Fishery and population dynamics of the sacred chank *Turbinella pyrum* (=*Xancus pyrum* Linnaeus, 1758) off Kayalpattinam in the Gulf of Mannar

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ABSTRACT

The fishery and population dynamics of the sacred chank, *Turbinella pyrum* exploited by bottom-set gillnet off Kayalpattinam, Gulf of Mannar were studied during 2004-2006. The size/weight range was between 80-290 mm / 60 to 1600 g. The age of the chanks was estimated to be 20+ years and it reaches 94/135, 154/453, 197/833 and 227 mm /1195 g in 1st, 2nd, 3rd and 4th year of life. The length–weight relationship (L-W) of *T. pyrum* was $W = 0.001728 * L^{(2.47087)}$, length–maximum shell diameter (L-MSD) was $W = 0.0011749 * MSD^{(2.851393)}$. The VBGF parameters estimated are L_∞ = 306.1 mm, K = 0.33 yr^{-1} and W_α = 2.5 kg. Estimated total mortality, natural mortality and the fishing mortality are 1.6913 yr^{-1}, 0.45909 yr^{-1} and 1.2322 yr^{-1} respectively. From the estimates arrived at, the fishing pressure on chanks in the fishing ground is evident and about 30% reduction from the present effort of 5,943 units operated from Kayalpattinam is required to sustain the stock and return to the maximum sustainable yield (MSY) of 48.5 t.

Keywords: Age and growth, Fishery, Length-weight relationship, Mortality, *Turbinella pyrum*

The sacred chank *Turbinella pyrum* (= *Xancus pyrum* Linnaeus, 1758) forms a commercial fishery along the south-east coast of India. In the Gulf of Mannar (GoM), there are about 10 chank beds extending from off Vaipar to Tiruchendur, exploited from Tuticorin as base. These beds extend from 6-27 m depth or even beyond and chanks are found to be abundant in 16-20 m depths (Hornell, 1914, 1922; Mahadevan and Nayar, 1966). Over 95% of the catch is from skin diving in depths up to 20 m while the remaining comes from the incidental catches from various fishing gears, especially trawlers. Chanks exploited all along the GoM area are the mainstay of the bangle industry in West Bengal. Studies on Indian chanks are very limited, restricted to the early underwater observations of chank beds in GoM and studies conducted on its ecology, tagging and recapture, growth of juvenile chanks and on dynamics (Mahadevan and Nagappan Nayar, 1966; Devaraj and Ravichandran, 1988; Pon Siraimetan *et al.*, 1988; Lipton and Selvakku, 2001; CMFRI, 2004).

Kayalpattinam is an important fish landing centre along the GoM, south-east coast of India (lat. 8° 34' N; long. 78° 07' E). Shellfish fishery in this centre is supported by various species of crabs, lobsters and gastropods especially chanks. The major gear employed for exploiting these resources is bottom-set gillnets (shingi/mandal valai). Chanks form a considerable catch in this gear throughout the year, contributing over a lakh chanks annually with peak catches from October to April. An attempt was made to find out the age and growth, length-weight (L-W) as well as length-maximum shell diameter (L-MSD) relationships and important fishery parameters of exploited chanks by bottom-set gillnets to understand the current status and sustenance of the fishery.

Samples of *T. pyrum* were measured at fortnightly intervals from the commercial catches from bottom-set gillnet units operating off Kayalpattinam during 2004 -'06. Data on total length, weight and maximum shell diameter (MSD) and other fishery data were collected from the landing centre and the monthly estimates of catch were arrived at. A total of 523 chanks in the size range of 80-290 mm total length was used for L-W and MSD-weight calculations. Length and MSD linear relationship was derived using least square method.

Parameters of growth in length were estimated using the von Bertalanffy growth equation: $Lt = L_\infty (1- e^{-K(t-t_0)})$. The von Bertalanffy growth parameters were estimated using FiSAT (Gayanilo *et al.,* 1988; Sparre and Venema, 1991). The pooled sample data for the period 2004-06 were used for the estimation of growth parameters of chank. The growth parameters were estimated using monthly length frequency distribution of each year. A total of 1142 chanks in the length range of 80-290 mm in total length were used for estimation of growth parameters. The L_∞ values and their associated K values were selected using FiSAT.

The rate of total instantaneous mortality (Z) and exploitation ratio (E) were estimated from the length converted catch curve of Pauly (1983) using the total annual length frequency distribution of catch. The natural mortality rate (M) was estimated using the equation of Pauly (1980). For this purpose, the temperature in the fishing grounds was taken as 29 ^{0}C. The rate of fishing mortality (F) was calculated from Z and M. Estimation of yield and biomass at different levels of F and t_c was made using Beverton and Holt's (1957) yield per recruitment analysis. The mid-point of the smallest length group in the catch during 2004-'06 was taken as length at recruitment (L_r). The length corresponding to the first value of the descending limb of the length converted catch curve was taken as the length at first capture (L_c). The L_r and L_c values were converted to t_r and t_c values using inverse VBGF equation. The value of W_∞ was derived using the value of L_∞ and the length-weight relationship. Estimation of yield was done as follows: the present F values of *T. pyrum* were decreased and increased by the same factor (as 10%, 20%, 30%….. 100%…200% of present F). Using the resultant F values, the present t_c and other parameters, the Beverton-Holt (1957) yield per recruit analysis was made. The yield-effort curve obtained from the analysis was used for interpretation. Taking the value of yield per recruit (Yw/R) at the annual t_c and F as well as the value of annual average yield (2004 -'06) of *T. pyrum,* the recruitment in numbers was estimated. The Yw/R at each F at 'b' obtained above was weighted by the value of R to obtain values of yield in weight at different F values.

At Kayalpattinam, chanks are fished by bottom-set gillnets operated at depths ranging from 8-40 fathoms primarily meant for lobsters and crabs. Each unit consists of 40 pieces of 100 fathom length nets connected together. The nets are deployed by a motorised plank-built boat having manpower ranging from 3 to 7 nos. The mesh size

of the net is 90 mm. During the period, the total number of chanks fished annually at Kayalpattinam ranged from 92,654 to 1,15,500 nos. with an annual average of 1,09,225 nos. The size and weight range were 80-290 mm and 60 to 1600 g respectively. The average annual catch per unit effort (CPUE) was 18 (3-46) during 2004-'06. Maximum catch was observed during October–April in both the years and it was low during the rest of the months (Table 1).

Table 1. Effort and catch data of *Turbinella pyrum* landed at Kayalpattinam (average for 2004–'06)

Month	Effort (units)	Catch (numbers)	CPUE	Percentage (monthly)
Jan	473	21655	46	19.83
Feb	555	13116	24	12.01
Mar	500	5335	11	4.88
Apr	719	5183	7	4.75
May	527	1512	3	1.38
Jun	510	1684	3	1.54
Jul	270	3197	12	2.93
Aug	563	1849	3	1.69
Sep	313	1264	4	1.16
Oct	423	11209	27	10.26
Nov	590	22826	39	20.90
Dec	500	20396	41	18.67
Total	5943	109225	18	100.00

The length frequency distribution shows that the number of chanks having >60 mm MSD (=112 mm TL) forms about 5.5% of total (Table 2). The results are comparable to the catch patterns obtained by experimental trawling in GoM region (Pon Siraimetan *et al.,* 1988). The chank catch from Kayalpattinam (off Tiruchendur) was

Table 2. Estimated MSD percentage of *T. pyrum* landed at Kayalpattinam (average of 2004-'06)

MSD group (mm)	Catch (Nos.)												Total catch (Nos.)	Percentage
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec		
40-49	0	0	0	0	37	0	0	90	15	28	0	0	170	0.16
50-59	1352	367		465	222	274	595	338	200	524	318	1373	6028	5.52
60-69	6132	2077	210	1540	582	632	1192	811	438	5787	6444	7055	32900	30.12
70-79	6198	4150	1990	1922	543	494	1032	428	438	3246	9812	6657	36910	33.79
80-89	4324	3138	1705	807	119	268	378	160	150	764	3587	2941	18340	16.79
90-99	2348	2302	660	326	9	16	0	22	23	592	1096	1965	9359	8.57
100-109	1301	773	550	123	0	0	0	0	0	0	1215	318	4280	3.92
110-119	0	236	110	0	0	0	0	0	0	0	354	87	787	0.72
120-129	0	73	110	0	0	0	0	0	0	0	0	0	183	0.17
130-139	0	0	0	0	0	0	0	0	0	268	0	0	268	0.24
Total catch	21655	13116	5335	5183	1512	1684	3197	1849	1264	11209	22826	20396	109225	100
Effort	473	555	500	719	526	510	270	563	313	423	590	500	5943	

about 17-23% of the GoM catch. As per the present estimate, the chank landing from Tuticorin, Kayalpattinam and Ramnad area were 3,47,899; 1,03,918 and 1,12,954 nos. respectively forming a total of 5,64,771 from the whole GoM area. This was nearly half of the chank landing during 1978-85 period at Tuticorin (5,54,451), Kayalpattinam (1,65,615) and Ramnad (1,80,017), totalling 9,00,083 (GoM) reported by Devaraj and Ravichandran (1988).

The length-weight relationship of *T. pyrum* based on 523 specimens of length range 80-290 mm was calculated as $W = 0.001728 * L^{(2.47087)}$, $r = 0.930036$ and $r^2 = 0.864697$ (Fig. 1). The present 'b' value lies in between the values of 3.11369 and 2.8475 reported earlier by Pon Siraimetan *et al.* (1988) and Kasim (1988) respectively. The MSD-weight relationship of *T. pyrum,* estimated from 523 specimens in the length-range of 44 -103 mm is :
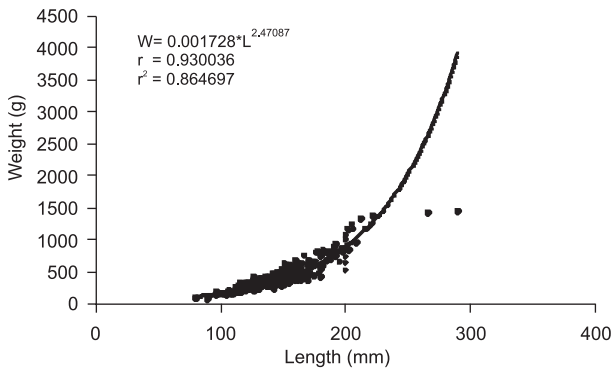

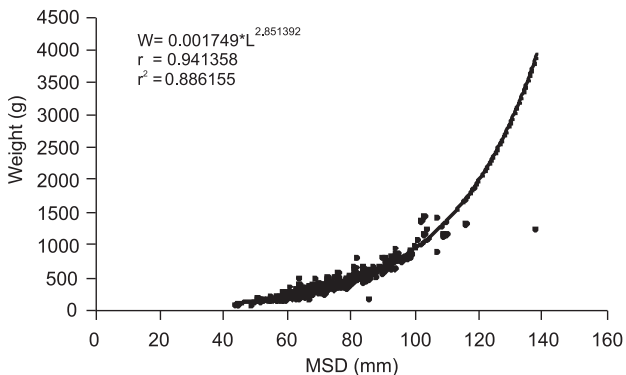Fig. 1. Length-weight relationship in sacred chank *Turbinella pyrum*

Fig. 2. MSD-weight relationship in sacred chank *Turbinella pyrum*

$W = 0.0011749 * MSD^{(2.851393)}$, $r = 0.941358$ and $r^2 = 0.88615$ (Fig. 2). The length and MSD linear relationship calculated based on the measurements of 523 specimens in the size range of 44-103 mm was: $MSD = 0.409242 *L + 14.3074$, $r = 0.872377$ and $r^2 = 0.761041$ (Fig. 3).
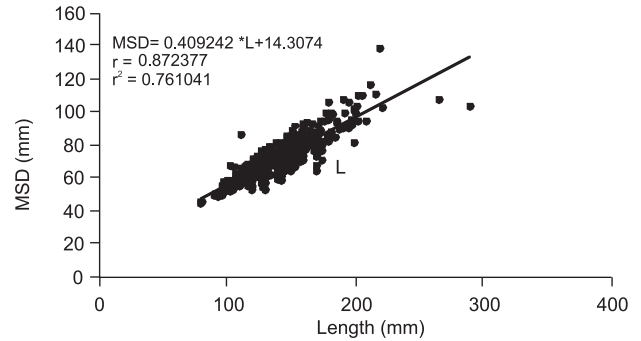

Fig. 3. Length-weight and MSD relationship in *Turbinella pyrum*

The VBGF parameters estimated are: $L_\alpha = 306.1$ mm, growth constant $K = 0.33$ yr^{-1} and $t_0 = 0.115$ yr. The length was 94;154;197 and 227 mm at the end of 1, 2, 3 and 4 years respectively (Table 2). The VBGF arrived for *T. pyrum* exploited off Kayalpattinam is $L_t = 306 (1-e^{-0.33 (t-0.115)})$ (Table 3). The VBGF parameters of this species estimated from GoM by Devaraj and Ravichandran (1983) were: $MSD_\alpha = 119$ mm ($L_\alpha = 255$), $K = 0.0946$ which are lower as compared to the present values.

The estimated life span of the chank was found to be 20+ years. The estimated length and weight attained by chanks in different years are given in Table 4. The chanks are observed to grow in wild about 5.0 mm/month during the first year. The estimated growth for the first year in the present study is more or less comparable with the observations made during the laboratory growth studies of chank juveniles conducted at Mandapam and Vizhinjam (CMFRI, 2004).

The total mortality (Z) of *T. pyrum* ranged from 1.662 to 1.740 with an average of 1.693. The results of total mortality estimated by different methods such as length converted catch curve, Ault and Erhardt as well as Beverton and Holt model are given in Table 3. The fishing mortality (F) obtained in the present study ranged from 1.2029 to 1.2809 with an average of 1.2322. The estimated natural mortality (M) was 0.45909. The present values are much higher than the values obtained in earlier studies. During

Table 3. Population parameters of *T. pyrum* from Kayalpattinam during 2004-'06

| L_α (mm) | K/year | Z | | | Mean Z/year | M/year | F/year |
		Catch curve method	Beverton and Holt model	Ault and Erhardt model			
306.1	0.33	1.74	1.672	1.662	1.6913	0.45909	1.2322

1984-85, the mortality estimates were: Z=0.1736, M = 0.0921, F= 0.0815 and E = 0.4483, whereas the present values are much higher probably because of the higher exploitation rate and less abundance of the resource in the fishing grounds (Devaraj and Ravichandran, 1988).

Table 4. Length and weight attained by *T. pyrum* off Kayalpattinam.

Age (years)	Length (mm)	Weight (g)
1	94	135
2	154	453
3	197	833
4	227	1195
5	249	1504
6	265	1753
7	277	1947
8	285	2093
9	291	2202
10	295	2283
11	298	2342
12	300	2385
13	302	2416
14	303	2438
15	304	2455
16	304	2467
17	305	2475
18	305	2481
19	305	2486
20	306	2489

T. pyrum forms one of the most valuable species contributing to shellfish fishery off Kayalpattinam (Fig. 1). The estimated values of total catch in different months are presented in Table 1. Month-wise length frequency distribution of *T. pyrum* has shown that a total of 1,09,225 chanks are landed, with maximum during October, November, December and January. The values of W_α was estimated as 2.489 kg from the length-weight relationship, the values of t_r was estimated as 0.84 year taking 83 mm as the smallest length at recruitment and t_c = 1.79 year from L_c = 143 mm. The yield per recruit against different values of F keeping the values of t_c and M as constant shows that
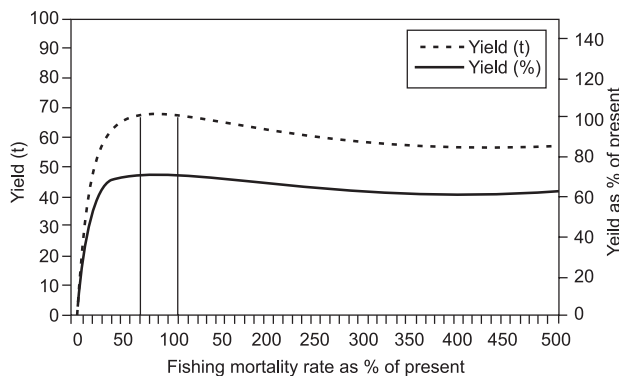

Fig. 4. Estimated yield of *Turbinella pyrum* as function of different F values

Yw/R increases with F reaching maximum of 205 g and corresponding B/R was 159 g for *T. pyrum*. In *T. pyrum,* the maximum yield corresponds to 48 t at 100% of the present effort (Fig. 4). Thus there is no scope for further increase in the yield from the present level of effort, from the present fishing grounds. The MSY of 48.5 t numbering 1, 10,555 chanks can be obtained at F of 70% of the present F. For the better management of fishery, one of the options is to reduce 30% of the present annual effort of 5943 units which will result in sustainable return of 48.5 t in long term fishery.

The chanks are having low growth rate, low fecundity and also slow movement as compared to finfishes and the demand in the market will further increase overexploitation of chanks from the present fishing ground. Hence, it is suggested that continued monitoring is essential for sustaining the fishery of chanks.

Acknowledgements

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