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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

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Cover photo: Catch of white pomfret from Palk Bay.

PAIR TRAWLING STRIKES GOOD GROUNDS FOR WHITE POMFRET IN THE PALK BAY, TAMIL NADU

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Introduction

Gear technologists of the FAO Project on development of small-scale fisheries under the Bay of Bengal Programme (BOBP), funded by the Sweedish International Development Authority (SIDA) established in 1980 at Madras have designed and fabricated a two-boat, high opening bottom trawl for pair trawling operations to be taken up in different sectors of the coastal area of the Bay of Bengal. Of the several zones where they introduced this method, as part of a phased programme, Palk Bay zone with Mandapam, Pamban and Rameswaram as bases of operation was chosen for experiments during 1980-81. In addition to their trials, practical demonstrations of the two-boat trawling were also given to local fishermen which provided necessary stimulus for the mechanised boat owners to take up pair trawling as a new fishing venture in this part of the country. During the course of commercial-scale operation the mechanised boat owners met with a certain amount of success during the earlier part of their fishing. In early February 1982 a few units each operating from Mandapam, Pamban and Rameswaram landed heavy catches, especially of pomfrets. This generated great interest among the boat owners resulting in intense fishing effort by pair trawling which yielded unusually large catches of fishes mainly rainbow sardines and pomfrets. Pomfrets being in demand as quality table fishes and the landings, as was witnessed during these operations, quite unusual in this region, attention was paid to gather the details and the results of the operations during February to April 1982 are presented.

The authors wish to express their sincere thanks to Dr. E. G. Silas, Director for encouragement and S/Shri T. Jacob, G. Venkataraman and S. Mahadevan for their suggestions on improvement in the manuscript. They are also grateful to Skipper Shri P. V. Ramamurthy of F A O / Bay of Bengal Programme for making available valuable information and sketches of the gear.

Area of operation

The areas where the pair trawling was conducted are shown in Fig. 1. Fishing was restricted to within 79° 10′—79° 30′E longitude and 9° 20′—9° 40′N latitude in the Palk Bay north of Mandapam in Tamil Nadu. The sea bottom in this area is mostly muddy and the depth of operation ranged between 10 to 12 m.

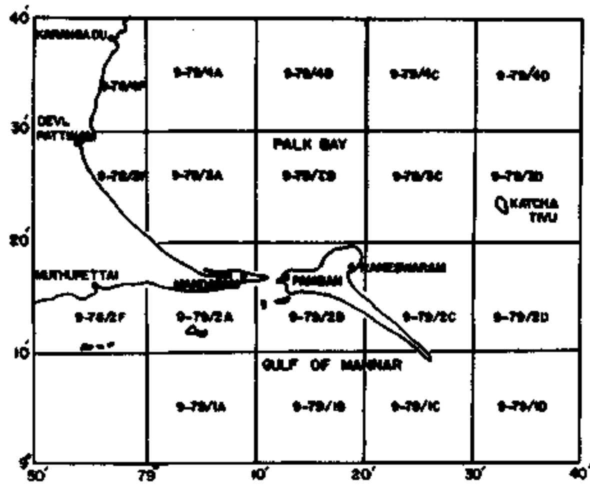


Fig. 1. Map showing the areas of pair trawling operations conducted in Palk Bay off Rameswaram and Mandapam.

Craft and Gear

Mechanised boats (45 to 70 HP, diesel engines) of size ranging from 9.14 m to 9.75 m conducted pair trawling operations. The vessels have a free speed of 7 knots but at operation the trawling speed of the unit was maintained at 2.5 knots. The boats resorted only to daily fishing between 04 00 to 20 00 hrs due to lack of adequate fish hold facilities and limitations in working deck space.

The design of the two-boat, high opening bottom trawl (Fig. 2) introduced by the FAO is in the form of a conical bag consisting of wings 15.4 m, over hang 3 m, belly 23 m, throat 5 m and cod end 7.5 m with an overall head-rope length of 33 m. The size and specifications of nets used varied slightly according to the power of the engines of the boats. A diagrammatic sketch showing the operation of the net is given in

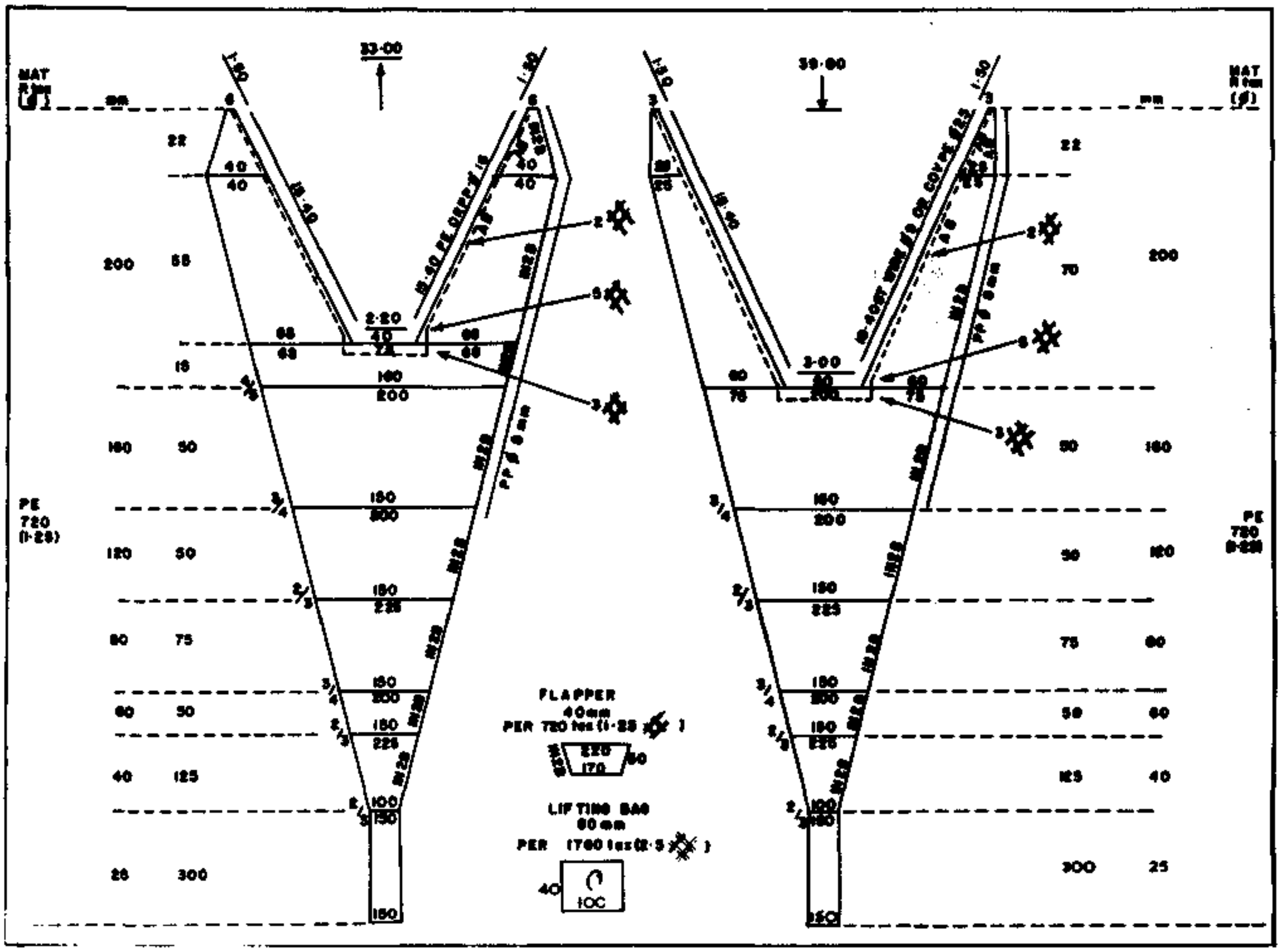


Fig. 2. The net design of the two-boat high opening bottom trawl.

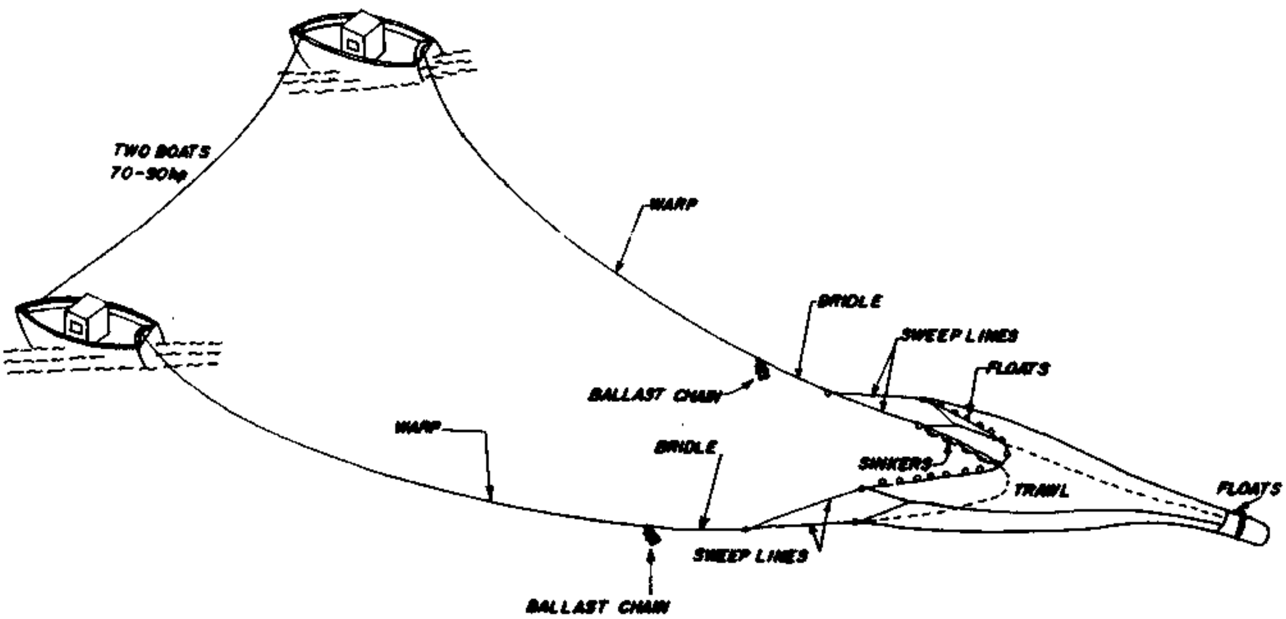


Fig. 3. The diagrammatic sketch showing the pair trawling operations.

Fig. 3. Two boats of identical size and horse power are employed.

Results of operation

The number of units operated and catch particulars of pair trawling conducted off Rameswaram and Mandapam during February to April 1982 are furnished in Table 1. While 384 units conducted trawling in February, it increased to 650 units in March. In April the number of units, however, declined. The total estimated landings of fishes during these three months was 1,166.7 tonnes and the catch per unit effort 1,093.4 kg. The maximum yield of 761.26 tonnes and yield rate of 1.17 tonnes is observed in March (Fig. 4).

Catch composition

The percentage composition of the dominant groups of fishes (Fig. 5) shows that pomfrets and rainbow sardines were landed more or less in equal proportions. *Dussumieria* spp. (mostly *Dussumieria acuta* Valenciennes) constituted 29.95% of the total catch closely followed by silver pomfret, *Pampus argenteus* (29.66%). Stray catches of black pomfret, *Parastromateus niger* (Bloch) were also present. Sciaenids and cat fishes formed 17.55% and 9.32% respectively. Other important groups landed were silver bellies (5.75%), rays (4.79%) and miscellaneous fishes, mainly *Pellona* spp., *Hilsa* spp., *Ilisha* spp., Carangids and lesser sardines other than rainbow sardines (2.98%).

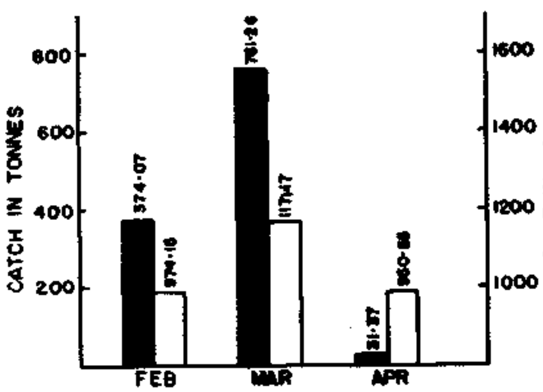


Fig. 4. Total catch (■) and catch per unit effort (□) of all categories of fishes landed.

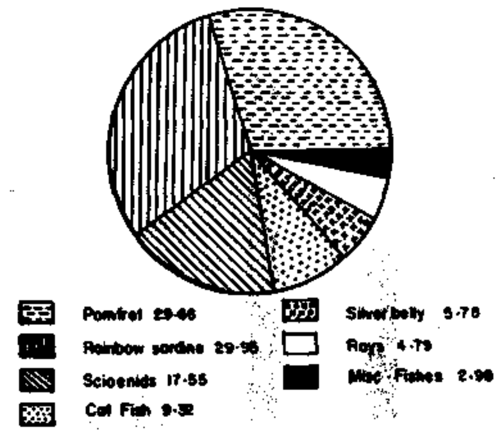


Fig. 5. Percentage composition of dominant groups of fishes landed by pair trawling.

Table 1. *Total catch in tonnes and catch per unit effort in kg (in parenthesis) of dominant groups of fishes landed by pair trawling operations during February to April 1982.*

Months	No. of units operated	Pomfrets	Rainbow sardines	Sciaenids	Catfishes	Silver bellies	Rays	Misc. fishes	Total catches
February	384	113.13 (294.62)	114.58 (298.37)	76.59 (199.45)	9.12 (23.76)	13.93 (36.28)	28.70 (74.74)	18.02 (46.94)	374.07 (974.15)
March	650	226.88 (349.05)	225.24 (346.53)	124.20 (191.07)	95.05 (146.22)	48.12 (74.02)	27.29 (41.98)	14.48 (22.28)	761.26 (1,171.17)
April	33	6.06 (183.85)	9.67 (292.93)	3.97 (120.21)	4.57 (138.39)	5.00 (151.52)	- -	2.10 (63.64)	31.37 (950.55)
Total	1,067	346.07 (324.35)	349.49 (327.54)	204.76 (191.89)	108.74 (101.91)	67.05 (62.83)	55.99 (52.47)	34.60 (32.43)	1,166.70 (1,093.45)

Observations on silver pomfret

Catch trends

As can be seen from Table 1 and Fig. 5 silver pomfret forms one of the two predominant constituents. During the three months of pair trawling operations an estimated 346.07 tonnes of pomfrets were landed by 1,067 units with a catch per unit effort of 324.35 kg. Pomfrets occurred in February with fairly good catch rate of 294.62 kg. The maximum catch (226.88 tonnes) and catch rate (349.05 kg) was in the month of March. The fishing gradually came down to a catch rate of 183.85 kg and abruptly ended by the middle of April (Fig. 6).

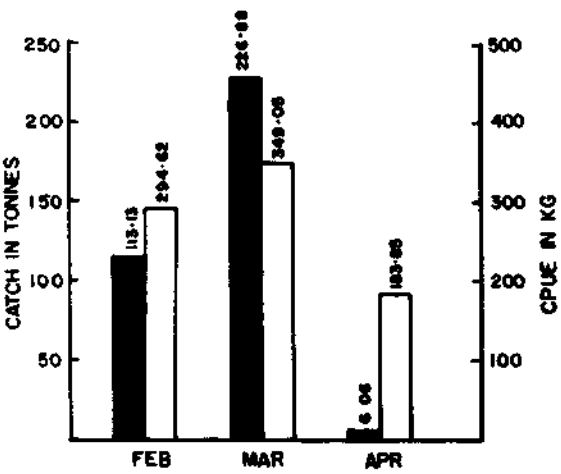


Fig. 6. Total catch (■) and catch per unit effort (□) of pomfrets.

Area-wise catch particulars are not available, making it difficult to assess the relative abundance of pomfrets in the ground. However, through information gathered from fishermen the sub-areas 9-79/3C and 9-79/4C (Fig. 1) appear to be more productive.

Biological Observations

Data on length of the pomfrets were collected for the month of March. The catches consisted of fish ranging from 145 to 280 mm size with the dominant size group at 235 mm. Examination of the stomach contents collected from representative samples indicated that the fishes have been feeding mostly on crustaceans apart from larval bivalves, gastropods and polychaetes. Most of the specimens examined were in the II, III and IV stages of maturity.

Marketing

During the peak period of the fishery, in the latter half of March, marketing of pomfrets was a problem faced by the fishermen. About 10 percent of the pomfrets caught weighed each 350 g and above, about 80 percent weighed in the range of 200 to 250 g each and the rest less than 200 g. The demand by the small traders for fresh fish in the nearby markets was far less compared to the aggregate supply. Hence bulk quantities of pomfrets were iced and sent to Madras, Trichy, Madurai, Coimbatore, Pollachi, Pudukottai, Karaikudi, Paramakudi and parts of Kerala. The Tamilnadu Fisheries Development Corporation (TNFDC) also came into the picture, procuring pomfrets from Rameswaram centre for sale at Madras. However, the number of commission agents and wholesale merchants involved in fish trade was comparatively less and the aggregate market demand was fully controlled by them, resulting in a lack of demand for pomfrets during the peak period. Thus the price declined from Rs 10/- per kg during first week of February to Rs 6/- per kg during the first half of March and Rs 4/- per kg during the latter half of March, when there were maximum catches. The fishermen

Table 2. *Average price per kg for different varieties of fish at the landing centre in Rameswaram and Mandapam (February-March 1982)*

Sl. No.	Name of fish/species	Average Price Rs/kg
1.	Pomfrets	6.00
2.	Rainbow sardine	1.00
3.	Catfish	1.50
4.	Rays	0.80
5.	*Thryssa* sp	0.75
6.	Silver bellies	0.60
7.	*Saurida* sp	1.25
8.	*Sardinella* spp	0.90
9.	*Upeneus* sp	1.75
10.	Sciaenids	1.50
11.	*Chirocentrus* sp	2.50
12.	*Scomberomorus* spp	7.00
13.	*Drepane punctata*	1.00
14.	*Lactarius lactarius*	3.00
15.	*Hilsa* sp	0.40
16.	*Trichiurus* sp	1.25
17.	Polynemus	1.25
18.	Cephalopods	4.00
19.	*Ilisha* sp	1.25
20.	*Cynoglossus* sp	2.00
21.	*Sillago* sp	1.25
22.	Misc.	1.00

could not even get enough ice to preserve the unsold pomfrets during the peak period. The average prices per kg received by the fishermen at the landing centre for different varieties of fish are given in Table 2. The lesser sardines, silverbellies and other clupeids were salted and sun dried to meet the demands of the lucrative interior markets in Kerala and Tamil Nadu.

Employment

The man power employed in pair trawling during the peak period of March 1982 was about 500 in Mandapam and Rameswaram region. Those engaged in pair trawling were previously doing the usual trawl fishing. The change in fishing pattern during this period was mainly due to comparatively lesser returns in trawl fishing and high profitability of pair trawling. About 200 persons got additional employment in the subsidiary activities such as handling, transportation, drying and curing during the peak period.

Operational cost and returns

The number of persons engaged in fishing with the high opening bottom trawl nets ranged from 10 to 12 per unit. The payment of wages for the fishermen were in two ways, one is fixed wages given to the crew irrespective of the catch, and the other the sharing system wherein 35 to 40 per cent of the net income is divided among them in addition to the daily allowance of Rs 5/- to Rs 15/- per head. Detailed information regarding the operational costs such as diesel and lubricating oil expenditure, wages to the crew members and shore costs were collected. The average operational expenditure per trip of pair trawlers, following the fixed wage system is given in table 3 and it works out to about Rs 1,200/- excluding the interest for capital investment, depreciation, insurance and repairing and maintenance charges.

Based on the average species-wise catch per trip (Table 1) and the price per kg at the landing centre (Table 2) the gross income has been computed to Rs 2,800/- per trip. However, during the first week of April all the pair trawlers shifted again to trawl fishing as the catch rate of pomfrets declined and as the prawn fishery became more profitable.

Remarks

The introduction of mechanised fishing in the east coast over the past twenty years has brought out changes not only in the pattern of fishing but also in the industry as well in many areas. Palk Bay is one such zone, which has been changing in recent years as far as the pattern of fishing is concerned. This area is well known for its rich traditional fisheries like lesser sardines, silver bellies, seer fish, perches and squids among others. In recent years commercial scale trawling operations in this area by mechanised boats have established an important prawn fishing industry in and around Rameswaram Island. The present fishing effort by pair trawling, a new venture for the fishermen of this area, is yet another diversification in fishing. This would definitely indicate future possibilities of large scale seasonal fishery for pomfrets from these waters. The trend of these operations and the landings in the coming years will be watched with special interest.

In this context it may be mentioned that pomfrets constitute only 3% of the total marine fishing landings in India (*Mar. Fish. Infor. Serv. T & E Ser.* No. 32, 1981). In the east coast, Tamil Nadu ranks only third

Table 3. *Average operational expenditure per trip of pair trawlers*

	Item	Qty or Nos.	Rate (Rs)	Amount (Rs)
1.	Diesel	250 litres	3.18	795
2.	Lubricating oil	3 litres	14.00	42
3.	*Crew members*			
	a. Drivers	2 Nos.	35.00	70
	b. Asst. Drivers	2 "	30.00	60
	c. Luskers	8 "	20.00	160
4.	*Shore cost*			
	Assistants	4 "	15.00	60
5.	Misc.	-	-	15
	Total	-	-	1,202

in importance for pomfret landings. A fishery comprising of *Pampus argenteus*, *Parastromateus niger* and *Pampus chinensis* has been known from the strip of Coromandel coast stretching north of Vedaranyam up to Arcatthurai by the traditional gear. In Rameswaram Island and in the vicinity sporadic catches have been reported in the past from gill nets and bottom set nets. Trawl fishing in recent years are also known to bring in stray catches of pomfrets. Therefore such huge landings of pomfret as observed during February to April by pair trawling conducted off Rameswaram, Pamban and Mandapam are quite a significant feature and this is the first time that such heavy landings have been reported here. It would seem that this valuable resource was not being exploited all these years because of lack of a suitable fishing gear to capture the shoals which might have been migrating to this area seasonally. It remains to be seen whether in the coming years pair trawling operations during the particular period would bring in pomfrets in such large quantities as to make it an additional regular seasonal fishery.

At a future time if such seasonal fishery of quality table fishes is established, measures should be taken to ensure reasonable prices for the fishermen. It is suggested that the Tamil Nadu Fisheries Development Corporation should either take necessary steps to procure the entire quantity of quality fishes at times of unusual catch abundance or some other measure has to be evolved so that the middlemen would not exploit the fishermen.

The objective behind the introduction of two-boat trawling is to maximise catch. The high percentage occurrence of the lesser sardines in the catch is yet another pointer to the usefulness of the gear in exploiting different resources, especially in view of the fact that the popular shore-seine fishing which used to be one of the main tackles for landing them, has virtually disappeared following the intensification of mechanised fishing. With the intensive operation of the gear in coming years it is likely that more of these resources might be exploited, when proper utilisation of the same may also have to be considered.

SCIENTIFIC BASIS FOR THE MANAGEMENT OF PENAEID SHRIMP FISHERY*

Introduction

A global review of the penaeid shrimp fisheries of the world would show that some of the largest fisheries for shrimp is in the waters off Indonesia, Thailand, India and in the Gulf of Mexico. In fact in the past few years India has reached the top rank in world shrimp production of over 7,00,000 tonnes, of course partly contributed by non-penaeid shrimps also. In most of the areas of large shrimp fisheries the fishery consists of a combination of multispecies. This fact in addition to the unique life history and the resultant population characteristics renders the shrimp fishery management somewhat different in concept than the management of other fisheries. Apart from this the aportioning of the fishing effort between the artisanal or small scale fisheries and the mechanised, industrial fisheries always comes into conflict, creating further problems in proper management. The substantial quantities of small fish or trash fish coming in as by-catch in the trawl fisheries, discarded or utilised to a certain extent also causes concern.

Realising these global problems associated with shrimp fishery management, a Workshop on the Scientific Basis for the Management of Penaeid Shrimp was held at Key West, Florida, USA from 18 to 24 November 1981, sponsored by US Department of Commerce, National Marine Fisheries Service (NMFS), Gulf States Marine Fisheries Commission, Mississippi and Food and Agriculture Organisation of the United Nations (FAO). Dr. John A. Gulland, Chief, Marine Resources Service, Fishery Resources and Environment Division, FAO and Dr. Brian J. Rothschild, Professor, University of Maryland, Center for Environmental and Estuarine studies, Solomons, Maryland were the Co-convenors of the Workshop, which was attended by 45 participants from 15 countries. The author takes this opportunity to thank the authorities concerned for making it possible for him to participate in the Workshop and present the views

*Prepared by M. J. George.

concerning the shrimp fisheries of India, representing the country.

The discussions were based on a set of 35 papers, most of them reviewing the current situation in the major shrimp fishing countries, highlighting the problems and a few others examining particular situations. The deliberations considered the shrimp fishery and the identification of problems associated with management under various heads such as the biology of the shrimp and rate measurements, the data base, methods of analysis, multi-species problems, environmental aspects, management and future work. A brief review of the discussions on these topics and the recommendations for future work is attempted here.

The problems

Initial review of the shrimp fisheries of the different countries revealed that most shrimp fisheries throughout the world face similar problems. The stocks are fully exploited, with little opportunity of increasing total catches. At the same time fishing effort continues to increase, giving rise to serious economic or social problems, although the stocks themselves may be in no danger of overexploitation. Often due to lack of delineation of the ultimate management objective the scientists in many countries were not well prepared to provide the managers with the advice they require in proper management of shrimp fisheries. So the problems faced by the scientists in advising the managers to tackle their problems were discussed. Failure to identify the potential for changes in effective fishing effort and failure to identify economic signals are two important problems apart from problems in relations between stock and recruitment. The following scientific problems were also identified:—

1) The variations in stocks may mask trends, which would require observations made over extended periods.
2) Nursery areas are often separate from areas of adult stocks and may be specially vulnerable to environmental and human influences.
3) Age cannot be determined directly and therefore, techniques based on age of shrimp must be used cautiously.
4) The presence of distinct fisheries on different sizes of shrimp using various gears causes a number of scientific problems, particularly in calculating fishing effort, apart from the major problem for the fishery manager in terms of conflicts between the different sectors.
5) Most fisheries being based on multispecies exploited by multigears, techniques need to be developed for estimating population dynamics parameters and management in such setting.
6) Most of the models employed require the entry into the fishery to be sharp which is not the case in most shrimp fisheries, where the size of recruits varies considerably.
7) Some of the shrimp stocks exist in one or more coastal states or shared by neighbouring countries, involving concerted international cooperation for effective management.

These were discussed in the following sections and in the final section proposals were made for dealing with the problems.

The biology of shrimp and rate measurements

Growth, mortality, migration and stock identification and other biological topics were considered. Discussions concerning growth centred on evaluating the potential importance of variability in growth. While the method for extracting growth curves from length-frequency data presented by Daniel Pauly was found to be quite useful, the lack of knowledge of possible density-dependent growth was pointed out.

In the discussion on natural mortality the poor precision and accuracy among existing estimates was stressed. Published estimates being highly variable and showing outrageously high values, careful re-examination of techniques within the existing frame works of analysis should be considered. In migration and stock identification the necessity for recognition of the importance of stocks and migrations across international boundaries was mentioned.

The data base

Catch statistics: Total catch statistics are readily available for most of the shrimp fisheries, but there were cases where portions of the catches were not recorded at all, eg., from sport, subsistence, artisanal or brackish water fisheries. As complete catch data are very essential for many of the analytical approaches, omissions of potentially large components of the total catch could lead to biased pictures of the condition of stocks. Quantitative estimates of discards, both fishes as well as small shrimps are also important in this connection.

Effort data: It was noted that standardization of fishing effort is not often attempted. Several gears other than otter trawls being used in many fisheries, the total fishing effort for shrimp would need to take into account all the gears in operation. For many applications, apart from consideration of fishing power, effort standardization would require a measure of catchability variations brought about by various factors such as physical aspects of gear performance, reaction of shrimp to gear, the large scale distribution of stock density and fishing effort etc. Decisions are required about the types of effort data and auxiliary information to be collected.

Methods of analysis

Production models: The production models require comparatively lesser data and are, therefore, widely used. The short life of shrimp meant that annual pairs of observation of catch and fishing effort are likely to match the equilibrium condition. One serious limitation in using production models is that of determining a suitable measure of effort.

These models usually showed a curved left-hand limb, sometimes a suggestion of a maximum, but very seldom a declining right-hand limb, for which various reasons were suggested. Yield-per-recruit analyses suggest a flat-topped curve so that if recruitment is not affected, a flat-topped curve of total yield may be more representative of reality than a parabola. Alternatively, declining total catches, and therefore even faster declines in catch per unit effort could cause the expansion of effort to stop for economic reasons before a declining right hand limb can be observed.

Age-or length-structured models: This type of models, based more or less directly on the yield-per-recruit calculations are essentially to study the effects of changes in the pattern of distribution of fishing mortality with age. Inevitably there were problems in estimation of certain parameters like natural mortality. One of the advantages of a length-structured analysis was that the critical parameter was usually M/K rather than M and it was suggested that M/K might be fairly constant within a species group.

Stochastic models: Stochastic modelling would be useful in understanding the relationship of parent stock size and environmental variation in establishing recruitment strength. Shrimp recruitment shows considerable variations from year to year which are not connected with any obvious changes in adult stock. The actual recruitment in any one particular year is determined very largely by environmental conditions in that year. So, the existence of environmental effects may bias the estimates of the stock-recruitment relation. If there are cases of low stock causing low recruitment, and fishing on these stocks is maintained at a high level, the risk of "recruitment overfishing" is very real. Thus the stock and recruitment relationship is quite important and stochastic models aim at working out equilibrium positions under a given stock-recruitment relation for various levels of fishing effort.

Multispecies problems

Two types of interactions have been considered. First is the problem of the incidental catch (by-catch) which is largely discarded (discards). The major part of the fish by-catch in several countries is discarded. The by-catch has three components, namely, (1) marketable fish, (2) juveniles of marketable species and (3) species for which no markets have been developed. The manager has 3 options regarding the by-catch, status quo, reduce the by-catch or increase utilisation of by-catch. Discussions centred around the ecological interactions between shrimp and the by-catch components. There is strong evidence that no reduction in shrimp production would occur if discards were removed from the system and utilised rather than deposited back into the system as dead animal biomass. The possibility of predation of shrimp by demersal fish affecting the shrimp biomass and the shrimp yield cannot be discounted. Further field, laboratory and analytical work needs to be oriented towards answering this question.

The second problem is caused by dependence of a fishery on several shrimp stocks, which may or may not be separated in space. There are two situations in this multispecies fisheries. In the first, the fishery depends on more than one stock occurring in different times because of behavioural differences. In the second case, a fishery may be dependent on two or more stocks harvested in the same operation. It is this case which gives fishery managers cause for concern. It is difficult to measure effective effort in order to make reliable stock assessments when fisheries are harvesting two or more species in the same place at the same time and this is one of the difficult problems facing the researcher in countries where such fishery exists.

Environmental aspects

Shrimps are very sensitive to the environment in which they live at all stages of their lives and this affects the operation of the fishery in many ways. Therefore, several aspects of the interaction between shrimp and the environment are important in the shrimp fisheries. In the discussions it was made clear that the important aspects to study are those which either lead to limit unfavourable changes (relations between destruction of nursery habitat and production) or at least predict them. The problem of the action of rainfall and river outflow on recruitment has also been discussed bringing out relationship between nursery favourable areas and production. The conservation of the static habitat and necessity to strengthen measures aimed at reducing undue larval mortality by littoral management was stressed.

Concerning the correlation approach, the main difficulties lie in three different fields: 1) the use of the appropriate index for resuming a biological phenomenon (spawning, migration, recruitment, abundance), 2) the need to detect and avoid spurious correlations between phenomena varying with the same frequency and 3) the need to interpret the short term changes (noise) which in many cases may be more important than the long term condition (signal) itself. The problem of occurrence of natural or non-natural variations in production have to be understood in order to distinguish between error and real phenomena that have to be taken into consideration for management. A distinction between periodic and aperiodic changes is important because the former refers to naturally reversible phenomena while the latter most often refer to unreversible ones, leading to completely different problems and solutions in terms of management.

In the matter of predictive models it was felt that it was necessary that the important changes be detected and predicted in order to look for appropriate measures of alternation of the effects. In general these models usually fail to predict when they are confronted with the test of time and they are only able to make useful predictions at the extremes of the range of possible environmental values. It was pointed out that priority should be given to the development of "understanding model" before the mathematical ones are developed.

Management

Fisheries management in a broad sense may be defined as the manipulation of factors to achieve a goal from a stock of fish. More specifically this goal may be quantifiable in terms of societal benefits in the form of food production, value, employment or some combination thereof while maintaining the stock at some high level of sustainable production. The objective is usually to achieve an optimum balance between inputs and various outputs. As the fishery is developed and societal needs and values change, the management goals will change. The goals and values to be obtained from the fishery are determined by the society and it is the responsibility of a decision maker or fishery manager at some level to decide how to obtain these benefits from the fishery. If there is to be a scientific basis for the management programme the manager needs biological, economic and sociological information to assist him in the decision making process. The scientist should take care that he does not second guess what he believes to be the desires of the manager, but provides him a range of options. Simple bioeconomic models to predict the outcome of fishery management actions are needed to aid the fishery manager in the decision process.

The shrimp fisheries throughout the world are generally fully exploited and there is concern in many areas over the impact of the high level of exploitation of the stocks. The fisheries in some countries face economic problems resulting from the high fuel costs in shrimp production. Allocation among user groups, offshore, inshore, and artisanal fishermen is another problem. It was the consensus of the work group that because of the highly developed nature of the world's shrimp fisheries some form of management resulting in regulation is in order for all stocks. Stock maintenance is of increasing concern and the precarious position of some stocks may be masked by high economic yield. Various objectives such as adjustment of fishing mortality, fishing capacity, size at first harvest and allocation among user groups have been sought through a variety of management measures.

Discussions followed on the various management measures applicable, which could be broadly grouped under three categories. The first category aims at increasing the size at first harvest with due consideration given to natural mortality and other factors. The management measures coming under this include mesh size regulation, seasonal closures, area closures and minimum size limits. The second category would control the catch or reduce fishing mortality. Gear restrictions—type, size and number—effort manipulation, short fishing seasons, catch quotas, limited entry and limitation of capital are some of the methods considered under this category. The broad measures which may affect capacity of fishing, such as import duties and quotas which increase markets for domestically produced shrimp in an importing country and government subsidy for vessel construction, loan guarantees or fuel costs may also be included. The third method is habitat modification involving habitat enhancement, water management and pollution control.

To be effective a management measure must be enforceable as well as acceptable to most of the fishermen who are regulated. The cost and level of enforcement necessary to implement regulations should be considered at the onset. The fishery managers and scientists should monitor the condition of the fishery and be prepared to take prompt action to revise the management objectives and techniques if the need arises.

Future work

In general the concerns being expressed on the various shrimp fisheries of the world are:

a) Most shrimp stocks are now being heavily fished;
b) Some shrimp stocks appear to have declined and the reasons for their decline are unclear;
c) The heavy fishing pressure in some fisheries may have resulted in a decrease in the abundance of spawning stocks to a level which is resulting in reduced recruitment;
d) In some areas there is a decline in the quality of the juvenile habitat;
e) The cost of operation of some segments of shrimp fisheries is increasing at a rate faster than the income generated;
f) There is conflict among user groups as to area and size at which shrimps are to be harvested. This can be at both the national and international level.

Within this frame work of concern, the workshop discussed future research needs and proposed that special attention be given to the following areas of research:

1. Stock and recruitment relationship:
   a) Definition of index of breeding stock abundance;
   b) Fecundity, with a view to estimating an index of age production;
   c) Definition of index of recruitment;
   d) Recruitment variability due to environmental factors.

2. Natural mortality:
   a) Comparative studies using data already available to obtain a greater understanding of the natural mortality of the different prawn types.
   b) Studies of the underlying causes of mortality—predation, physiological death, diseases.
   c) Further tagging studies with particular attention being given to the degree of tagging mortality.
   d) Life table studies and DeLury techniques.

3. Identification and standardization of effective fishing effort:
   a) Independent estimates of the stock, e.g. by fish locating techniques.
   b) Catchability studies—behaviour of the animals and fishing pattern of the fleet.
   c) Gear research—to estimate amount of fishing mortality generated by a particular gear type.
   d) Cohort analysis/Length composition analysis.

4. The habitat:

In summary, research should be undertaken on the life history of shrimp species in relation to the critical environmental influences. Also, a valuable contribution to the development of future research programs would be a global view of types and areas of inshore habitat in relation to shrimp abundance, and including information on habitat changes which have occurred.

5. Data base:
   a) Catch, catch composition and effort data (including by-catch species, discards and estimates of unreported catch);
   b) Number and type of fishing units;
   c) Number and type of personnel operating the units;
   d) Description of the fishing grounds, e.g. artisanal and industrial;
   e) Method of handling the production on the fishing units and in the factories;
   f) The market system;
   g) The value of the product at specified points of sale, and easily obtainable allied economic data;
   h) Significant changes which have taken place in the fishing units; personnel, grounds, marketing.
   i) Simple description of the environment, quantified where possible.

6. Data integration:

Greater attention for proper understanding of the method of collection and accuracy of the original data set. The data set will increase in complexity and value as research workers from the various disciplines start to work the data and make more specific their requirements for data collection. An appropriate technique of management information system should be adopted to assist in the integration of the data set, and this integration should include financial implications.

7. Use of models:

Concern was expressed that too much reliance should not be placed on the use of production models in terms of achieving optimum yield on a long term basis. Because of large variations in estimates of some of the parameters of shrimp stocks the applicability of the yield per recruit model is reduced. On the development of new models, adequate models were not available for a number of outstanding problems, like bio-economics, recruitment, decision making and allocation models. There is also a requirement for future work to include a model in conceptual form describing how the fishing fleet might respond to management options being considered.

8. Analysis of the system:

The workshop drew attention to the importance of scientific advice being presented in a manner which integrates the array of data available on the stock, the fishing units and the environment.

9. Ecological interactions:

Research is required on the ecological interactions of the fauna on the shrimp grounds to provide information on the likely consequences in terms of total yield of introducing gear changes such as shrimp separator trawl.

10. Socio economics:

a) Clarify management objectives for any particular fishery taking into account the existence of an inshore and an offshore fishery. In considering this subject consideration will need to be given to such matters as quantifying trade offs between net revenue, employment and individual income.

b) Determine costs and how these might be lowered by variations in the balance of elements of capital, manpower, energy, in the cost structure.

c) Determine the multiplier effect under various management options. For example, it is important to determine whether F for maximum employment is far to the right of F for maximum net revenue or F for optimum individual income. Such a study would assist in the resolution of conflicts between management objectives.

d) Provide information on the mobility in and out of the fishery of labour (especially in rural areas where there are cultural barriers), and of capital (access to loans, indebtedness and so on).

e) Provide information on fishermen's earnings.

f) Add to an understanding of the benefits of management options, such as the concept of property rights.

11. Priority and balance of research programmes

Methodology should be developed for determining criteria for the allocation of finance for research. While the management objectives will differ from one fishery to the other and from country to country, thus affecting the research priorities, the methodology will have general application.

BLACK KINGFISHES*

Rachycentron canadus (Linnaeus) (=*Elecate nigra*) popularly called black kingfish is the only representative of the family, Rachycentridae. It is also known as cobia, surgeon fish and lemonfish. It is reported to occur in all the warm seas except along the coasts off southern Australia in the Indo-Pacific area and the Pacific coast of North America and is rarely reported along the Japanese coast. These fishes are pelagic in nature and prefer largely the open seas, but are also recorded in shallow coral reefs and rocky shores. Occasionally they are reported to lurk near pilings, wrecks, buoys or other objects, stationary or floating.

These fishes possess an elongate sub-cylindrical body with a broad and depressed head (Fig. 1). The first dorsal fin is represented by 7–9 short strong isolated spines without any connecting membrane and are depressible into a groove. Caudal fin is rounded in juveniles whereas it changes to lunate form with a prolonged upper lobe in adults. The basic colour is dark brown and sometimes dark green along back, with two narrow black bands along the sides. Young specimens will have one or two sharply defined narrow silvery bands along the sides. These fishes were formerly grouped with remoras or sucker-fishes due to their external resemblances, but the osteological studies by Gill and Tate Regan established its close relation with Carangidae (Weber and de Beaufort 1931, *Fishes of the Indo-Australian Archipelago. VI Leiden*).

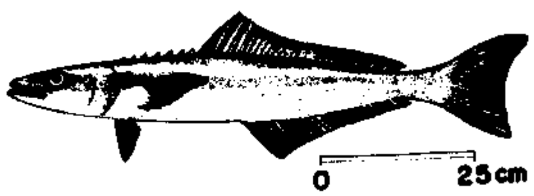


Fig. 1. The Black kingfish, *Rachycentron canadus* (Linnaeus)

The black kingfishes attain over 1.5 m in length with an average of 80–100 cm. Sometimes they travel in small shoals, but generally they appear solitarily. This slender and streamlined species with their fast swimming power are fine sporting fishes. Detailed studies on the biology of kingfishes are lacking. They mainly feed on crabs, squids and fishes.

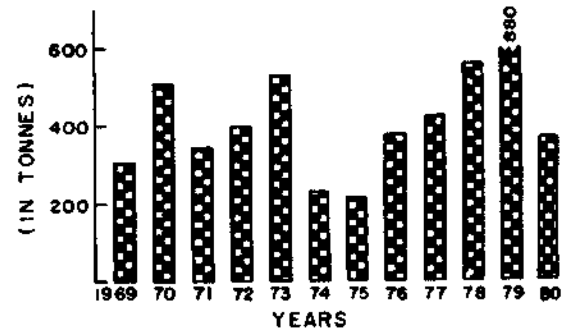
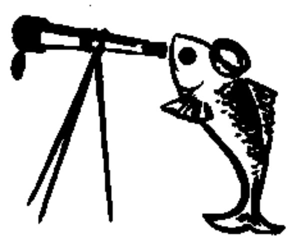


Fig. 2. Annual landings of black kingfishes in India from 1969 to 1980.

The landings of *R. canadus* along the Indian coast during the period, 1969–'80 show wide fluctuations. A steady increase in the catches were noted from 1975 onwards, the maximum landings being 880 tonnes recorded in 1979 (Fig. 2). With an estimated average catch of 438 tonnes per year Tamilnadu accounted for the maximum followed by Kerala. Being an excellent table fish they are in high demand and are marketed in fresh condition.

They are landed predominantly by drift gill nets, hand lines and troll lines mainly from the inshore waters along the Indian coast. In some countries they are also caught by artificial baits but generally taken on hooks with crabs or fishes as baits.

*Prepared by P. K. Mahadevan Pillai.



NEWS - INDIA AND OVERSEAS

Largest mass of krill find

Scientists who took part in the First International Biomass Experiment (FIBEX) in the Antarctic have reported the discovery of above 10 million tonnes of krill. Altogether 25 scientists and technicians from 11 countries were engaged in the two phases of the probe in which an international fleet participated from January to March 1981. The second part of the programme (SIBEX) is scheduled for 1983-84.

The survey focused on the Atlantic sector of the Antarctic and measured probably the largest ever concentration of sea creatures. Hydroacoustic methods have been mainly used for detecting swarms of krill. The enormous swarm was measured by this system over a period of three days north of Elephant Island and about 500 miles south east of Cape Horn. According to Dr. Osmund Holm-Hansen leader of the team of American scientists, this single mass contained enough krill to provide about 50 kg for each of the 226 million people in the United States!

Food uses have, however, still to be found for krill on this scale. One concern over krill as a potential human food has been an observed high fluoride content. But recent studies have shown that this is only in the shell. If the shells are quickly removed in processing and the body juices centrifuged off, the low fluoride content in the meat would be harmless. One more immediate use for krill is as food for salmon in marine farm projects.

FNI 20(6): June 1981

Fish attracting devices

The National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce has recommended for funding a proposal to design, construct, deploy and monitor pelagic fish aggregating devices (FADs) in the southeast region. These devices will be placed in shallow, middle and deep waters in order to benefit both recreational and commercial fishermen and would include tyre reefs, islands of plastic canisters, mid water artificial reefs etc.

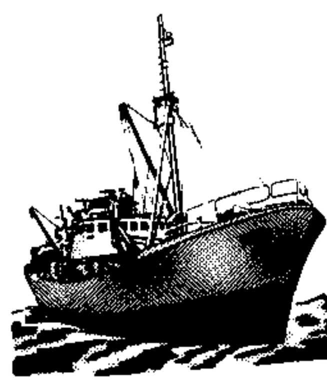
Fish aggregating devices have been successfully used in the Phillippines, Japan and Hawaii for the past several years to attract fish. Installations in the Pacific have proved quite beneficial to both commercial fishermen and recreational anglers. It is estimated that FADs in the State of Hawaii fishery is producing more than 500 tonnes of fish per year.

World Fishing 30(10): October 1981

Off-flavour in fish

Off-flavours, especially that of mud, have been reported in fish, both in cultured as well as wild fish. By taste and chemical analyses, geosmin has been identified as the primary compound responsible for this "muddy" or "musty" off-flavour. This is the predominant type of environment-related off-flavour in fish and has been found in cultured and wild fish all over the world. Recently other types of off-flavours like "metallic", "chemical", "grassy" etc have also been noticed in fish from intensively-fed ponds.

Aquaculture Magazine 7(6): Sept./Oct. 1981



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