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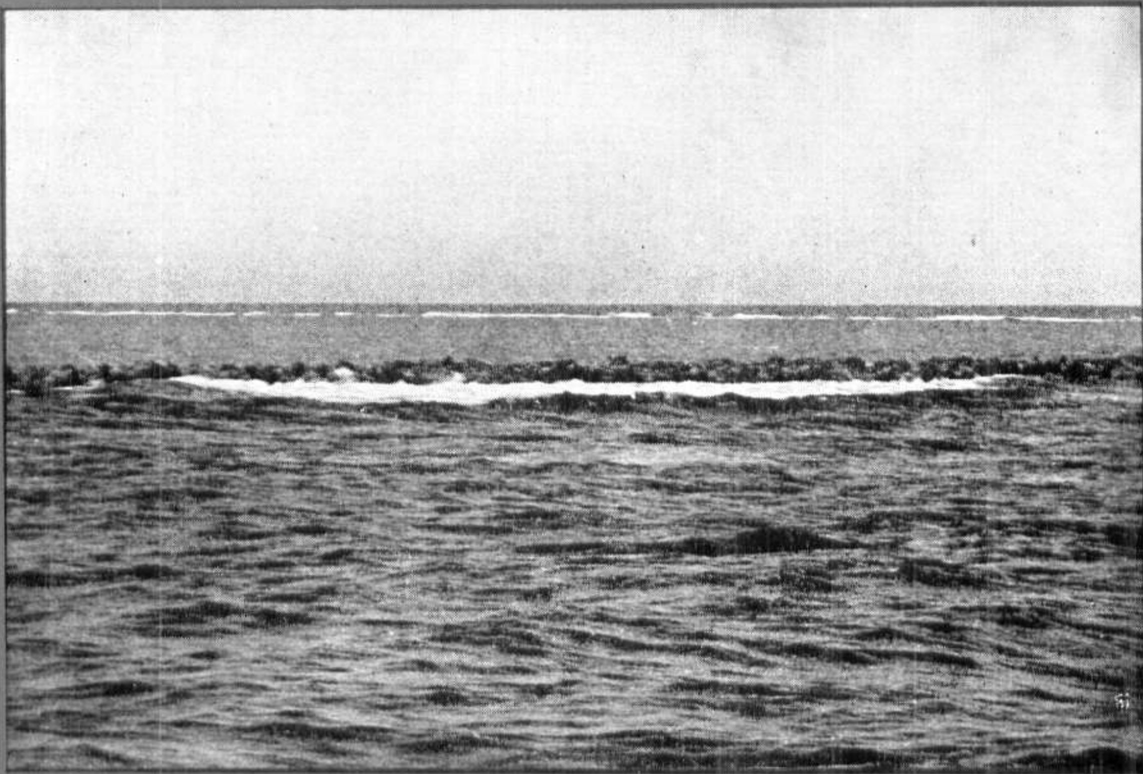

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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre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

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Front cover photo:

A view from the sea, of the lagoon and exposed coral reef of Bangaram Island, Lakshadweep. Note the waves striking against the reef and against the sandy beach in the background.

Back cover photo:

Tunas are being cut and prepared for making 'masmin' in Agatti Island, Lakshadweep.

SMALL-SCALE POLE AND LINE TUNA FISHERY IN LAKSHADWEEP — PRESENT TREND, CONSTRAINTS AND STRATEGIES FOR FUTURE DEVELOPMENTS

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Introduction

The mainstay of the tuna fishery of the Lakshadweep Islands is the small-scale pole and line fishery. It includes chumming with live-baits to attract and hold tuna schools close to the vessel and hooking by pole and line. The advantages of this type of fishing are: relatively small capital investment involved, ability to harvest small schools of fish, mobility to operate from small ports with minimum technical support and the ability to utilise unskilled labour. In Lakshadweep, as observed by Jones (1986), since the land and its resources are very limited, optimum exploitation of the resources of the vast expanse of its oceanic waters is the solution for furthering the development of the islands and the economy of the islanders. The introduction of mechanisation of the fishing boats in the early sixties and the extension of small-scale pole and line fishing which was traditionally in vogue only at Minicoy Island to some of the northern islands such as Agatti, Suheli Par and Bitra are the two recent developments in this direction.

The resource

Production of tunas (chiefly Skipjack and young Yellowfin) by pole and line fishery in the Indian Ocean and in the countries neighbouring India such as the Republic of Maldives and Sri Lanka during the period 1981-'85 is presented in Fig. 1. Total tuna production by this fishery in the Indian Ocean recorded an increase of about 40% from 1981-'85 and the Republic of Maldives contributed to 90.2% and Sri Lanka 5.6% of the total production (IPTP/FAO, 1986). Mechanisation of the traditional crafts engaged in the pole and line fishery has been instrumental for the increase in catches. Fish production in the Lakshadweep has increased from 2,570 tonnes in 1976 to 4,700 tonnes in 1985, of which tunas, especially Skipjack tuna *(Katsuwonus pelamis)* contributed 1,300 tonnes and 3,800 tonnes respectively in these years (Fig. 2).

Scientific estimates of potential resources of tunas in the Lakshadweep Sea, based mainly on the primary production and catch statistics indicate that they vary between 50,000 tonnes and 1,00,000 tonnes, and resource availability is not a constraint in the development of tuna fishery in this area. According to the recent estimation by Chidambaram (1986) the fishery potential in the southwest region of the Exclusive Economic Zone of India is 1.15 million tonnes, of which 90,000 tonnes are formed by tuna resource. James (1986) presented an exploitable potential of 5,00,000 tonnes of oceanic resources including tunas, pelagic sharks *etc.* from the area. This coincides with the observation by Silas and Pillai (1985) that tunas remain to be one of the least exploited resources of the Indian seas, and in 1984 it formed only 1.25% of the total marine fish landings in India.

Development of domestic small-scale fisheries and national harvesting capabilities become important to ensure rational exploitation of fishery resources in the Exclusive Economic Zone. As opined by Varma *et al.* (1986) an initial moderate scale of development by expanding pablo-boat fishery using traditional fishing methods can be encouraged in view of their efficiency and other advantages. It has earlier been suggested that for augmenting tuna production in the developing countries like India, expansion of surface fisheries is the prime means (Silas and Pillai, 1982; 1986). Introduction of highly mobile, large-scale purse seining is not a prudent proposition since it is capital intensive and may not provide local employment and also require shore based infrastructure facilities such as berthing and bunkering jetties, large scale freezing and canning

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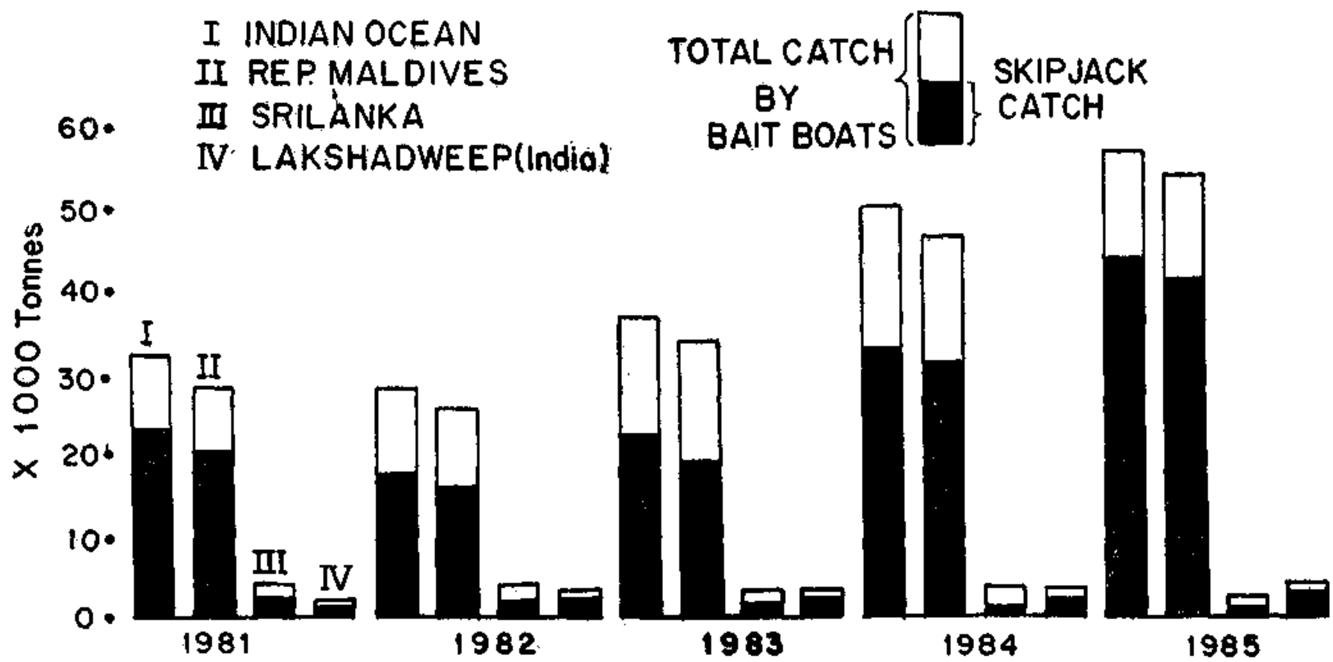

Fig. 1. Production of tunas by pole and line (bait-boat) fishery in the Indian Ocean, Republic of Maldives, Sri Lanka, and India 1981–'85. Shaded portions indicate composition of Skipjack tuna in the total catch.

facilities *etc.* Hence it is felt that one of the immediate steps which appears practicable and feasible for the development of surface fishery for tunas within our EEZ is the strengthening and expansion of the small-scale pole and line fishery and the introduction of medium sized purse seiners especially in the northern islands.

According to Varghese (1986), a fishery providing self employment to nearly 5,000 people has been established in the Lakshadweep with the necessary infrastructure. About 300 mechanised fishing boats operate in this area landing over 5,300 tonnes of tunas and other fishes annually, adding about, 2.5 crores to the income of the islands, with a per capita fish availability of over 100 kg.

The small-scale fisheries development requires in most cases special support from the administration. An integrated approach with the participation of fishing communities involved in fish production and marketing, and scientists involved in research and development is probably the best way of channelising technical, financial and other forms of assistance. In this context, it is felt opportune to outline the present trend, constraints and prospects for further development by designing and adopting technologies appropriate to local conditions, which would assist the policy planners involved in the development of tuna fishery in Lakshadweep.

Present trend

The pole and line fishery at present is concentrated mainly at Agatti, Bangaram, Perumal Par Reef, Minicoy, Suheli Par and Bitra islands of Lakshadweep.

At Agatti, pole and line fishery including the mechanisation started in early 1960. On an average 50 pole and line boats operate for about twenty fishing days in a month at Agatti during the active fishing months *viz.* November to April. The total average annual effort is about 6,000, yielding about 1,800 tonnes of tunas with an average catch per boat of 300 kg.

There is further prospect of developing the small-scale pole and line fishery around Agatti due to the added advantage of availability and abundance of live-bait fishes from the nearby lagoons of uninhabited islands and islets like Bangaram, Tinnakara, Parali and Perumal Par Reef. The shallow sandy areas of the lagoons of Agatti, Bangaram and Perumal Par harbour a rich resource of the common live-bait fish *Spratelloides delicatulus,* which is the only live-bait fish exploited at present. Recent exploratory live-bait resource survey, conducted by scientists from Central Marine Fisheries Research Institute, at Minicoy and Agatti (November–December, 1986) in the deeper parts of the lagoons of the above mentioned islands using lift nets operated by poles revealed that the above

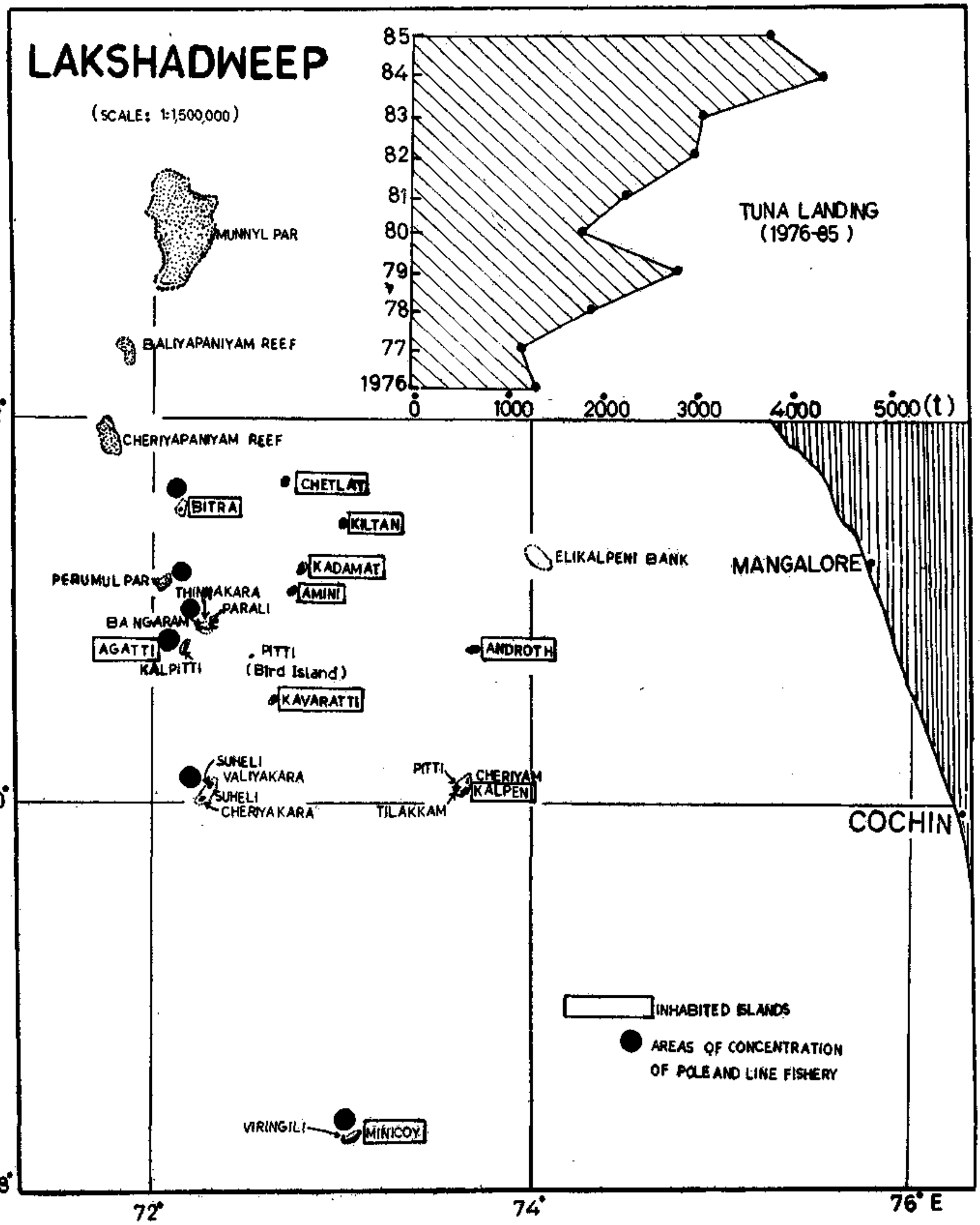

Fig. 2. Topography of islands in the Lakshadweep, areas of concentration of pole and line tuna fishery, and total landing of tunas in the Lakshadweep, 1976–'85.

lagoons also inhabit unexploited live-bait resources of apogonids, pomacentrids and caesionids which can sustain a moderate fleet of small-scale pole and line fishing boats *(Appendix)*.

Fig. 3. A pole and line tuna fishing boat with bait baskets alongside the boat at Agatti Island.

The fishermen at Agatti go out for pole and line fishing to nearby islands and islets like Perumal Par Reef, Suheli Par, Bitra, Pitti, Cheriyapaniyam Reef and Baliyapaniyam Reef, when the tuna schools are not obtained around Agatti and Bangaram. This is an added advantage for the fishermen at Agatti, as compared to those at Minicoy, who are not able to move out of the vicinity of the island without navigational aids, due to the isolated geographical location of the Minicoy Island.

Biological examination of Skipjack tuna landed at Agatti indicates that they occur in the fishery in the size range of 32-68 cm. Two major modes at 46 and 64 cm representing one and two year olds respectively are recorded.

As to the economy of tuna fishery, the fixed capital involved in pole and line tuna fishing is the cost of the hull, engine and accessories which comes to about Rs. 1,25,000/-. The cost of gear which includes the bait net, poles, lines and hooks comes to about Rs.2,500/- annually. The operational expenditure for a pole and line boat at Agatti for a fishing season, which includes the cost of diesel, lubrication oil and the food and refreshment charges of the crew (120 fishing days on average ten hours running per day for engine and for 9 fishing crew) is about Rs. 25,000/-. The average maintenance cost of hull, engine and gear is about Rs. 5,000/- per fishing season. All the expenditure is borne by the boat owner. The price of *masmin* at present is about Rs. 30 to 40 per kg. (Source: Planning Department, Secretariate, Lakshadweep, Kavaratti – Revised Seventh Five Year Plan 1985–1990, Sector – Introduction, 1987). The average *masmin* produced per boat during a fishing season is about 6 t, the revenue from which comes to about Rs. 1,80,000/- at the average rate of Rs. 30 per kg of *masmin*. Half of the revenue is the share of the boat owner and the rest is shared by the crew (usually nine). It is worth mentioning that there is no indebtedness or middlemen problem at the islands.

Minicoy: Detailed information on the pole and line tuna fishing and estimates of stocks of Skipjack and Yellowfin tunas at Minicoy in recent years are available (Madan Mohan *et al.*, 1985; Silas *et al.*, 1986a, b; Gopakumar *et al.*, 1986 MS and James *et al.*, 1986). Estimates of the effort expended, catch and catch per boat are presented below for the period 1984–'85 and 1985–'86 for comparison.

Fig. 4. Live-bait fishing using lift net.

In both the year, the Skipjack tuna occurred in a wide range of size 30–70 cm with two dominant modes

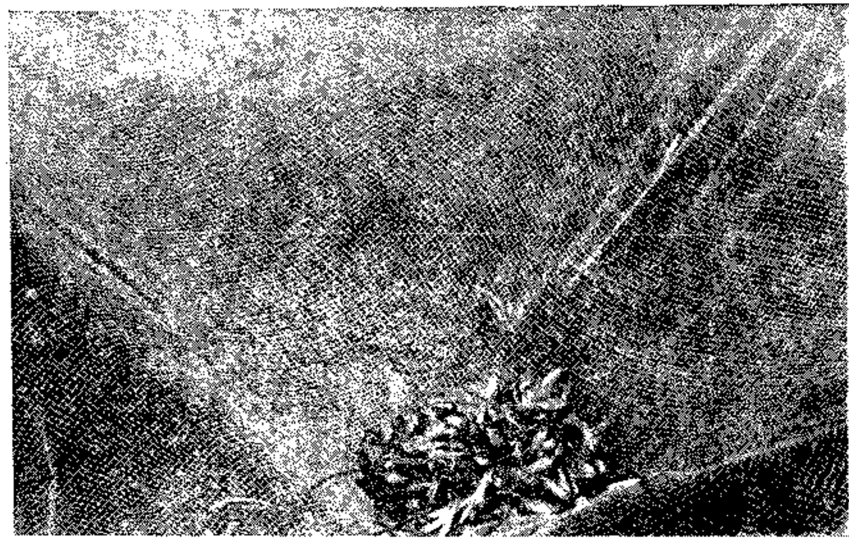

Fig. 5. Live-baits caught in a haul of the lift net.

Fig. 6. A catch of Skipjack tuna brought to the shore.

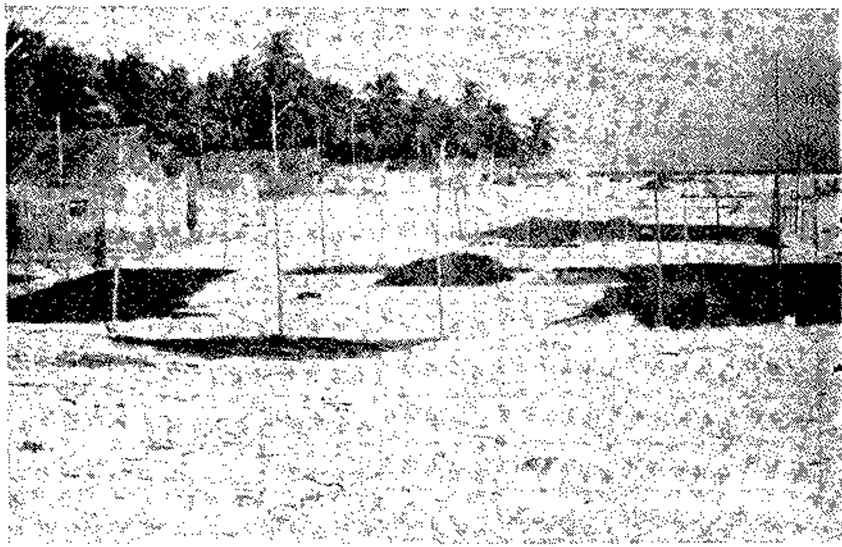

Fig. 7. A view of 'masmin' being prepared in Bitra Island.

Fig. 8. Fish wastes are simply buried on the beach in Bitra Island and this is a major health hazard in the Island.

at 53 and 63 cm representing one year and two year old groups respectively. The estimated total mortality rate of Skipjack tuna was 1.89. The standing stock and average annual stock of this species from the average catch of the two years were 455 and 1,013 tonnes respectively. The yield per recruit analysis showed that there will be increase in yield with the increase in effort, and the present level of exploitation may not affect the stock.

Year	Effort (boat trips)	Catch (tonnes)	CPUB (kg)	Skipjack (%)
1984–'85	2,649	633	240	94
1985–'86	2,601	686	264	89

Tuna fishing from schools associated with flotsam was studied at Minicoy (Madan Mohan, 1985; Gopakumar *et al.*, 1986, MS). During 1984-'85 season fifteen boats fished from these schools, and caught about 9,045 kg of tunas with a catch per boat of 580 kg. The Yellowfin tuna, *Thunnus albacares* dominated the catch (70.0%) followed by *K. pelamis*. During 1985-'86, 81 boats fished from schools associated with flotsam and caught 95 tonnes of tunas with a catch per boat of 1,176 kg. *K. pelamis* dominated the catch (50.6%) followed by *T. albacares* (48.6%). Two advantages of fishing associated with flotsam are its high catch rate and effective returns per unit of bait (in kg) used for the fishery.

Studies in the recent past on tuna live-bait fishes (Madan Mohan and Kunhikoya, 1986, MS; Pillai *et al.*, 1986; Gopakumar *et al.*, MS, 1986) and the baitfish resource surveys conducted recently throw more light on their occurrence and seasonal abundance at Minicoy (*Appendix*). Eventhough, *S. delicatulus* is the most dominant single species of live-bait fish employed for the tuna fishery, it constitutes on an average about 40% of the total baitfish catch at Minicoy. The rest of the bait catch is composed of the other species of sprat, *S. gracilis*, pomacentrids like *Chromis caeruleus*, *C. nigrurus*, *C. ternatensis*, *Pomacentrus pavo*, *Lepidozygus tapeinosoma*, apogonids such as *Apogon sangiensis*, *Archamia fucata*, *Rhabdamia gracilis* and caesionids like *gymnocaesio argenteus*, *G. gymnopterus*, *Caesio caerulaureus*, *C. xanthonotus*, *Pterocaesio tile*, *P. pisang* and atherinids such as *Pranesus pinguis*. At Minicoy, the fishery by pole and line started from time immemorial, and the traditional practice of collecting *S. delicatulus* and other deeper species which was in vogue in the Maldive group of islands was adopted at the time of introduction of this fishery at Minicoy, which is followed even now. This is in striking contrast to the other pole and line tuna fishing islands of Lakshadweep, where only *S. delicatulus* is being caught and used as live-bait. At Minicoy, during 1984–'85 season, a total of 5,595 kg of live-bait fishes were caught of which *S. delicatulus* formed 36.1%, *S. gracilis* 7.8%, *Dussumieria hasselti* 2.2% *Chromis caeruleus* 2.1%, *Lepidozygus tapeinosoma* 0.5%, *Caesio caerulaureus* 18.5%, *C. chrysozona* 12.9%, *Gymnocaesio argenteus* 12.2%, *Apogon sangiensis* 2.1%, *Rhabdamia gracilis* 1.1% and *Archamia fucata* 1.8%. In 1985-'86 season, a total of 5,051 kg of live bait fishes were caught of which *S. delicatulus* formed 22.6%, *S. gracilis* 11.4%, *C. caeruleus* 8.1%, *L. tapeinosoma* 7.0%, caesionids 35.6%, apogonids 14.9%, *P. pinguis* 0.2% and *D. hasselti* 0.2%. A direct quantitative relationship was observed between the live-bait fish catch and tuna catch, the months of good catch of tuna being those of good availability of live-bait fishes.

The present status of live-bait fishery at Minicoy indicates that the demand for the live-bait fish exceeds their availability in the atoll. The environmental deterioration by way of large scale siltation has resulted in the mass mortality of corals, which in turn affected the resident ichthyofauna, many of which are employed as live-baits.

At Minicoy, the investment on fixed capital, operational expenditure and the returns are almost similar to those at Agatti. The average crew of a pole and line boat is twelve. A unique traditional system of collective effort and sharing of the total income is prevalent at Minicoy. There are ten fishing villages in this island and each village head is known as 'Moopan.' The majority of the pole and line boats which are in the name of village Moopan is the collective property of the village. Pole and line fishing is a combined effort of the village since it involves various specialised activities such as fabrication of live-bait fish net, bait box, bait basket, diving for location of live-bait fish, bait fishing, scouting for tuna schools, chumming the shoals and hooking. There is division of labour and each fisherman is specialised in a particular aspect of fishing. Hence their catch sharing system is also very peculiar. One third of the catch is the share of the boat owner. Out of the rest of the catch, two shares go to the captain of the boat, two for the diver for bait fish location and the other crew get one share each. There is a second category of shares for the other collective efforts involved in the fishing. They include shares for the village house, Moopan, repair of boat and engine, cleaning the beach for unloading the catch, fabrication and repair of live-bait fish basket, supply of hooks for fishing, for mosque *etc.* However, if the catch is very poor, shares for the second category of collective efforts are not given. On the contrary, if the catch is very good, even some other shares which are not listed above are also given.

Suheli Par: Suheli Par consists of two uninhabited islands *viz.* Cheriyakara and Valiyakara. The fishing operations are based at Cheriyakara. The pole and line fishing around Suheli Par is practised by the fishermen mainly from Kavaratti and Agatti, who come with the fishing equipments and necessary provisions for camping at Cheriyakara for a period ranging from three weeks to one month at a time. Temporary thatched huts and other necessary arrangements are made by them for camping and for the preparation of *masmin.* Each day's catch is converted to *masmin* and stored.

On an average, twenty pole and line boats operate for about twenty fishing days in a month from Suheli Cheriyakara during the active fishing months *viz.,* November to April. The total annual effort comes to 2,400, yielding about 600 tonnes of tunas with an average catch per boat of 250 kg.

The vast sand flat of the lagoon of Suheli Par is a rich ground for *S. delicatulus* which is the only live-bait fish exploited at present. The recent exploratory live-bait fish survey revealed that the sprat *S. gracilis,* pomacentrids like *C. caeruleus,* apogonids and caesionids are also available for reasonable exploitation *(Appendix).*

The fixed capital involved in the fishing is same as that of Agatti and Minicoy. The average recurring expenditure for a fishing boat which includes the cost of diesel, engine oil, maintenance charges and food and refreshment of the crew comes to about Rs. 5,000/ and is incurred by the boat owner. The average quantity of *masmin* produced by a boat which camps at Suheli Par during one month is about 1,000 kg. The revenue from this comes to about Rs. 30,000/- at the rate of Rs. 30/- per kg of *masmin.* Half of the revenue is the share of the boat owner and the rest is shared by the crew whose number is usually nine.

It is felt that there is further scope for developing the small-scale pole and line fishery around Suheli Par. For the purpose, there is an urgent need to provide basic requirements in these uninhabited islands. As opined by Varghese (1986), infrastructural facilities including sweet water are not available in this place to attract fishermen from other islands, and the islands are privately owned. Arrangements for the camping of one mechanic with engine spare parts and arrangements for supply of diesel deserve attention. Since about 200 fishermen, on an average, camp at Suheli Cheriyakara during the fishing months arrangements for getting essential provisions and medicines require urgent attention. As stated by Varghese (1986) if Suheli Valiyakara is acquired and made into a common fishing centre with infrastructural facilities and provision of drinking water, it can be converted as a major tuna fishing centre.

Bitra: Bitra, the smallest of the inhabited islands has got the largest lagoon. Fishing around Bitra, Cheriyapaniyam Reef and Baliyapaniyam Reef is practised by fishermen mainly from Bitra, Chetlat, Kiltan and Agatti. The fishermen coming from other islands camp at Bitra in temporary huts for a period ranging from three weeks to one month at a time and the tuna catch is converted to *masmin,* as is practised at Suheli Par.

On an average, 15 pole and line boats operate for about twenty fishing days in a month from Bitra Island during November–April season. The total annual effort comes to 1,800, yielding about 450 tonnes of tunas with an average catch per boat of 250 kg.

The shallow coastal areas and the southeast sand flat of the lagoon harbour a rich resource of *S. delicatulus* which is currently exploited for tuna fishing. The exploratory live-bait resource survey revealed that the vast lagoon of Bitra possesses exploitable resources of pomacentrids like *C. caeruleus,* apogonids like *A. fucata* and *R. gracilis,* caesionids like *C. caerulaureus* and the sprat *S. gracilis (Appendix).* The above factors indicate that the small-scale pole and line fishery now in vogue in the island can be further expanded. Economics of the fishing is similar to that practised at Suheli Par.

Strategies for further development and management

Fisheries development plans in the developing countries should take account of the infrastructure, technology and human resources in addition to harvesting, processing, marketing, servicing and material supply to enable better exploitation of their fishery resources, to increase the value added to economy and to provide better employment opportunities. In the programme planning for the development of small-scale pole and line tuna fishery in the Lakshadweep, the following strategies appear to be pertinent:

(1) Reliable and timely data and statistics on all aspects of fisheries are needed for planning, implementation and subsequent monitoring of fishery management and development. Departmental capability to collect data and information at sub-regional level in the Lakshadweep should be strengthened.

(2) Of recent, in Maldives, the growth of tourism and other economic sectors has led to a reduction of manpower available, but the introduction of machanisation and subsequent increased catch rates by *masdhonis* have ensured the maintenance of annual catches. According to Varghese (1986), the grave problem faced by the fishery sector is the shortage of manpower, and blocking of manpower in the non-productive sector may be the remedial measure. While presenting the scenario for 2005 A.D. in the Lakshadweep based on some current trend of events, Sagar (1986) opined that tourism would enhance the economy of the people mainly at Agatti and nearby islands, and according to him "these sources of income have helped to fill the gap left by fishing, which has declined greatly. Some pole and line fishing continues, but the fishermen are growing old." A suitable proposal for providing employment and income generation for the local population by introduction of enhanced per capita income plans by IRDP/NREP agencies would seem to make fishing in the small-scale sector more lucrative.

(3) Development and management plans should take into account the need to protect marine habitat around the islands from any form of degradation. The coral colonies which harbour the live-bait fishes are prone to natural senescence. In addition, indiscriminate dredging and blasting of the lagoon habitat may cause altered current patterns, which may result in the siltation in the areas of coral growth, thereby causing the death of coral colonies and the resident live-bait species. Environmental damage should be kept minimum while implementing development programmes for navigation.

(4) Recent, aimed exploratory tuna live-bait resource surveys conducted in the Lakshadweep by scientists attached to the CMFRI establishment at Minicoy and Agatti (November–December, 1986) have proved beyond doubt that vast resources of potential live-bait fish species, both migrants and residents (other than the traditionally used sprat *S. delicatulus)* are available around Agatti, Bangaram, Perumal Par, Suheli Par, Kadamat and Bitra. Results of these surveys, coupled with the economically viable methods of confinement and transportation of hardy live-baits would contribute much in planning the utilisation of live-bait species of these areas, without geopardising economic viability by exhausting their resources.

(5) About 3,000 tonnes of tunas are annually exploited by the small-scale pole and line fishery and the approximate contribution by Agatti, Minicoy, Suheli Par and Bitra are 45%, 20%, 20% and 15% respectively. Of these, at Minicoy, its isolated geographical location and the consequent inability of small pole and line boats from expanding the area of fishing without navigational aids and the scarcity of live-bait fishes often experienced by the fishermen are the main constraints for the further expansion of the fishery. On the contrary, Agatti, Suheli Par and Bitra, due to their proximity to other islands and reefs and also due to the added advantage of getting enough of live-bait fishes, offer further scope for the expansion of the present small-scale pole and line fishery.

(6) The introduction of a new generation of larger pole and line vessels with adequate navigational, chilling and storing facilities for 4-5 days of fishing as recommended by Silas and Pillai (1982) is particularly significant to Minicoy Island due to its isolated geographical location. In this connection, it is worth mentioning that a radio beacon station and a radar transponder beacon (RACON) (9,300 to 9,500 MHZ) are working at Minicoy Light House. These navigational aids can be made use of by the fishermen with the help of a simple direction finder/radar equipment.

(7) The high catch rate of fishing from schools associated with flotsam at Minicoy, as stated earlier indicates that installation of Fish Aggregating Devices (FAD) may be successful in augmenting tuna production. The major impact of FADs, as observed by Silas and Pillai (1982) will be in the small-scale sector such as pole and line fishery as tuna fishery around these structures result in increased catches, reduction in scouting and voyage times from shore which conserve fuel, energy and also it is a safety factor for the operation of small boats. However, the experiments conducted elsewhere indicated that they are very successful at aggregating tunas, but have todate suffered from very short life time. Further research appears to be necessary on this subject.

(8) There is an urgent need for encouraging the fishermen of different islands other than Minicoy for the rational exploitation of the live-bait resources other than *S. delicatulus.* As already mentioned, *S. delicatulus* is the only live-bait species currently exploited for

tuna fishing in the islands other than Minicoy. This being a shallow water species which exhibits good chumming qualities is easy to be fished in desired numbers using encircling type of nets. However, the major constraint in the utilisation of this species is the large scale mortality at the time of capture, storing in livebait tanks and transportation, due to osmoregulatory stress. Moreover, since the fishery is dependent on the availability of this single species, scarcity of the same often causes abrupt suspension of fishing activities even during peak fishing months.

Steps should therefore be taken to encourage fishermen for exploiting the baitfishes belonging to Pomacentridae, Apogonidae and Caesionidae which are associated with coral colonies in the deeper parts of the lagoon by means of lift nets. Species belonging to the above groups exhibit good chumming qualities. The exploitation of these groups will, not only augment the production of tunas but also dispel the threat of over-exploitation and the consequent depletion of the stock of *S. delicatulus*.

(9) Another aspect which deserves serious attention is the absence of significant pole and line fishing activity at certain islands such as Kadamat and Kalpeni where exploitable tuna live-bait resources belonging to sprats, apogonids, pomacentrids and caesionids have been located. Initiation and expansion of pole and line fishing in these islands and encouraging fishermen for utilising the unexploited resources of live-bait fishes are suitable propositions for the policy planners involved in the development of tuna fishing industry in Lakshadweep. As referred to earlier (2), this can be achieved by providing means to make tuna fishing lucrative by developmental agencies.

The non-availability of the required number of poles used in the fishing is a problem for the fishermen, since they have to be obtained from mainland. A scheme for making them locally available through Fisheries Development Agency in the Island, as is done in the case of diesel, will be an incentive for the small-scale fishermen.

(10) In Lakshadweep, the main method of disposal of catch is by converting it to *masmin*. At Agatti, Suheli Par and Bitra, the catch after removing a fraction for domestic consumption is converted to *masmin*. Approximately 500 tonnes of *masmin* are produced annually from Lakshadweep in recent years. The price of *masmin* varies from Rs. 30 to 40 per kg. At present there is no organised marketing system for *masmin* in Lakshadweep. The development of an organised marketing system will be beneficial to the tuna fishermen since it can solve to some extent the present problems of getting proper market and sudden price fall of the product. In this context, the recent experience in the Maldives in the tuna industry is an example while planning development of production of tunas in the small-scale sector in the Lakshadweep. The loss of Sri Lankan market for export of *'Maldive fish'* led to a shift in exports of frozen and canned tunas (Anderson, 1986). At Minicoy, a portion of the catch (average 70 tonnes annually) is canned by the Government Canning Factory, and a scheme for establishing canning factory at Agatti has recently been proposed. However, in view of the economical returns, steady market for *masmin* inside the country and outside should be explored and developed.

(11) Disposal of wastes is another aspect deserving immediate attention. At present, the head, bones, fins *etc.* of the fish are discarded on the beach of the islands, which get decayed and act as breeding sites of house flies and cause health hazards during the fishing season. An effective small-scale wastes utilisation method by converting them to fish-meal may be advisable since the product can be used as an excellent manure for coconut plantations in the islands. Alternatively, the possibility of converting the wastes from tunas as ensilage should be explored.

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APPENDIX

List of major species contributing to the live-bait resources of Lakshadweep

Family	Species	Local Name
Dussumieridae	*Spratelloides delicatulus*	Hondeli*; Manjachala*
	S. gracilis	Rehi*; Churaichala+
Apogonidae	*Archamia fucata*	Rybodi*; Poothan+
	Apogon sangiensis	Dombodi*; Poothan+
	A. leptacanthus	Dikkuribodi*; Poothan +
	Rhabdamia gracilis	Rehibodi*; Poothan+
	R. cypselurus	Digubodi*; Poothan+
	Ostorhynchus apogonide	Bondu*
	O. quadrifasciatus	Rumkuribodi*; Poothan+
Caesionidae	*Caesio caerulaureus*	Hudenmugurang*
	C. xanthonotus	Donkevumas*
	Gymnocaesio argenteus	Dandimugurang* Chooraichala +
	G. gymnopterus	Geretha*
	Pterocaesio pisang	Rymugurang*
	P. tile	Rymugurang*
	P. Chrysosona	Kekkurimugurang*
Pomacentridae	*Chromis caeruleus*	Nilamahi*; Pachakotai+
	C. nigrurus	Idugidari*
	Pomacentrus pavo	Huibui*
	Lepidozygus tapeinosoma	Bureki*; Majahibureki+
Atherinidae	*Pranesus pinguis*	Fitham*; Tholiyan+

* = at Minicoy; + = at northern islands

TIDAL WAVES CAUSE DAMAGES TO COASTAL VILLAGES IN KERALA*

The nature very often takes people by surprise and causes hardships by way of natural calamities. The incidence of such calamities are relatively more in the coastal areas. Every change in nature is reflected some way or the other along the sandy sea shores. One such instance occurred along the Kerala coast between Aarattupuzha (Alleppey District) in the south and Nattika (Trichur District) in the north for a distance of about 150 km. In the midnight of 10th October, 1987 when the coastal dwellers were peacefully sleeping after a day's hectic fishing activities, giant tidal waves started mounting in the sea and struck hard against the shore and rolled over the sandy beach. The water spilled over the sand mounds as if from a bowl filled to the brim. The sea water freely entered the thatched huts on the sea shore and filled them with knee deep or more water. The fishermen ran helter-skelter for their lives and properties.

On receiving the news a team of scientists from the Central Marine Fisheries Research Institute, Cochin visited the southern area between Thottappally & Aarattupuzha for an on-the-spot assessment of the situation. It was found that the tidal waves had caused considerable damages to houses and crops between Pallana (south of Thottappally Spillway) and Aarattupuzha (north of Kayamkulam bar mouth) especially where the sea walls were absent. It is a fact that in this area, as is the case with major portion along the Kerala coast, the land behind the beach is much lower than the mean sea level and therefore the tidal waters once crossed over the beach could find a convenient way into the coastal road and inundate agricultural lands thereby causing considerable destruction to the crops and filling fresh water wells in the villages with saline water.

At least 10 houses have been damaged in this area mainly due to heavy deposition of sand. In some houses it was found that at least a metre of sand had got deposited (Figs. 1 and 2). The sand found entry into these thatched houses through the side protections which are also made of coconut leaves. The team of scientists could witness people removing sand from inside the houses.

*Prepared by K.J. Mathew, N.Surendranatha Kurup, V.Chandrika, G. Balakrishnan and K. Gopalakrishna Pillai, CMFRI, Cochin.

Over a stretch of 17 km, the coastal road was found cut across at three places namely Pallana, Mangalam and Aarattupuzha due to the tidal flow. Deep trenches were formed across the road which disrupted the traffic Figs. 3 and 4. However, local people made alternate means to make good the way.

Several low lying areas were inundated with knee deep or more sea water especially at Mangalam. Fortunately these are areas where coconut trees are grown and hence no destruction to such crop has occurred due to saline water. In order to find out whether any alarming situation has been developed on account of inundation, water samples were collected for the analysis of environmental parameters including primary productivity and bacteriology. Simultaneous to this, samples were collected from the sea side also for a comparative idea. The parameters analysed and the results obtained are given in Table 1.

Table 1. *Details of the environmental and biological parameters analysed for the inundated and surf waters*

	Diss. O_2 (ml/l)	Salinity (‰)	Primary productivity (mgC/m³/day)	Microbial parameters Yeast (No/ml)	*E. coli* (No/ml)	Heterotrophs (No/ml)
Inundated water	3.52	23.6	500	22	2	78.4×10^{5}
Surf water	5.05	33.3	114	296	64	96.8×10^{6}

The results showed that the salinity of the inundated water was less by 10‰ than the sea water and this was due to its dilution with rain water. There was a marked difference in the rate of dissolved oxygen, being less in the stagnant inundated water but this was in no way less than the minimum required level for existence of life. The primary productivity value showed high rate of production in the over flowed water. As far as the bacterial flora was concerned the yeast and heterotrophs were seen in greater numbers in the inundated water

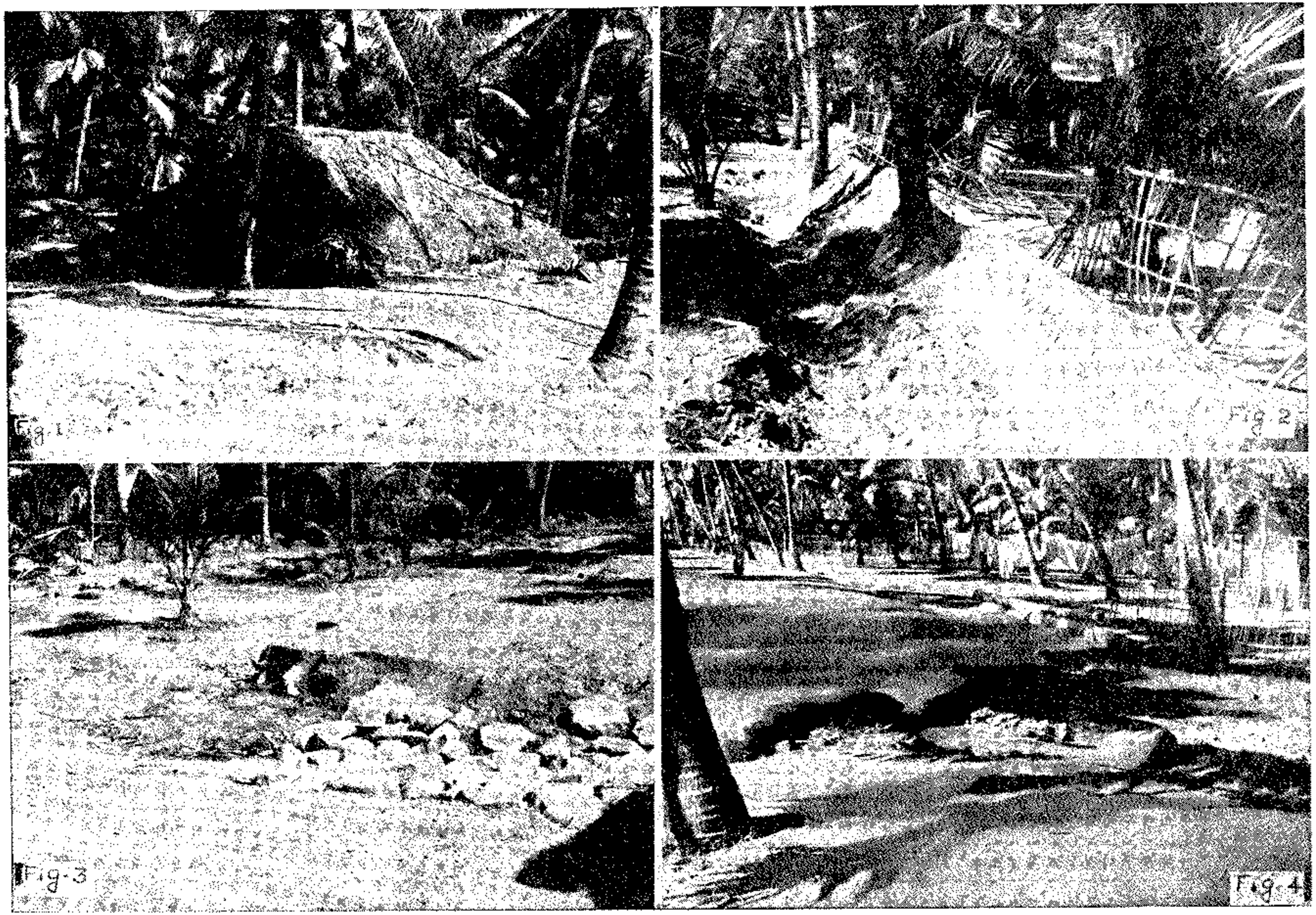

Fig. 1. The tidal waves have deposited sand upto the roof level of this hut (1987). Fig. 2. The fishermen have made sand ridges as a precaution against further erosion. Also please note the damaged fencing (1987). Fig. 3. A deep and wide cut across the road at Mangalam filled by people with granite stones for restoring traffic (1987). Fig. 4. Another view of the damaged road at Aarattupuzha (1987).

and *E. coli* though present in smaller numbers was relatively more. The large number of *E. coli* in sea water may be due to faecal matters found here and there in sea coast. The results obtained clearly indicated that the stagnant water was quite healthy and may not cause any health hazard to the local people.

The tidal waves as detailed above have swept the land at other places also namely Narakkal and nearby areas, and between Kodungalloor and Nattika on the same day and at almost the same time. According to reports, 2,000 houses have been affected of which 40 were totally destroyed and 100 partly in the Kodungalloor and Nattika taluks. The most affected area was between Kulimuttom and Kaippamangalam. The waves which rose to a height of 3 m caused havoc in a 10 km stretch of coast line in this area. In some places water reached upto the National High Way which is about 4 km away from the beach. The low lying areas were inundated to such an extent that the evacuated people had to be taken to safe place in canoes.

Four hundred families who had to run away from their houses were given temporary shelter in the local schools at Kaippamangalam, Perinjanam and Aarattukadavu. There have been considerable damages to fishing nets and canoes. At Perinjanam six canoes have been swept away by the tidal waters. Several coconut trees and other trees have been uprooted in this area. Vast areas were inundated with sea water.

There was no apparent reason for such a natural calamity along the coast except for the fact that it was a full moon day on the 7th of October. The sky was rather clear and there was no wind of any mentionable velocity.

The heights of the highest high tides predicted for Cochin in different months in 1987 are given in Table 2 for the sake of understanding whether there could be any unusual high tides indicated for October which could rise above the usual heights. However, it is found that in October the highest high tide measured 0.99 only which was to occur at 0228 hrs on 25th and therefore no positive correlation could be made between the conventional tides and the one which occurred in the night of 11th October. Therefore, it may be concluded that the tidal waves would have been the result of some changes in the climatic or oceanic conditions in the open sea.

Table 2. *The height of spring tides and their details predicted for Cochin during* 1987

Month	Height of the spring tide (m)	Date	Time (hrs)
January	1.19	2	0239
February	1.17	1	0246
March	1.08	1	0137
April	1.03	29	1411
May	1.05	15	1419
June	1.03	12, 13, 14	1343,1424, 1505
July	1.00	13	1443
August	0.94	10, 11, 12	1407,1407, 1431
September	0.89	9	1309
October	0.99	25	0228
November	1.09	23, 24	0224,0303
December	1.16	22, 23, 24	0218,0252, 0328

There have been earlier cases of such sudden changes in the sea. One such instance occurred in the midnight of 29th August, 1980 when tidal waves rose over the beach between Alleppey and Quilon in the same manner as has happened at present. The waves swallowed considerable stretches of sandy beach. The greatest havoc was caused at the mud bank region in the Ambalapuzha–Thottappally area where tens of coconut trees were uprooted and seven houses were washed off leaving no signs of their existence. Two fish storage sheds built in bricks and cement were also completely destroyed at Ambalapuzha and heavy movement of sand occurred. Inundation of low lying areas also occurred.

The mud of the mud bank was completely dissipated over night and rough sea prevailed there. The dissipation of the mud bank aided by the tidal waves in 1980 was quite sudden and phenomenal unlike in the normal way which is a slow and gradual process. Part of the mud of mud bank was washed ashore along with fishes, shells and polychaete colonies and the rest was aggregated in the sea to form a platform of mud of about 3 km long and 0.5 km wide which could be seen above water level during the low tide. However, within 12 hours the aggregated mud was beaten away and thus the mud bank was completely dissipated causing rough sea in the area.

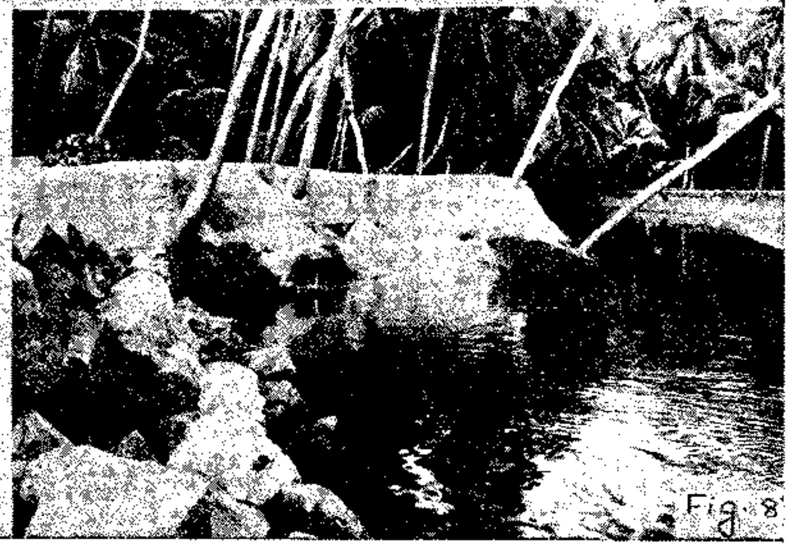

Fig. 5. Streaks of mud seen on the beach at Purakkad mud bank area. Major part of the mud is covered by sand (1980). Fig. 6. The mud thrown on to the beach at Purakkad after being baked in the sun (1980). Fig. 7. The sea has come far interier into the land. In the water is seen the sea wall which was no barrier to the roaring tidal waves. A scene at Ambalapuzha (1980). Fig. 8. Vast areas of unprotected beaches were eroded along the Alleppey–Quilon coast and the sea had come to the coconut plantations. A scene at Purakkad (1980).

In the present case since normality returned after about 24 hours when the team visited the tidal wave hit areas it could see normal life prevailing everywhere including fishing operations except in the case of damaged houses.

Eventhough of a short duration, such tidal waves can cause considerable damages and miseries to the coastal populace. It is extremely difficult to predict such happenings. One thing noticed was that damages were minimum wherever sea walls are present. Therefore the practical solution to such sudden natural calamities is to protect the coast line by constructing sea wall wherever the same is not present. These would save the land and other properties even during other times especially the southwest monsoon when heavy coastal erosion takes place as a regular phenomenon.

Thanks are due to Shri V. K. Balachandran, Technical Assistant for helping in the analysis of the productivity samples.

AN UNUSUAL CATCH OF THREAD-FIN BREAMS BY TRAWL NET AT VERAVAL*

Introduction

The thread - fin breams, locally known as 'Lal machala' constitute 0.6 to 12.39% of the total catch during the different months of their landing at Veraval. After the monsoon season, the trawl net fishing starts by the end of September or beginning of October. But in this year (1986), the operations commenced earlier and fishing was carried out from the middle of September onwards. During the mid September to October beginning, the trawlers brought heavy catch (estimated to be about 2.400 tonnes) of *Nemipterus* spp. and the observations recorded during that period is being reported here.

Fishing operations and fishery

The trawlers set out for fishing in the early morning and return in the afternoon. Each trawl unit normally undertake 2 to 3 hauls per trip, each haul lasting for 2 to 3 hours at depths varying between 30 and 40 metres.

From 16-9-1986 onwards the trawlers brought huge catches of *Nemipterus* spp. (Fig. 1). The catches which were abundant in the initial period started declining subsequently. The date-wise catch and other particulars are given in Table 1.

*Prepared by S. G. Raje and A. P. Lipton, Veraval Research Centre of CMFRI, Veraval.

Table 1. *Date-wise estimated number of units, catch, C.P.U.E. percentage and species composition of* Nemipterus *sp.*

Date	No. of units	Estimated catch (kg)	C.P. U.E. (kg)	% *Nemipterus* in total landing	Species composition (kg) *N. mesoprion*	*N. japonicus*
19-9-'86	105	1,80,900	1,723	88.11	1,75,016	5,884
22-9-'86	73	75,926	1,040	61.54	72,521	3,405
24-9-'86	145	56,926	389	29.72	54,513	1,823
26-9-'86	103	29,631	288	29.21	28,015	1,616

It could be seen from Table 1 that the percentage of *Nemipterus* spp. in the total landing was very high (88.11%) which decreased later (29.21%). In the catches two species *viz. N. mesoprion* and *N. japonicus* were recorded. The *N. mesoprion* dominated in the catch (94.55%) The *Nemipterus* in general are known to have their own specific (defined) depth ranges (Eggleston, *J. mar. biol. Ass. India*, **11**: 357-364, 1973).

The total estimated landing of *Nemipterus* spp. during the observation period of September was 2,399.621 tonnes. During this period, each boat was estimated to bring 804.70 kg of *Nemipterus* spp. which constituted 55.14% of the landings at Veraval.

Fig. 1. Trawl catch of *Nemipterus* sp. at Veraval.

Biological observations

Sex ratio and maturity

The sex ratio of *N. mesoprion* was 1:1 whereas that of *N. japonicus* was 1:3. The percentage of male and female, their size range and maturity are given in Table 2.

Table 2. *The size range (in paranthesis), sex ratio and relative abundance (%) among resting, developing and gravid* Nempterus *spp. landed at Veraval*

Name of species	Male	Female	Resting	Developing	Gravid
N. mesoprion	51.43 (113–170 mm)	48.57 (113–160 mm)	11.76	17.65	70.59
N. japoniceus	24.14 (149–172 mm)	75.86 (142–164 mm)	—	18.18	81.82

It could be noted from Table 2 that less number of males was encountered among *N. japonicus*, which could be attributed to their migratory behaviour. Eggleston (1973) reported that only sexually mature large males migrate to the deeper zones. It has been also stated by Eggleston (1973) that in the shallower part, smaller and sexually mature fish aggregate during the spawning season.

Feeding condition and food

The stomach content analysis of both *N. mesoprion* and *N. japonicus* indicated that stomachs of more than 60.0% and 80.0% in both the species respectively were empty (Table 3).

Table 3. *Feeding conditions of* N. mesoproin *and* N. joponicus

Species	Percentage: Gorged	Full	1/2	1/4	Trace	Empty
N. mesoprion	2.86	2.86	17.14	8.57	5.71	62.86
N. japonicus	—	3.45	—	6.90	6.90	82.75

The occurrence of more specimens with empty stomachs might be due to their feeding behaviour. Eggleston (1973) pointed out that *Nemipterus* sp. are day light feeders. As the trawling commenced in the early morning it was likely that majority of them was caught before feeding.

The only food item observed in the stomachs of both species of *Nemipterus* was *Acetes indicus* which was observed as freshly injected or partially digested conditions.

Size range

Size range of *N. mesoprion* was 90 to 200 mm (TL) with modal size of 130 mm. In *N. japoncius* the size ranged between 140 and 200 mm with modal size of 160 mm. It is presumed that the shoal belong to the first year group.

Fig. 2. *Nemipterus* sp. being transported through auto carriers in bulk quantities at Veraval.

Economics

Due to the heavy landing and lack of demand in the market and as the fish landed were of smaller sizes they were sold at the landing centre itself at Rs 0.70 per kg (Fig. 2). The total value realised during the second half of September at Veraval has been estimated to be Rs. 17.00 lakhs and the value per boat per day to be Rs. 563.29. The fishermen could recover the operational expenditure including the expenditure on food for crew members from the sale proceeds of *Nemipterus* spp. itself.

Remarks

The thread-fin breams form an important demersal fishery resource at Veraval. Their fishery is supported by two species *viz.*, *N. japonicus* and *N. mesoprion.* Although *N. japonicus* was recorded throughout the year, the *N. mesoprion* formed a seasonal fishery only.

Considering the bumper catch of *Nemipterus* spp. it becomes imperative to suggest steps to utilize the catch in diversified ways. It has been indicated that bacteriological peptone prepared from *Nemipterus* was of high quality. Also it is essential to observe some regulatory measures as more gravid specimens were observed in the catches.

Acknowledgements

Thanks are due to Shri B. P. Thumber, Shri H. K. Dhokia and Shri M. S. Zala for providing technical assistance during the observations.

INTRODUCTION OF MECHANISED-CUM-SAIL CRAFTS AT KAKINADA*

Kakinada is one of the important mechanised fish landing centres of Andhra Pradesh. Fishery resources from inshore waters off Kakinada have been traditionally exploited by indigenous crafts, *ie.* 'Navas' (plank–built boats). At present these 'Navas' cover only the nearby fishing grounds. Recently mechanisation of the fishing vessels is being taking place along this coast and this has resulted in increase of catches and thereby better income for the fishermen. These motorised beach-landing crafts conduct fishing at distant fishing grounds at depths ranging from 70 to 90 metres using synthetic drift gill nets of larger meshes. These fishing crafts are built by new construction material – the fibre glass. These beach-landing crafts are without keel and therefore flat-bottomed. They have long fore-deck and short stern deck. They are usually painted red and this colour helps their identification in the sea. The boats are fitted with in-board two cylinder diesel engines of 10 H.P. Generally the weight of the engine is 115 to 120 kg. The air cooled or water cooled engine is fitted at stern of these boats. The length of the boat is 8.45 metres, beam 2.27 metres, depth 0.828 metres and draft 0.45 metres and has a gross tonnage of 2.5 tonnes. There is no gear system to reverse the boat. Fuel tank is fitted at one corner very near to the engine. A mast and sail are provided in this craft as reserve, and are used whenever the engine fails.

*Prepared by C V. Seshagiri Rao, Kakinada Research Centre of CMFRI, Kakinada.

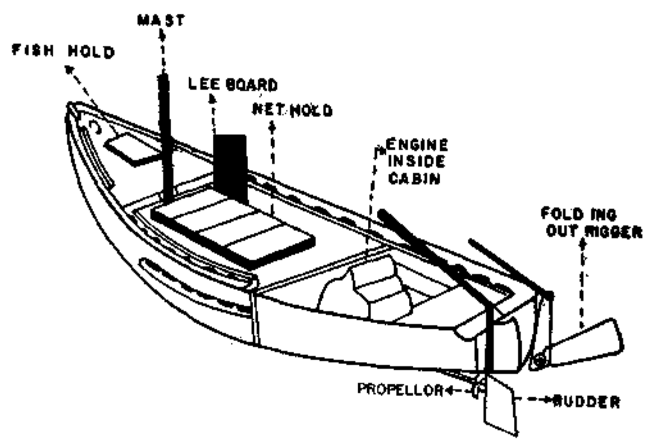

Fig. 1. A mechanised-cum-sail craft operating at Kakinada.

The craft is very economical as it requires very less repairs and maintenance. These crafts are manned by four persons. It does not require any jetty or wharf facilities to land. There is a fish hold to keep the fish caught and a net hold to keep the nets at the longer fore-deck. There are some arrangements of folding out-rigger (balancing) board and a straight lee board to manage the large sail during sailing. Durability of hull is longer when compared to the materials of other boats. The local boat building yard of Andhra Pradesh Fisheries Corporation at Kakinada is constructing these beach-landing crafts. They issue these boats to marine fishermen under Small Farmers Development Agency (S.F.D.A) on 50 percent subsidy scheme.

These beach-landing crafts leave the landing centre daily during afternoon and return the next day morning. Fuel consumption of the engine is at the rate of 1.5 litres per hour. Usually the running time of the engine is 6-8 hours for to and fro fishing trips. The average speed is 8 to 10 kilometres per hour.

Some of these motorised beach-landing crafts are regularly operating at Subbammapeta, Godarigunta, Kondalupeta, Kotha, Kakinada, Parralopeta, Dummulapeta, Yetimoga, Pagadalupeta and Uppulanka. In the lean season some of these crafts are taken to other places namely, Bhairavipalem, Rameswaram, Vadalarevu of East and West Godavari districts and Machilipatnam area and Puri, Paradeep and other places in Orissa State.

Synthetic drift gill net: These motorised beach-landing crafts conduct night fishing using synthetic drift gill nets with larger mesh sizes. The total length of these drift gill nets varies from 1000 - 1600 m and 9 m in height. Generally 45–75 webbed pieces are plied together. Round cement sinkers and cylindrical synthetic floats are used to keep the net vertical in water. The entire net is fabricated from No. 5 or 6 dark blue multifilament twisted twine.

These motorised crafts operating synthetic drift gill nets land mainly large sized pelagic fishes such as seer fishes, tunas, pomfrets, cat fishes, elasmobranchs, carangids, thread fins and other fishes in order of their abundance.

Sometimes the fishermen operate these gill nets as bottom set gill nets using more number of cement sinkers to catch demersal fishes.

At the time when the motorised beach-landing craft was introduced at Kakinada during June, 1986, its cost was about Rs. 1,23,600. The price details are as follows:

Cost of boat fitted with engine and its accessories	Rs.	1,22,000
Cost of canvas sail	Rs.	1,000
Cost of iron anchor	Rs.	150
Cost of 4 small oars	Rs.	100
Cost of miscellaneous items	Rs.	350
Total	Rs.	1,23,600

The drift gill net fishery with motorised crafts has proved highly profitable due to the increase in quantity and quality of fishes caught. The increased speed and accessibility to the distant fishing grounds are other factors responsible for this higher income.

NEWFANGLED TACKLES FOR CEPHALOPODS*

Eversince cuttlefishes and squids entered the export market, priority for their fishing, especially for the former whose value had been leaping ahead in recent times, is next to that of prawns. The cuttlefish *Sepia pharaonis,* constitutes an important seasonal fishery in the southern part of the west coast of India (Kanyakumari District in Tamil Nadu and Trivandrum District in Kerala) during the September–February period, while the squid fishery of this area, dominated by *Loligo duvaucelli,* is also seasonal almost coinciding with the same period. Though cuttlefishes here form a bycatch in gears like boat seine and shore seine, the major landings come from a few simple indigenous varieties of gears of either local innovation or adaptation from established gear elsewhere. The major squid catches of this area are from boat seine; yet operation of miniature anchor hooks also contributes substantially to its fishery.

What follows is a brief description of some of these less-known varieties of gears. These have been designed

*Prepared by Jacob Jerold Joel, Vizhinjam Research Centre of CMFRI, Vizhinjam and J. P. Ebenezer, Kanyakumari Field Centre of CMFRI, Kanyakumari.

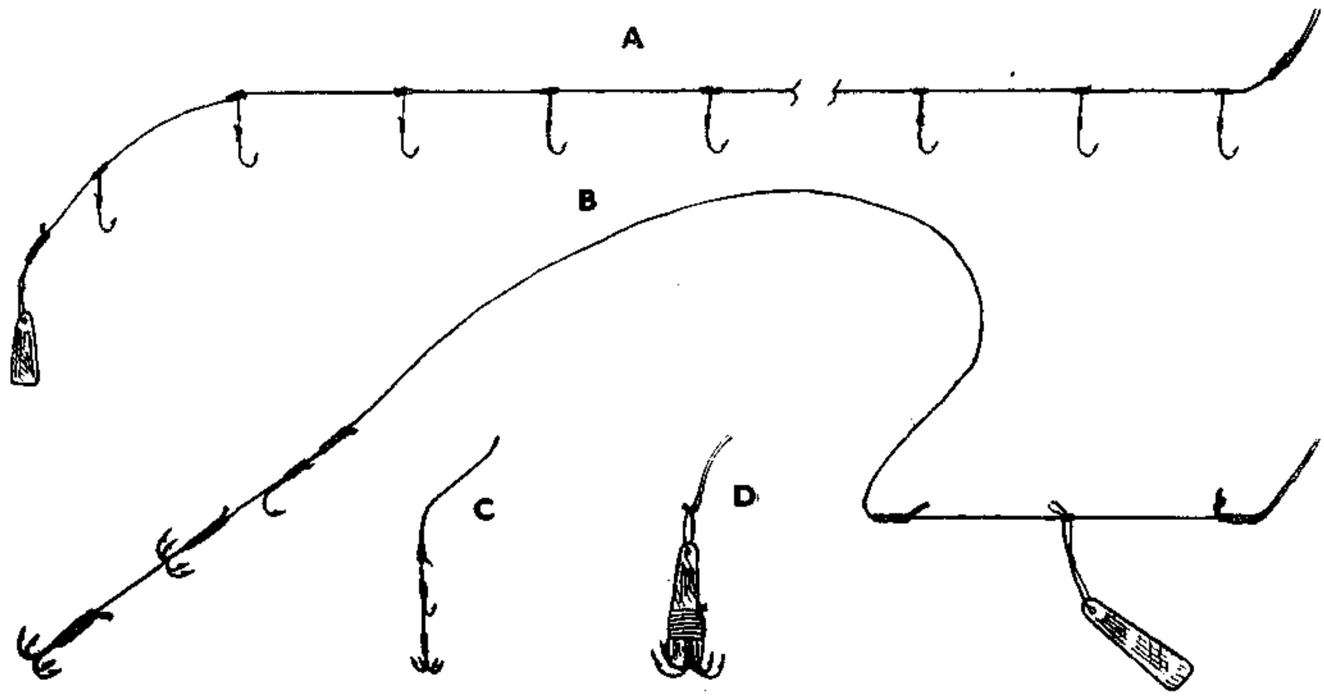

Fig. 1. (A) *'Vidukayiru'* for cuttlefish, (B) *'Nangoora choonda'* for cuttlefish, (C) *'Nangoora choonda'* for squid and (D) *'Disco nangoora choonda'* for cuttlefish.

making use of the line-sinker-hook-bait combination and the fishing technique is hand-jigging, with the species getting hooked or getting attached strongly to the bait till it is hauled up to the surface.

'Vidukayiru' for cuttlefish: This gear is similar to 'Achil' described by Lazarus *(Indian J. Fish.*, **31**: 368-370, 1984) but with minor variations to suit cuttlefish collection. Here, the main line, a nylon thread of gauge No. 60 and a length of 5 m or more, has a sinker weighing about 150 g attached at its far end. Short branch-lines, each having a hook (size No. 10 or 9) at its end are rigged to the main line at definite intervals. The length and the space between the branch-lines are so adjusted that no two adjacent branch-lines tangle with each other. Thus, if the length of the branch-line is 15 cm, the space between two adjacent branch-lines has to be a minimum of 30 cm or a little more. The other end of the main line is connected to a sufficiently long hand rope. Similarly, when many crafts are concentrated in a small area, the main line is often restricted to less than 5 m to avoid intertwining of many units. Lengthy and thicker main line (nylon thread No. 100) with more hooks (sometimes upto 100) and lengthier branch-lines are used when fishing by a crew is confined to a limited area. A heavier sinker is used when the impact of the ocean currents is high.

The bait used is the meat of crab or fish, the arms of cuttlefish *etc.*, depending on their availability, or synthetic fibres of different colours. The fishing operation generally is at 30 to 50 m depth from a catamaran with one or two men, or from a plank-built boat with outboard-motor and a crew of four or five. All the crew members operate the gear, sometimes each more than one unit. The operator holding the hand rope, lets the gear into the water till the sinker touches the sea bed and jigs it occasionally. When the cuttlefishes cling to the bait, the pull is felt by the operating fisherman dextrous at it and he slowly pulls the hand rope upwards. As the catch nears the surface, it is collected using a scoop net. This gear, according to the fishermen, is used to catch cuttlefishes that concentrate near the bottom during breeding season.

'Nangoora choonda' for cuttlefish: This is a simplified form of anchor hook, as the meaning of the vernacular term indicates. The design and operation of this gear has been elaborately dealt with by Prabhakaran Nair *(CMFRI Bull.*, **37**: 152-156, 1986). Two thin iron rods (usually umbrella or cycle spokes) of about 30 cm length, a sinker weighing about 150 g, a few metres of No. 60 nylon thread, eight to ten hooks of the size No. 10 or 9, a hook in size No. 8 or 7, and 30 to 50 m long

nylon rope are the essential parts of this gear. At the tip of one of the iron rods, a circle of hooks is formed by tying 4 or 5 hooks. A similar circle of hooks is made a few centimetres above the first circle, and a few centimetres further above this, a hook of the size No. 8 or 7. The free end of this rod is then connected to a 1.5–2 m long nylon thread, the other end of which is tied to one end of the other iron rod. At the centre of the second rod, an iron weight is hung on a short-nylon thread. The opposite end of this rod is connected to a nylon hand rope long enough to operate at the required depths.

Though artificial bait (synthetic fibres of many colours), meat of fish and arms of squid and cuttlefish are used, living crab is preferred in some areas. The bait is fixed on the single hook above the two tiers of hooks. In the case of crab as bait, after removing the chelate legs, the crab is tied to or hooked in the barb. The movements of the legs of the live crab are supposed to attract the cuttlefish more. When the gear is lowered at the fishing ground, the cuttlefish engulfs the bait with its arms and, feeling the additional weight in the gear, the operator, moving the gear as to give a few jerks at the hooks, pulls up the rope. The jerk causes the cuttlefish to be ripped by the upper tier of hooks. Any escaping from the upper hooks, has the chance of being caught in the lower. The catch on reaching the surface is collected by a scoop net or picked out by hand. During an operation normally only one (very rarely more than one) cuttlefish is caught by one unit.

Commonly seen modifications of this gear are: (a) Only a single circle of hooks at the tip of the rod with a hook attached a few centimetres above. (b) A single hook of size No. 7 or 6 alone in the place of anchor hook, the bait being either tied to the shank or pierced in the crook of the hook. Here, instead of getting hooked, the victim holds on to the bait and is pulled to the surface and collected by a scoop net. (c) A nylon line with not more than 10 branch-lines, each having one hook of size No. 10 or 9, instead of the rod with circle of hooks. Here also the exploitation is based on the victim's tendency to grip at the bait.

'Nangoora choonda' for squid: The squid-jigging practiced in this area is similar to Vietnam type. The gear is a miniature form of anchor hooks described above for cuttlefishes, but with minor differences. Here, a thin 9 cm long iron rod has 4 hooks of size No. 14 attached at the distal end to form a circle. A hook of the same or slightly larger size is tied a few centimetres above the circle. The other end of the rod is directly connected to a monofilament (No. 60) nylon hand line. The preferred bait is meat or arms of squid itself, but other items like meat of fish or crab, or synthetic bristles are also used. The bait is tied to or pierced into the hook provided for this purpose above the circle of hooks. A man sometimes operates 2 to 4 units at a time, holding the hand lines by the toes also. The ripped squid is pulled to surface and collected into the craft. According to the fishermen, night operation is very yielding during peak season.

'Disco nangoora choonda' for cuttlefish: This gear is made of a conical iron or lead weight of 150 to 250 g and a few hooks of the size No. 10 or 9. By fastening 4 or 5 hooks around the broad end of the weight, a circle of hooks is formed. An eye provided at the tapering end of the cone facilitates rigging through it of a nylon thread of variable thickness (normally No. 100) and required length. The lure is a nylex cloth-bit, preferably golden coloured, which envelops the cone just above the hooks. The method of fishing is jigging and ripping as in 'Nangoora choonda' for cuttlefish described above.

RECOVERY OF A RINGED 'DUSKY SHARK' *CARCHARHINUS OBSCURUS**

A 'Dusky shark' belonging to the genus *Carcharhinus* was landed on 28–3-1987 at Veraval with a ring pierced through the first dorsal fin and the right pectoral fin around the girth of body (Figs. 1 and 2). The shark was caught by gill net (28 mm mesh), 65 km southeast of Veraval at a depth of about 80 m. The morphometric measurements (in cm) of the shark are as follows:

Morphometric measurements (cm) of Carcharhinus obscurus

1.	Total length	185
2.	Fork length	147
3.	Pre caudal length	119
4.	Pre second dorsal length	120
5.	Pre first dorsal length	53
6.	Diameter of eye	2.7
7.	Length of pectoral	36.9
8.	Dorsal caudal margin	52
9.	Height of first dorsal	25
10.	Height of second dorsal	7.2
11.	Height of pelvic	4.7
12.	Height of anal	7.7
13.	Height of trunk	22
14.	Height of caudal peduncle	7.0
15.	Pre oral length	11.0
16.	Width of mouth	17.3
17.	Inter-narial space	10.4
18.	Length of right clasper	23.2
19.	Length of left clasper	20.5
20.	Inter orbital space	18.6

Dental formula

i. Upper jaw (4 rows)	
a. Right upper	14 (I row)
b. Left upper	14 (I row)
ii. Lower jaw (4 rows)	
a. Right lower	12 (I row)
b. Left lower	12 (I row)

*Prepared by A. P. Lipton, S. G. Raje, Ravi Fotedar and Ranjit Singh, Veraval Research Centre of CMFRI with the technical assistance of Thumber and Zala.

The gut was almost empty but with traces of bones of ribbon fish.

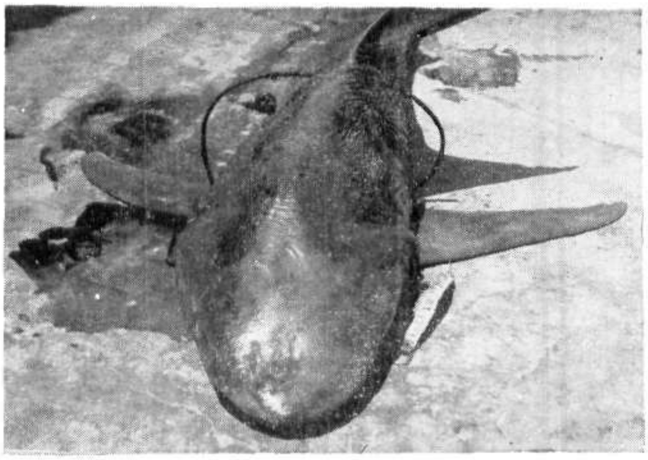

Fig. 1. Close frontal view of *C. obscurus.*

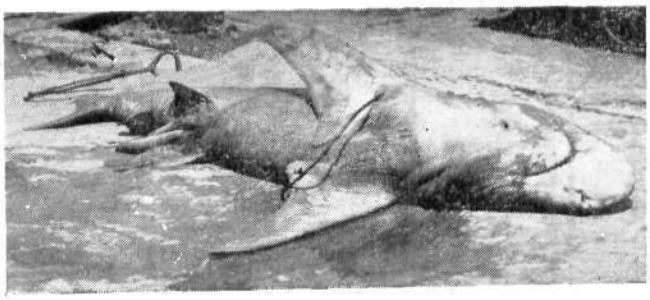

Fig. 2. Ventral view of *C. obscurus* showing the ring pierced through the pectoral fin.

The ring around the specimen was black and had no joint or marking. Tag or label was not present. The diameter of the ring was 28.64 cm and the thickness was 0.56 cm. The ring is preserved in the Veraval Research Centre of CMFRI.

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