

Changing Pattern of the Species Composition of Ring Seine Landings

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The changing pattern of species composition of ring seine landings is modelled with the help of the Markov chain model to interpret the observed changes and predict the status of dominance of major species. The species selected for the study were oil sardine, other sardines, anchovies, carangids and mackerel. The landings from gear other than ring seines and all gear together have also been analysed. The probability of oil sardine dominating the ring seine catch has come down and in the case of other gear, carangids tend to dominate.

Key words: Ring seine, species composition, Markov chain model.

Among the artisanal gear operated from Kerala coast, ring seines have become the single largest contributor towards pelagic fish landing. Its contribution was 21.4% of total landings in 1994. Various aspects of ring seine fishing have been studied by Anon (1991), Sathiadas *et al.* (1993), Rajan J.B. (unpublished), Balan & Andrews (1995) and Edwin & Hridayanathan (1996a). The ring seine is a mini-purse seine operated by large plank-built canoes using outboard motors for propulsion. This gear is targetted at pelagic shoaling species like oil sardine, mackerel, anchovies, other sardines etc. The recent trends in production of different species with respect to craft and gear was studied by Alagaraja *et al.* (1994). In the light of the studies by various authors, there appears to be a change in species composition of the landings from this gear since the time of its introduction in 1986. This changing pattern has been modelled using the Markov chain model in this study. This model has been used to study the dominance in pelagic fish

assemblage of Philippines (Formacion & Saila, 1994) and Kerala (Srinath, 1996). In the present study, an attempt is made to analyse the present dominance and to predict the dominance of major species in ring seines and other gear.

Materials and Methods

The species composition of ring seine landings at Ambalapuzha and Cochin, two centres of intense ring seine activity in Kerala was studied. The sampling method for collecting information on the species wise catch, effort details, area of fishing and total catch was as per Alagaraja (1984). The period of study was from January 1995 to December 1996. The quantity landed was estimated for four major pelagic groups of fishes viz. oil sardine, mackerel, other sardines and anchovies. Besides this primary data, secondary data on the quarterly landings of the above groups and that of carangids from 1986 to 1995 were obtained from the data base of Central Marine Fisheries Research Institute (CMFRI). The landings were

classified as those obtained in ring seines, other gear and all gear together for the purpose of comparison. The 'other gear' include all artisanal gear other than ring seines operated by mechanised vessels. All types of gear operated off Kerala coast come under the 'all gear' category. The catch per unit of ring seine was as per estimates of CMFRI, based on the average catch brought by each category of fishing vessel. The change in species composition of ring seine landings was modelled using the Markov chain model and the transition probabilities are estimated as given in Formacion & Saila (1994).

The maximum likelihood estimate of the transition P_{ij}

$$P = \frac{n_{ij}}{n_i}$$

where n_{ij} is the number of observed direct transitions from State i to State j in one step and $n_i = n_{ij}$ number of observations in State i .

The limiting probabilities are estimated as

$$K = \lim_{t \rightarrow \infty} P_{ij}(t)$$

Results and Discussion

The analysis of the ring seine landings from Cochin and Ambalapuzha during the period of study are given in Table 1. The catch per unit in respect of the major species viz., oil sardine, mackerel, anchovies, prawn and other sardines from ring seines and other gear are given in Fig.1-5. It is seen from the table and figures that oil sardine landings have decreased since 1990. Mackerel

Table 1. Species composition of ring seine landings

Species landed	Landings (Percentage)*	
	1995	1996
Oil sardine	7	6
Other sardines	26	18
Anchovies	18	15
Prawns	3	6
Mackerel	39	42
Miscellaneous	7	13

* Landings from Cochin and Ambalapuzha

landings, on the other hand fluctuated during the period under observation and reached a peak in 1994. Similarly, the data showed that other sardines which were not found in significant quantities in ring seine catches in earlier years, dominated the catches in 1995 and 1996. The anchovy landings by the ring seines also increased since 1989.

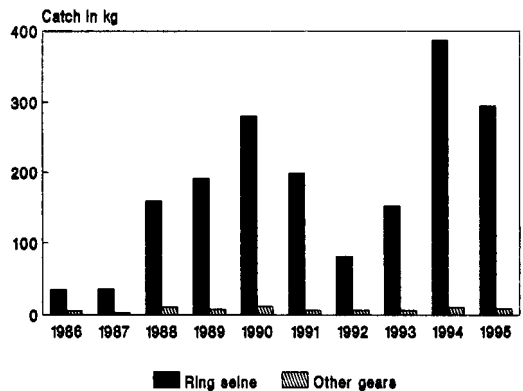


Fig. 1. Catch per Unit of Mackerel 1986-1995

There is a change in the species composition as reflected by the results of the present study and analysis of the catch per unit in respect of different species in ring seines and other gear in the 1989-95 period. These changes were analysed using the Markov chain model. The dominance order in the quarterly landings of five major groups of fishes

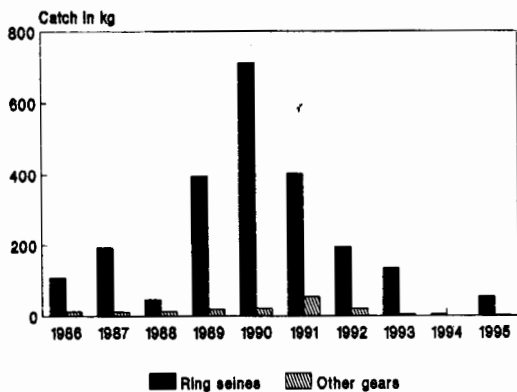


Fig. 2. Catch per Unit of Oil Sardine 1986-1995

from 1986 to 1995 are shown in Table 2. It is seen that oil sardine which was the most dominant species declined since the third quarter of 1993. In the case of other gear, oil sardine did not dominate the catch since 1991 but were solely dominated by carangids. When ring seines and other gear were considered together it was seen that oil sardine lost its dominance after the first quarter of 1992.

The process of dynamic changes taking place in the fishery with respect to the most abundant species was studied through transition probabilities computed using the maximum likelihood approach (Tables 3 and 4). It is seen from the

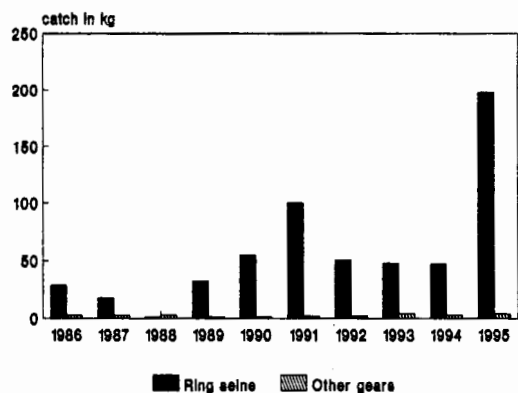


Fig. 4. Catch per Unit of other sardines 1986-1995

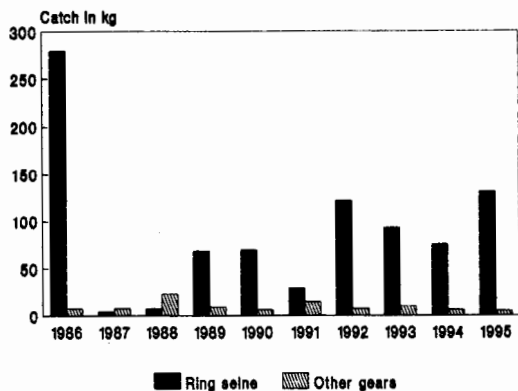


Fig. 3. Catch per Unit of Anchovies 1986-1995

transition probability matrices that if the present pattern of effort expended were to continue and if oil sardine is the dominant species, the probability that in the next year the dominant group will still be the oil sardine is 0.415. The probability that oil sardine will dominate the fishery, replacing other sardines is 0.384. It is also seen that from the transition probability matrices for the present and one year ahead, the probability of the oil sardine dominance has decreased considerably.

It was observed that in the long run oil sardine has the maximum likelihood of dominating the ring seine

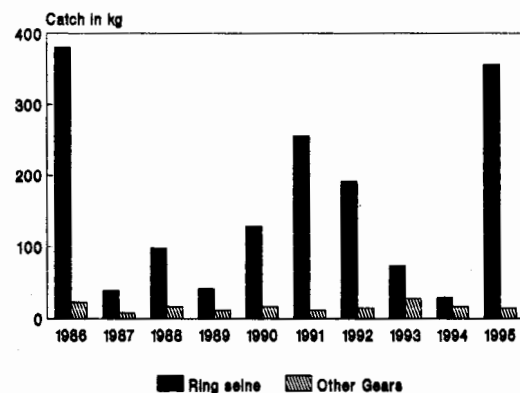


Fig. 5. Catch per Unit of Carangids 1986-1995

Table 2. Dominance of major groups in ring seines, other gear and all gear together during 1986-95

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Ring seine	-	E	E	A	A	A	A	A	C	E
	-	E	E	C	A	A	A	A	E	C
	-	A	A	A	D	D	D	E	E	D
	D	A	A	A	D	A	A	B	E	B
Other gears	A	D	D	A	A	D	D	D	D	D
	E	D	D	A	D	D	D	D	D	D
	D	A	C	A	A	D	D	D	D	D
	D	A	C	C	A	D	D	D	D	D
All gears	A	D	D	A	A	A	A	D	D	D
	E	D	E	C	A	A	D	C	C	C
	D	A	C	A	A	D	C	C	E	D
	D	A	A	A	A	C	D	B	E	B

A - Oil sardine; B - Other sardine; C - Anchovies; D - Carangids; E - Mackerel

landings with a limiting probability of 0.523. The present likelihood has been found decreased significantly. In the case of gear other than ring seines, the likelihood of being the most dominant species is taken up by carangids with a limiting probability of 0.625. When all

gear were considered together the likelihood of oil sardine being the most dominant group has reduced further and the likelihood of carangids has increased.

The important criterion of any model to succeed is that the empirical

Table 3. Transition probability matrix and limiting probabilities

	A	B	C	D	E	Limiting probability
Ring seines						
A	0.647	0.000	0.588	0.176	0.118	0.523
B	0.000	0.000	0.000	0.500	0.150	0.000
C	0.333	0.000	0.000	0.333	0.333	0.090
B	0.600	0.000	0.200	0.200	0.000	0.181
E	0.202	0.000	0.111	0.111	0.555	0.206
Other gear						
A	0.571	-	0.143	0.286	0.000	0.276
C	-	-	0.400	0.400	0.000	0.066
D	0.087	-	0.000	0.826	0.869	0.625
E	1.000	-	0.000	0.000	0.000	0.526
All gear						
A	0.682	0.000	0.231	0.770	0.000	0.403
B	0.000	0.000	0.123	0.500	0.000	0.203
C	0.125	0.000	0.123	0.625	0.125	0.207
D	0.273	0.091	0.182	0.364	0.091	0.297
E	0.2250	0.000	0.250	0.250	0.250	0.070

A- oil sardine; B - other sardine (not considered in other gear as landings were very poor
C - anchovies; D - carangids; E - mackerel

Table 4. Four step transition probabilities

	A	B	C	D	E
Ring seines					
A	0.527	0.000	0.086	0.182	0.210
B	0.513	0.000	0.090	0.181	0.214
C	0.514	0.000	0.090	0.181	0.209
D	0.530	0.000	0.090	0.182	0.198
E	0.547	0.000	0.810	0.179	0.223
Other gear					
A	0.278	-	0.076	0.595	0.050
C	0.271	-	0.068	0.607	0.054
D	0.275	-	0.059	0.612	0.054
E	0.286	-	0.081	0.579	0.471
All gear					
A	0.415	0.024	0.203	0.290	0.067
B	0.384	0.028	0.203	0.308	0.075
C	0.386	0.028	0.203	0.303	0.073
D	0.386	0.028	0.204	0.301	0.072
E	0.387	0.028	0.203	0.300	0.072

A - oil sardine; B - other sardine (not considered in other gear as landings were very poor)
 C - anchovies; D - carangids; E - mackerel

results should agree with actual observations. The study by Formacion & Saila (1994) on the pelagic fishery in the Visayan Sea of Philippines, through the Markov chain model, show that the family clupeidae will probably become dominant among the six families exploited. These results were found consistent with the biological observations. In another study on the pelagic fish landings of Kerala, it is seen that the chances of oil sardine dominating the landings and sustaining the fishery will decrease considerably if the ring seine effort is left unregulated (Srinath, 1996). The present study on the landings by ring seines, gear other than ring seines and all gear also show a similar trend. It is seen that the probability of oil sardines dominating the ring seine landings has declined. The contribution of the oil sardine landings fell from 72% in 1981 to 1% in 1994 (Srinath, 1996) and the average

contribution of oil sardine to the exploited fish landings decreased from 49% in the pre-ring seine phase to about 26% in the post-ring seine phase.

It has been observed that excess effort exists in different forms in the ring seine sector (Edwin & Hridayanathan, 1996b). This may be one of the reasons for the reduced probability of the dominance of oil sardine. Studies conducted by Jacob *et al.* (1982) on the impact of purse seines on the decline in oil sardine landings in 1980 showed that the effect of purse seining was not tangibly felt on the indigenous fishery and in 1981 there had been revival of the fishery. The result of the Markov chain model application show that the probability of oil sardine dominating the ring seine landings have decreased and this is found to reasonably agree with the changes currently observed in the ring seine landings of Kerala.

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