TRENDS IN THE YIELDS OF MAJOR EXPLOITED FISHERIES OF THE EAST COAST OF INDIA

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Abstract

On the east coast of India, the elasmobranchs, cat fishes, 'other sardines', anchovies and white baits, 'other clupeids', sciaenids, ribbon fish, silverbellies and penaeid prawns form the major fisheries and contribute about 63% of the total marine fish catch of the coast. The trends in the yields of these fisheries of this coast during the 21-year period from 1952 to 1972 have been analysed. A study of the fluctuations in the trends in the yields assumes greater importance as no up-to-date information is available at present about the nature of trends of major exploited fisheries of the east coast of India especially in view of the diversification of fishing on this coast. The study reveals that in West Bengal and Orissa, elasmobranchs, cat fishes, anchovies and white baits, other clupeids, sciaenids, ribbon fish and silverbellies form a good fishery and it is predicted that these fisheries will continue to yield good catches in future also. In Andhra the fisheries of other sardines, other clupeids, sciaenids, ribbon fish and penaeid prawns are successful and they will maintain the present increasing trend in their landings in the coming years also. In Tamil Nadu, it is seen that only cat fishes, other sardines, anchovies and white baits and sciaenids form very good fishery and they will yield higher catches also in the future years.

Introduction

On the west coast of India the bulk of the landings comprise of four major fisheries namely oil sardine, mackerel, Bombay duck and penaeid and nonpenaeid prawns. But these four category of fishes form very minor fishery on the east coast of India. However, elasmobranchs, cat fishes, 'other sardines',[*] anchovies and white baits, 'other clupeids',[**] sciaenids, ribbon fish, silverbellies and penaeid prawns which constitute the bulk of the total catch of the east coast form the nine major fisheries of this coast.

Nair and Banerji (1965), in their "Survey of the Statistics of Marine Fish Catch in India" from 1950 to 1962, have studied the fluctuations in the landings of various fisheries in the different maritime states of India. The Central Marine Fisheries Research Institute (1969) in its publication on "Marine Fish

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[*] all sardines other than Oil Sardines

[**] all clupeids other than sardines, Hilsa and Anchovies and White baits

Production in India — 1950 to 1968" has recorded the seasonal catches of various fisheries in the different maritime states of India. Chakraborty, Nair and Balakrishnan (1973) have studied the quarterwise landings of important fishes of India and recorded the seasonal and regional occurrence of the same. Similarly Jones and Banerji (1973), Prasad, Banerji and Nair (1969) and Rao (1969) have also dealt with the fluctuations in the landings of pelagic and demersal fishes in the assessment of the potential fishery resources of the same.

The present paper deals with the study of the up-to-date trends in the yields of nine major exploited fisheries of the eastern maritime states of India (West Bengal and Orissa, Andhra and Tamil Nadu (including Pondicherry)) on the basis of the data for the years 1952 to 1972. An attempt is also made to predict the trends of production of these fisheries in the coming years in the different states of the east coast.

MATERIALS AND METHODS

The Central Marine Fisheries Research Institute estimates the marine fish production in India on the basis of a sampling design which involves space-time stratification (Banerji 1968). From the catch data estimated by the Institute, nine major fisheries were selected on the basis of their abundance in respect of the total catch of the east coast of India. The fisheries thus chosen were elasmobranchs (8%), cat fishes (4%), other sardines (12%), anchovies and white baits (9%), other clupeids (4%), sciaenids (6%), ribbon fish (8%), silverbellies (7%), and penaeid prawns (5%). These nine major fisheries together contribute about 63% of the total yield of the east coast. A second-degree trend line was fitted to the data as followed by Snedecor and Cochran (1967) and Mohamed (1969). The trend values for the coming years were directly extrapolated from the trend line. The Von Neuman statistic defined by

$$Q = \Sigma \left\{ \hat{U}_t - U_{t-2} \right\}^2 \Big/ \Sigma \hat{U}_t^2$$

where $\hat{U}_t$ is the least square estimate of the disturbance U_t in the equation

$$Y = \Sigma \beta i \, X i + \hat{U}_t$$

(H. Theil and A. L. Nagar 1961) was computed. The null hypothesis of mutual independence of the residuals in the trend line has been tested using the tables of significant points computed by these authors. Chakraborty (1973) has followed similar method in the study on the evaluation of marine fish resources of India. The catch data of the nine major fisheries of the east coast from 1952 to 1972 were used for fitting the second degree equation, with 1962 as the origin ($Y = a + bt + ct^2$ where Y is the catch in tonnes and t the time in unit of year from 1962). The trend lines have been fitted independently for the nine major fisheries and are plotted in Fig. 1 to Fig. 9. To study the nature of

fluctuations, the Von Neuman statistic have been worked out for each fisheries separately and compared for the thoretical values of 1.25 and 1.53 at 1 and 5 per cent level respectively.

RESULTS

The salient features of the trends of the nine major fisheries of the east coast are discussed below:—

Elasmobranchs

The equations for the trend lines calculated in respect of elasmobranchs for the different maritime states of the east coast are:

West Bengal and Orissa   .. $Y = 235.97 + 16.85t + 1.90t^2$

Andhra   ....   .. $Y = 5335.52 + 198.85t - 17.61t^2$

Tamil Nadu   ....   .. $Y = 8879.07 + 395.62t + 46.31t^2$

The trend lines (Fig. 1) show different pattern for the different states of the east coast. While in W. Bengal and Orissa the landings show a steady increasing trend, from 1959 to 1972 after a minor decline from 1952 to 1958, in Andhra, however, the same showed an increasing trend up to 1968 and a slightly declining trend thereafter. The landings in Tamil Nadu showed a decreasing trend from 1952 to 1958 and then a steady increasing trend in the rest of the
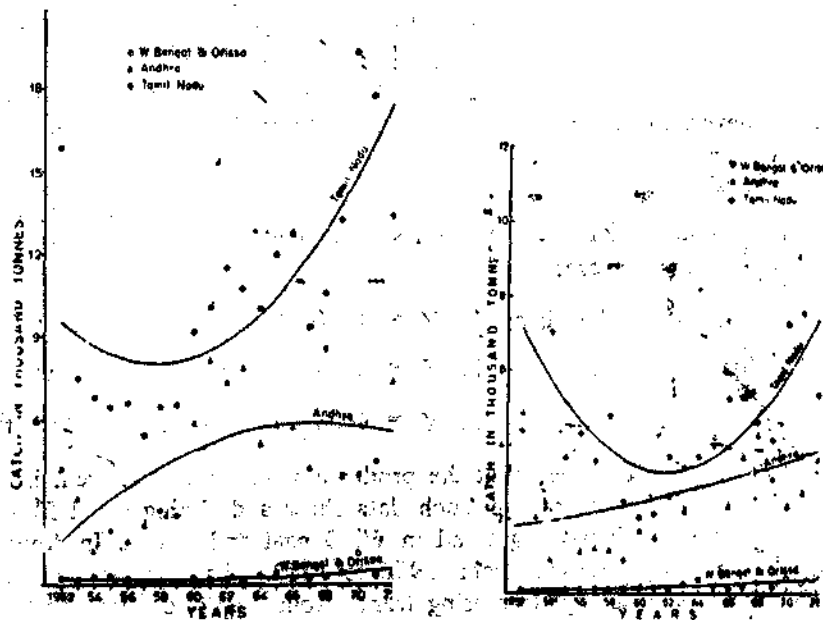

FIG. 1. Yield trends of elasmobranchs.   FIG. 2. Yield trends of catfishes.

period. The Von Neuman statistic value (Q) worked out (Table 1) show that in W. Bengal and Orissa we cannot reject the null hypothesis that the residuals in the quadratic equation are assumed to be mutually independent as the Q value is above the theoretical values at 1% and 5% level. But in respect of Andhra the Q value is below at 5% and above at 1% level respectively and in Tamil Nadu the Q value is below at both the levels. These show that only in respect of W. Bengal and Orissa the future landings of elasmobranchs can be reasonably predicted and may be said that this fishery will continue to yield higher catches in those states in future also at the present rate of exploitation.

Cat fishes

For the different maritime states of this coast the equations for the trend lines calculated for cat fishes are presented below:

West Bengal and Orissa .. $Y = 176.25 + 17.70t + 0.41t^2$

Andhra .... .. $Y = 2638.73 + 100.95t + 2.01t^2$

Tamil Nadu .... .. $Y = 3253.73 + 13.46t + 40.18t^2$

The trend lines (Fig. 2) show different pattern in all the maritime states of the coast. While in W. Bengal and Orissa and Andhra the landings show an increasing trend throughout the period 1952 to 1972, in Tamil Nadu, however, the landings show a decreasing trend from 1952 to 1962 and an increasing trend from 1963 to 1972. From the Von Neuman statistic values (Table 1) it can be safely predicted that in W. Bengal and Orissa and Tamil Nadu the cat fishes will continue to yield higher catches in the following years also as the calculated Q values are above the theoretical values at 1% and 5% level respectively. In Andhra, however, the future prediction is not possible for this fishery.

'Other sardines'

The equations for the trend lines calculated for the different maritime states of the east coast are:

West Bengal and Orissa .. $Y = 1380.72 + 26.92t + 21.68t^2$

Andhra .... .. $Y = 8088.30 + 603.51t + 28.99t^2$

Tamil Nadu .... .. $Y = 9034.77 + 600.19t + 88.45t^2$

From Fig. 3 it is seen that the production trends are different in all the maritime states of the coast. The catch data show a declining trend from 1952 to 1961 and then an increasing trend in W. Bengal and Orissa. In Andhra the landings uniformly increased from 1952 to 1972. The production figures of Tamil Nadu show a steady decreasing trend from 1952 to 1959 and then a uniform increasing trend from 1960 onwards. The Von Neuman statistic values

Name of fish	Q value			Theoretical values at 1% and 5% level		Remarks		
	West Bengal & Orissa	Andhra	Tamilnadu	at 1%	at 5%			
Elasmobranchs	2.06	1.29	1.23	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and < at 5%
						Tamil Nadu-Q value	<	at 1% and at 5%
Catfishes	2.21	1.36	2.04	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and < at 5%
						Tamil Nadu-Q value	>	at 1% and at 5%
Other Sardines	1.19	2.02	2.06	1.25	1.53	W. Bengal & Orissa-Q value	<	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and at 5%
Anchovies & whitebaits	1.87	2.38	1.97	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and at 5%
Other clupeids	1.74	1.82	2.87	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and at 5%
Sciaenids	1.85	1.94	1.65	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and at 5%
Ribbonfish	1.61	1.70	1.42	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and < at 5%
Silverbellies	1.97	2.94	1.27	1.25	1.53	W. Bengal & Orissa-Q value	>	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and < at 5%
Penaeid prawns	1.00	2.44	1.52	1.25	1.53	W. Bengal & Orissa-Q value	<	at 1% and at 5%
						Andhra-Q value	>	at 1% and at 5%
						Tamil Nadu-Q value	>	at 1% and < at 5%

(Table 1) show that excepting in W. Bengal and Orissa where the Q value is below the theoretical values both at 1% and 5% level, in other states of the coast the Q values are above the theoretical values at 1% and 5% level, respectively. That means only in Andhra and Tamil Nadu the prediction of future
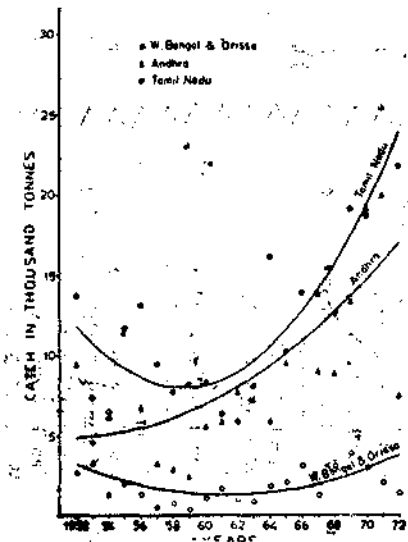

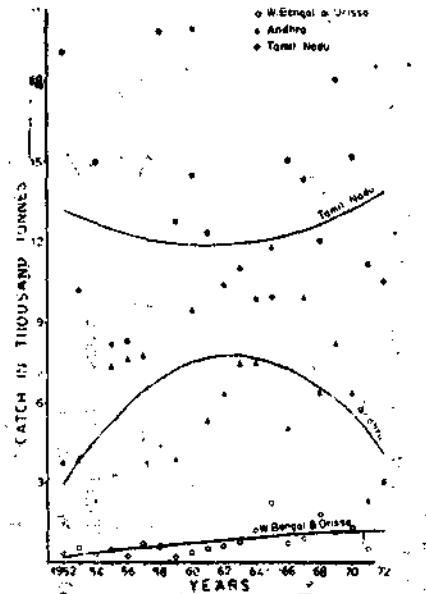FIG. 3.   Yield trends of 'other sardines'.

FIG. 4.   Yield trends of anchovies and whitebaits.

yield of other sardines is possible and may be said that in those two states the landings of other sardine will be augmented at the present level of exploitation in the coming years also.

Anchovies and white baits

For the different maritime states of the coast the following trend lines were fitted for the catch data of anchovies and white baits:

West Bengal and Orissa   .. Y = 846.51 + 49.30t   − 1.50t^2

Andhra   ....   .: Y = 7770.05 + 56.98t   − 42.70t^2

Tamil Nadu   ....   .. Y = 11886.65 + 33.80t + 16.80t^2

From Fig. 4 it is seen that the trend lines are not of the same pattern in the different maritime states of the coast. An increasing trend in the catch data is noticed in West Bengal and Orissa. In Andhra the landings data show an increasing trend from 1952 to 1963 and then a decreasing trend from 1964

onwards. From 1952 to 1961 the production figures showed a decreasing trend and then it showed an increasing trend from 1962 to 1972 in Tamil Nadu. From Table 1 it is seen that the Von Neuman statistic values are above the theoretical values at 1% and 5% level respectively for all the maritime states of the coast. It can be predicted that the anchovies and white baits landings will yield higher catches in future also in West Bengal and Orissa and Tamil Nadu. In Andhra, however, no increase in the landings is possible at the present rate of exploitation.

'Other clupeids'

The production trends for the different maritime states of the east coast in respect of the landings of other clupeids are represented by the following equations:

West Bengal and Orissa .. Y = 772.34 + 103.49t + 10.83t^2

Andhra .... .. Y = 1643.24 + 39.97t + 49.85t^2

Tamil Nadu .... .. Y = 3111.04 + 60.90t − 9.55t^2

The trend lines (Fig. 5) show various patterns in the different maritime states of the coast. In West Bengal and Orissa the landings show a declining trend up to 1957 and an increasing trend afterwards. The trends in Andhra show a decreasing trend from 1952 to 1962 and an increasing trend from 1963 to 1972. After showing a steady increasing trend up to 1965 the trend has fallen from 1966 to 1972 in Tamil Nadu. The Von Neuman statistic values calculated for all the maritime states of the east coast are above the theoretical values at
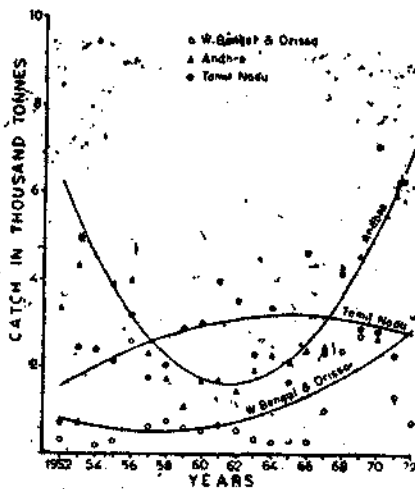

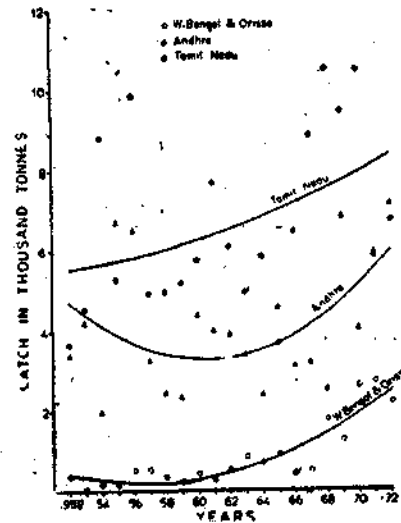Fig. 5. Yield trends of 'other clupeids'.

Fig. 6. Yield trends of sciaenids.

1% and 5% level respectively (Table 1). That means the production of other clupeids in West Bengal and Orissa and Andhra will continue to increase in the coming years also. But in Tamil Nadu the landings may not increase further at the present rate of exploitation.

Sciaenids

The trend lines calculated in respect of sciaenids for the different maritime states of the east coast and the equations of the same are shown below:

West Bengal and Orissa .. $Y = 479.68 + 105.10t + 9.84t^2$

Andhra .... .. $Y = 3352.14 + 62.82t + 20.35 t^2$

Tamil Nadu .... .. $Y = 6562.51 + 143.81t + 4.28t^2$

From Fig. 6 it is noticed that the pattern of the trends of sciaenids in the different maritime states are not the same. In West Bengal and Orissa, between 1952 and 1957 the landings show a declining trend and between 1958 and 1972 the same show an increasing trend. In Andhra, the production shows a declining trend from 1952 to 1960 and an increasing trend from 1961 to 1972. In Tamil Nadu, however, the catch data show a uniformly increasing trend from 1952 to 1972. From Table 1 it can be seen that the Von Neuman statistic values are above the theoretical value at both 1% and 5% level in all the maritime states of the east coast showing that in respect of this fishery it can be reasonably predicted that in all those states the catch statistics will show increasing trend in future also at the present rate of exploitation.

Ribbon fish

The equations calculated for the production trends in the different maritime states of the east coast are given below:

West Bengal & Orissa $Y = 648.85 + 30.13t - 1.30t^2$

Andhra .... $Y = 4835.46 + 351.26t - 11.28t^2$

Tamil Nadu .... $Y = 11757.36 - 255.29t - 3.66t^2$

Fig. 7 shows that the trends in the landings of ribbon fish in the different maritime states are not of the same pattern. In West Bengal and Orissa and Andhra the landings show an increasing trend during the period 1952 to 1972. In Tamil Nadu, however, the landings show a reverse trend as compared to the other states of the east coast. The Von Neuman statistic values (Table 1) show that in West Bengal and Orissa and Andhra they are above the theoretical values at both 1% and 5% level. But in Tamil Nadu the Q value is above the theoretical value at 1% and less at 5% level respectively. It may be concluded that it is possible to predict in West Bengal and Orissa and Andhra that the ribbon fish will continue to yield higher catches in future years also.

Silverbellies

For the different maritime states of the east coast the trend lines fitted are shown below:

West Bengal & Orissa $Y = 523.49 + 52.86t - 1.18t^2$

Andhra .... $Y = 3032.56 + 87.66t - 12.51t^2$

Tamil Nadu .... $Y = 10237.94 + 1221.86t + 5283t^2$

It is seen from Fig. 8 that in West Bengal and Orissa and Tamil Nadu the landings of silverbellies show an increasing trend from 1952 to 1972. But in Andhra, the same show an increasing trend upto 1966 and then a decreasing
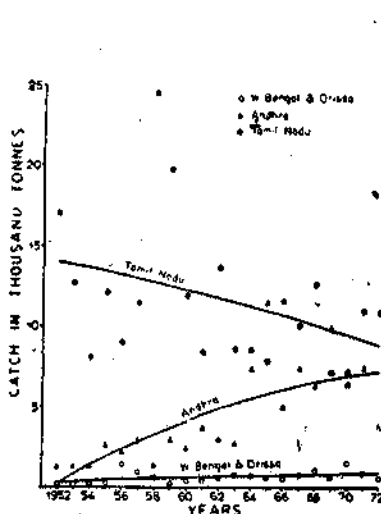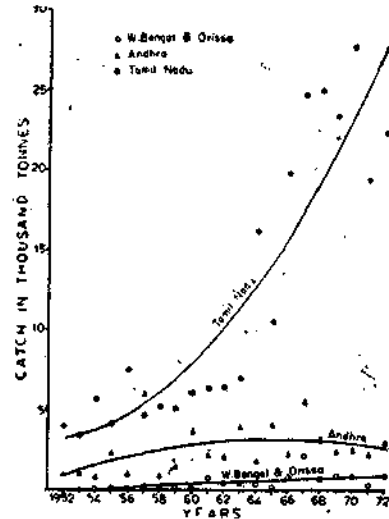

FIG. 7. Yield trends of ribbonfish.

FIG. 8. Yield trends of silverbellies.

trend from 1967 to 1972. The Von Neuman statistic values in Table 1 in respect of West Bengal and Orissa and Andhra are above the theoretical values at 1% and 5% level respectively. But in Tamil Nadu the Q value is above the theoretical value at 1% level but below at 5% level. It can therefore be predicted that in W. Bengal and Orissa, silver bellies will continue to yield higher catches in the following years also. In Andhra, however, at the present rate of exploitation no improvement in the landings is possible in future years.

Penaeid prawns

The equation of the trend lines calculated for the different maritime states of the east coast are given below:

West Bengal & Orissa $Y = 2922.76 + 225.32t - 12.37t^2$

Andhra .... $Y = 2859.38 + 228.29t + 18.96t^2$

Tamil Nadu .... $Y = 3497.31 + 208.11t + 4.48t^2$

Fig. 9 shows that the trends of the landings of penaeid prawns are not of the same pattern in all the maritime states of the east coast. In West Bengal and Orissa the landings show an increasing trend throughout the period, excepting a minor fall in 1972. In Andhra, the catch data show a decreasing trend from 1952 to 1956 and then an increasing trend from 1957 to 1972. A steady increasing trend is seen in the landings of penaeid prawns in Tamil Nadu. The Von Neuman statistic values (Table 1) are above the theoretical value at 1%
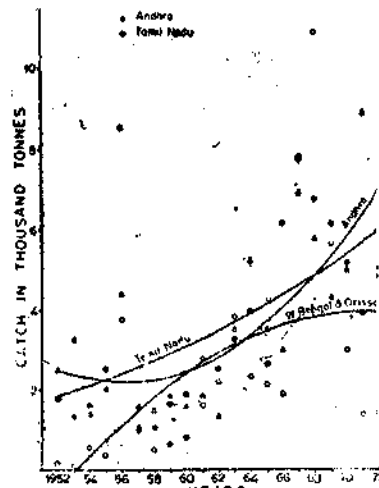

FIG. 9. Yield trends of penaeid prawns.

and at 5% level respectively only in Andhra. In West Bengal and Orissa the Q values are below in both the levels. In Tamil Nadu, however, the Q value is above the theoretical value at 1% level but below the theoretical value at 5% level. That means only in Andhra, it is possible to predict higher catches of penaeid prawns in the future years.

ACKNOWLEDGEMENT

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