the total catfish catch of the gear showed the peak in 1979 (41.5%) and the lowest in 1983 (10.2%) with a general declining trend in the yield. The annual average catch of *T. dussumieri* was 87.2 t, which is 28.5% in the annual total catfish catch by this gear. The wide variation in the yield of this species between years appears to be due to the highly migratory behaviour of *T. dussumieri* parallel to the coast along the mid shelf and coastal waters (James *et. al.*, 1987). Unlike *T. thalassinus*, this species forms large shoals and undertake both

horizontal and diurnal vertical migrations (Rao *et al.*, 1977). Therefore, the length of the period of their availability in the fishing grounds in any season probably determines the success of fishery.

*T. tenuispinis* was the most dominant species in this gear throughout the period 1977-1985, except in 1979. The landing of this species was generally high during 1980-1983, with a maximum catch recorded in 1980 (214.9 t). The lowest recorded catch was in 1979 (101.4 t), when *T. dussumieri* dominated the landings of hooks and line.

Annual average catch of *T. tenuispinis* was 149.2 t. The fishery showed a declining trend from 1984 onwards. The migratory pattern varied between years depending on monsoon drift, intensity of upwelling, strength of monsoon, etc. and the landings too showed marked fluctuations between years. The diurnal vertical migrations and seasonal horizontal migrations of large shoals of *T. tenuispinis* mostly along shallow waters during the spawning months made them vulnerable to purse seines and drift gill nets. The mass exploitation of shoals by purse seines along South Kerala and Karnataka—Goa region affected their availability to hooks and lines. This appears to be one of the major reasons for its decline in the hooks and line landings along North Kerala Coast in recent years.

*T. serratus* is poorly recorded in the hooks and line landings. The yield varied from 11.1 t (5.4%) in 1985 to 2.4 t (0.7%) in 1983 with an annual mean of 7.2 t (2.3%). The fluctuations between years were only marginal (Table 2). This species too is a highly migratory one frequenting the coastal water for breeding. This is positively correlated with the intensity of precipitation in southwest monsoon. They mostly remain in deeper waters of the outer or mid-shelf for a longer period of time when the resource is unavailable to this gear. The size range in the hooks and line landings was 62-103 cm and the dominant size classes were 74-92 cm.

TABLE 2. Species composition (kg) and percentage of catfish in the hooks and line for 1977-1985

Years	<i>Tachysurus thalassinus</i>		<i>Tachysurus dussumieri</i>		<i>Tachysurus tenuispinis</i>		<i>Tachysurus serratus</i>		Total	
	Catch	%	Catch	%	Catch	%	Catch	%		
1977	70,273	28.7	61,283	25.0	110,459	45.2	2,629	1.1	244,644	
1978	86,287	31.5	80,309	29.3	103,332	37.7	3,809	1.5	273,737	
1979	89,045	25.9	143,112	41.5	101,400	29.4	10,952	3.2	344,509	
1980	98,287	20.5	158,254	33.1	214,856	44.9	7,155	1.5	478,552	
1981	43,016	12.3	101,482	29.0	200,508	57.3	4,890	1.4	349,896	
1982	21,194	7.8	75,702	27.8	165,002	60.6	10,696	3.8	272,594	
1983	78,658	24.2	33,126	10.2	211,410	64.9	2,427	0.7	325,621	
1984	47,894	18.3	83,589	32.0	118,984	45.5	10,966	4.2	261,433	
1985	29,371	14.3	48,340	23.5	116,972	56.8	11,111	5.4	205,794	
Average	62,669	20.5	87,244	28.5	149,214	48.7	7,182	2.3	306,309	

TABLE 3. Specieswise monthly average catch (kg) and percentage of catfish in hooks and line at Calicut (1979-1985)

	<i>T. thalassinus</i>		<i>T. dussumieri</i>		<i>T. tenuispinis</i>		<i>T. serratus</i>		Total	
	C	%	C	%	C	%	C	%	C	%
Jan.	803	1.4	8,226	8.8	6,495	4.0	931	11.2	16,455	5.1
Feb.	115	0.2	21,576	23.1	12,428	7.7	796	9.6	34,915	10.9
Mar.	101	0.2	12,430	13.3	5,177	3.2	137	1.5	17,845	5.6
Apr.	343	0.6	9,166	9.8	4,129	2.6	—	—	13,638	4.3
May	4,544	7.8	7,762	8.3	2,868	1.8	546	5.6	15,720	4.8
June	34	0.1	1,763	1.9	26	0.0	2,270	27.3	4,093	1.3
July	74	0.1	162	0.2	70	0.0	2,036	24.5	2,342	0.7
Aug.	1,841	3.2	4,290	4.6	5,717	3.6	236	2.8	12,084	3.8
Sep.	18,794	32.5	10,569	11.3	43,731	27.2	370	4.5	73,464	22.9
Oct.	16,218	28.0	4,427	4.7	40,320	25.1	96	1.2	61,061	19.1
Nov.	13,325	23.0	4,514	4.8	21,294	13.3	501	6.0	39,634	12.4
Dec.	1,671	2.9	8,505	9.2	18,469	11.5	395	4.8	29,040	9.1

## SEASONAL CHARACTERISTICS OF THE FISHERY

The catfish fishery had two seasons, the major season from September to December and the minor one in February. A nine year average for 1977-1985 showed that the highest landings were in September (73.5 t) forming 22.9% of the total catfish catch of hooks and line. The secondary peak of February landed 34.9 t forming 10.9%. June to July was the lean period.

Seasonal trends in the landings of various species of catfishes showed that they all had high yields during September-December months, except for *T. serratus* (Table 3). Thus *T. thalassinus* and *T. tenuispinis* contributed 83.5% and 77.1% to the average annual catch of the respective species during the above season. In both *T. thalassinus* and *T. tenuispinis* the peak occurrence was clearly correlated with the spawning concentrations in the shallow nursery grounds. *T. dussumieri* had two periods of dominance, the major peak in January-May (63.3%) and the minor one in September-December (30%). The predominance of *T. dussumieri* during February (23.1%) coincides with the peak spawning season (Vasudevappa and James, 1980). *T. serratus* was the least among catfish species caught in hooks and lines. It had dominance in June and July contributing 51.8% of the total catch of the species. During these months of peak monsoon the fishing activity was confined to very shallow coastal waters mostly in patches of rocky bottom. This species also frequented the shallow grounds mainly for purposes of breeding and nursing the young ones.

The seasonal changes in the yield of various species depend on their availability in the fishing grounds and their vulnerability to the gear. The availability is mostly determined by their migrations to and from the fishing grounds either for breeding or for feeding.

## TRENDS IN ABUNDANCE

Catch per unit effort is used to reflect the relative apparent abundance of the fish in the fishing ground. Though estimates of abundance based on CPUE are affected by the availability and vulnerability of different species to the gear, they are still useful tools for drawing inferences about real changes in abundance. In a multi-species fishery by hooks and line, competition of the different species for the bait is yet another factor which may bias the estimates of their abundance.

The annual hooking rate (kg/1000 hooks) of catfishes fluctuated from 66.3 kg (1982) to 105.4 kg (1980), with a mean of 80 kg. The variation in the annual hooking rate is only marginal. The monthly average catch rate ranged from 24.5 kg in July to 128.7 kg in September. The primary peak of abundance vary in different years; August (in 1979 and 1985), September (in 1978, 1979, 1981 and 1982), October (in 1983 and 1984) and November (in 1980). A second peak of abundance was normally recorded in February (in 1978, 1980, 1981, 1982, 1984 and 1985) which was also found to shift from December (1977), March (1979) to May (1983). A minor crest was recorded in June (1982 and 1985) and May (1980). The abundance value of the principal peak ranged from 118.3 kg (1978) to 164.2 kg (1984), with only marginal fluctuation between years, whereas the second dominant crest varied from 54.2 kg (1985) to 147.1 kg (1980) showing a general downward trend (Fig. 2).

Trends in specieswise abundance showed that *T. tenuispinis* had the highest annual hooking rate ranging from 24.7 kg (1979) to 50.9 kg (1983) with an annual mean of 38.8 kg. Seasonal pattern of catch rate indicated that September to November were the peak months of abundance for this species. The annual mean hooking rate of *T. dussumieri* was 22.7 kg, which fluctuated from 8 kg (1983) to 85 kg (1979) and February-March was the peak

period of abundance. September-October was the peak period of abundance for *T. thalassinus* with an annual average hooking rate of 20.6 kg and the range of fluctuation between years was from 5.2 kg (1983) to 22.9 kg (1977). Both *T. tenuispinis* and *T. thalassinus* had high abundance during September-October months. The annual catch rate of *T. serratus* was between 0.6 kg and 3.9 kg during 1977-1985 and the peak abundance was in June (Fig. 3).

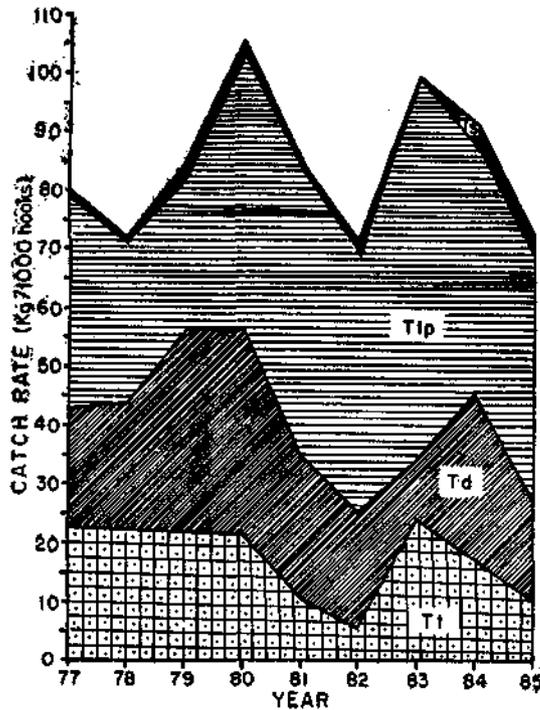


Fig. 2. Annual species-wise catfish catch rate (kg/1000 hooks) at Calicut during 1977-85. Tip—*Tachysurus tenuispinis*, Td—*T. dussumieri*, Tt—*T. thalassinus* and Ts—*T. serratus*.

During 1977-1985, the effort input increased till 1980 and thereafter it was reduced. The catch rate remained almost static without any appreciable rise or fall in response to effort variations. In 1980, with the highest effort (4,540,000 hooks) the hooking rate was 105.4 kg. From 1981 to 1985 the efforts declined (4,132,000 to 2,826,000 hooks), but the hooking rate remained in the range of 66.3 to 91.9 kg. The

relation between catch rate and effort showed a negative correlation (Fig. 4) with a very low value of the slope.

#### DEPTHWISE DISTRIBUTION

While hooks and line operated in the depth range 10 to 70 m, better catfishes were obtained from 20-50 m range. The depth-wise catch rates for all the four species are shown in Fig. 5. In general, species such as *T. tenuispinis*, *T. thalassinus* and *T. dussumieri* had high abundance in depth zone 25-60 m. However, during the peak season of breeding *T. tenuispinis* and *T. dussumieri* had better catch rates in shallow nearshore nursery grounds of 10 to 20 m. *T. serratus* generally showed high abundance along very shallow regions of 15-30 m during June-July months. In other seasons the species is beyond 70 m and mostly unavailable to this gear.

TABLE 4. Relative age composition (% in parenthesis) of *Tachysurus tenuispinis* in the hooks and line catches at Calicut during 1979-85

Year	No. of fish in different year classes				
	1	2	3	4	5
1979	—	1.2 (2.7)	34.0 (74.2)	10.5 (22.8)	0.1 (0.3)
1980	—	1.2 (1.8)	48.5 (75.5)	14.6 (22.7)	—
1981	—	0.3 (0.8)	27.5 (66.2)	13.7 (32.9)	0.05 (0.1)
1982	—	1.7 (2.8)	36.1 (57.1)	24.4 (38.5)	1.0 (1.6)
1983	—	12.3 (9.2)	124.8 (86.3)	6.0 (4.1)	0.6 (0.4)
1984	—	1.0 (0.9)	97.2 (96.9)	1.5 (1.5)	0.7 (0.7)
1985	—	3.4 (5.6)	30.4 (50.5)	36.5 (43.9)	—

## AGE COMPOSITION

Species such as *T. tenuispinis* and *T. dussumieri* together constituted more than 77% of the total catfish catch by hooks and line. Therefore, these two species were taken for detailed analysis of the age composition in the commercial hooks and line landings. Both the species are fully vulnerable to this gear only when they attained maturity. It is found that only mature fishes migrate to the shallow grounds for spawning and nursing the young ones.

mation of age composition, the sizes at different ages derived from Dan (1980) are utilised. Immature fish of one year was totally absent in the landings. Two year old fish was poorly represented, its percentage contribution varied from 9.2 in 1983 to 0.8 in 1981. The fully vulnerable age class was 3 years; the percentage composition of this age group fluctuated from 50.5 (1985) to 96.9 (1984) with a mean of 70%. Four year old fish was fairly well represented 1.5% (1984) to 43.9% (1985) with a mean of

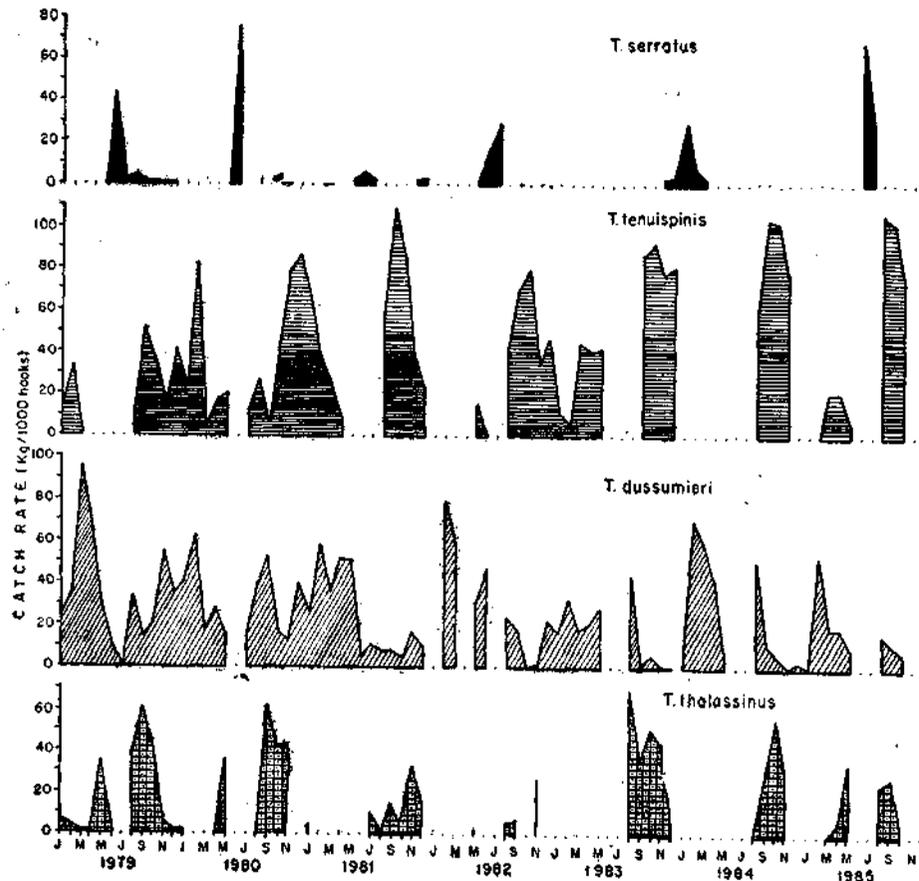


Fig. 3. Species-wise monthly catfish catch rate (kg/1000 hooks) at Calicut during 1979-1985.

*T. tenuispinis*: On an average it contributes about 49% of the catfish catch by the gear. The size range of *T. tenuispinis* in the hooks and line varied from 20-56 cm and the dominant size group was 40-48 cm. For the esti-

17.2%. Thus hooks and line fishery of *T. tenuispinis* was mainly supported by age groups 3 and 4 (40-48 cm). The contribution of 5 year old fish was only marginal, with 0.1% in 1981 to 1.6% in 1982 (Table 4).

The size at recruitment of *T. tenuispinis* was estimated at 20 cm and at first capture, 34 cm. The total mortality (Z) ranged from 0.14 (1983) to 2.16 (1981) with a mean of 2.03 and the M was 0.32.

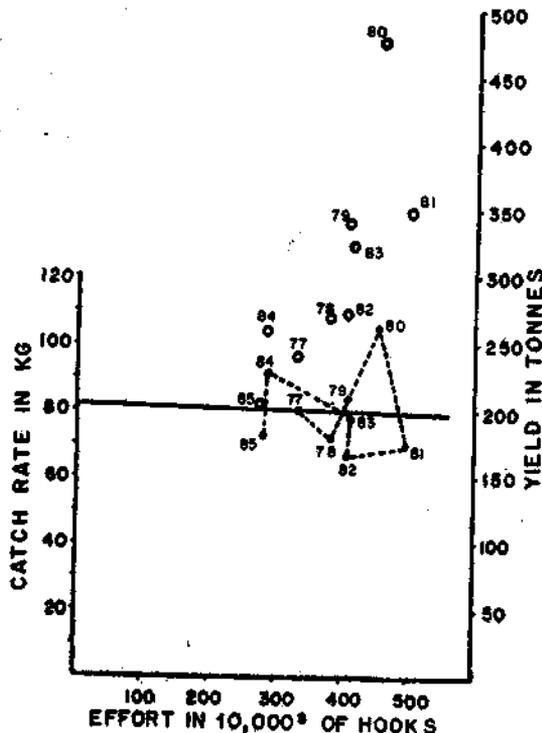


Fig. 4. Relationship between catch rate and annual effort and yield along Calicut during 1977-85.

*T. dussumieri*: This species was the next dominant in the hooks and line (28.5%). It is fully vulnerable to the gear from age 4 onwards. The size range in the fishery was from 30 cm to 82 cm and the dominant size class was 54-74 cm, which formed 73.5%. Immature fishes (upto 54 cm) were only nominally represented in the catch (20.5%). The fishery comprised of 1 to 8 years old and 4 to 6 years old individuals formed the bulk of the catch (Table 5). One year old fish were only marginally represented (0.1 to 2.1%). Whereas fishes of 2 year old contributed 2.4 to 10.1%, three year old fish formed 8.8 to 20% in the catch and four year old constituted 16.9 to

50.2% with a mean of 36.3%. By fourth year *T. dussumieri* attains maturity, and this is the age at which they are fully vulnerable to hooks and line. Fishes of the age group 5 are also recorded in high proportion in the catch (21.4 to 44.1%) with an annual average of 28.6%. The contribution of 6 year old fish varied from 2.9 to 18.5%, whereas the composition of 7 year old fish ranged from 3 to 7.5%. Fishes of 8 years were only very poorly represented (0.5 to 1.4%).

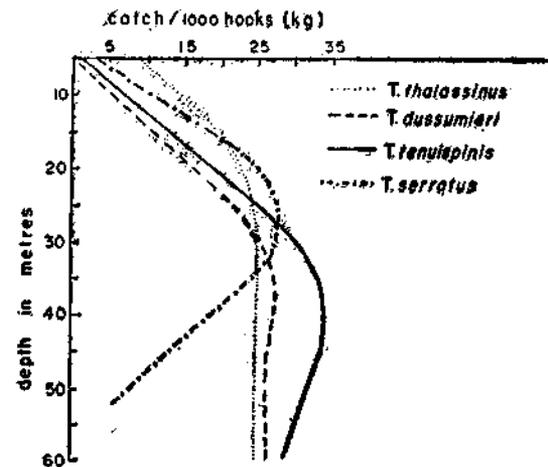


Fig. 5. Depth distribution of four species of catfish off Calicut.

The length at recruitment of *T. dussumieri* was at 30 cm and at first capture was 45 cm. The total mortality (Z) was in the range of 0.71 to 1.32 (Mean 1.07) with value of  $M = 0.18$ . The fishing mortality varied from 0.53 (1984) to 1.14 (1979) with a mean of 0.89.

#### MATURITY

Figs. 6 and 7 clearly show that in *T. tenuispinis* and *T. dussumieri*, the immature fishes were hardly caught in this gear. Fishes in gonadal maturity stages III to V and VII accounts for the entire catch. In *T. tenuispinis*, maturing females and males occurred in high percentage during August and September, whereas spent females had predominance during October to

December. Ripe females were not recorded in the hooks and line landings. Gestating males of *T. tenuispinis* also were not encountered in the catch, since they refrain from feeding during the gestation period. Spent males, after the release of young ones were recorded in the catches during November and December. The study also reveals that females dominated during breeding months, sometimes their percentage going upto 80%. In the months of January to May both males and females in the

## DISCUSSION

Dan (1980) has reported that the exploitation of *T. tenuispinis* along the northeast coast of India is beyond the optimum and has suggested the need for reducing the effort input in coastal waters. *T. tenuispinis* has almost disappeared from the grounds of northeast coast in the recent years. Anon (1987) reported that except *O. militaris* all other species of marine catfishes are under heavy exploitation in the present

TABLE 5. Relative age composition (% in parenthesis) of *Tachysurus dussumieri* in the hooks and line catches at Calicut during 1979-85

Year	No. of fish in different year classes							
	1	2	3	4	5	6	7	8
1979	0.21 (2.04)	0.47 (4.5)	0.92 (8.8)	3.49 (33.1)	3.04 (28.9)	1.03 (14.5)	0.79 (7.5)	0.06 (0.5)
1980	—	0.21 (3.8)	1.12 (20.0)	2.81 (50.2)	0.24 (4.4)	0.75 (13.4)	0.38 (6.8)	0.07 (1.4)
1981	0.05 (0.1)	0.89 (10.1)	1.28 (14.5)	2.79 (31.4)	2.13 (24.1)	1.52 (17.2)	0.26 (3.0)	—
1982	—	0.12 (2.4)	0.85 (17.1)	0.84 (16.9)	2.02 (40.8)	0.91 (18.5)	0.21 (4.4)	—
1984	—	—	0.59 (9.8)	4.18 (41.2)	4.49 (44.1)	0.30 (2.9)	0.59 (5.9)	—
1985	0.08 (1.2)	0.28 (3.7)	1.11 (17.7)	2.74 (43.5)	1.34 (21.4)	0.56 (9.0)	0.21 (3.4)	—

stage III dominated the catch. Similarly, in the case of *T. dussumieri*, the catch mainly comprised of adult fishes in stages III and above. The size at first maturity is at the age of 5 years. In September and February-March females in stages IVth and Vth formed the major constituent in the hooks and line landings. Ripe females were not recorded in this gear at all. Spent males, after the release of the young fish from their month, were caught in February-March months.

limits of fishing grounds and the exploitation rate is very high. Any more effort input should be exercised with extreme caution. There have been reports on the mass exploitation of brooders and spawners of *T. tenuispinis*, *T. dussumieri* and *T. serratus* from the coastal waters of southwest coast of India (Silas *et al.*, 1980; Dhulkhed *et al.*, 1982; Muthiah and Syda Rao, 1985). Among the three species, *T. tenuispinis*, is the worst affected, because of intense exploitation of brooders from the

breeding grounds of Mangalore-Karwar region. This being a migratory species, its effect is felt elsewhere also. Slowly, *T. dussumieri* is also at the verge of decline in the present fishing grounds. James *et al.*, (1987) have suggested the urgent managerial measures to overcome this situation along the Southwest coast of India.

Since most of the gears have no natural selection for non-brooders and non-spawners, the only possible way to conserve them is to

have a 'closed season' or 'limited entry' to the more effective gear during spawning months. The present study shows that hooks and line is an appropriate gear for catfishes, but at the same time, it has also an inbuilt natural selection for non-brooders and spawners. The gear also spares the young ones. Thereby any possibility of recruitment over fishing is eliminated. The fishing mortality by hooks and line, therefore will not have a pronounced effect on the stocks in the near future.

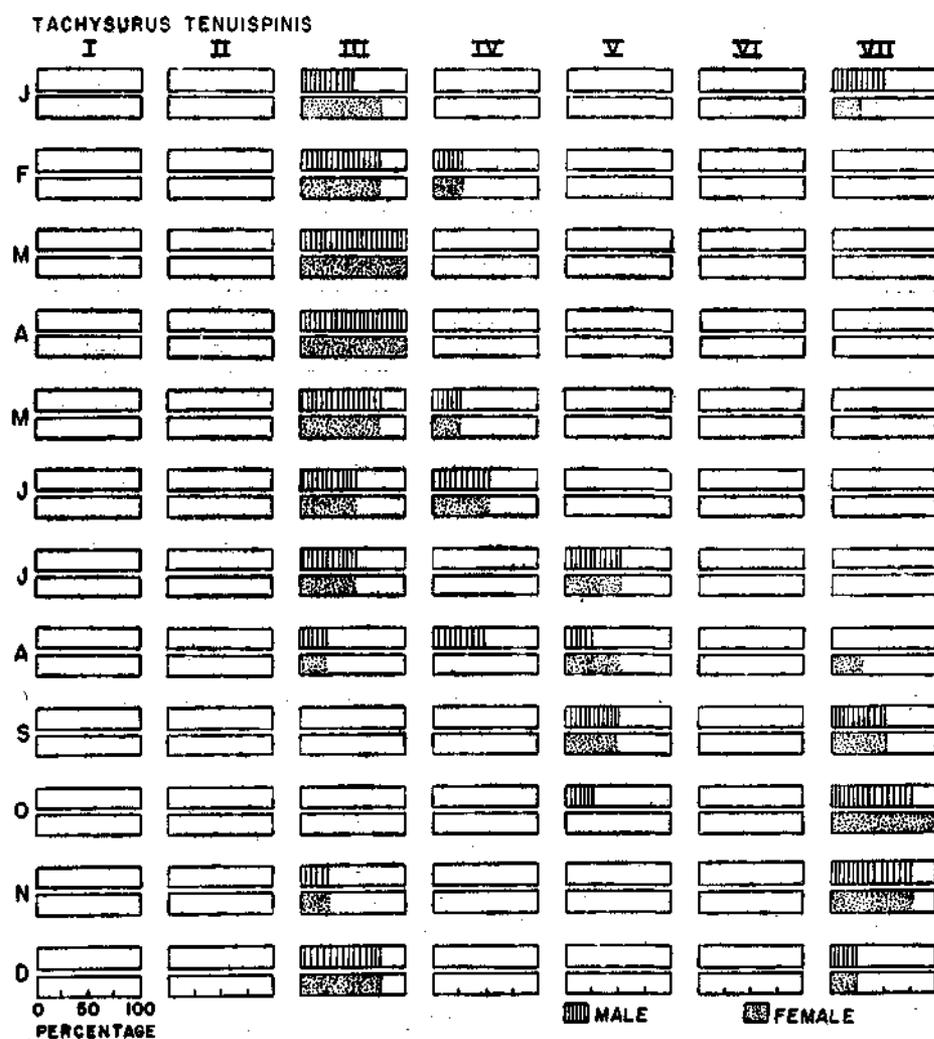


Fig. 6. Average monthly percentage occurrence of males and females of *T. tenuispinis* at different maturity stages in the hooks and line.

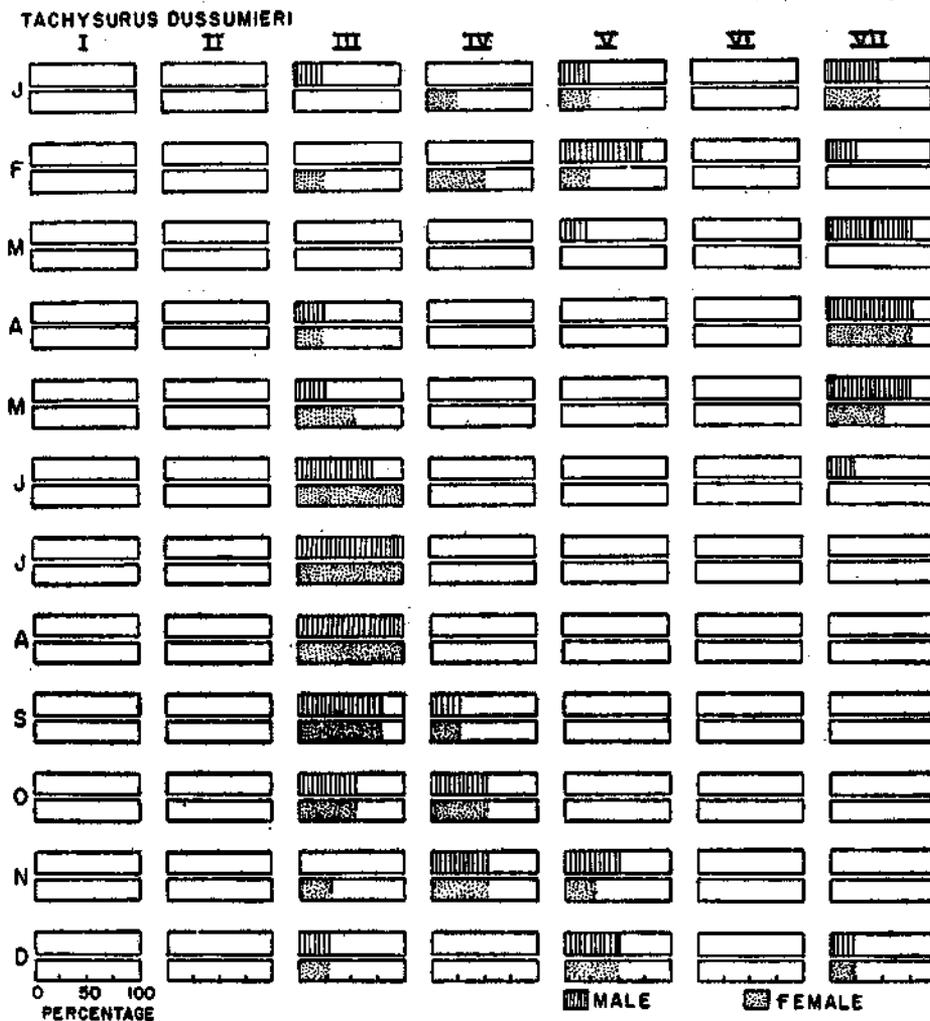


Fig. 7. Average monthly percentage occurrence of males and females of *T. dussumieri* at different maturity stages in the hooks and line.

The gear may be modified to exploit less migratory species of catfishes which usually restrict themselves to the bottom. For a better harvest of such bottom dwelling species e.g. *T. thalassinus*, the length of the branch lines may be increased depending on the area of operation, the seasonal availability of the species in the fishing terrains and the depth of occurrence.

For optimum exploitation of a species which is more prone to recruitment over fishing, fishing by more effective gear like purse seine should be controlled. The only way to overcome this situation is to discourage the exploitation of spawners and brooders of catfishes by purse seines during the spawning/nursing periods and encourage extensive operation by hooks and line at all seasons and depth zones.

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