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Part Three

FEBRUARY 1991



NATIONAL SYMPOSIUM ON RESEARCH AND DEVELOPMENT IN MARINE FISHERIES

MANDAPAM CAMP

16-18 September 1987

Papers Presented
Sessions V, VI & VII

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
P. B. No. 2704, E. R. G. Road, Cochin-682 031, India

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MANAGEMENT AND CONSERVATION OF MARINE FISHERIES RESOURCES

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ABSTRACT

The present understanding of the term fishery management includes, besides conservation (avoiding over-fishing), other aspects like avoiding under-fishing of stocks, meting out social equity and affording consumer protection. Mathematical models developed, based on experience in temperate waters, are of doubtful applicability in the tropical waters. Moreover, in a populous country like India, employment, economic and social aspects are the dominant considerations. In India, while fish production has increased, the unit production of both mechanised and nonmechanised sectors has dropped to about 40%, but the higher price of fish, both in the export and domestic market, is sustaining the fishing industry.

Management (legislative) responsibility in respect of fisheries in India is divided between State Governments and Central Government. In the absence of precise biological indicators management decisions are mostly based on economic considerations, administrative demands and political expediency. Management measures may include both conservation and promotion measures. Conservation measures include, closed season, ban on capture of berried females, closed waters, provision of fish passes, mesh regulations and legal size, levy of royalty/licence fee on a graduated scale, restriction on the number, manner and size of fishing units, banning of destructive and high efficiency gear, habitat preservation, removal of weed fishes, prescribing TAC for shared stocks, etc. Promotional measures include small boat mechanisation, introduction of deep sea fishing and provision of related infrastructural facilities. Some practical considerations are outlined in the paper.

RELEVANCE OF MANAGEMENT

The earlier belief, that seas are inexhaustible, is not only considered invalid, but proper management measures are deemed necessary to sustain the fishery at the optimum level. The present understanding of fishery management includes:

- (1) avoiding over-fishing and underfishing of stocks,
- (2) meting social equity, and
- (3) affording consumer protection.

Avoiding over-fishing

Kestaven (1962) indicated the sequential development of any fishery as:

- (1) nascent,
- (2) developing,
- (3) stabilising,
- (4) declining, and
- (5) extinguished

The primary object of fishery management is to develop and sustain the yield from fishery at the highest level. Several authors have attempted to give the 'Potential Yield' (PY) of the Indian Exclusive Economic Zone (EEZ), often based on an estimate of the standing stock of bio-mass, including standing stock of fish. However, since the

PY may not be sustained, we have the concept of 'Maximum Sustainable Yield' (MSY). Estimation of MSY takes into account various oceanographic and biological factors, and mathematical models have been drawn up for this purpose. However, these models have serious limitations even for the temperate water species, characterised by restricted spawning period, fishery supported by several year-classes and relatively less inter-specific competition. In our tropical waters with a multi-species regime and hence strong inter-specific competition, protracted breeding season and hence overlapping length-frequencies and fewer year-classes, it is doubtful whether these models could be applied in our situation. In fact most of our fishery is supported by 0-year class, which makes our fishery highly volatile. Many of our species are reported from a wide geographic area, and it is not clear whether they belong to the same race or breeding stock. Under such a situation economic considerations are likely to prevail over biometric calculations of MSY.

Meting out social equity.

Over years the emphasis on fisheries management in India has shifted from production to social considerations. It is quite evident that the rules framed by states under the Marine/Fishing

Regulation Act is borne out of social considerations, rather than any strong biological considerations.

Consumer protection.

Except for an attempt in price control in West Bengal, no consumer protection measures are taken in respect of fish in India. In fact, the consumer is almost taken for granted, except in the case of items intended for export.

Exploitation of under-exploited fishery resources

Mechanization of fishing craft, the most important development scheme in marine fisheries, has been introduced ostensible with the intension of exploiting the under-exploited stocks. Encouragement to deep sea fishing is also with this object in view.

ECONOMIC ASSESSMENT

In all economic activities, there are two cost components, viz. a fixed cost and a variable cost. At a certain level of production the total cost (of production) is equal to the earning, or the production is at the break-even point. Performance at below the break-even point is at a loss, while

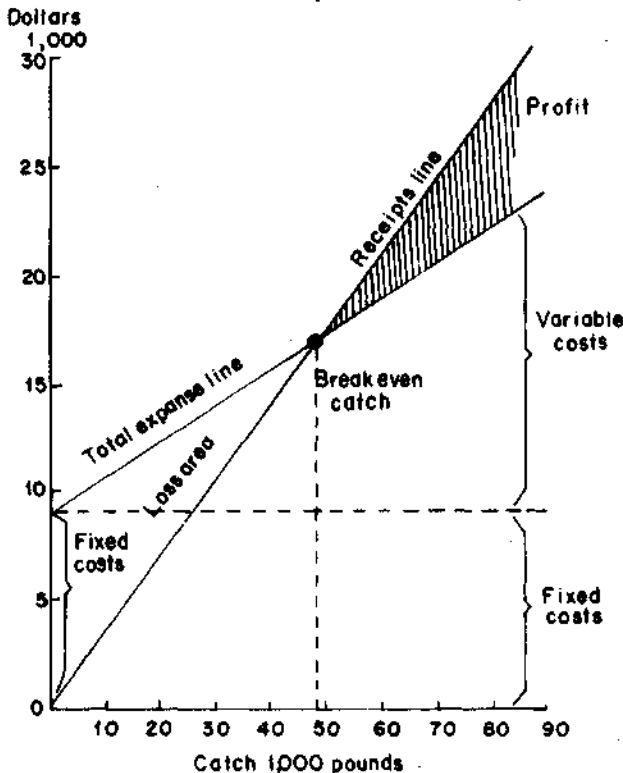


Fig 1. Break even concept

production above the break-even point is at a profit (Fig.1). But in actual practice, while there

is a close relationship between fishing effort and cost, the catch rate (relationship between effort and production) would decline, as the catch approaches the stabilization level. The level of Maximum Profit (MP) is before the commencement of the decline. If the fishing effort is continued far beyond MP, a level of No Profit (NP) is reached, beyond which the fishing is at a loss. This is well illustrated in Fig.2. However, this proposition is not quite applicable in the case of artisanal fisheries, where the main input is the labour and the labour is generally paid at a percentage of the gross earning. Very often fishing even at a loss is continued in the hope of striking a good fishing. Another insufficiently appreciated factor is the price which floats inversely as the production, i.e. when the overall supply is small, the price shoots up, while bumper catches are landed the price not only crashes, but there may be no takes.

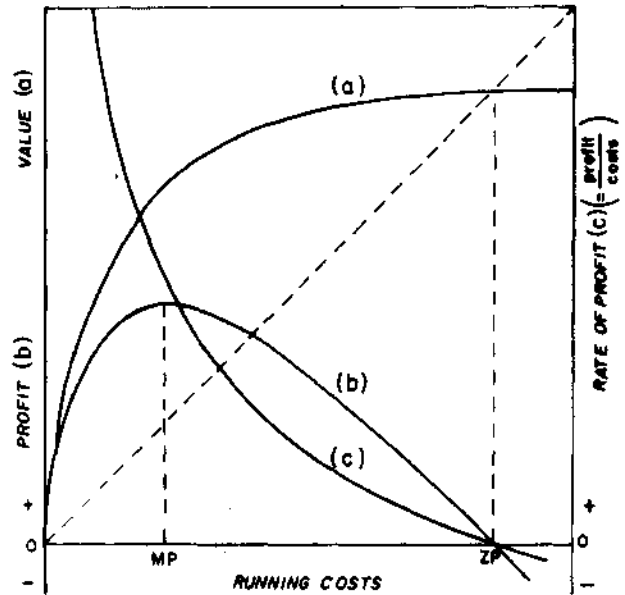


Fig 2. An exercise in bionomics: Curve (a) is a eumetric curve in which steady yield instead of being expressed in weight is now in money value, which is plotted against the economic equivalent of intensity fishing, namely, running costs. From those are derived (b) the annual profit and (c) the profit expressed as a rate on running costs, which in many situations bear a constant relation to capital outlay. MP-maximum profit point; ZP-zero profit point. (From Beverton and Holt, 1958, p. 417).

In such situation it is the Earning Per Unit Effort (EPUE) that determines the outlook on fisheries. In this context, as well as in the context of diverse catch co-efficients that go into the making of effort

statistics, the Catch Per Unit Effort (CPUE) has lost much of the original significance. However, CPUE is still being regarded as a reliable index for any specific boat-net combination.

MANAGEMENT CRITERIA

By and large marine fisheries management in India has been adopting the principle of 'common heritage' with 'open access' to any one wanting to take up fishing as his vocation. This approach has not changed, even though in many areas fishing is showing signs of having reached a stabilization level and further effort on these stocks might only lead to distribution of the same catch among more fishing units. Since the catch efficiency of different types of fishing effort is not the same, excessive effort can be particularly harmful to certain types of fishing, especially when high efficiency gear is deployed. This is probably what has happened in the Indian marine fishing scene. At the macro-level, it is seen that the contribution of the non-mechanised fishing sector has remained almost steady at around 5 lakh tonnes per annum over the past 35 years, while the number of non-mechanised craft has gone up by 2 1/2 times, indicating that the average catch of a non-mechanised boat has dropped to 40% over these years. There has also been similar reductions in the catch of mechanised boats also. Mammen (1987) has pointed out that while during the last 33 year period, i.e. between 1953 to 1985, the whole-sale price index of 'all commodities' has gone up by 7.6 times, 'food items' by 6.7 times and meat by 12.7 times, the fish price has gone up by 18 times. It is really this steep rise in fish price that has sustained the fishing, in spite of the fall in catch rates. While the consumer is the worst hit in this process, the plight of the fishermen is a stagnation in his real income (i.e. at constant price). It has given extra employment, but not beyond the rate at which the Indian population has been rising. The questions to be considered before imposing management restrictions are:

- (1) are the management proposals biologically desirable?
- (2) are they economically sound?
- (3) are they politically expedient?
- (4) do they satisfy the administrative demands for the purpose of 'appearing to do justice for all'?

These are difficult questions to answer. In many countries management measures then initiated were purposely harsh, or at least more severe than appeared to warrant. But the departmental attitude was that it would be more convenient administratively to relax than to tighten controls, should an alteration be needed in later years. In this context, India is in an unenviable position. With hardly any restrictions, except with a fair degree of consent, or in support of

the majority, which in other words is on considerations of political expediency. Moreover, it becomes difficult to establish beyond doubt whether a particular measure is biologically and economically desirable, especially since the artisanal fishermen would prefer to have some income, rather than remaining idle.

MANAGEMENT RESPONSIBILITY

The earliest fisheries legislation in India is the Indian Fisheries Act 1896, which by virtue of Article 372 of the Indian Constitution will continue to be in force until altered, repealed or amended by a competent legislature. This Act is obsolete as it concerns only with the operation of fixed engines, poisoning, dynamiting etc. However, many state governments have enacted state level fishery legislation under the enabling provision contained in the Indian Fisheries Act. Under the Indian Constitution, the legislative power in respect of 'fisheries' is with the state Government (vide item 21 of Part II of the 7th Schedule of the Constitution), while 'fishing and fisheries beyond the territorial waters' (vide item 57 of Part I of the 7th Schedule of the Constitution) is with the Union Government. Even though this would appear that the Union Government has legislative power only in respect of fishing and fisheries beyond the territorial waters (which is at present 12 nautical miles), the Union has control by virtue of proprietary rights in respect of 'things of value within the territorial zone (amended article No.297). Further Article 251 of the Constitution provides that in the case of inconsistency between laws made by the Parliament and the state legislatures, the laws made by the parliament shall prevail. The Marine Fishing Regulation Act, although drafted by the Central Government, was left to the states to legislate, as the main operational areas lay within the territorial waters, whereas the Maritime Zones Act was a piece of Central legislation. In keeping with the provisions of legislative authority, the Rules framed under the Kerala Marine Regulation Act has banned the operation of mid water trawl, pelagic trawl, ring seine and purse seine within the entire territorial waters of Kerala, the extent to which the State has legislative powers. When Gujarat Govt. wanted the chartered vessels to keep off beyond the 40 fathom line, they had to move the Central Government to issue orders under the Maritime Zones Act. Hence the constitutional provision is that legislation on management and conservation of marine fisheries within the territorial water is within the competence of the states, while the Central Government can legislate in the entire sea. The Coast Guard is generally responsible for the enforcement of the Maritime Zones Act, while fishing regulation within the territorial waters is generally the responsibility of the state, for the state, for which an effective organization is yet to be created.

MANAGEMENT MEASURES

As already mentioned management measures in marine fisheries include both conservation and promotion. The usual conservation measures are:

- (1) Closed season, ban on capture of berried females;
- (2) Closed waters (sanctuaries) and provision of fish passes;
- (3) mesh regulations, legal size etc.;
- (4) levy of royalty, licence fee etc. on a selective basis;
- (5) Restriction on the number, manner and size of fishing units;
- (6) Reduction in the number of fishing units, and 'buy back';
- (7) Prescribe Total Allowable Catch for shared stocks;
- (8) Banning of destructive/ high efficiency fishing methods;
- (9) Habitat preservation, pollution prevention etc.;
- (10) Removal of weed fishes.

In the inland fishery sector a closed season for fishing is observed in many inland states. In Madhya Pradesh, fishing, transportation, possession and marketing of fish from public waters is a punishable offence during the closed season. In Australia, where closed season is observed in respect of marine fisheries, it is necessary to declare the fished out stocks before the commencement of the closed season. Here rules prohibit capture of berried lobster etc. In Tamil Nadu pools below dams, rapids and water falls, where migrating breeders are known to assemble, are identified and declared as fish sanctuaries. In Punjab fish passes are provided for the migrating breeders to negotiate such barriers. In the Indian marine fisheries, no closed season as such is prescribed, but the monsoon certainly restricts the fishing effort during the monsoon season, which is generally believed to be the main breeding season. In many coastal states, local conventions ban the use of synthetic (silk) nets during monsoon. In Goa, the Government was keen that insurance cover was not extended to mechanised boats during monsoon, so that they do not go out for fishing during monsoon. In Kerala the stance of the traditional fishermen to ban the operation of mechanised boats during monsoon sparked off a major law and order problem. However the two committees appointed by the Government

of Kerala returned the verdict that 'Karikadi' fishery would be practically lost, if mechanised fishing during monsoon was banned. The results of exploratory survey in the Wadge Bank show that the fish catch rates are atleast double during the monsoon. In some states, mechanised boats are permitted to fish only during day time, for fear of damage to the gill nets operated by the traditional fishermen, even though results of research show that night fishing is more profitable.

Mesh regulations and imposition of 'legal size' are two important conservation measures. It is reported that mesh regulations were prescribed in England as early as the reign of king Edward III. In Australia, as many as 119 sea fish, 17 fresh water fish and 12 crustaceans have legal minima prescribed even in 1962. In many Indian inland states, minimum mesh sizes are prescribed for reservoir fishing to ensure that small major carps are not caught. In the trout fisheries of J & K, only licenced anglers are allowed to fish in trout waters and that too during day light and when escorted by a licenced 'fish shikari'. Many Indian marine states have started prescribing mesh regulations for marine fishing and fishing in back waters. In Kerala as per rules, the mesh should not be less 35 mm., but the fishermen are known to use extra thick twine in a bid to reduce the mesh opening.

Marine fishing is not a licenced industry in India, except for the chartered fishing vessels. However 'fixed engines' like stake nets, Chinese dip nets etc. and even prawn filtration are subject to annual licences. While various committees have recommended not to issue any more licences and to remove all unauthorised stake nets, their number is steadily on the increase. So also the restriction on the operation of stake nets etc. during incoming tide brightness of lights used for luring prawn etc. are observed more in their breach.

States like Gujarat, Rajasthan, UP., etc. levy royalty charge on inland fish caught from notified waters. The royalty amount may be as high as Rs.6/kg in respect of major carps, but may be nominal or free in the case of smaller fishes. Even then the minnow population is increasing. No such royalty system has been tried in marine fisheries, except in the case of chank fisheries.

It is well known that when the pressure of fishing increases, the catch per unit effort decreases. In many countries the public law often takes the side of the majority. Where the num-

ber of amateur (sports) fishermen exceeds that of professional fishermen and where the latter takes more fish, rules have been framed to restrict the number and size of nets used by the professional fishermen. In India and in almost all developing countries, the clash of interest is between the traditional fishermen, mostly operating non-mechanised boats, and the new comers into fishery mostly operating mechanised boats. In all these cases, laws are framed to protect the interests of the traditional non-mechanised sector.

In India, the fishing effort is steadily increasing and is heading towards a situation when fishing becomes unremunerative. In order to maintain the economic viability of fishing, it is necessary that the effort is regulated. In highly advanced countries, strong measures are taken to reduce the fishing effort. This includes besides 'limited entry' 'buy back' of licences already issued, states paying compensation to any who desire to retire from fishing and even scrapping /sinking of surplus fishing vessels.

All fishing methods are to some extent destructive, but some like anchor hooks in lobster fishing are definitely destructive. Similarly poisoning, dynamiting etc. are also destructive and are banned every where. There has always been a popular agitation against high efficiency gear like purse-seine, two boat trawl, and high opening bottom trawl etc. While the whole approach to development of fishing gear is to improve the catch efficiency, it is paradoxical that high efficiency should be the reason for banning them, albeit on the grounds of social equity.

Where stocks are shared, it is usual to prescribe catch limits to the participating nations/states, based on an estimate of Total Allowable Catch (TAC). In India, Kerala has already moved for constituting an InterStates Fisheries Commission, as they feel that all their restrictions on purse-seining is only benefitting the Karnataka Fishermen, and Karnataka has no such restrictions. Similarly Hilsa is a shared stock, but, no proposals have emerged on the man-

agement of Hilsa fisheries on a regional basis.

Traditional fishermen often complain that trawl nets that scrape bottom is destroying fish habitat, fish eggs and larvae. This, however, is not based on any valid observation. In some respects raking the bottom has a beneficial effect. More over most species have their eggs and larvae in the surface waters. The habit of prawn and fish larvae to seek shallower waters also goes counter to this presumption. However, two areas, where the habitat is badly affected are the back waters and edge of the sea. For instance the Vembanad Lake, which forms a major nursery for Kerala's prawn, is intensively fished with rows and rows of stake nets, and from thousands of places from where prawn filtration is being carried out. Various industries discharge their effluents into the river which would flow into the Vembanad lake. The practices of retting coconut husks is another man-made pollution. To make matters worse, the saline protection works affect the migration of both marine and fresh water prawn and lead to the concentration of acidity to lethal levels and infestation by various fish parasites. The dredging of Vembanad lake, in a bid to recover sub-fossil clam deposit is leading to burying the highly productive detritus cover of the lake bottom with dredged soil, which is poor in fertility. Extensive reclamation of the lake for agricultural purposes, shrimp farming, etc. have also reduced the area available as nursery for prawn and other species (Mammen, 1984).

Another area where habitat destruction takes place is the edge of the sea, which are rich in post-larvae of a variety of fish species immediately after the monsoon. In fact the 'nonnavu fishery' with shore seines is nothing but a fishery of post-larval stages of fishes.

The impact of weed fishes that compete for food and space with the desirable fishes in the reservoir fisheries is fairly well recognised. While maintenance of proper prey-predator ratio is often mentioned in management discussions, there are practical difficulties for such manipulation. However, it is very clear that a reduction

in the number of major predators like sharks, that take a heavy toll of many food fishes, is capable of practical application.

Besides the conservation measures so far discussed, there is a promotional aspect in management. Introduction of mechanised boats has been one of important measures taken, not only to increase access, but also to use more efficient gear with the aid of mechanical power. While the scheme has achieved this objective, it has also brought to light, some weakness, viewed in the context of social equity. Deep sea fishing is an extension of the principle of introducing small mechanised boats. Government has been assisting and encouraging deep sea fishing through measures like resource surveys, training of man power, creation of infrastructural facilities like fishing harbour, capital subsidy on indigenously constructed fishing vessels import of vessels, including second hand vessels, soft lending arrangements, chartering, joint ventures etc. However, these promotional measures were tempered with a host of restrictions on the area of operation, various rules and procedures etc., with the inevitable procedural delays.

PRACTICAL CONSIDERATIONS

Some practical considerations in the form of recommendations are given below to facilitate discussion.

General

1. It is time to consider formulating management measures in marine fisheries, as many of the exploited stocks are showing signs of stagnation in production. The problem of management would get further aggravated with the passage of time. Even otherwise also, it is not too early to consider such measures as marine fisheries research has been going on for the past 40 years by the various State Governments and by the CMFRI.

2. There should be a compulsory registration and licensing of fishing craft and gear. The

licence fee should be on the basis of a 'fair rent' and should work as a deterrent to the proliferation of fishing craft and gear. It is also necessary that registration marks are boldly exhibited for quick verification.

3. There should be an immediate freeze on the craft and gear to the number presently in use, pending a proper study of the economics of operation of various craft-gear combinations. If the study reveals that the number of craft-gear combinations is below sustainable levels, the level to which it could increase should be indicated by the study. If on the other hand, the maximum sustainable number of craft-gear combinations has already exceeded in certain areas, no more additions should be permitted and steps taken to reduce their number, by encouraging voluntary retirement on payment of compensation, 'buy back' arrangement, non replacement of craft and gear lost or otherwise become unusable, etc.

4. Data collection in the past had been largely on the basis of what was feasible, than dictated by the needs of management. It is necessary to identify the data requirements of effective management and develop a proper Management Information System (MIS).

5. As most exploited fisheries are on the basis of 0-year class, with the new born getting recruited into the fishery within 2 or 3 months, of breeding, a Fishery Information and Forecasting Service (FIFS) should be so developed as to make forecasts well in advance of the commencement of the fishing season.

6. To avoid undue restriction on fishing, critical period of their life history, spawning grounds, nursery grounds etc. should be identified and need based management measures should be drawn up, keeping an eye on the feasibility of management, economics of fishing as well as considerations of social equity.

7. There is hardly any enforcement machinery in the states for enforcement of management laws. States may therefore consider creation of a separate force like Fishery Guards,

on the lines of Forest Guards with adequate boats, training in management measures, use of fire arms etc.

Prawn fisheries

1. It is generally believed that prawn with its protracted breeding habit, may not be a suitable candidate for enforcement of any kind of fishing restriction on the breeding stock. Moreover, in the conventional prawn fishery, most of the prawn breeders move further away into the sea where there is less risk of breeding stock being fished out. Since the critical larval and juvenile life history of most of the commercially important species are in the brackish water areas, there is a strong case for enforcement of conservation measures as well as protection of brackish water environment.*

2. Measures like removal of unauthorised stake nets, operation of such nets only when the tide is receding, use of only the approved type of illumination, use of larger mesh size, or in short strict compliance with the already existing regulation should be insisted on.

3. While the smaller prawns dominate the catches of backwater, a varying quantity of juveniles of the larger prawns are also caught. As many of them are collected in a dead condition due to the pressure of the water current, it is suggested that a trough like extension should be attached to the tail end of stake net and prawn filtration nets like the 'gamcha' of the spawn collection nets used in rivers. The live

prawn juveniles caught could be segregated into desirable and undesirable species. If the percentage of desirable species is significant, it could be sold as stocking material to the shrimp farmers, who will be ready to pay a much higher price. Otherwise the catch may be disposed off in the usual way. Such a procedure serves the objective of allowing the fishermen to continue their fishing, but realise a better income on one hand and provide the necessary advanced fry for stocking brackish water farms, including paddy fields currently used for prawn filtration (Mammen, 1984).

4. The habitat degradation of brackishwater lakes and estuaries is more serious than what meets the eye. The more important suggestions are:

a) Effluent treatment of industries should be more stringent and if the effluents cannot be made absolutely harmless, Government should insist on discharge of such effluents further out into the sea where the currents are strong (Such a recommendation by the author has worked in the case of Zuary Agro-chemicals, Goa.)

b) The object of saline protection work could be achieved without deterrent to the environment if only the surplus water flowing out during monsoon is retained in reservoirs to be let out during the summer months to keep the saline wedge at the desired level.

c) Alternate methods to retting should be found out so that use of back waters for retting of coconut husks could be avoided.

*During 1978 MPEDA proposed to ban the export of shrimp of count more than 500, in a bid to discourage catching of very small shrimp from the backwaters. This move was opposed vigorously by fishermen and the exporters. According to them

1) there is no guarantee that prawn spared from fishing in the backwater would be caught back as a bigger prawn. In all probability, what is spared from fishing mortality would die of natural mortality.

2) Granting that a portion of the juvenile prawn spread from fishing in the backwater would ultimately be caught as bigger prawn by a fishing trawler, why should brackishwater fishermen make this sacrifice for the trawler operator to prosper?

3) In Cochin back waters, the overwhelming majority of the prawns caught are the smaller species, some of which are already mature. Any undue restriction on fishing in the back water would mean that this resource would remain unfished only to meet with a natural mortality

4) Why should the fishermen alone be blamed, when others also damage the environment, eg. by saline protection works, discharging industrial effluents, domestic sewage, dredging of lake bottom, retting of coconut husks etc.

All these are valid pointers to the nature of conservation to be adopted.

d) The practice of dredging the lake bottom for sub fossil clam deposits should stop, or alternately the dredged soil should be deposited between interlocking sheet piles to prevent dispersal.

Small pelagics

1. Small pelagics like oil sardine, mackerel, anchovies are some of the best studied fisheries in India. Although we have a wealth of information on these fishes, still we are lacking in certain vital information necessary for management. For instance, while these species reportedly have a wide geographic distribution, it is not clear whether we are not dealing with separate stocks. If they are not separate stocks, then the problem has wider ramifications and should be studied in that context. The information with regard to breeding areas, larval migration, natural mortality, etc. appear to be insufficient to suggest firm and appropriate management measures, that could be convincing. This doubt is accentuated by the disparity between the in-house forecasting by the CMFRI and the actual fishery and similar difference between the forecasting and reality in the case of Pelagic Fisheries Project.

2. A useful data thrown up by the CMFRI is the observation of large number of oozing oil sardine in purse-seine catches. It is possible that if fishing is suspended by these purse seiners on oil sardine for a while, it might result in large scale breeding, even though it is not clear whether this would have the expected impact on the ultimate fishery. It is therefore worth persuading the purse seine operators to cooperate by suspending fishing on the oozing fish and see whether there is the desired impact. If this works, more elaborate management measures on these lines could be thought of.

3. One of the recommendations of the erst-while Pelagic Fisheries Project was the extension of fishing to the off-shore regions, where shoals are available for a longer duration. This is precisely what is being done by the purse-seiners. They also catch larger sized fish. However, it is to be established whether fishing these larger

fish will have any adverse impact on the over all fish production.

4. We do not seem to have adequate information on fish eggs and larvae of the small pelagics, as commercial catches do not land them. Special survey on fish eggs and larvae is indicated to bridge the gaps in the MIS.

Cat fish fishery

The largeness of cat fish eggs and the largeness of the cat fish fry, when released from the buccal cavity of the incubating male are distinctive features of the cat fish. In the normal course, there should be better survival. However in certain areas, eg. Balasore coast, juvenile cat fishes are caught in enormous numbers. To what extent any imposition of restriction on the fishing of incubating males and the juvenile shoals will have their impact on the fishery should be watched and suitable management measures taken. Nevertheless-what appears more important is the extension of fishing effort on cat fish, as according to Joseph (1987) cat fish is among the lightly fished groups.

Shark fishing

Sharks being in the category of major predator, is not likely to have the effect of keeping down the weed fish population, but it is keeping down the population of many desirable food fishes. From the point of increasing shark catches, as well as to get the benefit of reducing predation on other esteemed food fishes, it is necessary that shark fishing is encouraged. According to Joseph (1987), sharks - both pelagic and demersal - are among the lightly exploited groups.

Other fishes

From the over all fish production point of view, fishes feeding on the lower trophic phase should support a good fishery, provided, fishing has the effect of thinning the stock on a fairly uniform rate. From this point of view, an increase on fishing on species like *Anchoviella* is indicated. It is a lightly fished resources also. Cephalopods, nemipterids, sciaenids, horse mackerel etc. are

other food fishes which are lightly fished. FSI has also found almost untouched resources of *Psenes*, *Priacanthus*, *Centrolophus* etc. which could be exploited, provide suitable value-added processing methods and suitable market strategy are developed.

REFERENCES

KESTAVEN, G.L. 1962. Analysis of the conditions of fishery. *Proc. Fishery Management*

Seminar, Canberra.

JOSEPH, K.M. 1987. Fish resources of the Indian EEZ. MS.

MAMMEN, T.A. 1984. Kerala fisheries - Backwater fisheries. *Fishing Chimes*, 4 (9), 1984.

MAMMEN, T.A. 1987. An analysis of production inputs and costs. *Paper presented at the National Seminar on 'Planning Export Strategy for Indian Marine Fisheries, Delhi, March, 1987.*