CMFRI
Special Publication
Number 40

Central Marine Fisheries Research Institute
40
YEARS
1947-1987

National Symposium on Research and Development in Marine Fisheries

Mandapam Camp
16-18 September 1987

ABSTRACTS

Central Marine Fisheries Research Institute
(Indian Council of Agricultural Research)
P. B. No. 2704, E. R. G. Road, Cochin-682 031

National Symposium on Research and Development in Marine Fisheries

Mandapam Camp, 16-18 September, 1987

ABSTRACTS

CMFRI Special Publication Number 40

Central Marine Fisheries Research Institute
(Indian Council of Agricultural Research)
P. B. No. 2704, E. R. G. Road, Cochin-682 031

Published by:

P. S. B. R. JAMES
Director
Central Marine Fisheries
Research Institute
Cochin, 682 031

NATIONAL SYMPOSIUM ON RESEARCH AND DEVELOPMENT IN MARINE FISHERIES

ABSTRACTS

Technical Session I

NATIONAL FISHERIES POLICY AND PLANNING

1. NEW HORIZONS IN FISHERY DEVELOPMENT PLANNING

P. C. GEORGE
Fishery Development & Management Specialist
3-D Saraswathy Nilayam, Jawahar Nagar,
Trivandrum 695 041

Fishery-policy planning at State and Central levels covering research, training and development during the last few decades has been more or less singularly focused to, and rightly too, towards increasing production and utilisation of modern technology to achieve the projected targets. The demand for increased production to meet domestic needs and export targets was the main compulsion. The acquisition of exclusive sovereign rights over a two-hundred-mile economic zone, bringing more than 2 million sq km of fishable waters and theoretical estimates of several million tons of fishable stocks in these areas, and the high production achieved in fish culture under controlled conditions have kindled hopes for a high growth rate in Indian fishery development, giving rise to increased optimism on production potential and possibilities in both inland and marine sectors.

However, in the course of the last three plan periods, we have been saddled with certain side effects which call for a more broad-based approach in development planning and careful assessment and appraisal of earlier policies and programmes in such sectors as expansion of fishing effort, creatian of technical manpower, introduction of modern technology, replacement of indigenous methods, protection of environment and conservation of resources. Inadequate studies on the social impact of many of the above programmes have created doubts on the extent of benefits accrued to the sectors for which these were meant.

As regards coastal fishery resources, we have reached a stage where further increase in production would be marginal and that too limited to certain selected varieties in certain zones only. Hence, additional investment in vessels and equipment has to be viewed against this concept. The offshore and deep-sea fishing sector is very much lagging behind the targets fixed and is yet to gather momentum to make any substantial impact on resource availability. A realistic planning exercise is needed to improve the efficiency and return from this sector.

The programme of manpower training has been taken up by several agencies such as state and central fishery institutions, Indian Council of Agricultural Research and universities. It is not very clear whether the actual requirements in the various subsectors have been carefully co-ordinated in order to have the optimum number of trained hands and at the same time to prevent wastage and unemployment, particularly because such training is costly and time consuming. A careful appraisal of the "self employment" programmes is also necessary to give adequate correction if necessary in planning for future needs. Overcapitalisation in infrastructure both at shore and at sea also is to be checked and assessed.

The inland capture fishery, in spite of its subdued role, contributes the lion's share of inland fish production. However, precious little is being done for its development and conservation and for environment protection. The inland culture fishery achieved remarkable

success under controlled conditions and requires promotional backup such as a more vigorous extension support and credit availability to bring it in line with the pace of development achieved in the agriculture sector.

In other words, planning for fisheries calls for a more broad-based approach with an eye on conservation and adoption of appropriate technology as well as its social impact on the traditional sector.

---

2. MARINE FISHERIES DEVELOPMENT — AN OUTLOOK FOR 21ST CENTURY AND KEY POLICY ISSUES

U. K. SRIVASTAVA
Professor and Chairman, Research, Indian Institute of Management, Ahmedabad - 380 015

Marine fisheries will have to play a crucial role in augmenting supplies both in the domestic as well as export markets. Thrust of the development will be on deepsea and brackishwater resources. The exploitation of these resources, particularly deepsea, will require a rapid transition from charter of vessels to joint ventures and owned fleet with modern and sophisticated technology. Creation of sizeable owned fleet would require massive credit and fiscal support. This thrust for exploitation of deepsea resources can be sustained with concerted attempts to formulate and implement strategies for product development and marketing in both domestic as well as exports markets. This will also require the attention to develop the necessary infrastructure to handle such vessels, onshore processing facilities, better management of fishing harbours, cold chain grid in the domestic markets, development of transit and terminal markets at wholesale and retail levels. Boatbuilding yards will have to take up new challenges. This also throws up challenges for net-marketing industry in this country. All these developments would also require massive efforts for training and development of manpower. This paper deals with all these areas in a systems framework and suggests appropriate policy support measures for strengthening various elements of the system.

---

3. GROWTH PROFILE OF MARINE FISHERIES IN INDIA

P. S. B. R. JAMES
Central Marine Fisheries Research Institute,
Cochin-682 031

An attempt is made in this paper to outline the growth and changes that have taken place in the marine fisheries of India over the past 4 decades. The trends in marine fish landings, the progressive changes that have taken place in the craft and gear employed to catch the fish, the progress made by the fish-processing and marketing industry, including the phenomenal growth of the export of marine products, are reviewed.

The rapid progress achieved in important areas of marine fisheries research in the post-Independence era and the areas in which more research is needed in the coming years are discussed. Education and training programmes aimed at providing the trained manpower to implement the various developmental programmes connected with the growth of the marine fishing industry are also outlined and the need for strengthening these programmes is pointed out

The growth in the fishermen population, the mechanisation of the indigenous craft, the introduction of the mechanised fishing vessels such as trawlers, purse seiners and gill netters into the marine fishery, the advent of large trawlers on the northeast coast of India and the effect of all these developments on the traditional fishermen are discussed. The attempts at promoting joint ventures and chartering of foreign vessels are analysed with respect to the advantages and disadvantages of such endeavours. The growth in the financial outlay during the successive five-year plans at the Central and State level and its impact on the development of the marine fishing sector are briefly elucidated

The socio-economic consequences of all these development, the new problems that have been thrown up by the progress and growth

of the marine fishing sector and the strategies for solving some of these problems are discussed. For the balanced growth of the marine fisheries in India, an integrated approach is needed involving all the factors, scientific, technological, administrative and social, that have a bearing on the capture, processing and utilization of the marine fishery resources.

---

4. PLANNING FOR FISHERIES DEVELOPMENT — SEARCH FOR APPROPRIATE POLICY INSTRUMENTS

A. G. JHINGRAN and S. PAUL
Central Inland Capture Fisheries Research Institute, Barrackpore - 743 101, W. B.

The Indian fisheries economy for the last several years has been characterised by sluggish growth rates in production (3.5%), inadequate marketing infrastructure, demand and supply imbalances, inter-sectoral conflicts, insignificant contribution of deepsea fishing (1%), lack of diversification in export trade and apathetic entrepreneurship in offshore fishing. Further, gains from extension of Exclusive Economic Zone (EEZ) are likely to elude us for want of well-identified technological options along with production incentives for the exploitation of living resources of EEZ.

Unlike marine fisheries, inland fisheries have registered a higher growth rate of production. Despite imperfections of marketing system, land-based culture fisheries have been favourably placed. Fish Farmers Development Agencies (FFDAs) have brought 1,50,000 ha under scientific fish farming. Reservoirs (3 million ha) afford opportunities for enhancing inland fish production for augmentation of domestic availabilities.

The present paper purports to examine some of these areas so as to have a sound basis for the task of policy formulation for both marine and inland fisheries.

Technical Session II

RESEARCH IN MARINE CAPTURE FISHERIES

5. DECADEWISE RESEARCH CONTRIBUTION OF CENTRAL MARINE FISHERIES RESEARCH INSTITUTE CONCOMITANT WITH DEVELOPMENT OF MARINE FISHERIES IN INDIA

P. S. B. R. JAMES and M. S. RAJAGOPALAN
Central Marine Fisheries Research Institute, Cochin

The Central Marine Fisheries Research Institute was established in 1947 under the Government of India, Ministry of Agriculture, at a time when organised research in marine fisheries was lacking in the country, especially on applied aspects that would lend support to the development of fisheries for augmenting production of protein-rich seafood.

In the formative years the Institute directed its researches toward getting a clear overall picture of the fishery resources of the country through an inventory survey of the production of commercially important fisheries and production means.

During the fifties, the Institute evolved a scientific sampling design to estimate seasonal and annual production of marine fish on an all-India basis. The biology and fishery of major resources such as oil sardine, mackerel, bombayduck and trawl fishes were studied in detail. The Institute was able to chart out productive fishing grounds for demersal resources including marine prawns through participation in exploratory surveys conducted by the vessels of Government of India and other agencies.

The research findings of the Institute gave the necessary impetus for progressive increase in the introduction of mechanised vessels and the exploitation of valuable prawn resources which was assuming an export potential. Significant observations were made in the sixties on the fishery oceanographic parameters such as upwelling, primary productivity and secondary production. Investigations on scombroid

fishery resources, and crustacean and molluscan resources yielded considerable information.

Since the early seventies, the Institute initiated research programmes in mariculture and, within a short span of time, several breakthroughs were achieved in the mariculture techniques for culturing prawns, finfishes, molluscs and seaweeds. In recent years, hatchery techniques have been evolved for breeding and seed production of many candidate species for sea farming. In addition, special attention has been paid to render advice on management and conservation of marine fishery resources.

The limited objectives with which the Institute was started were re-oriented and enlarged through the years to cope up with the development needs in the marine fisheries sector. The Institute is now playing a vital role in the exploitation and utilization of the vast potential of the EEZ of India and for augmenting production through open-sea farming.

The Institute's achievements during the successive decades commencing from the forties are briefly highlighted in this paper to provide the background for R & D inputs needed in the future.

---

6. A REVIEW OF MARINE FISHERY RESEARCHES IN ORISSA STATE

KAZA V. RAMA RAO,[1] K. C. DORA[2] and S. S. KHORA[3]

1,3 *Estuarine Biological Station, Zoological Survey of India, Hillpatna. Berhampur (Gm), Orissa*

2 *College of Fisheries, Rangailunda, Berhampur (Gm), Orissa*

The State of Orissa is divided into 13 districts, of which four are coastal, namely Balasore, Cuttack, Puri and Ganjam. These have a coastline of 480 km, which is 8% of the coastline of India. The continental shelf up to 200m depth covers an area of 25,000 sq. km, which is 4.5% of the total area of the Indian continental shelf. In the

northern part of Orissa the continental shelf extends 120 km from the shore and in the southern part up to 40 km. The marine fisheries sector of Orissa state has been showing a steady and slow expansion with a total marine fish catch of 46,070 t for the year 1984-85 compared to a catch of 38,200 t for the year 1980-81.

A wealth of information has been generated through the efforts of the scientists of central, state and private sectors after Jenkins (1911), who had initiated the marine fishery investigations along the Bengal and Orisse coasts using a steam trawler *Golden Crown* during the years 1908–1909. Over the eight decades good amount of research work on marine fishery of Orissa coast has been accumulated

A review of literature is given in the present communication to assist the fellow scientists who are working currently along the Orissa coast and to evaluate the work done so far. This would in turn help in framing the marine research activities along the Orissa coast, giving due importance to the missing links in achieving the Government of Orissa's plans to increase the fish landings to 1,20,000 t by the end of the 7th five-year plan (1989-90). The plan envisages the expansion of the fishing fleet in the inshore and offshore areas, improvement of landings, storage, processing and transport facilities and proper infrastructure for local marketing and foreign export.

---

7. DISTRIBUTION AND ABUNDANCE OF OIL SARDINE AND MACKEREL IN RELATION TO ENVIRONMENTAL CHARACTERISTICS IN THE INDIAN COASTAL WATERS

P. S. B. R. JAMES, K. N. KURUP, C. P. RAMAMIRTHAM, D. S. RAO, G. SUBBARAJU and V. KUNJUKRISHNA PILLAI
Central Marine Fisheries Research Institute, Cochin

With an extensive coastline of 6000 km and highly productive inshore waters, it is natural that the pelagic resources, especially the oil sardine and mackerel, play a key role in the overall marine fish production of the country. Marine fish production from the

Indian seas has shown considerable increase during the past four decades. From a meagre 0.5 million tonnes in the early fifties the production showed a steady increase till the middle of seventies and thereafter fluctuated around 1.4 million tonnes without any significant increase. However, from the early eighties the production showed slight increase, registering 1.7 million tonnes in 1986. The bulk of the resource caught was constituted by oil sardine *(Sardinella longiceps)* and mackerel *(Rastrelliger kanagurta)*, but these species showed characteristic wide fluctuations in abundance as well as distribution compared to other fishery resources.

In the early fifties, oil sardine and mackerel together contributed about 21% of the total marine fish production in the country. The quantity increased to 33% in the late sixties, in some years oil sardine alone contributing up to 30%. However, the picture changed slowly with the increased exploitation of certain demersal resources such as shrimps and also due to the introduction of new fishing gears for the same purpose. Consequently, in the early eighties oil sardine and mackerel accounted only 15% of the total marine fish production. Nevertheless, these pelagic resources of sardine and mackerel have been the mainstay in the landings particularly in the artisanal sector. Of late, considerable fluctuations have been noticed in the distribution as well as seasonality which alone cannot be attributed to fishery dependent factors.

The influence of environmental characteristics of the coastal waters on the recruitment and distribution of these resources are also not known adequately. The effects of monsoon and upwelling resulting in the shifting of thermocline and oxygen minimum layer as well as the role played by salinity and water currents have already been recorded. However, the changes in the environmental characteristics that occurred in the recent times such as the delay and failure of monsoon, marine pollution resulting from various sources and its effect on the marine ecosystem and resources in the coastal waters are not clearly understood.

Though the problem of pollution from various sources in the coastal waters has attracted the attention since the seventies, the available information is rather scanty. However, there is an apprehension that the pollution of the coastal environment along

with the changes in the physico-chemical environmental characteristics have a critical role in the changing pattern of fishery especially for the pelagic resources such as oil sardine and mackerel.

In this paper the relationship of the pelagic fishery resource, especially of oil sardine and mackerel, with the environmental characteristics that influence the resource directly and indirectly, such as salinity, temperature, dissolved oxygen content, ocean currents, plankton productivity and marine pollution, over a time span of four decades have been discussed and evaluated.

---

8. FISHERY AND BIOLOGY OF OILSARDINE, *SARDINELLA LONGICEPS*, FROM COASTAL WATERS OF PARANGIPETTAI

K. KUMAR and K. BALASUBRAHMANYAN
Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai 608 502

Although oil-sardine forms a major fishery on the west coast, it contributes to a minor fishery in some places on the east coast. Information about *Sardinella longiceps* on the east coast is scanty. The total catch landed at Parangipettai was about 79.95 tonnes from October 1985 to September 1986. Oil-sardine fishery was dominant in Parangipettai during July-September '86, amounting to about 70.5 tonnes. In the present study the length ranged from 102 to 193 mm in total length and nearly 60% of the catch comprised fish above 150 mm in length. By von Bertalanffy's method it was found that *S. longiceps* had a growth of 147.72 mm for the first year, 172.53 mm for the second year and 187.71 mm for the third year. In the present study the size at first maturity was 156 mm for females and 158.5 mm for males and spawning was found to occur from July to September 1986. A comprehensive and detailed study of the occurrence of oil-sardine on the east coast is needed to assess its resource potential.

---

9 EXPLOITATION OF SEERFISH RESOURCES IN GULF OF MANNAR

H. MOHAMAD KASIM and K. M. S. AMEER HAMSA
Central Marine Fisheries Research Institute,
Cochin - 682 031

On an average 34,476 tonnes of seerfish were landed in India during 1982-1985. *Scomberomorus guttatus* constituted 50% of the total catch, *S. commerson* 49.1%, *S. lineolatus* 0.3% and *Acanthocybium solandri* 0.3%. The resource was exploited by both mechanised and non-mechanised fishing units, using gears such as the drift gill nets, hooks and lines and trawl nets.

S. guttatus is dominant along the northern coasts and *S. commerson* along the southern coasts of India. In Gulf of Mannar, seerfish are exploited by drift gill nets of different mesh sizes, hooks and lines, trawl nets and, to a limited extent, by shore-seines. On an average 421.4 tonnes of seerfish are being landed annually by all these gears along Tuticorin coast. The drift gill net, *paruvalai*, landed on an average 156.7 tonnes at the catch rate of 46.5 kg per unit. Hooks and line units landed annually 141.2 tonnes at the catch rate of 14.6 kg per unit and trawl nets 113.4 tonnes at the catch rate of 3.04 kg per unit. The smaller-mesh sized drift gill net, *podivalai*, landed on an average 10 tonnes annually at the catch rate of 8.65 kg per unit. Though the trawlers landed 113.4 tonnes of seer fish, the catch rate indicates that this gear did not exploit this resource effectively.

The fishery of seerfish in Gulf of Mannar is supported by the three species; *Scomberomorous commerson* is the dominant species, constituting 91% of the total catch, followed by *S. lineolatus* (6.9%) and *S. guttatus* (2.1%). The growth in length of the dominant species *S. commerson* and the natural, total and fishing mortality rates have been estimated for this species with respect to different gears. The yield per recruitment for different combinations of age at first capture and fishing mortality rates for the prevailing M/K ratio are estimated and given in the form of yield isopleth for studying the exploitation rate and

yield. The estimated optimum age of exploitation for this species is 3.88 years and the potential yield per recruit is 1749 g.

The highly selective gears like the drift gillnet, *paruvalai*, and hooks and lines have been observed to exploit seerfish very effectively and more number of larger individuals have been caught as these gears are employed with the aim to exploit this resource. Whereas, the smaller mesh sized gillnets, *podivalai, chalavalai*, and trawl net have been observed to land smaller individuals in good numbers. The exploitation of smaller size groups by these gears is only incidental. Exploitation by *paruvalai* and hooks and lines may be encouraged for enhancing the production of this resource.

---

10. SOME OBSERVATIONS ON THE FISHERY AND BIOLOGY OF SILVER POMFRET, *P. ARGENTEUS*, OF SAURASHTRA COAST, GUJARAT

Y. A. TRIVEDI, D. N. CHANDRA, H. B. DAVE,
D. V. NANDASANA and I. C. JADEGA
Gujarat Fisheries Aquatic Sciences Research Station, Porbandar

Silver pomfret, *P. argenteus*, forms a very important part of commercial fisheries in Porbandar and Veraval sectors of Saurashtra, Gujarat. The present paper deals with certain biological observations on this fishery. 16-20 cm length group and 11-15 cm width group generally dominated in the landings at both the centres. Juveniles were also found in large numbers in the catch.

Female fish always outnumbered the males at both the centres. Mature females were encountered round the year at Porbandar.

---

11. RESOURCE RESPONSE TO MANAGEMENT METHODS IN THE MULTI-RESOURCE DOL FISHERY

ALEXANDER KURIAN
Central Marine Fisheries Research Institute,
Bombay Research Centre, Bombay

The dol fishery along the Maharashtra coast is based on a multiple resource base providing more than 60% of the total marine fish production of the state. This stable system of exploitation utilizes bombayduck, grenadier anchovy, non-penaeid prawns, pomfrets and other varieties. Considering the management objective for this sector as developing a system of exploitation without damaging the resource, the response of the resource to the variables which are subject to management such as amount of fishing and size at first capture are examined.

Dol fishery concentrates where fish are abundant with seasonal shifts. In this type of density dependent pattern of exploitation, there is no advantage in controlling effort. Since a multi-species fishery is considered stable, it can tolerate variations in effort. Thus the impact of fishing on the stock is considered to be insignificant. The fishery is labour intensive and it is an advantage in the populated coastal areas where rate of unemployment is high. Because of the complexity resulting from the diversity in the nature of the resource, deciding on a common optimum mesh size for all the resource is not possible and will result in reduced efficiency and economic loss as was shown by the experimental fishing employing cod-ends with varying mesh size.

The study shows that the multiple resource stock supporting the dol fishery is likely to be maintained about the same level with minor annual fluctuations. Therefore, management action of any type is not called for. What is essential is to find ways for a better post harvest utilization of the low priced dol components to improve the quality of life of the fishermen in this sector.

12. PRESENT STATUS OF POLYNEMID FISHERY IN INDIA

P. V. KAGWADE
Central Marine Fisheries Research Institute
Bombay Research Centre, Bombay

The polynemid fishery which is not of a big magnitude has shown rise and fall in the catches during the last 30 years from 1956 to 1985. Though represented by 9 species, the fishery is supported mainly by *Polydactylus indicus* ('Dara') and to a lesser extent by *Eleuthronema tetradactylum* ('Rawas'), both growing to over a metre in length and weighing more than 18 kg. Because of the dominance of *P. indicus*, fluctuations in its catches are reflected in the total polynemid landings. The decline in catch in the sixties is attributed to the heavy landings of 'Chelna' (which are nothing but juveniles of 'Dara') in the fifties and sixties by the commercial trawlers. Added to this are certain biological facts. 'Dara' matures above 80 cm in the IV year and is a gonochoristic hermaphrodite in which the ovarian part of ovotestis becomes active alternatively with the testicular part and because of this the egg bearing period for an individual is reduced to half. Hermaphodites are also encountered in other polynemid species.

Cessation of trawling in the nursery grounds of 'Dara' due to the concentration of fishing effort for prawns in other areas in the late sixties and seventies has helped the fishery to revive in the seventies and eighties and thus to conserve the species. The traditional fishermen use a highly selective gear, namely, 'Waghra Jal', a bottom drift gill net for 3-4 months in a year during the spawning migration of this species towards the Gulf of Cambay. This by itself is a good management policy to preserve such an important fishery, in spite of its moderate magnitude.

13. AN ASSESSMENT OF THE DEMERSAL FISHERY RESOURCES OF THE NORTHEAST COAST OF INDIA

S. REUBEN, G. SUDHAKARA RAO, G. LUTHER, T. APPA RAO, K. RADHAKRISHNA, Y. APPANNA SASTRY and G. RADHAKRISHNAN
Visakhapatnam Research Centre of
Central Marine Fisheries Research Institute

An overview of the demersal fishery resources of the continental shelf lying between latitudes 15°N and 21°N and longitudes 80°E and 88°E covering an area of 81, 341 sq km has been made based on data collected from the exploratory fishery surveys conducted by the Government of India fishing vessels during 1961-85. This region falls into 19 areas of size 1° long. X 1° lat. each, and each area has been further divided into squares of 10x10 minutes each. Effort has been standardized using one of the five vessels employed in the exploratory surveys. Catch rates in the shelf region ranged between 1 kg/h in square 17-83/C1 and 377 kg/h in square 20-88/B5. Squares that yielded 150 kg/h or more are 16-81/B5; 16-82/A2 and E3; 18-84/A2, D5 and E6; 19-84/F1; 19-85/A2, B4, D4, E4, F4; 19-86/A4, B4, B5, C5; 20-86/E1; 20-88/A6 and B5.

Potential yield of the bottom-trawl fishery resources (at 60% of the standing stock) has been estimated by 'swept area' method at 146,200 t for the area surveyed. It varied between 1396 t (in area 18-83) and 23,429 t (in area 19-85). Areas 19-84, 19-85 and 19-86 with potential yields at 3.13 t/sq km, 3.01 t/sq km and 2.84 t/sq km respectively were found to be rich fishing grounds for bottom-trawling. Potential yield estimates have been made for important groups of fishes met within the shelf area. A critical study of the category-wise estimates indicates that sharks & skates, rays, catfishes, mackerel, threadfin breams, drift fishes, jacks and goatfishes are under-exploited at present and that lizard fishes and croakers have already reached the optimum level of exploitation. Current knowledge of the bottom-trawl fisheries resources of the shelf area under reference has been reviewed and the factors responsible for the variations in the estimated potential yields obtained have been pointed out.

14. THE CATFISH RESOURCE OF SOUTHWEST COAST OF INDIA — PEOSPECTS AND MANAGEMENT PROBLEMS

P. S. B. R. JAMES, V. N. BANDE, N. GOPINATHA MENON and K. BALACHANDRAN

Central Marine Fisheries Research Institute, Cochin - 31

The marine catfish form an important resource along Kerala-Karnataka coast. Till early seventies this resource was mainly exploited by indigenous gears and to a lesser extent by trawlers, yielding a steady catch. The sudden introduction of a large number of purse seines brought in a boost in the production of catfishes along Karnataka coast. This increase in the production was achieved exclusively by exploiting shoals of brooders which frequented the coastal waters for spawning in the monsoon and post-monsoon months. The exploitation of the brooders year after year has led to the decline in production, probably due to poor recruitment. The yield of catfish along Kerala showed a decreasing trend after the massive purse seine operations in Karnataka. The possible extent and effects of this decline are discussed in detail. The yield trends of various species of catfish by different gears at the important fishing centres in Kerala and Karnataka have been studied in the light of declining production and destruction of brooders. This account is an attempt to establish the degree of destruction of brooders, spawners and eggs/larvae along the entire coastal stretch, especially during September-October period. An attempt has been made to suggest suitable management measures to overcome this situation, so that a maximum sustainable yield can be achieved without affecting the stock as well as the spawning population.

15. SOME ASPECTS OF BIOLOGY AND FISHERY OF *LATES CALCARIFER* IN MUTHUPET LAGOON

G. VENKATASAMY, G. SATHIYAMOORTHY and S. DURAIRAJ
Brackish Water Fisheries Survey Unit, Tamilnadu Fisheries Department, Muthupet - 614 704

Lates calcarifer, locally known as "Koduva", is available throughout the year in Muthupet lagoon in Thanjavur district. This fish can be cultured in brackish-water ponds. Detailed information about the biology and fishery of this economically important fish is lacking. So a study was conducted during September 1985 to August 1986. 645 specimens were examined for length-weight relationship. Based on the length-frequency distribution, the age and growth is studied. The mature fish landed during July-August were studied. Fecundity is around 0.5 million/kg of fish. Juveniles are available in the shallow margin of the lagoon during October-December. Peak landings were recorded during November to December and June to August.

---

16. MIGRATORY WINTER BAG-NET FISHERY IN COASTAL WATERS OF THE HOOGHLY ESTUARY

B. N. SAIGAL, P. M. MITRA and H. C. KARMAKAR
Central Inland Capture Fisheries Research Institute, Barrackpore, west Bengal

The migratory winter bag-net fishery is a typical feature of the coastal waters of the Hooghly estuary. 4,000 men with about 800 bag-nets migrated from different estuarine areas and established fishing camps in different islands during 1984-85 and 1985-86. Three and a a half months seasonal fishery accounted for an average estimated fish yield of 17,872 t, forming about 71% of the total fish yield from the estuary as against 29% to 33% about 15 years ago. An average catch

per unit of effort of 152 kg was about 18 to 36 times that obtained in the upper and middle stretches and about 3 times more than that 15 years ago in the lower coastal waters. *Harpodon nehereus, Trichiurus* spp., *Pama pama, Setipinna* spp. and different species of prawns dominated in the catches. The bulk of the catches are sundried and exported to marketing centres. The reasons for tremendous increase in the winter migratory bag-net catches have been discussed.

---

17. SHRIMP RESOURCES OF THE COASTAL WATERS OF KERALA AND THE EFFECT OF MECHANISATION

M. J. GEORGE
Girinagar, Cochin

The exploitation of shrimp resources in the coastal waters of Kerala by mechanised and traditional sectors together is limited to the 80 m depth zone in the continental shelf. Indications are the the shrimping grounds inside this depth zone all along the coast are being exploited to the maximum level, possibly by a combination of effort from the two sectors, except perhaps a few areas which are unreachable from the existing port facilities by the small mechanised vessels capable of only single day operations.

The trend in shrimp production right from the time of initial introduction of mechanisation using the shrimp trawls in the fifties through 1985 has been studied to assess the resource situation from an overall total shrimp production view point as well as the part played in the production by the two sectors. The total production which was less than 15,000 tonnes before the introduction of mechanisation rose tup to the maximum of nearly 85,000 tonnes in 1973 and thereafter declined to an average of 30 to 40 thousand tonnes in recent years

with slight annual fluctuations. The analysis of production data from important centres of fishing operations also shows a similar trend. Thus it is becoming more and more evident that a decline and stagnation has set in as far as the shrimp fishery of the coastal zone is concerned, inviting urgent measures for conservation of fishery in the area.

A comparative study of shrimp production data of the traditional sector and the mechanised sector shows that while the catches of the former decreased considerably, that of the latter increased over the years, resulting in the present conflict between the two sectors. This raises serious management problems for the fishery and some of the management measures which could be adopted with reference to the total fishery as well as the fishery at important centres are discussed.

---

18. SHRIMP FISHERY OF BOMBAY COAST

M. ARAVINDAKSHAN and J. P. KARBHARI
Central Marine Fisheries Research Institute
Bombay Research Centre, Bombay

With the introduction of mechanised trawlers, the shrimp fishery of Maharashtra coast, especially of Bombay region, has shown considerable variations both in species composition and in magnitude of landings. A study was therefore made for a five-year period from 1982 to 1986 to understand the trend of prawn fishery. Two important landing centres, namely Versova and Sassoon Dock, were selected for mechanised 'dol' fishery and trawl fishery, respectively. The results are presented along with the problems of management when mechanisation is on the increase enabling the fishermen to explore deeper areas hereto not fished at all.

---

19. A SURVEY OF THE EXPLOITATION OF JUVENILES OF GREEN TIGER PRAWN, *PENAEUS (PENAEUS) SEMISULCATUS*, ALONG PALK BAY AND ITS IMPACT ON THE PRAWN FISHERY OF THE REGION

P. E. SAMPSON MANICKAM, M. R. ARPUTHARAJ and P. VEDAVYASA RAO

Central Marine Fisheries Research Institute, Mandapam Regional Centre, Mandapam Camp

The green tiger prawn, *Penaeus (Penaeus) semisulcatus*, contributes to over 50% of the total prawn catch landed along the Palk Bay coast. They are caught by the indigenously developed trawl-like bottom nets and trawl nets operated by non-mechanised and mechanised fishing vessels within the 12 metre depth zone. With the increasing demand for prawns by the export trade, intense fishing for juvenile prawns which inhabit the seagrass ecosystem near the shore is taking place all along the coast. The results of the survey carried out on this exploitation pattern are reported in the paper.

Fifty fishing villages from Adirampattinam in the north to Thangachimadam in the south serving as bases for the operation of 2,500 indigenous fishing crafts are involved in the fishery. They are operated mainly during night and the area of operation is the 3-4 metre depth zone from the shore. The gear used is basically a miniature two-seam bottom trawl net without otter boards. The mouth opening of the net is maintained by two sticks provided at the wings of the net. The cod-end mesh size of the gear ranges from 5 mm to 25 mm. Depending on the size of the boat, either a single net or two nets are operated. Wind power using 1 to 3 sails is utilized for effective trawling. Besides this, juvenile prawns are also caught by small trawl nets tied to hip and dragged along the bottom very near the shore by two persons.

The prawn catch, the bulk of which is composed of juvenile *Penaeus semisulcatus*, is found to vary from 2 kg to 10 kg per unit per day. The size of the exploited *P. semisulcatus* ranges from 31 mm to 100 mm total length with the dominant size group at 45-70 mm. Besides prawns, each unit also takes about 5 kg of seagrass and seaweeds per haul.

Although the operation of bottom trawl nets by sail boats for prawns in this region is known, since one and half decades, such intensive fishing by indigenous crafts and gears in the very near shore waters throughout the year is a recent development. As the catch is composed exclusively of small sized juvenile prawns and since the nets are operated in the seagrass beds which form the nursery grounds for the prawn resources, the impact of this exploitation on the overall *P. semisulcatus* resource in the region is discussed.

---

20. PROSPECTS FOR INCREASING CEPHALOPOD PRODUCTION OF INDIA

K. ALAGARSWAMI and M. M. MEIYAPPAN
Central Marine Fisheries Research Institute, Cochin 682 031

From the order of a 1000 tonnes in 1973 the cephalopod production has risen to the order of 30,000 tonnes in 1985. With aimed fishing, it is certainly possible to increase production of squids and cuttlefishes from the presently exploited zone. Under the aegis of the Marine Products Export Development Authority certain actions have been initiated in this direction in the recent past at experimental fishing level. Going by the data of some of the chartered fishing vessels that operated in the Indian waters during the last five years, squid and cuttlefish resources in the neritic waters appear to be substantial.

Octopus production reported from Lakshadweep is very nominal, being about 14 tonnes/annum. Scope, if any, for improving this production and exploring new grounds needs detailed investigation.

From the oceanic waters of EEZ and beyond, the prospects are for the oceanic squids, considered next only to the tuna resources in importance. However, the information on the resource is more of a qualitative and indicative nature from the operation of research vessels in the Arabian Sea such as R. V. *Varuna* and R. V. *Shoyo Maru* and presently F.O.R.V. *Sagar Sampada*.

In the above background, the paper discusses the research and development needs for increasing production of cephalopods in India and suggests an organised cooperative programme among the governmental agencies concerned on the one hand and the industry on the other.

---

21. FISHERIES ECONOMICS RESEARCH IN INDIA -- A REVIEW

R. JAYARAMAN, P. SELVARAJ, R. SENTHILATHIBAN and R. SURESH
Fisheries College, Tamil Nadu Agricultural University, Tuticorin-628 008

India is endowed with abundant fishery resources. The declaration of Exclusive Economic Zone (EEZ) in 1971 provided opportunities as well as challenges in utilising these resources optimally. However, the optimal utilisation of fishery resources calls for the inter-disciplinary R & D efforts which seem to be inadequate now. Fisheries Economics is an important yet neglected area of education and research and it is inevitable for the optimal utilisation and management of fishery resources. The present paper reviews the various studies in Fisheries Economics carried out in India, discusses the aspects covered in these studies critically and suggests future lines of research.

---

22. NEW TRENDS IN THE TRADITIONAL MARINE FISHERIES AT TUTICORIN

P. SAM BENNET and G. ARUMUGAM
Central Marine Fisheries Research Institute Tuticorin Research Centre, Tuticorin

Quiet changes have taken place during recent years in the fishery by traditional craft and gear at Tuticorin. This study refers to the

changes due to the introduction of mechanisation of traditional fishing craft. Since 1985, over 90 Tuticorin-type boats have been fitted with inboard engines of 10 HP, mainly of the Kangaroo make. These boats operate drift nets and hooks & lines for demersal as well as pelagic species of fish. Data collected two years before and two years after the introduction of mechnisation of the indigenous craft have been compared. Operational parametres and benefits of mechanisation are discussed. The fishermen are benefited by increased catch per unit as well as increased price for the catch by arriving earlier.

23. A REPORT ON THE INSPECTION OF THE PEARL BANKS IN THE GULF OF MANNAR DURING 1981-86

S. M. IRULANDY and J. SEKAR
Department of Fisheries, Tamil nadu

The pearl banks of the Tuticorin Division or the Central Division, which are considered to be productive, were inspected during 1981-1986. The inspection was at random owing to inadequate facilities. The physico-chemical condition of the waters and the pearl oyster population and other co-inhabitants of the beds were studied. The data gathered are presented.

The physico-chemical conditions of the waters during the period of inspection closely follow the earlier findings. But the population of oysters was practically nil in almost all the beds. Only in the Cruxian paar, Kilathi paar and Utti paar very thin population of oysters of 1-year group was observed in 1981-82. In the following year only Utti paar showed the presence of thin population of oysters of 1-year age group. In 1983-84 practically no oyster was collected. In 1984-85 Devi paar and Vanthivu Arupagam paar indicated signs of presence of stray oysters. In short, all the banks were completely barren.

The paucity of population of pearl oysters in the beds is attributable to the intensive trawling operations in the area and also to the dense population of co-inhabitants like sponges, star fishes and seaweeds.

24. MARINE FISH GENETIC RESOURCE CONSERVATION

P. DAS, P. C. MAHANTA and D. KAPOOR
National Bureau of Fish Genetic Resources, B-209 Mehdauri Colony, Allahabad-211 004

Overfishing, unscientific commercial exploitation, and destruction of habitats caused by nature and also induced by man have been, of late, causing serious threat to the marine fish germplasm resources. Judicious exploitation, protection for improvement and conservation are, thus, required for keeping the natural resources truely renewable.

Conservation approaches are *in situ, ex situ*, entire biomass or flexible mix with the responsibilities required to be equally shared by the professional personnel, policy makers and the people themselves. Top priority may be given for conservation of endangered species for maintaining genetic variability to maximize probability of their long term survival.

The present status of knowledge about resource conservation has been outlined in the paper with mention about the present Indian strategy for the research on the subject. This broadly includes a thorough survey of fish fauna, cataloguing of genotypes, study of genetic variability, scanning of polymorphic characters, development of practicable methodologies for conservation of exploited and endangered species and implementation of the same through concerned agencies.

---

25. THE ROLE OF PLANKTON RESEARCH IN FISHERIES DEVELOPMENT

T. BALACHANDRAN and K. J. PETER
National Institute of Oceanography Regional Centre, Cochin 682 018

A survey of literature reveals the large-scale investigations carried out to assess the quantum of fish resources that can be harvested from the sea. However, the answer to the basic question concerned

with what makes some species of fish superabundant in the oceans remains unanswered. Recent studies on the associations between the plankton community and fisheries illustrate how the biological oceanographic data may be utilized in understanding the mechanisms contributing to the survival of fish. Many authors have indicated clearly defined relationships between the environmental parameters and the fishery. In this paper an attempt is made to assess the role of plankton that can contribute towards fisheries development.

Studies on Indian Ocean plankton based on I. I. O. E. meterial showed that the most important factor that influences the fisheries of a region is the nature and extent of plankton production because of the fact that the survival of fish and fish larvae in a locality is dependent on the type and availability of food. The period of successful fishery, especially the plankton feeders such as mackerel and sardine, have been found coinciding with the period of good plankton production. Thus the survival-density dependence at larval stages in terms of the amount of feed per organism may play a determinant role. The question to be considered is whether fish larvae are too dilute or not to affect the density of their food organisms. It can be concluded that fish larvae are probably too dilute during the early phases to affect their food but as larvae grow this tendency is reversed and food becomes a limiting factor. However, the production of food organisms relative to fish feeding is largely a density independent process.

---

26. UPWELLING - A BOON TO COASTAL FISHERY — AND ITS STUDY AT THE TURN OF THIS CENTURY

A. V. S. MURTY
Central Marine Fisheries Research Institute, Cochin

Upwelling in the waters around India and the transformation of physical properties of the neritic waters thereof with a stress on thermal

front and the potential utility for fish production in the sea are described. The necessity of obtaining snapshot pictures with high grade resolution of the locations and intensities of upwellings and thermal fronts is stressed for effective management of marine fisheries. The only means of fulfilling this objective is by switching over from the time-consuming shipborne observations to satellite produced imagery system. Therefore, by the turn of this century, the software suitable for local conductions should be developed and perfected so that the present day sea-rruth data collection system by ships would be used only for checking but not for calibrating every time the satellite imageries.

---

27. POTENTIAL APPLICATIONS OF SATELLITE REMOTE SENSING TECHNIQUE IN OCEANOGRAPHY AND FISHERIES

P. V. R. NAIR, V. K. PILLAI and V. K. BALACHANDRAN
Central Marine Fisheries Research Institute, Cochin

A wide range of data collection can be achieved by remote sensing in oceanography and fisheries which by conventional ship-board observation would take considerable time and effort. IRS 1 (Indian Remote Sensing Satellite 1), expected to be launched this year by ISRO, will form the first of a series of operational remote-sensing satellites in resources survey. The Joint Experiments Programme (JEP) for the development of suitable sensors in marine fisheries, organised by ISRO in collaboration with CMFRI and FSI, enabled the development of suitable sensors in the estimation of chlorophyll and bioproductivity. In addition to the IRS Utilization Programme, SPOT, LANDSAT MSS and TM data also will be available for this. The major thrust from these studies will be on the structure and synoptic variability of oceanic fronts, observations on eddies, their formation and evolution, internal waves through panoramic

images, precipitation intensity in oceanic areas, ocean currents by drifting buoys with transponders and distribution pattern of chlorophyll in coastal waters by means of differential spectral analysis of radiance. These parameters can provide considerable information to aid in forecasting, exploitation and management of fisheries which have been discussed in this account.

---

28. VALIDATION OF LANDSAT THEMATIC MAPPER DERIVED PHYTOPLANKTON PIGMENTS THROUGH SYNCHRONOUS SURFACE MEASUREMENTS : AREA OFF CALICUT TO AZHIKAL IN THE ARABIAN SEA

A. NARAIN, R. M. DWIVEDI and H. U. SOLANKI.
Space Applications Centre, Ahmedabad 380 053

P. S. B. R. JAMES, G. SUBBARAJU, V. K. BALCHANDRAN, A. NANDKUMAR and L. R. KHAMBADKAR
Central Marine Fisheries Research Institute, Cochin 682 031

AND

D. SUDARSAN and T. E. SIVAPRAKASAM
Fishery Survey of India, Bombay 400 001

This paper deals with an estimation of phytoplankton pigments from Landsat Thematic Mapper (TM) data after removal of atmospheric effect. The pigments derived from Landsat TM data of October 1986 has been compared with corresponding surface values measured during ship cruise programme synchronous to satellite overpass. A water algorithm for Landsat TM bands was developed from the sea data collected off Quilon to Malpe in the Arabian Sea at different periods of the year. A uniform bias towards underestimation of pigments has been observed and an appropriate modification in the pigment algorithm for Landsat TM band has been suggested.

---

29. ALTERNATIVES IN REMOTE SENSING FOR MARINE FISHERIES

R. SUDARSHANA and S. K. BHAN
Indian Institute of Remote Sensing (NRSA, Dept. of Space, Govt. of India) Dehra Dun 248001

In the event of rapid growth of satellite oceanography it is natural to expect that the approaches in monitoring and managing marine fisheries would be revolutionised. The early periods of satellite oceanography recorded a large number of physical oceanographic works owing to the availability of microwave sensors. Nevertheless, a number of alternatives through multi spectral sensors are still left for fisheries scientists to pursue. As a result, we are set in an era of basic and formative research in remote sensing for marine fisheries.

The present paper attempts to analyse the alternatives at hand. Broadly speaking, only sea surface temperature (SST) and components of ocean colour are detectable today from satellite sensors. A large number of radiometers to detect SST are being deployed in space at regular intervals by developed countries. Eventhough this is to study boundary layer oceanography it would also serve the interests of fisheries scientists in temperate ocean regions. However, ocean colour studies are to be made with the help of sensors that are meant to detect variations in terrestrial radiance. The much publicized Coastal Zone Colour Scanner (CZCS) has also been stopped and the coastal zone colour detection has to depend on spectral channels of marginal benefit.

This paper reviews the capabilities of past, present and future sensors that are of interest to fisheries oceanographers. It also analyses the various research approaches that are to be considered during a phase when we wait for better sensors to be deployed in space.

30. STOCK ASSESSMENT AND MANAGEMENT OF THE COASTAL MUD SHRIMP *SOLENOCERA CRASSICORNIS* (MILNE EDWARDS) IN THE TRAWLING GROUNDS OFF VERAVAL

VINAY D. DESHMUKH
Central Marine Fisheries Research Institute, Bombay Research Centre, Bombay

Solenocera crassicornis formed 44.86% of the penaeid prawn landings at Veraval during 1983-86. The growth parameter for the two sexes are $L\infty = 134.72$ mm, $K = 1.67$ and $t_0 = -0.033$ years for females and $L\infty = 96.06$mm, $K = 2.56$ and $t_0 = -0.0075$ years for males. Instantaneous rates of mortality are $Z = 6.86$, $M = 3.12$ and $F = 3.74$ for females and $Z = 14.52$, $M = 6.19$ and F 8.33 for males. Annual stock and standing stock for the species are 2023.2 tonnes and 264.2 tonnes and the exploitation rate is 0.56. From the yield per recruit analysis, MSY under present conditions of fishing is 1123.7 tonnes which is close to the present annual production. The catches of *S. crassicornis* are maximum during intense recruitment period of March-April. Hence 65-80% catch in these months consists of undersized prawns. If larger cod end mesh size of 35mm is used for the trawl during the recruitment period, the yield can be increased by 58.3% of the present production or doubled if used during entire trawling period.

---

31. PRESENT STATUS AND FUTURE PROSPECTS OF ELASMOBRANCH FISHERY IN INDIA

P. DEVADOSS, M. D. K. KUTHALINGAM AND R. THIAGARAJAN
Central Marine Fisheries Research Institute Madras Research Centre, Madras-105

An increasing trend in the elasmobranch fishery from 35.6 thousand tonnes during sixties to 53.9 thousand tonnes during

seventies and 59.6 thousand tonnes during the current decade (up to 1985) was observed. This increase is mainly due to the large scale mechanisation of the fishery during the seventies. At present, though 56.5% of the production is from the west coast, state-wise Tamilnadu ranks first contributing to 25% of the all India catches.

For assessing the future prospects of any multispecies fishery, precise identification of the species constituting the fishery, together with information on certain basic aspects of the biology of the fishes, is essential. The present paper provides an extensive and illustrated field key for sharks, skates and rays, the production trends with special refence to the major shark-fishing centres and the available biological details of some of the constituent species.

The optimum level of effort to get the MSY for sharks and rays using the Schaeffer model at selected centres has been worked out and presented. The study has indicated that there is scope for increasing the trawling effort at Visakhapatnam, Mandapam and Rameswaram whereas a reduction of trawling effort is suggested for Madras, Kakinada, Tuticorin, Calicut and Bombay. The MSY worked out for the mechanised gill-net at Cuddalore suggests the advisability of increasing the effort whereas a reduction of gillnet effort is indicated for the same unit at Calicut.

Similarly MSY for sharks obtained in the trawlers at Tuticorin and Nagapattinam indicates the need for a reduction in fishing effort at Tuticorin and increasing the effort at Nagapattinam.

---

32. DETECTION OF TUNA SCHOOLS FROM OBSERVATIONS ON SEA BIRDS IN THE SKIPJACK POLE-AND-LINE FISHING OF LAKSHADWEEP

P. LIVINGSTON
Central Marine Fisheries Research Institute Mandapam Regional Centre, Mandapam Camp.

The paper deals with the usefulness of sea birds in detecting tuna schools in the pole and line (live bait) fishing technique of

Lakshadweep with special reference to Minicoy. Brief notes on the ecology, habitat and distribution of four common species of sea birds, viz., *Anous stolidens*, *Sterna anatheetus*, *S. bengalensis* and *S. hirundo*, are given together with a list of birds recorded from the different Islands in Lakshadweep. A positive co-relation between the number of sea birds observed and the number of tuna caught on the same day by the observational boat could be established for the fair tuna season, November 1980 to May 1981, at Minicoy. Two peaks, November and April, could be observed in the number of birds, coinciding with peaks in tuna catch Standardised Effort. The various causes for the association of tuna and the birds are brought to light. This association is found to be a symbiotic one in which the bird feeds upon the mucus and copepod parasites attached to the tuna, thus benefiting the host. Discription is given on the method of detection of tuna schools from bird sightings as practised by the local fishermen at Minicoy. The need for sea-bird conservation and research is discussed.

---

33. SCHOOLING BEHAVIOUR OF TUNAS IN LAKSHADWEEP WATERS

P. LIVINGSTON

Central Marine Fisheries Research Institute Mandapam Regional Centre, Mandapam Camp

The present paper describes nine kinds of schooling patterns of the skipjack tuna (*Katsuwonus pelamis*) and the yellowfin tuna (*Thunnus albacares*) in the pole and line (live bait) fishing grounds, as identified locally by fishermen of Lakshadweep, particularly Minicoy. These are described here as schooling patterns I to IX after giving their local names and some clue to their identification from boats. The surface or subsurface nature of occurrence of the school, its leaping,

feeding and swimming activity, biting habit, vulnerability to the gear, size of the school, approximate size and species composition of the school, and the association of the school with water discolouration, floatsam, seabirds, predators, etc are described. The paper also describes four different approaches of the boat to the different kinds of tuna schools.

---

34. PRESENT STATUS OF OIL SARDINE FISHERY AT KARWAR, ON THE WEST COAST OF INDIA

G. G. ANNIGERI

Central Marine Fisheries Research Institute Karwar Research Centre, Karwar

The average annual yield of traditional gears (Rampan and Yendi) from 1967 through 1982 for 16 years is 146.4 t. Consequent to introduction of purse seiners from 1976, the average catch for the 10 year period from 1976 through 1985 for oil sardine increased to 2273 t at Karwar showing nearly 15.5 times more yield than the former period. This paper discusses whether this new development is a boon to the fishery or whether it has an adverse impact on the fishing stocks. For this purpose, the average standing crop and average annual stock of oil sardine in the fishing grounds for a year were estimated. An estimate on yield-per-recruit and the maximum sustainable yield (MSY) for varying fishing intensities and instantaneous natural mortalities was made to understand the extent of fishing stress on the resource. A closer scrutiny of all India catch data of oil sardine and mackerel from 1976 to 1980 when 35 to 400 numbers of purse seiners were introduced respectively, showed that the premechanisation period (1970-75) accounted for better annual average catch than the purse seine era (1976-1980) as the catch per day per purse seine declined. The optimum level of exploitation and the adverse effects on the stocks if they are indiscriminately exploited without proper planning are discussed in the proper.

---

35 PROBLEMS OF IDENTIFICATION IN *SARDINELLA* SPP.

K. P. SIVAKUMARAN, M. MANICKASUNDARAM and V. RAMAIYAN
CAS in Marine Biology, Annamalai University, Parangipettai-608 502.

In spite of several recent studies, confusion still surrounds the identification of a few Indian clupeoids such as *Sardinella, Ilisha,* and *Thryssa* because of the morphological similarity between species, which has severely restricted useful biological studies.

Of all clupeids, the identification of the species of *Sardinella* based on meristic and morphometric characters is often confusing. The identity of *S. longiceps, S. clupeoids, S. leiogaster* and *S. sirm* based on a few meristic and morphometric characters is relatively easy. However, the same characters are not satisfactory for *S. albella, S. brachysoma, S. dayi, S. fimbriata, S. gibbosa, S. melanura* and *S. sindensis.*

The present study, while demonstrating the unsuitability of meristic and morphometric characters for the identification of the species of *Sardinella* based on material consisting of ontogenic series, cautions the possibility of mixed material in future biological investigation on *Sardinella.*

---

36. SYSTEMATICS AND OBSERVATIONS OF BIOLOGY OF CODLET (PISCES: BREGMACEROTIDAE) FROM PARANGIPETTAI

K. P. SIVAKUMARAN, M. MANICKASUNDARAM and
R. SIVAKUMAR
Centre of Advanced Study in Marine Biology, Annamalai University,
Parangipettai – 608 502

The codlets (Bregmacerotidae) are small midwater fishes, common in tropical and subtropical seas throughout the world. A single genus,

Bregmaceros, is recognized, with several species. Their systematics and zoogeography have been treated recently by Munro (1950), D'Ancona and Cavinato (1965), Belyanina (1974), and Milliken (1975). Identification of bregmacerotid species is difficult, and there is no general agreement on the number of species that exists (Houde, 1981). Some may still be undescribed. D'Ancona and Cavinato (1965) recognized seven species world wide, while Belyanina (1974) thought only six were valid. Milliken (1975) reported three species from the Caribbean Sea and Gulf of Mexico.

Bregmacerotids may play an important role in pelagic ecosystems. They are found worldwide between latitudes 40°N and 30°S (D'Ancona and Cavinato, 1965). Among the described species there are both coastal and oceanic types. Munro (1950), D'Ancona and Cavinato (1965) and Belyanina (1974) have reviewed and summarized larval systematics. *Bregmaceros macclellandi* is one of the trash fishes landed at Parangipettai mainly with trawl catches. This paper reports systematics and observations on the biology of genus *Bregmaceros* from Parangipettai coast, southeast coast of India.

---

37. PROSPECTS OF GILLNET FISHERY OF VERAVAL WITH SPECIAL REFERENCE TO COSTS AND EARNINGS

H. MOHAMAD KASIM AND M. ZAFAR KHAN
Central Marine Fisheries Research Institute

The gillnet fishery fleet of Veraval was constituted by two types of fishing units. Out of 178 units, 110 were dugout canoes (5-6 m in length) fitted with outboard engines (OBM) and 68 were plank-built boats (7.5-9.5 m) fitted with inboard engines (IBM). Three types of gillnets, *Kandari* (85-95 mm mesh size), *Pakkujal* (140-155 mm) and *Jadajal* (180-215 mm) were in operation to exploit different resources in the region. These units landed 2976 tonnes in a year in which IBM units landed 1982 tonnes and OBM 994 tonnes. The important resources which constituted the catch

were elasmobranchs (26% in total catch), clupeids (25.8%), pomfrets (11.1%), chirocentrids (8.8%), seerfish (7.6%), catfish (5.6%), tuna (3.2%), ribbonfish (3%), cerangids (3%) and others (5.7%). A major portion of the quality fishes such as the silver pomfret, ghol *(Pseudosciaena diacanthus)*, koth *(Otolithus brunnaeus)* and *Argyropes spinifer* were exported to Gulf countries and the rest to the markets within India.

The average annual gross revenue from the sale of fish catch was Rs. 14.3 millions in which the OBM units contributed Rs. 4.6 millions and IBM units 9.7 millions. The average annual gross income realised by a single OBM unit was Rs. 79,583.33 and IBM unit was Rs. 2,24,647. The average capital investment by a OBM boat owner was Rs. 46,350 and IBM boat owner Rs. 1,10,900. The annual total expenses of an OBM unit were Rs. 30,193.95 and Rs. 85,322.90 for an IBM unit. The net returns and costs and earnings of these units have been studied. Though the investment turnover ratio of OBM unit is lower than that of the IBM units, the rate of return of the former is better than the latter. The low budgetted OBM unit is getting importance among the fishermen by virtue of its lower capital requirements and consequently there is a gradual increase in the number of OBM units at Veraval.

---

38. PRESENT STATUS OF PERCH FISHERY RESOURCES IN INDIA AND PROSPECTS

H. MOHAMAD KASIM, K. M. S. AMEER HAMSA and P. SAM BENNET

Central Marine Fisheries Research Institute, Tuticorin Research Centre, Tuticorin

The perch resources and fisheries in India have been dealt with in the paper. As seen from the statewise perch production during 1969-1981, on an average 27,184 t of perches were landed in India with fluctuation from 12,865 t in 1969 to 49,312 t in 1978. The order of statewise perch production was 11,341 t in Kerala, 6830 t in Tamil

Nadu, 2749 t in Maharashtra, 2504 t in Andhrapradesh, 2227 t in Gujarat, 496 t in Pondicherry, 404 t in Karnataka, 257 t in Goa, 170 t in Lakshadweep, 153 t in Andamans, 146 t in Orissa and 46 t in West Bengal.

The gearwise and statewise perch production from 1982-83 to 1984-85 indicates that the mechanised units contributed 72.4% and non-mechanised units 27.6%. Among mechanised units, the trawlers have landed the major portion of the catch (68.4%). The statewise species composition of perch landings indicates that the threadfin breams formed more than 50% of the catch. During 1982-83 and 1983-84, the perch production of Tamil Nadu was higher than all other states, whereas during 1984-85, Kerala was the first in perch production followed by Andhra Pradesh and Tamil Nadu. The different groups of perches landed by trawl and gill net units at important landing centres on the east and west coasts of India show that in all the centres the catch rates of trawlers were higher. The higher catch rate in trawl net operations in Sasoon Dock and New Ferry Wharf was due to voyage fishing for more than a day.

Among threadfin breams, *Nemipterus japonicus*, and among pig-face breams, *Lethrinus nebulosus* are the dominant species. The growth, mortality rates, optimum age of exploitation, potential yield per recruit and yield per recruitment at different combinations of age at first capture and fishing mortality coefficients of these species have been dealt with in detail. The prospects of the perch fishery by commercial trawlers and the possible increase in production by the introduction of pair trawling with high opening trawl net in Gulf of Mannar is discussed.

---

39. POPULATION DYNAMICS AND MANAGEMENT STUDIES OF *OTOLITHUS CUVIERI* (TREWAVAS) OFF BOMBAY WATERS

SUSHANT K. CHAKRABORTY
Central Marine Fisheries Research Institute,
Bombay Research Centre, Bombay-400 001.

Studies on the age, growth and population management of *Otolithus cuvieri* (Trewavas) based on the data collected for a period of

six years from 1979-80 to 1984-85 off Bombay waters are reported here. This species attains 170 mm, 260 mm and 318 mm at the end of first, second and third year respectively. The von Bertanlaff's growth parameters were estimated as follows: $L\infty = 395$ mm, $K = 0.5331$ (annual) and $t_0 = -0.0155$ years. Using the length weight relation formula the $W\infty$ was calculated as 615 g. Instantaneous rates of total, natural and fishing mortality calculated were as follows: $Z = 2.45$, $M = 1.45$ and $F = 1.00$. Exploitation ratio (E) and exploitation rate (U) were found to be 0.35 and 0.40, respectively.

The annual average yield at the present rate of exploitation is 762.815 t as compared to total stock of 2045.62 t and MSY of 928.972 t. The study indicated that at present the stock of *O. cuvieri* is slightly underexploited. The yield can be increased to 794.09 t by increasing the exploitation ratio (E) to 0.5, keeping the age at first capture (tc) at 0.8 years at which the corresponding fishing mortality, F would be 1.4.

---

40. OBSERVATIONS ON PELAGIC FISH EGGS AND LARVAE IN THE COASTAL WATERS OF TUTICORIN

PON. SIRAIMEETAN and R. MARICHAMY
Central Marine Fisheries Research Institute
Tuticorin Research Centre, Tuticorin

Quantitative estimation of pelagic fish eggs and larvae which occurred in the plankton collections of Tuticorin coast during 1976-85 indicated their abundance in space and time. A trimodal cycle in the distribution of fish eggs and larvae with peaks in February-March, June-July and September-October was observed, indicating the spawning seasons. A maximum occurrence of 7,584 eggs, contributing to 80.5% in the composition of total zooplankton, was recorded in October, 1978 coinciding with the premonsoon season. Abundance of fish eggs and

fish larvae exhibiting definite spawning season was identified and tabulated. Hydrological and meteorological feautres of the area in relation to the distribution of fish eggs and larvae are briefly discussed. A variety of types of eggs and larvae sorted in the collections indicated the area as an important resourceful ground in the fishery map of Southeast coast of India.

---

41. OYSTER RESOURCES OF INDIA: STRATEGIES FOR EXPLOITATION

K. SATYANARAYANA RAO, P. MUTHIAH, M. E. RAJAPANDIAN, R. SARVESAN, P. V. SREENIVASAN and R. THANGAVELU
Central Marine Fisheries Research Institute

Among molluscan resources of India, oysters are only marginally exploited at present but have high potential primarily due to their value as a nutritious delicacy. The oyster resources are distributed in India in diverse environments such as shallow coastal waters, creeks, estuaries, backwaters and mangrove systems in varying abundance.

Whilst several oyster species have been recorded, three, *Crassostrea madrasensis, C. gryphoides* and *Saccostrea cucullata,* are of definite economic significance and substantial research has been carried out on the bionomics of these species. Resource studies have been carried out only in a few areas. Major developments made recently are the evolving of culture methods for *Crassostrea madrasensis* and hatchery techniques for mass production of oyster seed. The present status of the resources and their exploitation are reviewed and the need for adoption of culture practices is emphasized. The strategies for the proper exploitation of oyster resources by taking appropriate measures like assessment of natural stocks and distribution of oyster seed, transplantation of seed oysters, conservation of oysters in vulnerable areas due to problems like pollution, urbanization etc., innovations in culture techniques to increase outputs, investigations to evolve high quality strains, propagation of culture methods by strengthening of extension services and steps for development of marketing of products within the country as well as for export are stressed.

---

42. PROSPECTS AND PROBLEMS OF MANAGEMENT AND DEVELOPMENT OF THE MARINE MOLLUSCAN RESOURCES (OTHER THAN CEPHALOPODS) IN INDIA

K. ALAGARSWAMI and M. M. MEIYAPPAN
Central Marine Fisheries Research Institute, Cochin 682031.

Typical of tropics, India has a large variety of molluscan resources in the coastal waters, and in the estuaries and backwaters. The clam resources consisting of species of *Meretrix, Katelysia, Paphia, Anadara, Villorita* and others have been exploited by the fisherfolk from time immemorial for food as also for their shells. Subsoil deposits of shells form a major resource in some of the estuaries and backwaters. The sea mussel *Perna* forms a moderate resource which is under intense exploitation in certain regions. Oyster resources *(Crassostrea)* are not extensive but collected here and there. Windowpane oyster *Placenta* is restricted in its distribution but is well exploited. The pearl oyster resource has been unproductive since the early sixties. The gastropod resources consist mainly of *Xancus, Turbo* and *Trochus,* which are confined to certain regions and are heavily exploited. Other ornamental gastropods used in shellcraft industry are thinly spread out. Deepsea molluscan resources, if any, are not known except *Pirula.*

Owing to manmade changes including pollution, the distribution and abundance of the molluscan resources, especially those in the estuaries and backwaters, have changed and will be subject to further change, if left unchecked. The level of exploitation has also advanced from subsistence to mechanised operation, though on a small scale, on certain resources for industrial uses. During the last five years export of frozen clam meat has increased. Some of the molluscs are emerging as source material for bioactive substances. Taking an overall view of these changes and their probable effects on the resources, the future of the molluscan resources, which were once considered substantial, does not appear to be encouraging, unless management and conservation measures are evolved and implemented. Many States have considered the shells as a mineral resource and are operating them under leasing/ licensing arrangements.

The paper briefly discusses the above aspects critically, gives the thrust areas for research and suggests broad management measures to ensure that.these natural resources are sustained and improved for the benefits of the fisherfolk to whom these molluscs form one of the means of their subsistence.

---

43. TREMATODES AS BIOLOGICAL TAGS FOR MOVEMENT OF SILLAGINID FISHES

K. SUJATHA and R. MADHAVI
Department of Marine Living Resources and Department of Zoology,. Andhra University Visakhapatnam

Most of the commercially important exploited Indian fishes in the marine environment are comparatively short lived. It has been known for a long time that in any one area in the coastal waters each species of fish occurs only for a part of the year and that the species is absen or is very poorly represented in that area for the rest of the year. This provides some evidence of their movement away from the area of active fishery. In other words, most of the exploited species constitute a seasonal fishery in each area.

Of the nine species of Sillaginids represented in the commercial catches off Visakhapatnam, *Sillago lutea* is the most common species. During the course of a survey on digenetic trematodes of marine fishes 150 sillaginid fishes collected from inshore and offshore regions of waltair coast were examined. The juvenile sillaginid fishes while in inshore regions acquire infections with *Helicometrina nimia*, *Decemtestis* spp. metacercaria of *Galactosomum* spp. and didymozoid larvae which complete the life cycles in the intertidal region. The adult sillaginids, while they move into deeper waters, gradually get rid of these flukes and acquire infections with metacercaria of *Stephanostomum* spp. and *Prosorhynchus* spp. which probably use benthic molluscs as intermediate hosts. So the trematodes can be used as biological tags for the movement of Sillaginid fishes.

---

44. MORPHOLOGY OF THE ALIMENTARY TRACT IN RELATION TO FOOD OF PLATYCEPHALIDS

R. SIVAKUMAR and V. RAMAIYAN

Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai 608 502

The interrelationships between the morphology of the alimentary tract and the food and feeding habits in five species of flatheads (order: Scorpaeniformes) coming under the family Platycephalidae were studied. The nature of teeth, gill rakers and the number or absence of pyloric appendices were noted. Based on the shape and relative lengths of the different parts of the alimentary tract and the types of food taken, the fishes were grouped into fish feeders and crustacean feeders. Qualitative analysis of the food of five species of flatheads was also made and the results are discussed.

Technical Session III

RESEARCH IN MARICULTURE FISHERIES

45. RESEARCH IN THE ASSESSMENT OF CAPTURE AND CULTURE FISHERIES ALONG THE INDIAN COAST

S. R. SREEKUMARAN NAIR, A. H. PARULEKÁR and B. N. DESAI
National Institute of Oceanography, Dona Paula 403 004, Goa

A review of the research conducted at National Institute of Oceanography, Goa, to assess the capture and culture fishery potential of India is presented in the paper. The primary, secondary and benthic productivity of estuaries and backwaters are elucidated by taking the Mandovi-Zuari estuarine system as an example. The productivity of the coastal and oceanic waters around India are discussed. The expected fishery yield and present level of exploitation are assessed and further course of action discussed in this paper. In culture fisheries the contributions of N10 in the fields of mussel culture, shrimp culture Brine shrimp culture, seaweed culture, horse-shoe crab culture and fish culture are reviewed and discussed.

46. MARICULTURE IN INDIA

P. S. B. R. JAMES and M. S. MUTHU
Central Marine Fisheries Research Institute, Cochin-682 031

Mariculture or coastal aquaculture is becoming increasingly important all over the world to meet the ever increasing demand for seafoods in the world markets. Apart from the export potential, mariculture activities also generate additional resources for local consumption and also provide employment opportunities in the coastal areas for the

rural poor. India has not lagged behind in realizing these possibilities and good progress has been made by the national research organisations like the CMFRI in developing viable technologies for cultivating marine food organisms such as penaeid prawns, milkfish, mullet, edible oysters, mussels, clams, pearl oysters and seaweeds in culture systems suited to Indian conditions.

The developmental agencies like the MPEDA, the Fisheries Departments of maritime states and the Central Government have initiated programmes to stimulate interest in coastal aquaculture among the coastal fishermen and entrepreneurs and the financial institutions and district level State Government agencies have come forward to assist in this programme.

The progress that has been made in all these areas connected with mariculture in the country, is reviewed and the problems and constraints are evaluated and strategies to overcome some of them are suggested. The major factors that are coming in the way of rapid development of mariculture, in spite of the availability of technical know-how in the country, are the lack of clear-cut Governmental policies on land and water use in the coastal regions, poor demand for some of the products in the local markets and the high cost of processing them for the export market, lack of incentives for private entrepreneurship, shortage of seed of cultivable species of marine organisms, non-availability of appropriate feeds for accelerating growth in culture systems and the paucity of sheltered bays along the Indian coast where open sea farming can be taken up.

---

47. STANDARDIZATION IN BRACKISHWATER FISHFARM MANAGEMENT FOR OPTIMUM PRODUCTION THROUGH MATHEMATICAL MODELLING

S. N. GHOSH, A. MITRA and A. N. BOSE
Indian Institute of Technolgoy, Kharagpur

The necessity to improve upon the management and performance of brackishwater farming for the culture of finfish and shellfish is

receiving considerable attention from various national governments and International agencies. This paper deals with the existing knowledge and concepts primarily under Indian conditions in the management of brackishwater aquacultural systems. It then highlights the need towards formulation of a mathematical model for predicting the optimum fish growth and production, considering the broad parameters influencing the growth and survival of the selected species in a highly complex dynamic physico-chemico-biological environment. A growth model as per von-Bertalanffy is then proposed for several brackishwater varieties of fish based on the experimental findings of Central Inland Fisheries Research Institute, Barrackpore. The model can be tested for standardization purpose from the actual output and that predicted by it in terms of the measured water quality parameters in the farms located at various places. Further it can be adopted as a feed-back device in any operational system to monitor the desired level of production after it has been successfully tested under various operating conditions.

---

48. ROLE OF BRACKISWATER CULTURE IN FISHERIES DEVELOPMENT

S. V. BAPAT
6, Swarali Apartments, Near L. I. C. Colony, Paud Road, Pune 411 038

The Seventh Plan envisages an export target of Rs. 1000 crores from the fisheries sector. For attaining this target the emphasis appears to be on exploitation from fishing grounds away from the conventional/ traditional grounds beyond the 30 fm line. These fishing grounds can be fished only by bigger trawlers, purse seiners and shrimpers which have the facility to remain at sea for a fortnight or more. Our experience has shown that the shrimp component from offshore grounds is negligible, less than 5%. Shrimp is the major component of our marine exports and if we have to achieve the targets laid down the shrimp catch has to be enhanced in a big way.

We have almost reached a saturation point in exploitating shrimp from coastal waters. Therefore the only alternative appears to be culture of shrimp on a large scale. Fortunately the country has plenty of Kharland along the east and west coasts. Pilot-scale projects in shrimp culture by research institutes have produced encouraging results. Hatchery production of shrimp seed in respect of commercially important species has been achieved. So we have the natural resources, and the technical know how. All that is needed is a boost to shrimp culture by the Government in providing incentives to farmers and industrialists by way of allotment of Kharlands on lease basis on easy terms, funding by banks, etc. If proper incentives are provided, as in agriculture, it should be possible to increase our shrimp production and achieve the export targets within five years.

---

49. ECOLOGY OF MACROBENTHOS FROM A COASTAL ZONE OF WEST BENGAL

K. C. PATRA, A. B. BHUNIA and ARUNABHA MITRA
Aquacultural Engineering Section, Agricultural Engineering Department
I. I. T Kharagpur-721 302

Studies on benthic macrofauna of a tidal creek (Mandarmani canal) and adjacent mangrove zone in the coastal zone of Midnapur District, West Bengal, have been carried out during November 1986-April 1987. The most common forms recorded were polychates, crustaceans, nemartines, actiniarians, molluscs and gobiids. Polychaetes were the dominant taxa in the environment. The maximum density was 420/m^2. The salinity of the environment was 2-18.9 ppt, while the water temperature and the dissolved oxygen varied from 18-32° C and 3.3 to 9.7 mg/L respectively. The pH was 6.5-8.0. The abundance of the organisms has been discussed in relation to prevailing hydrological and soil properties of the creek.

---

50. ON CONSTRUCTION AND MAINTENANCE OF MARINE FISH CULTURE PONDS ALONG SOUTH-EAST COAST OF INDIA

P. BENSAM
Central Marine Fisheries Research Institute
Mandapam Regional Centre, Mandapam Camp

The most expensive input in coastal aquaculture operations is construction and maintenance of culture ponds and farms. Experience gained on construction and maintenance of culture ponds in three localities along southeast coast of India during 1972-1985 has shown that, since the earth is porous and incohesive in this region, adequate precautions have to be taken. For instance, in order to overcome such problems as erosion of dykes due to prevailing rains, wave action of pond water at dyke bases and deposition of sand inside the ponds, suitable steps have to be devised. Another problem encountered has been poor tidal amplitudes, particularly during pre-monsoon months, closure of bar mouths in the post-monsoon season and the consequent paucity of seawater supply to culture ponds. The paper gives an account of the experience gained to minimise and/or counter these problems, in the context of the varying climatic and soil conditions in three localities. Also, the ways and means of applying such techniques for successful management of culture ponds and farms in similar preblem-prone areas are discussed.

---

51. MARINE PRAWN FARMING ALONG THE COAST OF THE GULF OF KUTCH — ITS PROSPECTS AND PROBLEMS

P. GOPALAKRISHNAN and V. KRISHNA RAJU
Tata Chemicals Limited, Mithapur 361 345 Gujarat, India

Along the 250 Kilometer long coastline of the Gulf of Kutch there are no prawn farming activities. Millions of juveniles of prawn ascending the creeks in the little rann of Kutch are trapped by staked bag nets and marketed for meagre revenue. The fishermen remain in

perpetual poverty owing to drought prone conditions of the coast during remaining period of the year. A tidal range of 2.6 metres and the high salinity conditions of the Gulf necessitate capital investment for supply, retention an exchange of sea water in farming operations. The available seed are not of quick-growing variety of prawns. An experimental project was initiated in 1979, firstly to explore the feasibility of utilisation of low saline reservoirs of a solar salt works in Okhamandal for extensive prawn farming using the indigenous seed and thereafter to assess the culturability, economic viability and management problems associated with small-scale intensive farming. During September 1986 to March 1987, seed of *Penaeus merguiensis* and *Metapenaeus kutchensis* @ 36332 nos/hectare were stocked in three ponds of 1.92 hectare each. A growth rate of 0.437 mm/day length and 0.56 gm/day weight in respect of the former and 0.33 mm/day length and 0.37 gm/day weight for the latter species in 187 days of rearing period was achieved. The harvested prawns were acceptable to freezing industry and fetched Rs 14000-Rs 23000 (head-on) per tonne.

The advantages such as employment generation, economic upliftment and utilisation of the monsoon seed resources for farming are discussed.

---

52. PROSPECTS OF TIGER PRAWN CULTURE IN KERALA

P. M. MATHEW
Kerala Agricultural University, College of Fisheries, Panangad, Cochin - 682 506

The role of tiger prawn culture in the fishery development of Kerala is discussed in the paper. The growth rate and yield potential of tiger prawn, *Penaeus monodon*, in the brackishwaters of Kerala are projected on the basis of the experience gained from the culture of this prawn in Vyttila Fish Farm, Cochin. The main problems in the development of its culture in this area and the probable solutions to these are discussed. Need to strengthen research on the cultural aspects of this highly demanded prawn is also stressed.

---

53. AN ECONOMIC ANALYSIS OF PRAWN CULTURE IN ANDHRA PRADESH — SOME PRELIMINARY FINDINGS

R. JAYARAMAN, J. PURUSHOTHAM SAI, V. SUBBA RAO, K. R. RAMESH BABU and K. JOSHUA
Marine Products Export Development Authority
Regional Centre (Prawn Farming), Machilipatnam-521 001

Adoption of prawn culture employing scientific methods is essential to establish a sound prawn production base in India which is inevitable to back up the marine ptoducts export comprising chiefly frozen shrimps as well as to exploit the vast brackishwater resources for the betterment of fishermen communities. There exists a paucity of data on the economics of prawn culture operations at various levels, which is necessary not only for persuading the financial institutions to release credit liberally but also to conduct research on acquaculture of these animals. This paper analyses the economics of prawn culture by fishfarmers in Andhra Pradesh, where adoption of prawn culture is witnessed to be highly encouraging, identifies the various constraints to prawn culture and offers suggestions to overcome them. The results of a case study on these aspects are also presented and discussed.

54. MANAGEMENT OF PRAWN CULTURE PRACTICES IN TUTICORIN AREA

R. MARICHAMY and S. RAJAPACKIAM
Central Marine Fisheries Research Institute,
Tuticorin Research Centre, Tuticorin

The coastal zone along Tuticorin, in Chidambaranar District of Tamil Nadu, affords suitable environment for the occurrence, survival, growth and production of commercially valuable marine prawns. The

prospects of prawn culture are discussed in relation to the available resources of land, water and prawn seed as well as the recent developments made in the area. The results of prawn culture experiments were highly influenced by the stocking intensity and hydrological features of the culture site. Best result in growth (27 mm/4.2 gm/month) and production (1200 kg/ha/crop) was recorded when the stocking rate was kept at 75000-80000/ha. A total production of 7258 kg of *Penaeus indicus* was attained from 4 ponds of a total area of 3.2 ha by raising 2-3 crops in a period of 21 months and fetched a gross income of Rs. 2,62,733. Various problems encountered in the development of prawn farming and suggestions for better management practices are highlighted. Information covering the suitable areas for the development of coastal farm, economics of culture operations, the sources of financial and technical aids available in this profitable venture are presented.

---

55. SUITABILITY OF KILLAI BACKWATERS FOR PRAWN CULTURE — A PRELIMINARY MICRO LEVEL SURVEY

R. THANKARAJAN, N. RAMSINGH, K. SRIRAMAN and G. SATHIYAMOORTHY

Department of Fisheries, Tamil Nadu Porto Novo

Brackishwater areas have been given much importance for prawn farming. No information was available on the Killai backwaters about factors like water quality, topography, contour, extent of the area, tidal amplitude, seed potential and possibilities of flooding, etc. Hence, during 1983, Killai area was thoroughly surveyed for the above aspects and the results have been discussed in this paper. It is inferred that a total area of about 155.00 ha is readily available for undertaking both pond and penculture in these backwaters.

---

56. DEVELOPMENT OF AN INDIGENOUS HATCHERY TECHNOLOGY FOR PRAWN SEED PRODUCTION

M. S. MUTHU and N. NEELAKANTA PILLAI
Central Marine Fisheries Research Institute, Cochin-682 031

The Central Marine Fisheries Research Institute has developed a totally indigenous technology for hatchery production of penaeid prawn seed and it has been successfully tested on a wide variety of commercially important penaeid prawns. The present technology differs from those employed by hatcheries in other parts of the world in two essential respects. The larval stages are fed with mixed diatom cultures which are grown by fertilizing raw seawater exposed to sunlight; in other countries pure monocultures of photoplankton are used for feeding the larvae. For rearing the postlarvae an inexpensive particulate diet is used instead of *Artemia* nauplii. These two innovations have greatly reduced the cost of prawn seed production. The other advantages of this simple technology are discussed in the paper.

The CMFRI is now providing technical assistance to the Fisheries Departments of Kerala, Karnataka and Andhra Pradesh for setting up prawn hatcheries. Suitable sites have been selected for the hatcheries and the project plans have been drawn up. The MPEDA is also co-operating in this venture by providing financial assistance to the States.

How this technology could be further adopted for use by fishermen families living on the shore for producing prawn seed on a small scale in their backyards is discussed in the paper. The equipment needed for a backyard hatchery and the economics of such operations are also given. There is great scope for developing it into a cottage industry in coastal areas.

---

57. DEVELOPMENT OF A SMALL SCALE PRAWN HATCHERY AND ITS ROLE IN THE DEVELOPMENT OF BRACKISHWATER PRAWN FARMING IN ORISSA

T. RAJYALAKSHMI, S. M. PILLAI, P. RAVICHANDRAN and A. N. MOHANTY
Central Institute of Brackishwater Aquaculture
Puri Research Centre, Puri 752 002

To develop a continuous seed production technology particularly of *Penaeus monodon*, which has maximum demand in brackishwater culture system, a small scale hatchery was designed at Puri Centre in 1984-85 and operated using recirculated water through a biological filtration system. The details of hatchery lay out, tanks filters, water and air systems, maintenance of breeders and feeds are given. The system is semi-intensive in the sense that developed feeds were used and salinity and pH were controlled to suit the hatchery needs. The problems encountered in the hatchery such as spawner availability, transportation stress, impact of environmental factors, water quality, etc. are discussed. The system and its cost of management are brought out with a view towards its suitability as a small scale operation under Indian conditions.

As a management technique, particularly in the context of coastal zone development and rural development schemes, this seed production technology as developed in Puri centre is particularly pertinent to Orissa where brackishwater culture (currently 1500 ha) has been started and intensified at a very fast rate in recent years. This is purely a lagoon-based and a rain-fed system. The seed requirement is presently 75 million/year and is collected from nature. Under a semi-intensive hatchery technology a farmer's co-operative can produce its own seed.

This technology is also a good management tool for large-scale seed production and stocking of coastal waters to support the inshore capture fishery which is getting fast depleted.

58. ON BANANA PRAWN *(PENAEUS MERGUIENSIS)* SEED PRODUCTION

I. N. MAHYAVANSHI, A. J. PATEL, A. A. VYAS and V. J. MOHILE
Gujarat Fisheries Aquatic Science Research Institute, Okha

A prawn hatchery was established at Gujarat Fisheries Aquatic Sciences Research Institute, Okha in 1980. A local species, the banana prawn *Penaeus merguiensis* was selected for seed production. During the first two years no postlarvae developed. In the third year, with the success in culture of *Chaetoceros* sp. and *Artemia salina* for feeding the larvae, 30% survival rate of larvae was observed. Subsequently the survival rate increased up to 86% in the following years (1985 and 86).

The technique has since been perfected to produce prawn seeds averaging 50% survival rate. Seed can be supplied up to 20-25 lakh PL -10 per year from this small hatchery.

---

59. EXPERIMENTS ON INDUCED MATURATION AND SPAWNING OF TIGER PRAWN *(P. MONODON)* THROUGH EYESTALK ABLATION

HARDIAL SINGH
Central Inland Capture Fisheries Research Institute, Barrackpore-743 101

Details of experiments on the ovarian maturation of *P. monodon* through eyestalk ablation in the brackishwater impoundments (bheries) in the lower Sunderbans areas of West Bengal are given. Immature female tiger prawns (100 g and above) cultured in a bheri (65 ha) were ablated uni/bilaterally and kept with an equal number of healthy mature males (80 g and above) in split bamboo enclosures (2.25m x 2.25m)

in the impoundment. The test animals were fed twice daily on the minced flesh of freshly caught metapenaeids and bivalves from the area. Fast gonadal maturation and subsequent spawnings were observed in a period of 10-21 days after the ablations. The prospect of setting up a seasonal tiger prawn hatchery during the dry months of February-July when the fast rate of water evaporation in these shallow coastal water bodies renders the salinity (26-32%) highly suitable for undertaking this venture are discussed.

---

60. PRELIMINARY OBSERVATIONS ON THE GROWTH AND SURVIVAL OF TIGER PRAWN (*PENAEUS MONODON* FABRICIUS) POSTLARVAE IN PEN-NURSERIES

HARDIAL SINGH
Central Inland Capture Fisheries Research Institute
Barrackpore-743 101.
and
S. MATTAI
Indian Statistical Institute, Calcutta-700 035

In an attempt to ensure all-time availability of stocking materials of *P. monodon*, experiments have been undertaken on a large scale in the lower Sunderbans areas of West Bengal for growing the wild-caught postlarvae (10-12 mm) of the species to an advanced juvenile (35-45 mm) stage under semi-controlled conditions. Six nursery pens (0.1 ha each) have been installed in a large (50 ha) brackishwater impoundment and stocked at the rate of 2.0-3.5 million per hectare. Besides encouraging the growth of natural food, the postlarvae are fed with well-balanced artificial diets having protein from both the animal and plant origin. Encouraging results with high survival (up to 73%) and faster growth rates have been observed in some of the trial runs. Leaf protein as an alternative source of animal protein has

given quite satisfactory results in the artificial prawn feeds. Details of stocking density, growth rate, percentage survival and the feeding schedule etc. are presented and discussed. Various physico-chemical parameters recorded at regular intervals are also given.

---

61. REARING OF PL 20 OF *P. MONODON* IN NURSERY POND—AN EXPERIMENTAL STUDY

K. SRIRAMAN and G. SATHIYAMOORTHY
Department of Fisheries, Porto Novo, Tamilnadu

In the present experiment postlarvae 20 (PL-20) of *Penaeus monodon* received from M/s. Hindustan Lever Limited, Hatchery Muthukadu, were reared in a nursery pond at Portonovo. In a span of one month they were reared to the stockable size of 30 to 48 mm (averege size 38 mm.) from an initial size of 8 to 12 mm (average size of 10 mm) Pond was suitably prepared after the application of cowdung. Coconut palm leaves were fixed at the sides of the pond to avoid the direct heat of the sun and evaporation. clam meat *(Meretrix* sp.*)* was used as the supplementary feed given at the level of 100% body weight. Hydrographical conditions of the pond waters in relation to length and weight (growth) are discussed. About 98% recovery was achieved.

---

62. AN APPRAISAL OF THE RESOURCE POTENTIALS OF *PENAEUS INDICUS* POSTLARVAE OF A MINOR ESTUARY IN ANDHRA PRADESH

K. SURENDRA BABU and K. SASIRA BABU
Department of Zoology, S. V. University PG Centre, Kavali-524 202

A four-year study was carried out on the incursion patterns of postlarval prawns, using the Midnapore type shooting net in the

Upputeru estuary along the southern coastal Andhra Pradesh. The most important species of Penaeidae encountered in the shooting net collections were *Penaeus indicus, P. monodon, P. semisulcatus, Metapenaeus dobsoni* and *M. monoceros. P. indicus* was by far the most dominant species. Its monthly percentage composition varied from a minimum of 3.25% to a maximum of 94 7%, with an average of 46.35% in the total postlarval abundance. The rate of influx of *P. indicus* postlarvae was highest (48,497 No./net/h) in July, 1982, and lowest (38 No./net/h) in June, 1985. The ingression patterns showed three peaks in a year with a slight shift over the years, in the months of their occurrence. The highest peak, however, consistently occurred during June-July. The results of the investigation bring to limelight the importance of minor estuaries as potential seed collection centres for brackishwater prawn culture.

---

63. NURSERY REARING OF SEED OF *PENAEUS INDICUS* IN VELON NET CAGES

S. VICTOR CHANDRA BOSE
Department of Fisheries, Madras

Fixed cages (16p velon ceges) were used for nursery rearing of early juveniles, of *Penaeus indicus* (0.25 to 0.3 g size) to stockable size (2.0 to 4.0g) for stocking in net pens at Killai. Three cages were placed with bottom 20 cm above the ground and another three cages were kept on the ground with the help of wooden anchors. The survival and growth of juveniles were better in the latter than in the former. The survival and growth were more or less the same at three stocking densities (0.666, 0.75 and 1.0 million/ha), where shrimp head and groundnut cake were given as feed at 100% of initial body weight (IBW). In 30 days the final average weight of shrimp juvenile was 1.87 g and in 40 days it was 2.34 g. In one of the experiments the boiled squid offal and groundnut cake (1:1 ratio) was given as feed at higher

percentage (200% of IBW for 15 days and 100% IBW for 20 days) for 35 days. Juveniles had grown up to 2.1 to 2.41 g with this feed and the survival was better at lower density (0.75 million/ha) than in higher density (1.25 million/ha). In another experiment squid offal alone was given as feed (at 100 % IBW for 15 days and 50% IBW for 35 days) for 50 days and the juveniles had grown well (4.25 to 4.38g) but survival was less (55 to 65% only). The results are discussed for field application.

64. STUDIES OF THE MATURATION AND SPAWNING OF GREY MULLETS OF A RESERVOIR FISHERY IN OKHAMANDAL (GULF OF KUTCH)

P. GOPALAKRISHNAN and SURENDRA R. THAKER
Tata Chemicals Limited, Mithapur 361 345

Grey mullets formed 57% of the annual fish production during 1984-87 from the reservoirs of a solar salt works along the Okhamandal coast of the Gulf of Kutch. *Mugil cephalus* (23.0%), *Mugil macrolepis* (35.03%), *Mugil parsia* (1.29%), *Mugil tade* (0.62%) and *Mugil carinatus* (40.06%) formed the composition of the catch. Maturing specimens of *Mugil cephalus, Mugil macrolepis* and *Mugil parsia* were observed in the catch.

In view of the excellent prospects of aquaculture of this highly esteemed group of fishes, and considering the limited seed resources of 1.64 million per annum from natural sources, a study of the gonadial development and spawning of commercially important species was undertaken. Based on the data, experiments to induce the development and spawing were also conducted. Conditioning and prevention of disease from infection due to injury were major problems. Both *Mugil macrolepis* and *Mugil parsia* responded to pituitary hormone injections, developed ovaries and spawned in 7 days and 37 days respectively.

The prospects of rural development through mullet culture in the coastal areas of Kutch are discussed.

65. RESEARCH AND DEVELOPMENT OF INDUCED BREEDING OF MARINE FINFISHES IN INDIA

P. NAMMALWAR and G. MOHANRAJ
Central Marine Fisheries Research Institute
Madras Research Centre, Madras.

The paper highlights the role of induced breeding of marine finfishes in aquaculture research and development in India. The methods employed, research results achieved and the constraints encountered in broodstock management and mass propagation of cultivable grey mullet, milkfish, rabbit fish and other marine finfish larvae in hatcheries are reviewed. Problems associated with ovarian development and maturation, larval foods, bacterial contamination, environmental influence and design of hatchery facilities are discussed. A survey on the cultivable marine finfish spawner resources to locate potential areas was conducted along the coastal waters and estuaries. A review of the present status of research and development in induced breeding of marine finfishes and the future strategies are presented.

---

66. SEAWEED CULTURE IN INDIA — AN APPRAISAL

V. S. K. CHENNUBHOTLA, N. KALIAPERUMAL and M. S. RAJAGOPALAN
Central Marine Fisheries Research Institute Cochin-31

In recent years there has been a steady increase in the demand for naturally occuring seaweeds as a result of many seaweed based industries coming up. In order to meet the raw material requirement of these industries attempts have been made in this country to develop suitable seaweed farming techniques by some Institutes notably the

CMFRI at its Mandapam Regional Centre and CSMCRI at its field centre, Mandapam, Experimental culture of economically important seaweeds such as *Gracilaria edulis, Gelidiella* acerosa and other species was undertaken since 1972 at Mandapam. In these experiments production rates ranging from 3 to 8 times the initial wet weight were obtained. The techniques of seaweed culture, the favourable seasons, optimum duration of cultare period and the influence of environmental parameters are discussed in this account with notes on economics of seaweed culture. General information on the seaweed resources along our coasts, their potential for exploitation and culture are also highlighted.

---

67. AN ECONOMIC ANALYSIS OF SETTING UP OF PRAWN SEED BANK IN ANDHRA PRADESH — SOME PRELIMINARY FINDINGS

R. JAYARAMAN, J. PURUSHOTHAM SAI, V. SUBBA RAO, K. JOSHUA and K. R. RAMESH BABU
The Marine Products Export Development Authority
Regional Centre (Prawn Farming), Machilipatnam - 521 001.

Inadequate supply of quality seed is one of the chief constraints that impedes the quick development of prawn culture. Estuaries still remain the largest source of prawn seed supply. They are likely to remain so atleast for sometime in offing before the hatchery production of seeds is undertaken commercially and massively. The Marine Products Export Development Authority assists the prawn farmers in setting up prawn seed banks by providing technical assistance on prawn culture, undertaking site selection and farm surveys, preparing project reports for submitting to the banks to get financial assistance, releasing subsidy to the tune of 15% on the capital cost of the project and providing continued technical assistance throughout the culture period. Already some prawn farmers have started establishing such prawn seed banks and supplying prawn seeds commercially. This paper presents and discusses results of case studies on the economic feasibility of setting up prawn seed banks by fish farmers/prawn farmers.

68 STATUS OF BRACKISHWATER PRAWN FARMING IN ANDHRA PRADESH

R. JAYARAMAN, J. PURUSHOTHAM SAI, V. SUBBA RAO, K. JOSHUA and K. R. RAMESH BABU
The Marine Products Export Development Authority
Regional Centre (Prawn Farming), Machilipatnam-521 001

Andhra Pradesh is estimated to have 762.51 ha of brackishwater area under prawn culture. Prawn culture in brackishwater ponds as

well as in paddy fields converted into prawn ponds is picking up fast in the coastal districts of Andhra Pradesh, especially in East Godavari, Krishna and Guntur districts. There are more than 200 ha of brackish-water areas suitable for prawn culture in West Godavari district alone. More and more are being brought under prawn farming in this district. Semi-intensive culture technology is employed by the fish farmers. The average yield is estimated at 450 kg/ha/crop. This paper presents and discusses the status of prawn culture in Andhra Pradesh, identifies the constraints and suggests strategies for bringing the abundantly available brackishwater areas under scientific prawn culture to increase the yield from these ponds.

---

69. PROSPECTS OF SHRIMP FARMING BY PRIVATE FIRMS — A CASE STUDY

S. FELIX, N. SUKUMARAN, G. JEGATHEESAN and R. SUNDERAJAN
Fisheries College, Tuticorin

In view of the encouraging results shown by the research organisations of India and other countries in prawn culture on scientific methods, a commercial research and development project on prawn culture was established by the Tata Oil Mills Co., Ltd, in 1981 at Pulicat. Experiments were conducted in earthern ponds of size ranging from 0.4 to 1.25 ha. Stocking rates ranging from 50,000 to 1,50,000 prawns/ha were attempted and production to the tune of 0.5 to 1.0 tonne/ha/crop were achieved. Survival rates over 80% could be maintained in all the crops. An artificial feed which was formulated with shrimp meal, trashfish and vitamin-mineral mix along with other usual ingredients with a protein content of 40% was proved to be better than the conventional feed. Effect of design of a pond, aging of a pond, stocking density, stocking size, and various hydrobiological parameters, *viz.* salinity, dissolved oxygen and pH, were also studied.

The intensive stocking rate, the successful feed formula and the effective water management adopted were the important reasons for the successfull production of shrimps in this farm. The cost of production of 1 kg of shrimps, considering the variable cost, varied from Rs. 10.00 to 15.00 and thus a net revenue of Rs. 8000 to 20.000/ha/crop was achieved.

---

70. POTENTIAL OF SPINY LOBSTER CULTURE — AN ASSESSMENT

E. V. RADHAKRISHNAN and M. VIJAYAKUMARAN
Central Marine Fisheries Research Institute
Madras Research Centre, Madras - 6001 05

Fluctuating catches and increasing demand in both internal and international markets for lobster tails necessitate augmentation of production through proper management strategies and possible aquaculture practices. The technical feasibility of economically viable aquaculture of a few species of spiny lobsters is under investigation at the Field Laboratory, Kovalam, Madras. Since production of postlarval lobsters through captive breeding and rearing under controlled conditions is not possible, any serious attempt to cultivate spiny lobsters should begin with rearing the juveniles which are caught in large numbers along with the commercial size lobsters.

It has been shown that commercial size (200 g) lobsters can be grown in less than half the time that is required in nature by proper feeding schedules and environmental management. A further reduction in this growing period has been achieved by inducing accelerated growth by eyestalk ablation. Enhancement of growth in ablated lobsters up to twenty times the normal rate indicates possibilities of rearing lobsters in shorter duration. The present status and the problems which need further attention for developing commercially feasible lobster culture are discussed based on these investigations.

---

71. MARINE FINFISH CULTURE RESEARCH AND DEVELOPMENT IN INDIA

P. NAMMALWAR and G. MOHANRAJ
Central Marine Fisheries Research Institute, Madras Research Centre, Madras

This paper is a review of research and development work done on marine finfish culture in India. Information on the resource potential of the various ecosystems utilised, different species of fishes cultured in mono and polyculture systems, economics and low-cost technology developed for the culture of various species of marine finfishes in different systems are given. The aquaculture practices mainly deal with milkfish, grey mullet, Indian sandwhiting, rabbit fishes and groupers in various ecosystems. Details of suitable areas for culture and production, pond construction, constraints, management and development of coastal fish farms are presented. The ecological and socio-economical criteria for the selection of suitable aquaculture sites for management and development of marine finfish culture in India are discussed.

---

72. MANGROVE WATERS AS NURSERY GROUNDS FOR JUVENILES OF MARINE FLATFISHES

A. RAJAGURU, G. SHANTHA and R. NATARAJAN
Centre of Advanced Study in Marine Biology Porto Novo 608 502

Pitchavaram mangrove waters serve as nursery grounds for juveniles of marine flatfishes. Food and feeding habits of juveniles of four species of marine flatfishes, *viz.*, *Pseudorhombus arsius*, *P. elevatus* (Paralichthyidae) *Brachirus orientalis* (Soleidae) and *Cynoglossus puncticeps* (Cynoglossidae) have been studied from Pichavaram mangrove waters and compared with those of their adults, which are marine. Amphipods and copepods dominated in the diet of the juveniles, while polychaetes and prawns were the primary food items of adults. Food composition, seasonal variation in the food, and variation in feeding intensity have been presented in this paper.

---

73. RESEARCH AND MANAGEMENT OF *CHANOS* FRY RESOURCES OF INDIA

R. S. LAL MOHAN
Central Marine Fisheries Research Institute,
Calicut Research Centre, Calicut

Canos fry is available along the southeast coast of India during the months of April-June though less numbers are reported from other parts of the country during various seasons. Along the south-east coast of India they occur in the low lying areas, tidal flats and in the creeks. The size ranges from 2 to 10 cm weighing 1 to 10 gr.

The methods of fishing, types of gear used and methods of disposal of the catch are discussed. Seasonal abundance, catch rates, transport and the rate of survival during transport are also described.

Conservation measures such as regulated fishing operation, regulation of mesh size, declaration of close season, and the notification of closed areas are discusseed. Better transport facilities such as aerated containers should be designed for the transport so as to reduce mortality.

---

74. EVALUATION OF LARGE SCALE CULTURE OF MILK FISH, *CHANOS CHANOS*, IN FISH PENS IN A LAGOON

R. S. LAL MOHAN
Central Marine Fisheries Research Institute
Calicut Research Centre, Calicut

Field trials were conducted from 1981 to 1986 on the culture of milk fish in large fish pens made of nylon webbing in the Pillaimadam lagoon, near Mandapam. Nylon webbings of various mesh size and

twine thickness were tried. *Chanos* seed of length 75-145 mm weighing 4-18 g were stocked at various rates and reared. Production ranging from 220 to 450 kg/ha was obtained without giving artificial feed. Details of cost of pens and income from pens are discussed.

The main advantage of the system is the availability of the water area and the seed. The constraints of the system such as damage to the webbing due to barnacles, predation by birds, poaching and unfavourable weather conditions are discussed. The efforts taken to overcome the problems are also described.

After the field trials the technology was transferred to the fishermen. The fishermen of an adjacent village formed a co-operative society with 8 members and obtained a loan of Rs. 6000 each under the IRDP scheme to establish a fish pen of area 2 ha in the Pillaimadam lagoon. They involved themselves in all the aspects of fish pen culture.

Suggestions are made so that the pen culture can be adopted as a viable fish culture technique in the rural areas with lagoons and low lying areas. The role of banks and IRDP schemes in helping the fishermen is discussed.

---

75. DEVELOPMENT OF POLYTHENE FILM LINED PONDS FOR THE CULTURE OF PRAWNS AND FISHES

R. S. LAL MOHAN
Central Marine Fisheries Research Institute
Calicut Research Centre

Prawns and fishes were cultured in the polythene film lined ponds in the sea shore of Calicut from 1976 to 1981 obtaining valuable data on the growth, survival and the production rate. The salient features of construction of ponds, maintenance and the constraints faced are discussed.

Technical Session IV

FISHERIES TECHNOLOGY

77. ROLE OF FISHING TECHNOLOGY IN RESEARCH AND DEVELOPMENT OF MARINE FISHERIES OF INDIA

Y. SREEKRISHNA and LATHA SHENOY
Central Institute of Fisheries Education, Bombay

Consequent to the declaration of Exclusive Economic Zone (EEZ) to 200 nautical miles, India has acquired right to explore, exploit, manage and conserve the resources of her seas. This provides greater challenge by way of financial investment, provision of infrastructural facilities, introduction of different types of large deep sea vessels, modern fishing gear and use of modern technologies in fish handling, processing, storage and marketing.

Of the total estimated potential of 4.5 million tonnes, India is now harvesting about 1.8 million tonnes of fish. The importance of utilization of all these resources needs no special emphasis.

Fishing Technology which deals with the study, development and improvement of the techniques used to catch the fish has a greater role to play in the exploitation of all potential fishery resources in the EEZ. This discipline concerned with fishing gear, fishing vessels and operations represent major share of investment. This technology helps

i) to increase the production per area, catch per unit effort and per fisherman.

ii) to improve the fishermen's living conditions by raising their income and improving their working conditions.

iii) for rational exploitation of fishery resources by moving the fishing effort to other areas or species in order to develop underutilised or latent resources and to decrease the

The main advantage of the system is the extensive areas of sea shore along the coast, and availability of seed of commercially important prawns and fishes in the surf area. High rate of survival and growth were also reported. The constraints are the high cost of polythene sheet, fuel for pumping sea water and the laws regarding the utilisation of sea shore by the individuals for farming. The high cost can be neutralised if the production levels can be kept as indicated by the field trials. A brief account of the cost-benefit of the system is also given. Suggestions are made for the utilisation of the technology by the development agencies such as the IRDP.

---

76. BIOCHEMICAL COMPOSITION OF SOME MARINE ALGAE FROM MANDAPAM COAST

V. S. K. CHENNUBHOTLA, M. NAJMUDDIN, J. R. RAMALINGAM and N. KALIAPERUMAL

Central Marine Fisheries Research Institute, Cochin-31

Studies were made on biochemical composition of 33 marine algae comprising 16 green, 7 brown and 10 red algae commonly occurring along Mandapam coast. The algae were analysed for protein, carbohydrate and lipid. In general, the protein content was found high in green algae, the values ranging from 6.8% to 25.8%. The carbohydrate content was found to be high (57%) in red algae, followed by brown algae (24.9%) and green algae (11.6%). The lipid content ranged from 4.0 to 8.0% in green algae, 0.5 to 4% in brown algae and 0.5 to 6.0% in red algae. The present investigation indicates that selected species could be utilized as an alternate source of protein and carbohydrate for the formulation of fish feed in fish culture or for the manipulation of other animal and human feed.

---

pressure on overfished regions or species by the development and introduction of selective method and gear.

iv) to assess the fishery resources by employing suitable gear and craft.

Great strides have been made in increasing marine fish production of India from 0.53 million tonnes in 1951 to 1.81 million tonnes in 1984. This has been possible by application of various technologies including fishing technology. The introduction of bottom trawls, purse seines, high opening trawls in selected areas, double rig shrimp trawls from deep sea fleet, etc. has made significant impact on the marine fish production. Introduction of synthetic twines contributed to the increase of efficiency of gear like gill nets and trawls. Mechanisation of fishing vessels resulted in economical operations, expansion of fishing range and duration of fishing. Other aspects of fishing technology which helped the overall fisheries development include exploratory surveys for resources assessment, deck equipment to handle the gear, electronic instruments for finding fish and to navigate the vessels safely.

This paper deals with fishing methods in marine waters, types of vessels in operation, prospective developments in fishing technology and recommendation regarding vessel and gear suitability for exploitation of deep sea resources.

---

78. IMPROVED VERSION OF A VERTICAL HIGH OPENING NET AND RESULTS OF OPERATION IN SAURASHTRA WATERS

P. P. SOLOMON, N. D. CHHAYA and H. D. CHAUHAN
Gujarat Fisheries Aquatic Sciences Research Station, Veraval

Field trials were conducted with an improved version of V. H. O. net of BOBP in Saurashtra waters by the Gujarat Fisheries Aquatic Sciences Research Station, Veraval. Both the fish catch and value

improved. This centre has been helping fishermen to fabricate this modified version of net which is popularly known as DISCO net to fishermen. The acceptance is total and within last two years 1500 modified V. H. O. nets were fabricated at Veraval alone. This paper gives the salient features of modified design and comparative statistics.

---

79. MECHANIZATION OF THE SKIPJACK TUNA POLE AND LINE (LIVE BAIT) FISHERY IN LAKSHADWEEP

P. LIVINGSTON
Central Marine Fisheries Research Insriture,
Mandapam Regional Centre, Mandapam Camp

The paper gives a comprehensive account for the first time of the early developments and progress achieved so far in the field of mechanization of the skipjack tuna pole and line (live bait) fishery of Lakshadweep, with special reference to the extension of this unique fishing technique from Minicoy to other Islands since 1958.

A total of 14 aspects of mechanization, *viz.*, (i) the beginning and prime objectives of mechanization, and improvements in (ii) growth and changes in size and cruising range of fishing boats. (iii) general feature of the fishing boats. (iv) types of engines used; (v) live bait equipment onboard (vi) onboard facilities for the operation of the fishing gear, (vii) fish preservation and handling equipment onboard, (viii) facilities for crew accommodation onboard, (ix) navigation, communication and fish-finding equipments onboard, (x) combination fishing boats (Pole and line with tuna long lining, tuna purse seining) trawling etc.), (xi) alternative fishing boats (like tuna purse seiners, to replace pole and line (live bait) boats, (xii) ancillary ships (like base ships and factory motherships) to co-operate with the tuna fleet, (xiii) materials used for construction of boats and also improvement in (xiv) patrol and transport work undertaken by the fishing boats are considered here for comparison. Based on this study, several of the immediate

and future needs in the above mentioned 14 aspects of mechanization of the Lakshadweep skipjack tuna pole and line (live bait) fishery are pointed out, so as to enable tuna fisheries developments in sophisticated lines in Lakshadweep, taking useful lessons from the Japanese and Californian fisheries.

---

80. POLE AND LINE TUNA FISHING TECHNIQUES — A COMPARATIVE STUDY WITH SPECIAL REFERENCE TO LAKSHADWEEP FISHERIES

P. LIVINGSTON
Central Marine Fisheries Research Institute, Mandapam Regional Centre, Mandapam Camp

The present paper gives a scientific exposition of certain hitherto little known aspects of the skipjack tuna pole and line (TPL) fishing technique of Lakshadweep. Four varieties of this gear are described besides giving a more detailed description of the typical gear. Six conventionally fixed gear positions meant for the operation of the gear and four similar positions meant for the water-splashing men on board the fishing platform, the concept of hook territory. shooting angle, hauling direction, underwater air-bubble formation of the hook to simulate an active prey, the tactics of chumming tuna with live baits and the spraying effect involved in the water splashing technique are reported. A comparison of this fishing technique with the skipjack TPL of Japan. highseas yellowfin TPL of California and yellowfin TPL of Polynesia is made based on literature. The problems of tuna not biting the hook or chum on certain occasions and of the breaking of poles in the Lakshadweep TPL technique are discussed and remedies suggested. The need for introducing the team-gear, the use of baithook, lure-hook and striker, and for improving the mode of angling, chumming and water splashing by adopting technological advancements from the other TPL techniques under comparison are given for

increasing the production of yellowfin tuna and skipjack tuna in Lakshadweep. Introduction of the Polynesian yellowfin TPL technique using the pearl-shell lure in Lakshadweep as a live-bait-saving and crewsaving technology is suggested. The need for more scientific work on gear technology of the TPL technique of Lakshadweep are pointed out.

---

81. POLE AND LINE FISHING GEAR-MAKING INDUSTRY OF LAKSHADWEEP

P. LIVINGSTON
Central Marine Fisheries Research Institute
Mandapam Regional Centre, Mandapam Camp

The present paper gives an account of the indigenous industry which makes the skipjack tuna pole and line (live bait) gear in Lakshadweep Islands. General aspects of this cottage industry such as the ownership, working place, tools, funds, labour, wages, materials and their procurement, economics and organisation are dealt with. Various aspects of hand-forging of hooks at Minicoy are described. Also aspects such as seasoning, selection and sizing of poles, selection of hooks, sizing of the line and assembling and testing the gear are dealt with. For augmenting the catch of skipjack and yellowfin tuna in Lakshadweep, the urgent need for modernising this gear-making industry by (i) manufacturing indigenously lure-hooks, strikers and special hooks for making baitooks, (ii) making indigenously and/or supplying to local fishermen FRP (Fibre-Reinforced-Plastic) Poles, (iii) introducing quarantine and quality control measures to supply quality bamboo poles from the mainland to the fishermen and (iv) supplying these fishery requisites to the Islander fishermen at low cost under subsidy, is stressed in this paper.

---

82. CONTRIBUTIONS OF CFTRI TO R&D IN POST HARVEST FISH PROCESSING TECHNOLOGY

N. V. SRIPATHY
Central Food Technological Research Institute Regional Centre, Mangalore

Research on fish as food was started in CFTRI, Mysore, around 1956. Soon, the need was felt for facilities for work on marine fish in a suitable coastal location. Accordingly, a field station was started at Mangalore in 1960.

The initial phase of work was concerned with fish as a means of combating protein malnutrition. The emphasis at that time was therefore on developing fish protein concentrates from oil-sardine and other fishes, and evaluating their nutritive value for use as food supplement. Composite foods with fish as an ingredient in farinaceous bases were developed. Proteolysis as a means of obtaining fish proteins in soluble form was tried out. Work was also initiated on control of post-harvest spoilage in shrimp and fish and to develop analytical tests for assessing degree of freshness.

The quality of cured fish as available in the Indian market was assessed. Procedures and formulations were worked out to obtain cured fishes of improved quality, longer shelf life and free of fungal and red halophilic growth. Work on fish meal and oil led to pilot plant design as the basis for developing indigenous technology. The possibility of obtaining sardine oil of high quality and of putting it into food uses by hydrogenation and in fish canning was demonstrated. The usefulness of fish oil as a hypocholesterolemic agent was brought out.

In more recent years, various fish products, in both dried and frozen forms, have been developed. Ready-to-use formulations for the urban market are receiving attention. Greater emphasis is being laid on the mechanisms by which the various results of research may be taken across to the intended beneficiaries.

83. TECHNOLOGIES FOR UTILISATION OF BLOOD CLAM (ANADARA GRANOSA)

C. C. PANDURANGA RAO, SUBRATA BASU, D. I. KHASIM SAHEB, R. CHAKRABARTI AND S. S. GUPTA
Central Institute of Fisheries Technology Kakinada Research Centre, Kakinada 533 003

Blood clam *(Anadara granosa)* forms a fishery of considerable magnitude in the Kakinada Bay where an estimated 2000 t are landed annually. In addition, culture technology for blood clam has been standardised in India, throwing open the possibility of large scale farming of this species. Presently clam meat is burnt along with shell to produce lime. In order to optimise the utilisation of blood clam as against the existing gross under-utilisation, Kakinada Research Centre of CIFT has developed the technologies for icing, freezing and canning of the clam. A pickled product and sausage are the other products developed by the Centre. The paper describes the technologies developed for utilisation of blood clam.

---

84. UTILIZATION OF TRASH FISH IN INCREASING MILKYIELD AND MILK QUALITY IN CATTLE

N. D. CHHAYA, K. C. PARMAR, C. N. KHATRI, and P. C. MALLI
Gujarat Fisheries Aquatic Sciences Research Institute Okha

The margin between cost of milk production and its selling price is very thin and is getting thinner due to cumulative increase in cattle feed prices on one side and limitations on marketing price of milk on the other. Possible utilisation of trash fish converted to liquid silage as a part of cattle feed to increase yield of milk and fat content is discussed in the paper. The development of silage and field trials on milk cattle were carried out by GFASRI Okha.

---

85. DEVELOPMENTS IN FISH PROCESSING AND PRESERVATION TECHNOLOGY IN TAMIL NADU

M. CROSS VICTOR RAJ, G. SUGUMAR,
G. JEGATHEESAN and V. SUNDARARAJ
Fisheries College, Tamil Nadu, Agricultural University, Tuticorin-628 008

The paper reviews the developments that have taken place in processing and preservation techniques over a few decades with a note on the various sea foods meant for export. The infrastructural facilities available in Tamil Nadu for freezing, canning and other methods of preserving fish and fish meal production are assessed and their relative developments presented. Further needs in this line are identified based on area requirement for a homogenous improvement in the economic status of the fisherfolk. The different kinds of fish processing methods of Tamil Nadu are presented with their merits and demerits. Specific improvements made in certain selected processing techniques are discussed and their advantages pointed out. The spectrum of diversification of fish products such as dry fish, shark fin rays, Beche-de-mer, fish maws etc. is brought out. The rapid developments evidenced in freezing methods and their application to sea food processing industries are explained. The establishment of seafood export industries and their sizable contribution to seafood export are highlighted. Constraints encountered in fish canning industry and its developments are listed and remedial measures indicated.

86. A COMPARATIVE STUDY ON THE QUALITY CHARACTERISTICS OF MASMIN AND MECHANICALLY SMOKE CURED TUNA

S. DAVID KINGSTON, CBT. RAJAGOPALASAMY and
G. JEGATHEESAN
Fisheries College, Tuticorin 628 008

'Masmin' a smoke cured product prepared from tuna in traditional smoking kilns is considered a delicacy by the people of southern States. It is shown by certain researches that some chemicals particularly the Phenolic components present in the smoke is carcinogenic in nature which is tremendously hazardous to human beings when consumed beyond a certain limit. So it is essential to have a knowledge on the total phenols present in masmin. In the present study the total phenolic content as well as other biochemical constituents of masmin were studied. Further, the results were compared with the mechanically smoke cured product.

Technical Session V

MANPOWER DEVELOPMENT FOR MARINE FISHERIES

87. MAN-POWER NEEDS FOR MARINE FISHERIES BY 2000 AD

M. SWAMINATH
Central Institute of Fisheries, Nautical and Engineering Training, Cochin 682 016

Formal training of operatives for marine fishing industry started in late forties when the erstwhile Deep Sea Fishing Station commenced training activities. However, organised training for fisheries personnel commenced with the establishment of CIFNET (erstwhile CIFO) and CIFE in the early sixties. The former catered to the manpower needs for operating the fishing vessels while the latter produced the managerial/administrative personnel for shore support. Today a number of fishery colleges and Agricultural colleges supplement the training activities of these two training establishments in fisheries-related disciplines.

Accent on innovations of harvest and post harvest technologies of marine capture fisheries has necessitated upgradation and modernisation of training processes of CIFNET. This has been done following a series of studies and evaluations commensurate with the type and kind of technologies, breed and nature of craft and gear introduced etc.

In addition to meeting the domestic needs, the trained manpower is the national wealth which is spared for development of industry in friendly developing countries to our advantage due to the inflow of foreign exchange.

Reckoning the present pace of growth of our marine fishing industry a projection of the manpower needs for 2000 AD is attempted in the present paper. The nature and specialities of the human resources that would be needed that time have been attempted to be identified and the innovation to be made in the production process outlined.

88. HUMAN RESOURCES DEVELOPMENT IN FISHERIES

Y. SREEKRISHNA and R. S. BIRADAR
Central Institute of Fisheries Education, (ICAR)
Versova, Bombay-61

Human resources development is an important part of fisheries development. Keeping this in View, the Government of India established the Central Institute of Fisheries Education (CIFE) at Bombay in 1961. The institute during its eventful 25 years of service has provided the requisite trained manpower at different levels for fisheries development, industry, research, education, training and extension. In addition to regular courses, a large number of short term training programmes on selected topics have also been conducted at national and international levels to meet specific demands. The Institute is today recognised as the centre of excellence in higher education in fisheries.

Besides the CIFE, Traditional and Agricultural Universities and Indian Institutes of Technology are also engaged in imparting fisheries education. There is a need for standardisation and inter-collaboration of these courses. Establishment of a Central Fisheries University will go a long way in achieving these objectives.

---

89. EDUCATION TRAINING AND EXTENSION OF FISHERIES IN ORISSA

K. C. DORA and K. C. BOSE
College of Fisheries Rangailunda, Berhampur-760 007

There are several fisheries educational, training and extension centres in Orissa. The College of Fisheries was started in the year 1981 under the Orissa University of Agriculture and Technology, Bhubaneswar. There are five research and training institutions in

Orissa working in the field of marine fisheries, brackishwater culture and freshwater fish culture. Detailed information is given about the training programme for marine fisheries extension officers, their activities, performance and achievements, organizational chart of extension service, giving certain immediate needs indicating potential areas for fisheries extension work in Orissa.

---

90. RESEARCH AND DEVELOPMENT IN MARINE FISHERIES EXTENSION

J. VASANTHAKUMAR, V. SUNDARARAJ, N. SUKUMARAN and P. SELVARAJ

Fisheries, College, Tamil Nadu Agricultural University, Tuticorin-628 008

Improvement in the standard of living of fishing households and fishing labour households and optimal utilisation of fishery resources for employment, production and export are the important goals of marine fisheries extension service. Despite the increasing attention of the Government to fisheries extension work, majority of fisherfolk are caught in a vicious cycle of poverty and indebtedness. The paper analyses the present strategies of fisheries extension service in Tamil Nadu, identifies the pitfalls and lists suggestions for improving the efficiency of fisheries extension work in the state. The extension teaching methods used for individual contact, group contact and mass contact, the subject-matter fields covered in extension teaching with their relative importance, the characteristics and extension personnel, research support provided, co-ordination among the various agencies involved and participation of the clientele and their organisations are analysed and discussed. The analysis helped in identifying the major impediments to success of extension efforts. The analysis provided a basis for evolving future extension strategies focussed on marine fisheries development. It provides suggestions in term of personnel requirement, effective extension methods, thrust areas among different subject-matter-fields, co-ordination among organisations concerned with marine fisheries and extension research support. The recommendations will be of use to the organisations concerned with fisheries extension in their approach to tone up the service of fisheries extension.

---

91. TRAINING OF FISHERFOLK AND COASTAL AREA DEVELOPMENT

P. SELVARAJ, V. SUNDARARAJ and J. VASANTHAKUMAR
Fisheries College, Tuticorin 628 008

Research in social sciences has revealed the need for diversification of income sources of rural households to cope with risk and uncertainty inherent in rural occupations like fishing and agriculture. Part-time farming is growing in importance in countries like Japan. It may be a guidepost for part-time fishing in maritime states.

Experience has shown that the labour force of the fishing households possesses skills in fishing-related and non-fishing activities and such skills can be improved upon by conducting training programmes. The paper analyses critically two such training programmes - one conducted by MPEDA and the other by TNAU.

This paper focuses on the training needs of fisherwomen and the practical problems in organising training programmes. The fishing households suffer from economic problems like underemployment and proverty and social problems like dowry and alcoholism. The socio-pathological problems can be tackled by improving the levels of living of the fishing households. Training of fishermen and their spouses and children will go a long way to achieve this goal. The impact of diversification of income sources on fisheries development is highlighted. The methodological issues in organising training programmes for the welfare of fisherfolk and the techniques to resolve them are discussed. The paper closes with a futuristic programme in the area of training.

---

92. EXTENSION SERVICE FOR PRAWN CULTURE

R. JAYARAMAN, J. PURUSHOTHAM SAI, K. R. RAMESH BABU, V. SUBBA RAO and K. JOSHUA

The Marine Products Export Development Authority
Regional Centre (Prawn Farming), Machilipatnam-521 001

The technology of prawn culture in India is still traditional, but adoption of semi-intensive prawn culture technology is claimed to be picking up fast in several places notably in West Bengal, Kerala, Andhra Pradesh and Orrissa. The production from such culture practices is estimated to be 15,000-17,000 tons/year, accounting for about 5% of the total prawn production in India. The technology of scientific prawn culture is now available. Though steps are being taken to motivate and encourage the fishfarmers to take up prawn culture on scientific lines to increase their income, lack of an appropriate and proper extension network is felt to be a major handicap in the field. This paper attempts to review the various extension services available for taking up prawn culture by the fishfarmers, identifies the pitfalls and proposes a working fisheries extension programme for prawn culture in India.

93. TRAINING FISHERWOMEN IN FISH PROCESSING

P. SUKUMAR, J. VASANTHA KUMAR and P. SELVARAJ

Fisheries College, TNAU, Tuticorin

A project on training fisherwomen for their participation in rural development, sponsored by Ford Foundation (U. S. A.), has been started by the Centre for Agricultural and Rural Development Studies, T. N. A. U., at the Fisheries College, Tuticorin. The project aims to select a few literate rural women with leadership qualities for imparting to them a training in the organisational and managerial aspects of a viable fish processing enterprise. It also aims to assist

the trained fisherwomen in organising and operating cottage industries by continued technical backing and thus making the production units demonstration centres for the benefit of other women in the region. The first batch was trained in fish processing enterprise management from 30-3-'87 to 22-4-'87.

The preliminary survey helped in identifying 5 candidates from each of the 3 selected villages. The pre-survey revealed the respondents' choice of subject-areas to undergo training and their enthusiasm to learn techniques for the preparation of fish products like fishpickle and Masi Meen. It also revealed their desire to be exposed to new products like fish wafers, fish oil, fish meal, shark fin-rays etc.. The pre- and post-evaluations of the training programme helped in i) identifying training needs in the fields of marketing and financial management; ii) identifying some low-cost technological substitutes for some of the commercial products (eg: 'Gadi' for vineger); iii) identifying the products or techniques appreciated by the trainees and the products or techniques that received lukewarm response with reasons for such a response; iv) identifying the level of managerial efficiency gained by the trainees and the kind of support required for each individual to start cottage industries. The programme is being followed up by interpersonal contacts and by the co-ordinated efforts of the development departments.

Technical Session VI

MARINE FISHERIES DEVELOPMENT

94. STRATEGIES FOR MARINE FISHERIES DEVELOPMENT IN INDIA

P. S. B. R. JAMES and K. ALAGARSWAMI
Central Marine Fisheries Research Institute, Cochin

Four decades of planned development of marine fisheries in India has raised the production level from about 0.5 to 1.6 million tonnes per annum. This growth in tonnage is not commensurate with the effort that has been expended over the period in terms of planning, research and development. Stagnation in production has been witnessed during the last one decade. The deep-sea fishing programme is yet to yield any tangible result by way of a quantum jump in production and its contribution has been marginal, not able to influence the overall production trend. However, marked changes have taken place in the pattern of exploitation and resources during the span of 40 years.

The paper analyses the cause and effect of some of the important aspects of marine fishery development in the maritime States and Union Territories. Resource research at various periods of time has come out with tentative recommendations on strategies that may be adopted in development of particular fisheries. These have, willy nilly, not been given a try, perhaps due to several constraints. Taking into consideration the present scenario of research and development, strategy options are indicated for management and development of the marine fisheries of the country.

95. FISHERIES IN MAHARASHTRA STATE

R. H. JOSHI
Department of Fisheries, Maharashtra, Bombay

Maharashtra State, endowed with a coastline of 720 km, has a continental shelf of 87,000 sq. km. The shelf up to 40 fathoms with an

area of 44,000 sq. km possesses rich fisheries potential and almost the entire present fishing activity is restricted to this zone. The harvestable potential of this zone is estimated at 3.74 lakh tonnes. The shelf between 40 and 100 fathoms, measuring 43,000 sq. km, has harvestable potential of 0.80 lakh tonnes. The paper deals with the potential fishery resources, status of traditional fishing, developmental activities in the areas of mechanisation, construction of fishing harbours and other infrastrucural facilities, as well as fishermen welfare activities like the functioning of co-operative societies,

---

96. STATUS REPORT ON MARINE FISHERIES DEVELOPMENT IN TAMILNADU

FREDA CHANDRASEKHARAN
Department of Fisheries, Tamil Nadu, Madras

The declaration of Exclusive Economic Zone extending up to 200 miles from the coastline has provided a great opportunity to exploit the fishery resources. The fishery resources, the number of traditional craft, mechcnised fishing boats and other shore facilities available are indicated. The various schemes implemented by the Department to increase marine fish production in Tamilnadu are narrated. Future plans of the Department for maintaining and improving the fishery is also discussed.

---

97. CIFE CONTRIBUTION TO MARINE FISHERIES R & D

M. DEVARAJ and Y. SREEKRISHNA
Central Institute of Fisheries Education, (ICAR) Versova, Bombay-61

The CIFE contributions to marine fisheries R & D are mainly in the areas of fish stock assessment, brackishwater farming, fishing and

product diversification, fishery socioeconomics & technology transfer. Stock assessment studies, limited to the west coast and particularly to the northwest coast, include those of *Coilia dussumieri, Otolithus cuvieri, Johnius glaucus, Polynemus heptadactylus, Harpodon nehereus, Arius thalassinus, Nemipterus japonicus,* all northwest coast inshore species, penaeid prawns, *Rastrelliger kanagurta, Sardinella longiceps* and *Xancus pyrum.* In respect of brackishwater fisheries, R & D activities are concerned with prawn hatcheries, seed banks, low input culture, live feed culture, and fishery estates. Simple techniques for making laminated bombayduck, fish wafers and minced meat have been developed for the purpose of product diversification. High-opening bottom trawling has been experimentally proven to be more productive than the traditional bottom trawling, and is being popularised. Studies on profitability of mechanised fishing indicate some prospects for additional investment. Small private-owned brackishwater farms are more profitable than large government-owned farms, indicating thereby the need to privatise the farm sector. The fisheries cooperative society at Versova, investigated in detail by the CIFE as to its sccuess, is recommended to be a model for other fisheries societies in the country. Technology transfer is effected through periodic short-term training courses on subjects of critical importance to specific target groups including fish farmers, fishermen, processors, entrepreneurs, etc.

98. A SUGGESTED PLAN FOR DEVELOPMENT OF MARINE FISHERIES SECTOR OF ANDHRA PRADESH

T. RAJYALAKSHMI
Puri Research Centre of Central Institue of Brackishwater Aquaculture
Puri 752 002, Orissa

A suggested plan for the development of marine fisheries sector of Andhra Pradesh is presented here. The condition of the State fisheries shows stagnation of overall productivity of the waters. Andhra Pradesh contributes on an average 1.3 lakh tonnes, forming around 8.97% of the total fish catches of India (in 1982). The following are

major areas to be considered for proper planning and development. Several of the stocks are being fished in a narrow coastal belt and there is thus concern on the depletion of these resources; secondly, there is the threat of increasing incursion of foreign fishing vessels; thirdly, the increasingly fast degradation of coastal waters by multiple users on the one hand and multiplication of traditional users on the other; lastly, the potential of aquaculture is yet to be fully assessed.

The plan hence recommends four major but broad thrusts for the overall development which includes management and conservation of marine fisheries; prevention of pollution and degradation of wetlands as pertaining to fish habitats; strengthening the commercial fishing industry, particularly of the 200 miles EEZ; and aquaculture as an additional technology.

The implementation of the plan is to be vested with the State Department with collaboration from Research Institutes and Universities and agencies such as Rural Development, Irrigation and Power, Environment and Pollution Control Board. The implementation of action plans depends on information available. It also needs a management regime or Task Force. Legislation and organisational changes will be needed.

The management and development of these four thrust areas are detailed further with recommendations in each area of action.

---

99. STATUS OF PRAWN FISHERY AND IT'S MANAGEMENT AT JAKHAU, GUJARAT

SMITA KRISHNAN, RISHAD PRAVEZ, A. P. MANSURI, M. S. MURTHY and R. M. NAIK

Department of Biosciences, Saurashtra University, Rajkot 360 005

During the past one decade, Jakhau has become an important seasonal (September to March) fishing centre in Kutch, attracting an increasing number of fishermen and traders from different parts of Gujarat. The prawn fishery contributed 24% of the total trawl landings

during the 1985-86 season. The pawn fishery is chiefly supported by penaeids like *Penaeus monodon, P. indicus, P. semisulcatus, Metapenaeus brevicornis, M. kutchensis,* and non penaeids like *Hippolysmata ensirostris* and *Expalaemon styliferus.* The peak season for the fishery is from October to January. The average catch per unit effort for prawns showed a clear decline during 1985-86 and 1986-87 seasons. This is apparently attributed to the fact that increasing number of migrant fishermen come here to fish, leading to overfishing. Management measures, that should be taken to conserve the stock in these fishing grounds are suggested.

---

100. STATUS AND PROGRAMMES OF MARINE FISHERIES DEVELOPMENT AND MANAGEMENT IN LAKSHADWEEP

GEORGE VARGHESE
Department of Fisheries, U. T. Lakshadweep, Kavaratti

Tuna and tuna-like fishes of Indian seas, which remain largely under-exploited at present, hold the greatest promise for development of fishing industry in India. The percentage composition of total tunas in the all-India marine fish production ranged from 0.3% in 1970 to 1.36% in 1984-86. Lakshadweep, a group of coral islands in the Arabian Sea, have got the distinction of being the only region in India where an organized fishery for tuna has been established in the small-scale mechanised sector. Lakshadweep waters, consisting of 20000 sq km of territorial waters and 40,00,00 sq km of Exclusive Economic Zone, are potentially rich for tuna and shark. It is estimated that Lakshadweep waters support a fishable stock of 50,000 tonnes of skipjack, 50,000 tonnes of deepwater tuna and allied species and 100,000 tonnes of shark. Against this, the present exploitation is 4807 tonnes of tuna in 1986, forming 87% of its total marine fish catch and around 16% of the total tuna catch of India. The principal gear employed is pole and line. Troll lines and hand lines form subsidiary gears.

The progress achieved in the fisheries sector of Lakshadweep is remarkable. From a meagre annual fish catch of 500 tonnes in 1960 the production has leaped to 5535 tonnes by 1986. Out of the total population of 42,000, who were basically coconut growers, about 5000 persons found employment in fisheries sector. The contribution of income from fisheries sector at current price is about Rs 2.13 crores annually, which work out to a per capita income of Rs 510. The average catch of a pole and line tuna fishing boat is 70 tonnes worth Rs 2.7 lakh for 6 months of operation in a year. The income per fisherman is worked out to Rs 15,000 for the said period.

These striking achievements were made possible due to proper planning and execution of fisheries developmental schemes since 1959. Prior to this, fishing was primitive with catch insufficient even for domestic consumption. Tuna was not caught in any Island except Minicoy. Various schemes were drawn up and launched by the department of fisheries for the proper exploitation of the fishery resources of the area. These include introduction of mechanised boats, popularisation of pole and line, long line and troll line fishing, experimental and demonstration fishing, training of manpower, setting up of boat-building yards, canning factory and workshops, issue of fishery requisites and oil, providing infrastructural facilities and research and development for the improvement of craft and gear.

---

101. MARINE FISHERIES DEVELOPMENT IN ANDAMAN AND NICOBAR ISLANDS

R. SOUNDARARAJAN and K. DORAIRAJ
Central Agricultural Research Institute, Port Blair
and
E. K. RAVINDRAN
Directorate of Fisheries, A & N Administration, Port Blair

The marine fish production in Andaman and Nicobar Islands has reached a level of a little over 10,000 tonnes in 1986 from a

meagre catch of 44 tonnes during 1950. The average annual catch of fish during the past five years works out about 5800 tonnes. About 92 mechanised and 1006 non-mechanised craft are engaged in fishing and fishes are landed at about 55 centres distributed all over the Islands. The substantial increase in the production has been to some extent due to introduction of several developmental programmes. In this paper, the details pertaining to regionwise, yearwise and specieswise marine fish production covering the the period up to 1986, available infrastructure facilities and various development programmes being implemented are presented and the strategies to be evolved for further augmentation of the fish production to its maximum potential are discussed.

---

102. DEVELOPMENT OF MARINE FISHERIES IN THE UNION TERRITORY OF PONDICHERRY

V. V. FRANCIS XAVIER
Fisheries Department, Union Territory of Pondicherry, Pondicherry

Development of marine fisheries in the Union Territory dates back to 1955-56, after the merger of the former French territories of Pondicherry, Karaikal, Mahe and Yanam. The Union Territory has a coastline of 45 km and a fishermen population of about 34,000. The annual fish production of the Territory has risen from a meagre 900 t in the beginning to more than 20,000 t in recent years.

This paper deals with mainly the various developmental activities such as the introduction of mechanised boats, beach-landing craft, outboard motors, provision of cold storages, transport facilities, fishcuring yards, construction of fisheries harbour, fishlanding platforms, subsidies provided to the fishing activities and training imparted to the fishermen undertaken since the Second Five Year Plan period. It also presents the various social welfare schemes for improvement of the fishing community and its socio-economic conditions.

---

103. ROLE OF NABARD IN FINANCING MARINE FISHERIES PROJECTS

S. C. PATHAK and B. VENKATESH
National Bank for Agriculture and Rural Development, Bombay-400 018

National Bank for Agriculture and Rural Development is the apex organisation dealing with the policy, planning and operational matters related to credit for development of agriculture and allied sectors including marine fisheries. NABARD has been playing a significant role in promoting marine fisheries development as a refinancing agency as well as developmental agency through conducting training programmes, supporting innovative type of schemes and funding research projects. NABARD has been extending refinance assistance to schemes for acquiring fishing vessels, mariculture and for building infrastructural facilities. The experience of NABARD in implementing various fisheries schemes is discussed in this paper. The significant features of the pilot credit project implemented in Orissa with BOBP assistance are highlighted. With view to increasing the participation of financial institutions in the process of marine fisheries development, suggestions are made to improve flow of credit to marine fisheries.

---

104. IMPORTANCE OF DOMESTIC FISH MARKETING IN THE DEVELOPMENT OF FISHERIES IN INDIA

R. SATHIARAJAN
Integrated Fisheries Project, Cochin

Fisheries development of any country should have a close link with the domestic consumption. The infrastructure needed for domestic fish marketing in this country is practically inadequate. The successive five year plans did not give emphasis on this aspect. Instead, importance was given only to export, and that too only one item ie. shrimp. This has resulted in the lopsided development of Indian fisheries and the

capital invested in the mechanisation, research and development did not bring the desired result. This paper deals with this aspect of giving importance to the domestic fish marketing for the real development of fisheries. A strong domestic market is a guarantee for a healthy export trade.

---

105. STRATAGIES FOR PRODUCTION OF AND MARKET DEVELOPMENT FOR INDIAN MARINE RESOURCES

R. JAYARAMAN[1], M. CHINNADURAI, S. NARAYANAN[2], R. SENTHILATHIBAN, R. SURESH, P. SELVARAJ[3] and N. DURAIRAJ[4]

1. *The Marine Products Export Development Authority, Machilipatnam*
2. *Centre for Agricultural and Rural Development Studies, Tamil Nadu Agricultural University, Coimbatore*
3. *Department of Fisheries Economics, Fisheries College, Tuticorin*
4. *Department of Economics, Madurai-Kamaraj University Madurai*

The non-optimal utilization of Indian marine fisheries resources has led to concentration of fishing effort on a few high-unit-value species and negligible harvest and utilization of other species that are abundantly available. Further, the marine fish production has been showing only gradual increase for the past 15 years. Marketing studies pointed out that the supply of marine fish fell short of demand by about a million tonnes in 1985. Adoption of appropriate conservation/ management practices for the heavily and indiscriminately exploited capture fisheries, exploitation of other potential marine fisheries, and deepsea fishing are some measures that could step up marine fish production. Further the potential of coastal aquaculture in supplementing marine fish production has not been fully utilized in India. This is vital to back up the Indian marine products export industry which is predominently a shrimp-dependent one. To ensure optimal utilization and adequate supply of marine fish, strategies for the production and marketing of our marine fisheries resources are needed. This paper discusses such strategies in detail.

---

106. AN ECONOMIC ANALYSIS OF TRENDS IN THE EXPORT OF INDIAN MARINE PRODUCTS

R. JAYARAMAN, P. SELVARAJ, J. VASANTHA KUMAR and R. K. RAMKUMAR
Marine Products Export Development Authority Regional Centre, Machilipatnam

Export of marine products has increased dramatically from a mere Rs. 400 million in 1971 to about Rs. 4000 million in 1985-86. The share of shrimps in the Indian marine products has increased steadily since their introduction to international market in 1971 and is about 60 percent in terms of quantity and about 83 percent in terms of value of total marine products exports from India during 1985-86. In terms of unit value realisation also shrimps, in frozen form, rank high. The development of Indian marine fishing industry is in fact claimed to be largely due to the development of shrimp fisheries as the demand for them seems to be on the increase forever. The present economic investigation analyses the trends in the export of Indian marine products including frozen shrimps to the major importing countries. For this purpose a time-frame of 14 years from 1971 to 1984 was chosen and seven growth models in log-log form were constructed. Based on the results of the analyses, projections of future exports were made for 1985, 1986, 1987 and 1988. The projections for 1985 were found to go hand in hand with those reported figures for 1985 and it is suggested that these models can be used by the policy planners and concerned administrators.

---

107. MARINE FISHERIES DEVELOPMENT IN TAMIL NADU

V. SUNDARARAJ, P. SELVARAJ and G. JEGATHEESAN
Fisheries College, Tuticorin 628 008

Fisheries development is governed by the stock of fishery resources, the level and types of fishing effort and the use of diversified craft and gear. The growing importance of fishery resources and the

level of their exploitation are traced in this paper. The marine capture fisheries account for a substantial proportion of the total fish production in Tamil Nadu. The present level of fish landings, their seasonal variation and the major species groups are brought out. The developmental programmes aimed at increasing fish production are reviewed. The need for innovations in and diversification of fishing methods is highlighted. The impact of investment on fish production is analysed with a time frame of ten years. Basic needs of fisherfolk which have a bearing on fisheries development are identified. Technological developments made over the last decade are mentioned with a note on the extent of non-adoption of new technology and the major determinants thereof are pointed out for remedying the situation. Culture practices in suitable areas along the coasts are stressed to provide employment opportunities that step up production. Developments in the preservation and processing of the seafoods are presented and the scope for the establishment of a stable internal and external market is explored. The state of affairs of marine or coastal fisheries management and suggestions for toning up resource management are stressed. The need for sea ranching and SCUBA diving is indicated. The vital feature of training and the nature and areas of extension programmes are also pointed out for ushering in speedier development of the sector.

---

108. COASTAL ZONE MANAGEMENT IN FISHERIES DEVELOPMENT

D. R. JOEL, V. SUNDARARAJ and G. JEGATHEESAN
Fisheries College, Tuticorin - 8

The shallow coastal zone and the adjoining regions assume greater significance in fisheries, since a very high percentage of fish harvest relies on this zone at some point in their life cycle. The resource utilization of this narrow but productive zone is increasingly threatened due to a wide variety of factors like overfishing, dumping of sewage, oil and heavy metal pollution, reclamation of coastal land for agriculture, denudation of mangroves, unauthorised mining of corals for lime-burning, etc. Other factors of some

consequence are the periodical beach drifting, unavailability of natural seed and failure of certain fisheries in the open sea. The urgent need for an indepth study of the coastal ecosystem on fertility, productivity, potential and actual yields of fish is indicated for a rational management. Evolution of policies for the allotment of coastal waters and coastal lands for fish farming is stressed for augmentation in marine fish production. The reasons for utilisation of the productive areas such as estuaries, lagoons and mangroves along the coast are traced and remedial measures are suggested for improvement in production, adopting the proven technologies. Pollution abatement programmes, measures to prevent silting of the mouths of estuaries, adoption and implementation of sound and scientific long-term policies in the management of fishery resources and coastal zone, opening of model farms and the need for continuous monitoring and research are focused upon.

---

109. NEED FOR AN INTEGRATED APPROACH TO PLANNING IN R & D FOR FISHERY RESOURCE DEVELOPMENT

G. P. KUMARASWAMY ACHARY
Central Marine Fisheries Research Institute
Vizhinjam Research Centre, Vizhinjam

The author presents in this paper the process of marine fisheries resource development, research as the basis for planning and development, problems during technology transfer, personnel for resource development, the role of educational institutes in developing resource management personnel, planning by unit system and an integrated approach for developing a national net work.

The paper also deals with the co-ordination to be followed in inventory type, basic and opplied fields of investigations having specific bearing on welfare and production oriented programmes. It also suggests an interinstitutional and inter departmental approach in the R & D to cope up with the situation with specific reference to programmes connected with resource development.

Technical Session VII

MANAGEMENT OF MARINE FISHERIES

110. MANAGEMENT AND CONSERVATION OF MARINE FISHERIES RESOURCES

K. CHIDAMBARAM
Matsyasagar Consultancy Services Pvt. Ltd, Madras

The marine fisheries resources of India including the EE Zone of about 2 million sq. km are of considerable magnitude. It is estimated that the Economic Zone may support about 4.5 million tonnes. They consist of demersal fishes, shoaling pelagic fishes, large pelagic fishes, crustaceans, cephalopods, sedentary molluscs, seaweeds, etc.

At present, the landings are confined mostly to inshore belt up to 50 metres in depth. Prawn resources are intensively fished. Pelagic fisheries like mackerel and sardine are highly fluctuating in this belt, due possibly to the limitations in operations and to migrating and breeding influences. Bombayducks are intensively fished. There is no fishing effort for cephalopods, tuna and tuna-like fishes worth mentioning, though their potentjal is rich.

Shell fisheries like oysters, mussels, clams, etc , cannot now be considered as organised fisheries, though there is subsistence fishing in selected regions. Pearl oyster fishery is highly fluctuating.

In view of the different nature of fisheries at different levels and in coastal, off-shore, deep sea and high sea areas, the varying intensities of fishing at different seasons, their behaviour, characteristics and the stocks, they call for different approaches for management. Conservation of the fisheries and the methods to be adopted will also naturally be different. The approach and stratagy for each of these fisheries will have to be worked out carefully, taking into consideration the biological, economic, social and political problems, proving each type of fishery. Some of these aspects are highlighted in the paper.

111. MANAGEMENT AND CONSERVATION OF MARINE FISHERIES RESOURCES

T. A. MAMMEN
Tropical Fisheries Consultancy Services, New Delhi 110 032

The present understanding of the term fishery management includes, besides conservation (avoiding over-fishing), other aspects like avoiding under-fishing of stocks, meting out social equity and affording consumer protection. Mathematical models developed, based on experience in temperate waters, are of doubtful applicability in the tropical waters, Moreover, in a populous country like India, employment, economic and social aspects are the dominant considerations. In India, while fish production has increased, the unit production of both mechanised and nonmechanised sectors has dropped to about 40%, but the higher price of fish, both in the export and domestic market, is sustaining the fishing industry.

Management (legislative) responsibility in respect of fisheries in India is divided between State Governments and Central Government. In the absence of precise biological indicators management decisions are mostly based on economic considerations, administrative demands and political expediency. Management measures may include both conservation and promotion measures. Conservation measures include, closed season, ban on capture of berried females, closed waters, provision of fish passes, mesh regulations and legal size, levy of royalty/ licence fee on a graduated scale, restriction on the number, manner and size of fishing units, banning of destructive and high efficiency gear, habitat preservation, removal of weed fishes, prescribing TAC for shared stocks, etc. Promotional measures include small boat mechanization, introduction of deep sea fishing and provision of related infrastructural facilities. Some practical considerations are outlined in the paper.

112. THE CONTRIBUTION OF SOCIAL SCIENCE RESEARCH FOR THE INTEGRATED DEVELOPMENT AND MANAGEMENT OF MARINE FISHERIES

N. SUBBA RAO
Dept. of Coop. and Applied Economics,
Andhra University, Visakhapatnam

The main objective of this paper is to analyse the contribution of social science research for the integrated development and management of marine fisheries. Specifically, it is intended 1) to study the past trends of fisheries research and its role in the development and management or marine fisheries, 2) to identify some of the constraints and weaknesses inherent in fishery science research in the promotion of fisheries, 3) to discuss about the need for social science research, especially fisheries economics, to deal with the problems associated with increased modernisation and expansion of the marine fisheries, and 4) to suggest an integrated approach for the sound development and management of marine fisheries.

Fishery science is relatively young and it came into prominence only in early 1950s. Three separate institutions were set up to develop fishing technology, to survey and locate fishing grounds and to conduct studies on biological research, and one more was added later to promote exports. However, due to a variety of reasons the process of fisheries development is rather slow and the fish production is stagnant. As shrimp became the mainstay of exports, the whole gamut of marine fisheries sector is centered round the production and marketing of shrimp. This led to depletion of fish stocks, decrease in incomes of fishermen, clashes between fishermen, management problems and a host of others. Further, very few fishermen have embraced mechanisation, while a multitude of them still hold on to the traditional technology. These problems were not adequately studied by the natural scientists/technologists, Although, few sporadic attempts were made, they are not of much consequence.

Now the government is intending to exploit the deep sea potential of the EEZ by strenghtening deep sea fishing fleet and by joint ventures.

This calls for detailed research studies on various aspects of the fishing industry which include planning, investment, cost-return studies, marketing and distribution studies, socio-economic of fishermen, management, etc.

---

113. STRATEGIES FOR TUNA FISHERIES DEVELOPMENT AND MANAGEMENT IN THE INDIAN EXCLUSIVE ECONOMIC ZONE

P. S. B. R. JAMES *and* P. P. PILLAI
Central Marine Fisheries Research Institute, Cochin-31

In recent years, one of the significant changes in the international tuna industry has been both the reduction and redeployment of the major tuna fishing fleets of the world. These developments coupled with the imposition of the 200 miles EEZ, have altered the pattern of tuna resources exploitation and motivated a number of developing countries to extend their operation and participation in the international tuna fishery.

In the present communication, a retrospect of national tuna fishery in India is presented, and strategies and perspectives for the development and management of tuna fisheries, chiefly through augmentation and melioration in the (i) traditional small-scale sector, (ii) medium commercial fishery sector, and (iii) large scale commercial fishery sector are presented with substantiating data and information. The prime need of tapping the skipjack tuna resource from the oceanic sector of the EEZ of India and strategies involved in the augmentation of skipjack production by planned development of the small scale fishery sector around our oceanic islands are discussed. The prospects of acquisition and utilisation of the vessel capacity, equipments and expertise of the developed nations in the operational sector of large scale commercial tuna fishery for yellowfin and bigeye from the EEZ, and other policy options for tuna fishery development in the oceanic waters are reviewed.

The need for development and improvement of post-harvest technology on coastal and oceanic tunas and tuna products as part of diversification of exports of marine products is emphasised.

---

114. STRATEGIES FOR THE DEVELOPMENT AND MANAGEMENT OF PURSE SEINE FISHING IN INDIA

M. SHAHUL HAMEED and M. MUKUNDAN
Department of Industrial Fisheries, Cochin University of Science and Technology, Cochin - 682 016

Purse seine, an important bulk catching method was first evolved in the Atlantic Coast during the last quarter of the 19th century and in India the developmental efforts were initiated by the Indo-Norwegian Project in 1954 and the operations on commercial lines were taken up from 1976 onwards. Enterprising fishermen of Karnataka were the first to introduce this modern method of fishing, switching over from the traditional rampani nets. The purse seines spread to Kerala and Goa later. Initially boats of different length and deck arrangements were tried and after gaining competency, 15m boat emerged as the suitable vessel with deck arrangement for portside operation of a purse seine net of 600m length and 55m depth.

Competition and conflict arose between traditional fishermen and purse seine operators as their gears are operated in the inshore region and for the same pelagic species of fishes. Regulations were formulated delimiting the activity of purse seiners to avoid conflict resulting in the reduction of catch. In the light of the above situation the paper deals with the recommended strategy for management of resources and development of purse seine fishery in India.

---

115. MANAGEMENT AND CONSERVATION OF MARINE FISHERY RESOURCES OF ANDAMAN AND NICOBAR ISLANDS

K. DORAIRAJ and R. SOUNDARARAJAN
Central Agricultural Research Institute, Port Blair - 744101

The Andaman and Nicobar Islands with their typical oceanic nature have a total coastline of about 1962 km and a limited

continental shelf area of about 16,000 sq.km. Further, the islands, numbering over 500, have numerous bays, creeks and inlets. The Exclusive Economic Zone around these islands encompasses 0.6 million sq. km. These extensive water bodies offer vast potential fish resources. The remoteness of these islands, lack of adequate information on the areas of abundance of the important fish resources and inadequate infrastructure facilities have posed composite problems in management of the fishery resource exploitation with the result that many important resources like tunas and tuna like fishes, the fishery potential of which is estimated to be around 1,00,000 tonnes, have baen hitherto unexploited. Several other fishery resources like sharks, perches, squids, prawns etc. are also very much under exploited. In this paper, the need for studying and monitoring the important pelagic and demersal resources, establishment of Fisheries Development Corporation for these Islands and improving the various infrastructure facilities like suitable large vessels, modern gears, fish processing and marketing facilities etc. are discussed. The role of different fishery development agencies including research and extension organisations both Government and non-government in integration and co-ordination of various fishery management programmes are elucidated. The conservation measures to be taken in protecting and reestablishing overexploited resources like corals, molluscan resources like *Turbo, Trochus* and *Tridacna* and other endangered species like sea turtles are also dealt with.

---

116. RESEARCH, CONSERVATION AND MANAGEMENT OF EDIBLE HOLOTHURIANS AND THEIR IMPACT ON THE *BECHE-DE-MER* INDUSTRY

D. B. JAMES
Central Marine Fisheries Research Institute, Madras Research Centre, Madras

Very little research has been done on the edible holothurians from India. Although more than seventy species of holothurians are known

from the shallow waters of India only about ten species are found to be economically important. At present one species *viz., Holothuria (Metriatyla) scabra* Jaeger, is almost exclusively used in the Gulf of Mannar and Palk Bay and also Andamans for the preparation of *beche-de-mer*. There are already indications of fishing pressure affecting the stocks. It is, therefore, necessary to collect data on catch, effort and length composition and also to study age and growth, longevity, length at first maturity, spawning, fecunding, development and culture, recruitment and dispersion to take up necessary conservation methods to manage and monitor the resources rationally. The relevance of these studies on the *beche-de-mer* industry is discussed in detail in in the paper.

---

117. RESEARCH NEEDS FOR THE BETTER MANAGEMENT OF DOLPHINS AND DUGONG RESOURCES OF INDIA

R. S. LAL MOHAN
Central Marine Fisheries Research Institute,
Calicut Research Centre, Calicut

The marine mammals which form a part of the bycatch in the fishery are represented by dolphins and dugong. The smaller cetaceans that are caught along the Indian coast are *Stenella longirostrts, Delphinus delphis, Sousa chinensis* and *Tursiops truncates*. The dugongs are caught in the Gulf of Mannar and Palk Bay.

Annually about 250 dolphins get entangled in the gill nets along the Indian coast. About 90% of the catch is reported from the southwest coast. About 25 dugongs are caught in the Gulf of Mannar and Palk Bay.

Our information regarding the species is mainly restricted to the number of animals caught. For proper management of the resources information on size groups, age at first maturity, gestation period, fishing mortality, population size and the fishing intensity are required. Further, being endangered animals, the protection of marine mammals

involves protection of their habitats, regulation of fishing activity and the response and reaction of the people to the conservation measures. The conservation measures often become difficult as the management of fishery and the marine mammal fishery overlap.

Suggestions are made for the better management of the resources taking into consideration the above constraints.

---

118. INCIDENTAL CATCHES OF DOLPHINS (DELPHINIDAE : CETACEA) ALONG PORTO NOVO, SOUTHEAST COAST OF INDIA

G. SHANTHA, A. RAJAGURU and R. NATARAJAN
Centre of Advanced Study in Marine Biology, Porto Novo 608 502

Dolphins of two species, viz. *Stenella longirostris*, the spinner dolphin, and *Tursiops truncatus*, the bottlenose dolphin, are often accidentally entangled in bottom-set gill nets. Percentage occurrence, seasonal variation, size ranges, and sex ratio of these fatal dolphins, collected since 1982, have been presented and discussed for the first time from the east coast of India. Biological information, especially on food and feeding collected from the carcasses of the dolphins, is provided. Along with these dolphins, commercially important scombroids, sharks, swordfish and sailfish were usually caught and their species composition is given in the paper.

Session I

119. MONITORING INDUSTRIAL EFFLUENTS DISCHARGE ALONG GUJARAT COAST BY BIO-ASSAY TEST AND PHYSICO-CHEMICAL PARAMETERS

Y. B. RAVAL, V. R. KHADSE, D. J. VADHER, M. BHASKARAN and N. D CHHAYA
Gujarat Fisheries Aquatic Sciences Research Institute, Okha, Gujarat

GFASRI in consultation with Gujarat Pollution Control Board and on its own undertook studies on chemical parameters of effluents of a few factories in the Saurashtra region and their effects on fish through bio-assay tests.

In the case of M/s Tata Chemicals, LC-50 value ranges 0.4 to 5% conc/vol; temperature 86.0 to 91.0°F; Ammonia 21.84 to 48.98 ppm and total solids from 184 to 234 g/litre.

In the case of M/s Saurashtra Chemicals, Porbandar, LC-50 value varied 2-100%. In the case of M/s Indian Rayon, Veraval, pH was between 2 to 10.5 and LC-50 value was from 20% to 100% conc/vol. For Billeshwar Sugar Factory, Kodinar, pH was between 4.0-5.5, BOD was 450 to 1600 ppm and LC-50 value was 0.5 to 7.

Results of investigations in general, factory-wise comments and impact of these studies in monitoring the effluents on the Gujarat coastline are discussed.

Session - I

120. A BRIEF APPRAISAL OF MARINE FISHERIES IN INDIA

K. ALAGARAJA
Central Marine Fisheries Research Institute, Cochin

Using Relative Response Model and Maximum Contribution Approach, estimates on potential yield from the 0-50 m depth area of Indian coastal waters are obtained as 2.20 and 2.00 million tonnes respectively. Basing on productivity estimates, potential yield from 50-200 m depth area is expected to be one million tonnes. It is suggested that no further increase in effort in 0-50 m depth is advisable. Instead, mechanisation of indigenous craft and/or replacement of existing small mechanised ones by medium sized vessels may improve the yield to 2.00 million tonnes. In the case af 50-200 m depth, introduction of 400 large vessels of length above 10 m is suggested.

Session - IV

121. UTILIZATION OF LOW COST DEEP-SEA FISH — PROXIMATE COMPOSION, CALCIUM AND PHOSPHORUS CONTENTS OF FIVE VARIETIES OF DEEP SEA FISHES OF ANDHRA COAST

D. IMAM KHASIM, R. CHAKRABORTI, and C. C. PANDURANGA RAO
Kakinada Research Centre of C. I. F. T., Kakinada-3

Five varieties of deep-sea fishes, *Psenes indicus, Decapterus dayi,* Priacanthids (Bull-eyed fish), *Centrolophorus niger* (Black ruff) and pink deep-sea prawn, *Solenocera hextii,* were collected from the deep-sea fishing vessel of Fishery Survey of India from Visakhapatnam base. These were analysed for their proximate compositions and calcium and phosphorus contents in the edible muscle portions. Sensory evaluation (organoleptic qualities) of the edible muscle portions of these fishes was carried out and found to be tasty and acceptable. The fat content is particularly very high in these deep-sea fishes and this deserves consideration while developing processing techniques. Some points are discussed on these aspects in this paper.

Session - II

122. AN ASSESSMENT OF DEMERSAL STOCKS IN THE SOUTHWEST COAST OF INDIA WITH PARTICULAR REFERENCE TO THE EXPLOITABLE RESOURCES IN OUTER CONTINENTAL SHELF AND SLOPE

D. SUDARSAN, M. E. JOHN and ANTONY JOSEPH
Fishery Survey of India, Bombay

In spite of added inputs, the increase in marine fish production in India has been only marginal during the last several years. In some segments of the coast, exploitation of target species have apparently reached the level of MSY. But in the case of some other species, wide gaps exist between the estimates of stock size and the actual level of exploitation. A general awareness has rightly been created that shrimp-oriented growth of industry is rather limited and further addition to production can largely be realised only by exploiting the stocks of outer shelf and continental slope.

In this paper, an attempt has been made to assess the exploitable stocks off southwest coast between 8° North and 15° North latitudes, covering Kerala and Karnataka coasts. Several estimates of stock sizes projected by different authors were mostly based on indirect methods or fragmentary data. Recent date available has been analysed in the light of increase in fishing pressure and the estimates of the resources have been revised.

Trawl survey data collected by 17.5 m vessels from inner shelf area up to 50 m depth and the data collected by the larger vessels up to the continental slope are considered. From the catch and effort data, stock density by the swept area method is worked out for each depth zone separately for Kerala and Karnataka coasts. Quantitative assessment is made on the major demersal stocks, viz., rays, catfish, perches, nemipterids, lizard fish, carangids, bull's eye, green eye, black ruff,

cephalopods, deepsea lobsters and deepsea prawns. The density indices are converted to absolute standing stock estimates. MSY figures for the species mix as well as for the major species are computed with due regard to the mortality parameters and present level of exploitation.

Session - II

123. TREND OF MAJOR EXPLOITED MARINE FISHERY RESOURCES OF INDIA DURING 1961-'85

M. SRINATH
Central Marine Fisheries Research Institute, Cochin-682 031

The annual estimated total marine fish landings in India during 1961-'85 are given. The contributions of the four regions namely North-east, South-east, South-west, and North-west to the total landings are presented. The trends in the landings of some of the major exploited resources are depicted. Estimates of the potential yields of the major fishery resources are given. Strategies for monitoring and rational exploitation of the fishery resources are also indicated along with the future perspective.

Session - II

124. CATCH RATES AND CATCH COMPOSITION OF FISH IN THE WADGE BANK IN COMMERCIAL FISHING

G. N. MITRA
Professor Para, Cuttack - 753003

The paper embodies the un-published results of commercial fishing in the Wadge Bank located south of Cape Comorin between long. 77° and 78° 10'. The area is approximately 4000 sq. miles exposed to full force of both the S. W. and N. E. monsoons. The continental shelf off Cape Comorin has a gentle slope up to 100 metres, beyond which the

depth sharply increases. Bottom is coarse yellow sand overlying flat rock up to 60 metres contour. Beyond this the bottom is firm clear sand with stretches of flat rock. There are rough patches of pinnacle rocks. Commercial large fishes consist mainly of rock fishes (47.8 to 65%) and carangids (2.4 to 11.9%). Catch per hour of trawlers of 450 to 650 HP has been as below:-

Year	*Effort (hours)*	*CPUE kg/h*
1965-66	3652	243.6
1966-67	5791	173.1
1967-68	2834	136.3
1968-69	3412	190.9
1969-70	1924	154 0

Average seasonal catch was 183 kg/hour in November-April and 282.9 kg/hour in May to October.

In more recent operations by paired trawlers of 1100 HP 36M OAL, the catch rate has been 247.29 kg/hour in 1983 in operation of 358 hours. Squids and cuttle fish catch varied between 26% and 79% in August and September. Details have been presented in the paper regarding species composition.

Session - II

125. RESEARCH IN MARINE FISHERIES MANAGEMENT AND DEVELOPMENT — CAPTURE AND CULTURE FISHERIES

P. S. B. R. JAMES, K. C. GEORGE and GOPALAKRISHNA PILLAI
Central Marine Fisheries Research Institute, Cochin.

The paper deals with the research contributions of the Central Marine Fisheries Research Institute for the management and development of marine capture and culture fisheries of the country during the past four decades.

The development of a stratified random sampling method for estimating the marine fish landings from the mostly artisanal type of fishing; the assessment of stock magnitudes of several exploited commercial species and underexploited potential resources have been the major contributions in the field of capture fisheries.

Apart from routine monitoring of the environmental parameters influencing the abundance and availability of commercial stocks, the Institute undertook studies in basic problems like upwelling, organic production and pollution.

Concurrent problems arising out of increasing mechanisation of fishing such as impact of purse seining on pelagic fishes and other schooling fishes like cat fishes and shrimp prodution have been studied and concerned states have been give appropriate advices.

In the culture sphere success has been achieved in breeding commercially important penaeid prawns, oysters and mussels under controlled conditions and maintenance of brood stocks, for raising seed in the hatcheries. Techniques of pearl culture, edible oyster, mussel and sea weed culture have been perfected for conditions.

By the systematically planned research activities since 1947, the Institute built up a firm foundation for marine fisheries development in the country on modern lines and generated baseline information for the rational exploitation and management of the marine fishery resources of the country.

Session - II

126. NATIONAL STRATEGY FOR EXPLOITATION AND UTILIZATION OF THE POTENTIAL MARINE FISHERY RESOURCES — A PROPOSAL

P. S. B. R. JAMES, T. JACOB, K. C. GEORGE, V. NARAYANA PILLAI, K. J. MATHEW and M. S. RAJAGOPALAN
Central Marine Fisheries Research Institute, Cochin

Research and exploratory fishing efforts during the last four decades in the traditional fishing zones and beyond generated good

amount of information on the potentials of the various exploited, underexploited as well as unexploited fish resources of the Exclusive Economic Zone of the country. An estimated potential yield of 4.5 million tonnes of fish has been indicated to be available for harvesting annually from the EEZ. The maximum annual catch of marine fish so far recorded is only 1.7 million tonnes.

Past studies indicate that whereas increase in catches from the traditionally exploited resources like oil sardine, mackerel, bombayduck and prawns is expected to be marginal the increase possible from additional efforts to exploit varieties like small tunas, whitebaits, horse-mackerel, catfish, ribbonfish and threadfin bream is likely to be considerable. Likewise, the considerable edible fish biomass and crustaceans from the outer shelf and slope offer good scope for exploitation. The major potential of oceanic resources to be exploited are the larger tunas and squids.

The paper discusses the strategy for realising a portion of the additional available fish resources and their utilisation in a phased manner during a period of five years. Aspects such as the requirement of the number and type of fishing units and their distribution over space and time, shore and marketing infrastructure and the necessity for the development of appropriate technologies for conversion to products have been discussed in the paper. The constraints and limitations have also been highlighted.

Operational economics is conceived on the basis of average results abtained in exploratory fishing for the resources by Governmental agencies and fleet of foreign countries. It is seen that operations for distant water resources are highly capital intensive, the profit from the venture mainly depending on the sale of the catch at reasonably high prices which is possible only by disposal in the international markets. In the present context it is felt that in order to develop the distant water fishery enterprise and to manage operations at different levels, only joint ventures with foreign countries having expertise in high sea fishing would be feasible.

Published records have indicated varying quantitative estimates on certain resources. This calls for further critical evaluation of these data by a joint effort of the concerned organisations. From the very nature of the data base on which the projections are made, it is clear that they

should be open to debates, and discussions and changes are necessary. It is, however, felt that the present document will stimulate further thinking and some pioneering action to exploit at least a portion of the additional potential resources of the seas beyond our traditional fishing areas.

Session - V

127. POST-GRADUATE EDUCATION, TRAINING AND EXTENSION AT CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN.

P. S. B. R. JAMES, A. NOBLE and M. M. THOMAS
Central Marine Fisheries Research Institute, Cochin-31

In view of the increasing demand for trained personnel to meet the requirements of mariculture and brackishwater culture activities in the country, the Central Marine Fisheries Research Institute took steps to institute a post-graduate education programme in mariculture at the Institute, leading to the M.Sc. and Ph. D. degrees awarded by the Cochin University of Science and Technology. Through this programme a number of Post-Graduates have been turned out in the subject during the past seven years. The students were given both theoretical and practical instructions in different aspects of mariculture including basic subjects like physiology, nutrition, genetics and pathology. The Scientists of the Institute constitute the faculty for the programme and a number of members of the faculty have also been trained abroad in different specialisations. The Programme also had the advantage of Consultants from other countries who have contributed greatly to its improvement and also in the development of infrastructural facilities at the Institute. As a result of the consultancy, a number of manuals on special subjects have also been published.

The Krishi Vigyan Kendra and the Trainers' Training Centre handle a number of courses at the farmers level and at the trainers level based on the technologies developed at the Institute. In addition, an integrated programme of training including subjects in agriculture, animal husbandry and home management is also conducted.

---

128. MARINE NATIONAL PARKS AND CONSERVATION OF FISHERIES RESOURCES

A. G. K. MENON
Zoological Survey of India, Madras

Industrial development often takes priority over other sectors in developing countries. In the process, problems like pollution of air, water, growth of slums lack of sanitary facilities and other environmental hazards greatly increase, reaching to uncontrollable proportions. In the industrial development, in the sphere of both Fisheries and Tourism, mistakes of development are common. It is high time that we pay some attention to the proper planning and development of the sea-food export industries along our fine fishing coast.

Similarly the other economic activities of sea, in particular the exploitation of the sea bed and coastal zones in the west coast for oil, have increased in recent years to such an extent that the detrimental effects on the ecological balance in some habitats are no longer minor.

IUCN and WWF have now launched a World Conservation Programme of the Oceans. The objective of the programme is the conservation of all marine forms of life. The urgent need for the establishment of Marine National Parks along the Indian Coastline for the purpose of conservation of our Fisheries resources is highlighted in the paper. On the east coast of India on the Tamil Nadu Coast, the fauna and flora of the Palk Bay and the Gulf of Mannar are the richest in India.

The Krusadi Island with the nearby Pulivasal and Shingle Islands and their reefs with the surrounding waters are proposed to be set aside as the Marine Park Research Station. The string of sixteen coral Islands stretching south and west of Krusadi Island should be declared as a Coral Reserve and the stretch of beaches west of Mandapam up to Tondi on the Palk Bay and to Valinokkam on the Gulf of Mannar side can be developed as excellent beach resorts.

AUTHOR INDEX