

**CONTRIBUTION OF CMFRI
TO RESEARCH AND DEVELOPMENT
IN MARINE FISHERIES OF ANDHRA PRADESH**



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
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Cover : **The new Laboratory of the CMFRI and CIFT Research Centres at Visakhapatnam with some of the important marine fishery resources of Andhra Pradesh in the background.**

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CONTRIBUTION OF CMFRI TO RESEARCH AND DEVELOPMENT IN MARINE FISHERIES OF ANDHRA PRADESH

Andhra Pradesh is one of the biggest maritime States of India having a coastline of about 980 km, a continental shelf area of 31,000 sq. km, 453 marine fishing villages and 280 landing centres along nine coastal districts including two major functional fishing harbours

Introduction

at Visakhapatnam and Kakinada with two others at Bhavanapadu and Nizampatnam coming up. The contribution of Andhra Pradesh to marine fish production is about 1,31,000 t (1985-1992). With several pelagic and demersal fin and shell fish resources available off the coast, the State enjoys a prominent place in the marine fisheries of India.

The **Central Marine Fisheries Research Institute (CMFRI)**, Cochin, under the administrative control of the Indian Council of Agricultural Research, New Delhi, is the premier organisation in India, conducting need-based, multidisciplinary research in marine capture and culture fisheries and rendering advice on rational exploitation, management, development and conservation of exploited marine living resources. In view of the importance of Andhra Pradesh in the marine fisheries of India, the Institute established research centres at two important places at Visakhapatnam and Kakinada and six field centres at Palasa, Srikakulam, Narsapur, Machilipatnam, Ongole and Nellore to collect basic data and to conduct researches on exploited fisheries resources, and to develop technologies for culture of marine fish and shellfish for augmenting production.

The centre at Visakhapatnam was established in 1947 as a small Survey Centre to collect fisheries statistics along Andhra, Orissa and West Bengal Coasts. Subsequently the Centre was strengthened and elevated to the status of Research Unit in 1956 and to the present

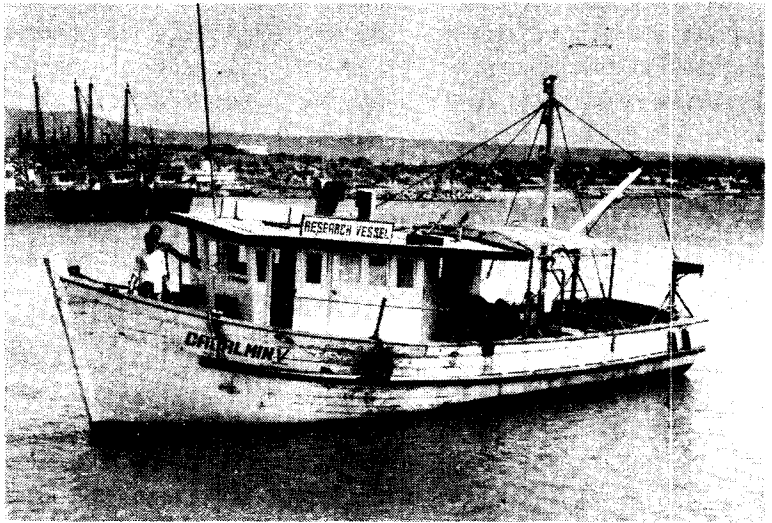
The Research Centre at Visakhapatnam and its Field Centres

status of Research Centre in 1965. Over the years, the Centre has been further strengthened and presently the laboratory is housed in two buildings - one in the Andhra University Campus (given by Andhra University on lease) and another building in the Fishing Harbour. The Field Centres at

Contai (West Bengal), Puri (Orissa), Palasa and Srikakulam (Andhra Pradesh) work under the administrative control of this Research Centre. This Centre has been collecting data and conducting researches on the various resources off North Andhra Coast.

With the mechanisation of fishing craft and modernisation of fishing gear and the associated developments and changes in the marine fisheries sector, a need was felt to strengthen research on marine fisheries of Andhra Pradesh. To meet this requirement, a Research Unit was established at Kakinada in 1965 which was elevated to the status of a Research Centre in 1977. The two Field Centres at Narsapur and Machilipatnam are under the administrative control of this Centre. The laboratory at Kakinada is housed in a rented building. This Centre has been conducting researches on the exploited resources off South Andhra Coast and also on the development of techniques for culture of shellfish.

***The Research Centre at
Kakinada and its Field Centres***



The Research Vessel *Cadalmin V* at Visakhapatnam.

Basic facilities for effectively conducting researches are created at these research centres. The Centre at Visakhapatnam is equipped

with a 43' Research Vessel, one Dinghy, two Jeeps with one trailer, Deep freezer, Refrigerator, Analytical Balances, Binocular and compound Microscopes, facilities for carrying out oceanographic research, Calculators, Cameras, etc.

***Facilities at
Research Centres***

The Research Centre at Kakinada is equipped with a Jeep and trailer, one 13' fibreglass Dinghy, two 7.5 HP outboard motor Engines, Binocular Stereozoom Microscope, Compound Microscopes, Deep freezer, Refrigerator, Electric Balances, Cameras, Calculators and equipments to carry out hydrographic work.

To meet the increased demand for improved facility for expeditious analysis of fisheries data, Computers (PC-AT) are being provided at these Research Centres. For efficient conduct of researches, important Indian journals dealing with aquatic sciences and fisheries are subscribed regularly and a large number of text books of reference value are added every year at the libraries of two Research Centres.

**RESEARCH ACTIVITIES AND ACHIEVEMENTS
IN ANDHRA PRADESH**

The research work is carried out through research projects formulated at Headquarters, in consultation with Research Centres, on priority areas of national as well as regional importance. The researches in marine fisheries in Andhra Pradesh are carried out under different divisions of the Institute.

Fisheries Statistics and Resources Assessment

The basic requirement for carrying out research in capture fisheries is data on effort (Number of boats, boat days, fishing ours, man hours, etc.) and species/group wise catch which enable making estimates of fish production and effort expended on a monthly, quarterly and annual basis. Such data are essential to formulate development strategies also. To meet this requirement, the Institute has designed a Multi-stage Stratified Random Sampling Scheme. To identify various landing Centres and for purpose of stratification of the landing Centres into homogenous zones, a frame survey of the

fishing activities is a basic requirement. This gives a picture of marine fishing activities in terms of census of fisherfolk and categorisation of their involvement in the profession along with their educational status. Besides, information on the type of fishermen houses, availability of electricity, drinking water and its source, availability of educational institutions at different levels, co-operative societies, hospitals, jetty facilities, ice factories and cold storages and petrol bunks all of which will help in understanding the socio-economic status of the fishermen in the coastal districts, is also gathered.

The data collected in Andhra Pradesh show that of the total 453 fishing villages, the Srikakulam District has the maximum number (24%) followed by East Godavari (19%), Visakhapatnam (14%), Nellore (14%), Prakasam (13%), Krishna (6%), Guntur (5%) and **Frame survey** Vijayanagaram and West Godavari (3% each) Districts. Among the landing Centres, maximum number of these (19.6%) are situated in Srikakulam District followed by Nellore (19.3%), East Godavari (15.0%), Visakhapatnam (13.9%), Prakasam (13.9%), Krishna (7.8%), Vijayanagaram (4.3%), West Godavari (3.6%) and Guntur (2.5%) Districts.

Among the fishermen families in the State, East Godavari District has the maximum number (27%) followed by Srikakulam (22%), Visakhapatnam (16%), Prakasam (9%), Nellore (9%), Krishna (6%), Guntur (5%), West Godavari (3%) and Vijayanagaram (3%) Districts.

Among the fishermen engaged in fishing in the State, 87.7% are full-time fishermen followed by 6.5% of occasional fishermen and 5.8% of part-time fishermen. East Godavari District tops (27.5%) in the number of full-time fishermen followed by Visakhapatnam (19.9%), Srikakulam (16.6%), Prakasam (9.8%), Nellore (9.1%), Krishna (5.6%), Guntur (4.8%), Vijayanagaram (4.3%) and West Godavari (2.4%) Districts.

The landing statistics collected at different landing centres on the basis of the sampling scheme developed by the Institute are utilised to make estimates of district-wise and gearwise effort and district-wise, gearwise and group/species wise marine fish production on quarterly and annual basis.

The data collected and analysed from Andhra Pradesh Coast show that 32% of total catch is taken by trawl, 24% by non-mechanised drift gill net, 14% bottom set gill net, 13% by shore seine and the rest by boat seine, drift net, hooks and lines and others.

The annual marine fish production during 1985-92 varied from 1,18,541 t to 1,52,153 t with an annual average of 1,30,725 t. In the total landings in the State, East Godavari District dominates by contributing 25.8% of total, followed by Srikakulam (19.7%) Visakhapatnam (15.0%), Prakasam (12.9%), Nellore (10.6%), Guntur (5.9%), Krishna (4.7%), West Godavari (3.4%) and Vijayanagaram (1.9%) Districts.

**Fish production
in Andhra Pradesh**

In the landings in the State, clupeoids (sardines, shads, anchovies) dominate forming over 34% of total production in the State. Among these, *Sardinella* spp. constitute 25.4% followed by white-bait (25%), shad (20.2%) and others. Ribbonfish is the second

Important resources important resource which constitutes about 10% of total catch in the State followed by penaeid prawns (8.9%), perches including groupers, threadfin-breems and other perches (6.3%), croakers (6.3%), Indian mackerel (4.3%), sharks and rays (3.8%), seerfish (3.4%), horse mackerels, scads and leather-jackets (3.0%), crabs (2.8%), stomatopods (2.6%), pomfrets (2.5%), silverbellies (2.1%), nonpenaeid prawn (1.6%), catfish (1.6%), cephalopods (0.4%) and others.

The above information is very useful for initiating developmental policies by the State Government. These data are also made available to different agencies such as Universities, developmental agencies and international agencies including FAO. Besides, these data are an essential prerequisite for research in marine capture fisheries.

On the basis of data on gearwise production of different resources from along Andhra Pradesh Coast, it has been shown that **Resources assessment** increased production from the present fishing grounds can be obtained. It has also been shown that gill net units can land about 45% of additional catches, if their increase is effected in a phased manner.

In the presently fished grounds (0-50 m depth) along northeast coast of India (West Bengal, Orissa and Andhra Pradesh), the catchable potential is estimated as 2,20,500 t of which the contribution of Andhra Pradesh is 1,42,000 t. As the present landings are estimated to be around 1,31,000 t, the scope for increasing production from the present fishing grounds is limited. However, in depths beyond 50 m along northeast coast, which are not presently fished, the estimated potential yield is 1,64,000 t of which about 70% is available for exploitation by trawl and the rest by other gears. The important resources contributing to this are mackerels, carangids (mainly scad), ribbonfish, catfish, clupeoids, Bull's-eye, pelagic sharks, threadfin-breems and coastal tunas.

Research in Capture Fisheries

Researches in capture fisheries are directed to understand the characteristic features of exploited stocks such as their seasonal variations in availability and abundance, distribution in different depth zones, biological characteristics such as food and feeding habits, maturation, spawning and fecundity, growth and other aspects. The results of these researches help in studying the population dynamics and estimating the stock size and maximum sustainable yield (MSY) and optimum effort required for the same.

During the earlier years, investigations were carried out on the basis of landings from artisanal gear. During early sixties, the establishment of Exploratory Fisheries Project at Visakhapatnam and its exploratory surveys along northeast coast of India enabled the scientists of the Institute working at Visakhapatnam to investigate the distribution of finfishes and shellfishes in different depth zones during different periods of the year. The charting of fishing grounds in the region led to commencement of commercial trawling along Andhra Pradesh Coast using small mechanised boats in the late sixties. Further development took place by introduction of large trawlers in late seventies and mini-trawlers and *Sona* boats in mid eighties to exploit distant grounds. During 1991 and 1992 an estimated average of 6400 t of finfish and shellfish were landed by trawlers at Visakhapatnam, of which shrimps constituted about 1000 t. During the same period at Kakinada Fishing Harbour, an estimated 17,600 t of total catch was obtained by trawlers, of which shrimps accounted

for about 3300 t. The motorisation of country craft and use of out-board motors in certain areas also helped in the operation of drift gill nets and bottom set gill nets in distant waters and the production of pelagic and demersal finfish and shellfish increased considerably. This necessitated expansion of capture fisheries research and investigations have been carried out on various resources.

The seasonal variations in the catches of a large number of species of exploited finfishes, the particulars of their yield by different gears and important biological characteristics from around Visakhapatnam and Kakinada were summarised and published as 'Fish Calendars'.

Pelagic finfish resources : Researches have been carried out on trevallies, scads, horse mackerel, Indian mackerel, ribbonfish, seerfish, tunas, sardines and white-bait which constitute the bulk of pelagic fish catch. Data have been collected from artisanal as well as mechanised gears and studies on length composition, food and feeding habits and maturation and spawning have been carried out and parameters of growth and mortality estimated.

One interesting feature along Andhra Pradesh Coast, is that oil-sardine *Sardinella longiceps* which was absent in the catches or occurred only in stray numbers along southern most part of the coast, started occurring in commercial quantities along the entire Andhra Pradesh Coast since middle of 1985. During 1991 and 1992 the estimated landings of this species were 1800 t and 4360 t respectively from off Andhra Pradesh Coast. The distribution of **Oil-sardine** this species along this coast shows that the catches are obtained mainly from areas close to harbours, backwaters and river mouths. The fishery season for oil-sardine along Andhra Pradesh is June - December. Detailed studies on the biological characteristics of this species from this region are carried out. The occurrence of mature fish and small fish of 20 mm length in the catch from inshore waters shows that this species spawns in nearshore waters.

In lesser sardines, October - April is the fishery season and about 80% of annual catch is obtained during November - March. **Lesser sardines** During 1991 and 1992 an average annual catch of 8800 t of these fishes are obtained. In *Sardinella fimbriata*, it has been observed that juveniles of 7 months

Horse mackerels, scads, leather-jackets and trevallies belong to a very dominant group called carangids. An estimated 3600 t and



Indian mackerel (*Kanagadathalu* in Telugu).

6400 t of these fishes were landed in 1991 and 1992. Though several species of carangids occur in the catches, *Decapterus russelli* and



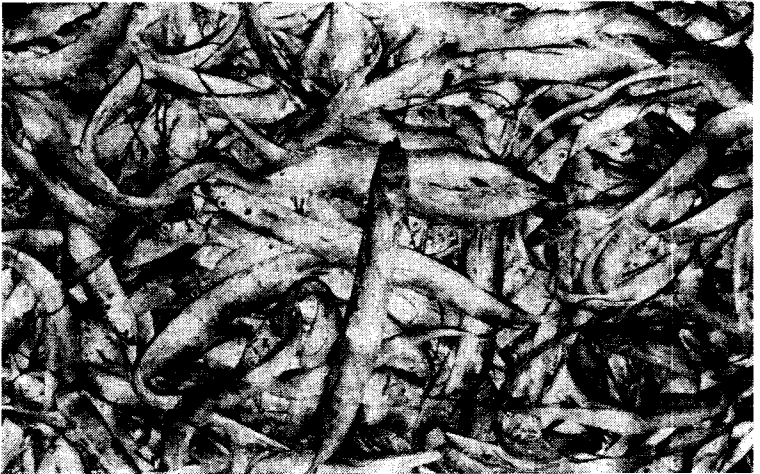
Carangids (*Paralu* in Telugu).

Carangoides malabaricus are dominant in catches of commercial trawlers whereas *Megalaspis cordyla* and *Alepes djedaba* dominate

in the catches of gill nets of Visakhapatnam. Off Kakinada, however *D. russelli* forms 80-90% of carangid catches by trawlers and February - April is the peak period of abundance of this species in the trawling grounds. The growth parameters and mortality rates of *D. russelli* and *M. cordyla* were estimated and stock assessment made.

During 1991 and 1992 the estimated landings of ribbonfish were about 12,000 t and 7000 t respectively. In ribbonfish, six species are known from Andhra Pradesh, but only one species *Trichiurus lepturus* which grows to a maximum length of 148 cm is most dominant and forms about 90% of ribbonfish catch. Investigations on aspects of biology have been carried out and stock assessment made.

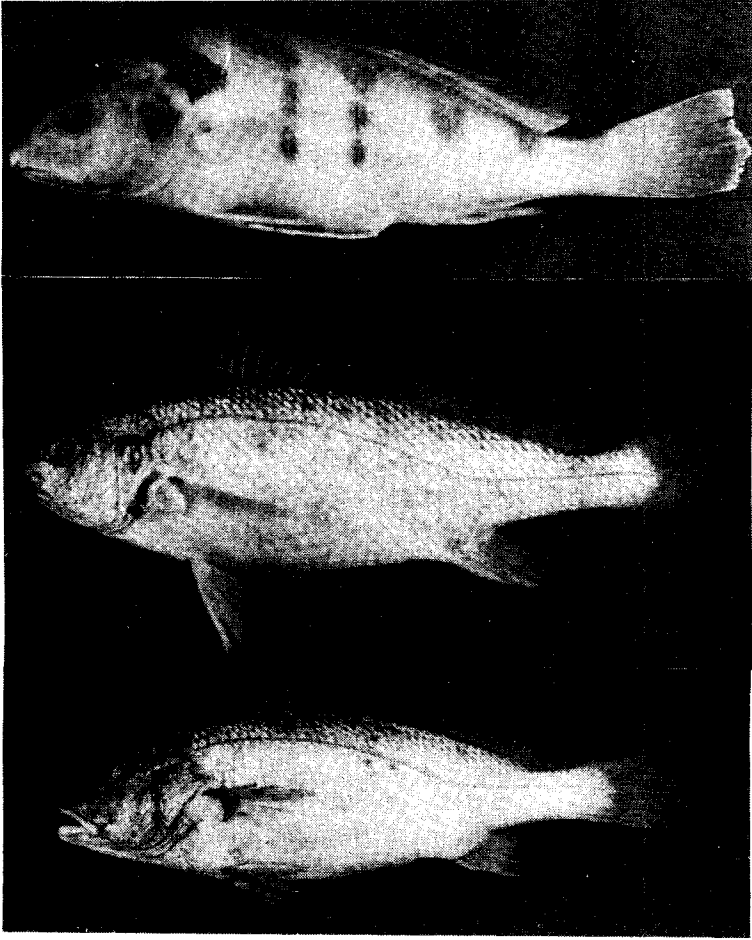
The average annual estimated landings of tunas are 625 t during 1991 and 1992. The important species along this coast are *Euthynnus affinis*, *Katsuwonus pelamis*, *Thunnus albacares* and *Auxis thazard*. These fishes are mainly taken by hooks and lines. Off Visakhapatnam, the length range of all these species in the catches is 20-75 cm. The main fishery season for tunas is May - September.



Ribbonfish (*Savallu* in Telugu).

Demersal finfish resources : In this category, croakers, threadfin-breems, catfish and silverbellies are the dominant groups that

contribute to the landings. Bulk of the catches of these fishes are obtained by small trawlers and investigations have been carried out on these fishes from Visakhapatnam and Kakinada Centres.



Croakers (*Gorasalu* in Telugu).

The average annual estimated landings of croakers in the State during 1991 and 1992 are 8200 t. About 18 species of croakers contribute to the fishery of which *Atrobucca nibe*, *Johnius carutta*, *J. vogleri*, *J. dussumieri*, *Pennahia macrophthalmus*, *Nibea maculata*,

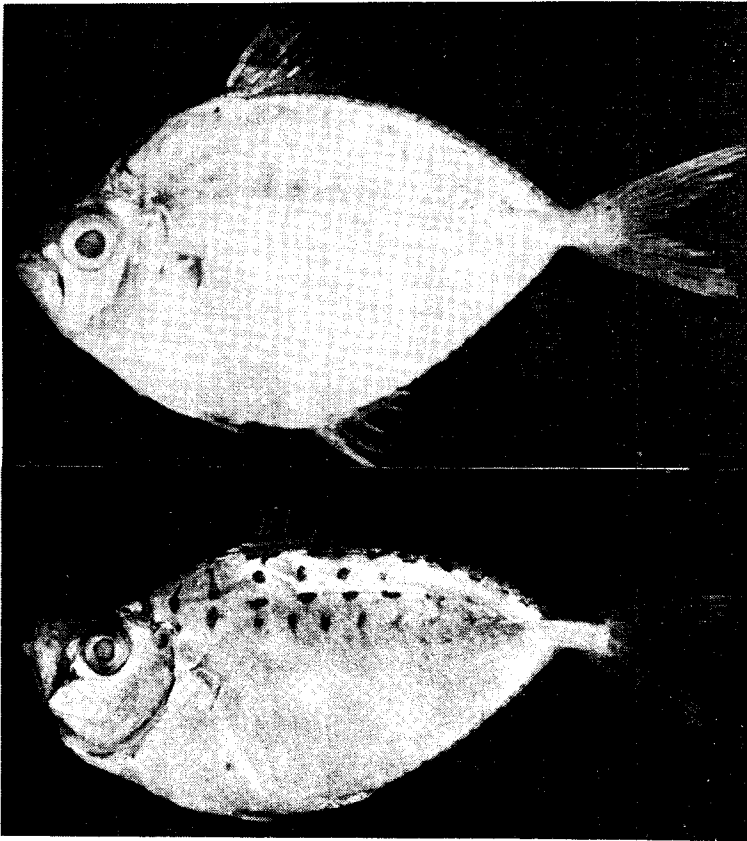
Chrysochir aureus and *Otolithes ruber* are dominant species. Detailed biological studies have been made on these species and stock assessment made. *Atrobucca nibe* spawns off the Andhra Pradesh Coast during February - July, *Johnius dussumieri* during March - August, *J. carutta* during January - June, *J. vogleri* during November - June, *Pennahia macrophthalmus* during October - June and *Nibea maculata* during April - November. The stock assessment study on *J. carutta* showed that the cod end mesh size of trawl net has to be increased to improve the yield from the present fishing ground. In *N. maculata* there is scope to increase production by 5%, by increasing the effort.



Threadfin-breems (*Erragulivindalu* in Telugu).

Threadfin-breems are more abundant in depths beyond 70 m and are presently exploited by trawlers from depths less than 70 m. About 2000 t are landed annually from along the coast of Andhra Pradesh, but fishing in the depth range of 70-125 m will result in increased yield. Five species are known from Andhra Pradesh Coast, but *Nemipterus japonicus* and *N. mesoprion* are most dominant and determine the success of the fishery. Off Visakhapatnam, January - March is the period of peak abundance of these fishes in the trawling grounds. The period of upwelling coincides with increased catches of *N. mesoprion*.

In *N. japonicus*, the feeding habits indicate bottom feeding. Off Visakhapatnam this species is known to spawn during December - May whereas off Kakinada the period is August - April. Males attain larger lengths and beyond 22 cm, all are males only. In *N. mesoprion* the spawning period is December - April.



Dominant Silverbellies (*Karalu* in Telugu).

The studies on stock assessment show that there is scope to increase the yield of these two species from the present grounds by increasing the effort by 40%; however, the increase in yield will only be 2% at this effort level. Hence increased effort will lead to decrease in catch per unit effort.

The relatively small, silverbellies are more abundant in shallower regions of the sea upto about 40 m depth and are exploited by trawl and artisanal gears such as shore-seine, boat-seine and gill net. The estimated annual landings from the State during 1991 and 1992 are 2612 t and 4682 t respectively. Bulk of the catches are however taken by trawls. Andhra Pradesh occupies second position in regard to silverbelly catches. In this State, highest silverbelly landings are obtained in Srikakulam District which accounts for 35% of total silverbelly landings in the State followed by East Godavari (27.7%), Nellore (16.7%), Visakhapatnam (11.9%), Prakasam (3.9%), Guntur (2.9%), Vijayanagaram (0.9%), West Godavari (0.4%) and Krishna (0.3%) Districts. In the northern part of the State, peak catches are obtained during April - June and during January - March in the southern part. Of the twenty species known from India, about 10 species contribute to the fishery in this State. Of these, *Leiognathus bindus* and *Secutor insidiator* are most abundant together forming 65% of silverbelly landings.



Catfishes (*Jellalu* in Telugu).

Detailed studies are made in *L. bindus* and *S. insidiator*. These two species spawn almost round the year. The investigations on stock assessment revealed that the present effort has to be reduced by 20% to obtain maximum sustainable yield from the present fishing grounds.

The average annual landings of catfishes are 2200 t during 1991 and 1992. These fishes are abundant in the trawling grounds during April - August and December - February period. **Catfish** *Tachysurus thalassinus*, *T. tenuispinis* and *T. dussumieri* contribute to the fishery. The length range of *T. thalassinus* in the commercial landings is 220-559 mm.

As the trawl fisheries take several species, each with different population characteristics, single species stock assessments only help to understand the status of the single species stock in the mixed fishery. Hence mixed fisheries assessments are essential for formulating regulatory measures. **Mixed fisheries assessment** With reference to five major demersal species off Kakinada, mixed fisheries assessment has been made and management options indicated.

Crustacean resources : Among the crustaceans, prawns are commercially the most important, because of their export market and almost the entire mechanised fishing is directed towards exploiting this resource. Andhra Pradesh contributes about 10,000 t of penaeid prawns from the marine capture fishery, of which about 65% is taken by the trawlers. The Research Centres at Visakhapatnam and Kakinada conduct investigations on penaeid prawns on the basis of samples collected from trawlers.

Penaeid prawns from about 10% of total catches by small trawlers at Visakhapatnam. During 1991 and 1992 the estimated average annual landing was about 1000 t. In the trawling grounds off Visakhapatnam, the maximum sustainable yield is estimated at **Penaeid prawns** 728 t with an effort of 2,70,785 trawling hours. A suggestion was made to keep the small trawler fleet at 135 units so as to ensure MSY and make the fishery economically viable. Although several species of penaeid prawns contribute to the fishery, only two species *Metapenaeus monoceros* and *Penaeus indicus* are very important. The researches on *M. monoceros* have indicated that the stock is heavily exploited and further increase in effort results in over-exploitation of the resource. It has also been suggested that for both the species, the yield can be improved by increasing the length at first capture.

In the sea off Kakinada, the small trawlers land about 2900 t (average of 1991 and 1992) of penaeid prawns per year, making the region the most important along the Andhra Pradesh Coast. Penaeids form about 70% of prawn catches by trawl. The catches are generally high during January - March and October - December. Of the several species of penaeids that contribute to the trawl fishery, *Penaeus indicus*, *P. monodon*, *P. merguensis*, *Metapenaeus monoceros*, *M. affinis*, *M. dobsoni*, *M. brevicornis* and *Parapenaeopsis stylifera* are dominant together forming about 85% of penaeid prawn landings. Investigations on the biology and population dynamics of these species have been made and MSY determined.



Prawns (*Royyalu* in Telugu).

The non-penaeid prawns are exploited in considerable quantities along Andhra Pradesh Coast, particularly along Kakinada Coast. They form about 30% of prawn catches by trawlers at Kakinada. *Nematopalaemon tenuipes* is the most dominant species forming about 45% of non-penaeid prawn catch followed by *Acetes indicus* (30%) *Exhyppolismata ensirostris* (11%) and others. Studies on impact of reduction in cod end mesh size of trawls at Kakinada showed that it had resulted in increase of non-penaeid prawn catch. During 1989 - 1992 an average annual catch of 540 t of these prawns were landed by trawlers and July - September is the peak period of fishery.

The backwaters around Kakinada serve as seed banks for cultivable species such as *P. monodon* and *P. indicus*. About 900 t

of juvenile prawns are exploited from these waters per year. The recruitment of postlarvae and juveniles of penaeid prawns into and their growth rate in the backwaters around Kakinada are found to

**Prawn resources
in brackishwaters**

be high. The estimated growth of juveniles, on an average, is 30 - 35 mm in length per month. Thus these backwaters are good nursery grounds of penaeid prawns. The thick mangrove vegetation provides shelter and food for the prawns. Peak landings are obtained during October - December. The bulk of the catch ranging from 40 to 100 mm length comprises of 2 - 4 months old prawns. In addition to the above two species, juveniles of *P. semisulcatus* of length range 20 - 60 mm are also exploited in considerable quantities (1 - 4 kg/boat) during July - August and January - March.

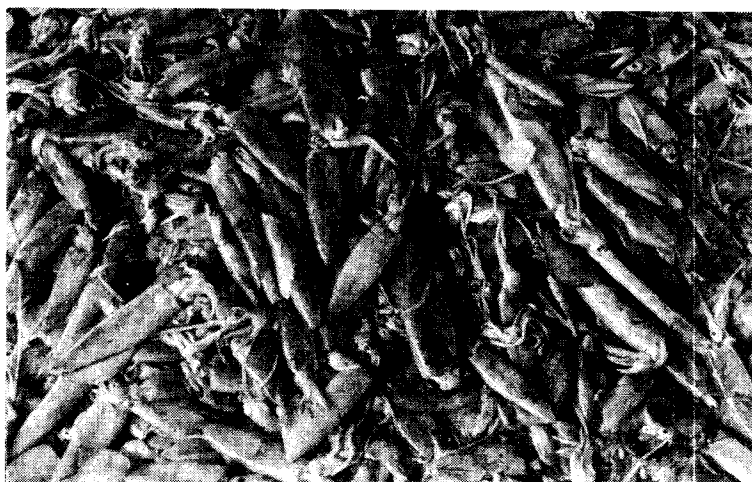
In recent years there is large scale exploitation of juvenile prawns from brackishwaters of Kakinada for culture purposes. The exploitation, which also takes species which are not cultured, is destructive for many species and there is urgent need to control exploitation of juveniles from brackishwaters, as otherwise the capture fishery from the sea is likely to be affected adversely.

Studies on the prawn resources of Andhra Pradesh, Orissa and West Bengal Coasts show that MSY of penaeid prawns is around 16,000 t of which about 104 large trawlers can take about 4500 t and the rest by artisanal gear and small trawlers maintained

**Resources of
the northeast coast**

at a level existing in 1990. The data collected by the Research Centres at Kakinada and Visakhapatnam on the demersal resources exploited along the northeast coast of India were analysed in the workshop on Bioeconomics of Demersal Fisheries of northeast coast of India organised by FAO/DANIDA/CMFRI/FSI at Visakhapatnam in February 1993. The analysis suggests that the different segments of the fisheries are operating on a profitable level though the operating and capital costs of large and mini-trawlers are higher than others. The analysis also shows that a reduction in fishing effort by any one (Large trawler, mini-trawler, *Sona*, Small trawlers and artisanal craft) of the five fleets or by all the fleets in combination would contribute to additional economic benefits in terms of additional profits, incomes and net foreign exchange earnings.

Molluscan resources : Among the molluscan shellfish resources, the cuttlefishes and squids are the most important resources having great export potential and Andhra Pradesh contributes significantly to the landing of this resource. Additionally, the State is blessed with the vast (146 sq. km area) Kakinada Bay which receives freshwater discharge from the Gauthami branch of Godavari River through several canals and which is bordered by extensive mangrove forest on the southern side. This supports rich bivalve and gastropod resources. Detailed studies have been carried out and valuable information brought out.



Squids (*Kandavalu* in Telugu).

During 1991 and 1992 the estimated landings of cephalopods from Andhra Pradesh are 446 t and 667 t. Trawls contribute to bulk of cephalopod catch. In the sea off Visakhapatnam the important species are the squid *Loligo duvaucelii* and the cuttlefishes *Sepia aculeata*, *S. pharaonis*, *S. brevimana*, *S. prashadi* and *Sepiella inermis*. In the sea of Kakinada, squids form 22% - 25% of cephalopod catch by trawlers and the rest by cuttlefish. Among squids, *L. duvaucelii* is most dominant forming 90% of catch; the other species contributing to squid fishery are *Doryteuthes* sp., *Loligo uyii* and *Loliolus* sp. Among cuttlefish *Sepiella inermis* is most dominant forming about 45% of cuttlefish catch followed by *Sepia aculeata*, *S. pharaonis* and others.

Various aspects of biology of cephalopods are investigated and stock assessment attempted.



Cuttlefish (*Kandavalu* in Telugu).

The stock sizes of various species were estimated through well-designed surveys. They are : Window-pane oyster (*Placenta placenta*) 12,400 t, blood-clam (*Anadara granosa*) 6900 t, other clams (*Paphia textile*, *Tellina* sp. *Meretrix meretrix*) 1900 t, pearl oyster (*Pinctada chemnitzii*) 30 t and gastropods (*Hemifusus pugilinus* and *Cerithidea fluviatilis*) 570 t.

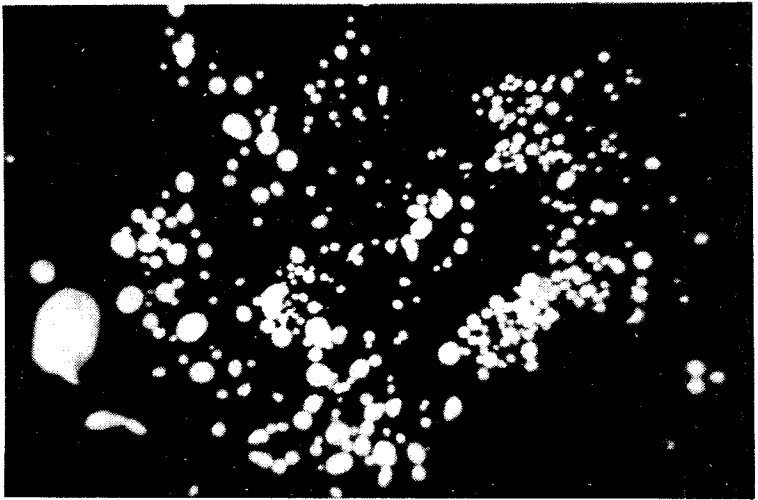
**Molluscan resources of
Kakinada Bay**

In addition to the above, a total of 21,000 t of shells of dead molluscs are estimated to be available in the bay.

Of all the molluscs in the bay, the window-pane oyster is most abundant. This oyster produces small natural pearls of poor quality which are in demand in the Unani system of medicine. It is estimated that about 51 t of window-pane oyster can yield one kilogram of pearls. These pearls are not extracted presently. Detailed investigations on the biology of this oyster have been carried out and it has been shown that this oyster lives for 3 - 4 years. It is recommended to maintain the present effort and length at first capture to enable harvest sustained yield.

Window-pane oyster

The blood-clam is another important resource in the bay. Though it is distributed almost all along the coastline, it does not form a fishery anywhere else. This species prefers soft, muddy bottom which is sheltered from strong wave action. Detailed **Blood-clam** researches have been carried out on this species; the life-span is estimated as 5 - 6 years. The stock assessment of this species shows that though there is scope for increasing production by increasing effort, the increase in yield will only be marginal. The meat of this species is suitable for human consumption and is eaten locally by the fishermen. Presently, there is considerable demand for the blood-clam as feed in prawn culture.



Pearls (*Mutyalu* in Telugu) of window-pane oyster from Kakinada.

Large quantities of gastropods such as *Hemifusus pugilinus* and **Gastropods** *Cerithidea fluviatilis* along with the above bivalves are also exploited in view of their great demand for ornamental purposes. The Research Centre at Kakinada is monitoring the exploited stocks of molluscs from the bay.

The irrigation cum navigational canal originating from the **Molluscan resources of Kakinada Canal** River Godavari, opens into the Kakinada Bay at Kakinada. The banks are strengthened by concrete structures and for distance of 5 km upstream, estuarine conditions prevail. The

oysters *Saccostrea cucullata* and *Crassostrea madrasensis* occur in beds on the canal banks. The population size of these oysters is estimated as 90 t.

With the scientists of the Institute participating in the cruises, the Fishery and Oceanographic Research Vessel *Sagar Sampada* conducted trawl surveys along northeast coast of India in depths beyond 50 m. The surveys revealed that :

**Resources survey by
FORV Sagar Sampada**

- Rich grounds for Indian mackerel exist off Orissa at a depth of 70 m during October. The catch per hour of trawling varied from 1.5 to 2.9 t in the region.
- The bull's eye (*Priacanthus* spp.) is abundant with catch per hour of trawling varying from 0.8 to 4.9 t off Andhra Pradesh Coast upto a maximum depth of 120 m.
- In the case of driftfish *Ariomma indica* and scad *Decapterus russelli*, rich grounds exist along northeast coast at depths of 60 - 70 m in February which yield about 7.5 t and 6.0 t respectively per hour of trawling.

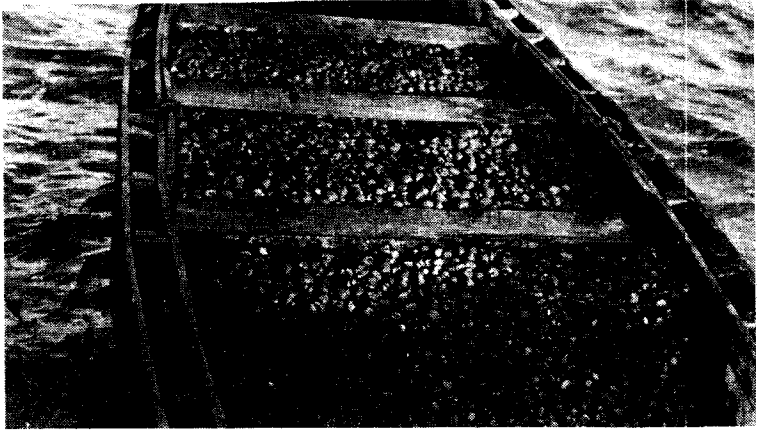
Research in Culture Fisheries

For the first time in Andhra Pradesh during 1976 and 1977 experimental culture of prawn *Penaeus monodon* was conducted in salt-pan reservoirs in the vicinity of Kakinada. This was done, because there are several hundred hectares of salt-pans in the region which are not put to any productive use during off season for salt production and it was believed that if they could be utilized for prawn culture, the small and marginal farmers could be benefited. The salt-pan reservoirs were stocked with juveniles of 5.4 cm average length and 1.04 g average weight. The stocking density was 30,040 per hectare. At harvest after 168 days, the mean length and weight were 12.3 cm and 10.9 g respectively. The survival rate was 79%. A production of 259 kg/ha in 168 days was obtained. The work was conducted in farmer's field and yield was given to him. The work demonstrated the feasibility of prawn culture in salt-pan reservoirs during off season for salt production.

Prawn culture

The blood-clam is suitable for 'on bottom' culture and the Kakinada Bay offers suitable areas for its culture. In view of poor production from the wild stocks and to increase production of this species which is rich in protein, glycogen and minerals, experiments in field culture in the Kakinada Bay were attempted in two plots of 100 m² and 625 m² areas.

Clam culture



Harvest of cultured clams (*Budithagulla* in Telugu) at Kakinada.

In 1979 in one experiment, 14,000 seed clams, of the length range 19-29 mm were stocked in the pen made of split bamboo slivers in an area of 100 sq. m in the Kakinada Bay. After 5 months, a total of 12,406 clams measuring 34 - 49 mm were harvested. This gave a survival rate of 88.6% and a production of 385.3 kg/100 m² in five months.

In an another experiment a total of 1,09,584 seed clams of length range 20 - 28 mm were stocked in a pen area of 625 m² in the bay. At harvest after 5½ months a total of 91,439 clams of the length range 34 - 50 mm were retrieved; this gave a retrieval of 83.4% and a production of 2.6 tonnes/625 m² in 5½ months.

During these experiments no artificial food was given. As the environmental conditions for spat-fall are differnt from those for growth and fattening, transplantation of seed clams to areas suitable

for growth results in increased production. The experiments conducted clearly show that such a practice in the Kakinada Bay will help in augmenting the production of blood-clam. It has also been shown that stocking rate can be increased to 240 clams/m².



Edible oyster (*Daragulla* in Telugu).

In view of the importance of the edible oyster *Crassostrea madrasensis* experiments on location testing for its culture are carried out at Kakinada. The seed produced at the Institute's hatchery at Tuticorin were transported to Kakinada and experimental culture was conducted on rens which showed that seed oyster grew from 27 mm to 72 mm in 8.5 months. It was concluded that this region is suitable for edible oyster culture.

Edible oyster culture

Researches in Fishery Environment and Mangrove Ecology

It is well-known that the environmental characteristics (monsoon, salinity, temperature and dissolved oxygen at different depths, primary and secondary productivity) influence the distribution, availability and abundance of fish stocks. Investigations on environmental characteristics are carried out from Visakhapatnam along Andhra Pradesh Coast.

Upwelling was observed to occur off Visakhapatnam between February and May with a revival during July - August. This phenomenon was observed to be intense close to the shore. Demersal fishes such as *Nemipterus mesoprion* and *Priacanthus hamrur* appear in significant quantities in the trawl catches during upwelling period and the former species has been identified as an indicator species of upwelling.

Among several groups of organisms found in the benthic fauna in the trawling grounds in the sea off Visakhapatnam, polychaetes and amphipods are found to be dominant. However, prawns followed by amphipods and stomatopods are found to be most dominant in the food of demersal fishes. In the region between Bhimuniapatnam and Gangavaram the density of benthic fauna is found to be lowest and this appears to be the consequence of continuous trawling in the region.

Detailed investigations are carried out on the ecology of mangroves near Kakinada. It is found that hydrographic conditions and sediment fertility in the mangrove canals and creeks of the Godavari estuarine system near Kakinada are quite suitable for and serve as a nursery of prawn, fish, crab and molluscan species. Penaeid prawn juveniles are most dominant forming 82% of bottom epifauna. Juveniles of *Penaeus indicus* are more abundant in Chollangi and Coringa estuaries with peak during May - August. Juveniles of *Metapenaeus dobsoni* are dominant in the Coringa River near B. V. Palem and Ramannapalem during September - December. Seed of *P. monodon* are found to be abundant in areas of tidal inundation in grassy fields and creeks between Gadimoga and Bhiravapalem with seasonal abundance during August - October. Among non-penaeids, juveniles of *Macrobrachium malcomsoni* and *M. rude* are abundant in the Matlapalem Canal towards upstream almost throughout the year.

The destruction of mangrove vegetation and indiscriminate exploitation of juveniles in the region will adversely affect the recruitment of prawns and it is suggested that the mangrove areas are protected.

Fisheries Economics

Investigations carried out on the economic performance of medium and small trawlers operating along Andhra Pradesh Coast showed that the medium trawler (*Sona*) of 12 - 15 m length had an acquisition cost of about Rs. 7.7 lakh in 1991 which resulted in a fixed cost of Rs. 2.62 lakh per annum. The fixed cost of a small trawler (*Pablo, Royya and Sorrah*) of 8 - 10 m, which had an initial investment of about Rs. 3.9 lakh was calculated as 1,42,250 per annum. The gross revenue of a medium trawler for 180 days of fishing was about Rs. 11.9 lakh and for a small trawler for 190 days about Rs. 7.2 lakh. The annual profit earned by a medium trawler was Rs. 1,79,390 and small trawler Rs. 77,273. The initial investment in both types of trawlers could be recovered within three years. The rate of return to the capital is worked out at 38.3% for medium trawler and 34.8% for small trawlers.

Economic performance of trawlers

The studies thus showed that both types of trawlers were running in profit, though the medium trawlers were found to be more efficient. It was recommended that further addition to the fleet should not be made.

FUTURE PROGRAMMES

Fisheries resources are renewable in nature and therefore monitoring the exploited stocks and economic aspects of the fisheries are of very great significance to enable understand the effects of exploitation and suggest measures to ensure maximum sustainable economic yield. This aspect has assumed greater significance in recent years in view of the fact that most of the exploited stocks reached optimum or near optimum levels in the presently fished areas.

Capture fisheries

In the capture fisheries sector, the following aspects will be studied.

- Production by different gears.
- Biological characteristics of exploited stocks : *Pelagic fishes* : Tunas, seerfish, mackerel, oil-sardine, lesser-sardine,

white-bait, ribbonfish; *Demersal fishes* : croakers, threadfin-breems, silverbellies, catfish, lizardfish; *Crustaceans* : Prawns, crabs, stomatopods; *Molluscs* : Squids and cuttlefishes.

- Effect of changing environmental characteristics on availability and abundance of fish and shell fish stocks.
- Economic performance of different fleets.
- Stock assessment with emphasis on mixed fisheries assessment.

The blood-clam and edible oyster have tremendous export potential and yield from wild is very much restricted. Therefore their production can be augmented by culture. The researches on culture of blood-clam and edible oyster at Kakinada yielded encouraging **Culture fisheries** results. The researches on culture of these organisms will be strengthened and possibilities of hatchery production of molluscan seed and sea-ranching will be studied. The possible changes in the production of clams by culture using pen enclosures and without using them will be examined.

