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MESH SELECTIVITY STUDIES FOR MANAGEMENT OF MARINE FISHERY RESOURCES IN INDIA

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Abstract

Mesh selectivity studies on commercially important species are essential to identify the fishable segment of the stock. This is required for assessing the effect of fishing effort on the exploited stocks and suggesting effective management measures for maximum sustainable yield.

The present paper attempts to give a general review of the work done in this sphere. At centres like Kakinada (Andhra Pradesh) change in the cod - end mesh size in trawls over the years has resulted in considerable variations in production, catch composition and size distribution of commercially important species of shrimps. Instances of heavy landings of undersized prawns (penaeids less than 65 mm TL) have been noticed during the peak landing period along the coast of Kerala particularly at Sakthikulangara and it is partly attributed to the smaller mesh size of the trawls operated there. Considerable quantities of juvenile prawns of the marine species are caught from the estuaries and backwaters using stake nets having cod - end mesh sizes as low as 5 mm which in turn will adversely affect the recruitment of the species in the marine sector.

Experimental studies on mesh selectivity of gill nets for oil sardine, and of trawls for shrimps in Kerala and of dol nets for Bombayduck in Maharashtra and Gujarat clearly indicate the necessity of mesh regulation for the judicious exploitation of these resources. Stock assessment studies carried out on shrimps along the southwest coast of India also emphasise the urgent need for an upward revision of the existing cod - end mesh size of 20 - 25 mm to atleast 30 mm in order to save the fishery from the danger of depletion.

Introduction

Exploited fishery resources require the utmost care so that their exploitation does not lead to depletion. Proper management measures applied in the capture fisheries by utilising the renewable characteristics of the resources will certainly result in maximum sustainable yields. Marine fishery resources, once supposed to be inexhaustible, have been affected by over exploitation in different parts of the world. The fishery of Antarctic whales is an example. However, fishery independent factors also play their role in affecting the exploited stocks. Peruvian anchovies, which once dominated the marine fish catches of the world, have almost disappeared. The reasons for this depletion are assigned to both fishery independent and fishery dependent factors. So also the North Sea herring and haddock fisheries. Though fishery independent factors are beyond human control, fishery dependent factors are not so. Hence what one can do in the realm of exploited fisheries is to control the fishery dependent factors only. Among these factors, two of them, considered to be decisive in the management of exploited fishery resources, are the mesh size, in other words gear selectivity, and the fishing intensity. Catching fish after they reach a reasonable size and leaving enough of them so as to keep up the recruitment at a required level are the important aspects for judicious exploitation. Once these things are taken care of fishing intensity even at higher level than what is required for optimum exploitation may not affect the stock. For instance, when recruitment is constant, increase in the intensity of fishing does not affect the exploited stocks. Hence, gear selectivity is a very important factor in the management of exploited fishery resources. In this paper the influence of this factor on the fisheries is considered with particular reference to some of the major marine fishery resources of India.

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Gear Selectivity

All fish do not experience the same amount of fishing mortality. Fishing mortality depends on the characteristics of the gear employed and the size of fish encountered by the gear. Large sized hooks catch large fish. Gill nets of larger mesh are expected to catch larger fish. With smaller mesh size the catch of the gear would comprise smaller fish. In the case of bag nets, selectivity depends on the cod-end mesh size since fish escape is found to occur mostly through the cod-end. Much work has been done on the selectivity of bag nets and gill nets notably in the temperate waters.

Bag nets : Trawls, seines and stake nets belong to this group. As the size of fish increases the percentage of its retention also increases. All fish of size greater than the size of full retention are caught by the gear. As such the selectivity in this case is one sided and the gear is termed as non selective one. When the percentage retention against the size, for instance length, is plotted the resultant curve is called **Selection curve or selection ogive.** To determine the selectivity, the percentage retention is to be obtained. By covering the cod-end with smaller meshed bags or fishing with smaller meshed nets side by side, information on the number of fish entering the mouth and escaping from the cod-end can be obtained and this information is used to estimate the percentage retention at each length of fish. Fishing mortality is proportional to the percentage retention. Hence, full mortality is experienced by the fish having size equal or greater than the one at which the complete retention is expected. For all practical purposes, instead of taking different levels of mortality for different sizes below that of full retention, the mean size of capture or retention is considered as the size above which full mortality is assumed and below which no mortality is assumed. The selection is called **Knife-edge selection.**

To determine the mean selection length or mean size at first capture selection ogive is used. In Fig. 1, l_c is the mean selection length.

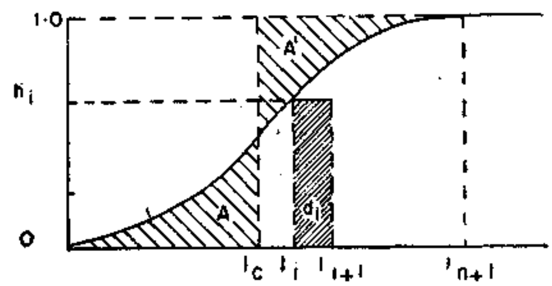

Fig. 1. Selection ogive.

This is the length at which 50% of fish of this length entering the net are retained and the other 50% escape. If the ogive is symmetrical l_c is the point at which the vertical passes through the mid point of the ogive. In general l_c can be determined such that the area left of the ogive upto the Y - axis and the area between the Y - axis and the vertical at l_c are equal. In other words, the shaded areas above and below the ogive in Fig. 1 are equal. When the ogive is not symmetrical this method helps one to find the l_c. The method of estimating l_c is as follows. Let the lengths be grouped in classes. Let the i^{th} class have interval d_i and ordinate h_i. The area under this rectangle is $d_i h_i$, where $i=0, 1, 2 \ldots\ldots n$. The total area under the ogive can be approximated to $\sum_{i=0}^{n} d_i\, h_i$ when d_i is sufficiently small for all i. When $d_i = 1$ for all i then the area under the ogive is $\sum_{L=0}^{n} h_i$ and the area between the lines Y-axis and $l_c = l_c$ *ie* l_c. 1. In other words,

$$l_c = l_{n+1} - \sum_{i=0}^{n} h_i \quad \text{.......................(1)}$$

There is another way of calculating l_c. Since the mean selection length is proportional to mesh size, *m* in trawls

$$l_c = b \cdot m \quad \text{...............................(2)}$$

where *b* is the selection factor. The selection factor can be estimated from the experiments conducted using trawls of different mesh sizes. Once the selection factor is known then, using the equation 2, l_c can be estimated for any mesh size in the given range.

The sharpness of the selection ogive depends on the spread of the curve. Wider the spread, lesser will be the sharpness. This is measured by the difference between the two lengths at 25 and 75% retentions. Using the terminology of normal distribution ogives can be broadly grouped under three categories as meso, platy and lepto-ogives. Let l_1. l_2 and l_3 be the lengths at 25, 75 and 100% retentions respectively.

Then

$$l_1 + l_3 - l_2 \lesseqgtr l_2 - l_1 \quad \text{..................(3)}$$

as the curve is platy, meso and lepto-ogive respectively.

Gill nets : The selectivity for gill nets differs from that of bag-type nets. In gill nets selectivity reaches maximum at a length and tapers off on both the sides for the lengths greater or lesser than this. When the selection is perfect the curve in this case is symmetric and bell shaped and hence a normal curve. The selection in this case is two sided as against one sided in the bag nets. Retention rate reaches from 0 to 1 and then recedes to zero. The entire curve can be considered as a combination of two ogives, one as the reflection of the other

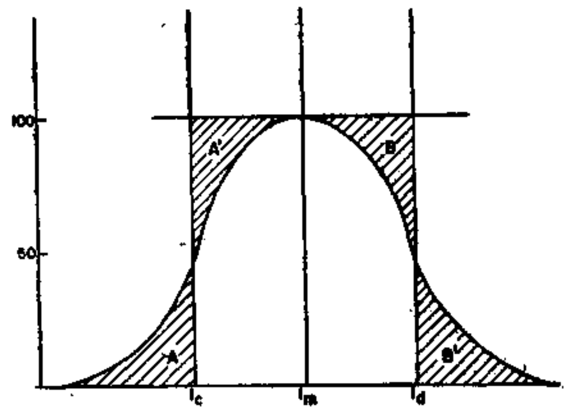

Fig. 2. Gill-net selection curve.

as shown in Fig. 2. Under this assumption it can be written (Holt, 1963).

$$C_l = N_l\, P_m \exp\left(-\frac{(l - l_m)^2}{2\sigma^2}\right) \quad \text{..........(4)}$$

where C_l and N_l are the numbers of fish of length l caught and liable to capture by the gear respectively; P_m is the fishing power of the net o fmesh size m; l_m is the length of fish at which the efficiency of the gear is maximum, and σ is the standard deviation of the selection curve. Equation 4 is two parametric, the parameters being lm and σ . To obtain the estimates for them the method used is as follows. Let two gears of mesh sizes m and M be used. Then, from equation 4 we have

$$\frac{C_{l_m}}{C_{l_M}} = \frac{N_l\, p_m \exp\left(-\frac{(l-l_m)^2}{2\sigma^2{}_m}\right)}{N_l\, p_M \exp\left(-\frac{(l-l_M)^2}{2\sigma^2{}_M}\right)} \quad \ldots\ldots\ldots(5)$$

Taking longarithems to base e

$$\log \frac{C_{l_m}}{C_{l_M}} = \log \frac{p_m}{p_M} - \frac{(l-l_m)^2}{2\sigma^2{}_m} + \frac{(l-l_M)^2}{2\sigma^2{}_M} \quad \ldots.(6)$$

To solve equation 6 which is linear in l we shall have three more assumptions. As in the

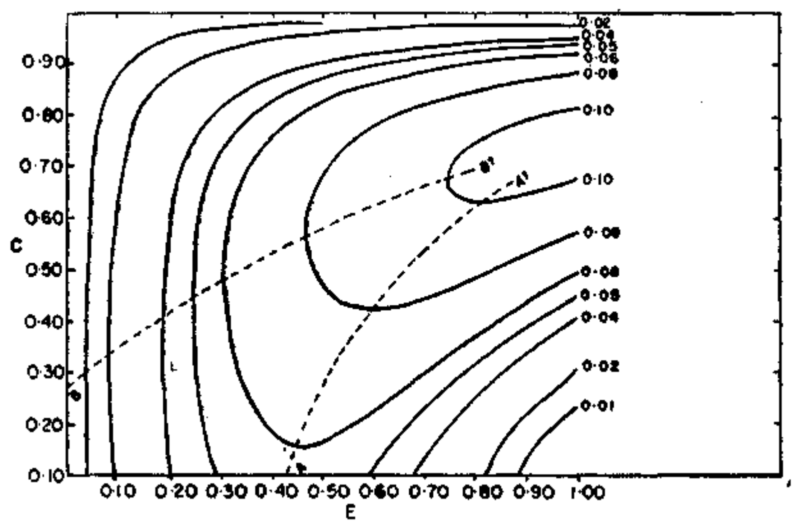

Fig. 3. Yield - isopleth.

equation 2 the first assumption is $l_m = b.m$ and $l_M = b.M$ and the second one is $P_m = P_M$ which would be true for the gears having mesh sizes within a small range. The last assumption is $\sigma_m = \sigma_M = \sigma$. Alagaraja (1977) modified the first assumption and gave the estimates comparing them with those obtained by others (Olsen, 1959).

Considering knife-edge selection, fishing mortality from l_c l_d in Fig. 2 may be taken as full for all the lengths in the interval between l_c and l_d. If C_{lg} and C_{lt} are the numbers of fish of length l caught by a gill net and a non-selective gear like trawl, then the fishing mortality due to gill net for fish of this length is proportional to C_{lg} / C_{lt}. Regier and Robson (1966) have dealt with the selectivity of gill nets in detail.

Uses of Mean Selection Length

Beverton - Holt yield model is of three dimensions with Y / R - yield - per - recruit, F - fishing mortality and t_c - the age at first capture as the three variables. Fig. 3 gives an example of yield - isopleth formed by these three variables. However, for a given value of F, the resultant curve is two dimentional and it is called yield - mesh curve where the age at first capture, that could be obtained from the mean selection length, is X - coordinate and Y / R is the Y - coordinate. Fig. 4 is an yield - mesh curve having a maximum indicating the mesh size required for obtaining maximum yield. In the same way, for different fishing pressures, *i. e.* at different levels of F, the required mesh sizes for obtaining MSY could be found out.

Two factors are to be considered for fixing suitable mesh size in order to maintain the fishery in a steady state. One is the size of fish at which maximum growth rate is registered. The other factor is the size at first maturity. If the mean selection length is just above these

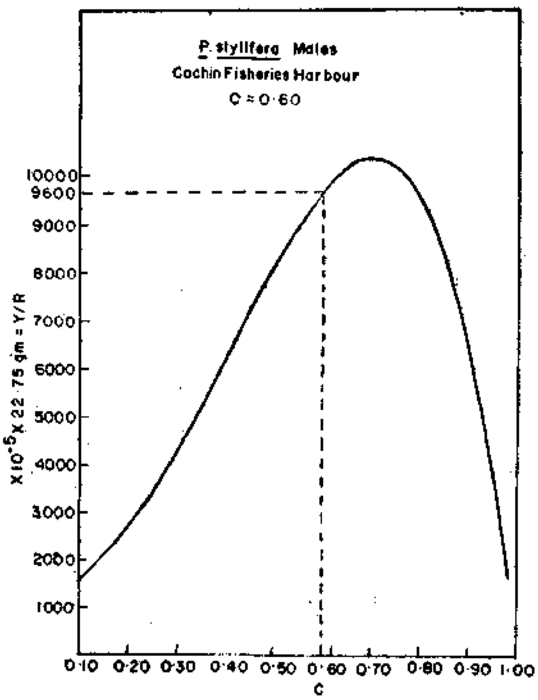

Fig. 4. Yield - mesh curve.

two lengths then both recruitment and maximum growth potential of fish are taken care of and fishing does not affect the stocks in any way. This would lead to fishery maintenance.

Impact of Mesh Size on the Exploited Resources

The impact of mesh sizes on the commercially exploited marine fishery resources of India has been examined by various authors. Some of the major observations in this regard are enumerated below.

Prawns : Among our marine fishery resources prawns occupy the top rank by virtue of their high export value. The insatiable demand for frozen shrimps in foreign markets results in tremendous increase in fishing input for raw materials with the result the shrimp landings were stepped up many fold during the past three decades. As is characteristic of exploited natural resource the constantly increasing fishing pressure over a number of years has led to the stagnation of shrimp production in many centres now (George *et al.,* 1980; Silas *et al.,* 1984; Alagaraja *et al.,* 1986). The fishery being essentially export oriented, the prime concern of the producers has been to catch more and more larger varieties of shrimps belonging to the penaeid group. While the non penaeid prawns, which attain only smaller sizes not attractive to the industry, are confined to the coastal areas supporting the indigenous fishery in certain regions, the penaeid prawns enjoy a wider distribution in the shelf waters and are fished extensively on both the coasts. The most common gear employed in the exploitation of penaeid prawns are shrimp trawls of various dimensions operated by mechanised vessels. These nets introduced in our waters about half - a - century ago on an experimental level are now the major source of penaeid prawn landings in the country. In the total prawn landings from the marine sector penaeid prawns constitute more than 60% of which about 2 / 3 is taken by the shrimp trawlers.

Though the introduction of shrimp trawlers in the commercial fishery has brought about phenomenal increase in the production of penaeid prawns in the country it has caused many changes as well in the pattern of exploitation of these resources in recent years particularly by the smaller vessels of the industrial sector. The changes were mainly manifested in the quantum of trawling effort expended on the shrimp stocks and the cod - end mesh size of the nets. Rapid increase in the number of shrimp trawlers in the fishing grounds has been a common feature at centres like Veraval, Bombay, Karwar, Mangalore, Cochin and Sakthikulangara on the west coast and Tuticorin, Mandapam, Madras, Kakinada, Waltair and Paradeep on the east coast. The Central Marine Fisheries Research Institute has been closely observing the increasing trend in trawler operations, mesh - size variations of the cod - end and other changes associated with fishing and their impact on the prawn resources at these centres in order to suggest proper management measures as and when required. The studies revealed a grave situation for the shrimp fisheries at Kakinada in Andhra Pradesh (Rao *et al.*, 1980) and Sakthikulangara in Kerala (George *et al.*, 1980, 1983), brought about by uncontrolled fishing by the commercial trawlers. Kakinada is one of the important prawn fishing centres of Andhra Pradesh. Commercial shrimp trawling at this centre was initiated in 1964 and since then there was a steady increase in the number of trawlers operating from there every year resulting in considerable expansion of the fishing industry. With the development of an export market for prawns from Kakinada by about 1970 the enthusiasm to harvest more and more prawns from this coast grew further and this eventually led to a gradual reduction of the mesh size of the cod - end of the shrimp trawls besides considerable increase in trawling effort as well as area of operation. Prior to this, the cod - end mesh size of the trawl net was 25 mm (Muthu *et al.*, 1975) and the prawn catch consisted mostly of bigger species of penaeid prawns (12%) like *Penaeus indicus* and *P. monodon* and medium sized ones (60%) such as *Metapenaeus affinis, M. monoceros, Parapenaeopsis stylifera* and *P. hardwickii.* The rest of the catch was contributed by smaller varieties such as *M. dobsoni, M. brevicornis*, the non - penaeids *Exhippolysmata ensirostris, Nematopalaemon tenuipes* and a number of other species in minor quantities. The reduction in cod - end mesh size of the trawl nets resorted to for enhancing the catch began during 1970-72 when the mesh size of most of the nets was reduced to 20 mm. The next step in mesh size reduction that occurred during 1977 - 79 period brought down the range of cod - end mesh size to 8 - 20 mm. By about the middle of 1978 more than 85% of the nets operating along the coast had meshes below 17 mm. Analysis of prawn catch in relation to the mesh sizes in operation showed that along with the reduction in cod - end mesh size considerable variations also occurred in the production, catch composition and size distribution of important species in the fishery. The reduction in cod-end mesh size coupled with enormous increase in the fishing effort resulted in substantial improvement in the total catch as well as cph of prawns till 1977 and thereafter the fishery began to decline as a result of depletion of stock. The most significant change that became evident after mesh size reduction was the change in species composition of the trawl fishery. Till 1976 more than 90% of the catch from shrimp trawlers was contributed by the penaeid prawns. But in the subsequent years the non - penaeid prawns, which are much smaller in size than the penaeids, contributed to the catches in greater proportions relegating penaeid prawns to a secondary position in 1977. A striking feature observed during this period was the entry of the sergestid prawns *Acetes* spp. into the fishery to the extent of forming 14 - 30%. These tiny shrimps, although available in abundance in the sea as well as backwater areas of this centre and caught regularly in the indigenous gears, have never been encountered before in the trawl catches in quantities large enough to support a fishery. Their entry into the trawl fishery in large quantities along with other non penaeid prawns of smaller sizes in 1977 coincided with the reduction in mesh size of the nets. Examination of the annual size frequency data of penaeid prawns caught by shrimp trawlers indicated a gradual decline in the mean size and downward shifting of the major size groups for species like *M. dobsoni* and *M. monoceros* as a result of the change in mesh size. In the case of *M. dobsoni* the major size group contributing to the fishery decreased from 81 - 100 mm in 1972 to 71 - 80 mm by 1978 - 79 period. The percentage of prawns measuring less than 60 mm total length was also found to be relatively high during 1977 - 78 than in the previous years. In the case of *M. monoceros* the major size group in the fishery was 111 - 150 mm during 1972 - 76 which by 1978 was reduced to 81 - 90 mm along with a steady decline in the mean sizes. All the above changes would suggest that an uncontrolled reduction in the cod - end mesh size of commercial nets can severely jeopardise the fishery and, in the long run, lead to a total destruction of the shrimp resource.

The southwest coast of India is well known for its rich fishery for penaeid prawns. Over 90% of this fishery is dependent on shrimp trawlers operating in the coastal waters upto about 50 m depth. The maximum exploitation of prawns is taking place off Sakthikulangara in Kerala where the fishery is at its peak during the southwest monsoon period. Of late, it has been observed at this centre that considerable quantities of undersized prawns of the major species *P. stylifera*, occur in the catches during the monsoon period. George *et al.* (1983) studying this critical situation in the fishery during 1980 - 82 observed that an average of nearly 30% of the catch in terms of number was constituted by smaller size groups below 65 mm which is around the minimum size at first maturity of the species. In fact, these sizes even dominated in the fishery on many occasions when the landing was at its peak during June - July period. The size preferred by the freezing industry is usually above 65 mm and since the meat recovery below this size is extremely poor they are totally discarded. It is believed that the heavy occurrence of undersized prawns of *P. stylifera* in the trawl nets along this coast is due to the small cod-end mesh size (20 - 25 mm) and the active recruitment of juveniles into the fishery during the period.

Satyanarayana (1965) studying the variations in sizes of prawns caught off Cochin by shrimp-trawls of four different cod - end meshes observed that inspite of the variations in cod-end mesh size (20 and 25 mm) the mean length of prawns caught at a particular depth remain more or less the same. As such, no clear - cut relationship between the cod - end mesh size and the mean length of prawn could be found out. Panicker and Sivan (1965) have conducted mesh selectivity studies using cod - end cover to determine the optimum cod - end mesh size for commercial shrimp trawls. The 50% escape level, coefficient of selectivity and selection factor have been estimated by these authors. Their findings indicated the need for increasing the then existing cod - end mesh size of 25.4 - 31.7 mm to 41.6 mm fabricated mesh size in order to avoid depletion of the natural population.

Yield - per recruit analyses on *P. stylifera* and *M. dobsoni* from Kerala (Alagaraja *et al.*, 1986) have indicated scope for enhancing the Y / R by increasing the mesh size currently in vogue at Sakthikulangara and Cochin as could be seen in Fig. 4. At the present level of C ($= l_c / l_\infty$) the Y / R is less than the Y / R_{max} for both the species. George *et al.* (1988) while discussing about the present status of the shrimp fishery of Karnataka coast also pointed out that the present mesh size of trawl nets may be increased so as to obtain the MSY. In other words, the present level of l_c (75 mm) may be increased to 85 mm by increasing the mesh size of the net. In the light of the above results it is suggested that increase in the mesh size of the cod - end of shrimp trawls to atleast 30 mm would lead to fishery maintenance.

Besides constant exploitation in the marine environment, penaeid prawns are also subjected to commercial fishing in estuaries and backwaters all along the Indian coast. The juveniles of estuary - dependent species such as *P. indicus*, *P. monodon*, *M. dobsoni* and *M. monoceros* are caught extensively from these nursery using a variety of indigenous gears. Since the major sources of recruitment of many commercially important penaeid prawns in the marine region are the estuaries and backwaters, large scale exploitation of juveniles from these areas will definitely lead to depletion of stocks in the sea. Among the various gears employed in capturing prawns from the estuarine areas, fixed bag nets are the most common, and also most deleterious when considering the smaller mesh sizes used in filtering the juvenile population. A survey conducted recently on the mesh sizes of these nets and the size distribution of prawns caught in selected estuarine systems (Table 1) has shown that exploitation of the young prawns is taking place even from advanced postlarval stage onwards, the minimum size of the cod - end mesh used being about 5 mm which is alarmingly small from a conservation point of view. George (1962) examining the catches of *P. indicus* obtained by different types of nets of varying mesh sizes from Cochin backwaters noticed considerable variations in the size distribution of the species in stake nets dip nets and cast nets operated in the same locality. The mesh sizes at the cod - end /interior of these nets were 10 mm, 10 - 15 mm and

TABLE 1. *Cod-end mesh sizes of nets and size distribution of penaeid prawns in the estuarine fishery at selected decentres*

Centres (Name of ecosystem)	Name of nets & Cod - end mesh size (stretched) in mm	Important species caught	Size range of prawns in mm
Karwar (Kali Estuary)	Sluice nets 5 - 15	*M. dobsoni*	30 - 68
		M. monoceros	24 - 95
		P. indicus	52 - 105
Mangalore (Nethravathy Estuary)	Bag nets 15 - 16	*M. dobsoni*	28 - 50
		P. indicus	43 - 115
Calicut (Korapuzha Estuary)	Stake nets 6 - 9	*M. dobsoni*	26 - 80
		M. monoceros	51 - 120
		P. indicus	56 - 140
Cochin (Cochin Backwater)	Stake nets 8 - 10	*M. dobsoni*	11 - 90
		M. monoceros	26 - 102
		M. affinis	22 - 93
		P. indicus	31 - 150
Quilon (Ashtamudi Backwater)	Stake nets 8 - 10	*M. dobsoni*	35 - 87
		P. indicus	60 - 127
Madras (Ennore Estuary)	Stake nets 15	*P. indicus*	56 - 140
		M. dobsoni	41 - 80
		M. monoceros	45 - 100
Kakinada (Kakinada Backwater)	Stake nets 15	*M. monoceros*	30 - 115
		P. indicus	30 - 195
		P. monodon	30 - 254

20 - 25 mm respectively. According to him, the minimum sizes of *P. indicus* in Cochin backwaters are recorded by the stake nets. Perhaps this may be the case with the other co - existing species like *M. dobsoni*, *M. monoceros* and *M. affinis* also which are extensively fished from these areas. If any mesh regulation is to be resorted to as a measure of conservation of juveniles it should, therefore, be tried on the stake nets. George *et al.* (1974), studying the size grade composition of prawns of different species caught by backwater fishing gear of Kerala, have recommended mesh size of 20 - 25 mm for the stake nets. They have observed that enhancement of mesh size to the recommended one has no adverse effect on fishing economics.

Other Resources : Mesh selectivity studies on other resources from India have also been attempted by different authors with reference to bottom trawls and the indigenous gears such as gill nets and fixed bag nets. Some of the studies in this regard are those of Joseph and Sebastian (1964) on oil sardine, CMFRI (Anon., 1984) on Bombayduck and Alagaraja and Srinath (1987) on catfish.

In their preliminary studies on the effect of mesh size of gill nets on oil sardine (*Sardinella longiceps*) using four nets of varying mesh sizes, Joseph and Sebastian (1964) have observed that the modal sizes landed by these nets are proportional to the mesh sizes. For the mesh sizes 14.0, 16.7, 19.3 and 20.9 mm (bar length) the corresponding ranges of modal lengths were 131 - 140, 161 - 170, 181 - 190 and 181 - 190 mm. Referring to the above work Dutt (1965) has suggested improvements in conducting the gill net selectivity studies on oil sardines and other pelagic fisheries of India. The major suggestions offered include (1) The placement of drift nets in juxtaposition for their uniform operation, (2) The positioning of nets not influencing the catches and (3) Estimation of the effect of wind and currents on disposition of meshes.

Experimental studies on the effect of cod-end mesh size of 'dol' nets on the stocks of Bombay-duck (*Harpodon nehereus*) were conducted (Anon., 1984) using conventional 'dol' nets (cod - end 15 mm mesh) and the CIFT designed 'dol' nets (cod ends 30 and 40 mm mesh). The results indicated that the catch of Bombayduck comprised 23, 15 and 10% of the total catch of these three types of nets respectively. The size ranges of the fish were 15 - 245 mm, 45 - 345 mm and 75 - 380 mm respectively. The percentage of fish caught below 150 mm size were in the order of 21, 13 and 5 in the above three nets. It is clear from the above that the escapement of smaller sized fish in the CIFT design nets is more when compared to the conventional net.

In catfish resource assessment based on trawl landings (Alagaraja and Srinath, 1987) the species considered were *Tachysurus thalassinus, T. tenuispinis, T. serratus, T. dussumieri* and *Osteogeneosis militaris*. Except in the case of *O. militaris*, the stocks of all other species were found to be under heavy fishing pressure. It is hence indicated that in order to get MSY from these stocks either the fishing pressure is to be reduced if the existing level of C is maintained or C is to be increased considerably if the existing level of fishing pressure is retained. However, the fact should not be overlooked that the trawl fishery is mainly aimed at shrimps and the suggestion for increasing the level of mesh size to the extent of improving the catfish fishery may not be advisable for the shrimp fishery.

CONCLUSIONS

From the data available on the exploitation of prawns by trawls it is concluded that the effective cod-end mesh size should be atleast 30 mm. As these stocks are heavily exploited and their catches have almost reached a plateau, this step will save the prawn fishery from over exploitation.

Enforcement of mesh regulation has to be taken up seriously in the larger interest of the fishing industry. Social awareness has to be invoked for appreciating such approach and adopting the suggested measures by arranging meeting of all concerned and explaining them the vital need for such measures.

Determining suitable mesh size for judicious exploitation of fish stocks requires experimental studies involving currently used gears in the areas where the fish stocks are exploited. Mean selection length, selection factor and selection range are to be estimated using statistical techniques. Since these factors vary according to the material used for webbing, such experiments are to be conducted periodically to update the information. Biological data on growth and maturity of the fish stocks are necessary to fix the required mesh size for each species. Since tropical fisheries are of multispecies operated upon by multigears, mesh size required for one species may not be useful for others. Hence from the class of such mesh sizes one size is to be selected to exploit the dominant species.

Selectivity studies on gillnets have to be intensified and methods have to be evolved to incorporate the fishing mortality due to gill nets with that of other gears such as trawls when the fish stocks are exploited by them. The existing models in gill net selectivity are based on experiments conducted on gillnets having a single mesh size whereas in practice, particularly in Indian waters, a gill net may have different pieces connected together, each piece having different mesh size. Hence the effect of these gillnets on the fish stocks exploited has to be studied by designing appropriate field experiments.

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