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20. DYNAMICS OF INDIAN CHANK FISHERIES

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ABSTRACT

The demand for chanks from the bangle industry in West Bengal had persisted at about 25 million chanks per year from the early part of this century to the present. The present supplies, which meet only about 40% of the demand, come mainly from the Gulf of IVIannar. The average annual stock in the Gulf of Mannar is 2.0 million adult chanks of which 44-83% are exploited. The initial stock size, however, varies from year to year, and hence, there exists different levels of optimum yields for different Initial stock sizes. Chank fisheries in Palk Bay and the Coramandal coast yield annually an average of 49,000 chanks and 24.600 chanks respectively while in Kerala the average annual yield is 20,100 chanks. The average annual stock of chanks in the intartidal Gulf of Kutch is 25,000 of which only 30.6% is exploited, but additional catch is possible only for the 60 80 mm diameter size chanks as the *y* 81 mm diameter size groups ate already well exploited. There is prospect for increasing the present supplies by introducing SCUBA diving in 20-30 m deep grounds in the Gulf of Mannar and by exploiting the Gulf of Kutch beyond the Intettidal zone.

INTRODUCTION

The demand for the Indian sacred chank *(Xancus pyrum)* from the bangle industry in west Bengal has remained at about 2.5 million chanks per year from the early part of this century to the present (Hornell 1914; Ghazi 1962; Mahadevan 1987). The present supply, which meets only about 40% of the demand, is contributed by Tamilnadu (96%), Kerala (3o/„) and Gujarat (1 %). Bulk of the catch in Tamilnadu comes from the Gulf of Mannar. This account summarises the fishery for chanks in the above states and its dynamics in the Gulf of Mannar and the Gulf of Kutch and examines the prospects for augmenting the present supplies.

MATERIAL AND METHOD

The data for the study was collected from the records of the Departments of Fisheries of the states where chank fishery exists. Standard methods were employed for the stock assess* ment of chanks (Beverton and Holt 1957; Schaefer 1957; Jones 1981; 1984; Devaraj MS; Devaraj and Smita MS).

RESULTS

Gulf of Mannar {Tamiinadu) : There are about t«" '"ajor chank beds (each comprising at """^ber of smaller beds, named after the pearl oyster beds they surround) extending from off Vaipar to off Tiiuchendur, exploited from Tuti-corinasthe base. Similarly, there are obout ^'^e major beds extending from off Rameswaram *° °" '^^'"^^'- exploited from Ramnad as the ^'^^- '^^^ '^'^^"^ ^'"^^ ^'^^^"^ *^°'" 6 to 27 m or even beyond, but chanks are more abundant in 16 to 20 m depths (Hornell 1914; Moses 1923; Mahadevan & Nayar 1966; 1967). Over 95% of the catch is taken by skindiving in depths of up to 20 m from November/December to March/ April, while the rememing comes from incidental catches taken in various fishing gears, especially trawls. Taxonomically, the Gulf of Mannar chank is called the acufa variety ('X. p/ru/n var. *acuta)* of which there are three races, namely ,^,/^^^,^ ;„ ,^^ .^uticorin beds and *kilaicarai* and ,,^,,^,*ram* in the Ramnad beds (Hornell 1914.18).

The growth data from chank marking experiments (Sambanda Murthy and Chacko 1969), the maximum recorded size of 113 mm

maximum shell diameter (MSD) and the incubation period of 0.115 year (Devanesan and Chacko 1944) formed the basis for fitting the following von Bertalanffy growth function according to the forced Gulland-Holt plot method (Pauly 1983).

$$D_t = 119\,(1 - e^{-0.0948\,(t + 0.116)})$$

where Dt is the MSD in mm at age fin years. The theoretical life span is about 51 years (for 119 mm), the observed maximum life span is 31.5 years (for 113 mm) and the fishable life span 14 8 years (for 90 mm). The size at first capture (Dc) was 57.15 mm MSD from 1876 to 1977, 60.325 mm MSD from 1978 to 1985 and 64 mm MSD since 1986. The minimum size of 58-60 mm MSD at first maturiry (D^) for males is close, to Do while the D^ of 70-80 mm for the males IS much higher than D, (Devanesan and Chacko 1944; Mahadevan and Nayar 19OD).

During 1978-79 to 1984 85, the average annual yield of chanks of < 60 mm MSD. 60-69 mm MSD and 70-90 mm MSD was 5.59%, 56.57% and 37.54% respectively. The annual total mortality coefficient r^; was extremely low at 0.0548 (being less than even *M; vide infra)* \n 1978-79 as the fully recruited 60-69 mm MSD group in the catch was only marginally higher than that of the > 70 mm MSD group. Barring this, Z during 1980-86 ranged from 0.1323 in 1981-82 to 0.2403 in 1980-81, with the mean at 0.1736. The natural mortality coefficient *(M)* was estimated to be 0.0921 by Cushing's (1968) method (Devaraj 1983). The fishing mortality coefficient *(FJ* during 1980-86 ranged from 0.0402 in 1981-82 to 0.1482 in 1980-81, with the mean at 0 0815. The annual exploitation ratio ff; for 1980-86 ranged from 0.3039 to 0.6167, with the mean at 0.4483.

The Tuticorin fishery for the period 1876-77 to 1985-86 is divisible into six phases: 51 years from 1876-77 to 1927-28, 18 years from 1928-29 to 1945-46, 13 years from 1947-48to 1959-60, 14 years from 1960-61 to 1974-75, 5 years from 1978-79 to 1982-83 and 3+ years from 1983-84 to 1985-86 (the present) during which the average annual catch was 180,714; 410,622; 823,301; 324,558; 890-102 and 324,802 chank8(only good adult chanks > 60 mm MSD. free from any destruction by borers are included) respectively. The average annual yield doubled successively in the first three phases, suggesting proportionate increases in the area fished and the effort deployed. But It declined rather abruptly in the fourth phase (when the average annual yield of 324,558 chanks was much less than half the average annual yield of 823,301 chanks for the previous phase) possibly due to overexploitation. It is therefore likely that the production limit has been reached in phase III itself, and hence, the optimum yield may lie at some production level between the average annual yield of 410,622 chanks for the second phase and 823,301 chanks for the third phase. The fishery evidently would not be able to absorb as many gkindivers as have participated annually in phase III. The average annual yield during the fourth phase was so low (324,558 chanks) that the fishery had to be suspended continuously for three years from 1975-76 to 1977-78 betwen the fourth and the fifth phases. The ^as distinctly evident in the abrupt increases in the catch to the all-time maximum of over a million chanks (1.05 xlO") in the first year (1978-79) of phase V while the minimum in »his phase was 778,132 chanks (i980-81) and the average 890,102 chanks. But obviously due to overfishing, phase V lasted only for five years and gave way to the present and the sixth phase characterised by the steady decline in yield (103,915 chanks in 1985-86).

During 1969-70 to 1974-75 an average of 34 canoes operated per day for 104 diving days with about 6 crew per canoe, realising an average effort of 23,017 diverdays per year. During 1978-79 to 1985-86, an average of 67 canoes operated per day for 111 diving days ^j^h about 5 crew per canoe, realising an average effort of 39,418 diverdays per year The catch of good adult chanks ranged from 9 ^Q 20 per diver per day during 1969-87, but declined to 3 in 1985-86.

The Ramnad fishery for the period 1978-79 to 1984-85 landed an annual average of 172.940 good adult chanks (> 60 mm MSD) with an annual average effort of 9,608 diver-

days (about 20 canoes per day for 70 diving days witli 6 or 7 crew per canoe). Tlius, for the 1978-85 period, the average annual yield from the entire Gulf was 900,838 chanks comprising 80 8% from the Tuticorin fisher/ and 19.2% from the Ramnad fishery. The average annual effort of 50,601 diverdays was also accounted for by the Tuticorin and Ramnad fisheries in the ratio of 79:21, which is about the same as for the yield. The average annual stock (P) estimated by dividing the annual yield (/) by the annual exploitation ratio (f) for the entire Gulf was 2.01 million chanks.

It has been observed that the restoration of the stock that is reduced by a certain level of effort (/) in one diving season rarely takes place along the same line of increase or decrease, but mostly along different lines, in the interval of about an year between two successive diving seasons. This may be explained by the fact that the revival of stock through growth and recruitment between successive diving seasons does not keep pace with the removal of chanks by the fishery. As a result, every season starts with an initial stock that is poorer than that in the previous year, until such time when the stock is made to recoup by suspending the fishery for an year as in 1884-85, 1946-47 and 1965-66 when fishing was apparently not very intense, and for as long as three years from 1975-76 ;o 1977-78 after a period of overexploitation (phase III) and stock depletion (phase IV).

Since there exists different levels of initial *P,* there must be different levels of maximum sustainable yield (MSY), and for this reason, the fishery cannot operate with a single MSY as its objective. They//for the first few days of diving, whic is a good index of initial stock size, can form the basis for determining and adjusting effort according to stock size for the rest of the season, so that the fishery could stay on the MSY appropriate to the given level of initial stock size. A progressive decline in *P* has been found to provoke a proportionate decline in effort, and hence, a deline in yield. But *yjf* also declined almost invariably with declining /, reflecting thereby the progressive decline in the initial *P.* The Schaefer model, built on the principle of a rather monotonia decrease *In yjf* with increasing/, could not, tiierefore, be applied in its original form to the chank fishery data. Increase in *yjf* with increasing / may happen in the initial learning phase of a newly developing fishery, but not jn the age old chank fishery operating since tj^e immemorial. The stratified Schaefer model, introduced in this study, seeks to resolve the problem of *yf* decreasing in tune with the decrease in / owing to the occurrence of initial P in different strata. This model identifies the various strata where *yjf* values distribute themselves as monotonically decreasing functions of /. The successive strata, thus identified. were seen to run more or less parallel to each other and represented different strata of initial stock size,

in the case of the Tuticorin fishery, six strata of stock abundance were apparent in the plot of j/Z/against / for 1978-86, with the MSY ranging from 143,016 chanks for stratum VI to 1,064,079 chanks for stratum I ^^^ ^^e effort (fn,sy) ranging from 18,768 diverdays for the former to 51,195 diverdays for the latter. The constant *a* in the relative yield equation *ylf~a-bf* is an index of initial *p* at the beginning of the diving season, Thus, changes in *a* are indicative of changes in initial *P,* but the rate of decrease in /// with increasing /described by 6 has been found to be nearly the same for the various strata of abundance,

The plot of annual yield against year for over hundred years for the Tuticorin fishery reveals the existence of a production cycle of four years with apeak, a valley and a peak at intervals of two years. The relatively poor parent stock at the production valley seems optimum enough to bring about high or even maximum recruitment so that there could follow apeak after the valley. Obviously, there exists a Ricker (1954; 1975) type bell-shaped stock-recruitment relation. In recent years, however substantial increases in yield and the resultant overexploitation have widened the interval between a production valley and peak to five years, with yields progressively declining to rock bottom levels. Therefore, the fishery is better closed for one to three years (depending on the level of depletion). Two years after

every peak so as to restore the stock to reasonably high levels.

In the case of the Ramnad fishery for the period 1978-85, five strata of stock abundance were evident from the plot, of /// against /, with MSY ranging from 69,160 chanks for stratum V to 350, 488 for stratum I for effort ranging from 6,494 to 14,619 diverdays.

MSY (=32/46) and fmsy {= a/2i&) values could be determined in advance at the beginning of the diving season for different levels of a, and the fishery regulated accordingly. The parameter a, for this purpose can be determined by substituting the /// and /values for the first few days of a diving season in the relative yield curves for the two fisheries given below.

Tuticorin fishery : Y/f = a - 0 000401 f
Ramnad fishery : Y/f = a-000164 f

Since the fishery by skindiving is limited to a depth of 20m, SCUBA diving may be introduced in 20 to 30 m deep grounds in order to augment the present yield.

Palk Ba\i {Tamllnadu) : Unlike in the Gulf of Mannar, there is no organised fishery for chanks in Palk Bay. The fishery, comprising only incidental catches in various fishing gears, is very insignificant, the annual yield of good adult chanks 0 60 mm MSD) in 1978 85 ranging from 15,061 in 1984-85 to 123, 061 in 1982-83, with the average annual yield at 48,986 chanks. Size composition and effort data are not recorded for this fishery, and hence, stock assessment and MSY estimates could not be made. The Palk Bay chank, described as A. p/m/77 var *obtusa* race *tn/rupa-/aqua/,* is inferior in quality to the races of chanks in the Gulf of Mannar.

Coramandal coast (Tamllnadu): Like in Palk Bay, there is an incidental fishery for chanks in the districts of Tanjore. South Arcot, Chengalpat and Madras and the Union Territory of Pondicherry, which together constitute the Coramandal coast. However, catch data is available only for the Tanjore district between Point Calimere and Pudukuda where the annual catch of good adult chanks (> 60 mm MSD) during 1951-64 ranged from 11,832 in 1954-55 to 44,981 in 1958-c9, with the annual average at 24,489 chanks.

The traditional fishing gears which land chanks include boat seines and crabnets, and the important landing centres include Tranque-b^,^ Pudupattinam, Sinnangudi, Kaveripattinam, Melamookavai and Thirumullaivasal. Since the 3^^^,^ of commercial bottom trawling in the sixties, large number of chanks are being taken ;„ ^^^^^^^ j„ 14,0 30 m depths along the Coramandal coast, particularly between Thirumullaivasal and Portonovo (Mahadevan Pilla and Devadoss, 1974). Of the two races of chanks occurring along the Coramandal coast ^ *PY'^"'^ '^^' °*^"** '^^^ coramandal* is inferior while X. p/m/77 var *obtusa* race *nayinathivu* is quite comparable to the Gulf of Mannar races,

Kerala The government leases its fishery rights by auction to the fishermen. Skindiving forms the main method of exploitation along the Trivandrum district where the important bases include Poovar, Vizhingam, Kovalam, Val.athura and Poonthura villages. Crabnets '^"d small quantities of chanks from Poovar to Q"''°"- At Vizhingam, 15 to iO units of longlines, each 250-500 m long with 500 to 1000 hooks (No. 6 or 8) are being operated for chanks since 1976 for about 25 days a year, with an average of obout 45 chanks per day per gnit. The operation, repeated 2 or 3 times g day, involves dragging the longlines along the chank beds for hooking the chanks by their f^ot. Inshore shirmp trawlers also land chanks regularly from Sakthikulangara to Cochin throughout the year with peak from July to December. During the period 1964-80, the annual catch of chanks ranged from about 4,750 in 1975-76 to 44,670 in 1979-80, with the average at 20,138 chanks. Of the three varieties of chanks known to occur along the ^^^^1^ ^^^^^ ^ ^^^^ ^^^ *giobbosa. X. pyrum* var *comorinensis* and *X. pyrum* var *acuta),* the variety *acuta* forms the bulk of the catches (Appukuttan ef. a/. 1980.

Gulf of Kutch (Gujarat) . The fishery is limited to the intertidal zone, in spite of indications of good potential beyond this zone. The annual catch of good adult chanks (> 60 mm MSD) during 1974-84 ranged from a meagre 2,572 in 1977-78 to 13,066 in 1974-75, with the annual average at 7,717 chanks comprising 39% of 60-80 mm MSD group, 50.19% of 81-100 mm

MSD group and 10.81% of > 100 mm MSD (upto about 115 mm MSD) group.

The Gulf of Kutch variety *(acuta)* is the same as that occurs in the Gulf of Mannar. Therefore, the growth equation for the Gulf of Mannar stock was used to determine the age composition of the catch from the Kutch, and ti,».*„ ,K , *, xu ,y ^ therefrom, the value of Z. The annual Z ranged X «..-,/No. -«-,« «« «-,^«, . .^^^ «.. from 0.1708 in 1979-80 to 0 2384 in 1980-81 except in 1982-83 when it was 0.0972; the mean annual Z was 0.1 725. Considering M to be the same as for the Gulf of Mannar stock, /^ was found to range from 0.0787 in 1979-80 to 0.1463 in 1980-81 and £ from 0.4608 in 1979-80 to 0.6137 in 1980-81, with the mean £ at 0.5201 (excluding 1982-83).

The annual stock of adult chanks (> 60 mm MSD) ranged from 7,880 in 1977-78 to 53, 018 in 1974-75, with the annual average at 25,234. Thus, the average annual yield of 7.717 chanks represent 30.6% exploitation of the stock of >60mmMSD chanks. However, . . . rro«..„, . the actual exploitation ratio was 52.01% since ,_____"', , „ °„^ only in 1981-82 and 1983-84, the 60-80 mm MSD group formed the fully recruited group in the catch while in all the other years the 81-100 mm MSD group formed the predominent portion of the catch. The stock of > 81 mm MSD group chanks was about 9,050 and the » u t /l -tr\-i u l < .u- . „ „„«.,•- catch of 4,707 chanks of this group represents 52% exploitation, indicating thereby little , ... scope for expanding the fishery in the intertidal zone for the > 81 mm MSD group and some prospects for increasing the catches of the 60-80 mm MSD group.

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