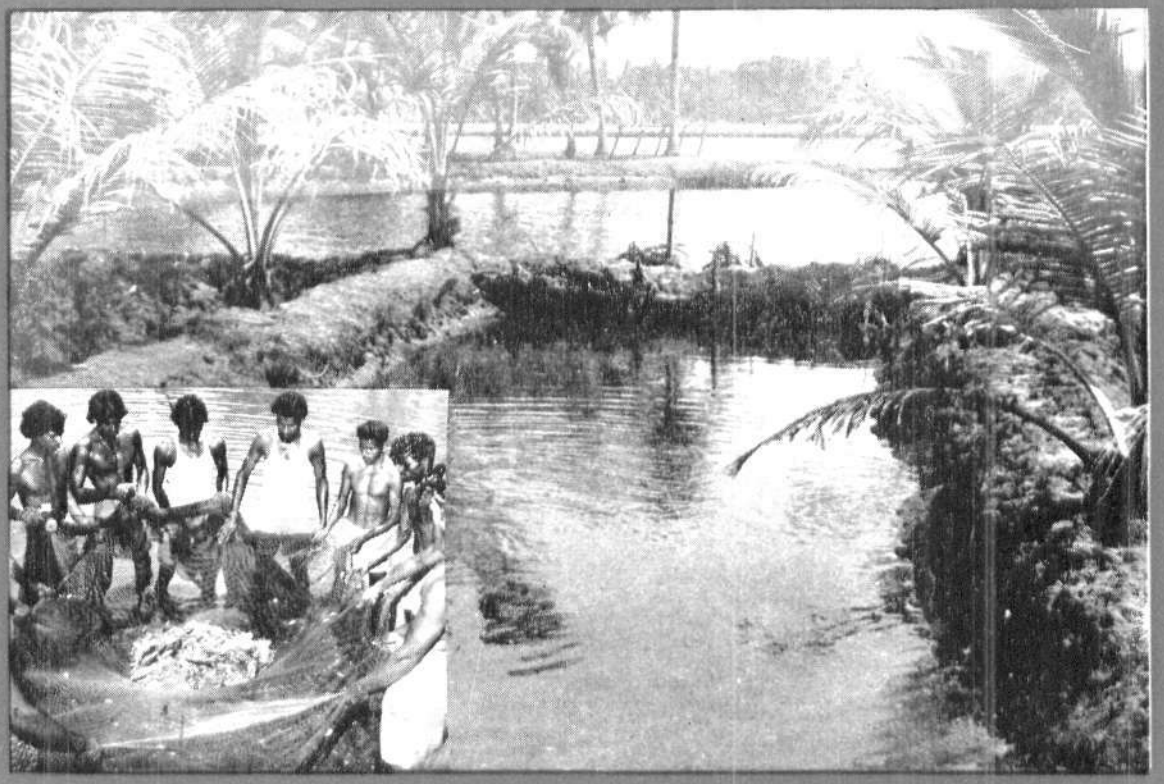
MARINE FISHERIES INFORMATION SERVICE



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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.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser.*, No. 62: 1985

CONTENTS

Cover photo : Fish farm in Cochin backwater area among coconut groves. Part of harvest is shown in inset

FIN FISH CULTURE

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Introduction

The potential inshore area in less than 18 m depth available for near sea farming along our coast is estimated to be of the order of 9 million hectares. But this zone is subject to the vagaries of the southwest and northeast monsoons. Sheltered bays with marine condition are restricted only to Andaman and Nicobar islands and Lakshadweep Archipelago. The paucity of such ideal bays for fish culture is compensated by extensive backwater areas at numerous river mouths, tidal creeks/inlets, mangrove swamps and lagoons. The total area under this complex ecosystem is estimated to be 2 million hectares. Out of this, the 'Pokkali' fields of Kerala, 'Bheris' of West Bengal, 'Gazani' farms of Karnataka and 'Khazan' lands of Goa accounting for 30,000 ha are known to be used for traditional and historical practice of fin fish culture raising the two major cultivable groups of fin fishes namely, mullets and milkfish with an annual yield known to vary from 35 – 750 kg/ha/year, depending on several factors. The pearl spot, bhekti, sand whiting and thread fins are also often grown. In other maritime states like Andhra, Tamil Nadu and Maharashtra hardly any cultivation in backwater is known except for a 100 ha area used in Gujarat.

The pioneering suggestion made eight decades ago to contemplate marine fish culture in India came from Hornell (1911). His later effort in 1915 to establish a fish farm in the Hare Island area at Tuticorin received a set back after inital experiments due to extreme difficulties in farm management during northeast monsoon season. Consequently the farm was abandoned. Fish farming work in Kerala started in 1940 at Narakkal, growing mullets and milkfish along with prawns in about 100 ha which gave encouraging production of nearly 1,000 kg/ha/year. The Madras Fisheries Department renewed fish farming experiments in 1944 by constructing a farm in a tide fed marshy swamp at Krusadai Island, near Pamban, for growing milkfish and mullets. Recurring hardship and handicaps forced discontinuance of these experiments also. Such trials in farming efforts underlined the paramount need for accelerated involvement to evolve suitable farm management strategies for different ecological niche.

Awareness was also created to focus our attention on several areas such as knowledge of the influence of water temperature and salinity in the grow-out systems on the candidate species cultured, understanding of the interaction of several environmental parameters in the culture system, basic productivity of different habitats, availability of suitable sites based on soil types and microfauna production, seed stock availability in space and time and devising techniques of transporting the seeds from areas of availability to areas needing them. Evolving appropriate growing techniques and assessing the production capabilitites of different methods were identified as priority areas for experimentation.

Fin fish culture in C. M. F. R. I.

In this context it will be of interest to mention here the significant advances made by the C.M.F.R. Institute in fin fish farming research. Pond culture experiments carried out by Tampi (1960) in saline mud flat at Mandapam emphasised the need for compensating the porous, loamy soil character of the area with low nutrient contents by improving pond designs and supplementing the food energy source. Other crucial problems to be solved were (a) overcoming disadvantages encountered during cyclonic months resulting in tidal erosion of bunds (b) avoiding silting of water supply channels at the water front due to tidal action and (c) solving the problem of low profile tidal amplitude during many months resulting in scanty water exchange in the ponds affecting the water quality. These adverse factors were considered common to other sectors of the east coast as well and called for improved

Fig. 1. A view of some ponds constructed with granite and cement (Photo: Courtesy of Shri P. Bensam).

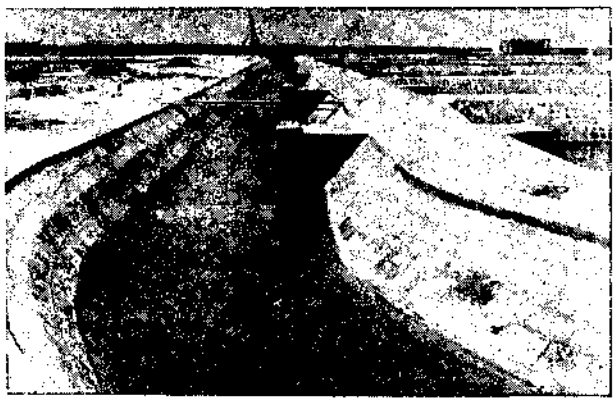

Fig. 2 & 3. Supply canal for flowing sea water into culture ponds. (Photo: Courtesy of Shri P. Bensam).

Fig. 4. Pumping of sea water into ponds. Sides of ponds protected by palmyrah rachis to prevent erosion on rainy days. (Photo: Courtesy of Shri P. Bensam).

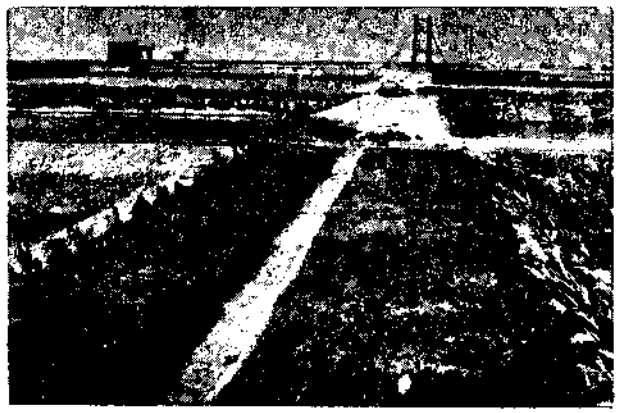

Fig. 5. Experimentation by lining pond slopes with palmyrah leaves, in order to make the dykes durable (Photo: Courtesy of Shri P. Bensam).

Fig. 6. Removing mangrove vegetation and constructing ponds at Tuticorin. (Photo: Courtesy of Shri R. Marichamy).

low cost designs in pond construction and water supply management plans.

Long after the farm at Mandapam was raged by the tidal bore during a cyclone which hit the Palk Bay coast, a set of 7 ponds were reconstructed in 1977 at Mandapam (in a 1.0 ha area of the saline flat) providing granite stone revetment for pond bund slopes, strong sluice for automatic exchange of tidal water to and from each pond and a common, concrete supply channel leading from the sea controlled by shutter sluice to let in and let out water (Figs. 1, 2 and 3).

Subsequently another 2 ha plot was converted into 21 earth excavated ponds of different dimensions with arrangements for water supply through direct pumping. The bunds were effectively turfed with sea water resistant grass and bund slopes held compact by palmyrah leaf matting all over (Figs. 4 and 5). The above systems worked very satisfactorily facilitating farming experiments for the last five years.

Experiments to harness the mangrove vegetated areas for pond culture were tried at Tuticorin from 1977. A portion of mangrove fringed water expanse of 15 ha was initially compartmentalised into 6 ponds (each 0.25 ha) with strong bunds using the clay removed during excavation. Water exchange to all ponds was ensured by digging a tide fed supply channel, and the entry and exit of water were regulated by P.V.C. pipes connecting the channel to the ponds. Tufts of mangrove plants with the rhizophores were left intact unremoved, here and there, to serve as shaded shelter for the pond stock and for affording refuge to natural mangrove associated fauna to coexist (Figs. 6 and 7). The ponds have withstood monsoon seasons well.

At Madras, also a portion of saline water spread of about 50 ha at Muttukad was converted into a fish farm during the last two years (Figs. 8 and 9). It is too early to assess the performance.

Pond culture: Experiments conducted so far in Tuticorin and Mandapam using ponds were mostly for milkfish and mullets although the Indian sand whiting was also stocked at Mandapam occasionally. Monoculture and mixed culture were attempted. Interesting results have been obtained as evidenced by the reports of James (1983), James, *et al.* (1980b, 1983), Silas *et al.* (1983), Mohanraj *et al.* (1983) and Marichamy and Rajapackiam (1982). Polyculture of *Chanos, Velamugil seheli, Liza macrolepis* and *Penaeus indicus* has been shown to be very productive (1.364.4–1,864.5 kg/ha) while mixed culture of *V. seheli* and *Chanos* also yielded 1,422.2–1,600 kg/ha in 1980–82 experiments at Mandapam. Monoculture of *V. seheli* and *Chanos* did not yeild production rate in excess of 358.2 kg/ha except in one year (81–82) when the production of *Chanos* grew to 852 kg/ha. During 1977–1979 Polyculture experiments at Tuticorin, an estimated production value of 499 kg to 731 kg/ha/yr of milkfish, mullet and prawn was obtained by Marichamy and Rajapackiam (1982).

In the Polyculture experiments with *Chanos chanos, L.macrolepis* and *Scylla serrata* at Tuticorin a production of 1,644 kg/ha/yr has also been reported. The striking aspect of the experiments was that the yield was encouraging enough to attempt further experiments to perfect and standardise the farming techniques.

Salt pan fish culture: This was yet another trial to find out whether vast areas of salt pans in the east coast could be profitably utilised for farming milkfish and mullets. During 1973–75 experiments in the salt pans at Veppalodai near Tuticorin (Fig. 10) Bensam and Marichamy (1982) reported about the possibility of harvesting 857.47 kg/ha of milkfish in 14 months. It was observed that the survival range of 44–85% could be further improved with predator control.

Pen culture: In view of the operational and experimental success of pen enclosures for growing fishes in countries like Malaysia, Singapore, Thailand and Philippines experiments were undertaken in India also to identify suitable areas and show the production capabilities. The inital experiments at Tuticorin 1973 using bamboo screen pens to grow *Chanos* and mullets in a selected area with shallow muddy bottom flopped due to technical defects in pen construction and site selection (Shanmugam and Bensam, 1982).

During 1976–78, bamboo screen pen enclosures (81 m^2 area) were put up in the Gulf of Mannar at Mandapam for growing milkfish and mullets (Venkataraman *et al.* 1980). Except for the details of growth of *Chanos* from 60 mm to 217 mm in 4 months (average growth 51 mm per month) production data are wanting for these experiments.

A more positive contribution in pen culture was the *utilisation of hypersaline, lagoon* area of Mandapam for growing *Chanos* in pen enclosures. The work was initiated in 1982 and an area of 2.25 ha in an expanse of 230 hectares of Pillaimadam lagoon acquired by CMFRI was converted as pen enclosures by erecting net screens (using 20 mm mesh nylon webbing) dividing the area into 5 compartments ranging from 0.25–1.00 ha (Fig. 11). Stocking the pens with 80–100 mm fingerlings of milkfish a growth rate of 450 mm in 180 days has been reported (Lal Mohan, 1983). Attempts to lower the hypersaline conditions (60–180‰) during certain months (due to evaporation) by keeping the bar mouth open not only helped to increase the standing water column inside the lagoon but also to bring down the salinity considerably. The production capability is estimated to be around 2,000 kg/ha (Lal Mohan, personal communication). This remains to be substantiated in the coming years.

Fig. 7. View of coastal ponds developed along Tuticorin Bay (Karapad). (Photo: Courtesy of Shri R. Marichamy).

Fig. 8. General view of earthern ponds at Mariculture Centre of CMFRI, Muttukad. (Photo: Courtesy of S/Shri. P. R.S. Tampi and M. Kathirvel).

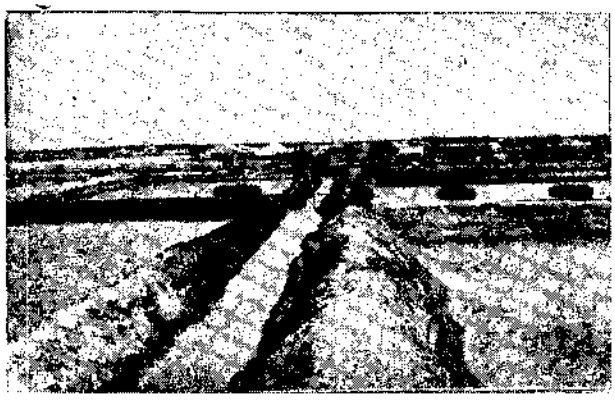

Fig. 9. Close-up view of earthern ponds. (Photo: Courtesy of S/Shri. P.R.S. Tampi and M. Kathirvel).

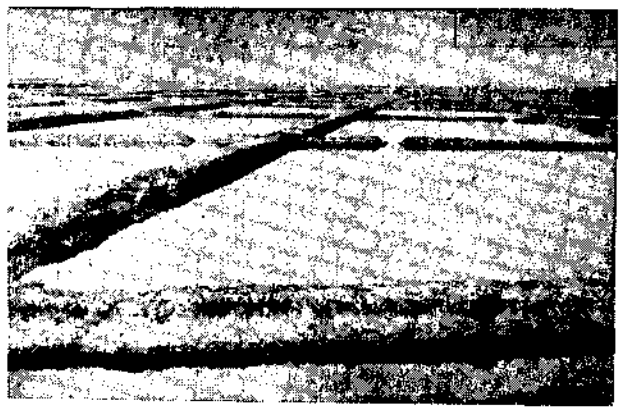

Fig. 10. View of fish ponds in salt pan area at Veppalodai. (Photo: Courtesy of Shri. R. Marichamy).

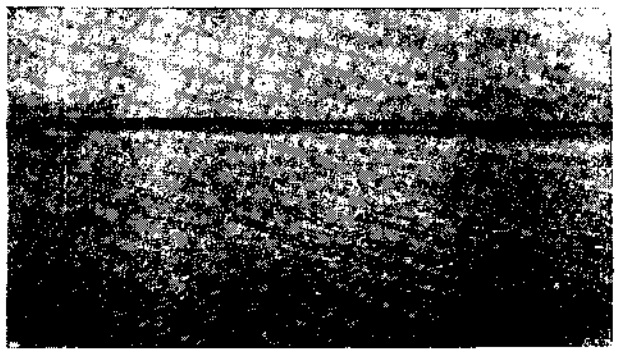

Fig. 11. Pen enclosure at Pillaimadam lagoon, Mandapam. (Photo: Courtesy of Dr. R. S. Lal Mohan).

Fig. 12. Pen enclosure at Muttukadu, Madras. (Photo: Courtesy of S/Shri. P.R.S. Tampi and M. Kathirvel).

Recently a few net pens have been erected (Fig. 12) in the Muttukad farm, (near Madras), by the Institute for studying the growth of *Chanos chanos*. Results are awaited.

Cage culture: Cage culture is a new experience in India. But considering the great potential it holds, it was decided to attempt this method for growing groupers and rabbit fishes at Mandapam. James *et al.* (1980a) tried the possibility of culturing *Siganus*, *Sillago* and *Epinephelus* using fixed cages made up of nylon nettings and palmyrah leaf stilts in the coastal areas of Palk Bay near Mandapam. The experiments did not last long enough to give any quantitative

assessment. Recently cage culture work at Mandapam has been restarted using new cage designs for growing *E. tauvina* and *Siganus*, in a total area of 250 m^2. The work has just commenced and the results will be closely watched.

Apart from the above, Lal Mohan and Nandakumar (1981) attempted rearing milkfish and pearl spot in ponds excavated in the sandy shore of Calicut. Polythene sheets were used to cover the entire pond bottom and sides for water retention. It has been reported that it is possible to achieve a production of 920 kg/ha in 7 months in the case of *Chanos* and 380 kg/ha in 15 months for pearl spot.

Tank culture of eel: Experimental culture of the eel *Anguilla bicolor* was conducted at Mandapam during 1974–76 in running water in fibreglass tanks. It was seen that they could grow to 27.8 cm (43 g), 38.9 cm (115 g) and 41.9 cm (177 g) in the first, second and third years respectively.

The production in outdoor tanks using recycled water was still greater (rate 2.15 kg/m^3) in 5 months. The eels were fed with silver belly and prawn flesh which gave better conversion ratio (7:1) than when fed with sardine and clam meat (MFIS, 23, 1980).

Remarks

It is difficult to review here all efforts in fin fish culture that might have been made by different states and Governmental agencies. After the initial experiments at Mandapam during 60's it is less than a decade since the C.M.F.R.I., formulated projects and experiments on fin fish culture. From these experiments varying results regarding the production capability have been obtained for different locations and for different methods of culture. But when compared with the low yield of the traditional coastal culture (35.5 kg in Gujarat, 258 kg in Karnataka, 700 kg in Kerala and 300 kg/ha/yr in West Bengal) the results obtained in controlled culture is rather impressive. In most of the experiments in the ponds, natural food availability has been supplemented with the addition of artificial feed in the form of oil cakes and rice bran at 10% of the body weight of fishes. While this imposes a burden on the cost of production it has enhanced production rate/ha.

Although other allied investigations engaging the attention of the Institute with regard to problems connected with the fish culture have not been elaborated in this review it may be mentioned here that commendable progress has been made by the scientists of the Institute in assessing the productivity of the coastal areas and documenting data on the seed stock availability of culturable species along the Indian coast. The Fishery Environment Management Division of CMFRI, has been conducting special survey using the mobile laboratory along the Tamil Nadu coast on a phased programme since 1983 to study the ecosystem along the coast to find suitable areas for sea farming. Five estuarine regions and one large swamp in the area between Devipatnam near Mandapam and Nagoor at Karaikal have already been completed. Dry organic carbon in %, dry wt fishing varying from 0.061 to 2.859 has been reported. This is considered as a fairly high value of productivity for the regions studied. Investigations during 1976–81 in 3 centres each in Kerala and Tamil Nadu have enabled identifying areas of abundance of seeds of *Mugil cephalus, Liza macrolepis, Velamugil seheli, Sillago sihama, Siganus javus, Etroplus suratensis, Chanos chanos, Lates calcarifer* and *Anguilla bicolor*. Safe methods for transporting the fry/fingerlings/elvers by using oxygen filled seed bottles have been successfully experimented upon.

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ARTISANAL FISHERY FOR PRAWNS AT UPPADA NEAR KAKINADA IN ANDHRA PRADESH COAST*

Introduction

Uppada (Lat. 17° 6′ N, Long 82° 23′ E) is an important marine fish landing centre of Kakinada region where prawns form about 4% to 95% in the total fish landings. Apart from the studies of Rao *(Indian J. Fish.* **26**: 52–64, 1981) on the marine prawn fishery at Kakinada by shore seine there are no other, reports on this aspect by indigenous gear from this region. Hence studies on the prawn fishery by indigenous gear at Uppada were initiated from January 1979, and the results of a five year study conducted during '79–83 are reported here. Ramamurthy and Muthu *(CMFRI. Bull.* **14**: 235–258, 1969) dealt with the craft and gear of Andhra coast.

Area of operation

Artisanal fishermen from Subbammapeta, Pallipeta, Kothapeta, Jagga Rajupeta, Ramisettypeta, Suradapeta, Mayapatnam and Ameenabad villages with indigenous craft and gear land their catches. Non-powered catamarans and the *Masula* boats operate different gears in 10–45 m depth.

Gears Operated

a) *Nylon gillnet:* There are four types of nets; *Madras* and *Jookavala*, mesh size 1.5–3 cm, *Big silk net*, mesh size 3–5cm and *Kilevala* (small silk net), mesh size 1.5–2 cm.

b) *Boat seine:* mesh size 1–2 cm at the cod end.

c) *Chinna alivi* (small shore seine), mesh size 0.5–1.5 cm at cod end and shore seine (big), mesh size 1.5–2 cm.

*Prepared by S. Lalitha Devi, Kakinada Research Centre of CMFRI, Kakinada.

Species exploited

Twenty three species of penaeid prawns and 4 species of non-penaeid prawns contribute to the prawn fishery of which 10 species of penaeid prawns and 3 species of non-penaeid prawns form regular fishery, throughout the year.

Species that contribute to the penaeid prawn fishery are *Penaeus indicus, P. monodon, P. merguiensis, P. semisulcatus, P. japonicus, Metapenaeus monoceros, M. dobsoni, M. brevicornis, M. affinis, M. ensis, Parapenaeopsis sculptilis, P. stylifera, P. hardwickii, P. probata, P. cornuta, P. acclivirostris, Solenocera crassicornis, Metapenaeopsis sp., Parapenaeus longipes, Atypopenaeus stridulans, Trachypenaeus curvirostris* and *T. sedili.*

The non-penaeid prawns are *Acetes* sp., *Exhippolysmata ensirostris, Nematopalaemon tenuipes* and *Exopalaemon styliferus.*

Gearwise catches

The yearly total catch of prawns, the catch rates (catch/unit), monthly trends of average catch by different gears are presented in Figs 1 and 2. In the following account, the trend of prawn fishery by different gears are given.

Nylon gillnet: These nets contributed to an average annual prawn catch of 41.05 t. Prawns formed nil to 3.8% in total fish landings by *Madras, Jooka,* and *Big silk nets* and 30–72% by *Kilevala.* The catch rates varied from 0.28 kg/unit to 1.1 kg/unit with an average of 0.73 kg/unit. *P. indicus, M. brevicornis, P. monodon, P. merguiensis, M. affinis, P. semisulcatus, P. japonicus* and *P. stylifera* contributed to the fishery

in the order of abundance. Prawns are caught in the gill nets throughout the year with peak landings in January and September to October.

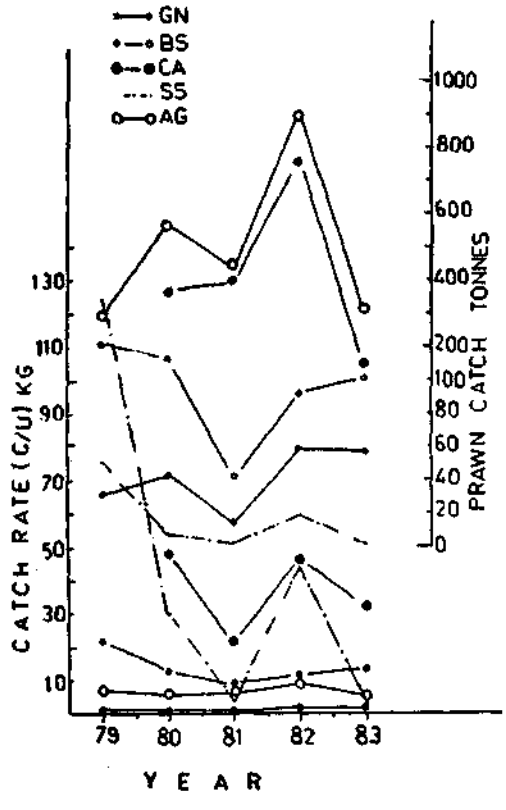


Fig. 1. Trends in the annual catch rates (C/U) of gillnet (GN), chinna alivi (CA), boat-seine (BS), shore-seine (SS) and all gears (AG) during the years from 1979 to 1983.

Boat seine: Average annual prawn landings are estimated at 119.39 t which was 22.55% in total fish catch. The unitwise catch rates varied from 8.95 kg to 22.04 kg with an average of 14.05 kg which accounted for 7.62% to 66.18% of the total fish landings. Penaeid prawns formed 46.74% and non-penaeid prawns 53.26%. *M. dobsoni, P. stylifera, P. hardwickii, M. brevicornis, M. monoceros, P. indicus, M. affinis, S. crassicornis, P. cornuta* and *P. acclivirostris* contributed to the penaeid prawn fishery in the order of abundance. *Acetes* sp., *N. tenuipes E. styliferus* and *E. ensirostris* are the important non-penaeids in the order of abundance. Catches were good from June to September and in December with peak landings during August and September.

Chinna alivi: Average annual prawn catch by this gear amounted to 326.51 t, accounting for 94.78% of the total fish landings with an average catch rate of 35.58 kg/unit. The catch rates varied from 21.90 kg/unit to 48.30 kg/unit, accounting for 85.65% to 98.69% in the total fish landings. Penaeid prawns formed 92.79% on an average and non-penaeid prawns 7.21%. In 1979, non-penaeids accounted for 29.72%.

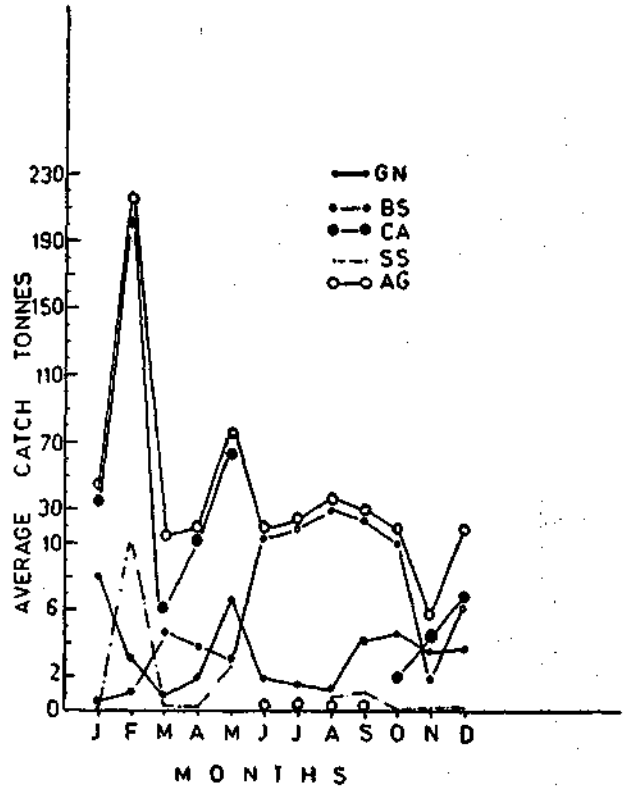


Fig. 2. Trends in the average monthly catch rates (C/U) of gillnet (GN), chinna alivi (CA), boat-seine (BS), shore seine (SS) and all gears (AG).

M. dobsoni, P. indicus, M. monoceros, P. stylifera, M. brevicornis, P. merguiensis and *P. monodon* contributed to the penaeid prawn fishery in the order of abundance. *Acetes* sp., *N. tenuipes, E. ensirostris* and *E. styliferus* contributed to the non-penaeid prawn fishery in the order of abundance. Using this gear prawns are caught in considerable quantities during the season May to December.

Shore seine: Estimated average annual catch of prawns is 14.53 t, which accounted for 11.49% of the total fish landings. The catch rates ranged from 1.31 kg/unit in '83 to 123.52 kg/unit in '79, with an average of 44.75 kg/unit. Penaeid prawns formed 90.9% and the balance by non-penaeids. Important penaeid prawns in the order of abundance are *M. dobsoni, M. brevicornis, M. monoceros, P. indicus, P. acclivirostris, P. japonicus, P. stylifera, M. ensis, P. sculptilis* and *P. hardwickii.* Fishery lasts from

November to May, with good landings in February and May.

Biological notes on the commercially important prawns

Penaeid prawns

P. indicus: This was a major component of the nylon gill net prawn fishery at Uppada, contributing 60–90% of the prawn landings. Annual landings were estimated at 38.09 t.

The length ranged from 50 to 216 mm and modal sizes from 95 to 179 mm. In most of the months, the modes ranged between 130–149 mm. Preponderance of females over males was observed, except in January to February and April to May of 1980 and '81. Mature females were found throughout the year with two peaks in January–April and August–October (Fig. 3).

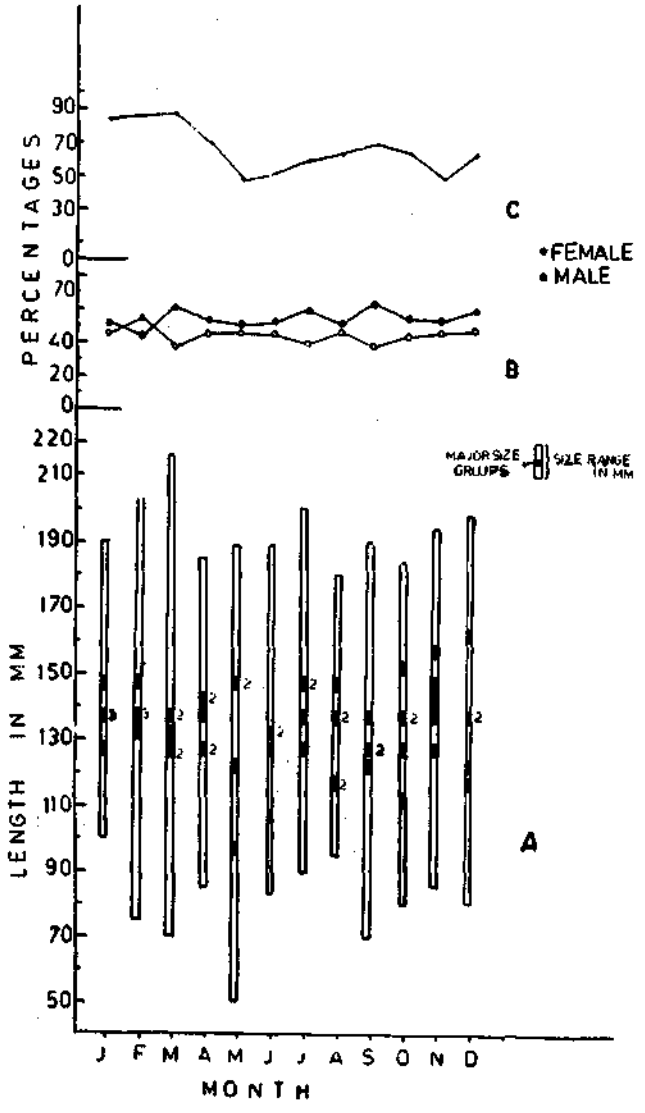


Fig. 3. Biological notes on *Penaeus indicus.*
*A. Size range and modal size in mm.
B. Sex ratio in percentage.
C. Mature females in percentage (stages III, IV & V).

M. dobsoni: This was another important species caught in 'chinna alivi', boat seine and shore seine, and ranked 1st among the penaeid prawns. The average annual landings were estimated at 267.83 t, forming about 65 % of the total penaeid prawn landings of this centre. Landings were good from December to May with peak landings during January to March.

The size ranged from 50–119 mm, with majority of them in the model size ranging from 50–70 mm during December–April and 80–99 mm during June–November. Females outnumbered males in all the months. Mature females were present in abundance during August–November and January–February (Fig. 4).

M. brevicornis: Average annual landings of this species were estimated at 21.19 t forming about

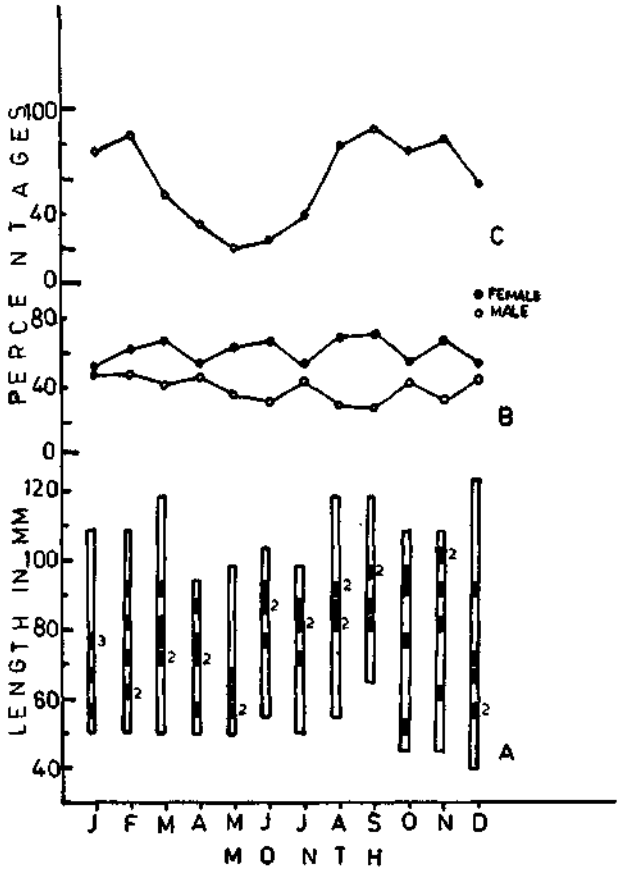


Fig. 4. Biological notes on *Metapenaeus dobsoni.*
A. Size range and modal size.
B. Sex ratio in percentage.
C. Mature females in percentage.

5% of the penaeid prawn catches. The landings were considerable during January–February and September–November. Size ranged from 50–164 mm, with majority of prawns in 110–120 mm size range in most of the months of the year. Females outnumbered males during the period of observation. Mature females occurred throughout the year with peak abundance during August–October and February–March (Fig. 5).

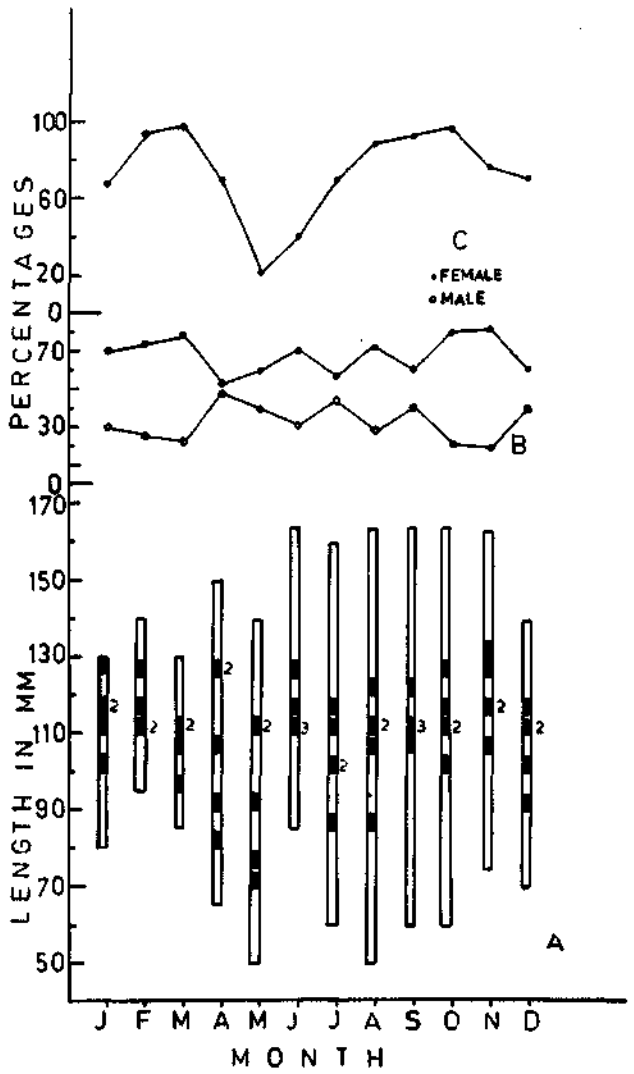


Fig. 5. A–C. Size range and modal size, sex ratio in percentage and mature females in percentage of *M. brevicornis*.

P. stylifera ranked 4th in total penaeid prawn catches with average annual landings at 20.65 t. Mostly boat seines, shoreseines and 'chinna alivi' landed this species in good quantities during August–November and February–March.

M. monoceros: Average annual landings were estimated at 15.08 t, forming 4% of the penaeid prawn catches. The fishery was good during August–September and in February.

The size ranged from 60–169 mm, with majority of prawns in 120–129 mm size group. Males outnumbered females during January–March and in August. Thirty per cent females in mature condition occurred during July–September.

P. monodon: The average annual catch was estimated at 8.1 t and it formed 2% of the penaeid prawns landings. Fishery was good during September–November and January–February.

P. merguiensis: On an average 8.11 t of this species were landed per year which accounted for 2% of the penaeid prawn catches. Fishery was good during January–February and July–September.

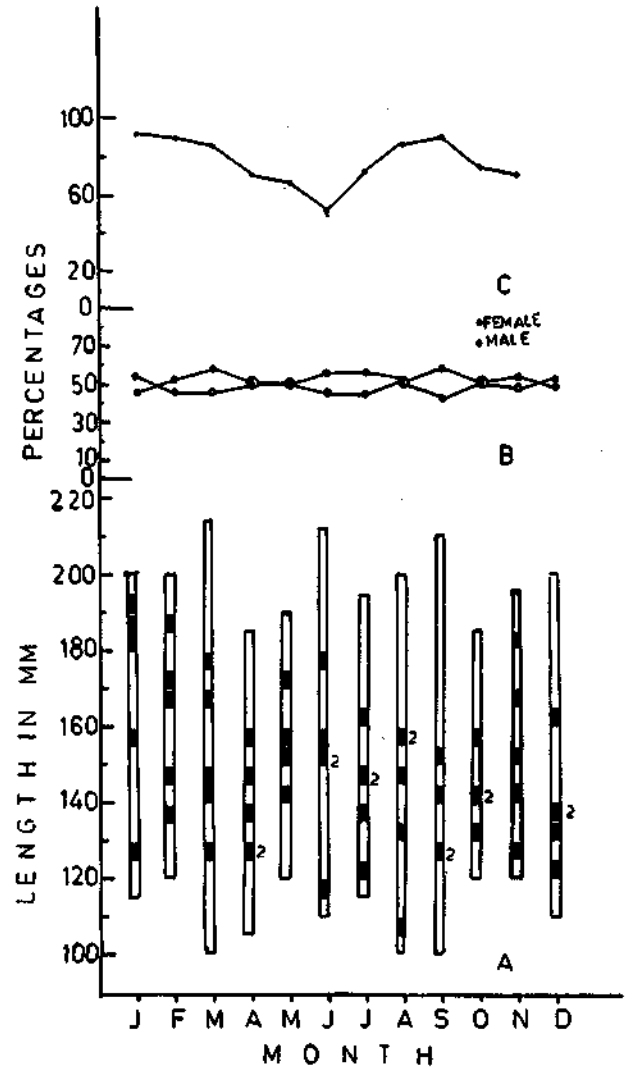


Fig. 6. *P. merguiensis*. A–C. Size range and modal size, sex ratio in percentage and mature females.

Sizes ranged from 100–214 mm, with majority in the size range 170–190 mm during January–February and 120–140 mm during the rest of the year. Males and females were found almost in 1:1 ratio, with slight predominence of females during January–March and September–November (Fig. 6).

Non-penaeid prawns

Acetes sp: This species ranked 1st in the total non-penaeid prawn catches with average annual landings at 60.2 t. Mostly boat seines and 'chinna alivi' landed this species in good quantities during May–September with peak landings during August.

N. tenuipes: Its average annual landings amounted to 15.6 t ranking 2nd in the non-penaeid prawn landings. Size ranged from 25–78 mm with majority of prawns in the 40–55 mm groups (Fig. 7). Females outnumbered males throughout with above 70% females in mature condition (late maturing and berried) during July–December. Landings were good during May to October with peak landings in July.

E. ensirostris: This species amounted to 8.1 t on an average, accounting for 9% in the non-penaeid prawn landings. Size ranged from 25–84 mm with majority of prawns in 50–60 mm modal size (Fig.8). Females outnumbered males throughout the year. Mature females occurred throughout the year with above 60% females in berried condition in April and September.

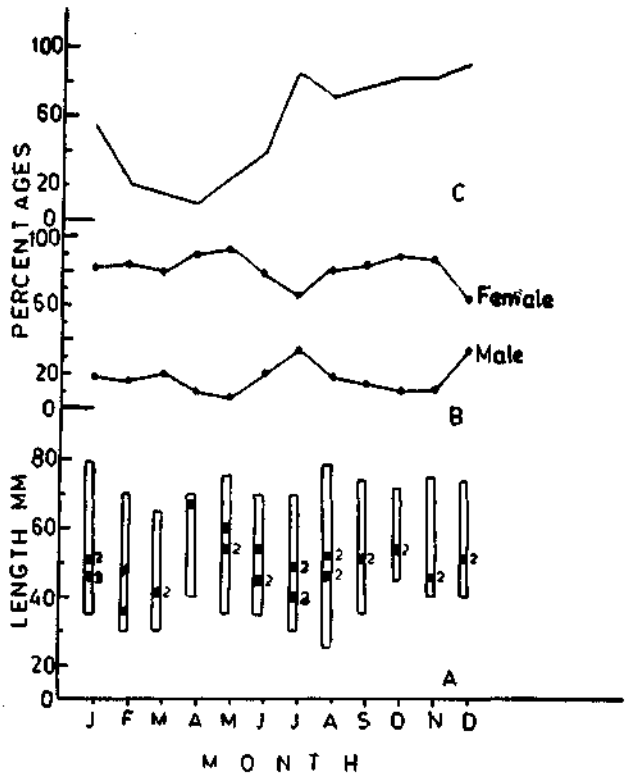


Fig. 7. *N. tenuipes* A–C. Size range and modal size, sex ratio in percentage and mature females.

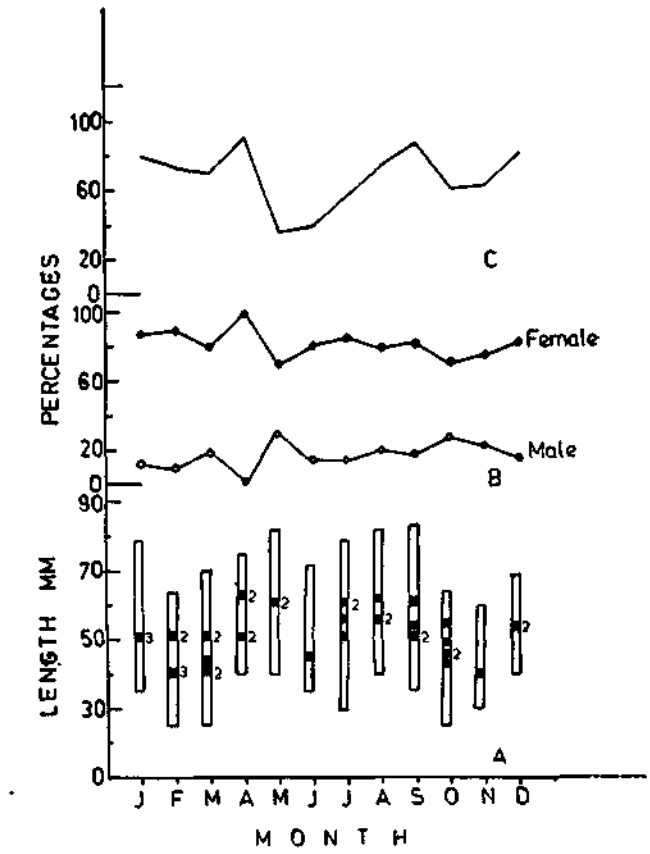


Fig. 8. *E. ensirostris.* A-C. Size range and model size, sex ratio in percentage and mature females.
*Number in Figs. 3A–8A indicates the *No.* of times that particular modal size has occurred during 79–83.

General remarks

Data on prawn catches at Uppada collected for a period of 5 years from 1979 to 1983 show that an average 501.5 t of prawns are landed per annum at this centre, accounting for 24.1% of the total fish landings. Penaeid prawns formed 82.4% in total prawn landings and 19.8% in total fish landings. The chief constituents of penaeid prawn fishery are *M. dobsoni, P. stylifera, P. hardwickii, M. brevicornis, M. monoceros, P. indicus, M. affinis* and *S. crassicornis* in the order of abundance.

Non-penaeid prawns accounted for 17.6% in total prawn landings and 4.3% in total fish landings. *Acetes* sp., *N. tenuipes* and *E. ensirostris* contributed to the fishery in the order of abundance.

Prawn fishery at Uppada is carried out throughout the year. Year to year fluctuations were noticed with maximum landings during 1982 and minimum in 1979; and catches declined in '83. Generally prawn landings were appreciable during January, February, May and July to October, with peak in February, May and August. Year to year fluctuations in the prawn landings of different gears were noticed, and the minimum and maximum sizes of the prawns caught in different gears were 85–249 mm by gillnets, and 25–170 mm by chinna alivi 30–185 mm by boat seines and 25–210 mm by shore seines.

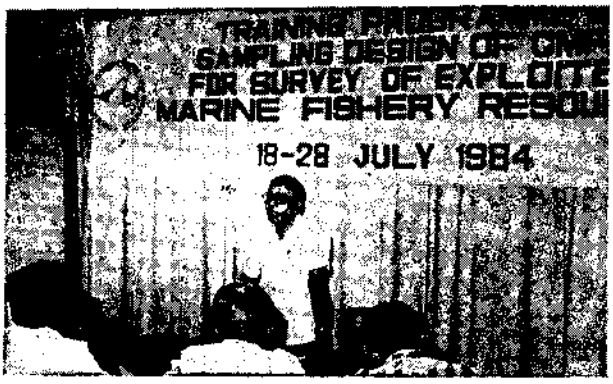
From the foregoing observations it is seen that out of 4 gears operated at Uppada, chinna alivi is the most efficient gear for prawns, though it is operated seasonally.

The author express her gratitude to Dr. M.J. George, for suggesting improvements. Assistance rendered by Shri J. B. Varma, T–1, is gratefully acknowledged.

TRAINING PROGRAMME ON SAMPLING DESIGN OF CMFRI FOR SURVEY OF EXPLOITED FISHERY RESOURCES*

Realising the potentialities of marine fishery sector in the national growth, Government of India established the Central Marine Fisheries Research Institute as early as in 1947. Since then this Institute is collecting marine fish catch statistics and other data on biological and environmental parameters as these data are required for understanding the conditions of the exploited fish stocks. Basing on its vast experience in the field of collection of marine fish catch statistics and the information obtained through pilot surveys conducted by the Indian Council of Agricultural Research during the fifties, the CMFRI has developed for this purpose a stratified multistage random sampling design.

The need for regionwise estimates for planning and development in the states was felt and the state governments have started collecting data on marine fish landings on regionwise basis to meet their plan requirements. The design of sampling for and the methods of collection of marine fish catch statistics differ from state to state. Cognising the importance of obtaining precise catch statistics for rational development and management of fishery sector a meeting of the chief ministers and ministers for fisheries of states and union territories was held in Hyderabad during 25–26 June 1983 and was presided over by the Hon'ble Minister for Agriculture and Co-operation, Government of India. In order to standardise the sampling method and streamline the process of collection of marine fish landings in India it was suggested in that meeting that the CMFRI, Cochin should arrange for training for the officials of state departments and U.Ts on the method of collection of



'To err is human'—a class on ways and means to reduce non sampling errors in session.

* Prepared by Fisheries Resources Assessment Division, C.M.F.R.I., Cochin.

marine fish catch statistics as developed by the Institute.

Accordingly the first training programme was organised by the CMFRI in Cochin during 18–28 July 1984 and there were 20 participants representing various states and UTs. In this programme basic theory on sampling with practicals was included so as to give an insight to the trainees on the importance of sampling on scientific basis for estimation of marine fish landings. The trainees were also exposed to field experience in the actual collection of data by arranging their visits to Fisheries Harbour in Cochin and other fish landing centres. In addition, training in the preparation of field programmes, filling up of schedules and estimation of fish landings was also given to them.

On 18–7–'84, in his inaugural address Dr. E.G. Silas, the Director, CMFRI, explained the purpose for which the training was arranged, the necessity for obtaining precise catch estimates for planning and developmental purpose and the importance of having a unified system of collection of catch statistics on a sound scientific basis. Wishing all success for this programme he expressed the hope that this ten day comprehensive training programme would go a long way in meeting the requirements for which it has been organised. In the afternoon to acquaint the trainees on the various aspects of research projects of CMFRI, lectures by Heads of the Divisions of this Institute were arranged. Dr. K. Alagarswamy, Head, Molluscan Fisheries Division, Dr. P. V. Ramachandran Nair, Head, Fishery Environment Management Division, Dr. P. V. Rao, Head, Physiology, Nutrition and Pathology Division and in-charge of Centre of Advanced Studies in Mariculture and Shri M. S. Muthu, Scientist in-charge, Narakkal Prawn Culture Laboratory explained the work done under various projects in their respective Divisions. During 19–23 July '84 lectures on basic theory of sampling with practicals were arranged. Three days were devoted to visit fish landing centres for the collection of data on marine fish landings. On 27–7–'84 the data collected by the trainess were taken up for processing and analysis. On 28–7–'84 general discussions were held so as to exchange ideas to improve the system of data collection and to clear doubts if any of the trainees.

The valedictory function was arranged in the afternoon of 28–7–'84. After the welcome speech by Dr. K. Alagaraja, Scientist, CMFRI, the Chairman Dr. E. G. Silas in his remarks expressed the hope that the knowledge gained by the trainees would be made use of in their respective states so as to improve the method of collection of marine fish catch statistics, and the purpose of the training to have a uniform method of collection of marine fish catch statistics on a sound scientific basis would be served. In his valedictory address, the chief guest Shri. K. M. Chandrasekhar, I.A.S. Director of Fisheries, Government of Kerala mentioned the importance of statistical sampling for planning and development purposes. Estimates, for short time intervals, were required for timely action particularly in the case of fisheries. Appreciating the work done by the CMFRI he indicated that more and more information were required to fill some of the gaps in the fishery statistics. While concluding he expressed his hope that this training programme would lead to improving the method of collection of catch statistics in the states and UTs and maintaining the good liaison between the scientists of CMFRI and the officials of state governments and UTs. The function came to a close with vote of thanks by Shri S. K. Dharmaraja, Scientist, CMFRI.

The schedule of the Training programme containing the topics and names of faculty members is appended. Lecture notes by the faculty members have been distributed to the trainees. The list of the names of the trainees is also appended. The statewise breakup of nominees is as follows.

	State and Department	No. of nominess
1.	West Bengal, Department of Fisheries	1
2.	Andhra Pradesh, Commissionerate of Fisheries	2
3.	Tamil Nadu, Department of Statistics	1
4.	Pondicherry, Department of Fisheries	6
5.	Kerala, Department of Fisheries	1
6.	Goa, Department of Fisheries	2
7.	Maharashtra, Department of Fisheries	2
8.	Gujarat, Commissionerate of Fisheries	2
9.	Andamans & Nicobar Islands, Department of Fisheries	2
10.	Lakshadweep and Minicoy Islands, Department of Fisheries	1
	Total	20

Training on Sampling Scheme adopted by the Central Marine Fisheries Research Institute, Cochin for the state department Personnel.

Date	Time (hrs)	Topic and members of faculty
18–7–'84	10.00	Registration.
	10.30	Inauguration.
	14.00–16.00	Highlighting the research programmes of the Institute by the Heads of Divisions.
19–7–'84	10.00–13.00	Introduction to sampling covering the items: need for sampling – units - population – frame – census vs sampling - random vs purposive sampling etc. Shri K. S. Scariah, Scientist S1.
	14.00–16.00	Simple random sampling – with and without replacement – its properties – selection of units – random numbers – estimation. Shri M. Srinath, Scientist S1.
20–7–'84	10.00–13.00	Cluster sampling and systematic sampling – their advantages and disadvantages – examples Shri. K. Balan, Scientist S1.
	14.00–16.00	Stratified sampling and methods of estimation with suitable examples. Shri. K. Narayana Kurup, Scientist S1.
21–7–'84	10.00–13.00	Multistage sampling and the sampling design of C.M.F.R.I. for collection of marine fish catch statistics. ICAR pilot surveys – uses of the data. Dr. K. Alagaraja, Scientist S2.
	14.00–16.00	Preparation of work programmes–schedules used – uses of random number tables supplied. Shri S. K. Dharmaraja, Scientist S2.
23–7–'84	10.00–13.00	Non sampling errors–sources of errors– ways and means to reduce them to the minimum. Shri T. Jacob, Scientist S3.
	14.00–16.00	Sampling designs followed by various state governments. The participants & Dr. K. Alagaraja, Scientist S2.
24–7–'84 to 26–7–'84		Visits to landing centres/Cochin Fisheries Harbour – collection of data in the prescribed schedules covering both mechanised and non-mechanised units. S/Shri G. Balakrishnan, Field Officer (T.6), U.K. Sathyavan, Field Officer (T6), Varghese Philipose, Field Officer (T5), K. C. Yohannan, Sr. Technical Assistant, (T.4), P. Karunakaran Nair, Sr. Technical Assistant (T. 4) and Joseph Andrews, Technical Assistant [T. 1(3)].
27–7–'84		Processing – analysis–estimation – comparison of estimates. S/Shri K. N. Kurup, K. Balan, M. Srinath

		and K. S. Scariah Scientist (S1) and Technical staff of the Divn.
28–7–'84	10.00–13.00	Discussions on various items of sampling – organisation and collection of marine fish catch statistics – adopting uniform procedure -- all scientists.
	14.00	Valedictory function.

List of participants for the training programme on sampling design for collecting fish catch statistics 18-28 July 1984

1. Shri A. R. Abdul Guddoose, Inspector of Fisheries, Department of Fisheries, Pondicherry.
2. Shri S. D. Adarkar, Statistical Inspector, Department of Fisheries, Maharashtra.
3. Shri S. Q. Ahmed, Sr. Investigator, Office of the Commissioner of Fisheries, Andhra Pradesh.
4. Shri M. Amanullah, Statistical Inspector, Department of Statistics, Tamil Nadu.
5. Shri R. Appaji, Sub-Inspector of Fisheries, Department of Fisheries, Pondicherry.
6. Shri D. P. Bhise, Research Assistant, Directorate of Fisheries, Goa.
7. Shri A. Bhopal, Inspector of Fisheries, Department of Fisheries, Pondicherry.
8. Shri J. Chandrasekhar, Assistant Fisheries Development Officer, Andamans.
9. Shri P. M. Dixit, Assistant Statistician, Department of Fisheries, Maharashtra.
10. Shri A. M. Joseph, Research Officer (Statistics), Directorate of Fisheries, Kerala.
11. Shri K. Koya, Statistical Assistant, Directorate of Fisheries, Lakshadweep.
12. Shri G. C. Nedurmath, Assistant Superintendent of Fisheries, Directorate of Fisheries, Goa.
13. Shri I. C. Parekh, Fisheries Officer (Statistics), Gujarat State Fisheries.
14. Shri K. S. Prajapati, Fisheries Officer (Statistics), Gujarat State Fisheries.
15. Shri E. K. Raveendran, Fisheries Development Officer, Directorate of Fisheries, Andamans.
16. Shri X. A. Roche, Inspector of Fisheries, Department of Fisheries, Pondicherry.
17. Shri Shyamal Kumar Sengupta, Supervisor, (Field-cum-Computation), Directorate of Fisheries, West Bengal.
18. Shri C. Subbarao, Statistical Officer, Office of the Commissioner of Fisheries, Andhra Pradesh.
19. Shri K.Suryanarayana Raju, Inspector of Fisheries, Department of Fisheries, Pondicherry.
20. Shri K. K. Vijayaraghavan, Inspector of Fisheries, Department of Fisheries, Pondicherry.

MASS MORTALITY OF CATFISHES AND OTHER BOTTOM FAUNA AT PUDIAPPA, CALICUT*

The sea off Calicut suddenly became rough on 7th April 1984 and severe wind, high waves and strong breakers flooded the coastal areas between Pudiappa and Beypore. The high breakers at several places crossed the narrow sand bar that divide the sea from the low lying areas and flooded many thickly populated pockets along the Calicut coast. Towards evening, breaches occurred along the sand bar and long stretches of low lying areas between Pudiappa and Marad, extending to about 15 km, were submerged in sea water. The wave height at certain places rose up to 2 to 2.5 meters and the rough condition of the sea prevailed till 9th April.

*Prepared by N. Gopinatha Menon and C. V. Mathew, Calicut Research Centre of C.M.F.R.I., Calicut.

Mass morality of fishes at Pudiappa

Along the coast of Calicut, Pudiappa is a semi-protected calm bay area. During the days when rough sea conditions prevailed the flow of water was from south to north. Along with this northward flow of water, probably the churned up bottom sediments in the shallow regions also would have shifted towards north and got accumulated in the semi-protected Pudiappa bay. This observation was further substantiated by the lack of any mud formation north of Pudiappa. Thus, there was a total churning up of the bottom mud in the bay consequent on high waves, strong breakers and an influx of mud from south. In the morning of 8th

TABLE 1

Station	Temp. (°C)	O_2 (ml/l)	Sal. (‰)	PO_4	NO_2	NO_3	SiO_3
				(μ gram atom/l)			
Date: 9–4–1984				Condition of the sea: Rough and turbulent			
1. Pudiappa	35.8	0.73	33.81	10.57	0.47	4.93	52.63
2. Kothi beach	34.1	4.68	32.92	6.00	0.08	3.00	26.31
3. Marad beach	32.2	5.18	32.64	0.32	1.30	3.60	13.15
Date: 5–4–1984				Condition of the sea: Calm			
4. West Hill	31.0	4.69	33.14	1.33	0.02	1.65	8.55

Fig. 1. The sunken boats (manchi) at Pudiappa in the mud flat (Fore ground: bags of rice washed ashore).

Fig. 3. Dead and decaying catfishes remained at the beach after the devastation.

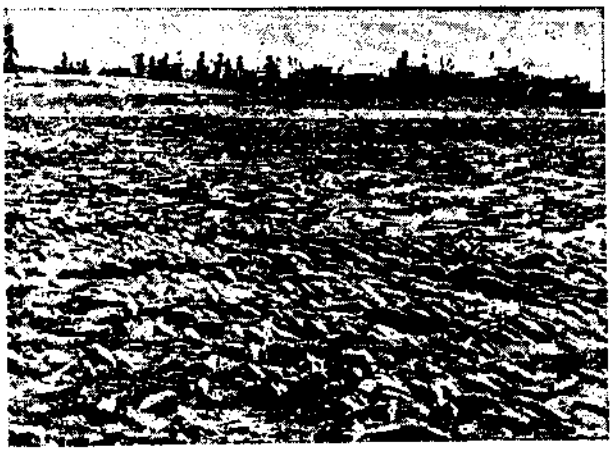


Fig. 2. Mass mortality of catfishes at Pudiappa.

Fig. 4. Large pallets of mud washed ashore when the bay became calm.

April the thick muddy water of Pudiappa was virtually teeming with thousands of fishes gasping for breath. The waves washed huge quantities of fishes and mud to the shore. Within a short time the whole of Pudiappa beach, extending to about 3–4 ha, was carpeted by fishes and loose mud. Along with fishes, huge quantities of bivalves and gastropods were also washed ashore. It was found that more than 90% of the fishes washed ashore were catfishes of a single species, *Tachysurus maculatus*. Other fishes suffered mortality were sciaenids, soles, eels, platycephalids, *Squilla* sp. and prawns. Roughly it was estimated that about 15 tonnes of fishes suffered mortality. The catfishes were in the size range of 92 to 338 mm in total length. Analysis of fish samples showed that the gills were completely clogged with soft mud and in many cases mud was found in the stomachs. The large scale mortality suffered by catfishes indicated their behaviour pattern and their aggregation in the bay. *T. maculatus* which is essentially an estuarine catfish, also occur along shallow coastal waters and seldom move beyond 10 to 15 meters in depth. Since the species is a scavenger, large shoals congregate in fishing harbours and coastal fish landing areas where more food is available. And as such, Pudiappa is a nourishing ground for these fishes. The sudden influx of mud together with the churning up process would have made the water of Pudiappa turbid and thereby reducing the oxygen content of the water to sub-lethal level. Thus, asphyxiation seemed to be the causasive factor for the sudden large scale mortality of the fishes.

For Pudiappa villagers 8th April morning gave rich catches of fishes without much effort. The asphyxiated fishes were hand picked from the surf. Since there was no fishing on 7th and 8th the fishes washed ashore found a good market and as such truck loads of catfishes were taken to various markets.

For a study on the physico-chemical characters of the turbulent sea, water samples were collected from three stations, Pudiappa, Kothi and Marad beach on 9th April. Eventhough there were no mass mortality or mud formation at the latter two stations, these areas were also seriously affected in the calamity and hence selected for the study. Analysis of the turbid water of Pudiappa showed that the concentration of find mud in the sea water was 38.2% by volume. The sea water samples from all the stations were analysed for salinity, dissolved oxygen, phosphate, nitrite, nitrate and silicate and the values are given in Table 1 along with the values from West Hill on 5th April for a comparative study.

The very low values of dissolved oxygen and very high values of silicate and phosphate of the affected waters compared to the unaffected waters give clean evidence to the condition that led to the mass mortality of fishes at Pudiappa. However, the actual cause of the sudden changes in the coastal areas remains enigmatic. A detailed study of such phenomena when they do occur would help in understanding the oceanographic processes associated with them.

RECOVERY OF A RINGED SANDWICH TERN, *STERNA SANDVICENSIS SANDVICENSIS* FROM RAMESWARAM ISLAND*

The sandwich tern *Sterna s. sandvicensis* Latham, which is known to perform intercontinental wintering migration has been known to frequent Sind and Makran Coast (Ali and Ripley, Handbook of the Birds of India and Pakistan, 3:1-70, 1981) and Sri Lanka Coast *(Ceylon Bird Club Newsletter, Sept.,* 1978). In India the bird has been sight recorded from Saurashtra (Dharakumarsinghji, *Bombay Nat. Hist. Soc.,* 55: 357, 1958).

On 19-9-1983 one specimen of the sandwich tern was recovered from Kundukal point of Rameswaram Island (Fig. 1) with a metalic ring having a Russian inscription and a number P.702628 on it. The bird (Fig.2) which is locally known as *Katrenji* in Tamil had the following salient features.

Crown black; a black stripe continues from the eye back to the crown; body ash coloured dorsally, white ventrally; bill long, slender, tipped with yellow; foot webbed and primaries black.

*Prepared by R. S. Lal Mohan, Regional Centre of C.M.F.R.I., Mandapam.

Table 1. *Details of the sandwich tern caught in India*

Sl. No.	Bill (mm)	Tarsus (mm)	Locality	Date	Remarks
1.	52	26	Pillaimadam lagoon, Mandapam	24-6-1983	Without ring
2.	50	25	Kundukal point, Rameswaram Island	19-9-1983	With ring
3.	45	25	Pillaimadam lagoon, Mandapam	7-11-1983	Without ring

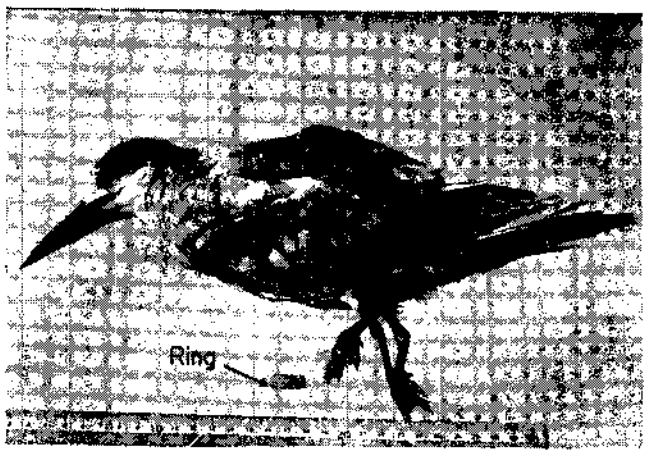


Fig. 1. *Sterna sandvicensis sandvicensis* with the ring from Rameswaram Island.

Fig. 2. The metallic ring with Russian inscription recovered from the sandwich tern (Length of the ring 18 mm).

The ring (Fig. 2) suggests that the bird was ringed in Russia. It may be mentioned that two other birds of same species were also recovered from the Pillaimadam Lagoon near Mandapam which indicates that the bird is a common visitor to these areas. They were found along with other common terns namely *Hydroprogne caspia* (Caspian tern), *Sterna aurentia* and *Gelochelidon nilotica*. The details of the birds recovered are given in Table 1.

There has been record of recovery of the Sandwich tern from Kalpitiya, Sri Lanka on 24-12-1977 which was ringed at Astrakhan Reserve, Caspian Sea, Russia *(Ceylon Bird Club Newsletter,* 1979).

The present capture of the sandwich tern from Rameswaram area in June is of special interest as it is much earlier than its usual arrival in Sri Lanka coast which is around December. The species is known to breed in British Islands, North sea Islands, Atlantic and Mediterranean coasts of Europe, Black Sea and Caspian Sea. It winters on the coasts of Northern Africa, Western Africa to Cape of Good Hope, Red Sea, Persian Gulf, Makran and Sind coast and Sri Lanka. Its wintering area now includes Southeast coast of India including Rameswaram island.

Compiled and prepared by Dr. M. J. George, Dr. K. J. Mathew, Mr. G. Nandakumar & Miss Jancy Jacob
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