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OBSERVATIONS ON THE FISHING POTENTIALITY OF THE SHELF AND SLOPE WATERS ALONG THE S. W. COAST OF INDIA BASED ON THE FISHING RESULTS OF IFP VESSELS

By

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1 INTRODUCTION

Availability of resources is perhaps the most important factor which determines the success of any Industry. In the case of fishing industry, the availability of fishable concentration of fishes and other marine life assumes great significance since the success of the fishing operation is entirely dependant on the availability of resources which can be effectively exploited with the fishing equipment carried on board.

1.1. BACKGROUND :

Earlier observations on experimental trawling along the south west coast of India at a depth range of 55-70 m conducted by "Lady Goschen" (Sunderraj 1930) and an account of experimental trawling carried out in Indian waters before the Second World War (Chidambaram 1953) made a beginning of systematic studies along these lines. Results of trawling operations conducted off Cape-Comorin between 70-100 m by the vessels "Kanyakumari" and "Sagarkumari" (Gopinath 1954), "Taiyo Maru" (Srivasta 1952), vessels of the erstwhile Indo-Norwegian Project (Per Sandevan 1955), "Ashok" and "Pratap" of the erstwhile Deep Sea Fishing Station of Govt. of India showed the existence of productive fishing grounds within the continental shelf area along the south west coast of India. Jayaraman *et al.* (1959), Nagabhushanam (1964), Tholasilingam *et al.* (1964), Virabhadra Rao (1968), Perumal *et al.* (1972), the relevant Reports of the Central Marine Fisheries Research Institute, Fishery Survey of India, Integrated Fisheries Project, erstwhile FAO/

UNDP Pelagic Fishery Project, Central Institute of Fisheries Nautical and Engineering Training, Central Institute of Fisheries Education etc. have thrown light on the total landings and catch rate of important types of fishes, their distribution and abundance in relation to depth and other environmental factors.

1.2. EXPERIMENTAL FISHING OPERATIONS CARRIED OUT BY INP/IFP VESSELS :

The Integrated Fisheries Project; the erstwhile Indo-Norwegian Project came into existence in the year 1953 as an area/community development programme. The project, as early as 1954, initiated experiments in diversified fishing techniques employing newly designed gear. One of the important objectives of the Project was to implement the programme of "increasing the fish production by improving the methods". Towards achieving this very important objective, the Project initiated the programme of mechanisation, introduction of new methods of fishing and also imparting training in diversified fishing techniques.

It is estimated that an area of approximately 21, 31, 318 Sq. km around the Indian subcontinent including the Islands situated in the Arabian Sea and Bay of Bengal lie within the Exclusive Economic Zone. Out of this, about 5, 86, 017 sq. km falls within the south west sub division and another 2, 46, 385 sq. km within the south-east sub division. The total coverage by the vessels attached to the Project since inception is estimated as under.

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CONTINENTAL SHELF AREA

OCEANIC AREA

(Approximately within
200m depth)(beyond 200m depth extend-
ing upto the limit of EEZ)

	Total Area available (sq. km)	Total Area covered by IFP Vessels (sq. km)	Total area available (sq. km)	Total area covered by IFP vessels (sq. km)
South West Sub-division	71,389	64,489 (90.33%)	5,14,628	25,300 (4.9%)
South East Sub-division	54,358	16,100 (18.38%)	1,92,027	9,200 (4.8%)

Between 1952 and 1985 fishing was carried out mostly within the continental shelf between Goa and Cape Comorin on the south west coast and between Cape Comorin and Mandapam along the south east coast. During the above period a total fishing effort of 68,380 Hrs. were expended in an area of approximately 1,15,000 sq. km.

The following is a summary of observations on the results of fishing activity with special reference to the fishing techniques adopted. The details regarding the type of craft and gear employed for conducting the fishing operations are also given.

2. DATA AND METHODS :

The details regarding the fishing vessels operated by the Project are given in Table-I. Broad specifications of Fishing Gear and accessories designed, operated and found successful by the Project are listed in Table II.

The fishing and allied data pertaining to this study were collected by the Project vessels and presented in standard fishing data sheets, the format of which was updated from time to time to meet any additional requirement. The Skippers in charge of individual vessels were entrusted with the responsibility of maintaining the data sheets on board which in turn was submitted to the shore officer on completion of each cruise. The fishing programme drawn out by the shore officer was implemented in the presence of scientific staff who remained on board during each cruise. Since early sixties the Project started using Fishing Square charts. On the admiralty chart each 1° square was sub-divided into 36 equal divisions each smaller square cover-

ing an area of 100 sq. nautical miles or 256 sq. km. Each 10' square was also serially numbered both alphabetically (from A to F) and numerically (1-6) on the x and y axis respectively to identify each of the smaller squares,

In general, fishing operations commenced at 0530 hrs. and were continued till sunset except in operations, where a particular operation required fishing during night time. The duration of fishing (during each haul/set) was decided by the Skipper in consultation with the Scientific Staff present on board. Supporting meteorological / oceanographic data were gathered simultaneously on board larger vessels like "Samudradevi", "Varuna" etc. An on the spot comparison of echograms with the fish catch was made and recorded separately, for attempting possible quantitative / qualitative correlations.

3. DISCUSSIONS:

The results are presented fishing technique wise; since evolving new fishing techniques, experimenting, improving the design and dissemination of results of successful fishing gear to the end users formed one of the major objectives of the Project. Moreover it would also enable the end users to know how best the technology developed and proved by the Project has been accepted by the Industry, in stages over the past 3 decades.

3.1. SHALLOW WATER TRAWLING:

All the vessels operated by the Project since inception were engaged in shallow water trawling operations at one time or other.

Trawling was conducted in 103 fishing squares covering an area of approximately 26,000 sq. km located within the continental shelf (up to 200m depth.)

3.1.1. Catch per unit effort :

Out of a total of 103 fishing squares covered by Project vessels (located within a depth range of 20 to 200m) 3 squares viz. 12-74/5E, 12-74/4E and 7-77/4B yielded average fish catches of 500 kg and above per hour of trawling, the maximum being 750 kg/hr. in fishing square 12-74/4E. 3 fishing squares viz. 12-74/2F, 10-75/1F & 9-76/1A yielded average catch per unit effort of 400-500 kg. 6 fishing squares 11-75/5B, 11-75/6A, 9-76/6B, 9-76/3A, 8-76/4C and 9-74/3B yielded values between 300-400 kg./hr. 25 fishing squares 14-73/6F, 5F, 12-74/1F, 11-75/5C, 10-75/5F, 3F, 5E, 3E, 10-76/1B, 2A, 9-76/5B, 4B, 5A, 4A, 8-76/2F, 4E, 3E, 6D, 7-77/6F, 3C, 6A, 5A, 9-79/4B, 2B and 3A yielded values between 200-300 kg/hr. 49 squares yielded between 100-200 kg/hr. and the balance 17 squares yielded an average catch/hr. of less than 100 kg.

Maximum effort was expended in the fishing square 9-76 5A located off Cochin (approximately 6500 hrs). The total fishing effort expended in all the 103 fishing squares for shallow water trawling alone works out to about 48000 hrs.

3.1.2. Catch composition:

The dominant varieties of fishes represented in the shallow water trawl catches were Horse mackerel (*Megalapsis cordyla* and *Decapterus Spp.*), Silver bellies (*Leiognathus bindus*, *L. splendens*), Cat fish (*Arius thalassinus*, *A. dussumieri*), Lizard fish, (*Saurida tumbil*), Ribbon fish (*Trichiurus haumela*, *T. savala*), Threadfin bream (*Nemipterus japonicus*), Perches (*Epinephelidae*, *Lutjanidae*, *Lethrinidae* etc). Elasmobranchs (sharks, rays, skates etc.) (*Scoliodon* spp, *Carcharinus* spp., *Rhynchobatus* spp., *Rhinobatus* spp.), Balistids (*Odonus niger*, *Sufflamen capistratus*), oceanic crabs (*Charybdis edwardsi*), Flying gurnards (*Dactyloptena orientalis*) etc.

Less dominant varieties of quality and miscellaneous fishes were pomfrets (*Pampus* spp), Carangids (*Caranx* spp), Barracuda, white fish (*Lactarius* spp), Sciaenids, Seerfish (*Cybius* spp) etc. Prawns (*Penaeus indicus*, *Metapenaeus affinis*, *Parapenaeopsis stylifera*, *Metapenaeus dobsoni*) were caught mainly from shallow water fishing grounds between 10-40 m depth ranges by the smaller vessels of the Project.

In recent years (since 1982) *Priacanthus* spp. started appearing in the shallower areas of the continental shelf especially in the depth range of 35 to 75 m.

During the period 1954-59, the Project employed small mechanised vessels of 10.97 m OAL to exploit the shrimp resources in the shallower areas of the continental shelf between Goa and Cape Comorin on the south west coast and upto Mandapam on the south east coast. Shrimp trawls with comparatively higher horizontal opening were specially designed and deployed for the purpose. As a result, productive shrimp grounds were identified off Karwar (9-33 m), Mangalore (16-29 m), Cannanore (9-25m), Cochin (9-37m), and between Alleppey and Quilon (9-37 m).

During late sixties and the earlier part of seventies upto 1975, the dominant varieties in the fish catches were cat fish (15%), Threadfin bream (7%), Elasmobranchs (13%), Lizard fish (3%) and Ribbon fish (1%). It was generally observed that during the period 1965-75 either cat fish or killifish dominated the catches. An overall analysis of the fish catches for the period under review showed that approximately 50% of the total catch was formed of miscellaneous fishes which were not of much economic value.

During late seventies horse mackerel and silver bellies formed dominant varieties in the fish catches from the depth zone 30-50 m. Catches from the shallower areas predominantly consisted of Scads. During September 1978 one of the bottom trawl operations from 47 m depth south west of Cochin yielded 1750 kg of horse mackerel/hr. They were found in significant quantities from July to September in the Southern grounds and from November to January in the northern grounds.

Silver bellies were dominating in depth ranges of 30-40 m mainly between 9° and 10°N lat. and also between 11° 30' and 13°N (20-35m) and around 15°N lat. (20-25m). During January (1977) 700kg/hr. was obtained from 20 m depth off Karwar.

Cat fishes were found to dominate depth ranges of 30-60 m, mainly north of 9°N lat. Large concentrations of the fish were observed during November-April between 9° and 11°N lat. Very dense concentrations were observed during May-July in 9°N lat. area. During the south west monsoon period (July-Oct.) cat fish is found to be shoaling in the mid-water column, thereby showing poor results in bottom trawling.

Ribbon fishes were found dominant in the catches in the gulf of Mannar in July from 25-40 m depth ranges. Concentration of the fish was seen within 13° and 15°N lat. during May-June at 25-30 m depth range. During October-January, the distribution of the fish was widespread mainly between 13° and 15°N lat. at 25-40 m depth ranges.

Threadfin bream is known to occur in wide depth ranges from 20m to 100m. They form the dominant variety in the catches during August-October mainly between Quilon and Goa.

Trawlable perch grounds are mainly located in the Wadge Bank, South of Cape Comorin, known to be one of the best grounds for perches. Perches being inhabitants of rocky bottom are generally found throughout the year. The catches from the large vessels of the Project showed good returns in January-February (upto 560 kg/hr) in the depth range 20-55 m. On the Wadge Bank outside 50m depth contour maximum catches of 200 kg/hr. were obtained in June. Most of the trawlable perch grounds lie between 20m and 80m depth contour. South west of Karwar (14° 40'N. lat.), during September catch rates upto 170 kg/hr. have been obtained from a depth of 75 m. Bobbin trawling for perches was undertaken by the Project Vessel "Velameen" during 1970 using a 316 mesh fish trawl with steel bobbins in the fishing squares 10-75/3E, 4D, 5C, 4C, 6B and 5B. A total fishing effort of 32 hrs. yielded catches between 195 and

732kg/hr. in the depth range of 80 to 200m.

Good catches of Elasmobranchs have been recorded by Project vessels during December-June period, the peak season being January and February. The shelf area south of 10°N lat. particularly between 9° and 10°N. lat. was found productive, also the areas between 12°N and 13°N lat. between depth ranges of 20-50 m. Leave alone rare catches of individual large sized sharks, Rays and Skates in the trawl catches, the average catch/hr. for the fish remained at 50 kg with maximum catches of 560 kg/hr. during January south west of Quilon between 40-45 m depth.

3.2. DEEP SEA TRAWLING FOR LOBSTER:

Deep Sea Lobster *Puerulus sewelli* was recorded in about 46 fishing squares, mostly lying between 180 and 270m depth range. The highest catch per unit effort of 327 kg/hr. was obtained from the sub square 8-79/5D located off Mandapam in the depth range 200-270 m. Values above 150 kg/hr. were obtained from the sub squares 8-75/6F, 5F, 8-76/6A, 8-79/6B and 9-79/1B. Maximum catch/unit effort was obtained during the months February-June. Pandalid and penaeid prawns were also caught along with Deep Sea Lobster in the above mentioned area. A comparative study of the catch/hr. of trawling for deep sea lobster at the different grounds shows a decreasing trend towards north and south of Quilon. This is in conformity with the earlier findings of Joseph (1972), Pillai (1972) and also for the grounds located on the south east coast (Sathiarajan 1974).

In general and particularly in the grounds located off Quilon (squares 8-75 and 8-76), the catch was predominantly constituted of *Puerulus sewelli* (50 to 97%) with a small percentage of deep sea prawns and fishes such as *Emmelichthys* spp., *Chlorophthalmus* spp., *Centropristis* spp., *Cubiceps* spp. *Epinula* spp. and *Bemprops* spp.

The catch/hr. recorded by the Soviet Research Vessel "Academic Knipovich" for deep sea lobster in the southern part of the slope along the south west Indian shelf at depths of 200-320 m was 100 kg. It is quite evident from the present study that the catch/hr. of

trawling for deep sea lobster for the project vessels was comparable with the above results. In specific locations the catch rate was comparatively high during the February-April period

3.3. SINGLE BOAT PELAGIC TRAWLING:

The Project commenced single boat pelagic trawling as early as 1973 using the vessels, "Varuna", "Klaus Sunnana" "Velemeen", "Tuna" and "Norind-2" mainly in the area between 8°30'N lat. and 10°30'N lat. with a few cruises covering northwards upto Karwar, employing the vessel *Sardinella*. A total of about 1200 fishing hours were expended in about 25 fishing squares. The catch per unit effort showed wide variations with a maximum of 200 kg/hr. Silver bellies, Golden scad, lesser Sardines and horse mackerel dominated the catches in the northern latitudes. During May-August Catches above 500 kg/hr. predominantly of white baits have been made east of Cape Comorin at 25-30 m depth, white bait (*Anchoviella*) spp. at the rate of 100-500kg/hr. have also been recorded south of Goa, Karwar, Coondapur, Mangalore, Kasaragod, Cannanore and also east of Cape Comorin at 27-35 m depth during May-August. Operations on the south west coast in the shallow areas (20m) yielded mostly shallow water mixture composed of silver bellies, golden scad etc., while those in deeper waters (30m) north of 13°N Lat. yielded cat fish and Ribbon fish with small quantities of white bait. On a few occasions good catches of Balistids (300 kg/hr.) were obtained from the fishing square 7-77/4D at 39m depth during September - December. Off Goa, Mangalore and between Cochin and Quilon in deeper waters (28-60 m) Ribbon Fish was common in October. In shallow areas (10-30 m) Silverbellies, white baits and small sized Carangids were common. It is found that the period May-August is most suitable for single boat pelagic trawling which yield comparatively high catches of white bait. Catch rate of more than 500 kg/hr. consisting of oil sardine and mackerel has been recorded off Cochin from 20 m depth.

Flying gurnards were recorded in the fishing squares 9-76/3A and 8-76/4C in significant quantities in September.

3.4. PAIR TRAWLING :

In mid water trawling operations, the vertical and horizontal mouth opening of the trawl net is an important decisive factor. In this respect the pair trawlers have a big advantage over single boat trawlers. In pair trawling since no otter boards are used, the towing power of the boat is absorbed by the warps and netting only. The Project vessels M-11, M-12, M-13 & M-14 (all 9.75m OAL) took up pair trawling operations as early as 1973. During 1979-80 two larger identical vessels "Velemeen" & "Tuna" (23.8m OAL) also joined the experiments. A total fishing effort of more than 2000 hrs were expended on experiments conducted with 9.75 m OAL vessels. On an average the catch per unit effort varied between 66kg and 85 kg/hr. in the fishing squares 9-76 and 10-76. Experiments with 23.8 m OAL vessels in the area 9-76 yielded 490 kg/hr. for pair bottom trawling.

3.5. PURSE SEINING :

The Project initiated Purse seining experiments as early as 1954. Project vessels M2, M3, Kalava-2, Norind-2, Tuna and Samudradevi (9.75m OAL to 28m OAL size) were deployed for conducting purse seining mainly for the exploitation of Pelagic shoaling fishes like Oil Sardine, Mackerel, Tuna and Anchovies. A total of 36 fishing squares were covered by the above mentioned vessels employing Purse seine gear designed and fabricated by the Project. A total fishing effort of about 5000 hrs. have been expended for perfecting the methodology and demonstrating the same for the benefit of end users. The average catch/set showed wide variations, the maximum recorded being 5832 kg/set. (11-75/4D), 4344 kg/set (11-75/3C) 2450 kg/set (10-75/5F), 1408 kg/set (9-75/6F) (9-76/5B) and (9-76/3A). The catches were predominantly of a single variety of fish either oil sardine, Mackerel, Anchovy or small Tuna.

Purse seining with light attraction was also tried from the Project vessels Norind-2 and M-13 during the period 1974-75 expending a total fishing effort of about 36 hrs. The highest catch/hr. recorded was 332 kg. It was noticed that better results were obtained

on dark nights and also during peak tides.

3.6. HAND LINING AND TRAPPING FOR ROCK CODS :

A systematic survey of the Perch fishing grounds was taken up by the Project during 1956. Due to the uneven nature of the sea bottom and occurrence of Rocky patches trawling is not possible in the narrow belt of the shelf where rock cods thrive. The fishing gear employed for hand lining is very simple and inexpensive. The hand line equipment consists of a main line having 5-7 branch lines with hooks. The efficiency of hand lining depends on the ability of the vessel to remain stationary just above the ground without much drifting for a considerable period. Hand lines were operated on board *Kalava* (1956-66) *Varuna* (1968, 1976-84) *Tuna* (1976) and *Kalava-2* (1975-76). When the wind and surface currents gather strength, hand lining will become very difficult. To overcome this difficulty, the Project developed Traps for catching rock cods. Rock cods have a natural tendency to remain in crevices on the rocky ground. Once they are out they tend to move in small shoals. This behaviour pattern makes them more amenable for trapping. The collapsible nature of the trapes also makes it convenient to carry more of them even in small vessels of 13.5m OAL. Traps were operated on board the vessel *Kalava-2* (1975-76), *Tuna* (1976) and *Varuna* (1976-84).

Trapping and Hand lining were tried at a total of 34 fishing sub squares. Catch per unit effort of more than 100kg/hr. was obtained from a total of 9 sub squares viz. 8-76/6A, 9-75/1F, 2F, 10-75/4C, 11-75/1A, 1B, 11-74/2F, 5E and 6E in the depth range of 80-100m with a maximum of 269kg/hr. from the sub square 11-74/5E located off Mahe, during the months February-May.

3.7. SQUID JIGGING :

Hand lining for squid was tried during 1974-75 on trial basis with the help of simple pole and line gear consisting of a jig, line and pole. During 1978-79 squid jigging with two automatic jigging machines with 25-30 jiggs each was tried onboard the vessel *Varnua*. 4 Nos. of 1000 w. lamps with shades were arranged in a single row along side the

bulwark over the deck, side by side with the jigging machines.

Squid jigging operations which were mainly concentrated on the continental shelf between Cochin and Trivandrum yielded 3-6 Nos. of squids per hour of fishing.

4. CONCLUSIONS

Over a period of 3 decades (1954-1985) the Project conducted experimental fishing operations employing diversified fishing techniques with a view to find out the fishing potential in these waters areawise/season-wise/specieswise. The results were disseminated to the end users from time to time. Experiments on those of the fishing techniques which were accepted by the fishing industry were discontinued and the effort was diverted on new resources which were hitherto not exploited on a commercial scale.

Mechanised trawl fishing for prawn resources in the shallower areas of the shelf was discontinued by the Project during the early sixties consequent on the acceptance of this fishing technique by the Industry during the early sixties. Similar is the case with bottom trawling operations for deep sea lobster, Bobbin trawling operation in the wadge bank, Pelagic trawl operations for the commercial exploitation of *Anchoviella* spp., Purse seining for oil sardine, mackerel and *Anchoviella*, Trap fishing and Hand lining for Rock cods etc.

The results, in general, could be summarised as follows:

Productive shrimp grounds were identified off Karwar (9-33m), Mangalore (16-26m) Cannanore (9-25m) Cochin (9-37m) and between Alleppey and Quilon (9-37m) The shallow water mixture consisting of silver bellies, golden scad, glass perches etc. is a common constituent of shallow water trawl catches in the area between Quilon and Karwar. During the south west monsoon period (June-September) Cat fish, Ribbon fish and Lizard fish occurred in large quantities. Off Tuticorin in the Gulf of Mannar, bottom trawl operations yielded silver bellies, balistids and perches. During January-April trawling

in the Wadge Bank yielded perches (40-50m) North of lat. 9°N Cat fish and thread fish bream were well represented in the catches, especially in the depth range 20-50m.

During September - December period, the important varieties in the shallow water catches would be perches, balistids and porcupine fishes (wadage Bank area-40-45m) Cat fish, Ribbon fish and Thread fin Bream (between 9° and 16° lat. N)-(30-40m depth range), Lizard fish, *Saurida* spp. Flat head (*Platycephalus* spp.) goat fishes (Mullidae), Bull's eye (*Priacanthus*) spp. are normally caught in deeper water 70-80m. But during the past 3 years or so *Priacanthus* spp. is available in large shoals in comparatively shallower water (35-75m) especially during the post monsoon period (September-October).

Approximately 1-5% of the catches is composed of less dominant varieties of quality fishes like pomfrets, carangids, Barracuda, white fish, sciaenids, seer fish etc. There were a few instances, where large shoals of (8-to 10 tonnes) consisting predominantly of pomfrets were caught mainly between Quilon and Mangalore in Depth of 30 to 70m. Pomfrets form one of the major constituents in the catches during the post monsoon period (September - December) between Quilon and Mangalore.

Elasmobranchs were dominant in the catches during December-June period between 20 and 50m depth range. This is especially so in the area between 9°N and 13°N lat.

Out of a total of 103 fishing sub squares covered by Project vessels expending a total fishing effort of 48,000 hrs, 86 sub squares yielded and average catch of more than 100kg/hr.

For deep sea trawling for Lobster, highest catch rates were obtained during the months February-June from grounds located off Quilon and off Mandapam between 180 and 270m depth range, The average catch rate for Deep Sea Lobster (single species viz. *Puerulus sewelli*) varied between 150 and 327kg. Deep sea prawns were also caught along with Deep sea lobster at the above grounds.

For pelagic trawling, encouraging results were obtained during the monsoon and post monsoon period (May-September) with the average catch reaching values of 150-200kg/hr Silver bellies golden scad, lesser sardines and horse mackerel dominated the catches in the northern latitudes (above 10°N lat.) During May-August catches above 500kg/hr. have been made east of Cape Comorin at 25-30m depth consisting predominantly of white bait.

White bait at the rate of 100-500kg per hour has also been recorded south of Goa, Karwar, Coondapur, Mangalore, Kasargod and Cannanore during May-August (27-35m).

Operations in the shallower areas (20m) yielded mostly shallow water mix composed of silver bellies, golden scad etc. While those in deeper water (30m) north of 13° N lat. yielded cat fish and Ribbon fish with small quantities of white bait. Off Goa, Mangalore and between Cochin and Quilon in deeper water (28-60m) Ribbon fish was common during October.

Purse-seining was introduced by the Project for the first time in this region. By expending a total fishing effort of nearly 5000 hrs. the Project could perfect the technology and demonstrate the same for the benefit of the private industry as an efficient fishing methodology for catching of oil sardine, mackerel, anchovy and tuna. The industry accepted this methodology and introduced a sizeable number of purse-seiners to exploit the pelagic resources during the seventies. Consequent on the implementation of Marine Fishing Regulation Act by the Govt. of Kerala, the Project continued the experiments in deeper waters, exploring the possibility of deep water purse seinig for the same pelagic shoaling fishes. Even though the results are encouraging, more work is required to draw conclusions.

Hand lining and trapping for Rock cods got acceptance as an ideal fishing technique for the commercial exploitation of rock cods in the rocky patches of the continental shelf mainly between Alleppey and Ponnani, where no other fishing method can be employed. The fishing gear employed is very simple and inexpensive. Perhaps the only additional requirement onboard would be an echo

sounder of suitable range to locate the fishing ground and to retain the vessel above the ground for a certain duration of time. Catch rate above 100kg/hr was obtained from 9 sub squares in the depth range 80-100m with a maximum of 269kg/hr. from the sub-squares 11-74/5E located off Mahe during the period February-May.

Preliminary investigations on squid jigging conducted by the Project in the area between Cochin and Trivandrum revealed the presence of squid resources in this region. More intensive work is planned to be carried out during the VII Plan period for proving the commercial viability of squid jigging operation in these waters.

Among the major varieties of commercially important fishes caught from this area, cat fish and ribbon fish exhibit the widest distribution. They were mainly caught between 30m and 80m all along the south west coast, practically throughout the year with the exception of post monsoon period (September-October) when these fishes migrated to in-shore waters.

For horse mackerel, the main concentration was found in the southern waters near Cape Comorin, close to the shore between 50m and 80m and towards north they were caught mostly in deeper water beyond 90m. In general horse mackerel was found concentrated in shoals during day time. They disperse during the night and can be effectively caught with the help of midwater trawls.

The "shallow water mix", the group of fishes which are normally found within the 20m depth zone is composed of lesser sardines, rainbow sardine, silver bellies, golden scad, butter fish, glass perch and quite often the younger ones of cat fish and ribbon fish. During the day they form small shoals close to the bottom and at night they disperse in the entire water column. They are found all along the coast in shallow water. During the period July-October in areas where upwelling is pronounced, they form surface

shoals which can be effectively caught with the help of mid-water trawls.

Other commercially important fishes caught in this area, usually found in deeper waters, but rarely in large shoals are pomfrets, seer fish, travelly, barracuda, anchovy, small sharks, rays and squids. In deeper waters, beyond 50m depth the commonest forms which are available in dense concentration are thread fin bream and lizard fish. They are found through out the year in a wide area on the middle and outer shelf but there is a tendency for southward migration during south-west monsoon period.

Demersal fishes of good commercial quality found in the area are perches, snappers, pig head breams etc., which are caught in bottom trawls on the Wadge Bank, Quilon Bank, Pedro Bank and also on the narrow rocky patches found at depths of 70-120m between Cochin and Ponnani.

Since the availability of "fishable concentration" form the basis of commercially oriented fishing operations, a systematic monitoring of the availability of different types of commercially important fishes, their distribution and movement from place to place in time and space assume great significance. Experiments on evolving suitable fishing gear to exploit a particular fishery should also continue side by side with reference to the size and type of vessel to be employed for economic operation. The catchability expressed by the term catch per unit effort should form the basic criterion in commercial fishing operations. Care should be taken to choose the right type and size of the vessel, optimum size to be decided, since the economics of operation depends to a large extent on the size of the vessel employed for the operation. Adoption of diversified fishing techniques will help the operator to catch a particular variety of fish which is available within the fishing capability of the vessel in different depth ranges/distances from the coast. It will also ensure a steady supply of commercially important varieties of fishes in sizeable proportions so as to make commercial operations economically viable.

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Table-1 * Details of fishing vessels of the Project

Sl. No.	Vessel	OAL (m)	B. H. P.	G. R. T.	Type of fishing performed
1.	Varuna	28.00	400	160.34	Trapping and Hand lining, squid jigging, Long Lining
2.	Samudradevi	27.31	750	193.86	Trawling and Purse-seining
3.	Velameen	23.85	480	117.21	Trawling
4.	Tuna	23.80	480	115.62	Trawling, Trapping, Purse seining
5.	Klaus Sunnana	19.81	220	61.28	Trawling
6.	Norind-2	17.50	233	47.25	Trawling, Purse seining,
7.	Kalava-2	13.17	72.5	19.27	Trawling, Purse seining, Trapping and Hand lining
8.	M - 3	10.97	48	12.00	Purse seining
9.	M - 12	9.75	48	7.00	Trawling

* Selected number of vessels which were utilised for diversified fishing alone are included in this list.

Table 2 List of important Fishing gear designed, operated and found successful on board Project Vessels :

1. BOTTOM FISH TRAWLS:

700 mesh, 650 mesh, 600 mesh, 500 mesh, 450 mesh, 400 mesh, 360 mesh and 316 mesh.

(For details please refer to IFP Bulletin No. 8, January, 1984)

15.2m }
22.5m } (Flat trawls)
25.5m }
37.5m }

10.85m } (Out rigger type)
16.5m (Mexican type)

2. MID WATER FISH TRAWLS ;

SINGLE BOAT : 25.8 m, 31.0 m
(Diamond Type)

33.1 m (Star Type),
38.3 m.,

19.4 m (Sputnik type)

22.4m } (High open-
31.6m } ing trawl
32.35m } nets)

18.2m } (Four seam
24.0m } type)
54.6m }

22.0m } (Norwegian
29.0m } type)
37.2m }

21.2m } (Kuwait type)
35.0m }
46.2m }

(For details please refer to IFP Bulletin No. 9, June, '84)

14.0m } (Otter type)
12.6m }

3. SHRIMP TRAWLS :

32m, 34m, 37m, 42m,
41m

(For details please refer to IFP Bulletin No. 10, February, 1985)

5.6m } (Try nets)
4.45m }

Table - 2 Contd.

PURSE SEINES :

1. 366m x 27.5m (M-1)
2. 384m x 27m (M-1, M-4)
3. 550m x 68m (Tuna)
4. 370m x 64m (Tuna)
5. 550m x 64m (Tuna)
6. 550m x 91m (Tuna)
7. 366m x 36.5m (M2, M3)
8. 293m x 29m (M2, M3)
9. 292m x 25.65m (M2, M3)
10. 366m x 46m (Norind -2)
11. 502m x 72m (Samudradevi)

12. 350m x 31.8m (Kalava-2)

(For details please refer to IFP Bulletin No. 3, 1980)

4. KALAVA TRAPS :

1.86m x 0.86m-Rectangular-Collapsible.

5. LONG LINE:

80 Baskets each containing 5 hooks
Length of each basket-270m

6. SQUID JIGGING EQUIPMENT:

Automatic squid jigging machine with
35-50 jigs-2 sets,