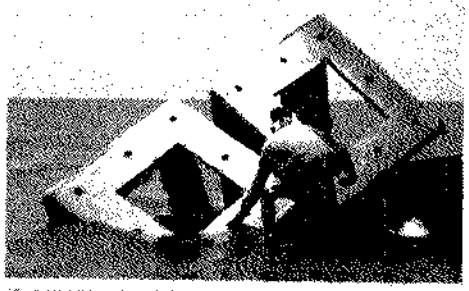
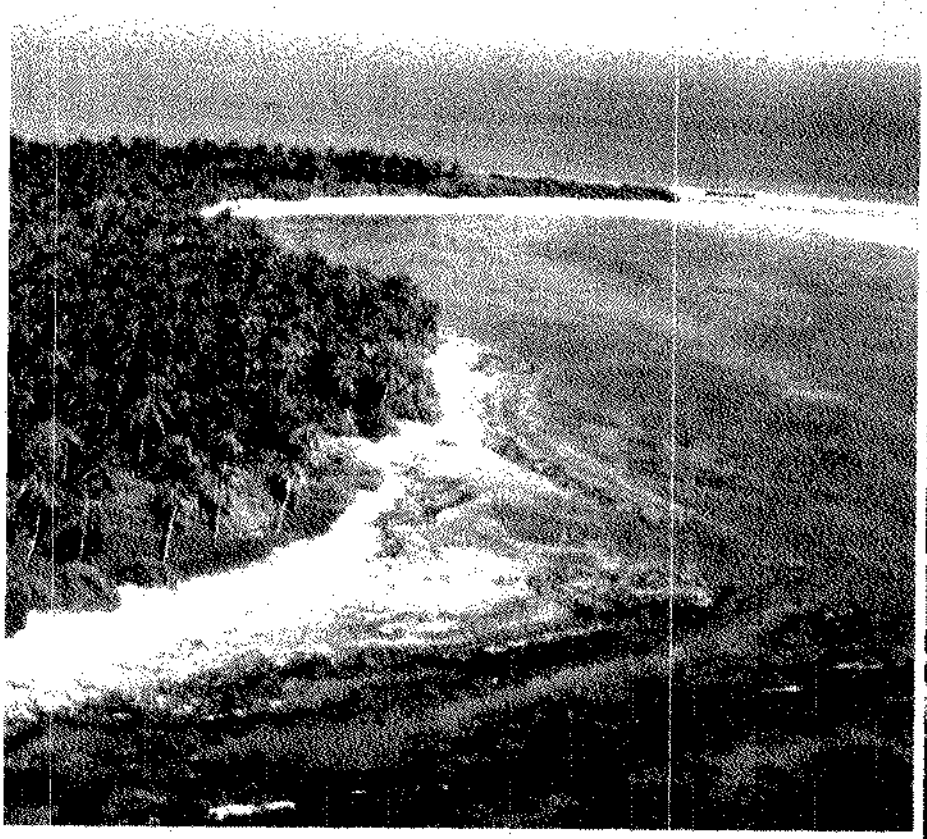
ISSN 0972-2378

CMFRI





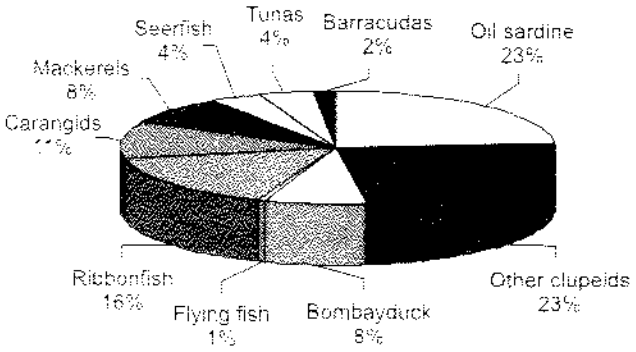
वार्षिक प्रतिवेदन

Annual Report

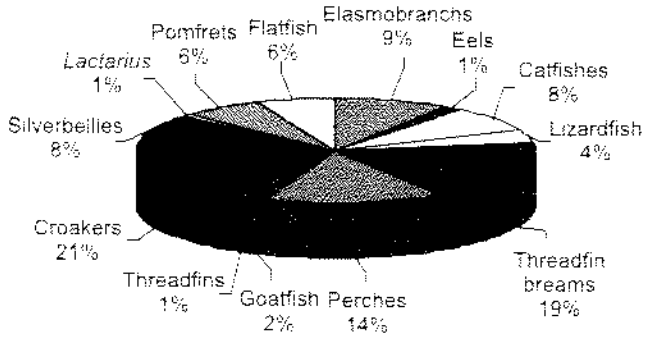
2001-2002

Major components of marine fish landings in India - 2001

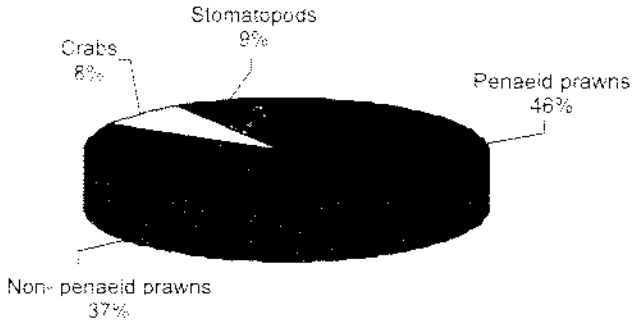
Components of pelagic finfish landings



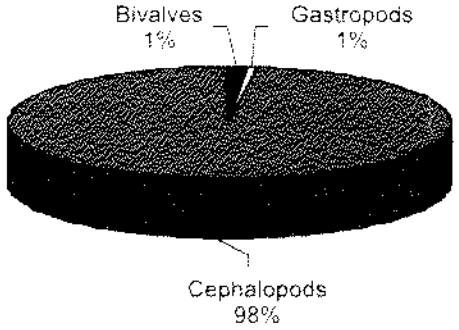
Components of demersal finfish landings



Components of crustacean landings



Components of molluscan landings



Annual Report
2001-2002

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Tatapuram P.O.
Ernakulam, Cochin - 682 014, India

Published by
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Director

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Hindi Translation
Mrs. P.J. Sheela

Photo credit
Mr. P. Raghavan

Word Process
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Mrs. N.R. Letha Devi
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Printed at
Nlseema Printers & Publishers
SRM Road, Cochin - 18
Ph : 403760

Citation: CMFRI. 2002. *Annual Report 2001-2002*. Central Marine Fisheries Research Institute, Cochin, 160 pp.

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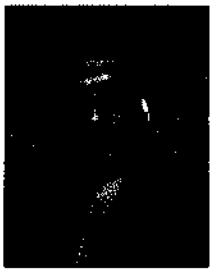
PREFACE



The aquatic living resources are renewable and hence their exploitation needs to be regulated in order to ensure sustainable harvests, year after year. The CMFRI has the major mandate to monitor and assess the exploited marine fishery resources and render research supppt for policy planning in terms of effort, gear and mesh regulation, closure of areas and seasons, socioeconomic development and livelihood securities of the communities. Thus a considerable part of the Institute's work is towards generating information leading to decisions concerning management of marine fishery resources. During the year, data on exploited resources from all along the country's coast were collected, estimates of effort and catch made. Data on the fishery and biological characteristics of major exploited finfish and shellfish resources were gathered as part of the research programmes on stock assessment to render the required advice on management issues. A special effort was made during the year to impress upon the Ministry of Environment and Forests on the need to generate additional data on elasmobranch resources through a time bound project in order to identify appropriate management and conservation options. A Project Finalization Meeting, sponsored by the Ministry of Environment and Forests was organised at the Institute involving all the stakeholders in the country. The Institute has also submitted new proposals in the area of marine capture fisheries to the Department of Ocean Development for funding support on tuna resources, predictive modeling in marine fisheries, marine mammals and turtles and taxonomy of marine fishes.

In the area of mariculture, the Institute continued its efforts in technology development and transfer. Additional species of ornamental fish were bred and larval rearing completed. It is through the concerted efforts of the Institute that fish farmers along Kerala have adopted bivalve culture as a major activity and about 200 tonnes of edible oyster and 950 tonnes of mussel were produced in the region during the year.

In addition to the in-house projects, the Institute has implemented 27 sponsored projects, 11 consultancy projects and 12 NATP projects. Two important research project proposals, one on "Ornamental fish production through culture in Lakshadweep" and the other on "Black pearl production through culture of Black lip peart oyster in the Andamans" were proposed to be implemented during the X Plan by funding assistance from the Department of Ocean Development.

The Institute realized the need for focused attention in mariculture research, training, education and effective extension, in view of the declining scope for increasing production from the wild stocks and the consequent necessity to increase production through mariculture to achieve the 4% growth in the marine fisheries sector during the X Plan. To achieve this objective, the Institute proposed the establishment of a 'Centre of Excellence in Tropical Mariculture' at Mandapam Camp, which is the ideal location in the country for mariculture research and where the Institute has the required basic facilities. The Institute also proposed the establishment of a 'Marine Bio-diversity Division' to give the required focus for this area of research and offer research support for effective management and equitable utilization of marine living resources.

The meetings of the Staff Research Council, Institute Management Committee and Research Advisory Committee were held as per schedule. The QRT recommendations have been approved by the Governing Body of the Council and proposals on the basis of these recommendations are being submitted to the Council for approval and implementation.

In the area of Human Resources Development, a large number of trainings were conducted by the TTC and KVK at the Institute. In the education programme, 10 M.F.Sc. and 9 Ph.D. degrees in mariculture were awarded to the students of the Institute during the year. The Mangalore University accorded recognition to the Institute to carry out doctoral work in the Faculty of Biosciences.

In the area of publication, the Institute brought out the *Indian Journal of Fisheries* and published Marine Fisheries Information Service containing the important observations made on marine fisheries along different parts of the Indian coast. Special publications on elasmobranch resources of India, marine ornamental fish resources of the Lakshadweep and scombroid fishes of India were issued during the year.

The Institute continued its linkage with the ICLARM and participated in the project 'Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit the poor households in Asia' and proposed participation in the collaborative project on Trawlbase Phase II.

The details of the research work carried out at the Institute are presented in this report. The staff of the Institute have contributed significantly towards accomplishment of the Institute's mandate and I record my appreciation to each one of them. I am thankful to Dr. Panjab Singh, Director General, ICAR for the support that he has been extending to achieve our targets. The Institute has received all required support from the Fisheries Division of ICAR and I place on record my thanks to Dr.K.Gopakumar, Deputy Director General (Fy.), Dr.A.D.Diwan, Assistant Director General (M. Fy.) and Shri Anil Agarwal, Principal Scientist (M.Fy.) for their continued support to the Institute.

Cochin
June 2002

MOHAN JOSEPH MODAYIL
Director

प्राक्कथन

जलीय जैव संपदाएं अब नवीकरण करने लायक है अतः वर्षावर्ष इनका लगातार संग्रहण सुनिश्चित करने हेतु विदोहन नियमित करना आवश्यक बन गया है. विदोहित समुद्री मात्स्यिकी संपदाओं का अनुवीक्षण एवं प्रत्याशित संपदाओं का निर्धारण करके मत्स्यन प्रयास, संभार व जालाक्षि नियमन, अनुकूल मत्स्यन क्षेत्र एवं मौसमों पर सूचना, समाज-आर्थिक विकास एवं समुदायों की आजीविका सुरक्षा केलिए नीति योजना बनाने में सहायता प्रदान करने का अधिदेश केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान पर निर्भर है. अतः समुद्री मात्स्यिकी संपदाओं के प्रबंधन के संबंध में आवश्यक निर्णय लिए जाने लायक सूचनाएं उत्पन्न करना संस्थान का प्रमुख कार्य है. वर्ष के दौरान देश के समूचे तटों से विदोहित संपदाओं के आंकडे संग्रहित किए गए और प्रयास एवं पकड का आकलन भी किया गया. मात्स्यिकी प्रबंधन की समस्याओं के हल के लिए आवश्यक सलाह देने केलिए स्टॉक निर्धारण से संबंधित अनुसंधान कार्यक्रमों के भाग के रूप में विदोहित प्रमुख पख मछली एवं कवच मछली संपदाओं की मात्स्यिकी और जीवशास्त्रीय विशेषताओं पर आंकडे इक्ट्ठे किए गए. सभयबद्ध परियोजना के द्वारा उपास्थिमीन संपदाओं के प्रबंधन एवं परिरक्षण के पहचान केलिए आवश्यक अतिरिक्त जानकारी उत्पन्न करने की आवश्यकता के बारे में परिस्थिति एवं वन मंत्रालय में तात्पर्य जगाने केलिए वर्ष के दौरान विशेष प्रयास किया गया. देश के सभी पणधारियों को सम्मिलित करके संस्थान में परिस्थिति एवं वन मंत्रालय द्वारा प्रायोजित परियोजना के अंतिम रूपायन की बैठक आयोजित की गई. महासागर विकास विभाग को ट्यूना संपदा , समुद्री मात्स्यिकी , समुद्री स्तनियों और कच्छपों में पूर्वसूचक मॉडलिंग तथा समुद्री मछलियों के वर्गीकरण पर निधिबद्ध सहायता प्रदान करने हेतु संस्थान ने समुद्री प्रग्रहण मात्स्यिकी के क्षेत्र में एक नया प्रस्ताव प्रस्तुत किया.

समुद्री संवर्धन के क्षेत्र में, संस्थान ने प्रौद्योगिकी विकास एवं हस्तांतरण के प्रयास जारी रखे. अलंकार मछली की और एक जाति का प्रजनन किया गया और डिंभक पालन पूरा किया गया. संस्थान के समग्र प्रयासों के द्वारा केरल के मछुआरों ने द्विकपाटी संवर्धन को एक प्रमुख कार्यकलाप के रूप में स्वीकार किया और वर्ष के दौरान इस क्षेत्र में लगभग 200 टन खाद्य शुक्तियों और 950 टन शंबुओं का उत्पादन किया गया.

स्वगृह परियोजनाओं के अतिरिक्त संस्थान ने 27 प्रायोजित परियोजनाओं , 11 परामर्श परियोजनाओं और 10 एन ए टी पी परियोजनाओं का कार्यान्वयन किया. दस वीं योजना के दौरान महासागर विकास विभाग की निधिबद्ध सहायता द्वारा कार्यान्वयन की जाने वाली दो प्रमुख परियोजनाओं याने कि *लक्षद्वीप में संवर्धन द्वारा अलंकार मछली उत्पादन* और *आन्डमान में काले अधर वाली मुक्ता शुक्तियों के संवर्धन द्वारा काला मोती उत्पादन* केलिए प्रस्ताव प्रस्तुत किया गया.

संपदाओं की घटती की प्रवणता की दृष्टि से प्राकृतिक स्टॉक से समुद्री संवर्धन द्वारा उत्पादन बढ़ाए जाने और परिणामस्वरूप दसवीं योजना के दौरान समुद्री मात्स्यिकी क्षेत्र में 4% वृद्धि प्राप्त करने की आवश्यकता के बारे में समझते हुए संस्थान ने समुद्री संवर्धन पर अनुसंधान, प्रशिक्षण, शिक्षा और प्रभावकारी विस्तार कार्यों पर अधिक ध्यान केंद्रित किया. इस लक्ष्य की प्राप्ति के लिए संस्थान ने मंडपम कैंप , जो देश में समुद्री संवर्धन पर अनुसंधान करने लायक वास्तविक स्थान है और इसके लिए आवश्यक प्राथमिक सुविधाएं भी मौजूद हैं, में *उष्णकटिबंधीय समुद्री संवर्धन में उत्कृष्ट केंद्र* की स्थापना का प्रस्ताव दिया है. संस्थान ने एक *समुद्री जैव-वैविद्यता प्रभाग* की स्थापना का प्रस्ताव भी दिया है ताकि इस क्षेत्र में केंद्रित करके आगे के अनुसंधान किए जा सके और समुद्री जीव संपदाओं के प्रभावात्मक प्रबंधन एवं न्यायोचित उपयोगिता केलिए अनुसंधान सहायता की वादा की जा सके.

कर्मचारी अनुसंधान परिषद और अनुसंधान सलाह समिति की बैठकें समय पर ही चलाई गई. पंचवर्षीय निरीक्षण टीम के सिफारिश परिषद के शासी निकाय द्वारा अनुमोदित हैं और इन सिफारिशों पर आधारित प्रस्ताव परिषद के अनुमोदन एवं कार्यान्वयन केलिए प्रस्तुत किया जा रहा है.

मानव साधन विकास क्षेत्र के अंदर संस्थान में प्रशिक्षक प्रशिक्षण केंद्र एवं कृषि विज्ञान केंद्र द्वारा कई प्रशिक्षण आयोजित किए गए. शिक्षा कार्यक्रम के अंदर वर्ष के दौरान समुद्री संवर्धन के छात्रों को 10 एम.एफ.एस सी एवं 9 पी एच.डी की उपाधियाँ प्रदान की गई. मांगलूर विश्वविद्यालय ने संस्थान को जैव विज्ञान में डॉक्टरी कार्य में संकाय की मान्यता दी है.

प्रकाशन के क्षेत्र में संस्थान ने *इंडियन जर्नल ऑफ फिशरीस* प्रकाशित की. भारतीय तट के विभिन्न भागों में समुद्री मात्स्यिकी पर चलाए गए प्रमुख आकलनों को संकलित करके *समुद्री मात्स्यिकी सूचना सेवा* भी प्रकाशित की. वर्ष के दौरान *भारत की उपास्थिमीन संपदाएं, लक्षद्वीप की समुद्री अलंकार मछली संपदाएं* और *भारत की स्कोम्ब्रोइड मछलियाँ* नाम के विशेष प्रकाशन भी निकाले गए.

संस्थान ने *आइ सी एल ए आर एस* के साथ संपर्क जारी रखा और *एशिया के गरीब परिवारों के हित केलिए टिकाऊ मत्स्यन और जलकृषि से उत्पादन बढाने केलिए नीति एवं विकल्प* विषयक परियोजना में भाग लिया और ट्रालबेस फेस - II पर सहकारी परियोजना में भागीदारी का प्रस्ताव किया.

संस्थान में किए गए अनुसंधान कार्यों के विवरण इस रिपोर्ट में प्रस्तुत किए जाते हैं. संस्थान के अधिदेश के निष्पादन में सभी कर्मचारियों ने अपना महत्वपूर्ण योगदान दिया है और हर एक कर्मचारी को मैं आभार व्यक्त करता हूँ. हमारे लक्ष्यों की पूर्ति के लिए डॉ पंजाब सिंह, महानिदेशक, भारतीय कृषि अनुसंधान परिषद से दी जाने वाली सहायता के लिए मैं विशेष आभारी हूँ. संस्थान को भारतीय कृषि अनुसंधान परिषद के मात्स्यिकी प्रभाग से आवश्यक सहयोग प्राप्त हुआ है और संस्थान केलिए लगातार सहायता प्रदान करने के लिए मैं डॉ के. गोपकुमार, उप महा निदेशक (मा.), डॉ ए.डी. दिवान, सहायक महा निदेशक (स. मा.) और श्री अनिल अगरवाल, प्रधान वैज्ञानिक (स.मा.) के प्रति आभारी हूँ.

मोहन जोसफ मोडयिल
निदेशक

कोचीन
जून 2002

सारांश

वर्ष के दौरान संस्थान में 59 स्वगृह परियोजनाओं, 33 प्रायोजित परियोजनाओं, 11 परामर्श परियोजनाओं और 17 एन ए टी पी परियोजनाओं का कार्यान्वयन किया गया.

समुद्री मछली उत्पादन, जो 2.29 मिलियन टन आकलित किया गया था, में पिछले वर्ष की अपेक्षा 12% घटती दिखाई पडी. स्कडों के उत्पादन में वृद्धि होने पर भी यह घटती मुख्यतः तारलियों की पकड में 27%, क्रोकर की पकड में 24%, बांगडों की पकड में 34%, पेनिआइड झीगों की पकड में 15% और शीर्षपादों की पकड में हुई 9% की कमी की वजह से हुई थी. उत्पादन में उत्तर पश्चिम तट का योगदान सब से अधिक (8.6 लाख टन) था. इसके पीछे करते हुए दक्षिण पश्चिम तट ने 7.4 लाख टन, दक्षिण पूर्व तट ने 5.2 लाख टन और उत्तर पूर्व तट ने 1.7 लाख टन मछलियों का योगदान दिया.

पकड में 67% यंत्रीकृत सेक्टर, 25% मोटोरीकृत सेक्टर, और 8% कारीगरी सेक्टर से प्राप्त हुआ.

पश्चिम तट में, सारडीनों में ओइल सारडीन (तारली) और पूर्व तट में छोटी तारलियाँ प्रमुख पकड थी. कोष संपाश और ट्राल जालों की तुलना में वलय संपाशों से तारलियों के तरुण अधिक मात्रा में दिखाए पडे. तारलियों का अंडजनन मांगलूर में मार्च - अक्तूबर, कोचीन में मई - सितंबर और विशाखपट्टणम में जनवरी - अप्रैल और जून - अगस्त को हो जाता है. पूर्व तट में छोटी तारलियाँ मई - सितंबर के दौरान अंडजनन स्थिति प्राप्त करती हैं. दक्षिण - पश्चिम मानसून के समय *स्टोलिफोरस माक्रोप्स* प्रचुर जाति के रूप में उपलब्ध हो जाती थी. लेकिन हाल के वर्षों में *एस. कमेर्सोनी* मुख्य पकड हो गई है.

मिनिकोय में ट्यूना के दूरस्थ परंपरागत मत्स्यन धरातलों में स्किप जैक ट्यूनाओं का झुण्ड नहीं दिखाया पडा. दिसंबर - जनवरी के दौरान वडिश रज्जू के जरिए येलोफिन ट्यूना की भारी पकड़ प्राप्त हुई जिसके कारण लंबी डोर की पकड़ कम थी. फिर भी मिनिकोय में वडिश रज्जुओं के जरिए बडे आकार के (160 से मी) येलोफिन ट्यूना मछली प्राप्त हुई. राजा सुरमई *स्कोम्ब्रोमोरस कमेर्सन* की विदोहन दर सारे केंद्रों में तुलनात्मक रूप से उच्च थी. मानसूनोत्तर अवधि के दौरान बांगडों के कम उत्पादन की वजह से पकड भी बहुत कम थी. मूलतः फीतामीनों का विदोहन ट्रालरों के जरिए किया गया और इसमें *टी. रिक्चूरस लेप्टचूरस* प्रचुर जाति थी. पश्चिम तट की तुलना में पूर्व तट से प्राप्त *टी. लेप्टचूरस* की लंबाई कम थी. पिछले वर्ष की तुलना में करंजिडों की पकड़ में सीमांत वृद्धि हुई.

भारत की अनन्य आर्थिक मेखला में किए गए गहरा प्रकीर्णन स्तर सर्वेक्षण में चारा और गुणवर्द्धन से खाद्य के रूप में इस्तेमाल किए जाने

योग्य मछलियों का समुच्चय दिखाया पडा. इस समुच्चय को रात के समय 50 – 100 मी के गहराई तल में उत्तर - पश्चिम और दक्षिण - पश्चिम तटों में प्रचुर मात्रा में दिखाया पडा. इसके वाणिज्यिक विदोहन के लिए अनुकूल मौसम और समुच्चय सांद्रता के केंद्रों को ढूँढ निकालने की कोशिश अब की जा रही है.

विभिन्न केंद्रों में से सुराओं की चौदह, स्केट्स की सात और शंकुशों की दस जातियों को पकडा गया. गुजरात और महाराष्ट्र से सुराओं की भारी पकड हुई जबकि तमिलनाडू से शंकुशों को बडी मात्रा में पकडा गया.

वेरावल में जनवरी में और महाराष्ट्र में फरवरी-मई तक सूत्रपख ब्रीमों की पकड का श्रृंगकाल था.

मांगलूर में सितंबर - दिसंबर और कोचीन में अक्तूबर के दौरान सूत्रपख ब्रीमों के अंडजनक प्रौढ़ों को प्राप्त हुआ. भारत के दक्षिण पूर्व तट में मुल्लनों की भारी पकड हुई जिनमें , मान्नार की खाडी में *एल. डसुंमेरी* और पाक खाड़ी में *एल. ब्रेविरोस्ट्रिस* और *एल. जोनसी* प्रमुख थे. पूर्व तट में इस मछली की कई जातियाँ मिली थी.

क्रोकेर्स का अधिकाधिक विदोहन ट्रालरों द्वारा और कुछ हद तक गिल जाल द्वारा किया गया. पकड और प्रमुख जातियों का जाति मिश्रण विभिन्न क्षेत्रों में विभिन्न तरह था. तुम्बिलों की मात्स्यिकी में दो जातियाँ प्रमुख थी जिनमें *एस. तुम्बिल* उत्तर - पश्चिम तट और *एस. अन्डोस्क्वामिस* पूर्व तट के केंद्रों में प्रचुर मात्रा में मौजूद थे. महाराष्ट्र में दोनों ट्राल और गिल जालों द्वारा पाम्फ्रेटों की पकड में घटती हुई. डोल जाल और ट्राल द्वारा किशोरों को बडी मात्रा में पकड़ा गया. मांगलूर में वर्ष के दौरान श्वेत मछली की पकड में 34% की घटती हुई.

पश्चिम तट में पेनिआइड झीगों की पकड में 14% की घटती हुई. कोइलोन तट में गभीर सागर झीगों की पकड में घटती अंकित की गई. उत्तर - पश्चिम तट में डोल जाल द्वारा नोन पेनिआइडों का विदोहन किया गया. नोन - पेनिआइड झीगों की कमी की वजह से डोल जाल एककों के परिचालन में भी कमी हो गई. भारत के उत्तर-पश्चिम तट में नोन-पेनिआइड झीगों की अधिकतम वहनीय पकड 1.4 लाख टन आकलित किया गया. महा चिंगटों की आकलित पकड़ में पिछले वर्ष की अपेक्षा 40% की घटती हुई. महा चिंगटों की 40% पकड महाराष्ट्र तट से हुई. कर्कटों की पकड लगभग 30,000 टन आकलित किया गया था और दक्षिण पूर्व तट का योगदान 46% था.

शीर्षपादों की पकड में पूरे तट में घटती अंकित की गई. कोचीन में *एल.डुआसेली* की विदोहन दर 0.57 लाख टन थी. इन जातियों की प्रथम परिपक्वता में मछली जो लंबाई प्राप्त करेगी उससे कम लंबाई की शीर्षपाद जातियों की पकड़ भारी मात्रा में हुई थी।

द्विकपाटियों की पकड 55,000 टन आकलित की गई जिस में 73% सीपी, 26% शंबु और 1% शुक्ति है.

पर्यावरणीय विशेषताओं का मॉनीटरन जारी रखा गया. मानसूनोत्तर अवधि के दौरान प्राणिप्लवकों की जैवमात्रा सबसे अधिक दिखाई पडी.

उड़ीसा तट में मार्च - अप्रैल के दौरान

अरिबाडा ओलिवेरड्ली कच्छप को भारी मात्रा में दिखाया पडा और लगभग इनके 7.4 लाख नीड भी दिखाए पडे.

तलमज्जी मछलियों की चार जातियों के प्रजनन एवं डिंभक पालन की कार्यपद्धति परीक्षणात्मक ढंग से विकसित की गई.

मान्नार की खाड़ी में स्फुटनशाला में उत्पादित *पेनिअस सेमीसल्केटस* के 2.39 मिलियन पश्च डिंभकों को समुद्र में छोडा गया. *पी. मोनोडोन* की तीन पीढ़ियों को विकसित किया गया. *पी. होमारस* के डिंभकों को पांचवीं अवस्था तक पालन किया गया. कर्कट *पोर्ट्नस पेलाजिकस* के प्रजनन एवं डिंभक पालन के प्रथम परीक्षण में ही 210 छोटे कर्कटों का उत्पादन किया जा सका. टूटिकोरिन में, द्विकपाटियों के 5.31 लाख स्पाटों का उत्पादन स्फुटनशाला में किया गया. *पाफिया मलबारिका* के डिंभक पालन का मानकीकरण किया गया. उत्तर केरल और वेम्बनाड झील में शंबु पालन के प्रदर्शन खेत सजाए गए. टूटिकोरिन की सफुटनशाला में *सेपेल्ला इनेर्मिस* के एफ-9, एफ - 10 और एफ - 11 पीढ़ियों का पालन किया गया.

तमिलनाडू , आंध्रा प्रदेश और कर्नाटक में द्विकपाटी पालन की तकनो - आर्थिक साध्यता का अध्ययन किया गया . समुद्री मोती उत्पादन के वाणिज्यिक प्रचार के अंदर कुल 2,05,610 शुक्तियों और 22,438 केंद्रक लगाई गई शुक्तियों को खेत में पालित किया गया. कुल उत्पादित 5 लाख स्पाटों में से 1.27 लाख स्पाटों को समुद्र में प्रतिरोपित किया गया. केंद्रक लगाए गए 36,415 शुक्तियों में से 48.6% शुक्तियों में धारण प्राप्त हुआ और 16% शुक्तियों से विपणन योग्य मोती प्राप्त हुए. वर्ष 2002 तक मोती विपणन से 4,47,376 रुपए की आमदनी प्राप्त हुई.

शुक्तियों में त्रिगुणन को प्रेरित करने के लिए रासायनिक कारक डी एम ए पी अत्यंत दक्षतापूर्ण देखा गया. द्विगुणितों की अपेक्षा त्रिगुणित शुक्तियों ने तेज़ वृद्धि दर दिखाई.

नल मीनों तथा समुद्री घोडों की डिंभक आवश्यकता प्रारंभ अवस्था में प्रतिदिन प्रतिडिंभक के लिए 350 रोटिफर और 10 वां दिन से लेकर प्रतिदिन प्रतिडिंभक के लिए 650 रोटिफर आकलित किया गया. संतृप्त लवण जल में सामान्य माप में संग्रहित लवणजल चिंगट के पुटियों (सिस्ट्स) ने तीन महीनों के बाद 80.4% और 12 महीने के बाद 75.1 % स्फुटन किया.

काकिनाडा के दो खेतों से संग्रहित 70% मोनोडोन झींगों के नमूनों में वाइट स्पोट रोग का पहचान किया गया.

वाइट स्पोट वाइरल डी एन ए के पी सी आर (पोलिमरैस्ड चेइन रियाक्शन) उत्पाद का क्लोन किया गया और अनुक्रमण का कार्य प्रगति पर है.

बहुदिवसीय आनायकों के प्रति ट्रिप की परिचालन लागत का रेंच केरल में 18,371 रुपए और आंध्रा प्रदेश में 28,665 रुपए था. केरल में बहुदिवसीय ट्रालरों का सकल राजस्व 26443 रुपए आकलित किया गया. एक दिवसीय ट्रालरों के प्रति ट्रिप का सकल राजस्व आंध्रा प्रदेश में 8,596 रुपए और तमिलनाडू में 9,827 रुपए था. भारत में समुद्री मछली की पकड़ का कुल मूल्य पहली बिक्री के स्तर पर 10,341 करोड रुपए

आकलित किया गया.

मछली संसाधन के क्षेत्र में महिलाओं का प्रत्यक्ष या परोक्ष रूप से संबंध पर अध्ययन किया गया.

स्थानीय ग्रामीण संपर्क कार्यक्रम (आइ वी एल पी) की पहली दिशा के रूप में मात्स्यिकी आधारित आठ मध्यस्थता कार्य किए गए.

संस्थान के कार्मिकों द्वारा लगभग 70 वैज्ञानिक कागज़ातों का प्रकाशन किया गया.

शिक्षा कार्यक्रम में 11 छात्रों को पीएच.डी और 10 को एम.एफ.एस सी उपाधि प्रदान की गई और दो एम.एफ.एस सी छात्रों को स्वर्ण पदक से सम्मानित किया गया.

संस्थान के कृषि विज्ञान केंद्र ने 97 प्रशिक्षण कार्यक्रम और प्रशिक्षक प्रशिक्षण केंद्र ने 11 पाठ्यक्रम आयोजित किए.

EXECUTIVE SUMMARY

During the year, 59 in-house projects, 33 sponsored projects, 11 consultancy projects and 12 projects of NATP were implemented at the Institute.

The marine fish production in India, which was estimated at 2.33 million t, showed a decline of 13% over the previous year. This was caused by a decline of 27% in oil sardine landings, 24% in croakers, 34% in mackerel, 15% in penaeid prawns, 9% in cephalopods though there was an increase in the landing of scads. Northwest coast contributed 8.6 lakh t followed by southwest (7.4 lakh t), southeast (5.2 lakh t) and northeast (1.7 lakh t). The mechanised sector accounted for 67% of the landings followed by motorised (25%) and artisanal (8%) sectors.

Oil sardine was the most dominant species among sardines along the west coast and lesser sardines along the east coast. Juvenile and pre-adults occur more commonly in ringseines than in the puseseine and trawl. Spawning population of oil sardine occurred during March-October off Mangalore and May-September off Cochin, January-April and June-August at Visakhaptnam. The lesser sardines along the east coast were in spawning condition during May-September. *Stolephorus macrops* used to be the abundant species during the southwest monsoon but in recent years *S. commersonii* has become important.

The shoals of skipjack were conspicuously absent in the traditional fishing grounds of Minicoy while catches of yellowfin by hand-lines was abundant during December-January resulting in a temporary suspension of pole-and-line fishing operations. However, at the same time, unprecedented catches of very large sized (upto 160 cm) yellowfin tuna was observed in the hand-line fishery at Minicoy. Exploitation rate of king seer, *Scomberomorus commerson* at all centres was relatively high. The poor recruitment resulted in poor catches of mackerel during postmonsoon period. The Bombay duck landings along Gujarat declined by 30% and by 12% along Maharashtra.

Ribbon fishes were landed principally by trawlers and *Trichiurus lepturus* was the most dominant. The carangids registered a marginal increase over the previous year.

Deep scattering layer (DSL) survey in the Indian EEZ revealed the concentration of myctophids and pelagic shrimps of use as forage and for direct consumption through value addition. Both the groups have abundance along the NW and SW coasts respectively during night time in depth realm 50-100 m. Major surveys are contemplated to locate concentration pockets and seasons for commercial exploitation.

Fourteen species of sharks, 7 of skates and 10 of rays were landed at different centres. Gujarat and Maharastra accounted for the bulk of shark landings whereas Tamilnadu contributed to the major landings of rays. Peak landings of threadfin bream were obtained in January at Veraval and February-May along Maharashtra. Spawning adults of threadfin breams were caught during September-December at Mangalore and during October at Cochin. Bulk of the silverbelly landings were obtained along southeast coast of India where *L. dussumieri* was most abundant in the Gulf of Mannar and *L. brevirostris* and *L. jonesi* were abundant in the Palk Bay. The number of species that contributed to the fishery was much greater in the east coast.

Croakers were exploited by trawlers and to a lesser extent by gill nets. The species composition of the landings and the dominant species varied in different regions. In lizardfish, two species contributed to the fishery, of which *S. tumbil* was dominant along the northwest coast whereas *S. undosquamis* along the east coast. In the pomfrets, along Maharashtra, the landings declined in both trawl and gill net. The *dol* net and trawl exploited large quantities of juveniles. During the year, the landings of white fish decreased by 34% at Mangalore.

The landings of penaeid prawns along the west coast declined by 14%. The landings of deep-sea prawns continued to decline from the Quilon bank. The non-penaeids are exploited by *dol* net and trawls along the northwest coast. The *dol* net units showed decline in the numbers because of poor landings of non-penaeid prawns. The MSY of non-penaeid prawns is estimated at 1.4 lakh tonnes along northwest coast of India. The estimated landings of lobsters showed nearly 40% decline over the previous year. About 40% of the lobsters were landed along Maharashtra. The landings of crab was estimated at around 30,000 tonnes and southeast coast contributed 46%.

The landing of cephalopods registered a decline all along the coast. The exploitation rate of *L. duvauceli* was estimated as 0.57 lakh t at Cochin. In this species, the bulk of the landings comprised the population less than length at first maturity. The bivalve landings were estimated at 55,000 tonnes with clams accounting for 73%, mussels 26% and oyster 1%.

Monitoring of the environmental characteristics of coastal waters continued. The zooplankton biomass showed the peak during post monsoon period. The *Arribada olive ridley* turtle occurred during March-April along Orissa coast with an estimated 7.4 lakh of nests.

Methodology of breeding and larval rearing of four species of demersal fish was developed on an experimental scale. 2.39 million hatchery-produced postlarvae of *Penaeus semisulcatus* were released in the Gulf of Mannar. Three generations of *P. monodon* were produced. Larvae of *P. homarus* were reared upto fifth stage. In the breeding and rearing of larvae of the crab *Portunus pelagicus*, 210 baby crabs were produced from one experiment.

5.31 lakh bivalve spat were produced in the hatchery at Tuticorin. Standardization of larval rearing protocol of *Paphia malabarica* was done. Demonstration farms for mussel culture were set up in North Kerala and Vembanad lake. The F_9, F_{10} and F_{11} generations of *Sepiella inermis* were reared at the hatchery at Tuticorin. Techno-economic viability of bivalve farming was studied in Tamilnadu, Andhra Pradesh and Karnataka. In the commercial propagation of marine pearl culture, a total stock of 2,05,610 oysters and 22,438 nucleated oysters were maintained in the farm. Of the five lakh spat produced, 1.27 lakh spat was transplanted to the sea. Of the 36,415 nucleated oysters, 48.6% nucleus retention was achieved and commercial quality pearls were obtained in 16% of the oysters. An amount of Rs.4,47,376 was earned through the sale of pearls till 2002.

The chemical agent DMAP was found to be more efficient in inducing triploidy in oysters. The triploid oysters showed faster growth rate in comparison to the diploid ones.

The pipefish and seahorse larval feed requirement was estimated as 350 rotifers/larvae/day in the beginning and 650 rotifers/larvae/day from the 10th day. The brine shrimp cysts stored in saturated saline water at room temperature gave 80.4% hatching after three months and 75.1% after 12 months.

White-spot disease was identified in 70% of the *P. monodon* samples from two shrimp farms at Kakinada. The PCR product of the whitespot viral DNA has been cloned and work is progressing for sequencing.

The operating cost per trip of multi-day trawlers ranged from Rs.18,371 in Kerala to Rs.28,665 in Andhra Pradesh. The gross revenue per trip of multi-day trawlers was estimated at Rs.26,443 in Kerala. In the single-day trawlers, the gross revenue per trip ranged from Rs.8,596 in Andhra Pradesh to Rs.9,827 in Tamilnadu. The total value of marine fish landing in India was estimated as Rs.10,341 crores at the first sale price level.

The direct and indirect role of women in the fish-processing sector was studied. In the IVLP programmes, eight fishery-based interventions were implemented in the first phase.

The staff of the Institute published about 70 scientific papers.

In the education programme, 11 students were awarded the Ph.D. degree and 10 the M.F.Sc. degree. Two M.F.Sc. students received gold medals.

The KVK of the Institute conducted 97 training programmes and the TTC conducted 11 courses.

INTRODUCTION

India is endowed with a long coastline of 8,129 km, 0.5 million sq km of continental shelf, 2.02 million sq km of EEZ and an estimated annual Marine Fishery Resource Potential of 3.93 million t. The vast areas along the coastline offer ideal sites for seafarming and coastal mariculture. The Indian marine fisheries sector plays a significant role in supplying protein-rich food to the increasing population, employment generation and foreign exchange earning. The present marine fisheries scenario in India is characterised by declining yields from the inshore waters, increasing conflicts between different resource users, increasing demand for sea-food for domestic consumption and export and prospects for large scale seafarming and coastal mariculture. This warrant greater and more effective R&D efforts to enable implement suitable action plans for sustained marine fisheries and mariculture development.

The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of 55 years since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R&D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established marine fisheries laboratory in the world.

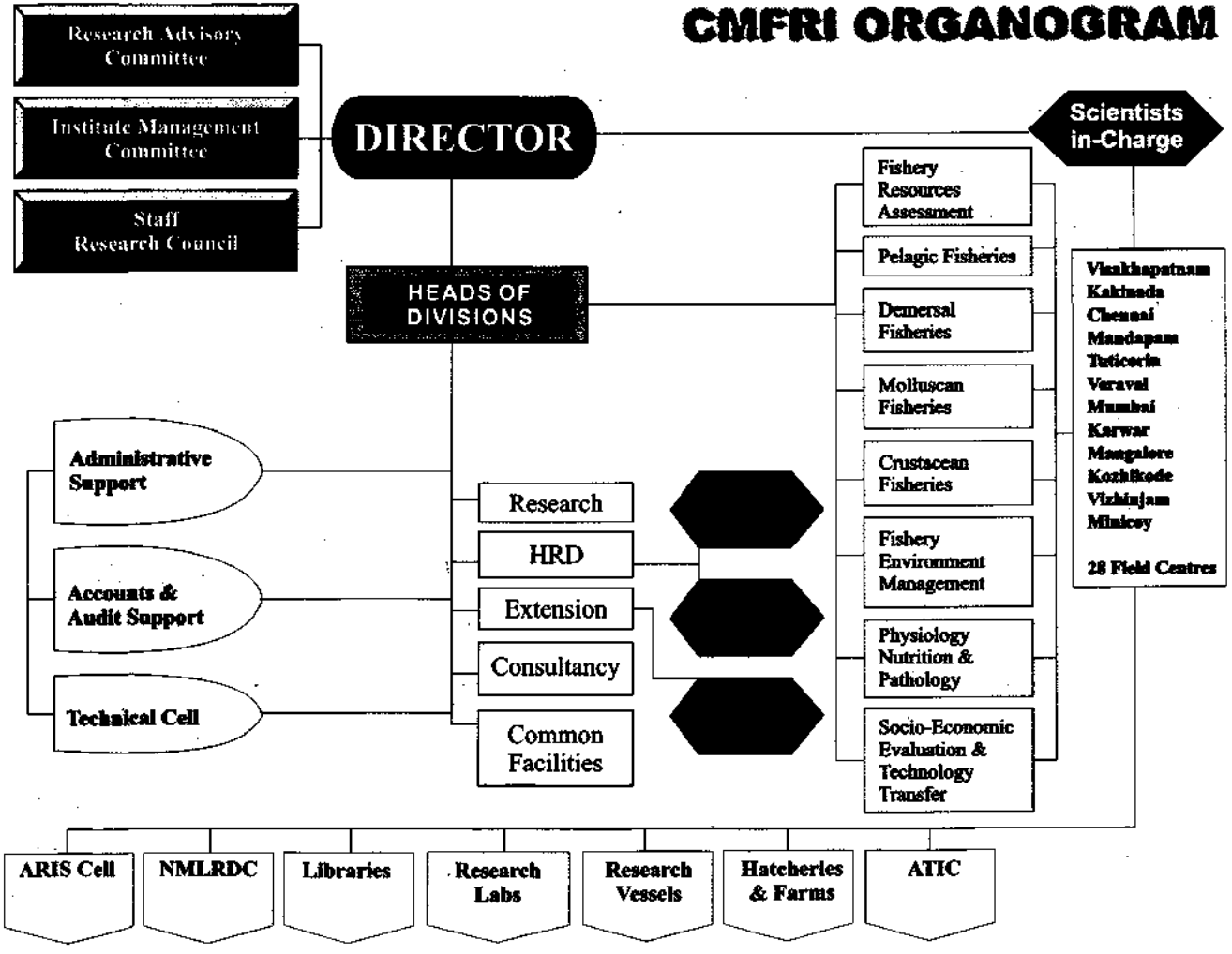
To accomplish its mandate, the Institute monitors the landings on a continual basis from all along the country's coast, conducts researches on characteristics of exploited marine fish stocks; carries out exploratory surveys and assesses the under - and unexploited resources, develops seafarming techniques, undertakes research in fishery environmental characteristics and sea-dynamics and conducts postgraduate education programmes leading to M.F.Sc. and Ph.D. degrees. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set-up

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research Centres at Minicoy, Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin, Chennai and Kakinada and 28 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Kochi. The Institute has, over the years, built up laboratory and field facilities for carrying out research programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientific 191, Technical 392, Ministerial 170, Auxiliary 6 and Supporting 321.

The multidisciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries,

CMFRI ORGANOGRAM



Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-economic Evaluation and Technology Transfer. Interdivisional and interinstitutional programmes are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas through *ad hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D. programmes of the Central Institute of Fisheries Education, Mumbai, a Deemed University under the ICAR. The teaching programme is carried out by the scientists of the Institute.

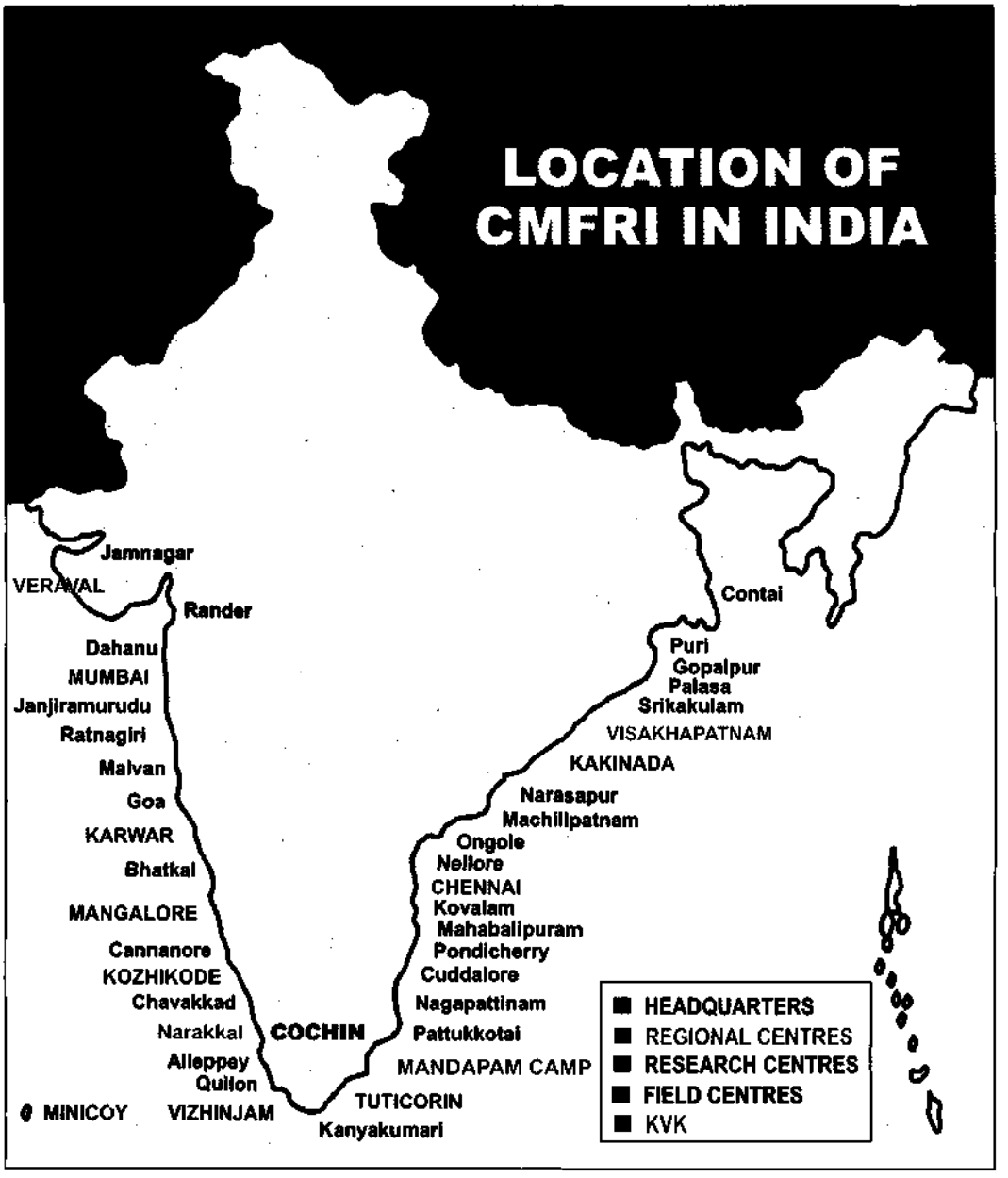
The *Krishi Vigyan Kendra* imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women and the Trainers' Training Centre to the officials of state and central governments, banks, societies and autonomous bodies interested in fisheries development.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country.

The results of researches carried out in the Institute are published in various Journals. Besides, the Institute brings out Bulletins, Special Publications and Marine Fisheries Information Service and publishes the *Indian Journal of Fisheries*.

The Mandate

- To monitor the exploited and assess the under-exploited resources of marine fisheries resources of the Exclusive Economic Zone
- To understand the fluctuations in abundance of marine fisheries resources in relation to change in the environment
- To develop suitable mariculture technologies for finfish, shellfish and other culturable organisms in open seas to supplement capture fishery production
- To act as a repository of information on marine fishery resources with a systematic database
- To conduct transfer of technology, post graduate and specialized training, education and extension education programmes
- To provide consultancy services


LOCATION OF
CMFRI IN INDIA
Jamnagar
VERAVAL
Rander
Dahanu
MUMBAI
Janjiramurudu
Ratnagiri
Malvan
Goa
KARWAR
Bhatkal
MANGALORE
Cannanore
KOZHIKODE
Chavakkad
Narakkal
COCHIN
Alleppey
Quilon
MINICOY
VIZHINJAM
TUTICORIN
Kanyakumari
MANDAPAM CAMP
Nagapattinam
Pattukkotai
Cuddalore
Pondicherry
Mahabalipuram
Kovalam
CHENNAI
Nellore
Ongole
Machilipatnam
Narasapur
KAKINADA
VISAKHAPATNAM
Srikakulam
Palasa
Gopalpur
Puri
Contai
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REGIONAL CENTRES
RESEARCH CENTRES
FIELD CENTRES
KVK

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C/o Inspector of Fisheries
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Thanjavur Dt.,
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New A.C. Bubba Reddy Statue
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Manidipakam, Ongole-523 002
Prakasam District, Andhra Pradesh

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Chinnasubraya Street
Pondicherry-605 001

Puri Field Centre of CMFRI
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Near Hotel Sea 'n' Sand
Chakratirtha Road
Puri-752 002, Orissa

Quilon Field Centre of CMFRI
Municipal Stadium Buildings
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Quilon, Kerala

Rander Field Centre of CMFRI
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Surat-395 005

Ratnagiri Field Centre of CMFRI
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Lower Lane, Ratnagiri-415 612
Maharashtra

Srikakulam Field Centre of CMFRI
Door No. 4-1-23/1 Opp. Govt. Employees
Co-operative Stores Ltd., No. A-675
Srikakulam-532001
Andhra Pradesh

BUDGET 2001-2002

(Rs. in lakhs)

Sl.No.	Budget Heads	RE for 2001-2002	Expenditure incurred
		PLAN	
1.	T.A.	30.00	30.00
2.	Other charges including equipments	129.56	129.56
3.	Works:	154.28	
	Major works		108.25
	Minor works		46.03
4.	Other items	11.04	11.04
5.	HRD	2.00	2.00
	TOTAL	**326.88**	**326.88**
		NON PLAN	
1.	Estt. Charges	1240.00	1240.00
2.	O.T.A.	1.20	1.20
3.	T.A.	13.80	13.80
4.	Other Charges	259.80	259.80
5.	Works	32.00	32.00
6.	Other items	4.00	4.00
	TOTAL	**1550.80**	**1550.80**

LIBRARY AND DOCUMENTATION SECTION

During the period under report 57 books, 4 CD-ROMs and 1624 issues of journals were added to the library at Headquarters. Essential books and journals were also acquired for libraries at Regional and Research Centres. Inter-library loan and inter-library collaboration of publications were continued. Reference and reprographic facilities were provided to visiting scientists, scholars and others.

The Library stocks and distributes the Institute publications.

The following publications were issued during the period:

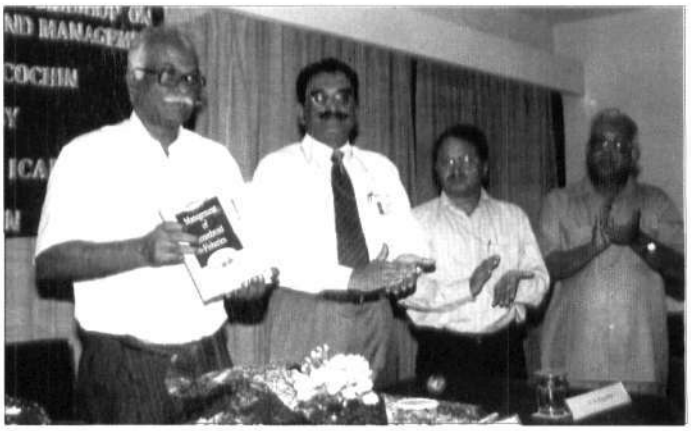
1. *Indian Journal of Fisheries* Vol. 48 No. 1,2 (2001)
2. *Marine Fisheries Information Service* T&E Ser. Nos. 167, 168 & 169 (2001)

Book release function of CMFRI special publication No. 72 - Marine Ornamental Fish Resources of Lakshadweep by Shri. Jose Cyriac IAS

3. CMFRI Newsletter Nos. 91, 92 (2000) & 93 (2001)
4. CMFRI Annual Report 2000-2001
5. *Matsyagandha* – Hindi

VESSEL MANAGEMENT CELL

As part of a Marine Living Resources Programme of the Department of Ocean Development, the Institute participated in eight cruises (Nos. 190, 192 B, 193, 194, 195, 196, 198 and 199), four along the West coast, three along East coast and one in the seas along Andaman & Nicobar Island within the Indian EEZ during 2001 to meet the objectives of the projects on Deep Scattering Layer, Toxic Algal Blooms and Stock assessment of deep sea species.



Prof. K.V. Peter, Vice Chancellor, KAU releasing the book on Management of Scombroid Fisheries at CMFRI, Cochin

The Institute's Research Vessel *Cadalmin*-VI stationed at Cochin undertook 27 trips off Cochin upto 30 m depth for studies related to oceanography, productivity and marine resources. The R.V. *Sagitta*, based at Mandapam Camp was utilised for inshore hydrography and studies on the seaweed resource.

THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

I. Assessment studies

1. Use of stationery items, issue of section 3(3)

documents and release of procedural literature of the Institute were continued.

2. Based on the suggestion made by the Committee of Parliament on Official Language, the publications: MFIS, Newsletter and Annual Report have been redesigned by giving equal status to Hindi.

3. Now, the notified offices under CMFRI are 8 and 5 are yet to be notified.

4. Training in Hindi typewriting and stenography has been continued under the time bound training programme.

5. On the basis of assurance given to Parliament Committee, workshops on official correspondence are being organised.

6. Purchased and issued necessary dictionaries and reference books to different Section/ Divisions at Headquarters and the outstations. As a statutory requirement, 8 Rules/Codes and manuals used by the office published by the Ministry of Public Grievance and Pension have been procured.

6. The policy of the Government to ensure compliance of the Official Language policy through encouragement and motivation has been implemented. Financial Sanction for the conduct of extension activities, workshops, publications etc and contribution to various Town Official Language Implementation Committees have been made. A special cash award scheme has also been introduced to encourage the staff to work in Hindi.

Parliament committee on OL at HQs, Cochin on 05.11.2001

II. Intensive Programmes

1. An intensive *Pragya* course of 15 days duration was conducted at Headquarters, by deputing staff from the Centres.

2. The Hindi software '*leap*' office has been installed in 35 computers of the Headquarters and 5 at Centres. Training in '*leap*' office courses was imparted to 3 Hindi officials. With the experience gained leap office course has been modulated to suit the Institute's work and training was imparted to 15 selected employees with knowledge in Hindi Typing/ Stenography to intensify the bilingual word - processing and e-bilingualisation.

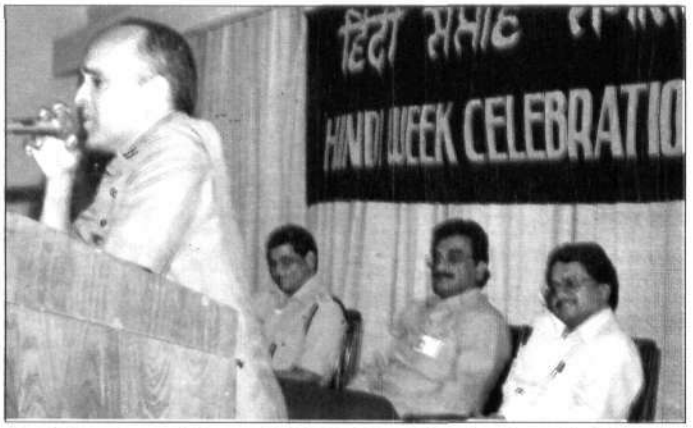
3. Two Sections of the Institute, VMC and EM Lab have been notified to undertake 100% work in Hindi to intensify the use of Hindi.

III.Comprehensive programmes

1. Workshops were organised at Headquarters and at Calicut, Visakhapatnam Centres.

2. With a view to elevate Hindi as a language of original thinking of fishery functions and to develop strategies for the same a National Seminar on Official Language Hindi on the subject 'Use of Hindi in ICAR Fisheries Research Institutes-Issues and Prospects' was conducted exclusively for the ICAR Fishery Research Institutes on 12th October 2001. The Seminar was inaugurated by Dr. S.A.H Abidi, Member, Agricultural Scientists Recruitment Board. Directors of 7 ICAR Fishery Research Institutes along with experts from 5 other related organisations presented papers and the recommendations were forwarded for implementation at various levels.

Dr. S.A.H. Abidi, Member, ASRB, ICAR, New Delhi inaugurating the National OL Seminar held on 12.10.2001 at CMFRI, Cochin



Dr. K. Devadasan, Director CIFT, Cochin addressing the staff during the valedictory function of Hindi week held on 21.09.2001

3. The abstract of dissertation of 8 M.F.Sc and 8 Ph.D theses were written in Hindi.

2. Hindi day/week was organised at Headquarters and all Centres with various competitions, cultural and awareness programmes and public meetings. The winners were encouraged by giving prizes, incentives, trophies etc. The Administration Section by scoring maximum points won the Rajbhasha Rolling Trophy of the year.

5. In the Fishfarmers' Day at Veraval Regional Centre on 10-7-2001, Hindi was used for interaction.

IV. Inspections by the Committee of Parliament on Official Language

The sub-committee of Parliament on Official Language comprising 10 Members of Parliament and their officials inspected the Hindi implementation activities of the CMFRI Headquarters, Visakhapatnam and Mandapam Regional Centres and the Research Centre at Minicoy.

Two inspections by the ICAR Headquarters and one inspection by the Department of Official Language were also held during the year. ■

Visit of OLIC team from ICAR, NewDelhi, headed by Shri. Mohan Kumar Nayyar to Veraval Centre

RESEARCH ACHIEVEMENTS

FISHERY RESOURCES ASSESSMENT DIVISION

PROJECT CODE FSS/FRA/1.1

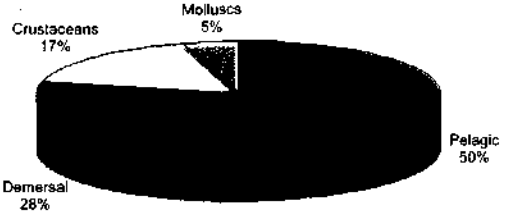
PROJECT TITLE Assessment of exploited marine fishery resources

SCIENTISTS K. N. Kurup, M. Srinath, K. Balan, K. Vijayalekshmi, T.V. Sathianandan, Wilson T. Mathew, Somy Kuriakose and K.G. Mini

CENTRES Cochin

The salient findings of this project are:

- Marine fish production in India during the year 2001 has been estimated at 2.33 million tonnes (t), registering a decrease of 13%, compared to 2.70 million tonnes in the year 2000.
- The pelagic, demersal and crustaceans formed about 51%, 27% and 17% respectively of the total landings.
- The mechanized and motorized sectors contributed 67.7% and 24.6% respectively to the total landings.



Components of marine fish landings in India during 2001

Changes in the landings (tonnes) of some of the major exploited resources are as follows :

Resource	2001	2000	Change (%)
Oil sardine	2,67,790	3,67,537	-27
Elasmobranchs	57,022	72,450	-21
Catfishes	49,729	57,651	-14
Bombayduck	85,836	96,682	-11
Croakers	1,21,487	1,72,040	-29
Mackerel	90,130	1,35,579	-34
Penaeid prawns	1,76,717	2,04,547	-14
Non-penaeid prawns	1,45,232	1,51,515	-4
Cephalopods	1,01,281	1,11,627	-9
Scads	40,914	25,575	60
Hilsa shad	16,756	10,747	56

ESTIMATED MARINE FISH LANDINGS (t) DURING 2000 AND 2001

Pelagic finfish

Name of fish	2000	2001
CLUPEOIDS		
Wolf herring	12899	13783
Oil sardine	367187	267790
Other sardines	80686	76374
Hilsa shad	10746	16756
Other shads	11835	4834
Coilia	36911	31955
Setipinna	4601	3445
Stolephorus	45534	44539
Thrissina	31	1
Thryssa	30904	30042
Other clupeoids	45672	43539
BOMBAYDUCK	97548	85836
HALF BEAKS&FULL BEAKS	7316	4378
FLYING FISHES	2377	5724
RIBBON FISHES	182386	175837
CARANGIDS		
Horse Mackerel	22179	18982
Scads	25584	40914
Leather-jackets	7287	6957
Other carangids	55684	50735
MACKERELS		
Indian mackerel	134556	90134
Other mackerels	0	0
SEER FISHES		
S. commersoni	36484	27549
S. guttatus	13755	14840
S. lineolatus	54	39
Acanthocybium spp.	82	150
TUNAS		
E. affinis	23514	21171
Auxis spp.	9090	11202
K. pelamis	4387	2672
T. tonggol	9935	9040
Other tunas	7075	3827
BILL FISHES	3570	4367
BARRACUDAS	18299	18576
MULLETS	6546	5594
UNICORN COD	492	482
MISCELLANEOUS	53242	55964
Total	**1368449**	**1188028**

Demersal finfish

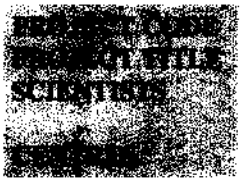
Name of fish	2000	2001
ELASMOBRANCHS		
Sharks	48525	34586
Skates	2627	2254
Rays	21811	20182
EELS	9187	8198
CATFISHES	58332	49729
LIZARD FISHES	26714	24331
PERCHES		
Rock cods	24876	25885
Snappers	6268	4004
Pig face breams	11110	13215
Threadfin breams	116680	114410
Other perches	57282	45942
GOATFISHES	15627	10434
THREADFINS	9195	6976
CROAKERS	180723	121487
SILVERBELLIES	49384	51814
WHITEFISH	6179	4913
POMFRETS		
Black pomfret	12680	12795
Silver pomfret	24637	25026
Chinese pomfret	854	1147
FLAT FISHES		
Halibut	1724	962
Flounders	171	251
Soles	50275	37979
MISCELLANEOUS	30266	30504
TOTAL	**765127**	**647024**

Shellfish

CRUSTACEANS		
Penaeid prawns	207080	176717
Non-penaeid prawns	151288	145232
Lobsters	2387	1389
Crabs	48384	29880
Stomatopods	46005	34944
MOLLUSCS		
Cephalopods	111544	101287
Miscellaneous	2006	
Total	**566688**	**491455**
Grand total	**2700264**	**2326507**

Region-wise marine fish landings (tonnes)

Region	2001	2000	Change (%)
North East	1,69,377	1,55,905	8.6
South East	5,15,479	5,95,579	-13.4
South West	7,44,757	8,48,894	-12.3
North West	8,63,090	10,52,550	-18.0

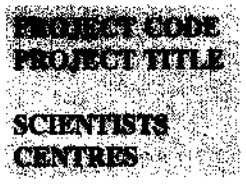


FSS/FRA/ST.1

Management information system in marine fisheries research

K.Balan, K. N. Kurup, M. Srinath, T.V. Sathianandan, K. Vijayalekshmi, Wilson T. Mathew and K.G. Mini
Cochin

- The large volume of data on the exploited marine fishery resources generated through the programme on the Resource Monitoring of the Institute during the year 2001 have been computerized, processed and results stored on magnetic tapes/CDs. These data are archived at the National Marine Living Resources Data Centre of the Institute.
- A suite of application programmes needed for retrieval, processing and updation of data were also developed.
- The WINDOWS based user-friendly query programme, **marine fishery data retrieval system** developed in Visual Basic Ver 6.0 has been updated with the estimates on landings of 2001.
- The processing and dissemination of information on marine fish landings was done through the Computer Centre of the Institute. The **ARIS (Agricultural Research Information System)** cell was also strengthened.
- A multi-media presentation of the activities of the Institute on a **Touch Screen Display system** was created.
- A web site for the Institute **www.cmfri.com** was created and hosted on the Internet. The site has information on different activities of the Divisions, Research Centres and Regional Centres.



FSS/FRA/1.19

Evaluation of change in the pattern of catch and composition of marine fishery resources in India

K. Vijayalekshmi, K. N. Kurup, M. Srinath, K. Balan and Somy Kuriakose
Cochin

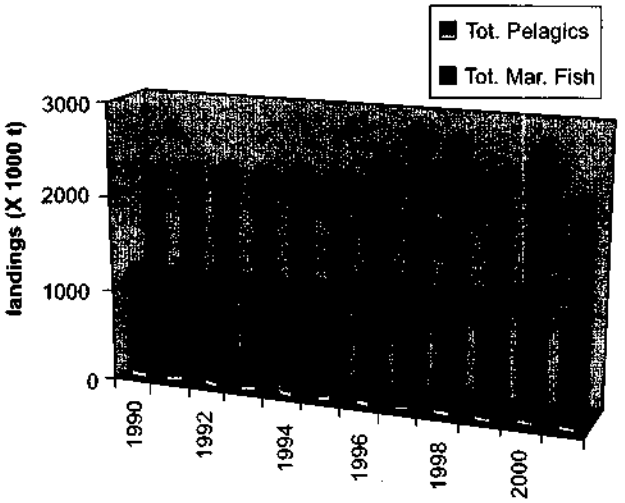
- The marine fish landings data for the 40 year period from 1961 to 2000 pertaining to Tamilnadu was analysed. The changes in the resource contribution and trends in the landings by different sectors viz., mechanized, motorised and non motorised were analysed. One of the most significant features of the catches was the emergence of oil sardine as a significant contributor to the total production and the increasing contribution by the motorised sector.

PROJECT CODE FSS/FRA/1.3
PROJECT TITLE **Stock assessment techniques in marine fish and shellfish resources and management**
SCIENTISTS **M. Srinath**, K. N. Kurup, Somy Kuriakose and K.G. Mini
CENTRES Cochin

- The non-equilibrium models are applied to assess the status of the demersal resources along the southeast cost.
- A simulation study is also carried out to depict the effect of change in fishing effort in the catch and biomass.

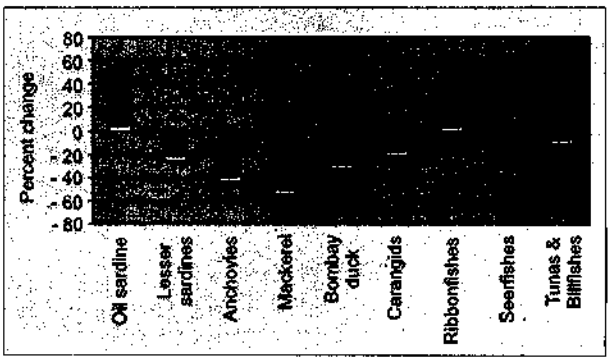
PELAGIC FISHERIES DIVISION

- The Pelagic Fisheries Division implemented eight Institute Research Projects on important pelagic finfish resources. The Division has built up a strong database on catch, effort, c/e, species composition, size composition and other biological parameters of all the commercial pelagic finfishes and based on this, stock assessment studies have been made.



Pelagic fish and total marine fish landings in India during 1990- 2001

- Pelagic finfish production during 1985-2001 fluctuated from 0.78 million t in 1985 to 1.07 m t in 2001. During the last decade, pelagic finfishes have contributed 46 –56% (Average 51%) of the total marine fish production in India.
- There was a significant decline (21%) of pelagic fish landings during 2001 compared to previous year and 13% decline compared to average pelagic fish landings during the last decadal period of 1990 –2000.



Change in the pelagic fish landings during 2001 compared to the decadal average

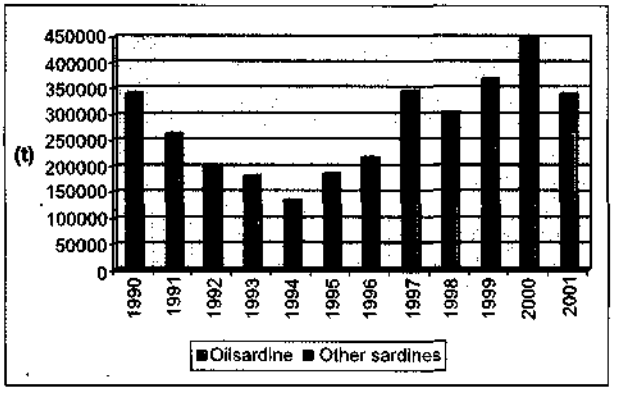
- 68% of the production of pelagics in 2001 was obtained from the west coast, 32% from the east coast.
- Oil sardine landings, which had peaked at 3.6 lakh t during 2000 declined by 28% during 2001. However the catches were still higher than the estimated average decadal landings.
- The Indian mackerel showed a decline of 34% compared to previous year. Compared to the annual average decadal landing of 1.9 lakh t, the catches in 2001 were at the lowest at 0.88 lakh t. There was a conspicuous absence of an intensive recruitment to the fishery in the immediate post-monsoon period.
- Ribbonfish landings showed an increase (+ 49%) during 2001 over the decadal average landings, although the catches were lower than the previous year by about 9,700 t.

PROJECT CODE PF/RE/1.1
PROJECT TITLE **Fishery and resource characteristics of sardines (*Sardinella* spp.)**
SCIENTISTS **N.G.K. Pillai**, A.A. Jayaprakash, Prathibha Rohit, M.Sivadas, E.M. Abdussamad and A.K.V. Nasser
CENTRES Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam

- A fishery forecast made (based on the decadal trend in oil sardine landings and sunspot activity) of peak oil sardine production has come true. As predicted the landings touched an all time high of 3.6 lakh t during 2000 and subsequently showed a decrease during 2001
- Along the east coast from 1991 a steady increase in oil sardine catches was recorded and it touched an all time high of 1.1 lakh t in 1999. Thereafter, catches declined and plummeted to 0.56 lakh t in the current year. Along the west coast the oil sardine production dipped from 2.91 lakh t during the last year to 2.1 lakh t in 2001.

Trend of production

- During 2001, the all India landing of oil sardine was 2.67 lakh t and that of lesser sardines 0.73 lakh t. The production showed a decrease to the tune of 18-86% in various maritime states with the lone exception of Karnataka where it showed a 23% increase.



Landings of Sardines in India during 1990-2001

- At Mangalore the production increased by 59%, gearwise; catch trends indicated that the purseseine and trawl catch improved by 61% and 287% compared to a decrease in *Ranibale* catch. At Karwar also, the purse seine catches were higher compared to the previous year. The ringseine catch increased by 70% at Calicut but decreased by 35% at Cochin. However, at Cochin, the purseseine and trawl landings improved by 1% and 25% respectively.
- Along the east coast, at Tuticorin the catch by the shoreseine and gillnet units improved by 562% and 74% respectively. The pair trawl landings at Rameswaram was less by 52% compared to a 7% increase in the gillnet catch. The effort input of ringseines at Pamban was 542 units against 158 of last year with catches increasing by 85%. At Chennai, the *Kavalavalai* and *Edavalai* brought sardines. The boatseine catch at Visakhapatnam slumped by 33%, however, the gillnet production indicated marginal increase.

The catch per unit effort

- The highest c/e of 4.2 t was realized by ringseines at Pamban followed by 1.5 t recorded by pair trawlers at Rameswaram. Along the west coast the purseseines recorded a c/e of 0.7-0.8 t. The c/e of ring seines at Cochin was 0.55t against 0.1 t realized at Calicut. In the remaining gears that exploited

sardines at various centres the c/e was less than 100 kg with the exception of the shoreseines (0.8 t) at Tuticorin.

Species composition

- Oil sardine dominated the catch of all the gears along the west coast with occasional occurrence of lesser sardines like *Sardinella fimbriata* and *S.gibbosa* at Mangalore and Cochin.
- Along the east coast, at Tuticorin, in the gillnets, *S.gibbosa* (66%) *S.sirm* (22%) and *S.albella* dominated but in the shoreseines oil sardine was the major constituent as also in the boatseines at Visakhapatnam. At Mandapam *S.gibbosa* and *S.albella* constituted the catch in gill nets, but in the pair trawl and ringseines oil sardine was the dominant component. In the *Edavalai* at Chennai, oil sardine occurred almost throughout the year.

Spawning

- Spawning population of oil sardine was observed during September at Karwar; March to October at Mangalore; May to September at Cochin; September at Tuticorin; and January to April and June to August at Visakhapatnam. *S.gibbosa* and *S.fimbriata* indicated spawning during January-March and July-November at Mangalore. Along the east coast spawning activity of lesser sardines was observed from May to September.

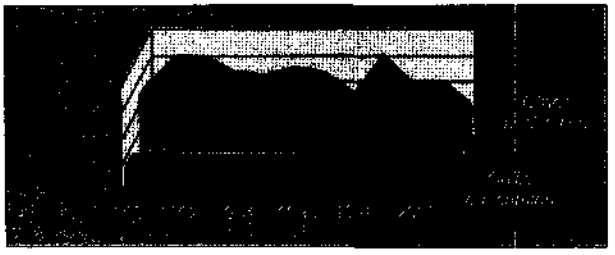
Exploitation of juveniles:

- At Karwar, 71% of the oil sardine exploited by the purse seines consisted of juveniles (<100mm) and pre-adults (105-140 mm). At Mangalore these two groups together formed nearly 76% in the trawl catch, but in purseseines they constituted 27% only. Fishes less than 140 mm comprised 61% of the catch of ringseines at Calicut and 52% of the catch by purseseines and ringseines at Cochin. In the pair trawl and in the ringseine catch along the south-east coast, these small sardines accounted for only 2% compared to nearly 78% in the *Edavalai* and 50% in the boatseines at Visakhapatnam.

Stock assessment

- Centre-wise, species –wise stock assessment was carried out. The studies over the years have indicated that the stocks of sardines are highly variable annually. It is usual, now a days, that the effort input is adjusted to the MSY and MEY levels by various gears at all the centers.

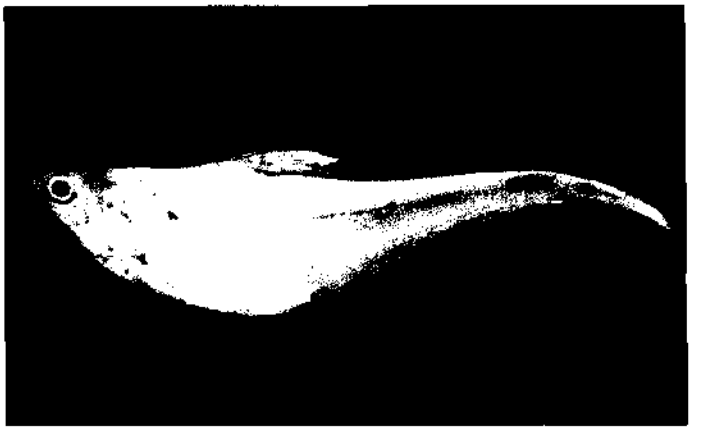
PROJECT CODE PF/RE/1.2
PROJECT TITLE **Fishery and resource characteristics of anchovies**
SCIENTISTS **R.Thiagarajan,** M. Zaffar Khan, Prathibha Rohit, A.A.Jayaprakash and H. Mohamad Kasim
CENTRES Mumbai, Mangalore, Cochin, Vizhinjam, Mandapam, Chennai and Kakinada



All India landings of anchovies

- During 2001, the estimated anchovy landings were 0.75 lakh t showing a drastic decline compared to the previous year's catch as well as the average decadal catch of 1.34 lakh t.
- Major gears employed were trawlers, purseseines, boatseines , shoreseines and gillnets.

- Landings by trawlers showed a decline at all the major fishery centres like Mangalore-Malpe, Kochi, Kakinada and Chennai. However, catches by seines (shore and boat) and gill nets have shown an increase at Vizhinjam. Catches by purse and ring seines at Mangalore have also increased by 15% and 175% respectively

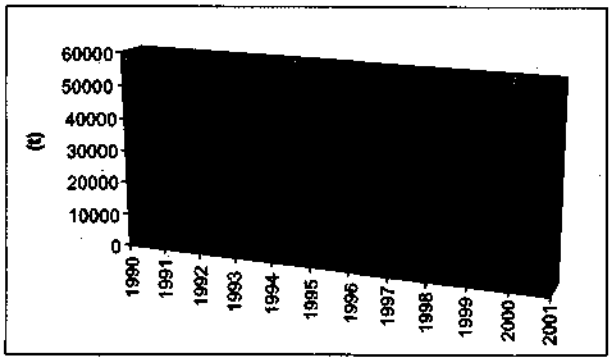


Gold-spotted grenadier anchovy *Coilia dussumieri*

- Major species recorded were *Encrasicholina devisi* (*Stolephorus devisi*), *E.punctifer* (*S.buccaneeri*), *Stolephorus bagenensis* (*S.macrops*) *S.waitei* (*S.bataviensis*), *S.indicus*, *S.commersonii* and *Coilia dussumieri*
- The MSY for *Coilia dussumieri* which sustains the anchovy fishery along the Maharastra coast has been estimated at 15,000 t against an average yield of 11,000 t.
- Species replacement is observed in the white-bait fishery at Cochin. *Stolephorus macrops* was the most abundant species and was exploited by ringseines during the south-west monsoon but of late the abundance of this species has come down and presently *S.commersonii* is dominating the landings.
- Catches of *S. commersonii,* which is one of the two large growing white-baits, is mainly constituted of pre-adults.
- Decrease in trawl catches are reflected as a consequence of extension of trawling operations to more offshore areas and due to discards of by-catch by multiday fishing trawlers for storing target species.

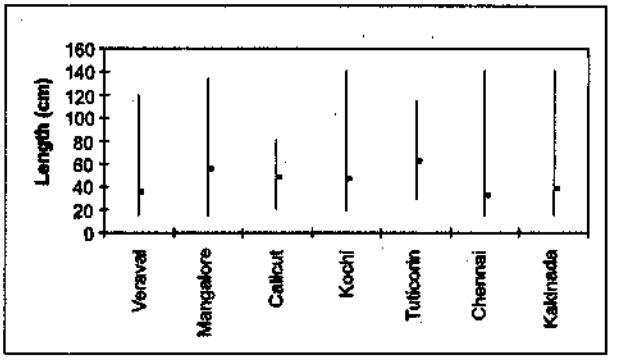
PROJECT CODE PF/RE/2.1
PROJECT TITLE **Fishery and resource characteristics of seerfishes**
SCIENTISTS **C. Muthiah,** M. Sivadas, N.G.K. Pillai, U.Ganga, E.M. Abdussamad, H.Mohamad Kasim and A.K.V. Nasser
CENTRES Veraval, Mangalore, Calicut, Cochin, Tuticorin, Chennai, Kakinada and Visakhapatnam

- Seerfish landings were estimated at 0.41 lakh t which was slightly lower (-2%) than the annual average decadal (1990-2000) catch of 0.42 lakh t. On the west coast the major increase in seerfish landings was observed along the Goa-Maharashtra coast while in other maritime states catches declined by 22-45% compared to the previous year. Catches also showed an increase along the east coast in the states of Andhra Pradesh and West Bengal.



Seerfish landings in India

- Major gears were gillnets, trawls, hooks and line and purseseine which contributed 60%, 33%, 6% and 1% respectively. Catch rates in large-meshed drift gillnet ranged from 13 kg at Calicut to 110 kg at Chennai. Catch rate in trawls varied from 0.7 kg at Kochi to 23 kg at Mangalore-Malpe.
- Species recorded in the catches were *Scomberomorus commerson* (67%), *S. guttatus* (30%) and *S. lineolatus* (3%). The Wahoo *Acanthocybium solandri*, accounted for less than 0.4%.
- King seer, *S. commerson* dominated the seerfish catch of all the gears at centres like Mangalore, Calicut, Kochi, Tuticorin and Chennai. At Kakinada and Veraval, the spotted seer, *S. guttatus* dominated the landings.
- Size range of *S. commerson* was 10-142 cm. Fishes as small as 10 cm were observed in catches at Kakinada.

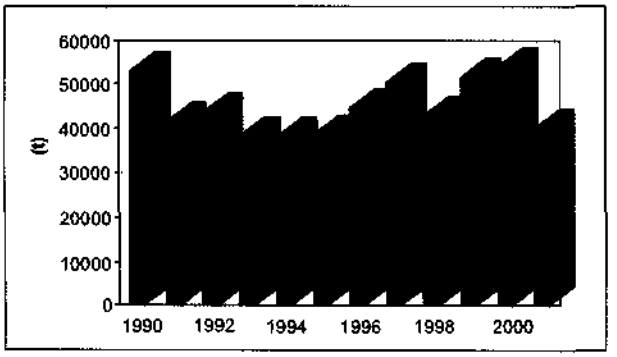


Length range and mean length of *S.commerson* at different centres

- Juveniles (< 34 cm) of king seer constituted on an average 59% of the total catch in numbers. Young fish of king seer were most abundant in the catches at Mangalore (65%) followed by Kakinada (64%), Tuticorin (46%), Kochi (28%), Calicut (23%) and Chennai (2%).
- The length range of *S. guttatus* was 10-64 cm with a mean of 32.7 cm. Size range of fishes at Veraval was 14-58 cm and at Kakinada 10-62 cm. At Mangalore a size range of 22-56 cm was observed. Young fish (< 17 cm) formed 27% of the catches at Kakinada while at Veraval it was less than 0.5%.
- Growth parameters and mortality rates were estimated for *S. commerson* and *S. guttatus* at all the fishery centres. Exploitation rate (E) of king seer at all the centres ranged between 0.61 - 0.77. The exploitation rate of spotted seer was 8.71 at Kakinada and Mangalore compared to Chennai 0.5 and at Veraval 0.41.

PROJECT CODE PF/RE/2.2
PROJECT TITLE **Fishery and resource characteristics of tunas, tuna live-baits and billfishes**
SCIENTISTS **P.P. Pillai,** M. Zaffar Khan, C. Muthiah, T.M.Yohannan, M.Sivadas, N.G.K. Pillai, U.Ganga, G.Gopakumar, E.M.Abdussamad, H. Mohamad Kasim and K.P. Said Koya
CENTRES Veraval, Mumbai, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Chennai and Minicoy

- The All-India tuna and billfish landings during 2001 was 40,000 t which was 26% less than that of the previous year and 11.5% less than the average for the decadal period 1990-2000.



All India landings of tunas and bill fishes

- Major gears employed in the fishery were drift gillnets, hooks and line, purseseines, pole and line and troll line.
- Pole and line and troll line were exclusively used to fish skipjack and yellowfin tuna in Lakshadweep waters, and catch rate was 227 and 21 kg respectively.
- *E. affinis* dominated the drift gillnet landings while *A.rochei* dominated the hooks and line landings. Skipjack *K. pelamis* dominated the pole and line and troll catches at Minicoy. The yellowfin, *T. albacares* constituted 48% of the troll catches in Minicoy.
- The hand-line fishery at Minicoy was entirely constituted by yellowfin and dogtooth tuna (*Gymnosarda unicolor*)
- Major livebaits caught for the pole and line tuna fishery were apogonids and sprats but their catch rates showed a decline (10%) compared to last year.
- Billfishes were landed by drift gill nets at Mumbai, Mangalore-Malpe, Vizhinjam, Tuticorin and Chennai and by hooks and line at Vizhinjam and Tuticorin.
- Sailfish *Istiophorus platypterus* was the major billfish species landed. *Makaira indica* was also observed at Tuticorin and Mangalore-Malpe landing centres.

- Major tuna species caught along the Indian coast are *Euthynnus affinis, Auxis thazard, A.rochei, Thunnus albacares, T.tonggol, T .obesus* and *Katsuwonus pelamis*
- Catches of *Thunnus tonggol* showed an increasing trend since the early 90s along the mainland
- Skipjack shoals were conspicuously absent in the traditional fishing grounds of Minicoy while catches of yellowfin by hand-lines was abundant during December –January resulting in a temporary suspension of pole-and-line fishing operations . However, at the same time, unprecedented catches of very large sized (upto 160 cm in Fork Length) yellowfin tuna was observed in the hand-line fishery at Minicoy.

- Size range of *E. affinis* in the fishery was 18-82 cm, *A. thazard* 18-47 cm, *A. rochei* 14-38 cm, *T. tonggol* 32-62 cm, *T. albacares* 28-122 cm, *K. pelamis* 24-76 cm and *S. orientalis* 32-58 cm.
- Mature and spent fishes of *A. rochei* were available in catches at Vizhinjam, throughout the year.
- While about 64% of the skipjack caught by the pole and line fishery were above the size at first maturity only 37% of yellowfin caught were mature.
- The exploitation rate (E) of tunas at Mangalore was estimated to be 0.76 (*E. affinis*), 0.46 (*A.thazard*), 0.40 (*A. rochei*) and 0.43 (*T. tonggol*).

PROJECT CODE PF/RE/2.3
PROJECT TITLE **Fishery and resource characteristics of Indian mackerel**
SCIENTISTS **T.M. Yohannan,** Prathibha Rohit, M.Sivadas, P.N.Radhakrishnan Nair, G. Gopakumar, E.M. Abdussamad, H.Mohamad Kasim and A.K.V. Nasser
CENTRES Karwar, Mangalore, Calicut, Cochin, Vizhinjam,Tuticorin, Chennai and Visakhapatnam

⇨ Mackerel landings during 2001 showed a drastic decline of 34% compared to 2000 and were a mere 0.88 lakh t compared to an average catch of 1.9 lakh t during the 1990-2000 period. The landings were the lowest since 1986 and lower than the average decadal catch by 55%.

⇨ Recruitment to the fishery was observed in March in Mangalore, January and October in Calicut, February in Cochin, July in Tuticorin and April and October in Visakhapatnam.

⇨ While the fishery during the July-November period on the south-west coast employing surface gears like seines was extremely poor, no corresponding increase was seen in the trawl catches for the same period.

⇨ The summer trawl fishery has however shown a tremendous improvement along the Malabar coast in the current year, with catches exceeding those made by surface gears.

⇨ Recruitment along the south-west coast during monsoon was conspicuously poor, resulting in extremely low catches of mackerel by surface seines in the post-monsoon period. Environmental phenomenon, especially upwelling, is a critical factor in determining the abundance of mackerel in surface waters.

⇨ Record catches by trawlers operating on the south-west coast during summer indicated abundance of mackerel in the deeper areas. This confirms the observation of the mackerel shoals dispersing into deeper waters with the sinking of the thermocline.

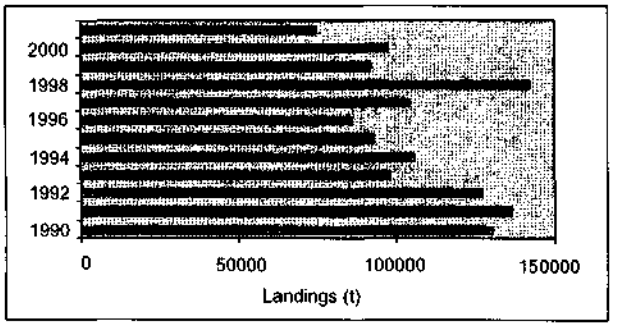
⇨ Inter-annual variations in thermocline movement have been found to influence the trawl fishery for mackerel

⇨ Maximum landings were observed from the Karnataka-Goa belt followed by Kerala. The catches from east coast accounted for 24,000 t where, Tamilnadu was the leading state. The north-east coastal states of West Bengal and Orissa recorded better catches than the previous year with an estimated landing of about 1,300 t.

- In general, the fishery depended mostly on recruits of the previous year and the mean size of the fish in the commercial catches was above 200 mm. However, at Mangalore and Calicut, the mean size was 199 and 163 mm respectively indicating higher exploitation of the young fishes.
- Young fish in the size range of 85-124 mm occurred abundantly in trawls and ring seines at Calicut.

PROJECT CODE PF/RE/ 3
PROJECT TITLE **Fishery and resource characteristics of Bombay duck**
SCIENTISTS **Alexander Kurien** and H.Mohamad Kasim
CENTRES Veraval, Mumbai, Kakinada

- During 2001, the total Bombay duck landing was estimated to be 0.74 lakh t. This formed 7% of the total pelagic fish landings and 3% of total marine fish landings.

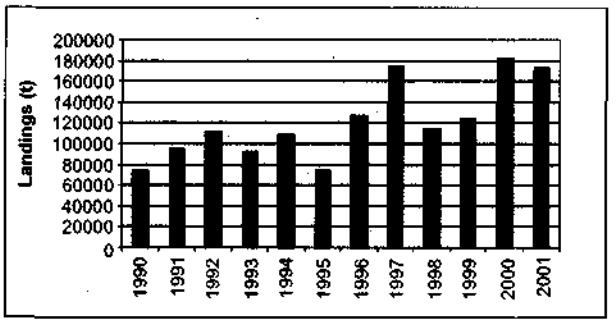


All India Bombay duck landings

- Catches decreased by 32% compared to the decadel (1990-2000), average catch of about 1.1 lakh t.
- Catches along the Gujarat coast declined by 30% and in Maharashtra by 12%.
- Along the Gujarat coast, size of Bombay duck ranged between 30-300 mm. Very small fishes 30-119 mm were observed in landings at Jaffrabad while at Rajapara and Nawabunder landing centre, larger fishes of 105-240 mm constituted bulk of the catches.
- Along the Maharashtra coast, fishes in the size range of 165-180 mm constituted bulk of the catches.
- It is observed that *dol* netters discard Bombay duck especially juveniles, when other priced fishes are caught abundantly.

PROJECT CODE PF/RE/ 4
PROJECT TITLE **Fishery and resource characteristics of ribbonfishes**
SCIENTISTS **P.N.Radhakrishnan Nair,** M. Zaffar Khan, C. Muthiah, R. Thiagarajan, H.Mohamad Kasim and A.K.V.Nasser
CENTRES Veraval, Mumbai, Karwar, Mangalore, Cochin, Vizhinjam, Chennai, Kakinada and Visakhapatnam

- ★ The ribbonfish landings in India showed an increasing trend during the last decade in spite of annual fluctuations. The average annual landings for the period 1991- 2001 was 1.25 lakh t and a decrease of 3.9% was noticed in the landings during 2001 compared to the previous year.
- ★ The overall growth rate in production over a period of 11 years from 1991 to 2001 was 6.3%.
- ★ West coast accounted for 88% of the all India ribbonfish landings.



All India landings of ribbonfish in India

★ Trawl net, which contributed 96.3% of the catch, was the major gear in the fishery in all the monitoring centres except at Vizhinjam where only traditional gears were in operation. The landings of ribbonfishes by trawls increased at Veraval, Karwar and Kochi while it decreased in other centres.

★ Compared to the previous year, the gillnet fishery declined both at Veraval and Madhwad to the tune of 42% and 32% respectively. In boatseine the landings increased at Visakhapatnam by 25% but decreased by 77% at Vizhinjam.

★ The peak fishery season was generally in the post monsoon period (October to December) but it varied at different centres. At Vizhinjam and Visakhapatnam maximum production was in June-September (monsoon period), at Mumbai, Mangalore-Malpe and Karwar it was during January to May (pre-monsoon period) and at Veraval, Cochin and Chennai it was in October-December (post-monsoon period).

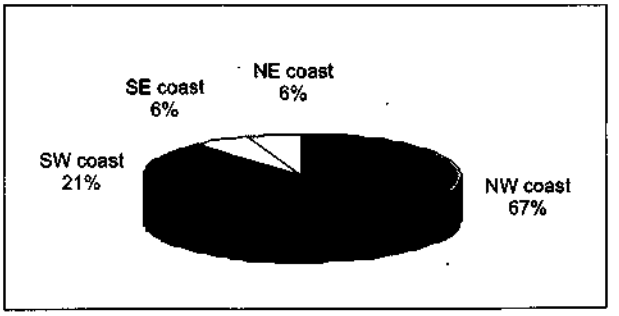
Ribbonfishes rank top in frozen finfish export

The ribbonfishes are now a target group. Nearly 60 -70% of the landings in frozen form are exported to China, Japan and other Southeast Asian countries. The country earned Rs. 363 crores during last year.

★ *Trichiurus lepturus* was the dominant species all along the coast of India.

★ The minimum size of recruitment of the species to different gears was - 16cm (trawl), 18cm (boatseine) at Visakhapatnam and 44cm (gillnet) at Madhwad. Along the west coast the 1-year-old group dominated in the fishery followed by the 0-year group. However, at Cochin the dominant 1-year group was followed by the 2-year group. Along the east coast the 0-year group dominated the fishery at Chennai, Kakinada and Visakhapatnam followed by the 1-year group.

★ The mean length of *T.lepturus* in the catches was comparatively less (<50cm) along the east coast compared to the west coast (60-70cm).



Region-wise contribution to ribbonfish landings - 2001

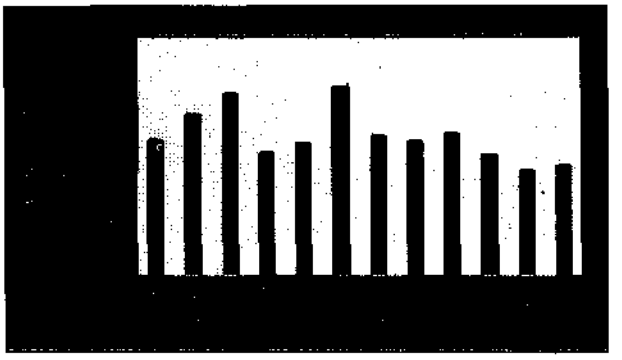
★ Food items were mainly fishes (*Stolephorus* spp., *Sardinella* spp., scads, lizard fishes, bull's eye, sciaenids, *Nemipterus* spp., leiognathids, *Acetes* and squids.

★ The assessment of *T. lepturus* stock at Mangalore-Malpe area, Cochin and Kakinada showed that the exploitation during the period was above the optimum level at Mangalore-Malpe and Kakinada areas while it was at the MSY level at Cochin.

★ Two recruitment peaks, one in January and another in July-September were noticed at Cochin while there was a single peak at Kakinada in January.

PROJECT CODE PF/RE/ 5
PROJECT TITLE **Fishery and resource characteristics of carangids**
SCIENTISTS **H. Mohammed Kasim**, Prathibha Rohit, P.N.Radhakrishnan Nair, R.Thiagarajan and E.M. Abdussamad
CENTRES Veraval, Mangalore, Cochin, Vizhinjam, Tuticorin and Kakinada

- The all India carangid landings during 2001 was 1.2 lakh t. Although the landings were higher by about 5000 t compared to the previous year, they were still lower than the decadel average by 22%.



All India landings of carangids

- Trawls landed major quantity of carangid fishery all along the Indian coast in addition to purse seines, gillnets and ringseines along the west coast and gillnets and hooks and line on the east coast.
- There was a notable decline of 31% in the catches at Veraval mostly due to the low abundance of carangids in the fishing ground and consequent reduction (10%) in effort input by trawls.
- At Kakinada, catches slumped by 62% compared to the previous year.
- Several species supported the carangid fishery and among them, *Megalaspis cordyla* dominated the gillnet landings and *Decapterus russelli* in trawls. At Cochin, *S.crumenophthalmus* dominated the gillnet landings and *Alepes djedaba* in purseseines. At Tuticorin, *C. carangus* dominated the small mesh gillnet (*Podivalai*) and trawl landings compared to *C.sexfasciatus* in hooks and line and large meshed gillnets (*Paruvalai*).
- Size range of *D. russelli* was 70-230 mm, *M. cordyla* 80-520 mm, *D. macrosoma*, 75-220 mm, *S. crumenophthalmus* 110-359 mm, *A. djedaba* 180-329 mm and *C. kalla* 90-175 mm.

Decapterus russelli

Gear-wise percentage contribution of carangids at different Centres

Centre/ gear	TR	GN	PS	RS	H& L
Veraval	72.5	22.5	-	-	5.0
Mangalore	50.7	0.7	48.5	-	0.1
Kochi	58.0	21.6	19.5	0.9	-
Kakinada	95.8	4.2	-	-	-
Tuticorin	88.7	10.2	-	-	1.1
Average	73.1	11.8	34	.9	2.1

TR- Trawl GN- Gillnet PS- Purseseine RS – Ringseine H&L – Hooks and line

DEMERSAL FISHERIES DIVISION

The demersal fisheries division continued the research work in the eight in-house projects. Besides, the scientists of the division implemented four externally funded projects. During the year 2001 an estimated 6,25,000 t of demersal fishes were landed in the country forming 27% of the total marine fish production.

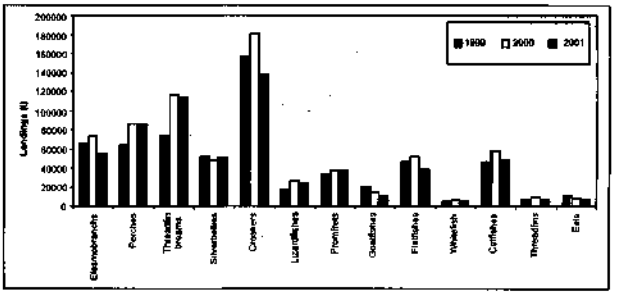
The division took initiative in addressing the issues related to the ban on fishing of elasmobranchs by making an elaborate presentation in the Ministry of Environment and Forests and convincing the Government on the need for a concerted effort to gather additional information on the elasmobranch resources of India to be able to address the issue effectively. As a prelude to taking up such a research project, a project finalization meeting was held at the Institute at Cochin involving all the organisations responsible for research, development, management, livelihood and trade of elasmobranchs and a project proposal was finalised and submitted to the Ministry of Environment and Forests for funding. On this occasion, the division brought out a publication on the status of knowledge on elasmobranch fisheries of India to serve as background information and was released on the inaugural day of the Project Finalisation Meeting.

The division also brought out a publication, for the first time in India, on the ornamental fish resources of Lakshadweep incorporating the results of study on the stock sizes of 165 species, their catch quotas, the management measures required for sustaining the yields and colour photographs of fishes. This book is very useful for the industry, government departments and the research workers.

The in-house research projects generated voluminous data on the characteristics of the major exploited demersal fish species and the impact of coastal bottom trawling on fisheries.

The finfish mariculture project progressed satisfactorily and additional species of ornamental fish were bred and larval rearing done successfully.

The scientists of the division presented research project proposals on the breeding and the propagation of ornamental fishes in the Lakshadweep and taxonomy of marine fishes of India for funding by the DOD.

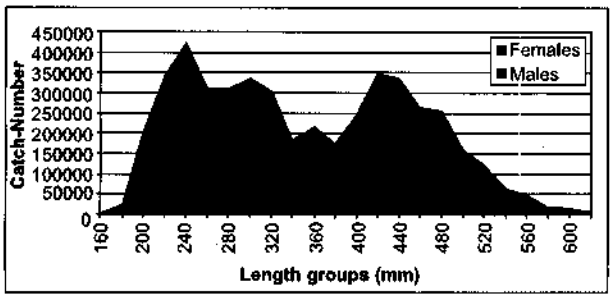


Estimated landings of major demersal fishes in India during 1999-2001

PROJECT CODE **DF/RE/1**
PROJECT TITLE **Investigations on the resource characteristics of elasmobranchs**
SCIENTISTS **S.G. Raje**, G. Mohanraj, V. Gandhi, P.Livingston, K.K. Joshi, P.P. Manojkumar
CENTRES Mumbai, Chennai, Mandapam, Tuticorin, Cochin, Calicut

Fourteen species of sharks, 7 of skates and 10 of rays were landed at different centres. Sharks were caught mainly by gill nets and rays by trawl nets. The maximum quantity of sharks was caught off Gujarat and Maharashtra and rays from Tamilnadu.

At Mumbai the trawl, gill and 'dol' nets landed 1918 t, 104 t and 10 t of elasmobranchs respectively. Among sharks, *S. laticaudus* was the most dominant species and the length range of males was 150 – 580 mm and females 160 – 620 mm. *Dasyatis zugie* (31 – 106 cm) was the main constituent in rays. The length range of *Dasyatis imbricatus* was 140 –290 mm.



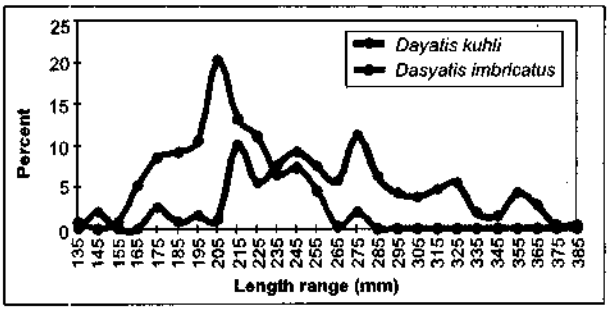
Estimated length frequency distribution in the catch of *Scoliodon laticaudus* (males & females) in the trawl landings at Mumbai during 2001

At Calicut, the estimated catch of elasmobranchs by trawlers was 207 t. The catch declined by 61% over the previous year. *Carcharhinus melanopterus* (35%) was the dominant species in sharks and *Aetobatus narinari* (64%) in rays. The length range of *C. melanopterus* was 402-1198mm.

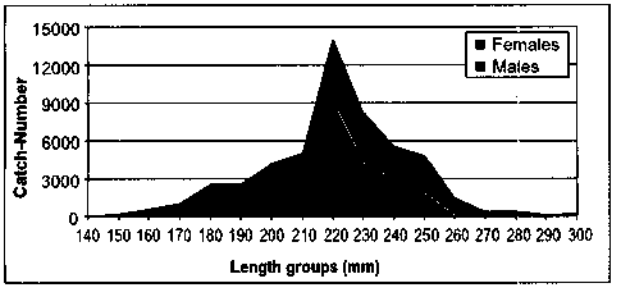
At Cochin, the estimated catch of this resource was 85 t by trawl and 143 t by gill net. Among sharks, *C. melanopterus* formed 25% in trawl and 28% in gill nets; *D. uarnak* (52%) was the most dominant species in trawl. The size range of *Rhizoprionodon acutus* was 320-960mm and *C. melanopterus* 240-820 mm.

At Tuticorin, 659 t of elasmobranchs were landed by trawlers, drift gill net, hook and line and bottom set gill net. The length range in *Scoliodon palasorrah* was 700-1240 mm, *D. kuhli* 140-389 mm and *D. imbricatus* 130-279 mm.

At Chennai, the total elasmobranch catch of 1063 t was landed by trawlers and gillnets. Rays (85%) were dominant in trawl and sharks (99%) in gill nets. *D. jenkinsii* was the most dominant species among rays and *C. melanopterus* in sharks. The size range of *D. jenkinsii* was 150-1090 mm.



Estimated length frequency in the catch of *Dasyatis kuhli* and *Dasyatis imbricatus* in the bottom set gillnet landings at Tuticorin



Estimated length frequency distribution in the catch of *Dasyatis imbricatus* (males & females) in the trawl landings at Mumbai during 2001

At Mandapam the total landing of elasmobranchs was 1676 t, which was 726 t more than that of the previous year. Gillnets contributed 46% of the catch followed by trawlers. Among rays *Himantura uarnak* was dominant at Rameswaram and Pamban, *D. sephen* at Mandapam and *A. narinari* at Chinnapalam.

Shark landing by hooks and line at Tharuvikulam landing centre (Tuticorin) ready for auction

PROJECT CODE **DF/RE/2**
PROJECT TITLE **Monitoring the resources characteristics of Groupers, Snappers and Pigface breams**
SCIENTISTS **V. Gandhi,** P. Livingston, P.P. Manojkumar, Rekha J. Nair
CENTRES Mandapam, Tuticorin, Calicut, Cochin

At Mandapam, 21 t of groupers were landed consisting of seven species. *Epinephelus caeruleopunctatus, E. hexagonatus, E. areolatus, E.tauvina, E. polyphekadion, E. bleekeri* and *E. formosa* of which *E. areolatus* was dominant. Five species of snappers: *Lutjanus rivulatus, L. bohar, L. fulviflammus, L. kasmira* and *L. decussatus*. were landed. Estimated landing of pigface breams was 35 t. *L. nebulosus, L. ornatus, L. harak, L. mahsena, L. crocineus, L. ramak* and *L. microdon* and *L. nebulosus* contributed to the catches.

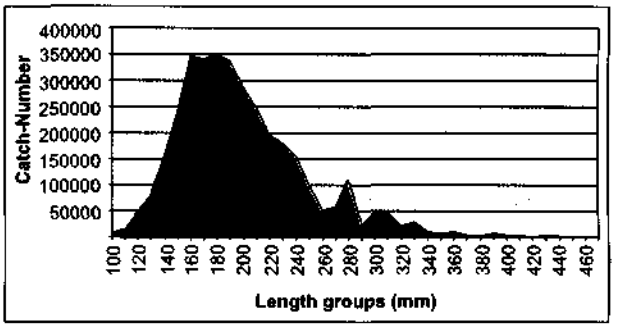
At Tuticorin, the estimated catch of perches was 4628 t. *L. nebulosus; E. tauvina* and *L. rivulatus* were dominant.

In the landings at Vizhinjam, groupers accounted for 150 t, snappers 153 t and pig face breams 91 t.

At Cochin, 123 t of groupers were landed by trawlers. Gut contents consisted of shrimp, *Stolephorus*, squilla and shell pieces.

At Calicut, the estimated catch of groupers was 1115 t. *E. diacanthus* was the dominant species with size range 102-468 mm.

At Mumbai, of the 3214 t of perches landed, 2934 t was groupers. *E.diacanthus* was dominant.



Estimated length frequency distribution in the catch of *Epinephelus diacanthus* in the trawl landings at Mumbai during 2001

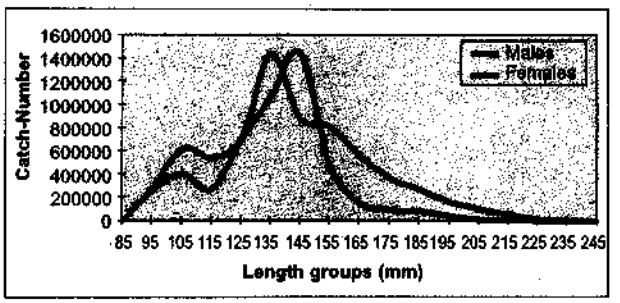
PROJECT CODE	**DF/RE/4**
PROJECT TITLE	**Development of management strategies for sustainable fishery of Threadfin breams and Silverbellies**
SCIENTISTS	**V.Sriramachandra Murty,** E.Vivekanandan, P.U.Zachariah, K.K. Joshi, P.P.Manojkumar, K.V.S. Nair V.Gandhi, U.Rajkumar, Shobha, Joe Kizhakudan
CENTRES	Vishakapatnam, Kakinada, Chennai, Mandapam, Cochin, Calicut, Karwar, Mangalore, Mumbai, Veraval

Threadfin breams

At Veraval, the estimated catch of threadfin breams by trawlers was 11,762 t (9% of the total trawl catch) showing a decrease of 54% over the previous year. Maximum catch was recorded in January. *N.mesoprion* (58%) and *N.japonicus* (36 %) were the major species. The length range of *N. japonicus* was 60-289 mm and *N. mesoprion* 80-279 mm. Dominant food items were fish and *Acetes*.

The estimated catch was 3893 t at Mumbai, (7% of total trawl landing). February-May accounted for 64% of the annual threadfin bream landings. *N.mesoprion* was the most dominant species (58 %) followed by *N. japonicus* (36%) and others.

At Mangalore, the estimated catch was 15,744 t (23% of the total trawl landing). *N. mesoprion* was the dominant species (51%) followed by *N.japonicus* (49 %). The length range of *N. mesoprion* was 80-259 mm and *N. japonicus* 80-319 mm. Ripe and partially spent fishes were caught during September -December.

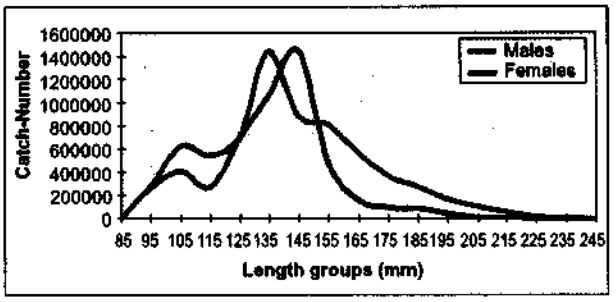


Estimated length frequency distribution in the catch of *N. mesoprion* (males & females) in the trawl landings at Cochin Fisheries Harbour during 2001

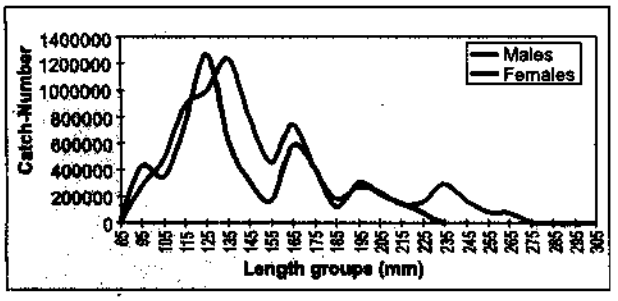
At Cochin, the estimated catch was 1147 t. *N. mesoprion* formed 45 % and *N. japonicus* 44% of the threadfin bream catch. In *N. mesoprion*, the length range of males was 80-235 mm and females 85-235 mm. Mature and ripe specimens occurred during October. The length range of *N. japonicus* was 85-275 mm.

At Chennai, the landings were estimated at 1669 t. Of the four species that contributed to the fishery, *N. japonicus* was dominant (57%) followed by *N. mesoprion* (18%). The length range of *N. japonicus* was 80-279 mm.

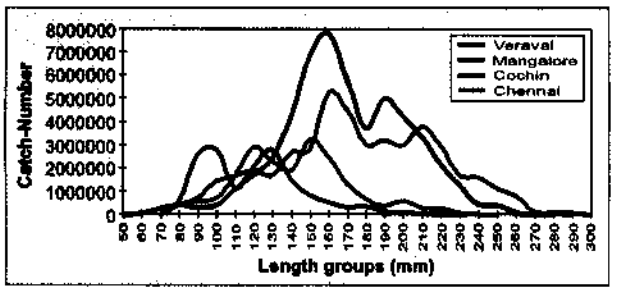
Catch of threadfin breams landed at Malpe Fisheries Harbour by multi-day trawlers



Estimated length frequency distribution in the catch of *N. mesoprion* (males & females) in the trawl landings at Cochin Fisheries Harbour during 2001



Estimated length frequency distribution in the catch of *N. japonicus* (males & females) in the trawl landings at Cochin Fisheries Harbour during 2001



Estimated length frequency distribution in the catch of *Nemipterus japonicus* in the trawl landings at Veraval, Mangalore, Cochin and Chennai during 2001

At Visakhapatnam, 784 t was landed showing an increase of 613 t over the previous year. *N. mesoprion* was the most dominant species (49%) followed by *N. japonicus* (41 %). The length range for *N. japonicus* was 110-220 mm.

The trawlers at Kakinada landed 375 t showing an increase of 49% over the previous year. Of the five species that contributed to the fishery, *N. japonicus* was dominant (62%) followed by *N. tolu* (19%), *N. mesoprion* (12%) and others. The length range of *N. japonicus* was 35 - 275 mm and *N. mesoprion* 55 –195 mm.

Silverbellies

The estimated catch by trawlers at Cochin was 57 t. The catch showed a marginal increase over the previous year.

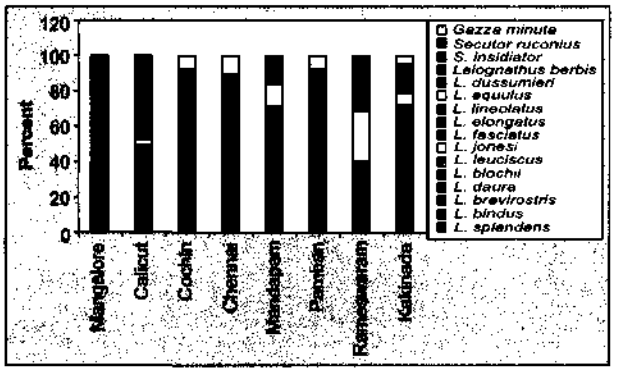
At Calicut, 489 t was landed showing a marginal decrease over the previous year. The major species contributing to the trawl fishery are *Secutor insidiator* (46%) and *L. bindus* (34%).

At Chennai, 2429 t of silverbellies (12% of trawl catch) was landed. *L. bindus*, S. *insidiator* and *L. splendens* were dominant in the landings. The length range of *L. bindus* was 30-129 mm.

In the Gulf of Mannar *L. dussumieri* was dominant where as in the Park Bay *L. brevirostris* and *L. jonesi* were dominant. *L. jonesi* did not occur anywhere else. The number of species contributing to fishery is greater in the east coast than in the west coast.

At Mandapam, the trawlers landed 12,416 t. *L. brevirostris* (43%) was the most dominant followed by *L. jonesi* (27%), *L. dussumieri* (12%) and others. The length range of *L. brevirostris* was 50 -140 mm and *L. dussumieri* 70 -150 mm.

At Vishakapatnam, 651 t of silverbellies were landed with a decline of 13% over the previous year. Maximum catch was obtained in June.



Species compostion of silverbellies at different centres along the coast line during 2001

At Kakinada, 824 t of silverbellies were landed. Of the ten species reported, *L. bindus* was dominant (40%) followed by *L. brevirostris* (19%), *S. insidiator* (12%), and others. The length range of *L. bindus* was 20 -120 mm and *S. insidiator* 20-120 mm.

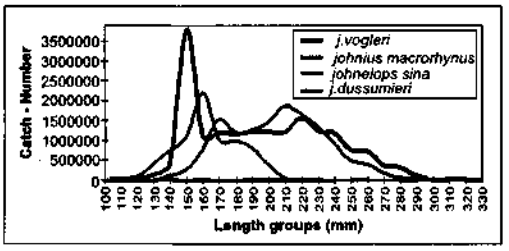
PROJECT CODE **DF/RE/5**

PROJECT TITLE **Development of management strategies for judicious exploitation of Sciaenids**

SCIENTISTS **G. Mohanraj,** S. Sivakami, P. Livingston, K.V.S. Nair, Shobha Joe Kizhakudan, U. Rajkumar

CENTRES Veraval, Mumbai, Karwar, Cochin, Tuticorin, Chennai, Kakinada, Vishakapatnam

At Veraval, 13,608 t of sciaenids were landed by trawlers, 187 t by gill nets and 735 t by "dol" nets. The dominant species was *O. cuvieri* followed by *J. glaucus.*



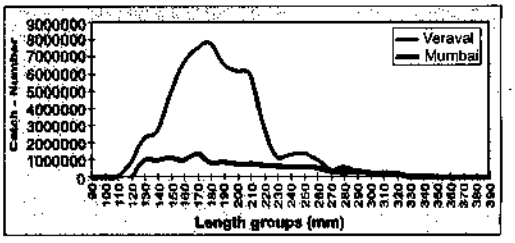
Estimated length frequency distribution in the catch of species of Croakers in the trawl landings at Mumbai during 2001

The trawlers at Mumbai landed 7192 t. The dominant species were *J. vogleri* and. *J. macrorhynus*. The dominant length range in the fishery was 150 – 250 mm, 130 – 200 mm and 150 – 250 mm for *J. vogleri, J. sina* and *J. macrorhynus* respectively.

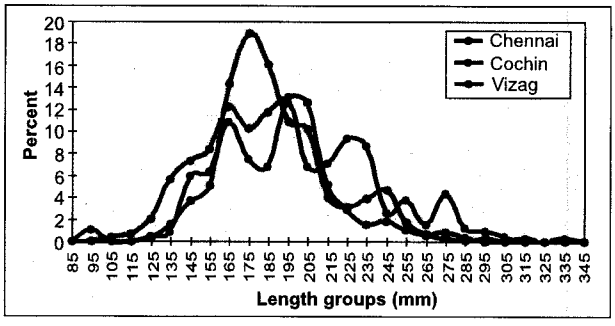
At Tuticorin, the estimated catch was 222 t. The dominant species in trawl was *J. maculatus* and *O. ruber*. The dominant size group was 215 mm in *O. ruber* and 135 mm in *J. maculatus*.

At Chennai, the estimated catch was 1393 t. *O. ruber* was the dominant species (32%), followed by *J.carutta* (15 %) and others. The dominant size was 155 mm in *O. ruber* and *J. carutta.*

At Kakinada, the estimated catch was 1543 t. *P. macrophthalmus* was dominant fol-



Estimated length frequency distribution in the catch of *Otolithus cuvieri* in the trawl landings at Veraval and Mumbai during 2001



Length frequency distribution in the catch of *Saurida undosquamis* in the trawl landings at Chennai, Visakhapatnam and Cochin during 2001

1587 t, with *S. tumbil, S. undosquamis* and *S. micropectralis* being the major contributors. Length range of *S. undosquamis* in the fishery was 100 – 320 mm, with the bulk of the catch in the length range 140 – 250 mm.

Bull's eye

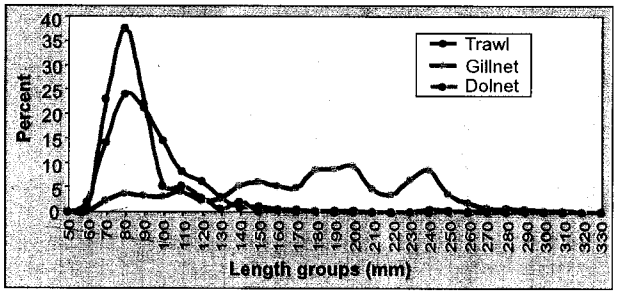
At Veraval 2168 t of *Priacanthus hamrur* was landed, the length range in the fishery was 120 – 330 mm, with the maximum catch in the range 160 – 290 mm. September was the peak spawning period with 42 % of the fishes landed in the mature stage.

At Mumbai, 305 t was landed. In *P. hamrur* the length range was 120 – 350 mm, with the bulk of the landing in the length range 150 – 280 mm.

802 t of *P. hamrur* was landed at Cochin; the length range observed in the fishery was 160 – 340 mm. At Vishakapatnam and Chennai, a total of 76 t and 56 t were landed.

Pomfrets

At Mumbai 446 t was landed by trawlers with peaks during January and September. The catch declined by 22% over the previous year. The gillnets at Satpathi landed 164 t registering 86% decline over previous year with a 11% decline in the effort. *Pampus argenteus* was the dominant species in all the gears. The 'dol' nets at Mumbai landed 15 t (5 lakhs fishes) principally consisting of *P. argenteus*; 96% of the catch by number was in the length range of 60 – 120 mm.

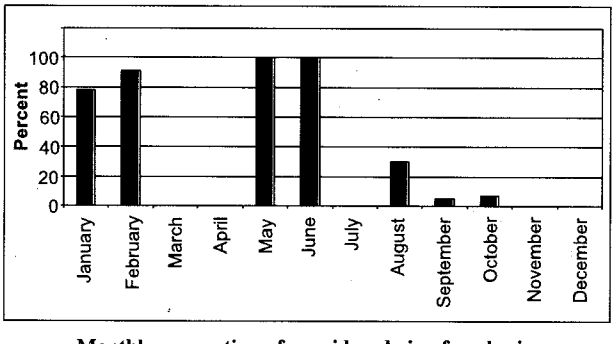


Estimated length frequency distribution in the catch of *Pampus argenteus* by different gears at Mumbai during 2001

Threadfins

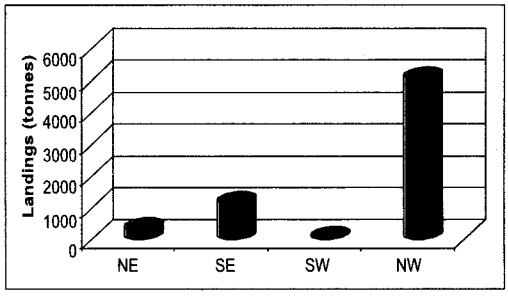
At Veraval, 37 t were landed by gillnets comprising three species *Eleutheronema tetradactylum* (54 %), *Polynemus indicus* (35 %) and *P. heptadactylus* (1%). The trawl catch was 171 t with *P. heptadactylus* accounting for 66% of threadfin catch.

At Mumbai 164 t of threadfins comprising three species were landed by trawl of which *P. heptadactylus* formed 90%. Bulk of the landings in this species was in the length range 110 – 180 mm.

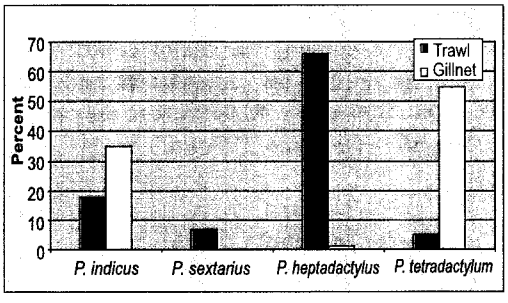


Monthly proportion of gravid and ripe females in *P. hamrur* at Cochin

Polynemus indicus caught in monofilament gillnet of Navibander (Gujarat)



Estimated landings of threadfins along different regions



Proportion of major threadfin species in the trawl and gillnet landings at Veraval

PROJECT CODE **DF/RE/7**
PROJECT TITLE **Biology and fishery of Flatfishes, Goatfishes and Whitefish**
SCIENTISTS **E. Vivekanandan,** V. Gandhi, P.U. Zacharia, Rekha J. Nair, U. Rajkumar
CENTRES Chennai, Mangalore, Cochin, Vizhinjam, Mandapam, Visakhapatnam

Flatfish

At Mangalore, 3490 t were landed. Of the six species landed, *Cynoglossus macrostomus* dominated the catch, contributing 97 %. Bulk of the landings was in the length range 90 – 150 mm. October – December was the peak spawning period of *C. macrostomus* off Mangalore. The catch and catch rate of flatfishes increased during the five-year period from 1997 to 2001 (2236 t to 3490 t) at Mangalore.

At Cochin, six species were landed. Of the 555 t landed by trawlers, 68 % was *C.macrostomus*. The length range in the fishery was 60 – 170 mm.

At Vizhinjam, 34 t was landed by *discovalai*. *C.bilineatus* contributed 74 % to the total catch. The length range in the fishery was 120 - 370 mm.

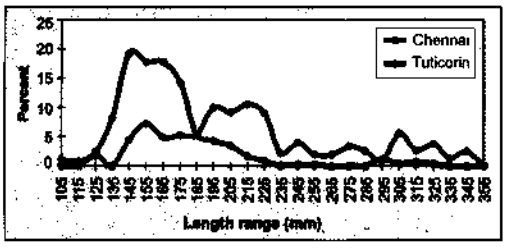
At Mandapam, the estimated landing was 169 t. *C.macrolepidotus* contributed 84 % and *C.bilineatus* 16 %.

Goatfishes

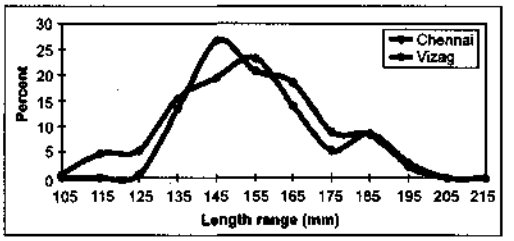
892 t of goatfishes was landed at Mandapam by trawlers. Of the five species landed, *Upeneus sundaicus* (36 %) dominated the landings followed by *U.sulphureus* (10 %) and *U.vittatus* (6 %). The dominant length range of *U. sundaicus* was 95 – 170 mm.

lowed by *O. ruber*. In *Nibea maculata* the modal size was 145mm.

At Visakhapatnam, the estimated catch was 1977 t and the dominant species was *P. macrophthalmus* followed by *O.ruber* and *J. dussumieri*. In *J. carutta* the modal size was 145 mm.



Estimated length frequency distribution in the catch of *O. ruber* in the trawl landings at Chennai and Tuticorin



Estimated length frequency in the catch of *J. carutta* in the trawl landings at Chennai and Visakhapatnam

PROJECT CODE **DF/RE/6**

PROJECT TITLE **Resource characteristics and biology of Lizard fishes, Threadfins, Pomfrets & Bull's eye**

SCIENTISTS **S. Sivakami,** E. Vivekanandan, S. G. Raje, Shobha Joe Kizhakudan, U. Rajkumar

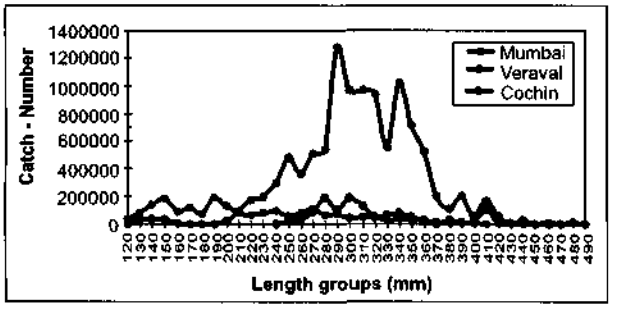
CENTRES Cochin, Mumbai, Veraval, Chennai, Kakinada, Visakhapatnam

Lizardfish

At Veraval, of the 3061 t landed, 94 % was contributed by *Saurida tumbil*. Though the length range of the species in the catch was 130 - 450 mm, the bulk of the catch was in the length range 210 - 360 mm. Of the estimated 11, 87,244 fishes landed, 10, 21,030 were mature.

At Mumbai of the three species contributing to the fishery, *S. tumbil* was dominant. The length range was 140 -320 mm, while fishes of length 120 – 430 mm were encountered in the trawl landings.

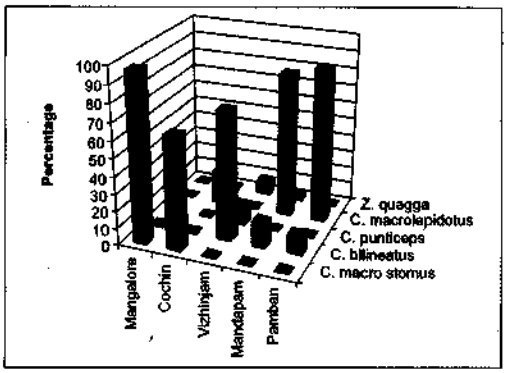
877 t of lizardfish were landed by trawlers at Cochin. Of the four species contributing to the fishery, *S. undosquamis* and *S. tumbil* were dominant. The length range in the catch was 90 – 300 mm and 230 – 480 mm in the two species with the bulk of the catch being in the length range 130 – 250 mm and 260 – 360 mm respectively. October was the peak spawning period for *S. undosquamis* at Cochin; 71 % of the catch landed was in the mature stage.



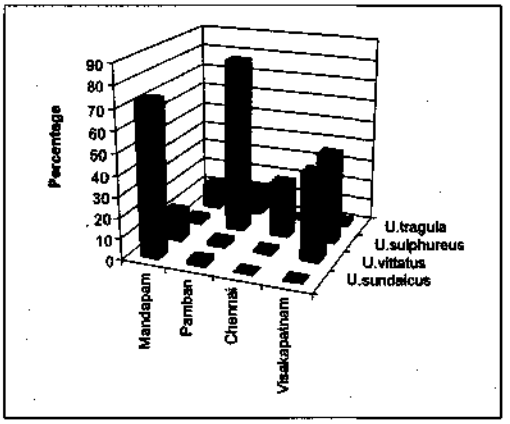
Estimated length frequency distribution in the catch of *Saurida tumbil* in the trawl landings at Veraval, Mumbai and Cochin during 2001

S. undosquamis was the only species landed by trawlers at Chennai and the length range was 100 – 340 mm, with the major portion of the catch in the length range of 140 – 240 mm.

Four species of lizardfishes were landed by trawlers at Vishakapatnam together contributing to



Species composition of flat fishes from different landing centres during 2001



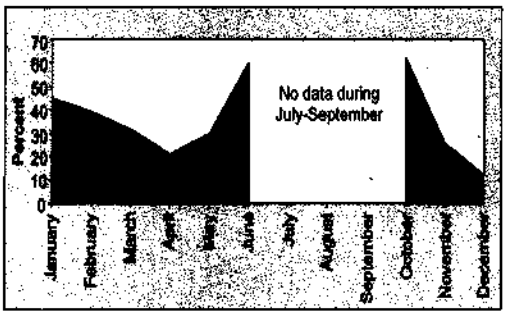
Species composition of goatfishes landed at different landing centres during 2001

At Chennai, 1158 t was landed by trawlers showing a marginal decrease over the previous year. *U.taeniopterus* (38%) and *U.moluccensis* (31%) were dominant in the fishery. The length range of *U.taeniopterus* in the fishery was 100 – 190 mm.

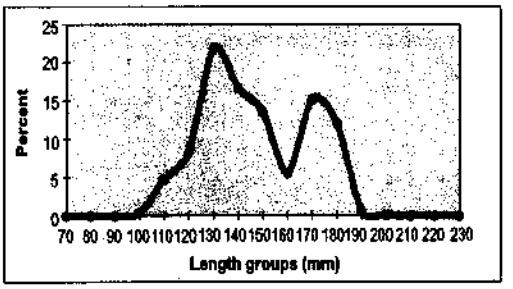
At Vishakapatnam, 1355 t was landed. *U.sulphureus* (42%) and *U.vittatus* (42%) were the dominant species. The length range of *U. sulphureus* was 70 – 180 mm.

Whitefish

The whitefish landings decreased by 35% off Mangalore. The length range and mean length of the exploited population were 80 – 239 mm and 151 mm, respectively. Spawning occurred during November-May with higher intensity during February-April. The food items were *Acetes*, penaeid prawns, crabs and squilla in addition to squids and finfishes such as anchovies and silverbellies.



Monthly proportion of gravid and ripe females in *Lactarius* at Mangalore



Estimated length frequency distribution in the catch of *Lactarius* at Mangalore during 2001

***Lactarius lactarius* in trawl landings of Veraval**

PROJECT CODE DF/TR/1
PROJECT TITLE **Investigations on the impact of coastal bottom trawling on demersal fishes and macrobenthos**
SCIENTISTS **N.G.Menon,** K.V.S.Nair, P.U.Zachariah, P.Nammalwar, I. Jagdish
CENTRES Cochin, Mangalore, Chennai, Mandapam, Karwar, Kakinada

At Karwar, the single day trawlers landed 6833 t consisting of finfishes (40 %), prawns and cephalopods (8 %) and non-edible biota (51%). Stomatopods (93%) and crabs (6%) were the constituents of the non – edible biota. The multiday trawlers landed 35 t comprising of finfishes (82 %), prawns and cephalopods (14 %) and non-edible biota (3 %).

At Mangalore, 2549 t of non-edible biota was landed. Stomatopods formed the major component forming 90 % followed by gastropods (4%), non-edible crabs and bivalves (4 %). The multiday trawlers landed 1683 t of non-edible biota. Stomatopods (69 %), non-edible crabs (8%) and non-edible fishes (5%) were the major constituents.

At Cochin, trawlers landed 8743 t consisting of finfishes (50 %), prawns, lobsters and cephalopods (49 %) and non-edible biota (1%).

At Chennai, juvenile nemipterids formed 37% of the young fish catch followed by silverbellies (31%), rays (16%) and sciaenids (15%). The non-edible biota consisted of stomatopods, gastropods, bivalves, crabs, sea urchin and fishes like *Fistularia, Narcine* sp., *Tetradon* and *Dactyloptera orientalis*.

At Kakinada, of the 30,355 t landed by trawlers, finfishes (66 %), prawns, lobsters and cephalopods (31%) and the non-edible biota (2%) were the constituents. Crabs (54%) and stomatopods (41%) were the major components of the non-edible biota.

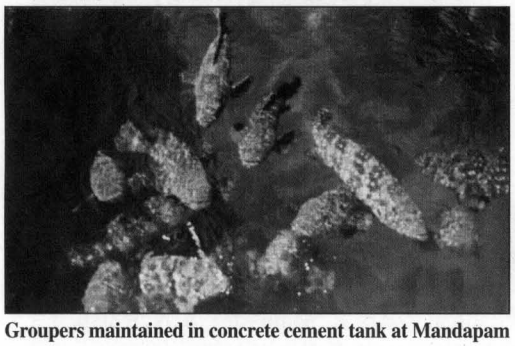
PROJECT CODE DF/CUL/3
PROJECT TITLE **Culture of Groupers, Snappers, Seabreams, Rabbit fish and ornamental fish**
SCIENTISTS **P. Nammalwar,** D.C. V. Easterson, A. Raju, I. Jagadish, I. Rajender, V.S. Rangaswamy, D. Kandaswamy, Grace Mathew, L. Krishnan, Molly Varghese, T. Narender, G. Gopakumar
CENTRES Chennai, Tuticorin, Mandapam Camp, Vizhinjam, Cochin

Groupers

- At Cochin, broodstock of groupers (*Epinephelus malabaricus*) was developed from wild caught juveniles. The fishes are in the 68-70 cm length range. Fishes measuring around 65 –70 cm were chosen for sex inversion to male through hormone administration in pellet form along with feed.
- Sex inversion was obtained in *E.diacanthus* in a period of 40 days by oral feeding with androgens.
- Stock as well as mass culture of live feed organisms, were maintained. Good count (85 rotifers/ml) was noticed in 1 t tanks.
- 29 female groupers (*E. tauvina*) of size range 750-212 g stocked in 0.2 ha earthen pond at Tuticorin during August 1998, were maintained. A total of 810 juveniles (151.5 mm/5.2 g mean size) (*E. tauvina*) were stocked in 0.3 ha earthen pond during December 1998. After a rearing period of 1026 days, the fish grew to a mean size of

5070 mm/1839 g. Further, a total of 35 *E. tauvina* of 85– 208 mm length reared in one-ton capacity FRP tanks, were transported to SRF nylo broodstock pond during January 2001. After a rearing period of 260 days the fish grew to a mean size of 314-mm/57 g. The fishes were fed with fresh trash fish once in two days @ 5% of the body weight in addition to *Tilapia* fingerlings stocked as forage fish during maintenance. Hydrological conditions of the water in the ponds were monitored.

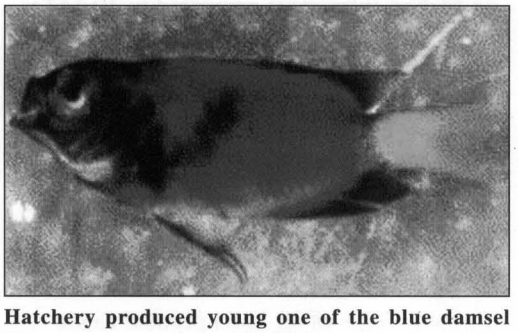
- At Mandapam, the fishes were maintained in 100 t, 40 t and 5 t tanks. The size of brood stock ranged from 400-745 mm/1200-5485 g.



Groupers maintained in concrete cement tank at Mandapam

Ornamental Fishes

Damselfish: Methodologies for breeding and larval rearing of four species of damselfishes viz. *Neopomacentrus filamentosus N. nemurus, Pomacentrus caeruleus* and *P. pavo* were developed on an experimental scale at Vizhinjam.



Hatchery produced young one of the blue damsel *Pomacentrus caeruleus* at Vizhinjam

Several experiments were conducted on the breeding and larval rearing of the peacock damselfish *P. pavo* in one-ton capacity rectangular FRP tank. Egg laying was noted during early morning hours. The male parent guarded the eggs till hatching. The number of eggs ranged from 1500-5000, were capsule shaped, attached to the substratum by one end and measured 1.15 mm in length. Hatching took place on the fourth day immediately after sunset. The survival rate of the damselfish (*P. pavo*) larvae was only 5-6 %.

Facility for clownfish growout experiments at Vizhinjam

Sea-horse: Live seahorses *(Hippocampus kuda)* were collected and maintained in outdoor 5-ton FRP tanks at Tuticorin. One specimen of *H. kuda* released 519 babies during February 2001. The babies of 7 – 9 mm length range attained 123-128 mm after a rearing period of 12 months.

Sea horses collected from wild were maintained in one-ton tank at Mandapam. On the 14th day six fishes released 1200 babies (5-6 mm). They were fed with newly hatched *Artemia* nauplii @ 300 nos/ baby/day. Brood pouches developed in males in the 4th month, when they were of 9-11 cm. From the 5th month, these fishes started producing young.

CRUSTACEAN FISHERIES DIVISION

The Crustacean Fisheries Division implemented eight Institute projects during 2001-2002. Monitoring of the exploited crustacean resources generated a strong database on catch, effort, species composition, size distribution and other biological parameters of commercially important species. Research on seed production and farming of penaeid shrimps, lobsters and crabs was also carried out with the objective of developing hatchery and farming technology. The estimated landings of crustaceans amounted to 3,79,959 t, which accounted for 17.1% of the total marine fish production of India.

The salient findings are:

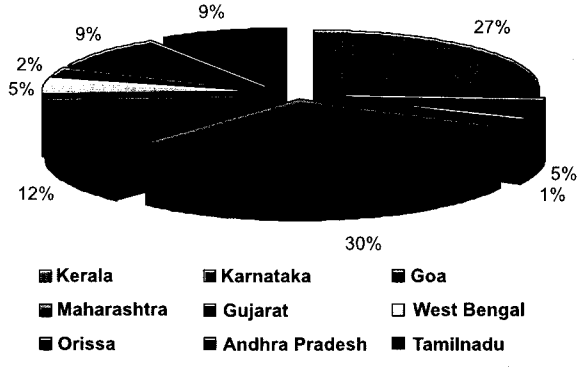
- ▲ Penaeid prawns formed 44.5% of the All India crustacean landings followed by non-penaeid prawns (38.2%), stomatopods (9.2%), crabs (7.8%) and lobsters (0.3%).
- ▲ Artificial reefs were developed along the north Kerala coast to increase fish production.
- ▲ 2.39 million hatchery-produced postlarvae of the green tiger shrimp *Penaeus semisulcatus* were released in Gulf of Mannar as part of a restocking programme.
- ▲ Successfully domesticated and produced three generations of *Penaeus monodon*.
- ▲ Superior quality lobster larvae produced from captive broodstock

PROJECT CODE CF/RE/1.11

PROJECT TITLE **Assessment of fishery and resource characteristics of penaeid shrimps of the west coast of India**

SCIENTISTS **G.Nandakumar**, E.V. Radhakrishnan, Mary K. Manisseri, K.N. Rajan, K.K. Philippose, P.T.Sarada, K.N. Saleela, A.P. Dineshbabu, V.S. Kakati, V.D. Deshmukh and Joe K. Kizhakudan

CENTRES Veraval, Mumbai, Karwar, Mangalore, Calicut, Cochin and Vizhinjam.



State wise Penaeid prawn landings in India during 2001

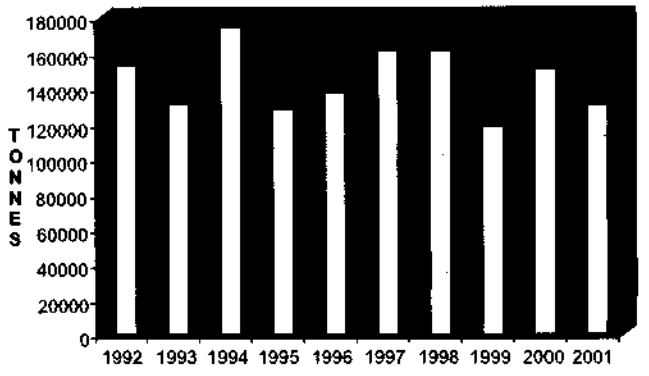
- ❑ At Veraval the estimated penaeid prawn landings by trawlers amounted to 2,979 t. The prawn catch landed at New Ferry Wharf in Maharashtra coast amounted to 10,147 t at a catch rate of 7.2 kg/hr. The catch and catch rate in these two centres declined with decrease in effort in comparison to previous year. *Solenocera crassicornis* and *Parapenaeopsis stylifera* were the main contributors.
- ❑ The estimated penaeid prawn landings along the west coast was 1,23,675 t which formed 73.2% of all India penaeid catch.
- ❑ At Karwar, 551 t of penaeid prawns with catch rate of 8.3 kg/hr were landed showing a marginal increase of 12% in catch

in comparison to 2000. *P. stylifera* and *M. dobsoni* were the major contributors to the fishery.

- The trawlers at Mangalore and Malpe landed 4077 t of penaeid shrimps with a catch rate of 2.3 kg/hr. 52% increase over the last year's catch was observed. *S. crassicornis* was dominant in the fishery followed by *M. monoceros*, *M. dobsoni* and *P. stylifera*. Purseseiners landed 19 t of *M. dobsoni* during January-April.

- Penaeid prawn landings along the west coast declined by 14.5% during 2001 when compared to last year.
- *Solenocera crassicornis* was the main contributor to the penaeid prawn fishery in Gujarat , Maharashtra and South Karnataka.
- *P. stylifera* and *M. dobsoni* were the main constituents of prawn landings along Kerala and North Karnataka coast.
- Failure of *P. stylifera* fishery during monsoon was the main reason for the reduction of prawn landings of Kerala.
- Declining trend of deep-sea prawn catch from 'Quilon Bank' continued during this year.

- The penaeid prawn landings at Calicut amounted to 938 t with a catch rate of 53.4 kg/unit. *M. dobsoni*, *P. stylifera*, *P. indicus* and *M. monoceros* were the important constituents of the prawn fishery.
- The estimated prawn landings at Cochin Fisheries Harbour from the 15-60 m depth range was 2989 t with a catch rate of 7.8 kg/hr. The catch showed a drastic reduction of 54% when compared to last year. *M. dobsoni* and *P. stylifera* were the main contributors to the fishery. Peak months of prawn fishery were April, May and August.
- The estimated landings by trawlers at Neendakara-Sakthikulangara was 8545 t at a catch rate of 8.1 kg/hr. The catch decreased by 42% over the previous year. *P. stylifera* and *M. dobsoni* were the important constituents.
- Size range of *S. crassicornis*, *P. stylifera* and *M. dobsoni* in the fishery was 46-125 mm, 51-140 mm and 46-121 mm, respectively.
- The peak spawning season was February-May for *S. crassicornis* and January-April for *M. dobsoni*. There were two peak spawning durations for *P. stylifera* (January-March and August-November).
- During monsoon season ringseine operation in the nearshore areas yielded good quantities of penaeids along South Kanara and Calicut coasts. *M. dobsoni* and *P. indicus* were the contributors to the fishery.
- *P. indicus* in the size range of 126-180 mm contributed to prawn fishery exploited by trammel net and bottom set gillnet along



Penaeid prawn landings along west coast of India during 1992-2001

Vizhinjam-Manakudy coast during May-August.

- The main contributor to the juvenile prawn fishery exploited by stake nets in Cochin backwaters and Korapuzha estuary (Calicut) was *M. dobsoni* of size range 26-80 mm.The estimated catch amounted to 400 t in the former centre and 110 t in the latter.
- The deep sea prawn landings at Cochin amounted to 804 t with a catch rate of 19.8 kg/hr. There was a reduction of 77% in catch in comparison to last year. The penaeids, *Aristeus alcocki*, and *Metapenaeopsis andamanensis* and pandalids, *Heterocarpus gibbosus* , *H. woodmasoni* and *Plesionika spinipes* were the main constituents of the fishery. The deep-sea prawn catch at Sakthikulangara was 9511 t at a catch rate of 44.1 kg/hr. The catch showed a decline of 33 %. However in this centre the pandalids dominated the fishery. The multiday fishing trawlers landed 370 t of deep-sea prawns at Mangalore and *A. alcocki* was the predominant species.

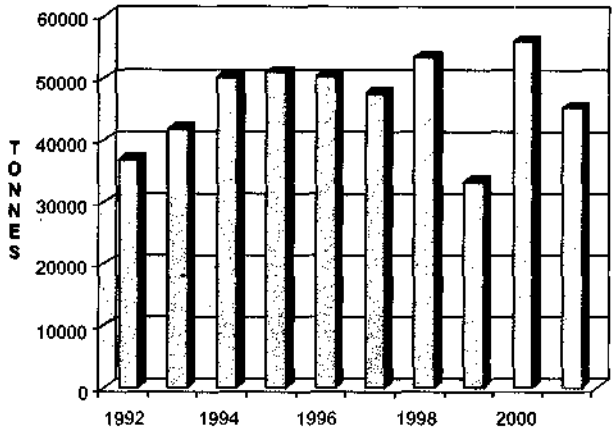
PROJECT CODE **CF/RE/1.12**

PROJECT TITLE **Assessment of fishery and resource characteristics of the penaeid shrimps of the east coast of India**

SCIENTISTS **G. Maheswarudu**, M. Rajamani, K.R. Manmadhan Nair, Miriam Paul and K. Asokakumaran Unnithan

CENTRES Visakhapatnam, Tuticorin, Mandapam Camp, Chennai and Kakinada.

- At Tuticorin the penaeid prawn landings amounted to 318 t. The fishery was supported mainly by *Penaeus semisulcatus* and *P. indicus*.
- At Mandapam, an estimated catch of 618 t of penaeid prawns were landed with a catch rate of 1.4 kg/hr. Five species contributed to the fishery of which *P. semisulcatus* was dominant followed by *Metapenaeopsis stridulans*. The peak fishing season for *M. stridulans* was June-September. Monthly mean length of *P. semisulcatus* ranged from 123 mm to 154 mm.
- At Chennai, the prawn fishery was constituted by nineteen species of which *Metapenaeus dobsoni* and *P. indicus* were dominant followed by *M. monoceros, P. semisulcatus, M. stridulans, P. monodon* and others. The prawn catch was 2487 t with a catch rate of 3.3 kg/hr.
  - Trawling ban was observed for 45 days during April-May in Tamilnadu and Andhra Pradesh
  - Increase in prawn landings along south-east coast was due to the enhanced catch of *P. semisulcatus*.
  - *Thalluvalai* at Mandapam and *Thallumadi* at Tuticorin continued their exploitation of juvenile green tiger prawns from their nursery grounds in the nearshore waters.
- At Kakinada, the fishery was supported by several species and the estimated catch was 7465 t showing a marginal decrease of 3% over last year. *M. dobsoni* and *M. monoceros* together contributed 58% of the catch. *P. indicus, P. monodon, P. semisulcatus, P. merguiensis* and *P. japonicus* formed 3.3% of the catch. Dominant size group of male and female of *M. dobsoni* was 66-70 mm



Penaeid prawn landings along east coast of India during 1992-2001

and 76-80 mm, respectively. This species spawns throughout the year with peak season during February-April. Dominant size group of male and female of *M. monoceros* was 86-90 mm and 91-95 mm, respectively.

- At Visakhapatnam, the fishery was supported by eighteen species of which *M. monoceros* dominated the catch and this species breeds throughout the year. Shrimp landings by *Sona* boats decreased by 42.6% i.e. from 2456 t in 2000 to 1408 t in 2001.

- An estimated 77 t of juvenile penaeid shrimps were landed from Kakinada backwaters by stake nets and drag nets. *M. monoceros, M. dobsoni, P. indicus, P. monodon, M. brevicornis* and *M. affinis* contributed to the fishery in the order of abundance.

- At Mandapam, 9 t of *P. semisulcatus* was landed by *Thalluvalai* with cph of 0.26 kg. Catch declined by 42 % over the previous year. At Tuticorin the estimated catch of *thallumadi* was 11 t with a catch rate of 2.3 kg. registering a decline of 36 % over the previous year and *P. semisulcatus* dominated the catch. Gillnets caught 213 t of *P. indicus* at Tuticorin with a cpue of 9.8 kg.

- During this year, 1795 t of deepsea prawns were landed by trawlers at Tuticorin with a cpue of 918 kg. *Plesionika* spp. and *Heterocarpus* spp. dominated the catch.

PROJECT CODE CF/RE/1.13
PROJECT TITLE **Investigations on the non-penaeid shrimp fishery of the northwest coast of India**
SCIENTISTS **V.D. Deshmukh** and Joe K. Kizhakudan
CENTRES Mumbai and Veraval

- Non-penaeid prawns are largely exploited by 'dol' nets and trawlers in Maharashtra and Gujarat states.

- At Versova, 'dol' nets landed 1,301 t of non-penaeid prawns at the catch rate of 29.9 kg/haul, registering 18% decline in annual catch and 6% decline in catch rate as compared to the previous year. The catch was mainly constituted by *Acetes* spp. followed by *Nematopalaemon tenuipes* and *Exhippolysmata ensirostris* .

- On account of lower returns from 'dol' net fishing, the units based at Versova are being converted into trawlers. The number of units declined to 21 at present from 170 about a decade ago.

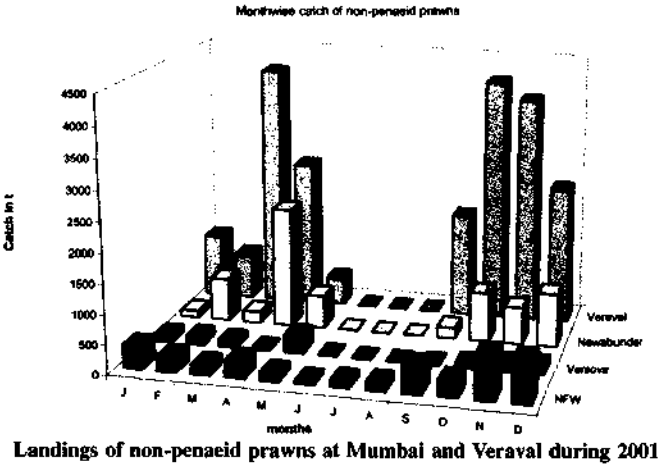
- The maximum sustainable yield of non-penaeids from the entire northwest coast was estimated to be 1.41 lakh t which is just 20% more than the present average annual catch of 1.14 lakh t.

- As exploitation of these shrimps is not economical, but they being important forage organisms for Bombayduck as well as for majority of pelagic and demersal fishes, further exploitation of this resource is not advised.

- Estimated 3,840 t of *N. tenuipes* was landed by the trawlers at New Ferry Wharf at the catch rate of 2.7 kg/hour registering marginal decline in annual catch as well as catch rate. Almost 40% of the annual catch was landed in November-December period. At Versova, although trawling effort increased by 3.1%, the catch of non-penaeid prawns increased by 130%.

- In Gujarat, at Nawabunder 'dol' nets landed 6189 t of non-penaeid prawns at the catch rate of 22.4 kg/haul. These shrimps contributed 32% to the total landing by the 'dol' nets. When compared to previous year, the catch recorded 55% decline. *Acetes* spp. and *N. tenuipes* were the major constituents. Trawlers at Veraval landed 21011 t of non-penaeid prawns contributing 21% to the total fish landed by the gear. A marginal decline of 1% as compared to the previous year was seen in the landings. The catch consisted mainly *Acetes* spp.

- Size of *N. tenuipes* in 'dol' nets ranged from 27mm to 69 mm. Maximum percentage of berried females was observed in September at New Ferry Wharf and in November at Nawabunder.



Landings of non-penaeid prawns at Mumbai and Veraval during 2001

- At Nawabunder, the size of *E. ensirostris* ranged between 36 mm and 98 mm and the 71-80 mm size group formed the mainstay of the fishery. Berried individuals occurred maximum in August.

- Analysis of catch and effort data for 1991-2000 period from Gujarat and Maharashtra by Schaefer-Fox model showed that maximum sustainable yield (MSY) is 76,500 t for Gujarat and 64,700 t for Maharashtra.

PROJECT CODE CF/RE/1.14

PROJECT TITLE **Investigations on exploitation, management and conservation of the lobster and crab resources of India**

SCIENTISTS **Mary K. Manisseri**, E.V.Radhakrishnan, V.D.Deshmukh, V.S.Kakati, M.Rajamani, K.R.Manmadhan Nair, K.K. Sukumaran, K.Asokakumaran Unnithan, K. K. Philippose, A.P.Dineshbabu, K.N.Saleela, P.T.Sarada and Joe K. Kizhakudan

CENTRES Veraval, Mumbai, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam, Chennai and Kakinada.

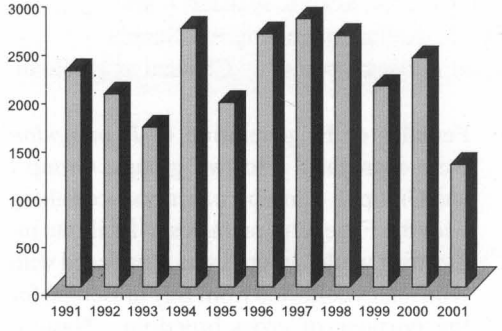
- The provisionally estimated total landing of lobsters during the year 2001 was 1283 t as against 2387 t in 2000 and 2093 t in 1999. Catch was better (39.59%) during the first quarter of the year.

- Maximum landing of lobsters was reported from Maharashtra (39.44%) followed by Gujarat (23.15%) and Kerala (20.58%). The landings in Kerala and Karnataka improved due to the catch of the deep-sea lobster, *Puerulus sewelli*.

- Total landing of lobsters by trawl net at Veraval was 46 t. 62% of the catch was constituted by *Thenus orientalis* and the remaining by *Panulirus polyphagus*. The sizes ranged from 21 to 105 mm (CL) in *T. orientalis* and from 21 to 115 mm in *P. polyphagus*.

- At New Ferry Wharf, Mumbai the total landing of lobsters was 62 t at a cpue of 2.55 kg. The catch was almost entirely constituted by *P. polyphagus* ranging in size from 75 mm to 385 mm (TL).

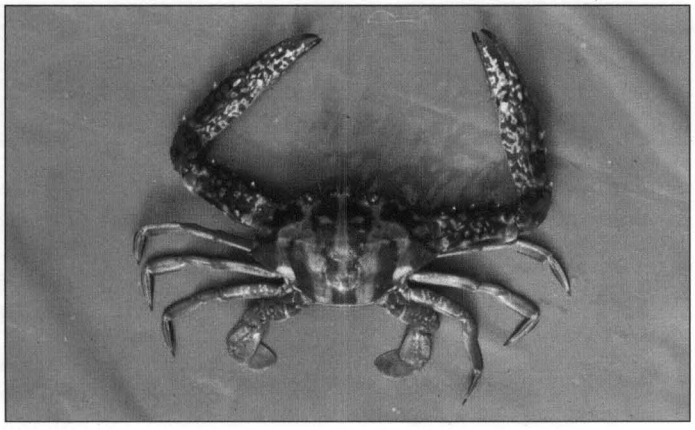
- At Mangalore, the multi-day trawlers operating beyond 300 m depth, landed 77 t of deep-sea lobsters (*Puerulus* spp. and *Nephropsis* spp). The total estimated landing of *P. sewelli* in Kerala in 2001 was 238 t. Maximum landing was noticed at Sakthikulangara (161 t) followed by Neendakara (48 t).



Lobster landings (t) in India during 1991-2001

The total landing of crabs during the year 2001 was 29,563 t as against 48,259 t in 2000 and 27,547 t in 1999. Landing about 10422 t, Tamilnadu contributed maximum to the fishery.

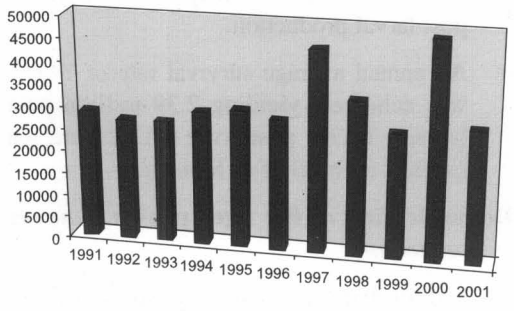
- The southeast region contributed maximum (46%) to the fishery for edible crabs followed by the northwest region (24.8%). Maximum landing was reported during the first quarter.



Marine crab *Charybdis feriatus*

- 759 t of crabs were landed by trawlers at Chennai with a catch rate of 0.78 kg/h. *Portunus sanguinolentus* with sizes ranging from 46 mm to 160 mm predominated the fishery (46%). 62% of the catch was constituted by females.

- *Charybdis feriatus* predominated the fishery of edible crabs at Veraval and Mumbai, *P. pelagicus* at Karwar, Tuticorin and Mandapam and *P. sanguinolentus* at Mangalore, Calicut, Cochin, Vizhinjam, Chennai and Kakinada.



Crab landings (t) in India during 1991-2001

PROJECT CODE CF/RE/3
PROJECT TITLE **Development of artificial reefs**
SCIENTISTS **M. Rajamani** and K.K. Philippose
CENTRES Tuticorin and Calicut

- Artificial reefs were installed to study their utility in increasing fish production.
- Two artificial reefs were developed at Moodadi and Thikkodi in Kozhikode district, Kerala.
- Each reef was developed using 100 modules in a rectangular design of 100 m x 50 m dimension and installed at a depth of 15 metres. The entire reef installation was carried out with the involvement of the local body and a committee constituted from the fishermen community.
- Fishery observations in the reef area indicated assemblage of pelagic and demersal fishes.
- At Tuticorin, experiments on the utilization of fly-ash in artificial reef technology using fly-ash based bricks were initiated. Transplantation trials of seaweeds on these bricks showed good settlement.
- A training programme on Artificial reef was conducted at Tuticorin in collaboration with M.S. Swaminathan Research Foundation, Chennai for the benefit of local fishermen and members of Non-Governmental Organization under MSSRF's scheme for promotion of alternative livelihood for the poor in the Biosphere of Gulf of Mannar.

PROJECT CODE CF/CUL/1.9
PROJECT TITLE **Seed production, experimental farming and tagging of marine prawns**
SCIENTISTS **V.S. Kakati**, E.V.Radhakrishnan, G. Nandakumar, K.R. Manmadhan Nair, P.E. Sampson Manickam, Josileen Jose, G.Maheswarudu, Miriam Paul, N. Kaliaperumal and P.T. Sarada
CENTRES Karwar, Cochin, Mandapam Camp, Visakhapatnam, Chennai and Calicut

Penaeus semisulcatus

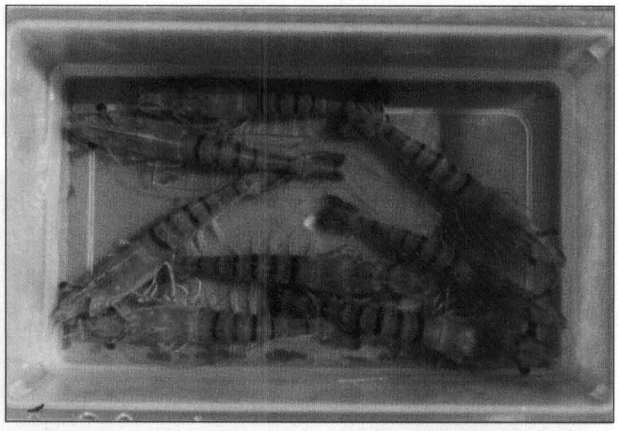
- 30 larval rearing runs were carried out and a total of 30,53,6000 nauplii were used for post larval production.
- An annual average survival rate of 74.6% was achieved, yielding 2.39 million post larvae. These postlarvae (PL_{20}) were sea ranched in the Gulf of Mannar.

Domestication of the tiger prawn *Penaeus monodon*

- Induced maturation and spawning of domesticated F_2 generation *P. monodon* by artificial insemination and eyestalk ablation was successfully carried out.
- Females of F_2 generation of *P. monodon* were segregated into two groups: Group I and Group II. Group I was introduced along with the F_2 generation males to facilitate in-breeding while Group II was introduced with wild males collected from Bay of Bengal for the purpose of cross-breeding. Natural mating did not take place and hence artificial insemination was carried out.
- Induced maturation and breeding of *P. monodon* by artificial insemination and eyestalk ablation standardized.
- Successful domestication of *P. monodon* achieved through application of artificial insemination and eyestalk ablation

techniques

- F_2 generation seeds stocked in a farmer's pond attained 18 g in 65 days but got infected with white spot virus. Seeds obtained from a hatchery and stocked in a nearby pond were infected after 50 days.
- F_3 generation attained an average 63 g in captivity in 15 months.
- The F_3 generation postlarvae were reared for 15 months in captivity after eliminating slow growing ones. The shrimp attained an average weight of 71 g (females) and 56 g (males). 20 females and 10 males are currently maintained for producing the F_4 generation.
- The F_2 generation (Group II) were also induced to mature and spawn. All the females responded to eyestalk ablation. One of the females spawned six times during 3 moult cycles. The postlarvae obtained are maintained for producing F_4 generation.



F_3 generation *Panaeus monodon*

PROJECT CODE	**CF/CUL/1.10**
PROJECT TITLE	**Broodstock development, seed production and fattening of commercially important spiny and sand lobsters**
SCIENTISTS	**E.V.Radhakrishnan**, M. Rajamani, K.K. Philippose, S. Lakshmi Pillai, Joe K. Kizhakudan and K.N. Saleela
CENTRES	Cochin, Tuticorin, Calicut, Veraval and Vizhinjam

Breeding of captive lobsters and larval rearing

- Broodstock exposed to a light intensity of 100-120 lux show increased breeding activity compared to a higher light intensity of 700 lux.
- Captive broodstock produced lesser number of eggs per brood compared to lobsters of similar size from the wild.
- Higher hatching percentage and healthier larvae obtained from captive broodstock.
- Performance of larvae obtained from wild breeders was inferior due to handling stress and prolonged exposure of eggs outside the water.
- Fecundity is a factor of nutritional quality of broodstock feed.
- Phyllosoma larvae of *P. homarus* reared upto stage 5. Larvae fed with artificial feed showed lesser survival (20%) in stage 1 compared to *Artemia* nauplii feed.
- Point of No Return (PNR) for the first stage phyllosoma larva was 48 hours.
- Point of Reserve Saturation (PRS) was estimated as 48 hours for phyllosoma larvae of *Panulirus homarus*.
- 66% of the larvae moulted to stage 2 when fed initially to a minimum of 48 hrs and thereafter on discontinuation of feeding.

- Phyllosoma larvae are to be fed within 48 hours after hatching and needed daily feeding for successful moulting and growth.
- Stage 1 Phyllosoma larvae failed to moult to stage 2 at a salinity of 25 ppt.
- At higher salinities of 40 and 45 ppt, moulting to stage 2 was delayed and failed to proceed to stage 3.

Spiny lobster *Panulirus homarus* fattened in indoor growout system

- The optimum salinity range for moulting and higher survival of larvae was 30-35 ppt.
- Value addition to young lobsters (< 100 g) by fattening profitable.
- Fattening of different sizes, 2.5 g, 89 g and 428g in captivity yielded 122 g, 360 g and 647 g in 210, 312 and 424 days, respectively.
- The price difference between a low priced smaller grade (< 100 g) to a high priced larger grade (> 100 g) is three fold.

PROJECT CODE	**CF/CUL/1.11**
PROJECT TITLE	**Mariculture of crabs**
SCIENTISTS	**K.R.Manmadhan Nair**, P.E. Sampson Manickam, Miriam Paul, S. Lakshmi Pillai, P.T. Sarada, G. Maheswarudu and Josileen Jose
CENTRES	Cochin, Calicut, Mandapam, Vishakapatnam

★ Breeding and rearing of larvae of the blue swimming crab *Portunus pelagicus* were continued. 210 baby crabs produced from a single experiment. Attempts to improve the survival rate are progressing.

★ Broodstock of the mud crab *Scylla tranquebarica* maintained in a recirculation system attained maturity and spawned.

★ A total of 51.4 million zoea were produced.

★ Low survival due to high mortality in first zoeal stage and high cannibalism in megalopa stage.

★ *S. tranquebarica* in indoor grow out system without shelter showed cannibalism. Survival improved on providing shelter.

MOLLUSCAN FISHERIES DIVISION

During the year 2001 the Molluscan Fisheries Division implemented 10 Institute projects, two on fishery resource characteristics and eight on mariculture. The Division also has implemented the two National Agricultural Technology Projects, 4 AP Cess Fund projects, 1 ICAR Revolving fund project and 2 Projects funded by the International Foundation for Science.

PROJECT CODE MF/RE/1
PROJECT TITLE **Investigations on the resource characteristics of cephalopods**
SCIENTISTS **M.M. Meiyappan,** R. Sarvesan, Geetha Sasikumar, P.K. Asokan, Sujitha Thomas, K.S. Mohamed, V. Kripa, M.K. Anil, A.C.C. Victor, B. Ignatius, G.S. Rao
CENTRES Mangalore, Calicut, Cochin, Vizhinjam, Mandapam, Tuticorin, Chennai, Kakinada and Visakhapatnam

Studies on the resource characteristics of cephalopods exploited from the traditional fishing grounds by commercial fishing fleets was continued from 4 centres each along the west and east coasts. Trawl net was the chief gear in all the centres except Vizhinjam where the entire catch came from indigenous gears viz., boat seines and hooks & line operated from mechanized and non-mechanized crafts.

Production: The west coast accounted for the bulk of the landings. Multi-day trawlers and daily voyage trawlers with the former contributing bulk of the landings contributed the catch in all centres. There was ban on mechanized fishing for two months along the west coast during monsoon period. Along the east coast Andhra Pradesh and Tamilnadu implemented the ban during April and May.

Cephalopod production estimates from different centres

Centre	Catch (tonnes)	C/U (kg)	% in AF	Squids (%)	Cuttlefishes (%)	Octopus (%)
Mangalore	3644	100	8	55	45	0
Malpe	1387	57	6	75	25	0
Calicut						
Puthiyappa	1877	107	11	56	43	1
Beypore	1405	96	11	39	60	1
Cochin	2064	166	9	36	60	4
Vypeen	848	78	11			
Sakthikulangara	4828	112	16			
Neendakara	5645	107	10			
Tuticorin	889	26	6	22	78	0
Mandapam	440	23	7	27	56	17

Rameswaram	777	13	5	25	57	18
Chennai	847	24	4	42	57	1
Kakinada	624		2	14	86	0
Visakhapatnam	402		2	32	68	0
Vizhinjam						
H&L (mech)	395	5	8	68	32	0
H&L (Non-mech)	4	1	4	92	8	0
Boat Seine	46	4	2	100	0	0
Gillnet	6	26	94	100	0	0
All India	101465		4.4	52.2	45	2.8

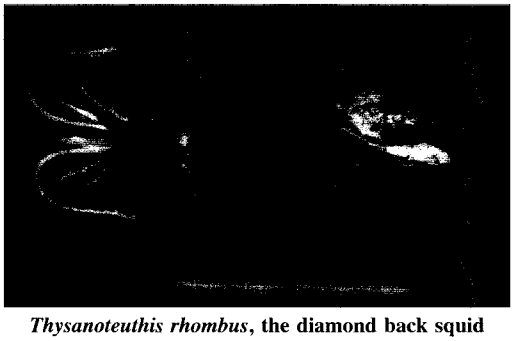
When compared with production statistics of the year 2000, the landings at Mangalore declined by 25%, Malpe 43%, Beypore 32%, 24% at Cochin, 45% at Vypeen, 31% at Sakthikulangara, 21% at Neendakara, Mandapam 19% Rameswaram 18% and Vizhinjam 52%.

Seasonal abundance: Periods of peak abundance of cephalopods as reflected by the catch rates at different centres are shown below:

Centre	Period
Mangalore	January, September
Malpe	April, September
Puthiyappa	March, August-October
Beypore	May, August, September, November
Cochin	March, August, September
Vizhinjam	August, September
Mandapam	June, July-September
Rameswaram	June, July
Chennai	October-November
Kakinada	September-October
Visakhapatnam	April, October

Along the west coast, peak abundance was noticed during the post monsoon period while it was monsoon and pre-monsoon along the east coast.

Species composition: Among squids, *Loligo* sp. dominated catches at all centres except Tuticorin, Rameswaram and Mandapam where *Sepioteuthis lessoniana* was the dominant species. *Doryteuthis* sp. formed a substantial percentage of the catch at Cochin, Tuticorin, Chennai and Vizhinjam. Among cuttlefishes, *Sepia pharaonis* dominated catches at all centres except Calicut, Kakinada and Visakhapatnam, where *S. aculeata* was the dominant species. The octopus catch at Chennai was composed of *Octopus dolfusi* (45%) and *Cistopus indicus* (55%) and at Cochin *O.membranaceous* constituted 69%, *O. dolfusi* 18%, *O. lobensis* 7% and *Cistopus indicus* 4%.



Thysanoteuthis rhombus*, the diamond back squid (450 mm DML) caught off Alleppey at 300 m depth by FORV *Sagar Sampada

Biological Characteristics: In *S. pharaonis*, the size varied from 40 to 390 mm at Cochin. At Vizhinjam, it varied between 180 and 380 mm with mean sizes between 184 mm and 277 mm. Sexes were in equal proportion

Species compositions (%) of Squids and Cuttlefishes at different centres

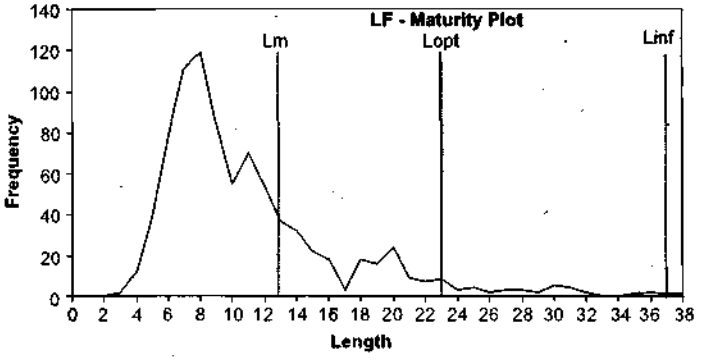
Centre	L.d	L.u	D.sib	D.sin	S.L	SA	SP	SE	SB	SPR	SI
Mangalore	100						71	19		7	3
Malpe	100						67	22		9	2
Puthiyappa	100					51	49				
Beypore	100					50	38				12
Cochin	58		30	12		1	88	5		2	4
Tuticorin	12		39		49		19	60	8	13	
Mandapam	9				91						
Rameswaram	26				74						
Chennai	62	5	33			21	72		2	1	4
Kakinada	89	4	6				51	29	2	1	17
Visakhapatnam	100						47	38			15
Vizhinjam	4		15	81				100			

KEY: L.d: *Loligo duvauceli* **L.u**: *Loligo uyii* **D.sib**: *Doryteuthis sibogae* **D.sin**: *Doryteuthis singhalensis*, **S.L:** *Sepioteuthis lessoniana* **SA**: *Sepia aculeata* **SP**: *Sepia pharaonis* **SE**: *Sepia elliptica* **SB**: *Sepia brevimana*, **SPR**: *Sepia prashadi* **SI**: *Sepiella inermis*

during February, March and December. Females out numbered males in all months except August. Mature cuttlefishes were dominant almost throughout the year except in August – September. The size range was 90 - 250 mm with mean sizes between 144 and 179 mm in Kakinada waters.

Stock Dynamics:

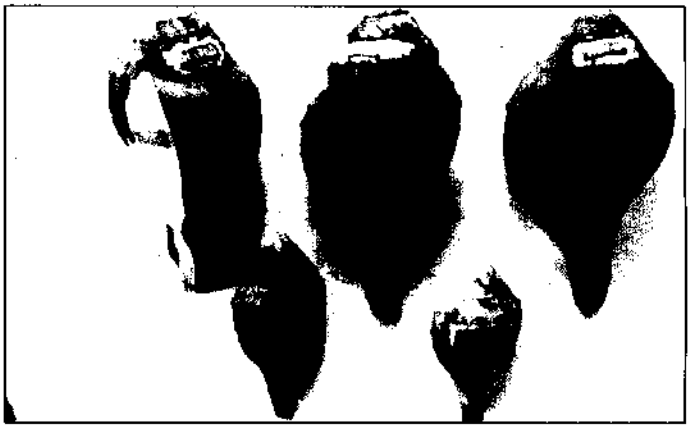
The exploitation rate of *L. duvauceli* at Cochin showed decline from 0.72 in 2000 to 0.57 during 2001, while the exploitation rate of *S. pharaonis* and *O. membraneaceous* showed considerable increase. The decreased abundance of *L. duvauceli* in the grounds off Cochin is very evident. The annual length frequency maturity plot of *L. duvauceli* shows that the bulk of the exploitation is taking place at very small sizes even before the length at first maturity (Lm) of females. The estimated optimum length for capture (Lopt) is 23 cm. The status of cephalopod stocks, especially squid and cuttlefish needs to be carefully monitored along the Kerala coast.



Annual length-frequency maturity plot of *L. duvauceli*

PROJECT CODE MF/RE/2
PROJECT TITLE **Investigations on the resource characteristics of bivalves and gastropods**
SCIENTISTS **K. Ramadoss,** T.S. Velayudhan, V. Kripa, P. Laxmilatha, Shoji Joseph, N. Ramachandran, P.V. Sreenivasan, R. Sarvesan, P. Natarajan, P.K. Asokan, Sujitha Thomas, Geeta Sasikumar, Boby Ignatius.
CENTRES Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Mandapam Camp, Tuticorin, Kakinada,Chennai, Vishakapatnam,

- The total bivalve landings was estimated as 55343 t with clams contributing 39513 t (73%), mussels 14,216 t (26 %) and oysters 591 (1%) t.
- The total biomass of *Villorita cyprinoides* in 200 ha area in Vaikom *kayal* in Kerala was estimated as 1877 t with an average biomass of 1.1 kg per sq.m.
- In Uppanaru estuary, the bivalve biomass was estimated as 932.5 t in 18.18 ha with *Crassostrea madrasensis* forming 72.9%, *Perna viridis* 21.8% and *Meretrix casta* 5.3%.
- In Kandaleru estuary, the bivalve biomass was estimated as 574.1 t in 58.7 ha with clams (*Anadara granosa, Meretrix casta, Marcia opima,* and *M.meretrix)* forming 96.5 %, edible oyster 4% and green mussel 0.6%. In both the estuaries, these resources are utilized by the local people.
- The gastropod landing was estimated as 665 t mainly contributed by the sacred chank *Xancus pyrum* and the elephant chank, *Chicoreus ramosus* .
- 7.05 lakh sacred chank *Xancus pyrum* (app 5,64 t) and 1.16 lakhs of the elephant chank, *Chicoreus ramosus* (approx 92 t) were fished from the Tamilnadu coast. In Kakinada, 43.74 t of *Cerithidea* and 2.32 t of *Telescopium* were also landed.
- The major landing centers for chanks were Tuticorin, Keelakarai, Rameswaram and Mandapam. The chanks were fished by bottom set gill nets and by diving.
- 192 chanks were tagged and searanched at a depth of 7 meters in the Gulf of Mannar. 4 chanks which were ranched earlier were recaptured.

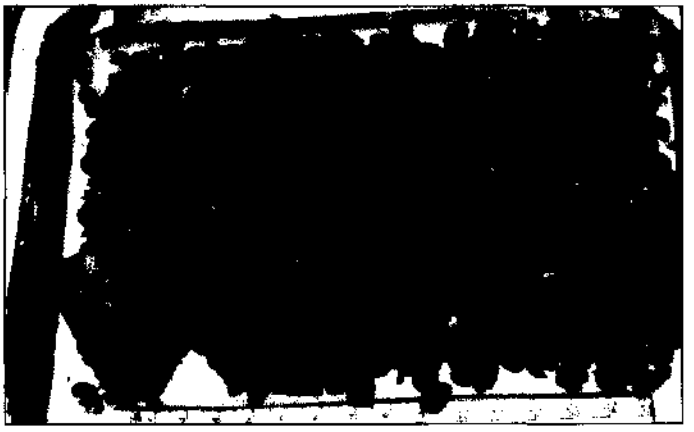


Tagged and recovered *Xancus pyrum*

- Adult chanks (brood stock) were maintained in the hatchery to study the egg case release, larval development and growth of baby chanks. 7 chanks released egg capsules in the laboratory and produced baby chanks. The average length of baby chanks increased from 29.17mm to 41.98 mm with a corresponding average weight of 2.55 g to 9.03 g. when earth worms were used as feed.

PROJECT CODE MF/CUL/4
PROJECT TITLE **Seed production and ranching of bivalve molluscs in coastal waters**
SCIENTISTS S. Dharmaraj, K. Ramadoss, P. Muthiah, A. Chellam, P. Laxmilatha and N. Ramachandran
CENTRES Cochin, Vizhinjam, Tuticorin

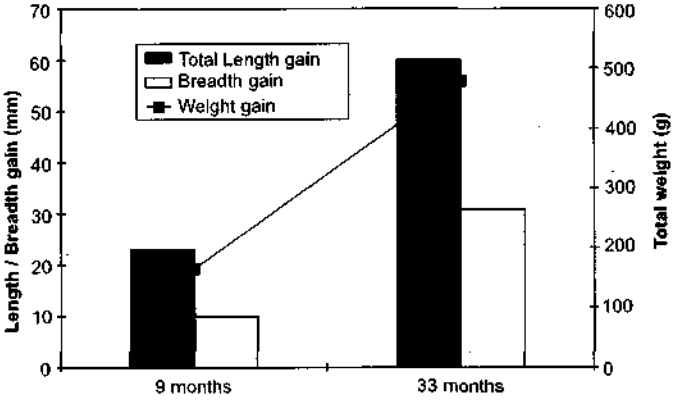
A total of 5.31 lakh bivalve spat viz. 2.6 lakh spat of *Pinctada fucata*, 1.29 lakh of *Paphia malabarica* and 1.42 lakh spat of *Crassostrea madrasensis* was produced in the molluscan hatchery at Tuticorin. From this, 6500 and 1000 pearl oyster spat were supplied to the CMFRI pearl farms at Lakshadweep and Vizhinjam respectively. The rest were sea ranched in suitable areas in Tamil Nadu and Kerala for survival studies.



Hatchery produced seed of *Marcia opima*

Standardization of larval rearing protocol of *Paphia malabarica* was done. Experiments conducted to standardize the larval protocol of *P. malabarica* gave the following results :

- 33 ppt was found to be the ideal salinity for larval rearing and 25 ppt for rearing of spat with maximum survival rate.
- *Isochrysis* was found to be the best algal feed for larvae with a survival 14 % (length -185im). The survival was 1.42 % (length - 184 im) with *Chaetoceros* and 100 % mortality for *Nannochloropsis*. Growth was almost similar in the first two diets.
- The optimum feed requirement for the larvae was identified as 4000 cells of *Isochrysis* / larvae/day which gave 32% survival. The survival in different cell concentrations ranged from 0.6 % to 18 %.



Growth attained by tagged and ranched chanks which were recaptured after 9 and 33 months

PROJECT CODE MF/CUL/8
PROJECT TITLE **Technological feasibility of bivalve culture at selected centres**
SCIENTISTS **R. Sarvesan**, P.V. Sreenivasan, P. Natarajan, G. Syda Rao, Geeta Sasikumar, P.K. Krishnakumar, K.Ramadoss and P.Muthiah
CENTRES Mangalore, Tuticorin, Chennai, Vishakapatnam

Clam culture in Tamilnadu, oyster culture in Andhra Pradesh and mussel culture in Karnataka were undertaken in different sites to demonstrate the techno economic viability of bivalve farming.

- 40 kg (40,000 nos) of *M. casta* with average length of 13.2 mm collected from Vellar estuary were transplanted in Palar estuary during June in a demarcated area (8 x 5 m) at the rate of 1 kg/m². The clams transplanted showed a growth of 27.4 mm in 8 months from June to February 2002 at the rate of 3.4 mm per month.
- In Bhimili backwaters in Andhra Pradesh, good spat settlement of *C. madrasensis* was observed in June. By the end of December 2001 the oysters reached a size of about 62 mm weighing 40 gm which indicated that the edible oyster culture is possible in this area.
- At Byndoor in Karnataka a demonstration programme on open sea mussel farming was taken up. The fabrication of raft and seeding was done with the help and involvement of fishermen. The average growth of mussel was 7.35 mm / month. The production per meter of the rope ranged from 2.36 to 5.32 kg.
- The hatchery produced seed of *M. opima* (520 nos of length 6.5– 4.3 mm) were ranched in Punnakkayal estuary and 16,948 seed of average size of 5.5mm were ranched in Tuticorin Bay (Total 17,500 nos).
- 22,300 seed of edible oyster were ranched in the Punnakkayal estuary and 5650 seed in Karapad creek (Total – 28,000 nos).

PROJECT CODE MF/CUL/10
PROJECT TITLE **Upgradation and transfer of pearl culture technology**
SCIENTISTS **A.C.C. Victor**, A. Chellam, S. Dharmaraj, I. Jagadis and Boby Ignatius
CENTRES Mandapam Camp, Tuticorin

The experiments on testing the efficiency of different materials for fabrication of cages for pearl farming and effect of stocking density (SD) on the growth and survival of *Pinctada fucata* were continued.

- The growth of *Pinctada fucata* was higher in Gulf of Mannar (5.5 to 6.0 mm/month) than in Palk Bay (4.5mm /month).
- Among the three stocking densities, *viz.* 1000, 2500 and 5000 nos per cage, the growth in length and weight and the survival of pearl oysters was highest in the first after 9 and 15 months. At the end of 15 months the spat reached implantable size.
- Nucleated oysters were maintained in onshore tanks by providing a mixed feed of *Chlorella* sp. + *Chaetoceros* sp. + *Isochrysis*. The pearl nacre coating on these oysters was thin.
- In the 1000 nos *Pinctada chemnitzi* stocked in the pearl farm in Gulf of Mannar, 25% survival has been recorded.

PROJECT CODE	**MF/CUL/11**
PROJECT TITLE	**Popularisation and transfer of bivalve culture technology at selected centres along Kerala coast**
SCIENTISTS	**K.K. Appukuttan**, T.S. Velayudhan, V. Kripa, K.S. Mohamed, P. Laxmilatha, Shoji Joseph, P.K.Asokan, Sujitha Thomas, N. Ramachandran
CENTRES	Calicut, Cochin, Vizhinjam

Production of farmed bivalves. The mussel farmers in North and Central Kerala continued the farming activities during this season also. New farms were set up in these regions and the production of farmed mussels has been estimated as 950 tonnes. In southern Kerala, oyster farming was started by new groups in Ashtamudi Lake and Kayamkulam Lake. Financial assistance from BFFDA to oyster farmers was provided this year also. The estimated production of oyster was 200 tonnes.

Yields obtained in some of the major mussel farming areas in North Kerala.

Sl.no:	Farm site	Total yield (tonnes)	No.of mussel ropes	Yield/rope (kg)
1	Koyambram	22.75	700	32
2	Kayuthakadu	36.22	900	40
3	Kavuchira	25.2	900	28
4	Paranthamadu	12.75	300	42
5	Badekad	18.75	625	30
6	Ori	13.5	482	28
7	Thekkekadu	22	760	29
	Average	30	667	32

Utilisation of wasted mussel seed . It was observed that nearly 30% of the total mussel landings at Thikkodi, a major landing center in North Kerala comprised of seed of 15-45 mm length, which is discarded by the fishers. An attempt was made to utilize this wasted seed for mussel farming.

Growth of *Perna viridis* at Thangaserry Bay : It was observed that the salinity profile is suitable for perennial mussel farming. The length of the stocked mussels showed 3.5 fold increase in 10 months while the total weight and meat weight indicated 12.5 and 16.5 fold increase respectively. The condition index of the farmed mussel which was 53 in February at the time of seeding reached a peak of 891 in June.

Mussel seeding by trainees at Atholi

Semi automation of mussel farming: A mussel-seeding device that can be easily operated by two people was designed and fabricated at Cochin. This device has three main detachable parts *viz.* (1) A rectangular basin with a central opening into which the mussel seed can be placed (2) A PVC central tube of 6 cm dia, upper end of which is inserted into the central opening of the receiving basin and (3) a modified wooden stand with a upper and lower platform to support the basin and the central tube. Field trails of this showed better efficiency in terms of labour and time.

Demonstration farms. New demo farms were set up at Purangara, Badagara, Kozhikode (Moorad estuary), Parapanagadi, Malappuram (Poorapuzha estuary), and at Manakkad and Panambukadu (Vembanad Lake). In addition to this a training on mussel farming was organized, jointly by TTC and CRC, CMFRI, at Kozhikode and a training on oyster farming at Cochin.

PROJECT CODE MF/CUL/12

PROJECT TITLE **Selective breeding of bivalves and evaluation of performance by farm trials**

SCIENTISTS **T.S. Velayudhan**, V. Kripa, K.S. Mohamed, P. Laxmilatha, Shoji Joseph, S.Dharmaraj,C.P. Gopinathan, Sujitha Thomas, N. Ramachandran, P.Muthiah and P.C.Thomas

CENTRES Calicut, Cochin, Vizhinjam,Tuticorin, Chennai, Vishakapatnam

Observations on the morphometric characters of the black clam, *Villorita cyprinoides* in three different locations indicated higher shell thickness in the clams collected from southern part of Vembanad lake.

To assess the influence of environment on the growth and survival of clams the seed clam from Muhamma area which were from the same brood stock were stocked in three different sites viz. Narakkal, Nettor and Vaikom located in north, central and southern parts of Vembanad Lake. The correlation of the Specific Growth Rate in Length with the environmental characters showed that SGR is negatively correlated (-0.657) with silt content of the sediment and positively correlated with (0.734) with coarse sand.

Correlation matrix of environmental variables in the 3 clam beds

	Organic Carbon	*Clay*	*Silt*	*Coarse sand*	*Fine Sand*	*Length-SGR*
Organic Carbon	1.000					
Clay	0.988	1.000				
Silt	0.553	0.673	1.000			
Coarse sand	0.849	0.759	0.029	1.000		
Fine Sand	-0.999	-0.982	-0.521	-0.868	1.000	
Length-SGR	0.265	0.115	-0.657	0.734	-0.301	1.000

PROJECT CODE MF/CUL/13
PROJECT TITLE **Culture of cephalopods**
SCIENTISTS **A. Chellam**, G. Syda Rao, M.K. Anil
CENTRES Vizhinjam, Tuticorin, Vishakapatnam

Four species of cephalopods *viz. Sepiella inermis, Sepia aculeate, Sepioteuthis lessoniana, and Sepia pharaonis* were reared and aspects related to their hatching rate, feed preference, survival and nursery rearing were studied.

- The F9, F10 and F11 generations of *Sepiella inermis* were reared in the shellfish hatchery at Tuticorin by observing their survival rate and feed requirement and feed preference at different stages. The hatchlings were fed with mysids initially and later with prawns and fingerlings of fishes. Rearing the young ones in cages in the farms were not successful.
- 8632 juveniles of *S.inermis* of mantle length 2 to 40 mm were ranched near Hare Island.
- The egg cases of *Sepia aculeata* collected from the Vizhijam bay were reared in the hatchery. 98% hatching was observed and the hatchlings could be reared without any mortality.
- At Tuticorin, egg clusters of *Sepioteuthis lessoniana* collected from Korampallam creek were maintained. The hatchlings (61 mm ML – 79.4 mm ML) survived upto 67 days. Juveniles of the squid collected from the same site are reared. Egg clusters of this species found on the pearl oyster cages in Vizhinjam in August were collected and reared in the hatchery. The 9-11 cm long egg capsules contained 6 to 8 developing embryos. Within 12 days all the hatchlings were released. The larvae did not accept any of the feed provided (*Artemia* nauplii, *Brachionus, Moina*, copepods, mixed plankton, suspension feed etc.) and mortality started from the third day onwards.
- Juveniles of *Sepia pharaonis* were reared upto 10mm size at Vishakapatnam Research Center.

PROJECT CODE MF/CUL/14
PROJECT TITLE **Seed production and pearl culture in the abalone *Haliotis varia***
SCIENTISTS **A.C.C. Victor**, A. Chellam, I. Jagadis, Boby Ignatius
CENTRES Mandapam,Tuticorin

Experiments on the spat production of abalone for improving the percentage of survival were continued in the shellfish hatchery at Mandapam. Mature abalones collected from Tuticornin and Mandapam were induced to spawn in the laboratory at a male : female ratio of 1:1. About 1 million eggs were obtained after spawning. The fertilized eggs hatched out into veliger larvae after 22 hrs of incubation. These floating larvae were collected and reared for three days. After third day the larvae failed to settle on the substratum provided in the tanks. The poor quality of the algal mat provided on the substratum is one of the reasons for the mortality.

PROJECT CODE MF/CUL/16
PROJECT TITLE **Development of low cost technology system for sea farming of pearls and mussels**
SCIENTISTS **N. Ramachandran**, Rani Mary George, M.K. Anil
CENTRES Cochin, Vizhinjam

Experiments on spat collection from wild and farms for mussels and pearl oysters were carried out in the Vizhinjam harbour area.

- Suitability of different types of stocking cages such as lantern cage, book cage, and traditional oyster culture cages, fruit baskets etc. for pearl oyster (*Pinctada fucata*) farming was tried. For the conventional cages with iron frame corrosion was identified as a major problem. The cheaper plastic basket type cages covered with net was used successfully for all other purposes including spat settlement. The plastic cages could be used for a minimum period of two years without much damage and were easier to clean.
- Results of experiments indicated 6 cm growth in DVM (2.2 cm width) in one year for *P. fucata* under farming conditions. Very high annual variability in spat settlement was observed. Compared with spat settlement of 80 spat /collecter, observed last year, this year spat settlement was very poor.
- Growth of seeded brown mussel *Perna indica* indicated 0.6mm/month at Vizhinjam.

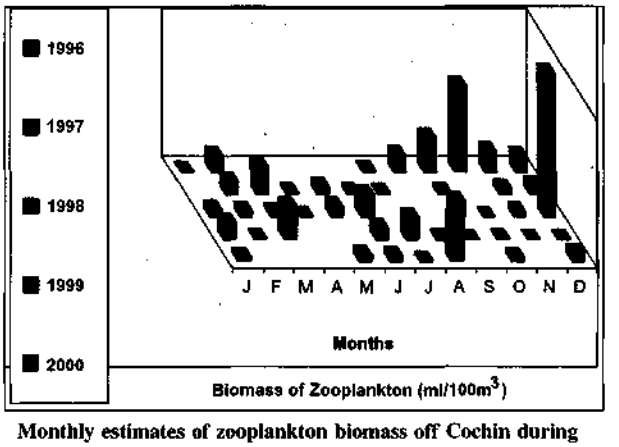
FISHERY ENVIRONMENT MANAGEMENT DIVISION

The Division conducted research to achieve the targets in environmental monitoring, conservation and farming of sea cucumber and seaweeds through 10 Institute projects, 5 funded projects, 2 NATP and 1 ICAR Revolving fund project. In addition to this, 6 Consultancy programmes related to environment were also implemented.

PROJECT CODE	**FEM/ES/1**
PROJECT TITLE	**Investigations on environmental parameters of inshore waters in relation to fisheries**
SCIENTISTS	**C.P. Gopinathan,** S. Muthusamy, T.S. Naomi, Gulshad Mohamed, P.S. Asha, P.K. Krishnakumar, V.V. Singh, Rani Mary George, M. Rajagopalan, K. Vijayakumaran
CENTRES	Cochin, Calicut, Mangalore, Karwar, Mumbai, Minicoy, Vizhinjam, Tuticorin, Mandapam, Chennai and Visakhapatnam

In order to study the various hydrobiological parameters of the inshore waters, regular water samples were collected, fortnightly/ monthly. The parameters studied were water temperature, salinity, dissolved oxygen content and nutrients such as Nitrite, Nitrate, Phosphate and Silicate. In addition to this, primary and secondary production of the inshore waters was also studied from selected centres.

- Water temperature recorded a range of 24.5-32.8°C in the west coast while in the east coast it ranged from 25.5-31.8°C.
- The values of salinity were in the range of 1.85 to 35.3 ppt in the west and 18.02 to 36.84 ppt in the east coast.
- The dissolved oxygen content varied from 1.06 to 4.77 ml/l in the west coast while it was 1.4 to 7.77 ml/l in the east coast.
- The nutrient concentration of the water revealed less fluctuations in the west and east coasts. The values of NO_2, NO_3, PO_4 and SiO_3 were found to be slightly high at Mangalore and Vizhinjam.
- The rate of primary production by light and dark bottle oxygen technique and chlorophyll a estimates indicated high values at Cochin, Mumbai, and Vizhinjam inshore waters.
- The biomass of zooplankton showed high values at Mumbai inshore waters and moderate to low values at Cochin, Mangalore and Mandapam during 2001.



Monthly estimates of zooplankton biomass off Cochin during 1996-2000

- The mean biomass values of the zooplankton collected off Cochin from the near shore waters for a period of five years (1996-2000) given in the figure in previous page.
- In general the post monsoon season recorded high values of zooplankton biomass and the peak 180.8 ml/100m^3 was observed during 1999 at 20 m depth zone.

PROJECT CODE FEM/ES/6

PROJECT TITLE **Ecological investigations on the intertidal and surf zones of the Kerala coast in relation to finfish and shellfish seed and juvenile resources**

SCIENTISTS **G.S. Daniel Selvaraj,** Molly Varghese, Gulshad Mohamed and S. Jasmine

CENTRES Cochin, Calicut and Vizhinjam

Monthly data on hydrographic parameters of the surf zone and adjacent backwater/estuarine systems were collected along with biological samples at Calicut, Cochin and Vizhinjam.

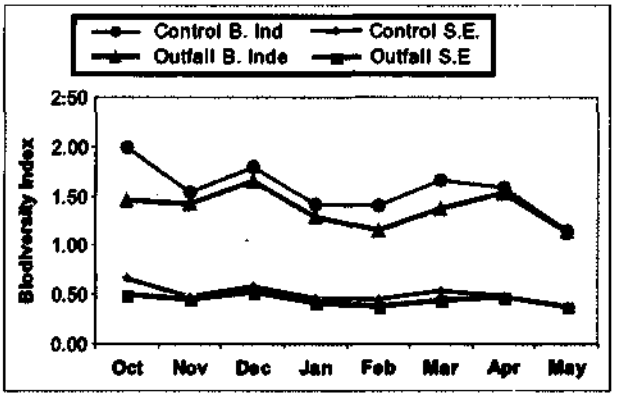
- Rainfall data for the year 2001 indicated failure of northeast monsoon along the Kerala coast which has resulted in relative increase in salinity in the surf zone and adjacent backwater/estuarine systems during postmonsoon period as observed in the previous year.
- In the surf zone, mean water temperature showed low values (25.4-25.5°C) along the Kerala coast during southwest monsoon season.
- Dissolved oxygen values indicated an increasing trend from Calicut to Vizhinjam during premonsoon and southwest monsoon seasons.
- Perumathura (Vizhinjam) recorded the highest mean values of dissolved oxygen in all the three seasons of the year.
- The surf zone and backwaters around Calicut recorded very low nitrite values in all the three seasons and higher values of nitrates during premonsoon and postmonsoon seasons of the year than those values recorded around Cochin.
- Nitrate values were higher than nitrites in the intertidal zone of the Kerala coast.
- Annual averages of gross primary production in the surf region of Calicut, Cochin and Vizhinjam were 1.125, 0.523 and 1.046 g C/ m^3/d and that of the backwaters were 0.848, 0.726 and 0.572 g C/ m^3/d respectively.
- Analysis of plankton samples from the surf zone (Vizhinjam) revealed the occurrence of fish eggs and larvae, decapod larvae and molluscan larvae as 175, 375 and 300 per 100 m^3 of water during premonsoon and 188, 488 and 2200 nos/100 m^3 during southwest monsoon season respectively.
- Among juvenile prawns, *M.dobsoni* dominated in all the three estuarine systems throughout the year. Juveniles of *P.indicus* and *P.monodon* were relatively more in the Korapuzha estuary during premonsoon and southwest monsoon period.
- Nonpenaeids were generally more in the Cochin backwater and Korapuzha estuary during southwest monsoon and postmonsoon seasons of the year.

PROJECT CODE FEM/MP/1

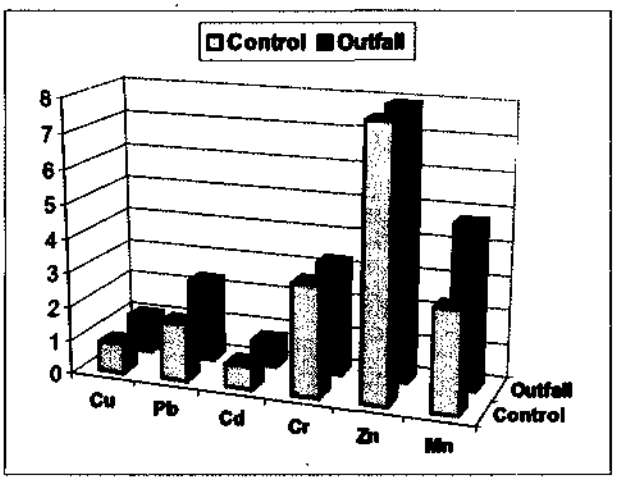
PROJECT TITLE **Monitoring the state of health of coastal waters in relation to pollution and aquaculture activities**

SCIENTISTS **P.K. Krishnakumar**, P. Kaladharan, J.P. George, D. Prema, V. Chandrika, S. Jasmine, K. Vijayakumaran, M. Rajagopalan, D.C.V. Easterson and P.S. Asha

CENTRES Cochin, Mangalore, Vizhinjam, Tuticorin, Chennai, Visakhapatnam and Mangalore



Biodiversity index of zooplankton



Bioaccumulation of heavy metals in mussels

Monitoring the impact of treated effluent discharge from an oil refinery into the coastal waters off Chithrapur and Mangalore, was continued. Water, zooplankton and macrobenthos samples were collected from a clean (control) site, from the marine outfall, 500 m away and 1000 m away from the marine outfall for monitoring the impact of the effluent discharge.

- Significant changes were not observed in the quality of seawater (TSS, BOD, sulphide, nutrients, oil & grease etc) collected from the marine outfall, compared to the control site (ANOVA test).
- The Shannon Wiener biodiversity index of macrobenthos near the marine outfall varied from 1.06 – 1.11 compared to 1.56 near the control site.
- The biodiversity index for the zooplankton near the marine outfall was 1.37 compared to 1.57 near the control site.
- Bioaccumulation of heavy metals in mussels (*Perna viridis*) was studied from a control site and from the marine outfall of major industries off Mangalore.
- Accumulation of toxic heavy metals such as Cd, Pb, Cu and Zn in mussels was within the permissible limits except Hg and Mn. Tissue concentration of lead in mussels from the marine outfall was 2.34 ppm compared to 1.67 ppm in mussels from the control site.
- The amount of tar balls settled on beaches along Mangalore coast varied from 1 – 2.5 g/m^2. Similar incident was reported during the same period of previous year.

Cochin

Work on environmental monitoring from the estuary and inshore waters off Cochin was continued. Basic hydrographic data were collected during the reporting period and found to be within the normal range.

- Humic substances estimated from the sediment showed an annual mean of 0.824 mg/g during pre-monsoon, 1.445 mg/g in monsoon and 2.313 mg/g during post-monsoon months in the estuarine areas. Whereas, the inshore areas registered 1.008 mg/g during premonsoon, 1.396 mg/g during monsoon and 0.874 mg/g in post monsoon periods.
- Sediment collected from inshore areas showed higher heavy metal concentration than the estuarine areas of Cochin.
- Chavakkad beach registered relatively high tar deposition of 28.77 g/m^2 during March and 8.6 g/m^2 during June 2001.

Vizhinjam:

- At Valiathura, north of Vizhinjam, 2.6 – 6.2 g/m^2 of tar ball was observed during April to June 2001.

Tuticorin:

- Monitoring fly ash pollution at Hare Island and mercury pollution from the marine outfall of a chemical plant at Kayalpattinam was continued. Very low dissolved oxygen value was observed at the fly ash laden station near the Hare Island with effect from May.
- The average annual mercury concentration in seawater varied from 0.84 – 18.38 mg/l while, in the lagoon (Lagoon NP) near the marine outfall was 0.42 - 23.28 mg/l.
- No incidence of tar ball contamination was reported from beaches in and around Tuticorin.

Chennai

- Regular pollution monitoring programme at Ennore and Chennai Harbour were carried out.
- Lowest dissolved oxygen value such as trace level was observed during May to September 2001. The sea water collected from Ennore analysed for heavy metals such as iron, copper, cromium, manganese, zinc, cadmium and lead and the levels were found to be within the permissible levels.
- No instance of tar ball contamination was reported from beaches in and around Chennai.

Visakhapatnam

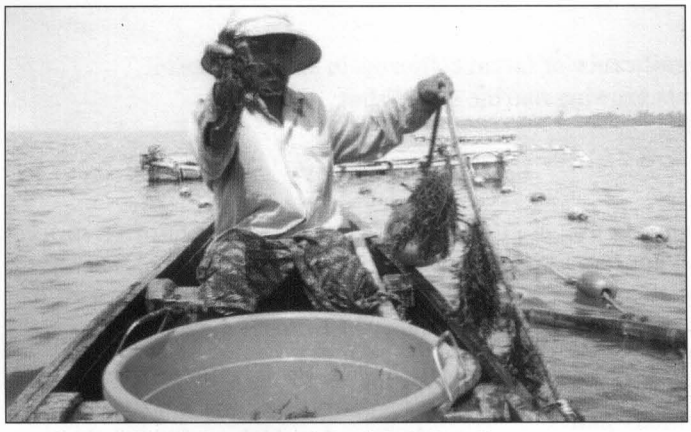
- No incidence of tar ball contamination was reported from beaches in and around Visakhapatnam, Poodimadata to Mukkom.

PROJECT CODE	**FEM/SW/1**
PROJECT TITLE	**Seaweed investigations – Resource assessment of seaweeds and their culture**
SCIENTISTS	**N. Kaliaperumal,** P. Kaladharan, Reeta Jayasankar, Gulshad Mohamed
CENTRES	Mandapam, Cochin and Calicut

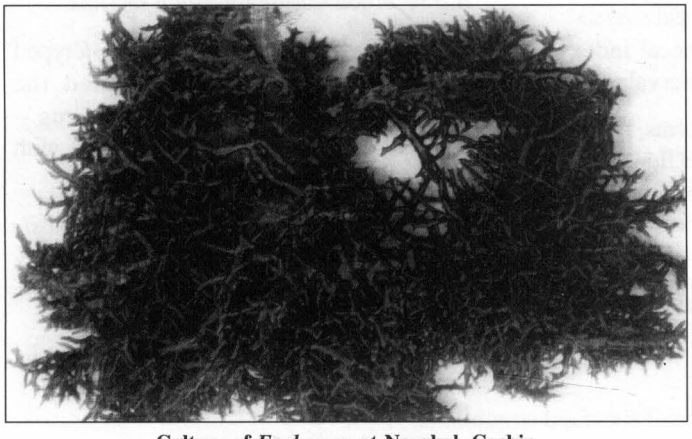
Mandapam

Experimental culture of the agar yielding red seaweed *Gracilaria edulis* was carried out in 1 ton capacity FRP tanks with running seaweed and providing aeration under greenhouse condition.

- 150% increase in 38 days with Ammonium sulphate at 5 mg/l., 100% increase in 37 days with organic fertilizer at 40 mg/l, 84% increase in 33 days with organic mixture fertilizer at 30 mg/l.
- Data were collected from 13 landing centres



Fragment culture of *G. edulis* in long line rope



Culture of *Eucheuma* at Narakal, Cochin

in Tamilnadu on the quantity of seaweeds exploited from the natural seaweed beds.

▼ The quantity of seaweeds landed was 2194 tonnes (dry wt) consisting of 1124 tonnes of *Sargassum* spp., 9 tonnes of *Turbinaria* spp., 560 tonnes of *Gelidiella acerosa* and 501 tonnes of *Gracilaria edulis*.

Cochin

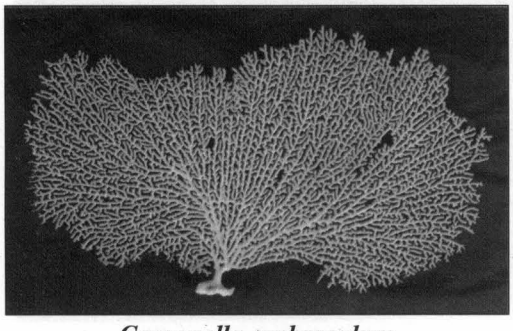
Vegetative propagation of *G. edulis* and *Eucheuma* were carried out on longline nylon rope tied between the raft in west coast of India off Narakal. The growth of *Eucheuma* was very encouraging showing a crop growth rate of 12g per day.

Calicut

▼ Survey of seaweed resource was done at Puthiapa, Elathur and Thikkodi.

▼ A total of 8 species recorded from Puthiapa, 10 species from Elathur and Thikkodi.

PROJECT CODE	**FEM/AR/1**
PROJECT TITLE	**Biodiversity studies**
SCIENTISTS	**P.A. Thomas,** Rani Mary George, S. Jasmine, M.K. Anil, K.N. Saleela
CENTRES	Vizhinjam



Gorgonella umbraculum

❑ During the period under report collection of gorgonian specimens was made at different centres along the south west cost of India. The specimens were identified and the dominant species recorded were *Gorgonella umbraculum*.

PROJECT CODE	**FEM/MB/1**
PROJECT TITLE	**Sanitary significance of faecal coliforms in selected coastal environments growing marine shell fishes**
SCIENTISTS	**V. Chandrika**
CENTRES	Cochin

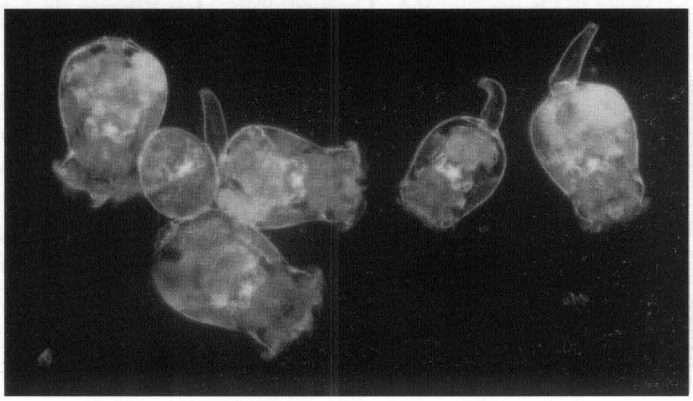
Regular monitoring programme in the shellfish farming sites like Dalavapuram, Chettuva was conducted to study the effects of sewage effluents from live aboard boats and ships, septic tanks, agricultural run off as well as other warm-blooded animals wastes and bird faeces on the cultured marine animals and environment. Five parameters, viz. (1) Total coliforms (2) faecal coliforms, (3) faecal *streptococci* (4) *staphylococci*, and (5) faecal index was monitored at regular monthly intervals.

- The average values of total coliforms, faecal coliforms, and faecal *streptococci* fluctuated considerably. However, the total aerobic heterotrophs content was high during June and October 2001.
- Multiple Antibiotic Resistance (MAR) assays of *E.coli* showed out of 48 surface estuarine and farm water samples analysed 20 *E.coli* exhibited MAR pattern which indicated R+ factor in them.
- High levels of faecal coliforms and *streptococci* were seen (20% above standards and as high as 500000 (FU/100 ml) recorded during monsoon months.
- High rate of incidence of MAR *E.coli* type I in shellfish farm sites indicated the possibility of R-factor mediated drug – resistant bacteria in this environment with transferable drug resistance.
- *Nocardia – asteroids* causing *Nocardiosis* occurred in the months January and February 2001 indicating their presence in this environment.

PROJECT CODE	**FEM/LF/1**
PROJECT TITLE	**Mariculture of live feed organisms**
SCIENTISTS	**C.P. Gopinathan,** K.G. Girijavallabhan, P. Kaladharan, T.S. Naomi, Reeta Jayasankar, Molly Varghese, Rani Mary George, S. Jasmine
CENTRES	Cochin, Vizhinjam, Tuticorin

Maintenance of eleven species of microalgae as stock culture was carried out in the phycology laboratory at Cochin. Few important phytoplanktons such as *Chaetoceros, Isochrysis, Tetraselmis, Nanochloropsis* and *Chlorella* culture are being continued at Vizhinjam, Calicut, Tuticorin, Mandapam, Veraval, Visakhapatnam, Madras, Mangalore and Karwar.

- Stock as well as mass cultures



Brachionus rotundiformis

of the live feed organism, rotifer – *Brachionus rotundiformis* was maintained successfully.

- Stock cultures of three different strains from Kochi, Mandapam and Thailand were maintained separately.
- Small strain of *Brachionus* sp. was isolated from Vypeen and its culture is in progress.
- Pure culture of the cyclopoid copepod, *Oithona rigida* Giesbrecht is being maintained. Pure culture was restarted every thirteenth day using gravid females. Mass culture was stepped up during September-October 2001 period.

Vizhinjam

- Culture and maintenance of marine harpacticoid, *Eutoxipina acutiferous* was successfully carried out.
- Some marine calanoids and brackish water cyclopoids were also isolated for regular culture.

Tuticorin

- On an average about 300 litres of the pure culture of *Isochrysis galbana* is being supplied to the edible oyster and pearl oyster hatcheries.
- Mixed culture of micro algae, dominated by the species of *Chaetoceros* are developed in outdoor tanks for feeding the spat of these oysters and also for feeding the larvae of the sea cucumber, *Holothuria scabra* and *H.spinifera*.

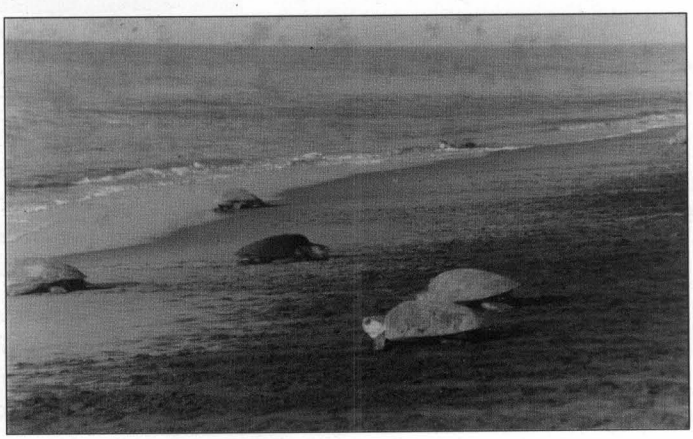
Mandapam

- An experiment was conducted with PSB (Photosynthetic Sulphur Bacteria) in indoor and outdoor tanks. By feeding this culture, good growth and multiplication was observed in rotifer, *Brachionus rotundiformis*.

PROJECT CODE	**FEM/MT/1**
PROJECT TITLE	**Conservation of marine turtles**
SCIENTISTS	**M. Rajagopalan,** S. Krishna Pillai, K. Vijayakumaran
CENTRES	Cochin, Vizhinjam, Tuticorin, Chennai and Visakhapatnam

The annual arribada of the olive ridley *Lepidochelys olivacea* along the Orissa coast occurred during March-April 2001.

- A total number of 7.4 lakhs of olive ridley nested during 2001 season along the Gahirmatha, Rushikulya and Devi river mouth when compared to 7 lakhs of olive ridley nested in March during 2000.
- Along the coastal districts of Balasore, Cuttack, Puri and Ganjam of Orissa about 12,000 turtles were incidentally caught by fishing gears during 2001 when compared to 10,000 in 2000.



Arribada of Olive ridley along Orissa caost

- A total number of 170 comprising of four species of sea turtles were recorded during 2001 in the incidental catch of Vizhinjam (olive ridley 43%, green turtle 22.5%, hawksbill 33% and leather back 1.5%).
- Gill nets, hooks and line, drift net and boat seine invariably cause higher mortality in the Vizhinjam coast. In the incidental catch 53% were females, and 24% were males and the remaining 23% were sub-adults.
- Incidental catch was maximum during July to December 2001. The curved carapace length of olive ridley ranged from 44 to 74 cm and weight varied from 33 to 56 kg.
- The curved carapace length of green turtle varied from 44 to 101 cm and the weight varied from 11 to 118 kg.
- The curved carapace length of the hawksbill varied from 25 to 59 cm and the weight ranged from 3 to 20 kg.

PROJECT CODE	**FEM/HOL/1**
PROJECT TITLE	**Breeding, seed production and sea ranching of the sea cucumber *Holothuria scabra***
SCIENTISTS	**P.S. Asha**
CENTRES	Tuticorin

During the period under report, a brood stock of 14 specimens of *H. scabra* having an average weight of 500g, were collected during Feb' 2001 and they were spawned naturally during March 2001.

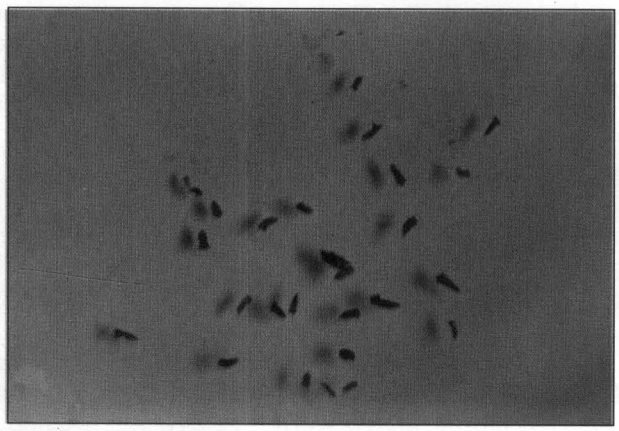
★ Four lakhs auricularia were produced.

★ Mixed culture of *Isochrysis* sp., *Tetraselmis* sp. and *Nanochlorosis* sp. were given as feed at a rate of 20,000 cells /ml initially and raised to 40,000 cells/ml in the later stages to the larvae.

★ On the 10th day, a few of the auricularia were first metamorphosed to doliolaria and settled as pentactula on the 13th day in the raw seawater tank.

★ Powdered algae "Algamac" was used at a rate of 0.1g /100 l to induce the settlement. On the 20th day, the juveniles having the length ranged between 415 µm to 1.8 mm and breadth 182µm to 697µm, finally attained a length of 2.5 mm.

★ Natural spawning occurred in the newly collected *H. spinifera* and about 18,000 auriculariae were produced.



Juveniles of *Holothuria scabra*

★ They were maintained in 200 l tank and fed with a mixture of *Isochrysis galbana* and *Chaetoceros calcitrans* at a rate of 20,000 cells /ml.

★ Presence of doliolaria could be observed in few numbers on the 10th day and by adding Algamac @ 0.06g they were induced to settle as Pentactulae on the 14th day.

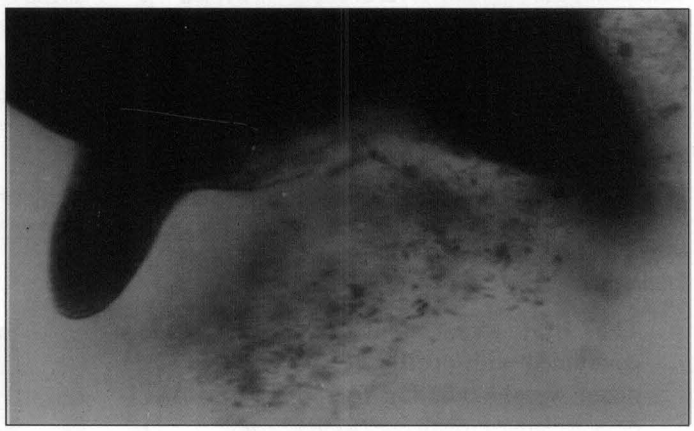
Comparison of larvae of two species

Name of the larvae	*H. spinifera* Length(µm)	*H. spinifera* Breadth(µm)	*H. scabra* Length(µm)	*H. scabra* Breadth(µm)
Dipleurula	265-282	166-199.2	265-282	166.2-192
Auricularia(Early)	448-548	299-365	448-531.2	299-338
Auricularia (Late)	796-946	432-581	830-1095	548-681
Doliolaria	448-514	199-299	448-564	199-299
Pentactula	266-448	199-266	349-498	215-315

PROJECT CODE FEM/T.CUL/1
PROJECT TITLE **Tissue culture of economically important seaweeds for breeding and hybridisation**
SCIENTISTS **P. Kaladharan** and Reeta Jayasankar
CENTRES Cochin

During the reporting period, towards the maintenance of seaweed germplasm, fresh thallii of *Gelidium, Ulva fasciata, Ulva retticulata, Gracilaria corticata, G.edulis, G. crassa* and carrageenan yielding *Kappaphycus* sp. were maintained in Walne's medium at 32 ppt salinity.

- rafting experiments of seaweed thallus was attempted on *G. crassa*. The grafted thallus along with agar blocks were maintained in Walne's medium. After 15 – 20 days grafting was noticed. Efforts are on to observe the feasibility of interspecific grafting.
- Explants of *G. edulis* and *G. corticata* (about 5-8 mm) were incubated in PES medium containing 5 ppm 2-4-D and 2-3 ppm of Kinetin. Few developed thin film of callus at the cut ends of explants and after 34 days developed "multiple shoots".



Multiple shoots of *G. edulis*

PHYSIOLOGY, NUTRITION & PATHOLOGY DIVISION

The Division implemented 6 in-house projects, 9 sponsored projects and two NATP projects in the areas of Nutrition, Pathology, Genetics and Biotechnology. A 21-day Summer School on Fish and Crustacean Nutrition and Aquafeed Biotechnology sponsored by ICAR and a 6-day training programme on cost-effective shrimp feed production to State Govt. officers were conducted. Disease diagnosis and feed quality analysis services were provided to the farmers.

PNP/35

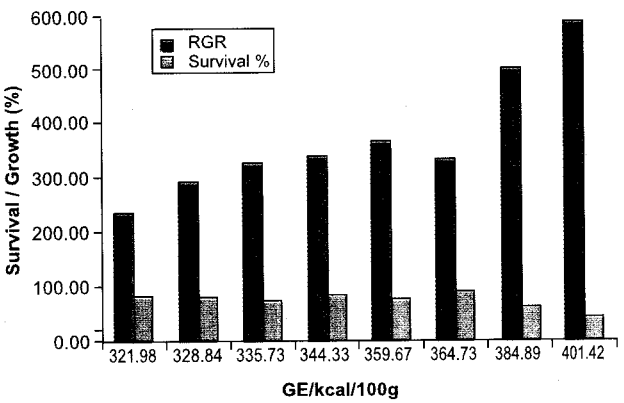
Development of feeds and optimisation of feeding regimes for culturable crustaceans, marine finfishes and pearl oysters

R. Paul Raj, D. Kandasami, Manpal Sridhar, P. Vijayagopal, Imelda Joseph and Preetha Panikkar
Cochin, Calicut, Madras

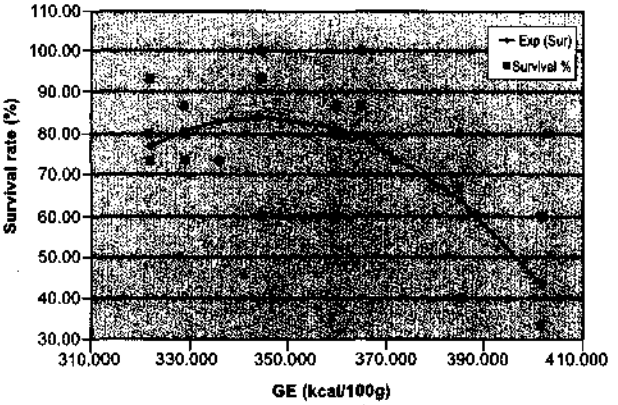
Macronutrient interaction

Macronutrient interaction studies were continued in the Indian white shrimp *Fenneropenaeus indicus* with the objective of delineating the optimum level of energy at a fixed level of protein. A common ingredient mixture consisting of fish meal, shrimp meal, clam meal, groundnut oil cake, tapioca flour, dextrin, cellulose and albumin was formulated and using this eight experimental feeds were prepared keeping a constant level of 30% protein and gross energy levels varying from 320 kcal/100g to 401 kcal/100g.

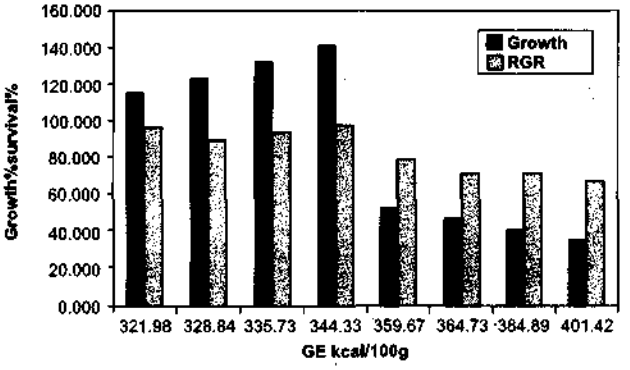
- The first experiment was conducted with post-larvae of mean weight 0.0385g for 35 days. Relative growth rate (RGR) and survival were the main response parameters. The estimated optimum energy level for maximum survival was 345.58 Kcal/100g at 30% protein. The survival data were regressed with the GE levels and second degree polynomials of the form $y=a_1 + a_2x + a_3x^2$ were fitted.
- The second experiment was conducted with juveniles of mean weight 1.260g for 45 days, with the same feed. Growth was maximum at the GE level of 344.33. Survival data were regressed with P/E ratios (mg protein/kcal) and second degree polynomials of the form $y=a_1 + a_2x + a_3x^2$.



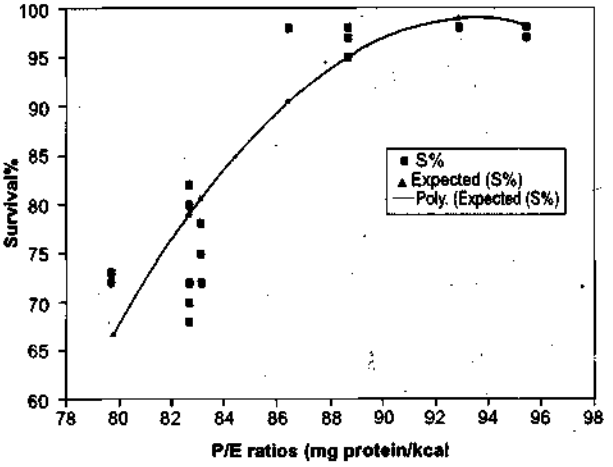
Survival rate on GE levels of *Fenneropenaeus indicus* post-larvae reared on 30% protein and varying levels of energy for 35 days



Regression of GE levels on survival rates of *Fenneropenaeus indicus* post-larvae reared on 30% protein and varying levels of energy for 35 days



Relative growth rate and survival % of juveniles (1 g) *Fenneropenaeus indicus* grown on 30% protein and varying levels of energy for 45 days



Regression of survival on P/E ratios of *Fenneropeneaeus indicus* juveniles (1 g) reared on feeds containing 30% protein and varying energy levels

Feed Biotechnology

Three experiments were conducted in Solid State Fermentation (SSF) using *Bacillus coagulans* as inoculum and soybean flour as substrate.

✧ In the first experiment 2.5 kg soy flour was subjected to SSF using *Bacillus coagulans* for 6 days. Proximate composition analysis of the fermented product showed a slight reduction in ether extract. Fermentation of soy flour for 6 days was found to cause excessive ammonia production due to breakdown of protein by bacteria.

✧ The second experiment was conducted to standardize the actual duration required for substrate modification using *B. coagulans* and soy flour. The duration of fermentation was 12 h, 24 h, 36 h and 48 h. Low fibre product was obtained after 48-h fermentation.

✧ The third experiment was conducted by direct inoculation of *B. coagulans* in to autoclaved soy flour, without any filtration process with triplicates for each treatment. Proximate composition analysis of the product showed significant reduction in the fibre content after 48h of fermentation.

Ornamental fish feed

✧ A compounded feed has been developed for the post-larval juvenile and adult stages of *Amphiprion* sp. using a mixture of ingredients with mineral and vitamin mix supplements.

✧ The pipe fish and seahorse larval feed requirement was estimated as 350 rotifer/larvae/day in the beginning and 650 rotifer /larvae/day from tenth day onwards.

Storage studies in *Artemia* and *Moina* cysts

- Dormant cysts of the brine shrimp *Artemia* (California strain) produced at Mandapam, sun dried and stored in room temperature yielded hatching rates of 80% up to 3 months and 65% up to 12 months. The percentage of hatching decreased with increase in duration of storage at room temperature.
- Brine shrimp cysts stored in saturated saline water at room temperature resulted in 80.4% of hatching after 3 months and 75.07% after 12 months.
- Moina cysts sun-dried and stored in glass tubes at 0-4°C yielded hatching rates of 82.5% after 2 months of storage and 70.2% after 6 months of storage.

Lobster feeding

- Feeding experiments were conducted on lobsters of two different size groups, 100-110g and 150-160g with *ad libitum* feeding. The results are shown below. It was observed that the moulting took place at night and the animal stopped feeding three days prior to moulting.

Feeding experiments on Lobsters

	Size A (150-160g)	Size B (100-110g)
SGR	0.21±0.051	0.462±0.027
% Wt. Gain	28.71±2.3	73.45±5.08
Apparent feed intake (%)	8.23±0.24	6.38±0.58
FCR	3.8±0.15	2.22±0.06
PDC(%)	43.7±1.8	51.01±2.2
PPV(%)	2.35±0.16	4.32±0.08

PROJECT CODE
PROJECT TITLE
SCIENTISTS
CENTRES

PNP/46
Disease investigations in marine fish and shellfish
M. Vijayakumaran, A.P. Lipton and S.R. Krupesha Sharma
Madras,Vizhinjam, Calicut

Crustaceans:

- White spot disease was identified in 70% of *P. monodon* samples preserved and sent from two shrimp farms in Kakinada. The gills of the infected shrimps also had pronounced growth of *Zoothamnium* spp. The muscle was opalascent and showed dystrophy.
- Gill disease in *P. monodon* caused by the ciliate, *Zoothamnium sp* was recorded during February-March in Rajakkamangalam area. In some of the shrimps subsequent to the ciliate infestation, secondary bacterial infections were noted. The bacterial load in the gills was 6.96 x 10^5 CFU/g tissue. In the laboratory trials, BKC @ 7.5ppm cured the infections. In another experiment, after ascertaining the antibiotic sensitivity, feeding with medicated feed @100mg chloramphenicol/kg/body weight for 7 days controlled the infections.
- Phyllosoma larvae of *Panulirus homarus* reared at Kovalam had severe infestation of *Zoothamnium, Acinata, Epistylis* and the filamentous bacteria, *Leucothrix*.

Marine finfishes:

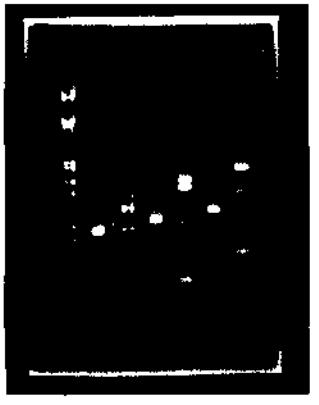
- Bacterial infections formed an important and common causative factor for the mortality of marine ornamental fishes in the marine aquarium at Vizhinjam. Symptoms such as fin erosions; haemorrhages on body surface and erythemia were recorded. Among the ornamental fishes, damsels (12.81%), sergeant major (12.58%), sergeant fish (10.76%), rabbit fish (9.15%), parrot fish (7.78%), *Chaetodon* (7.55%) and goatfish (5.23%) were found to be susceptible in the decreasing order.
- In order to understand and correlate the possible role of environmental conditions culminating in disease conditions in the aquarium, hydrological parameters were recorded. Temperature ranged between 24.4 and 29.1°C; pH 7.05 and 7.44; the dissolved oxygen content fluctuated between 2.38 ppm and 8.34 ppm; H2S 0.02-0.04; microbial load ranged from 2.6X10 3 to 5.9X10 3.
- Studies on the inflammatory response in finfish is in progress.

PROJECT CODE
PROJECT TITLE
SCIENTISTS
CENTRES

PNP/48
Development of fingerprints and probes for detection of pathogens of finfish and shellfish
P.C. Thomas
Cochin

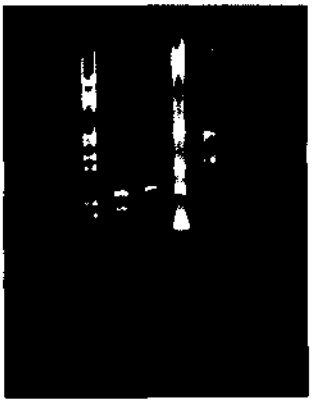
DNA fingerprint of bacterial pathogens

- DNA fingerprint of *Vibrio harveyi* and *Vibrio parahaemolyticus* were developed using random primed PCR. A panel of ten Operon decamer primers viz., OPA01 to OPA08, OPA15 and OPAH05 were used for this.
- The amplified DNA fragments were resolved through submarine agarose gel electrophoresis and visualized under UV light. While 2 to 9 fragments were amplified by these primers in *Vibrio harveyi*, 3 to 10 fragments were amplified in *Vibrio parahaemolyticus* .The DNA fingerprint patterns are presented.



DNA fingerprint pattern of *Vibrio harveyi*

- *Vibrio harveyi* were isolated from infected shrimps and their DNA fingerprints were generated in order to determine the amplification pattern, genetic homogeneity and species specificity. The DNA segments amplified by all the isolates of the species were identified as they could be used for the development of probes for identification.



DNA fingerprint pattern of *Vibrio parahaemolyticus*

- Of the ten arbitrary primers tried, OPA04 was identified as the primer of choice for *Vibrio harveyi*. DNA fingerprint pattern of the field strains of *Vibrio harveyi* generated by OPA04 is presented.

DNA fingerprint of the field strains of *V. harveyi*

→ The species specific DNA fragments of the PCR products, which are shared by the various field strains have been eluted out and were cloned in appropriate plasmid vectors, so that they could be used for DNA probes with appropriate labelling system for *Vibrio harveyi.*

Molecular detection of White Spot Baculovirus

→ The standard protocol for extraction of de-proteinised DNA, conventionally used for extraction of DNA is spread over two days involving several steps using expensive chemicals. A simple, fast and inexpensive protocol for extraction of template quality DNA from shrimp tissue infected with white spot virus was optimised in the laboratory, using a buffer consisting of Glucose, EDTA, Sodium chloride and Tris (GENT) which yielded template quality viral DNA for PCR detection of White Spot Baculovirus.

→ Nested PCR has been optimized for the white spot virus using a pair of internal primers, whereby the reliability of PCR technique could be enhanced several fold. The nested PCR procedure is now used for detecting white spot virus in shrimp.

→ Shrimps collected from field as well as those brought by the farmers are being periodically screened for the PCR product length and to determine their homology with the previous ones and to detect variants, if any.

→ The PCR product of the white spot viral DNA has been cloned and work is underway for sequencing.

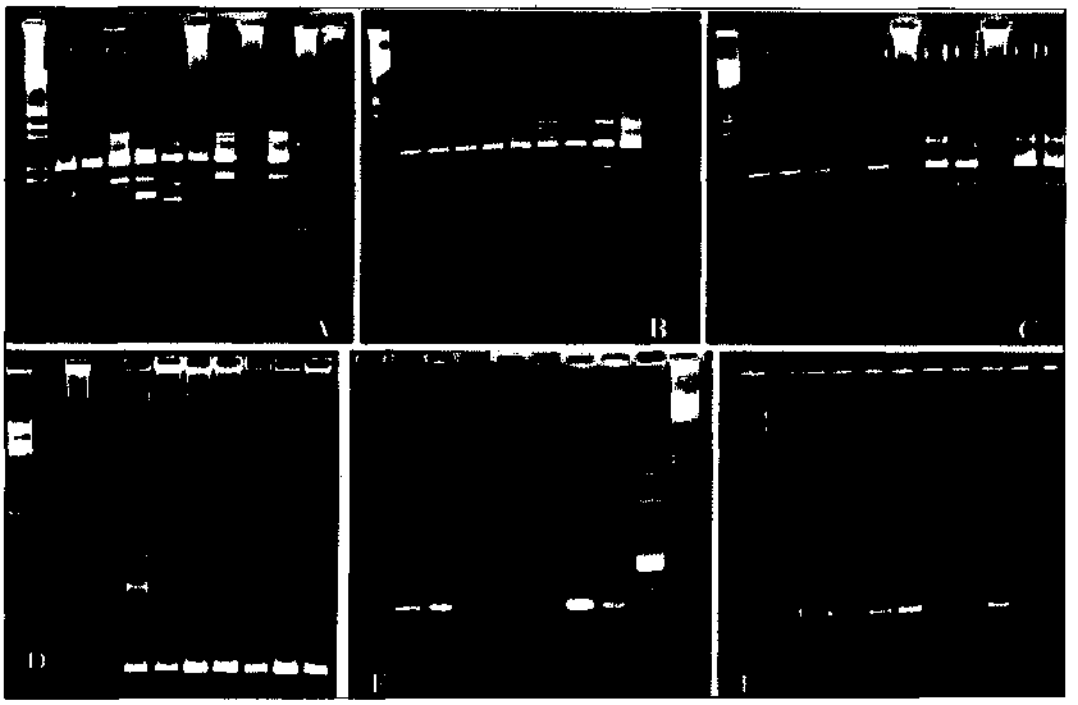
PNP/49

Population genetic studies in *Rastrelliger kanagurta* and *Sardinella longiceps.*

P. Jayasankar and P.C. Thomas
Cochin

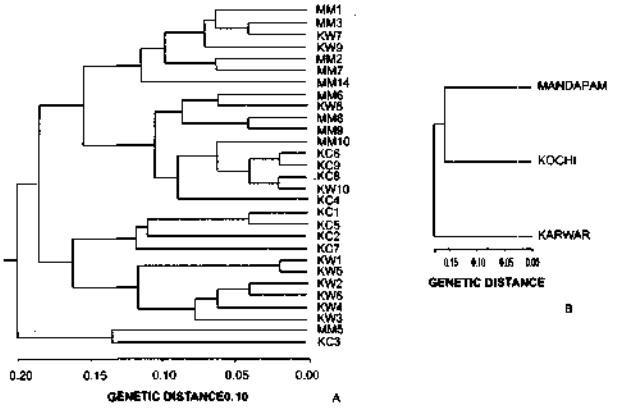
Molecular genetic studies:

- Genomic DNA was extracted from Indian mackerel (n=50) and oil sardine (n=54) obtained from Kochi, Karwar Mandapam and Chennai. Twelve decamer primers from Operon Inc kits A and F were initially screened to determine (a) amplification and (b) level of polymorphisms with a view to selecting primers which produce repeatable, polymorphic and robust bands. Primers OPA 04, OPA06, OPF05, OPF02 and OPF03 were short-listed based on these advantages.
- Genetic distance matrix based on presence ('1') or absence ('0') of each locus was calculated and dendrograms were generated. Dendrograms of individual mackerels from three centres did not show a clear pattern of clustering but population dendrograms showed proximity of Mandapam and Kochi samples.
- ANOVA was performed to test differences in genetic distance values and both the intra population differences (F=0.991, P>0.05) and inter population differences (F=1.81,



RAPD amplification patterns of individual fishes : A, mackerel/Karwar/OPF 05; B, mackerel/Mandapam/OPF 05; C, mackerel/Kochi/OPF 05; D, oil sardine/Karwar/OPF 03; E, oil sardine/Chennal/OPF 03; F, oil sardine/Kochi/OPF 03.

P>0.05) among 3 populations were not significant. The results indicate that genetic variations observed in mackerel populations from the selected centres are not significantly different.



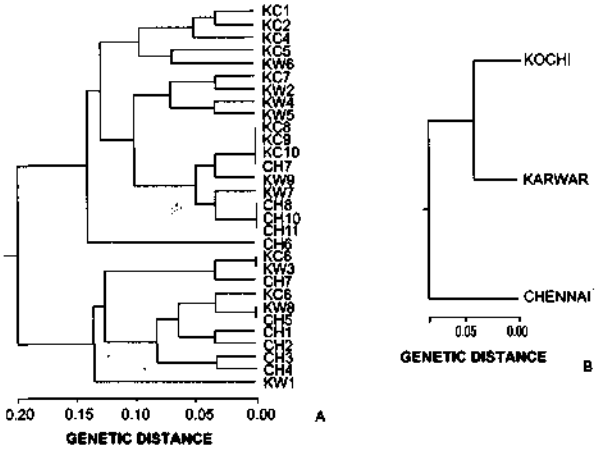
UPGMA dendrograms constructed on the basis of the genetic distance estimated from RAPD assay (3 primers), showing genetic relationship among 29 individuals of Indian mackerel (A) and three populations (B) represented by them (MM Mandapam; KC-Kochi; KW-Karwar).

- Dendrograms of individual oil sardines from three centres indicate clustering of Kochi and Karwar samples and the population dendrograms also indicated clear clustering of those populations.

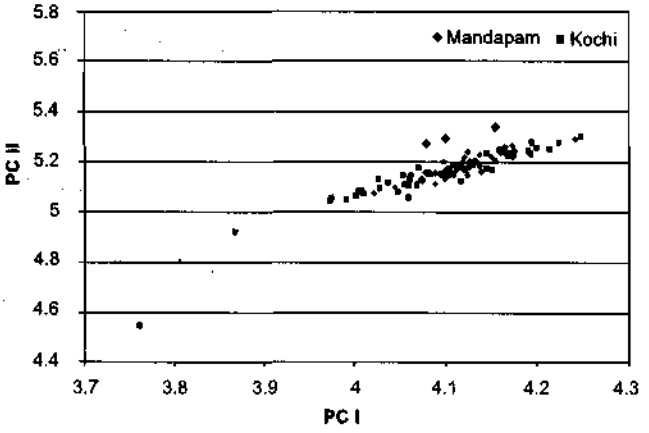
- Differences in genetic distance values were tested using ANOVA and both intra population genetic differences ($F=8.93$, $P<0.01$) and inter population genetic differences ($F=10.75$, $P<0.01$) were highly significant. These results reveal significant genetic variation among the oil sardine populations.

Truss Network analysis:

- Truss landmarks from a total of 71 fishes from Mandapam (220-247 mm total length) and 75 fishes from Kochi (220-250 mm total

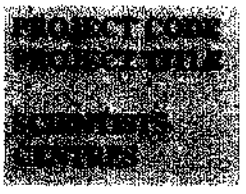


UPGMA dendrograms constructed on the basis of the genetic distance estimated from RAPD assay (3 primers), showing genetic relationship among 30 individuals of Oil sardine (A) and three populations (B) represented by them (KC-Kochi; KW-Karwar; CH-Chennai).



Sheared Principal Component analysis of truss landmarks of Indian mackerel from Kochi and Mandapam

length) were collected and distance measures calculated. These values were log transformed. Scatter plot of principal component I and principal component II generated using the data showed overlapping of points between the two samples with no clustering even on PC I. Size correction of truss morphometric data (Shear PCA method) was done. But the results were similar. The present results of both genotypic and phenotypic approaches indicated that the mackerel population from Kochi, Karwar and Mandapam are genetically homogeneous.

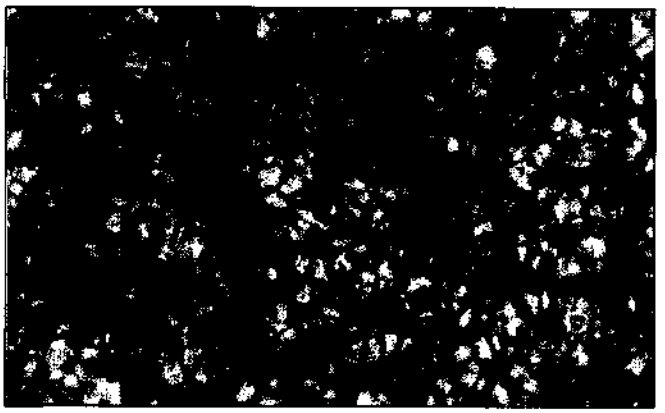


PNP/52

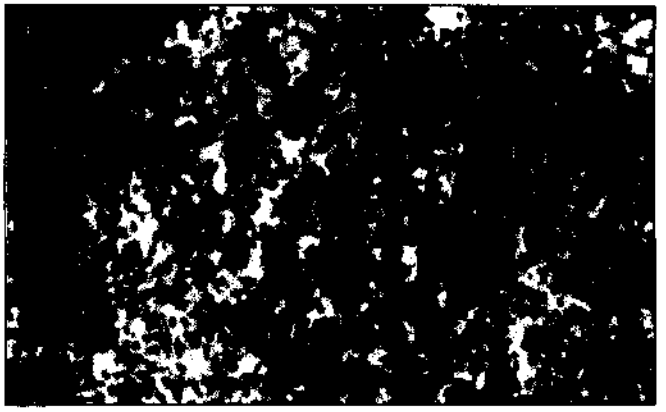
Studies on the effect of toxins, pollutants and probiotics in fish health with special reference to immune system

K.C.George, N.K.Sanil and K.S.Sobhana
Cochin

The effect of sub-lethal doses of the organophosphorous pesticide, Nuvan on the following aspects in pearl spot, *Etroplus suratensis* (Bloch) was studied after determining the 96h LC_{50}; (a) effect on haematological parameters; (b) effect on humoral antibody response; (c) histopathological alterations in important organ systems and (d) ultrastructural characterization of alterations in important organ systems.

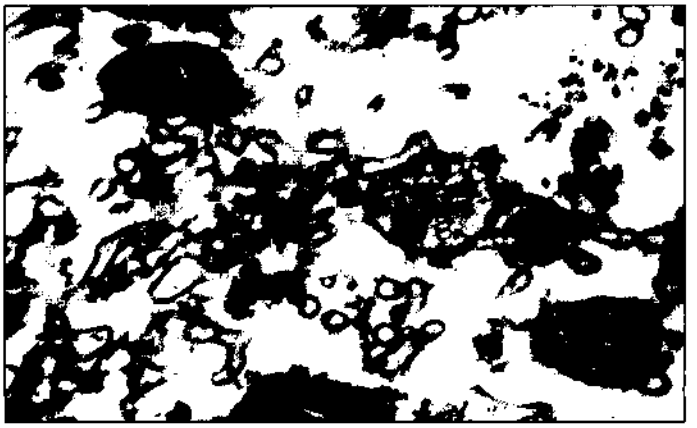


Histological section of liver from Nuvan treated *E. suratensis* showing vacuolation of hepatocytes and mild to moderate proliferation of biliary epithelium. (H & E 400 x)

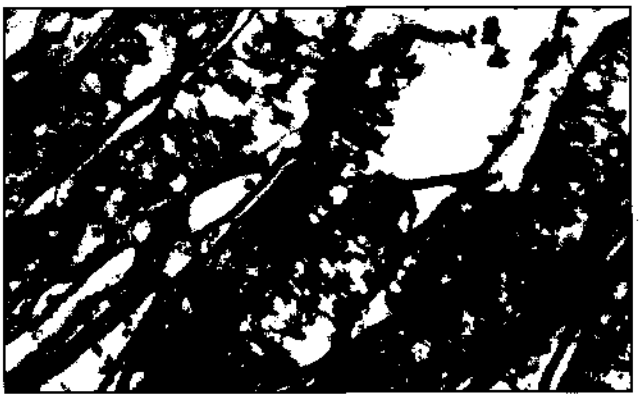


Histological section of spleen from Nuvan treated *E. suratensis* showing depletion of haemopoietic tissue (H & E 400 x)

- Three experiments were conducted each with triplicate groups of 10 fish to determine the 96 hour LC_{50} of Nuvan in *Etroplus suratensis*. It was observed that 0.1 ppm is the 96 h LC_{50} of Nuvan in *Etroplus suratensis*.
- The fish exposed to a sub-lethal dose of Nuvan (0.01 ppm, ie., 1/10th of 96 hour LC_{50} value) for a period of one month showed significant reduction in haemoglobin content. The Total erythrocyte count (TEC), Haematocrit values(PCV), Haemoglobin content and Erythrocyte Sedimentation Rate (ESR) in control groups were lower compared to test group, but the difference was not statistically significant ($P < 0.05$). Total leucocyte counts were significantly higher in test groups compared to control fish.
- The agglutination titers were significantly reduced in test groups compared to control fishes.
- Histological examinations revealed extensive necrosis and lytic changes in the kidney, liver, spleen and gills of the Nuvan treated fishes. Liver of test fishes had vacuolation in hepatocytes and mild proliferation of biliary epithelium. There was also reduction in the hemopoietic tissue in the spleen of test group.
- Transmission Electron Microscopy revealed severe damages in almost all the organs (gills, brain, liver, kidney, spleen and heart) of the Nuvan



Electron micrograph of gill epithelial cells of Nuvan treated fish showing condensation of mitochondria, degranulation, fragmentation and vesiculation of ER (50000 x).

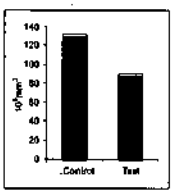


Electron micrograph of kidney epithelial cells of Nuvan treated fish depicting loss of cristae, fusion of membranes with bacillar infoldings in mitochondria (20000 x).

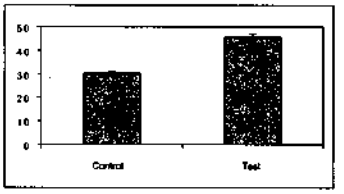
Electron micrograph of kidney epithelial cells of Nuvan treated fish showing rupture of mitochondria, loss of cristae and vacuolation (50000 x).

treated fishes (Fig.5). Peroxidation of membranes leading to accumulation of electron dense bodies was also noticed. Mitochondria had severe structural changes such as loss of granules from cristae, swelling, condensation, rupture of outer membrane, fusion of membranes with basillar invagination and calcification. Nuclei showed dialation of nuclear membrane and condensation of nuclear material. Cytoplasmic vacuolation was also prominent.

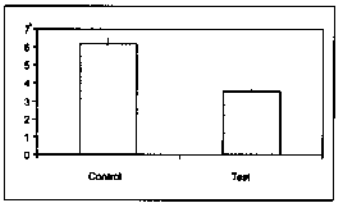
◆ The results established sub-lethal doses of the organophosphorous pesticide, Nuvan can suppress the specific humoral antibody response, can alter some of the haematological parameters and can cause pathological changes in important organs such as kidney, spleen, liver and gills in *E. suratensis*.



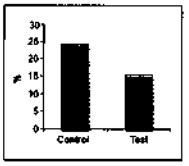
Total erythrocyte count



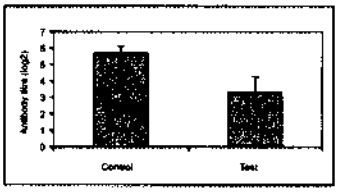
Total leucocyte count



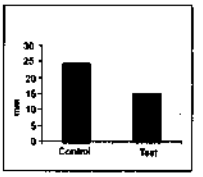
Haemoglobin %



Haematocrit



Humoral antibody response



Erythrocyte Sedimentation Rate

Haematological parameters in *E.suratensis* on sublethal exposure (0.01 ppm) of Nuvan for 30 days

PROJECT CODE
PROJECT TITLE
SCIENTISTS
CENTRES

PNP/53

Extraction and isolation of substances of pharmacological importance from marine organisms

R. Paul Raj, P.A. Thomas, A.P. Lipton, I. Rajendran and T. Narender and Imelda Joseph
Cochin, Vizhinjam, Mandapam

☞ Crude methanolic extract of the marine alga *Ulva fasciata* inhibited the growth of the MTCC bacterial cultures such as *Bacillus subtilis, Micrococcus luteus, Aeromonas hydrophila, Pseudomonas aeruginosa* and *Vibrio fischeri* at 37^0 C. In addition, the pathogenic strain of *Aeromonas hydrophila* (CF-1) isolated from the infected clown fish (from marine aquarium, Vizhinjam) was also inhibited.

☞ The methanol extract of *Ircinia fasciculata* also exhibited lethal activity against the *Artemia* larvae from 4.0% concentration onwards. Mortality was 100% within 24 hours of exposure to the extract from 6.0% concentration onwards.

Antibacterial activity of sponge extracts

Bacterial strain	Activity of sponge extracts			
	S.c	*I.f*	*C.d*	*Z.a*
Bacillus subtilis	-	+	-	+
Micrococcus luteus	+	+	+	+
Aeromonas hydrophila	-	+	+	+
Pseudomonas areuginaos	+	+	+	-
Vibrio fischeri	-	+	-	+

☞ Antimicrobial activity profile of methanolic extracts of sponges such as *Sigmadocia carnosa, Ircinia fasciculata, Callyspongia diffusa, Zygomycale angulosa* showed that the extracts of *Ircinia fasciculata* exhibited maximum inhibition towards all the tested bacterial cultures. The same extract also inhibited the pathogenic bacteria isolated from infected grouper (GYD – isolate) and shrimp (SI – isolate).

☞ In the 5.0% raw extract of *Sigmadocia carnosa*, the fungus *Penicillium* sp., (SH-I isolated from moribund seahorse) was totally inhibited. Extracts of *Ircinia fasciculate* and *Callyspongia diffusa* inhibited fungal growth at a higher concentration of 20.0%.

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

The division has undertaken 10 research projects - 5 in house, 4 NATP and one project funded by Ministry of Environment and Forests (MOEF). The division is involved in transfer of technology programmes for empowering fisherfolk and also organized 'Fishermen-Farmers-Industry-Institution-Scientists' meets in different locations. Besides providing artistic and audio-visual supporting services, the division participated in exhibitions and provided information on the research achievements and ongoing programmes and activities of the Institute to the innumerable visitors of the Institute.

PROJECT CODE **FE&E/31**
PROJECT TITLE **Empowerment of coastal communities through fisheries extension**
SCIENTISTS **Sheela Immanuel**, R. Narayanakumar, S.Ashaletha C. Ramachandran and V.P. Vipinkumar
CENTRES Cochin

An overview of the socio-economic status of coastal communities indicated the need for empowering them using appropriate development strategies enabling adoption of innovations.

★ In Panambukad, 20 farmers were motivated to take up prawn farming, providing inputs and technical guidance.

★ Three "Fishermen-Farmers-Industry-Institution meets" were organized on the culture of prawn, crab and finfish at Kumbalam, Azhikkodu and Udayamperur respectively to facilitate the transfer of technology efforts of the Institute. 'Farmers' Day' was organized at HQs, Regional and Research Centers of CMFRI.

Shri K.V. Thomas, Hon'ble Minister for Fisheries and Tourism inaugurating the *Special Fish Farmers' Day* jointly organised by CMFRI and CIFT

PROJECT CODE **FE&E/33**
PROJECT TITLE **Economics of resource management and socio-economics of small scale fisheries**
SCIENTISTS **R. Narayanakumar** and R. Sathiadhas
CENTRES Cochin, Chennai, Mandapam, Tuticorin, Kakinada, Karwar, Mangalore, Vishahkapatnam, Mumbai, Veraval, Vizhinjam and Kozhikodu

- The data collected on costs and earnings of different craft-gear combinations from selected landing centres in the maritime states of India were tabulated and analyzed. The operating costs, catch and earning of all major fishing methods were worked out on an annual basis.
- The operating cost per trip of the multi-day trawling (three day trip) ranged from Rs.18,371 in Kerala to Rs.28,665 in Andhra Pradesh.
- The gross revenue per trip of multi-day trawler was Rs.26,443 in Kerala.
- In the case of single day trawling, the gross revenue per trip ranged from Rs.8,596 (from 177kg catch) in Andhra Pradesh to Rs.9,827 (from 247 kg of catch) in Tamilnadu.
- The net operating income per multi-day trawler ranged from Rs.8,072 in Kerala to Rs.16,687 in Tamilnadu per trip.

PROJECT CODE **FE&E/36**
PROJECT TITLE **Economic evaluation of marine fish marketing system and price structure**
SCIENTISTS **R. Sathiadhas** and R. Narayanakumar
CENTRES Cochin, Chennai, Mandapam, Tuticorin, Kakinada, Karwar, Mangalore, Vishakhapatnam, Mumbai, Veraval, Vizhinjam and Kozhikodu

- The collection of price data on all commercially important fish varieties traded at landing centres, wholesale and retail markets were continued in the major centres in all maritime states.
- There was a general increase in price of almost all varieties of fish indicating not only the enhancement in the demand for fish in the international market but also the rising trend of consumer preference for fish in the domestic markets.
- On the basis of fish price at first sales, the total value of marine fish landings in India during the year 2000 was estimated at Rs.10,341 crores.
- At the national level, the average landing centre price varied from Rs. 9 / kg for silver bellies to Rs. 97 / kg for pomfrets.
- At the state level the silver bellies fetched an average price of Rs. 7 / kg at Andhra Pradesh to Rs.11 / kg at Kerala and pomfrets from Rs.44 / kg at Andhra Pradesh to Rs.186 / kg at Maharastra.
- The average wholesale market price at macro level ranged from Rs. 15 / kg for silver bellies to Rs.122 / kg for pomfrets. The average retail market price varied from Rs. 21 / kg for silver bellies to Rs.114 /kg for pomfrets.

PROJECT CODE FE&E/37
PROJECT TITLE **Women in fisheries - An analysis of the gender disparities and strategies for development**
SCIENTISTS **S.Ashaletha**, Sheela Immanuel,C. Ramachandran, V.P.Vipinkumar and P.S.Swathilekshmi
CENTRES Cochin, Kozhikodu and Chennai

- The project was undertaken to assess the role of women in fisheries and to analyze the gender disparity for making policy recommendations.
- The direct and indirect roles of women in fisheries were studied. The entire processing sector was found to be highly dependent on women and the direct roles played by them were quantified. The indirect roles like responsibility of household management and generating additional income from alternate employment were also assessed.
- Majority opined that mechanization has reduced the job opportunities while a smaller proportion perceived it in the other way.
- Seventy-five percent of ladies engaged in fish trading, 89% in fish drying and 85% of the netmaking expressed their discontent towards the benefits of technological advancements.
- The social, technical, economic, institutional and structural constraints were analyzed to design a development strategy.

PROJECT CODE FE&E/38
PROJECT TITLE **Behavioural pattern of fisherfolk on changes in technology regime and regulatory mechanisms**
SCIENTISTS **C.Ramachandran,** Sheela Immanuel, S.Ashaletha, V.P. Vipinkumar, and P.S.Swathilekshmi
CENTRES Cochin, Kozhikodu and Chennai

★ Study on impact of electronic equipment has been completed

★ It was observed that the involvement of young age group was more in the modernized sector compared to that of the traditional sector. Educational status of the fishermen also showed a similar trend.

★ Among the technologies, Echosounder and GPS were perceived to have maximum impact by all the three categories.

★ Among the various regulatory mechanisms that have been cited in the KMFRA, majority of the fishermen of all the categories had awareness on the monsoon trawl ban.

★ Trend analysis indicated that leisure time, income and profitability of fishing were perceived to have increasing trend among the mechanised sector compared to that of the traditional sector.

SPONSORED PROJECTS

The Institute has research and development projects funded by various agencies like Department of Ocean Development, Department of Biotechnology, Ministry of Environment and Forests, International Foundation for Science, Sweden and ICAR under the Cess fund scheme. Brief reports of the findings under these projects are presented below:

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Investigations on the toxic algal blooms in the EEZ of India**
SCIENTISTS	**C.P. Gopinathan**
CENTRES	Cochin

Blooms of *Trichodesmium thiebautii*

A total of 298 stations covered during 13 research cruises on board *FORV Sagar Sampada*.

⇨ Five incidents of algal blooms were observed during the cruises. Three of them recorded as *Noctiluca miliaris* bloom and rest as *Trichodesmium thiebautii* bloom.

⇨ All the hydrobiological parameters were studied in these areas and no mortality of any organism was observed in these instances.

⇨ Three instances of algal blooms were observed off Cochin and Thallassery, in the cruises onboard *RV Cadalmin*.

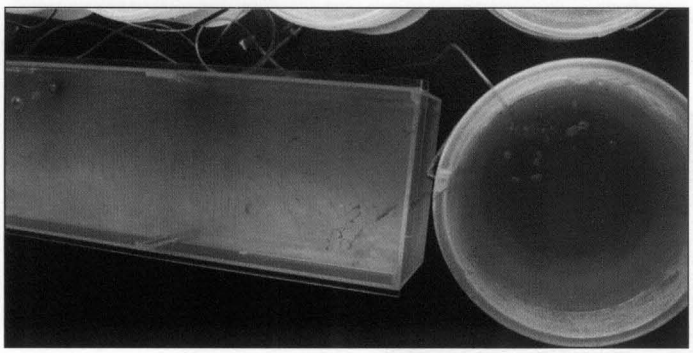
⇨ Species recorded at Cochin are *Gymnodinium breve*, and *Gonyaulax sp.* whereas *Hornellia sp.* at Thallassery. No fish mortality was observed in this area.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Studies on incidence of toxic principles and parasites in seafoods**
SCIENTISTS	**C.P. Gopinathan** and V. Kripa
CENTRES	Cochin

During July, August and September 2001, seven algal blooms were reported along the Kerala coast of which are given below :

Blooming of toxic algae in the inshore waters of west coast

Sl.No	Date	Location	Algal species
1	28-10-00	Fort Kochi	*Gymnodinium pulchellum*
2	25-7-01	Calicut	*Noctiluca scintillans*
3	4-08-01	Chombala	*Noctiluca scintillans*
4	9-08-01	Narakkal	*Heterodinium* spp.
5	26-08-01	Vizhinjam	*Noctiluca miliaris*
6	17-08-01	Thankassery	*Prorocentrum micans*
7	11-09-01	Chombala	*Prorocentrum micans*



Laboratory culture of toxic algae

Bloom sample from Narakkal which contained *Heterodinium* spp. was mass cultured in the CMFRI lab and the clam *Sunetta scripta* was fed with the toxic algae.

- The result of the analysis of the clam was negative for both PSP and DSP.
- During October –November mussel samples from Fort Kochi and Calicut showed the presence of DSP.
- During January 2001, PSP and DSP in the clam was present in the water at Thikkodi and Dalavapuram.
- Water samples from Vizhinjam and Fort Kochi showed PSP in February 2001; a very high level of diarrhetic toxin was seen in water off Vizhinjam, Narakkal and Moodadi.

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Transfer of technology of seaweed culture for rural development**
SCIENTISTS	**N. Kaliaperumal**
CENTRES	Mandapam Camp

Fisherfolk involved in seaweed culture

The technology of culture of agar yielding red alga *Gracilaria edulis* by vegetative propagation on coir rope nets and long line coir ropes was transferred to the fisherfolk/rural people of Seeniappa Dharga near Vedalai in Gulf of Mannar side and Vadakadu near Rameswaram in Palk Bay side by involving them in the seaweed culture activities.

Seaweed seedlings in coir rope net

Harvested *G. edulis*

- The work was carried out in 0.4 ha area at Seeniappa Dharga and 0.2 ha area at Vadakadu.
- The fragments (seedlings) obtained from the mother plants were inserted in the twists of coir rope nets and long line ropes of 1" thickness.
- At Vadakadu, the seedlings of *G.edulis* grew well and reached harvestable size in 60 days.
- An average 3 fold increase over the quantity of seed material introduced was obtained.
- The harvested crop was dried and used as raw material for the demonstration of agar production in the CMFRI Agar Plant at Mandapam Camp to the fisherfolk/rural people during the seaweed culture training programme.

FUNDING AGENCY	**ICAR – AP CESS**
PROJECT TITLE	**Conservation of Green turtle *Chelonia mydas***
SCIENTISTS	**M. Rajagopalan** and E. Vivekanandan
CENTRES	Chennai

Surveys were carried out along the Gujarat coast (Anthroli to Madhavpur, Chinghariya to Ghovsad, Anthroli to Devasa, Mangrol to Bhara, Oduthar to Thukkada covering 30 km) to study the intensity of Green turtle *Chelonia mydas* nesting.

- A total number of 170 nests were located during November-December 2001.
- During the survey along the Kerala coast, turtle trade was noticed near Vizhinjam and the meat of olive ridley, green and hawksbill turtle were sold.

FUNDING AGENCY	**ICAR – AP CESS**
PROJECT TITLE	**Large scale cultivation of *G.edulis* by reproductive method.**
SCIENTISTS	**Reeta Jayasankar**
CENTRES	Cochin

Germlings of *G. edulis*

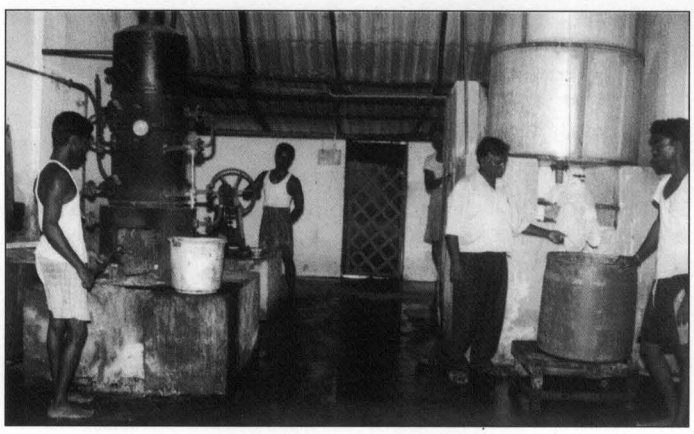
- Maximum spore settlement was observed at a depth of 0-30 cm at the rate of 11germlings/cm^2 followed by 30-60 cm (8 germlings/cm^2) depth.

- The plants attained a maximum size of 25 cm with an average of 11.4 cm (n=18) at 0-30 cm depths.

- The first harvest was done on 120 days after transplantation followed by intermittent harvest after 126 days and the final harvest after 143 days yielding a total quantity of 80 kg of matured G.*edulis*.

- Heavy epiphytic growth of amphipods, isopods, hydrozoan colonies, polychaetes, *Modiolus*, barnacles, bryozoans, clams, mussels, larvae of crustaceans and scanty growth of *Cladophora, Chaetomorpha* and *Centroceros* are observed .

FUNDING AGENCY	**ICAR – Revolving Fund**
PROJECT TITLE	**Production of Agar from the seaweeds of Gulf of Mannar and Palk Bay**
SCIENTISTS	**N. Kaliaperumal**
CENTRES	Mandapam Camp

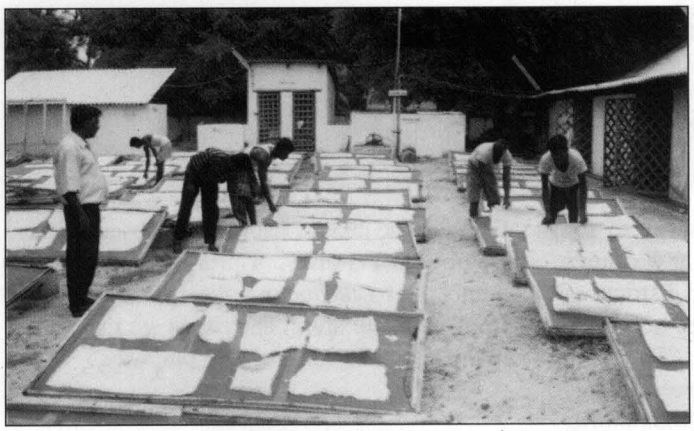


Agar plant at Mandapam

▲ Food grade agar is produced on commercial scale using the red seaweed *Gracilaria edulis* as raw material.

▲ Agar is manufactured in sheet and bits form by washing the dried seaweed in the agitator tank, treating with agar gel in aluminium trays, freezing the gel in the freezing unit, thawing, bleaching and sun-drying of agar sheets and bits.

▲ The yield of agar is 6 to 8%



Drying of agar sheets

on dry weight basis. The gel strength, gelling and melting temperature of 1.5% agar ranged from 74 to 122 g/cm^2, 44 to 46°C and 95 to 97°C respectively.

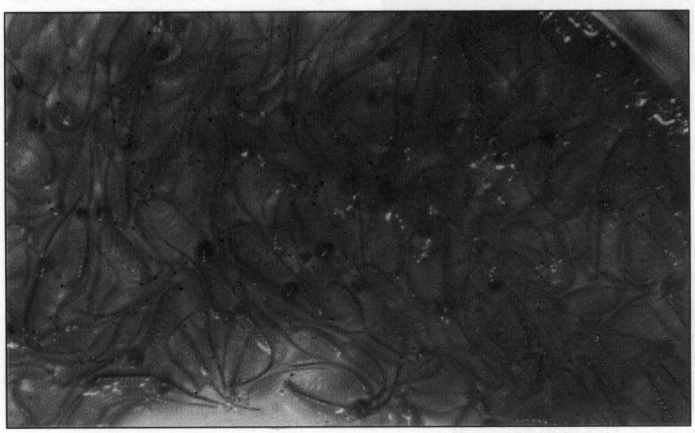
▲ The bleached and sun-dried agar sheets and bits are marketed by packing them in polythene bags.

▲ During January – December, 2001, 1325 kg of agar (agar sheets and bits) was produced. An income of Rs.1,16,360/- was generated by sale of 460kg of agar sheets and 70 kg of agar bits.

▲ Two training programmes on Agar Production one from 3.10.2001 to 8.10.2001 to 15 fisherfolk of Chinnapalam (Pamban) and 2 officials and another from 27.12.2001 to 2.1.2002 to 10 fisherfolk of Kunjarvalasai sponsored by M.S.Swaminathan Research Foundation, Chennai were organised under this project and an income of Rs.81,000/- was generated as training fees.

FUNDING AGENCY	**ICAR – AP CESS**
PROJECT TITLE	**Intensive culture of brine shrimp**
SCIENTISTS	**M. Rajamani**
CENTRES	Tuticorin

During the year, a series of experiments on the production of the biomass of the exotic species of brine shrimp *Artemia franciscana* were conducted in rectangular tanks under different ecological conditions.



***Artemia franciscana* cultured in mass production system**

In two experiments an average wet biomass of 263.4 g (Dry mass 32.4 g) were obtained in 21 days from an initial stocking of 90 riding pairs in each tank. The salinity ranged from 47 to 75 ppt and pH 8.1 – 9.6. On an average, 3 g cyst were collected from two experiments and the hatching time was 13.3 hours. Intensive survey in and around Tuticorin revealed complete absence of native species *A. parthenogenetica.*

FUNDING AGENCY	**Department of Fisheries, Government of Kerala**
PROJECT TITLE	**Survey assessment and breeding of the marine ornamental fishes along Malabar coast**
SCIENTISTS	**K.K. Philippose**
CENTRES	Calicut

During the year 2001 survey of the marine ornamental fish resources at 6 centres along the Kozhikode and Kannur districts of Kerala were carried out. 67 species of marine ornamental fishes were recorded. The most common among them are : *Neopomacentrus filamentosus, Chaetodon collaris, Gymnothorax* sp., *Siganus* sp., *Ostracion cubicus, Diodon histrix* and *Arthron hispidus*. Youngones of these fishes were most abundant in the fishery from November to January. The peak abundance of fishes in the coastal habitat was observed from October to February. During September, 200 numbers of *Chaetodon collaris* were collected from Thikkodi area. The fishes are maintained in the aquarium for breeding purposes.

98 aquarists were trained in collection, conditioning and aquariculture of marine and freshwater ornamental fishes. A one-day meet of the trainees was conducted during February in association with Trainers' Training Centre of CMFRI.

FUNDING AGENCY	**Department of Fisheries, Government of Kerala**
PROJECT TITLE	**Development of artificial reefs off Moodady-Thikkody**
SCIENTISTS	**K.K. Philippose**
CENTRES	Calicut

During this year two artificial reefs were installed at Moodadi and Thikkodi. The triangular concrete modules were fabricated by joining three independent slabs of 150 cm x 130 cm with 4 cm thickness. Each slab is provided with 2 feet size window in the middle. Each reef consisting of 100 modules were installed at a depth of 15 m in a rectangular design of 100 m x 50 m. The Moodadi-Thikkodi area is a traditional lobster fishing ground and the main objective is to enhance the lobster population by increasing the settlement area and by providing additional shelter and food.

Artificial reef modules being installed at Thikkodi-Moodadi

Observation on lobster fishery in the area indicated better catch during the year (2.6 tonnes) compared to the previous year (1.8 tonnes).

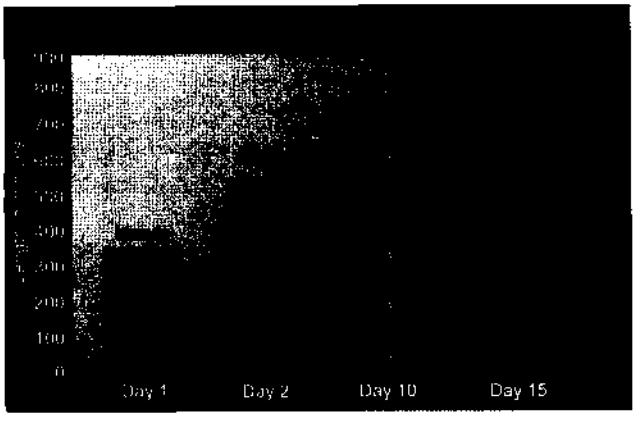
Good fishery resources consisting of both pelagic and demersal fishes were reported from the Dharmadom reef area.

ICAR - AP CESS
Onshore culture of marine pearls
P.V. Sreenivasan
Chennai

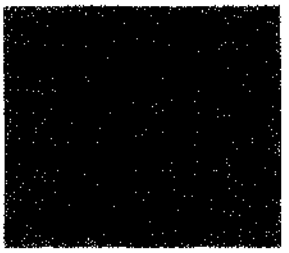
- A positive correlation between size and filtration rate was observed and the filtration rate (F) increased with body size (W: dry tissue weight). In the allometric equation, $F = a W^b$, where F = filtration rate in lts/hr, W = dry tissue weight of the oyster, the values of a & b were found to be 5.79 and 0.14 respectively.
- Filtration rate markedly reduced at 25% salinity, increased with increasing temperature up to an optimum of 33 °C and decreased as cell concentration of *Chaetoceros calcitarns* increased and dropped to 1 litre/hour at the concentration of 3×10^5 cells / ml.
- The modal chromosome number of *Pinctada sugillata* was found to be n =14.
- The triploidy percentage obtained for a concentration of 500 micromolar/litre 6-DMAP at 20 minutes after fertilization over a period of 20 minutes was 75% and for that of Cytochalasin-B for 15 minutes period was 72%. The larvae survived were 6.8% and 12% respectively.

ICAR - AP CESS
Development of seafarming technology for *Babylonia* sp.
K.K. Appukuttan and P. Laxmilatha
Cochin

- The broodstock maintained in the hatchery spawned and the larvae hatched out from the capsules on the 5th day. Settlemt of the planktonic larvae was between 12th to 16th day with 80% survival rate.
- Shrimp and squid meat were found to be good feed for the juveniles.
- The average shell length of the juveniles of *B. spirata* increased from 895.4µ to 2.43 mm on the 60th day after settlement.
- Optimum salinity conducive for the growth and settlement of larvae of *B. spirata* was 30 ppt.
- Adult *B. spirata* showed preference to clayey substratum while *B. zeylanica* preferred beach sand. This differential preference is reflected in their natural habitats also. The two species generally do not occur in the same grounds.



Development of *Babylonia* larvae produced in CMFRI hatchery

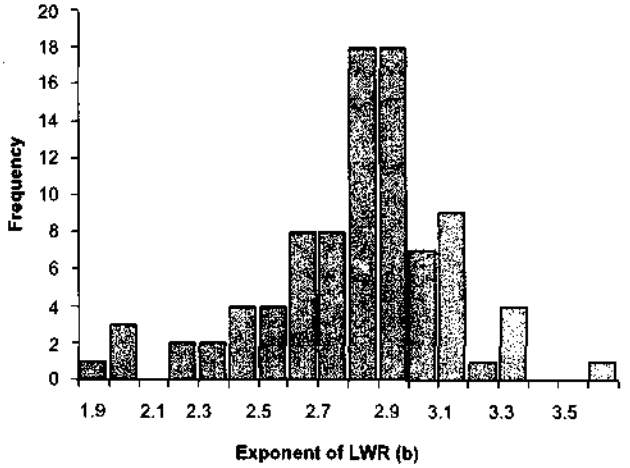


ICAR - AP CESS

Application of trophic modelling and multispecies virtual population analysis to formulate management options for the multigear marine fisheries of southern Karnataka

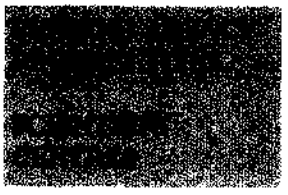
K.S. Mohamed, P.U. Zacharia, C. Muthiah, P.K. Krishnakumar, Prathibha Rohit
Mangalore

All necessary data for fitting the ecopath model have been collected and are being processed. Qualitative and quantitative analyses of stomach content data of 31 species including apex predators like sharks have been completed. Growth, mortality, aspect ratios and biomass estimates of 17 species have also been completed. For model fitting all species have been classified into 11 ecological groups. Model fitting and trial runs are in progress. Salient findings during the year are given below :



Frequency distribution of b values of the 51 species of marine fishes and shellfishes from Southern Karnataka

- ❑ The preliminary non-validated estimates of the biomass and P/B ratio of 5 major groups are complete.
- ❑ The length-weight relationship parameters (a & b) of all species and groups studied are complete.
- ❑ Two new records of finfishes (*Heteropriacanthus cruentatus*, an uncommon Bull's eye and *Variola louti*, the rare moon-tail sea bass) have been made.

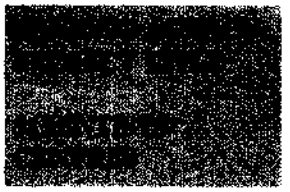


ICAR Revolving Fund

Commercial propagation of marine pearls adopting onshore culture technology

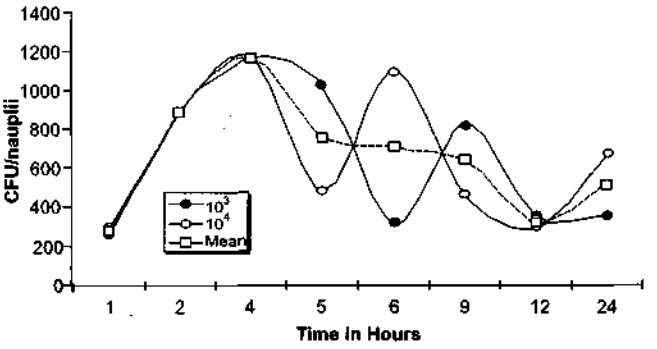
A.C.C. Victor, A. Chellam, D. Kandasamy and I. Jagadis
Mandapam Camp

- ★ A total stock of 2,05,610 oysters of different sizes and 22,438 nucleated oysters are maintained in the pearl farm.
- ★ 5.0 lakhs spat (< 1.0 mm) were produced and 1.27 lakhs spat of length 5-10 mm were transplanted to open sea.
- ★ 33,793 oysters were nucleated with 3, 4 & 5 mm shell bead nucleus.
- ★ In the 36,415 nucleated oysters survival was 57.9%, after 8-9 months. Nucleus retention was observed in 48.6% in which commercial quality pearls were obtained in 16% oysters.
- ★ 1256 pearls worth Rs.1,59,796/- were sold and the revenue deposited into ICAR A/C.
- ★ Under the project Rs.4,47,376/- has been earned through sales of farmed pearls till 2002.



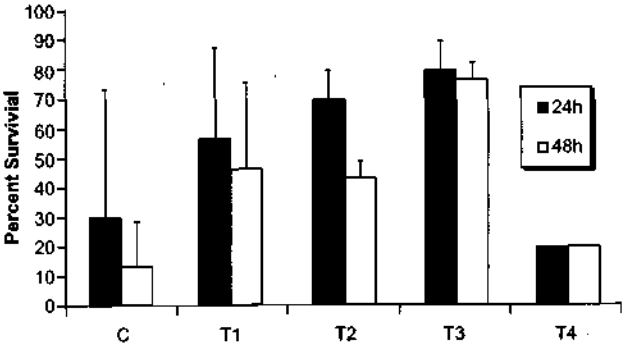
International Foundation for Science, Sweden.
Effect of probiotic feeding in the rearing and production of marine shrimp larvae
K.S. Mohamed
Cochin

Peak enrichment of the probiotic yeast *Saccharomyces boulardii* into *Artemia nauplii* instar II took place within 4 h post-enrichment. An enrichment duration of 4 h is therefore recommended for *S. boulardii*. Enrichment of another probiont *Lactobacillus plantarum* into *Artemia nauplii* took place at much lower levels as compared to *S. boulardii*. The capacity of the nauplii to ingest the rod-shaped *Lactobacillus* and the spherical *Saccharomyces* are evidently different. Maximum enrichment of *L. plantarum* took place between 4 and 12 hours.

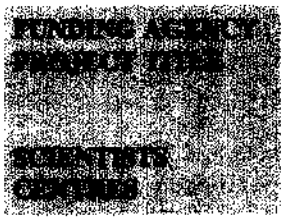


Entrichment of *S. boulardii* into Instar II *Artemia* nauplii over time

Enrichment of S. *boulardii* into *P. monodon* zoea and mysis stage larvae helped the larvae to surmount an artificial *Vibrio* pathogen challenge. The results obtained in the 3 trials showed high variation as to the level of enrichment necessary to effect a resistance to the pathogenic *Vibrio*. In general, it would appear that enrichment of at least 10^5 CFU/ml of *S. boulardii* is necessary to impart the resistance to *Vibrio harveyi*.



Survival of PL-1 *P. monodon* larvae after challenge with *Vibrio harveyi*



International Foundation for Science, Sweden.
Environmental impact assessment of suspended culture of the green mussel *Perna viridis* and the edible oyster *Crassostrea madrasensis* in a topical estuarine ecosystem
V. Kripa
Cochin

The organic content at the 7-year old oyster farm site was 2.5 times higher than in the estuary. The percentage of clay, silt and fine sand was higher at the farm site while coarse sand was lower at the farm site (5.34%) than in the estuarine system (9.3%).

Site	Organic carbon	Clay%	Silt%	Coarse sand%	Fine sand%
Farm	1.50	4.20	3.40	5.34	39.96
Estuary	0.6	2.9	1.0	9.3	28.8

The Total Suspended Solids within the farm was lower than in the open estuary. The difference ranged from 2 mg/l in April to 18.6 mg/l in May.

Ministry of Environment & Forests
Environmental economic analysis of inshore fishery resource utilization of coastal Kerala
R. Sathiadhas and R. Narayanakumar
Cochin

- A preliminary survey was conducted all along the Kerala coast. Munambam, Cochin and Neendakara centres in the mechanized sector and Kochuveli and Alappad in the non-mechanized sector under the highly degraded category were selected for detailed study.
- Valanjavazhi, Thangassery and Vizhinjam centres operating mostly motorized units represents degraded category and Arthungal and Poovar centres mostly operating non-mechanized fishing units represents the comparatively undisturbed category.
- The analysis on the investment pattern and operational costs and earnings of different craft- gear combinations were carried out.
- Suitable models for the estimation of the economic loss due to juvenile fishing as well as the functional relationship between input-output ratios were developed.
- The production function analysis for mechanized trawlers indicated that the annual fishing days and oil consumption can be increased by 5% and 38% respectively from the present level to obtain maximum profit.
- Considering the quantity of juveniles landed by various destructive gears along the study area, the total annual economic loss estimated was about Rs. 600 crores.

Ministry of Environment & Forests
Studies on the impact of bottom trawling on the ecology of fishing grounds and living resources of the Palk Bay and Gulf of Mannar
P. Jayasankar
Mandapam

Analysis of the data collected on commercial trawl fishing in the Gulf of Mannar and Palk Bay off Mandapam and Rameswaram island regions during the period 1998-2000 has been completed.

- Clupeoids and silverbellies are dominant, followed by commercial sized prawns, crabs, lobsters and cephalopods. Eighty two percent of the 185 species collected and identified during the present study consisted of low-volume ground fish, stomatopods, undersized prawns, gastropods, bivalves,

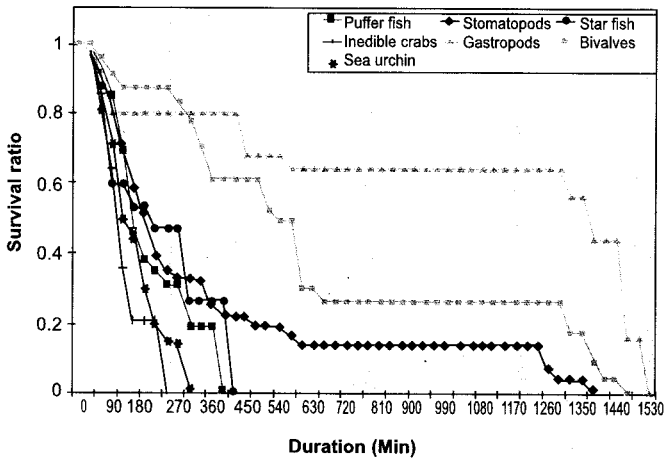
inedible crabs, echinoderms and seaweeds/ sea grass.

- The study revealed that with increased fishing effort, catch of edible groups is decreasing, while that of inedible groups is steadily increasing both in the Palk Bay and Gulf of Mannar. Monthly effort and catch of non-target groups showed positive correlation (r=0.905) and ANOVA showed highly significant (p=0.01) F value between the two. On the other hand, effort and target groups had poor correlation (r=0.248).

- Data on temperature, salinity, dissolved oxygen, phosphate, silicate, nitrate, nitrite, photosynthetic rate and zooplankton volume were collected regularly from Gulf of Mannar and Palk Bay. High volume of zooplankton coincided with high rate of gross and net photosynthesis in both the Palk Bay and Gulf of Mannar.

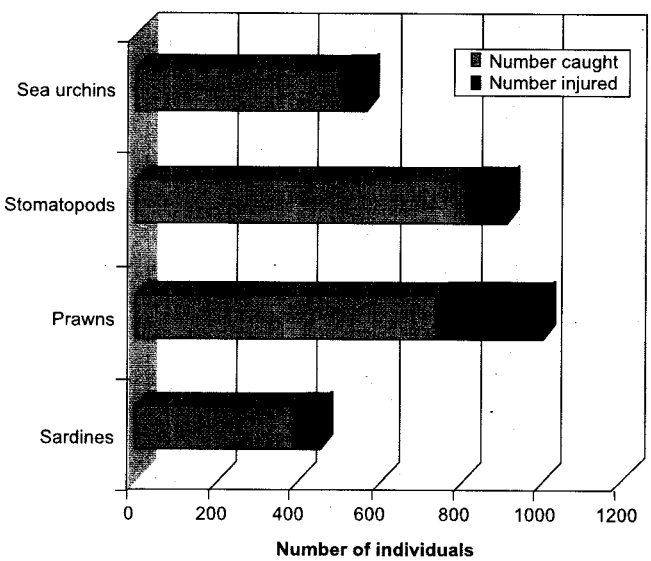
- From March 2000 to March 2001, a total of 18 trawling voyages were arranged in hired private boats and 21 hauls were made in both the Gulf of Mannar and the Palk Bay.

- Onboard experiments were carried out to study (a) damages inflicted on taxa (b) survival duration of taxa after being trawled and deposited on the deck. Mean survival duration indicates that 'non-target' groups are relatively hardier than the 'target' groups to trawling pressures. Except the crab, *Portunus pelagicus,* all other species died at the end of 150 minutes of capture. Gastropods, bivalves and stomatopods have survived almost a full day after capture, though significant mortalities occurred after about 480 minutes of capture.



Survival ratio (number of live animals/number captured) by elapsed time in bottom trawl-caught inedible biota

- About 50% of the total catch of these experimental trawling cruises were seaweeds/sea grass.



Extent of injuries sustained by some representative taxa during trawl entrapment

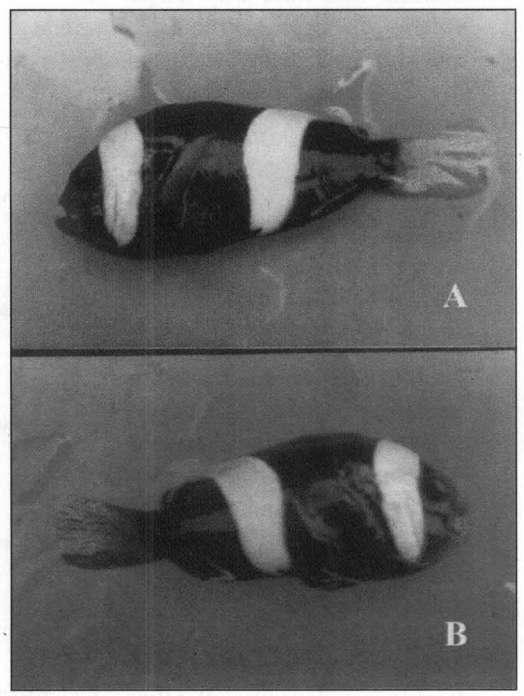
- Once the plants are dislocated, their holdfasts can not firmly attach to the substratum and the plants die out subsequently. Sea grass habitat is crucial to the life of several organisms especially the prawn *Penaeus semisulcatus*, the most important marine commercial species from the region. Declining catches in prawn fishery could be partly due to this dislocation of marine flora by trawling.
- Most of the 'in-edible' biota sustain less injury and survive longer after being captured in trawl gear. Lacerations, loss/ damages of appendages/carapace and loss of spines were taken as criteria for assessing injuries. Commercially important prawns sustained maximum injuries followed by stomatopods.
- The observation that generally most of the in-edible groups are less harmed and survive longer after being captured in trawl nets, should encourage the fishers to throw back these uneconomic catches back to the sea for their continued survival. On the other hand, if they are brought to the shore, only a portion of them would find any use in the form of raw material for animal feed and fertilizers. But damage done to the biodiversity of these groups will be of greater magnitude than any economic use for the fishers.

FUNDING AGENCY	**ICAR - AP CESS**
PROJECT TITLE	**Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers**
SCIENTISTS	**P. Jayasankar** and Bobby Ignatius
CENTRES	Cochin, Mandapam

Sixty one live specimens of *Amphiprion* and *Abudefduf* in the TL range 38-134 mm were collected from Mandapam and Vizhinjam alongwith one brood of embryos of clown fish from Vizhinjam. Morphological, meristic and colour characteristics of all the above specimens were recorded and from sub-adult and adult fishes caudal fin tips were collected and preserved in ethanol for genomic DNA extraction. One of the important objectives of the project is to ratify species status of clown fish domesticated at Mandapam and Vizhinjam marine aquariums.

RAPD experiments: A total of 12 decamer primers from Operon Inc kits A and F were initially screened to determine (a) amplification and (b) level of polymorphisms. Amplified products were run in 1.5% agarose gel and documented.

- A total of 4 primers were short listed from the two kits A and F, namely OPA 05, OPA 08, OPF 02 and OPF 03 for further analysis



***Amphiprion* sp. from Mandapam (A) and Vizhinjam (B)**

of clown fish from both the centres. OPA 05, OPF 02 and OPF 03 produced highly homogenous band pattern among the specimens from Mandapam and Vizhinjam.

- The loci were given score '1' and '0' based on the presence or absence of a band and a similarity/distance matrix was developed. Table 1 shows the data on genetic similarity and genetic distance of clown fish samples from Mandapam and Vizhinjam aquariums.

Table 1. Indices of genetic similarity (above the diagonal) and genetic distance (below the diagonal) in clown fish from Mandapam and Vizhinjam

Primers OPA 04 OPA 08OPF 02 & OPF 03 Method: Nei & Li (1979)

Mmm1	****	0.9524	0.9744	0.9744	0.9697	0.8235	1	0.9231	0.95	0.9091
Mmm2	0.0476	****	0.9268	0.9268	1	0.7778	0.9524	0.9268	0.9524	0.9143
Mmm3	0.0256	0.0732	****	1	0.9697	0.8485	0.9744	0.9474	0.9231	0.9375
Mmm4	0.0256	0.0732	0	****	0.9697	0.8485	0.9744	0.9474	0.9231	0.9375
Mmm5	0.0303	0	0.0303	0.0303	****	0.8276	0.9697	1	1	1
Viz1	0.1765	0.2222	0.1515	0.1515	0.1724	****	0.8235	0.8485	0.7647	0.8571
Viz2	0	0.0476	0.0256	0.0256	0.0303	0.1765	****	0.9231	0.95	0.9091
Viz3	0.0769	0.0732	0.0526	0.0526	0	0.1515	0.0769	****	0.9231	1
Viz4	0.05	0.0476	0.0769	0.0769	0	0.2353	0.05	0.0769	****	0.9091
Viz5	0.0909	0.0857	0.0625	0.0625	0	0.1429	0.0909	0	0.0909	****

- The results indicate high level of homogeneity among the clown fish individuals maintained in the aquarium at Mandapam and Vizhinjam. Further the low level of polymorphism reflects high level of inbreeding. This observation in combination with the fact that no distinct diagnostic marker separating the populations between Mandapam and Vizhinjam was obtained, confirms that both belong to the same species.

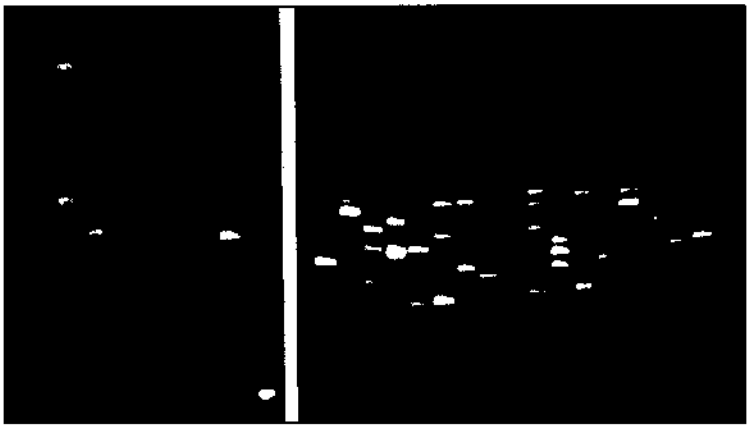
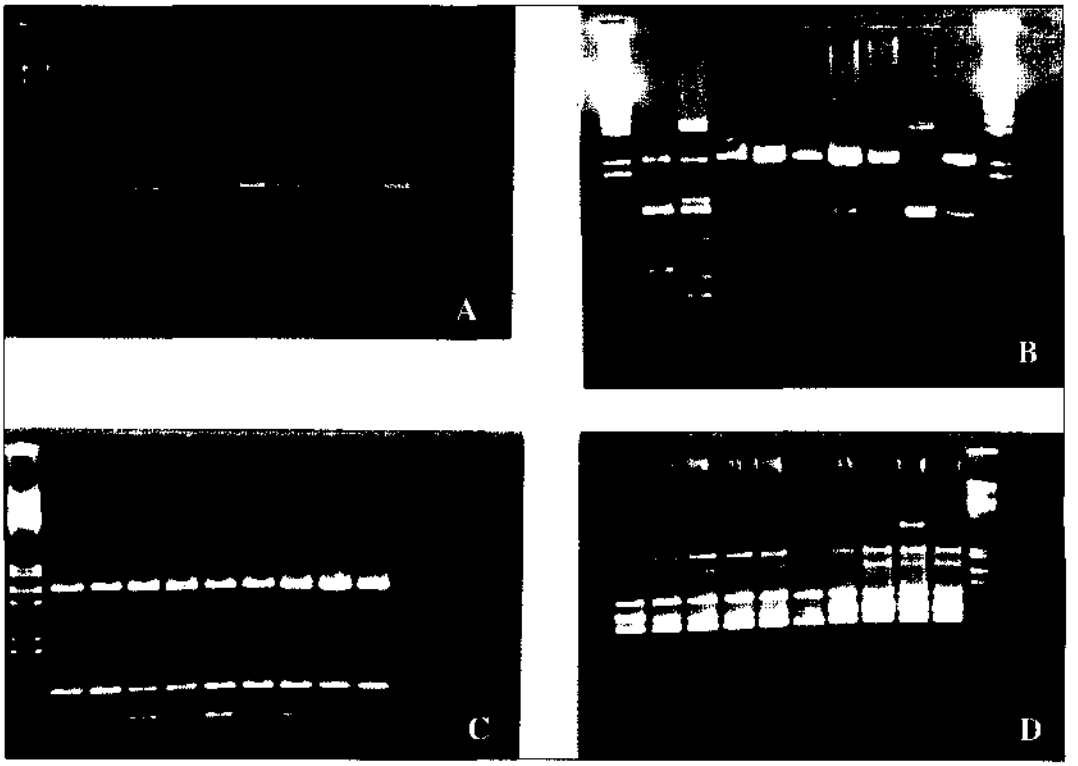
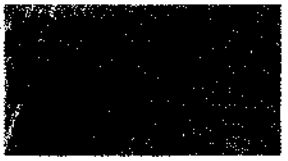


Fig. 1 RAPDs of clown fish *Amphiprion* – Screening of arbitrary primers: A, lane 1, OPA 05: lane 2, OPA 06; lane 3, OPA 07; lane 4, OPA 09; lane 5, OPA 10; lane 6, OPF 01; OPF 02; lane 8, OPF 03; lane 9, OPF 04; lane 10, OPF 05; lane 11, OPF 06; lane 12, OPF 07; lane 13, OPA 05; lane 14, OPA 06; lane 15, OPA 07; lane 16, OPA 09; lane 17, OPA 10; lane 18, OPF 01 (lanes 1-12) one speciment of *amphiprion sebae* from Mandapam; lane 13-18 one specimen of *Amphiprion* sp from Vizhinjam), B, lane 1, l *Hind* III/*Eco* R 1 marker; lane 2; lane 3, OPF 03; lane 4, OPF 04; lane 5, OPF 05; lane 6, OPF 06, lane 7, OPF 07 (all lanes one specimen of *Amphiprion* sp from Vizhinjam).



RAPDs of clown fish *Amphiprion* – A. amplifications by arbitrary primer OPA 05; lane 1, *Hin*d III/*Eco*R I marker; lanes 2 – 6, specimens of *Amphiprion sebae* from Mandapam; lanes 7-11, Specimens of *Amphiprion* sp from Vizhinjam. B. amplifications by arbitrary primer OPA 08; lanes 1 & 11, *Hin*d III/*Eco*R I marker; lanes 2-5, specimens of *Amphiprion sebae* from Mandapam; lanes 6-10, specimens of *Amphiprion* sp from Vizhinjam. C. amplifications by arbitrary primer OPF 02; lane 1, *Hin*d III/*Eco*R I marker; lanes 2-6, specimens of *Amphiprion sebae* from Mandapam; lanes 7-10, specimens of *Amphiprion* sp from Vizhinjam; lane 11, blank; lane 12, pBR322/*MSP* I marker. D. amplifications by arbitrary primer OPF 03; lanes 1-5, specimens of *Amphiprion sebae* from Mandapam; lanes 6-10, specimens of *Amphiprion* sp from Vizhinjam; lane 11, *Hin*d III/*Eco*R I marker.

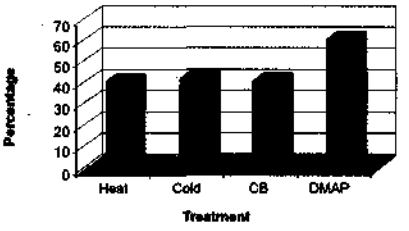


ICAR- AP CESS

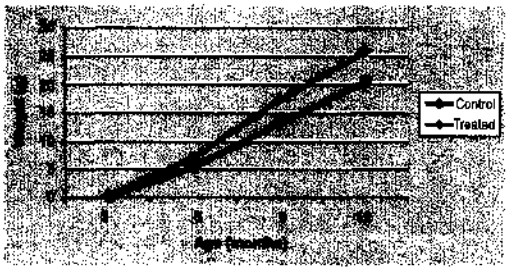
Induction of triploidy in commercially important bivalves

P.C.Thomas, P.Muthiah and T.S. Velayudhan
Cochin, Tuticorin

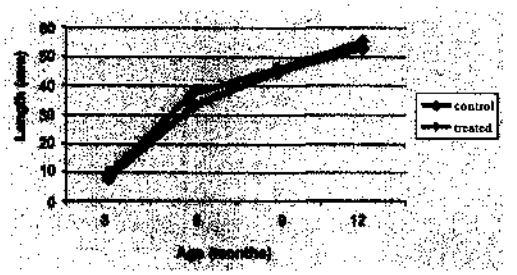
- Comparison of the triploidy inducing efficiency of the physical agents like heat shock and cold shock as well as chemical agents like cytochalasin B and 6-dimethyl aminopurine (DMAP) revealed maximum efficiency by DMAP. The percentage triploid larval (veliger) yields (average of triplicates) are presented.



Relative efficiency of different triploidy-inducing agents

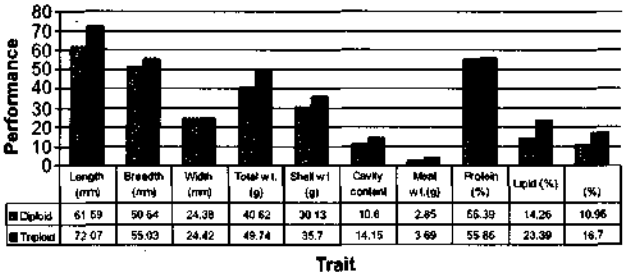


Comparison of weight increment in oysters exposed to DMAP for induction of triploidy



Comparison of length increment in oysters exposed to DMAP for induction of triploidy

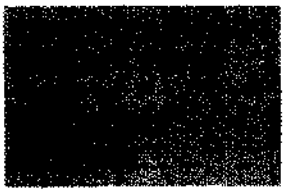
- Growth performances of the triploid oysters at 3 monthly intervals were compared with that of the diploid counterparts. Triploids showed higher growth in terms of total length, width and shell-on weight at 3, 6, 9 and 12 months of age.



	Length (mm)	Breadth (mm)	Width (mm)	Total wt. (g)	Shell wt (g)	Cavity content	Meat wt.(g)	Protein (%)	Lipid (%)	(%)
Diploid	61.59	50.54	24.38	40.62	30.13	10.6	2.85	55.39	14.26	10.96
Triploid	72.07	55.03	24.42	49.74	35.7	14.15	3.69	55.86	23.39	16.7

Comparative performance of triploid and diploid adult oysters

- The beneficial effects of triploidy in animals results mostly from the sterility of the triploids. Evaluation of the slaughter traits like cavity content, meat weight, as well as meat quality traits like glycogen and lipid content in adult animals indicated superior performance by triploids compared to the diploid controls.



Department of Biotechnology

Studies on biotechnological aspects of disease management in aquaculture using immunostimulants

A.P. Lipton

Vizhinjam

→ The efficacy of *Ulva fasciata* was evaluated along with other two immunostimulants viz., levamisole and chitosan. Three doses of levamisole and chitosan separately and two doses of *Ulva* were incorporated in the shrimp grower feed. The feeding was carried out thrice daily at a rate of 5% of shrimp body weight for a period of 30 days.

→ After determining LD_{50} (10^6 cfu/shrimp) of pathogenic *Vibrio alginolyticus* to *Penaeus monodon*, the immunostimulant fed shrimps and control group of shrimps were challenged. The infection/mortality was monitored for a period of 7 days and the survival particulars is given in table below :

Survival of *P. monodon* after challenge with the *V. alginolyticus*

Experimental group	Survival (%)
Control	0.0
Levamisole 300 mg/kg shrimp	40
Levamisole 150 mg/kg shrimp	64
Levamisole 50 mg/kg shrimp	55
Chitosan 300 mg/kg shrimp	34
Chitosan 150 mg/kg shrimp	62
Chitosan 50 mg/kg shrimp	46
Ulva 2000 mg/kg shrimp	62
Ulva 1000 mg/kg shrimp	34

- The immunological factors such as haemogram, phagocytic index, and bacterial clearance were considerably increased in the treated group.
- An extensive-type shrimp farm (0.24 ha) located at Rajakamanakalam, Tamilnadu (Southeast coast of India) was used for the field experiment. Hapas (2x1x1.5 m) were installed in the pond and each hapa was stocked with 50 healthy farm-reared juvenile *Penaeus monodon* shrimp (abw = 5.2±0.56). The feeds tested were *Ulva* feed: Feed + 2000mg/kg of *Ulva fasciata*, Levamisole feed: Feed + 150mg/kg of Levamisole and Chitosan feed - Feed + 150mg/kg of Chitosan. Feed was offered twice daily at a rate of 5% of shrimp body weight. The treatment was continued for a period of 30 days.
- After 30 days of feeding, the control and treated shrimp were challenged with pathogenic *V. alginolyticus*. The normal survival and the Percent Relative Protection (PRP) after challenge are shown below:

Survival in the experimental group

Control	58.0
Levamisole	74.0
Ulva	68.0
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Percent Relative Protection of shrimp challenged in the field

Experiment group	PRP
Ulva fed group	23.08
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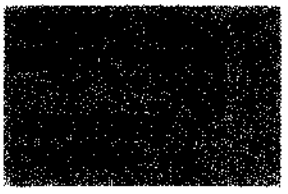

Department of Science & Technology
Studies on immune response during moult cycle in the spiny lobster *Panulirus homarus*
S.R. Krupesha Sharma
Calicut

- Lobsters were acclimatized to the laboratory conditions at the following water quality parameters: Salinity (ppt) 32±2; pH 7.5; temperature (°C) 27±3 and dissolved oxygen (ml/L) 3.7±0.3.
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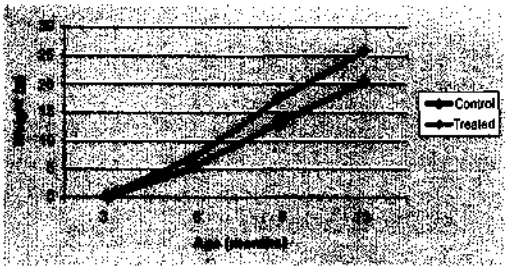

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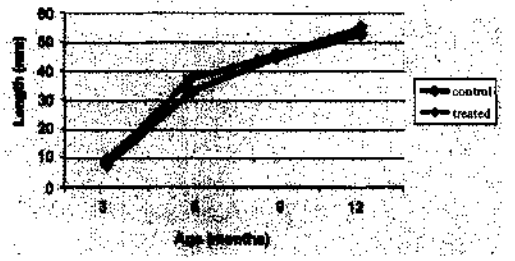

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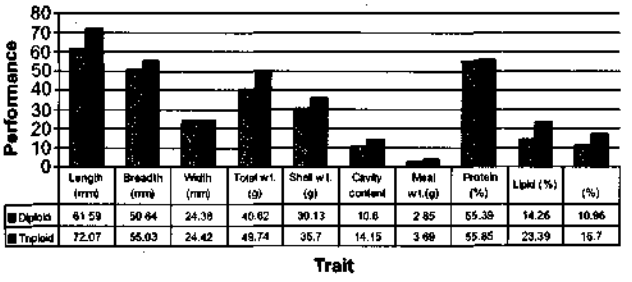

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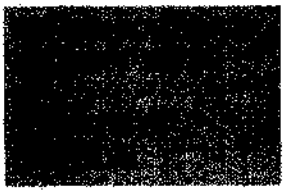

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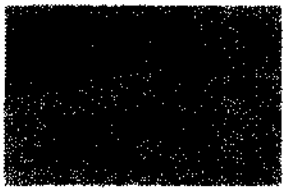

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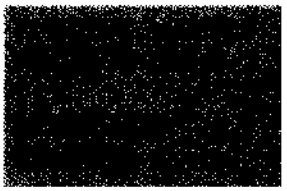
- Lobsters were acclimatized to the laboratory conditions at the following water quality parameters: Salinity (ppt) 32±2; pH 7.5; temperature (°C) 27±3 and dissolved oxygen (ml/L) 3.7±0.3.
- Immunological assays were performed for

each moult stage/sub stage in minimum of six samples (animals) with three replicates and repeated 3 times. Work is in progress.

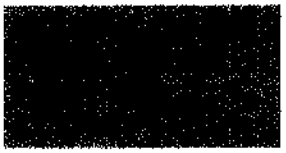


Department of Biotechnology
Induced maturation, breeding seed production and culture of groupers and breams
D. Kandasamy
Madras

Captive brood stock management, experiment on induced maturation of groupers were conducted at Mandapam Camp.

- The groupers reared in the RCC tank showed a growth rate of 2.5mm (26g), 2.3mm(46g) and 2.3mm (49g) per month for 2-3, 3-4 and 4.0kg weight groupers respectively. In the indoor five ton FRP tanks, groupers grew to 430-757mm (1360-6385g) from the initial size of 400-745mm (1200-5485 g).

- Pigface bream, *L.nebulosus* attained an average size of 339mm (775g) in outdoor 30-ton tank. Three breams of 1.650,1.800 and 2.300 kg were transferred to indoor FRP tanks for hormonal inducement. Hormone pellets were prepared by using LHRH-a, Ovaprim and Ovatide. For implantation a dosage of 100g and 60g/kg body weight of the fish in respect of females and male was administered. For injection it was 50mg for LHRH-a and 650-850 IU HCG/kg bodyweight of fish. Non-ethindrone and methyl testosterone were also given for males through pellets and feed respectively.



ICAR – AP CESS
Seed production of spiny lobsters, *Panulirus* spp.
M. Vijayakumaran
Madras

- The ovigerous female lobsters *Panulirus versicolor* and *P.homarus* collected from the holding centres and landing centres at Kovalam and Kazimodu were maintained separately in aerated 250 litres fibreglass tank with filtered (1mm mesh) seawater in the laboratory and were fed green mussel and marine clam. They were maintained in the hatchery under optimum temperature, salinity and pH. The eggs were at various stages of development. The quality of eggs and the larvae produced by such berried females were very weak and poor due to their long exposure to air during internal live transport in thermocole packing.

- Rearing of phyllosoma was done in 0.5 to 3 litre capacity glass beakers. Larvae were fed with newly hatched artemia nauplii at the rate of 1500/litre. The survival rate of the phyllosoma larvae at the 3rd, 6th, 9th, 12th, 15th, 18th, 21st, 24th and 27th days were 82%, 76%, 74%, 67%, 51%, 49%, 21%, and 2% respectively. On the 28th day the incidence of mortality was high due to protozoan and bacterial infections.

- Rearing of larvae in the specially designed U -shaped tanks enabled the larvae and the *Artemia* nauplii remain suspended and the larvae were reared to stage IV.

- The following water quality parameters are being maintained for broodstock and for larval rearing at Kovalam: temperature: 23 to 29°C, salinity: 32-35 ppt, dissolved

oxygen: > 4 ppm, ammonia: <0.1, nitrite: <0.1ppm and alkalinity: 140ppm.

- To maintain pH differential biological filters such as pebbles, granites, bivalve shells and a mixture of all was tested. The biological filter with shells was found to be suitable than the others to maintain the breeder and the larval rearing tanks.
- Biological filter is generally used to control the metabolic wastes like ammonia and nitrites. Instead of biological filter, *Gracillaria* spp. is being used for the removal of nitrogenous wastes in the system. The initial result is encouraging.
- During the larval rearing process infections of protozoans such as *Zoothamnium*, *Epistylis* and *Vorticella* hampered the normal swimming and feeding of the larvae.Therapeutic treatment with 0.05 ppm of malachite green and 10 ppm of formalin were found to be effective to control these protozoans.
- A prophylactic treatment of trifluralin 0.1 ppm every alternative day was provided to control fungal infections. Antibiotics, chloramphenicol and tetracycline, at 5-10 ppm were found to be effective at early stages of infections and as prophylactic treatments.

ICAR AP CESS

Studies on immune response in shrimp

S.R. Krupesha Sharma and E.V. Radhakrishnan
Calicut

- Studies on the immune system of the shrimp, *Penaeus indicus*, from wild as well as from shrimp culture ponds were carried out. Parameters such as total haemocyte count, serum protein, phenoloxidase and lysozyme activity of the serum and haemolymph and phagocytosis of yeast and bacterial cells by haemocytes were studied in shrimps from wild as well as from culture ponds and also in different moult stages.
- The immunological parameters recorded in shrimp from wild and culture ponds as well as in different moult stage are given below:

Average activity of immune response components of shrimp obtained from wild and culture ponds

Particulars	Haemogram (x10⁶/ml)	Total protein (mg/ml)	Protein (deproteinized)	Phenoloxidase activity (OD/mg Pro) (without elicitor)	Phenol oxidase activity (OD/m/mg Pro) (with elicitor, trypsin)	Phagocytic index (Yeast cells)	Phagocytic index	Lysozyme activity (OD/mg Protein)
Wild	16.81	43.04	29.12	22.74	25.96	5.13	1.44	0.45
Culture ponds	10.68	32.45	X	18.60	24.56	5.47	1.26	X

X : Not tested

Average activity of the components of the immune system of shrimp obtained from the wild and culture ponds with regard to moult stages.

Particulars	Haemogram ($x10^6$/ml)		Total protein (mg/ml)		Protein (deproteinized)		Phenoloxidase activity (OD/mg Pro) (without elicitor)		Phenol oxidase activity (OD/m/mg Pro) (with elicitor, trypsin)		Phagocytic index (Yeast cells)		Phagocytic index	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Wild	17.62	15.99	40.09	45.99	30.76	27.68	26.6	20.16	34.29	22.67	6.39	4.49	2.13	1.1
Culture ponds	10.86	10.51	29.18	35.73	X	X	22.44	16.04	32.34	16.79	5.86	4.69	1.3	1.05

A: Inter-moult B: Post-moult X: Not tested

FUNDING AGENCY
PROJECT TITLE
SCIENTISTS
CENTRES

Department of Ocean Development
Investigations on the effect of bottom trawling on the benthic fauna off Mangalore Coast
P.U. Zacharia
Mangalore

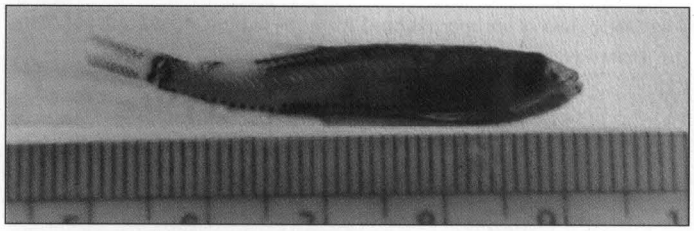
1. Collected trawl discard and juvenile fish data from 100 single day and 100 Multi-day boats
2. Discards in SDF formed 2.19% and 1.67% in MDF
3. Juvenile component formed 16.18% in SDF and 26.34% in MDF
4. Collected and analysed benthic and oceanographic parameters at 10, 20 and 30, 40 & 50 m at area between Panambur-Suratkal before and after experimental trawling using standard trawl net. The catch obtained was analysed for juveniles and non-edible benthic components.

- The total Biomass (wet weight) has increased from 1024g/m^2 before trawling to 1274 g/m^2 after trawling.
- Changes in extinction coefficient, total suspended solids, dissolved oxygen & chlorophyll a have been observed before and after trawling
- Sediment, pH and salinity showed a slight increase after trawling
- Species evenness showed decrease from 0.5516 before trawling to 0.3979 after trawling
- Biodiversity index showed decrease from 2.3289 before trawling to 2.0807 after trawling.

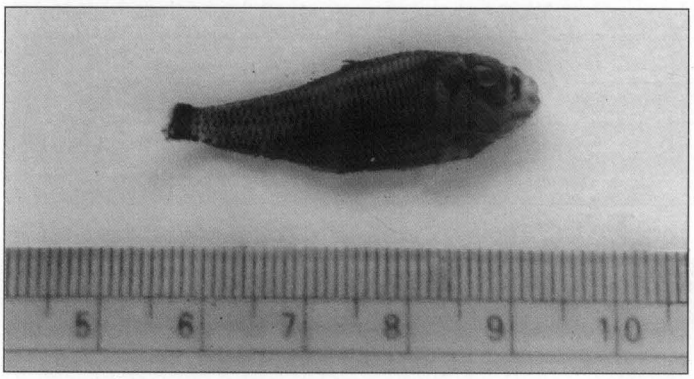
FUNDING AGENCY
PROJECT TITLE
SCIENTISTS
CENTRES

Department of Ocean Development
Studies on deep scattering layer in the Indian EEZ
N.G. Menon
Cochin

A total of 6 cruises, one along the west coast and five along the east coast were conducted during April 2001-March 2002 onboard FORV *Sagar Sampada* for studying the DSL. Along the west coast, the single cruise was conducted in the region 7°N-19°N and 71°-73°E, and eight IKMT samples collected. The thickness of DSL was 20-150m, the biomass of nekton ranged from 0.9-3.2



Vincigurria nimbaria, **a mesopelagic forage fish occurs widely in the DSL**



Ichthyococcus sp., **an important mesopelagic fish recorded from the DSL**

g/1000m^3 forming 52% in night and 47% in day hauls. The Myctophids formed 17% of the nekton and occurred only in night hauls while shrimps formed 4.5% of the nekton occurring 99% in night hauls and 1% in day hauls. Photichthids and leptocephalus also occurred in significant quantities.

Along the east coast, of the five cruises (6° N –21 ° N and 80 ° - 95 ° E), two were conducted in the Andaman sea covering 59 stations (23 day and 36 night). The DSL thickness ranged from 20-200m. The nektonic biomass ranged from 0.02-6.2 g/1000m^3. Highest biomass value of 50.4 g/1000m^3 was recorded at 17 ° 52 N and 84 ° 71'E at a depth of 829m and operation depth of 50m during night. Pelagic shrimps contributed 100% to the nektonic biomass. Myctophids contributed to 3.3% of the nekton and occurred 12.8% during day hauls and 87% during night hauls while shrimps formed 72.9% of the nekton, and occurred 97% in night hauls and 2% in day hauls.

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Resource assessment and biology of deep sea fishes along the continental slope of Indian EEZ**
SCIENTISTS	**V. Sriramachandra Murty**
CENTRES	Cochin

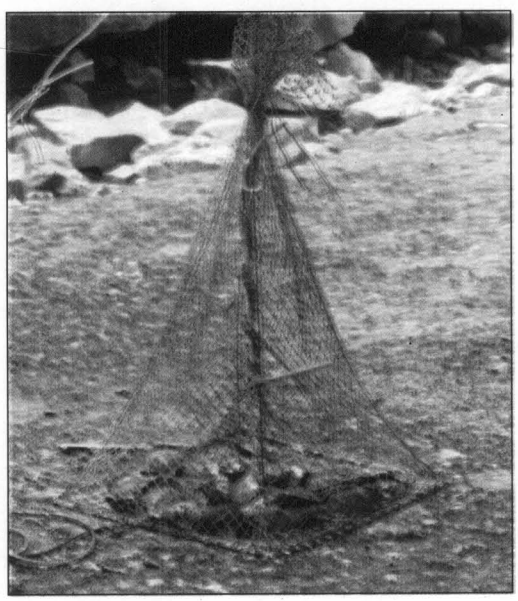
Participated in the cruise of FORV *Sagar Sampada* during 31st December – 23rd January in the demersal fishery resources survey along continental slope in the North- West coast. A total of 25 fishing operations were done in the depth range 59-740m in the area between lat. 22° 01' and 14° 54'N in the north west coast of Indian EEZ. The gears used were Expo model demersal trawl (19 operations), HSDT (cv) (4 operations) and HSDT (Fish) (2 operations) during this cruise. The total catch obtained from these 25 trawling operations was 1922.88 kg with a maximum catch of 627.7 kg. In the station No. 1034, the catch rate recorded was 83.24kg/hr. In the region less than 200m, a catch rate of 155.17kg/hr was obtained whereas the catch rates were merely 12.5kg/hr, 11.36kg/hr and 10.5kg/hr from 200-300m, 300-400m and 400-800m respectively.

Priacanthus hamrur, Epinephelus diacanthus, Decapterus russelli and *Acropoma japonicum* were dominant in depths less than 200m. The region 20°N/71°E yielded the maximum catch of 627kg mainly constituting of *Platycephalus indicus, Acropoma japonicum* and *Decapterus russelli*. The deep-sea fishes such as *Cubiceps natalensis, Neoepinnula orientalis* were caught from the deeper regions. Deep-sea prawn *Aristeus alcocki* was collected from the area 15°32' N-72°41' E. Studies on length frequency and biology of 12 species were carried out onboard.

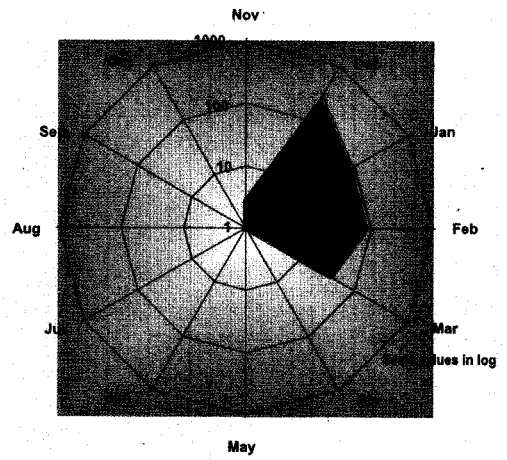
NATIONAL AGRICULTURAL TECHNOLOGY PROJECTS

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Breeding and culture of pearl oysters and production of pearls**
SCIENTISTS	**K.K. Appukuttan** , K.S.Mohamed, T.S.Velayudhan, V.Kripa, A.C.C. Victor, A. Chellam, S.Dharmaraj, N.Ramachandran and Shoji Joseph
CENTRES	Cochin, Tuticorin
COLLOBORATING INSTITUTES	**CIFT Cochin, CARI Port Blair and GAU, Gujarat**

- Use of Danforth anchors instead of Grapnel anchors on floating rafts has proved to be more successful in stabilising the raft.
- Spatfall season for pearl oysters at Port Kollam along the west coast has been identified as Nov-Feb (see figure).
- Best material for spat collection from farm site is the shade-net hapa followed by 9 mm mesh square lantern cages
- 9 mm mesh square lantern cage has been identified as the most suited pearl oyster holding cage with less fouling and least mortality.
- Pearl production using larger nucleus (4-6 mm) has been attempted along the west coast
- Relation of gonadal condition on pearl surgery was studied and results indicated that matured, developing and partially spent animals gave comparatively higher pearl production.
- Toxicity of Copper, Cobalt and Ferric salts on pearl oysters was studied and their LC_{50} determined for providing these metals through feed below their lethal limits.
- *In vitro* nacre formation from explant mantle tissues was obtained in abalones.
- Designed and fabricated a longitudinal shell cutting machine for longitudinal cutting of irregular shaped molluscan shells with reciprocating cutting mechanism
- Designed and developed a cutting machine working on the principle of high-speed rotary motion for making cubical shaped shell beads of various sizes.
- Designed a special purpose machine for improving the precision of roundness and surface finish of shell bead balls. This equipment consists of suitably grooved cast iron blocks mounted on a shaft with bevel gear rotating mechanism.
- Surveys were done to locate and assess pearl oysters population distribution and abundance in North, Middle and South Andaman including Richies' Archipelago.

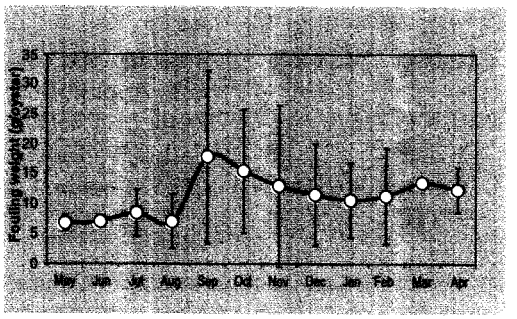


Square lantern cage devised for holding pearl oyster under NATP at Port Kollam



P. fucata spatfall on RAFT-1 2001-02 at Port Kollam

- Four sites were surveyed near Sikka coast for deploying raft and racks
- Site between Port Jetty and GSFC jetty was selected.



Mean FoulingRate (g/pearl oyster) at Port Kollam

FUNDING AGENCY NATP
PROJECT TITLE **Mussel Mariculture**
SCIENTISTS **T.S.Velayudhan**, V.Kripa K.K. Appukuttan , K.S.Mohamed, R.Sarvesan, P.V.Sreenivasan, P. Laxmilatha, P.K.Asokan and Geetha Sashikumar
CENTRES COLLOBORATING INSTITUTES Cochin, Chennai and Mangalore **KKV Ratnagiri and CARI Port Blair**

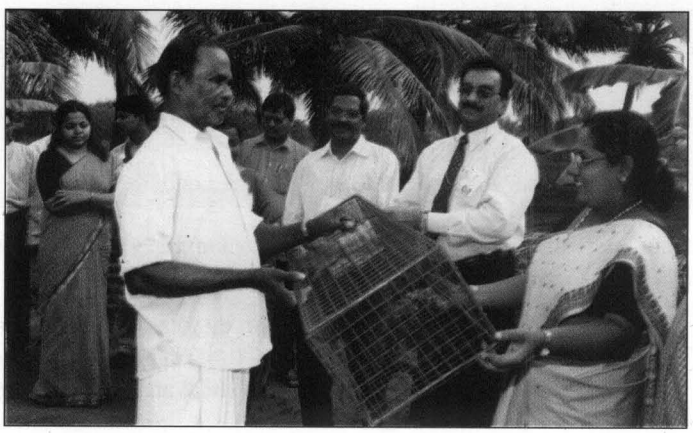
- Water quality monitoring in Southern Kerala indicated that the hydrocarbon content in the bay was negligible (0.00911 ppm) while in the estuary the values were high (0.4801 ppm) .
- Copper and Zinc content in water were lowest (0.0012 and 0.00278 ppm) in the estuary, compared to the open sea and bay while Cadmium, Nickel and Zinc were lowest (0.0006, 0.00063 and 0.0008 ppm) in the bay. Silver content was low both in the open sea waters and in the estuary while in the bay it was slightly higher, 0.0012ppm.
- The heavy metal level was negligible in the areas surveyed in Tamil Nadu and Andhra Pradesh. Iron was the only metal which was present in detectable level . All other metals were below detectable levels.
- Total Mussel seed estimated was highest in Kerala followed by Karnataka. Among the areas surveyed in 2001-02, the average biomass was highest, 5884 gm^2 in Uttara Kannada where the mussel beds were subtidal. In Kerala the average estimated biomass of seed was highest 3786 kg/m^2 at Chembarika in north Kerala.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Institution-Village-Linkage-Programme (IVLP) for Technology Assessment and Refinement in the Coastal Agro-Ecosystem of Ernakulam in Kerala**
SCIENTISTS	**R.Sathiadhas**, Sheela Immanuel, L.Krishnan, A. Laxminarayana and D. Noble
CENTRES	Cochin

Elankunnapuzha village of Vypeen Island, Ernakulam District was selected for implementing the programme.

- Eight fishery based interventions like integrated farming of fish and poultry, farming of juvenile sized crabs, polyculture of finfish (*M.cephalus, C.chanos*), cage culture of crabs, farming of *P.monodon* in tide-fed ponds, rack-drying of fish by women groups etc were carried out in the first phase.
- Three livestock based interventions such as assessment of effect of deworming, micronutrient supplementation and prophylactic immunization on the productive performance of dairy cows were carried out.
- Six agriculture-based interventions, such as, assessment of nutrient management practices [chemical fertilizer, green manure] in coconut plantations based on soil test data, assessment of the performance of tissue cultured dwarf Cavendish etc have been completed.

Dr. S.D. Tripathi, Member RAC visiting the IVLP site at Elankunnapuzha



Dr. Mohan Joseph Modayil, Director distributing cages for crab culture

FUNDING AGENCY	NATP
PROJECT TITLE	**Establishment of Agricultural Technology Information Centre (ATIC)**
SCIENTISTS	**Sheela Immanuel** and R. Sathiadhas
CENTRES	Cochin

The Agricultural Technology Information Centre (ATIC) was established mainly to implement a single window delivery system for all the technological inputs, products/ services and advices.

All the sales/services/products are channeled through Single Window Delivery system under the ATIC of the Institute.

- A total of 1012 farmers/ fishermen/ entrepreneurs visited the Centre during the period under report.
- The sale of products/services had benefitted about 561 farmers/ other end users.
- The ATIC has helped farmers to get information about the technologies, services and quality products.
- Diagnostic services and analysis are made easier for the farmers enabling them to get the sampling done faster through ATIC.

FUNDING AGENCY	**NATP/CGPII**
PROJECT TITLE	**Designing and validation of communication strategies for responsible /sustainable fisheries- A Co –learning approach**
SCIENTISTS	**C. Ramachandran**, S. Ashaletha and V.P. Vipinkumar
CENTRES	Cochin

- The tools to identify the information needs towards responsible fisheries have been developed.
- Translation of the FAOs Code of Conduct for Responsible Fisheries into Malayalam has been completed.
- A bibliography on the community based fisheries management has been compiled.
- Documentation of the existing practices of sustainable fisheries is in progress.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Studies on fisherwomen in coastal ecosystem in Kerala, Andhra Pradesh, Karnataka and Tamilnadu**
SCIENTISTS	**Vijaya Khader**, R.Sathiadhas, N.S.Suhdhakara, H.Mohammed Khasim & R.Narayankumar
CENTRES	Kerala, Andhra Pradesh, Karnataka and Tamilnadu

The project is undertaken by Postgraduate and Research Centre, ANGRAU, Hyderabad and Central Marine Fisheries Research Institute, Kochi is one of the four co-operating centres.

- Four villages (Aroor, Neendakara, Theckumbhagam and Poovar) were selected for the detailed study.
- Survey to assess the socio-economic status of the respondents is completed and statistical analysis is being carried out.

Principal Investigator examining the clam meat processed by a respondent

☞ Though more than 47% of the respondents were members in self-help groups, they were not actively involved in any productive works due to lack of technical guidance and financial crisis.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Impact of dams on river run-off into sea and changes in the nutrient and productivity profile of coastal waters**
SCIENTISTS	**P.K. Krishnakumar**, P. Kaladharan, D. Prema, K. Vijayakumaran and Shoba J. Kizhakudan
CENTRES	Mangalore, Cochin, Visakhapatnam and Veraval

The objective of the study is to assess the impact of altered river flow (due to dams and reservoirs) on the nutrient and productivity profile of coastal waters from west coast (Veraval, Mangalore and Cochin) and east coast of India (Visakhapatnam).

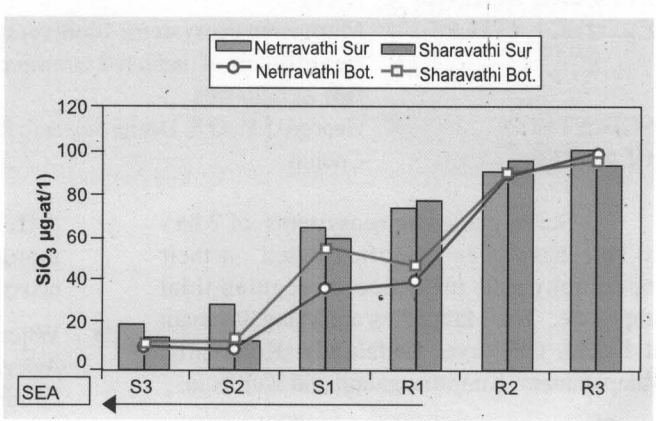
⇨ A two-day workshop was organised at Cochin on 6th and 7th Apr. 2001 to give training for the SRFs and scientific staff involved in the project.

⇨ Two laboratory manuals were released during the workshop and distributed among the participants for following uniform analytical methods.

⇨ The Mangalore Centre of CMFRI has successfully hosted the 8th meeting of the Scientific Advisory Panel of National Agricultural Technology Project (Coastal) during 20 - 21 April, 2001 at Mangalore.

Mangalore RC of CMFRI: Water sampling from Sharavathi and Nethravathi Rivers and the adjoining coastal waters were carried out during January - December 2001.

⇨ Relatively higher levels of silicate was observed in the upstream river stations and observed a decreasing trend towards the seaward stations.



Concentration of silicate

Concentration of silicate

- ⇨ Phosphate and nitrate levels showed increasing trend from river to the sea.
- ⇨ The pH values gradually increased downstream.
- ⇨ Nitrate levels showed increasing trend from riverine stations to marine stations.
- ⇨ Ammonia was not detected during May whereas during June, relatively high level of ammonia was observed from the seaward side compared to the samples taken from the riverward side.
- ⇨ Chlorophyll a content was higher in the bottom samples than in the surface samples and was higher in riverine stations.
- ⇨ Sediment characteristics showed higher levels of pH and salinity in the marine stations than in the riverine stations.
- ⇨ Works carried out at Fisheries college, Mangalore on the bacterial counts from 10^3-10^5 All samples had faecal coliforms, counts ranging from 93 to more than 1100/ 100 ml. Similarly, *Escherichia coli* was also present in all the samples at levels ranging from 3 to more than 1100 / 100 ml. *Salmonella* could be detected only in one sample of surface water from Riverine site 2.

Cochin:

Water sampling from Periyar and Mahe Rivers and the adjoining coastal waters were carried out during January - December 2001.

- ⇨ Levels of silicate, phosphate and nitrate recorded low values near the bar mouth of dammed river.
- ⇨ TDS and TSS registered steep increase proportional to the salinity of water.
- ⇨ Sediment characteristics showed higher levels of pH, salinity and organic carbon in the marine stations than in the riverine stations.
- ⇨ Percentages of sediment components (grain size) were considerably higher in riverine stations than that of marine sediments.
- ⇨ In Mahe River (non-dammed river), transport of nutrients except phosphate, pigments and levels of BOD and COD registered similar trend and magnitude as in Periyar River.
- ⇨ Heavy metals registered increasing trend in sediment from river stations to seaward stations.

FUNDING AGENCY NATP

PROJECT TITLE **Mangrove ecosystem: biodiversity: it's influence on the natural recruitment of selected commercially important fin fish and shell fish in fisheries**

SCIENTISTS **George. J.P.,** G.S. Daniel Selvaraj, P. Kaladharan, T.S. Naomi and D. Prema

CENTRES Cochin

Seven mangrove ecosystems of 2 ha - 20 ha have been identified based on their topography and influence of regular tidal amplitude. The Mangroves are Mangalavanam at Kochi, Chettuva, Kadalundy, Koduvally, Valapattanam, Kunjimangalam and Kumbala.

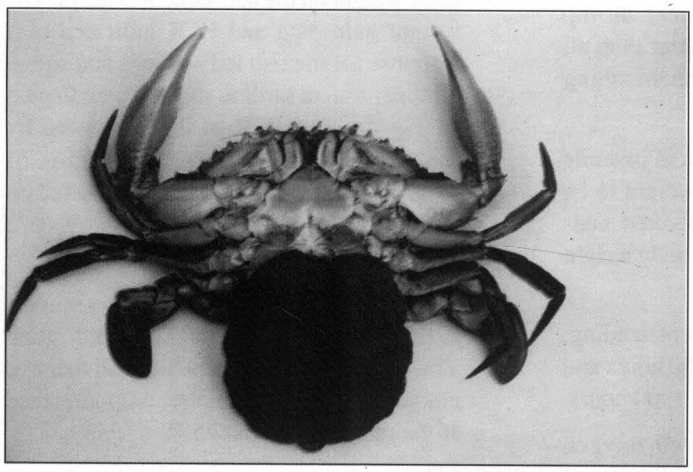
- ◆ The three month data show species differentiation and the abundance of mangrove vegetation in different ecosystems.
- ◆ Wherever freshwater influence is more *Avicennia* sp. is more and *Rhizophora* is dominant where seawater influx is higher.
- ◆ In all mangrove ecosystems, larvae of *Penaeus*

indicus, *Mugil* sp. and *Etroplus* were found. Chlorophycea and Copepods dominated among phyto and zooplankton respectively.

- The conservative and non-conservative parameters exhibit much variations in all the six mangrove ecosystems.

FUNDING AGENCY	**NATP /CGP**
PROJECT TITLE	**Broodstock development, breeding, hatchery production and restocking of mud crabs**
SCIENTISTS	**E.V.Radhakrishnan** and Mary K. Manisseri
CENTRES	Cochin

The project was initiated in July 2001. A recirculating broodstock holding system to hold the broodstock of the mudcrab *Scylla tranquebarica* for maturation and breeding was established in a 10 tonne FRP tank. Adult crabs weighing 450-1000 g were stocked at a ratio of 1.5 crab/m^2 and fed daily on squid, clam, mussel and small shrimp. Crabs were treated with 50 ppm formalin before introducing into the broodstock tank. Two crabs oviposited eggs and were transferred to spawning tank for completing the embryonic development and then to a 2 tonne capacity hatching tank for egg hatching. One of the females released 36.6 lakhs of zoea larvae. Larval rearing was conducted in series of plastic basins containing sterilized seawater. Larvae stocked at 25 nos/l were maintained in a greenwater system containing *Chlorella* and fed on rotifers. Few larvae on passing through five zoeal stages moulted to megalopa. Survival was low due to high mortality on the second day of rearing. Larvae released by a wild breeder were weak and therefore discarded. Larvae obtained from wild breeders are weaker compared to healthier larvae obtained from captivity evidently due to prolonged exposure of the breeders outside the water resulting in stress.



Mudcrab *Scylla tranquebarica* with fully developed eggs

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Nutrition and pathology in mariculture**
SCIENTISTS	**R. Paul Raj,** M. Vijayakumaran, D.C.V. Easterson, Manpal Sridhar Imelda Joseph, K.C. George and A.P. Lipton
CENTRES	Cochin,Chennai, Vizhinjam
COLLOBORATING INSTITUTES	**CIFT, Cochin, CARI, Port Blair and TANUVAS, Tuticorin**

Feeding trials with mudcrabs

- The farm survey to assess the feeds and feeding practices in selected mud crab farms in Ernakulam District has been completed.
- Experimental feeding trials on the mud crab *Scylla tranquebarica of* average body weight 70g with frozen fish, salted fish, shrimp head, fresh clam meat, frozen clam meat, dry clam meat showed that a diet mixture of frozen fish, clam and shrimp head in the ratio 4.5:4.5:1 is better than all other diets in promoting growth, moulting and FCR.
- Observations on the feed intake in juvenile crabs indicated 7.5% of body weight to be adequate when fresh, frozen and salted feeds are offered whereas 2.5% of the body weight is adequate for juvenile crabs.
- The crabs exhibited two peaks of feeding, one between 0200 hours and 0500 hours and another peak between 1700 and 1900 hours.
- Abrupt decline in the dissolved oxygen levels (2.5mg/l) results in the stoppage of feeding.
- A compounded feed pellet has been successfully developed for the culture of mud crab juveniles with locally available ingredients.
- Compounded feeds have been formulated with a view to determining the protein and lipid requirements of juvenile crabs.

Feeding trials with groupers

- A feeding trial was conducted with juvenile groupers, *Epinephelus tauvina*, initial weight 35-49 g, using five diets; viz., fresh clam meat, fish (sardine), small crabs, squilla and squid waste. The fish were fed daily at the rate of 6% of the body weight for the first 25 days and adjusted the feed level based on their consumption at 5% of their body weight on the subsequent 20 days. The weight gain data and FCR indicated best response for the fish fed sardines and squid. Grouper fed on sardine showed weight gain of 38± 4 g and FCR of 2.55 followed by those fed on squid (weight gain of 40.93±7.69 g with FCR 2.89). Those fed on clams showed the least gain of 9.49±3.72 with an FCR 9.92
- A moist compound feed was fed to groupers at the level of 25% of its daily feed ration along with trash fish. Then the trash fish was gradually replaced by moist compound feed at the rate of 50% and 75%.
- When the groupers were offered compounded feed and trash fish at a time, they showed a preference for trash fish and then moist feed.
- In preliminary feeding trials, groupers did not accept a compounded diet with 20 % fresh minced fish and 3 % fish oil. So fish content was increased from 20% to 47% and fish oil was added up to 6%.
- Experiments to determine optimum protein

and lipid level in compounded feed of grouper is in progress.

Solid state fermentation

- A fermentation protocol has been developed for soyabean flour using *Aspergillus niger and Bacillus coagulans*. Experiments on fermentation of soybean flakes and flour using, *Bacillus coagulans* resulted in breakdown of crude fibre and about 5 % increase in NFE.

Duration of Fermentation (hours)	Moisture	Parameters analysed (Mean value in %)						
		DM	CP	EE	CF	AIA	CA	NFE
12	4.948	95.06	54.34	0.364	2.508	0.285	8.236	29.59
24	5.222	94.75	52.56	0.424	3.005	0.320	8.361	30.56
36	3.595	96.40	51.65	0.391	1.758	0.348	8.810	33.79
48	3.870	96.30	55.34	0.373	1.125	0.300	8.778	30.68
Control	**4.800**	**95.20**	**57.14**	**0.879**	**2.800**	**0.120**	**6.510**	**27.87**

- Three experiments were conducted in solid state fermentation using soybean flour as substrate. In all the three, *Bacillus coagulans* was used for substrate modifications. Submerged fermenter was used for mass culture of *B. coagulans*. After the series of experiments conducted during the last one year a low fibre product was obtained in 48-h fermentation,
- Proximate composition analysis of the five feeds prepared incorporating varying levels of fermented soy bean was carried out. The moisture content of these feeds ranged between 3.39% in feed FS I to 4.42% for feeds FS II and FS III. While, crude fat ranged from 8.575% for feed FS V to 9.425% for FS I.

Isolation and characterisation of microbes: With an objective to isolate microbes, which can be used commercially for bioconversion of cheaper protein sources through solid state fermentation, thirty bacterial and 14 fungal colonies were isolated from mangrove swamp. Characterization and identification of the strains are in progress.

Diagnosis of bacterial diseases in pearl oysters, mud-crabs, lobsters and groupers was continued :

- Collection and isolation of total heterotrophic bacteria, *Vibrio* and *Aeromonas* from the spiny lobster, *Panulirus homarus* and mud crab were continued
- After preliminary identification by caper experiment *Vibrio parahaemolyticus* and *Vibrio cholerae* were confirmed from few crab farms. Few *V. cholerae* and *V. parahaemolyticus* samples were taken in random basis for their further identification. *V. parahaemolyticus* is responsible for tail rot disease in lobster..
- Challenge studies on their pathogenicity towards lobster is in progress.
- Presence of thermionic direct haemolysin (tdh gene) was studied which is responsible for production of toxin.The four bacterial strains which were tested in all cases it was *tdh* negative
- The groupers (*Epinephelus* spp.) maintained as brood stock in the marine Aquarium at Vizhinjam were monitored for disease occurrences. The water quality parameters of the grouper tank and bacterial load were monitored.

- **Isolation and characterization of bacteria from grouper:** Mortality of a grouper brood stock maintained at Kovalm (weight :3.5 kg) was noted. The symptoms were : air accumulation in the gall bladder and exophthalmia. Four bacterial cultures were isolated from liver, intestine and gall baldder of grouper and named as G1l,G2L,G2I and G2Gb.In addition to the biochemical characterisation experiments, ten antibiotics were tested against Grouper isolates. Trimethoprim Amoxyxillin Kanamycin Rifampicin were effective against the isolates.

- The bacterial load of the surface of pearl oysters maintained in the tank and mantle were examined by the pour plate method. The results of viable count of the bacteria are given in Table below :

Sampling area	Total viable count	
	Within '8' hours of catching	After 30 days
Surface of the oysters	3.5×10^2	3.7×10^3
Mantle	1.9×10^4	2.6×10^3
Water in rearing tank	-	1.1×10^3

- Three bacterial isolates: two obtained from the mantle and one from the surface were isolated and their characterization is in progress.

Assessment of mycotoxin problems in feeds and management of mycotoxicosis in shrimp:

- An experiment was conducted to study the survival and growth of *P. monodon* post larvae fed on diets with Aflatoxin B1. All the diets were formulated with Fish meal 25%; shrimp meal 20 %; soybean meal 22 %; wheat flour 20%; cholesterol 0.25%; oil 5g; lecithin 2 %; vitamins 2 %; mineral mix 3 % chromic oxide 0.5%. Five diets were prepared : Control, Control & alcohol, Feed I, Feed II, Feed III. Vitamin, Mineral mix and oil were added.

- Results of the experiment showed 100% survival of postlarvae in the control diet and the control plus alcohol diet; All the three diets with aflatoxin produced low survival(26 to 54%) and poor growth .In Group I, II, III feed intake was less and cannibalism was observed. In Group I & II animals were less active. Histological work is in progress.

- Survey of commercially available shrimp feeds to detect the level of toxins present in them is in progress. Analysis of few feed samples obtained from shrimp hatchery and grow out farm showed the presence of low levels of AFB1 AFB2 and AFG1.

EDUCATION AND TRAINING

POSTGRADUATE PROGRAMME IN MARICULTURE

Ph.D. Programmes

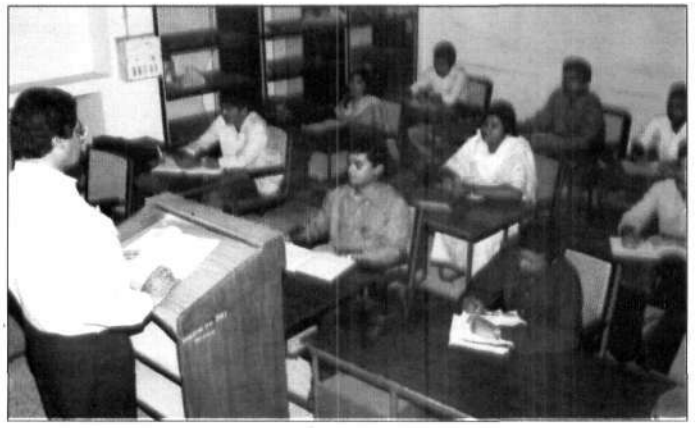
- 9 students have been awarded Ph.D. Degree in Mariculture by the Central Institute of Fisheries Education (Deemed University), Mumbai.
- 2 students have been awarded Ph.D. Degree in Marine Sciences by the Cochin University of Science and Technology.
- 23 Ph.D. Mariculture students are currently progressing with their research/course work under the Central Institute of Fisheries Education.
- 21 Ph.D. students are currently under roll of the Cochin University of Science and Technology under the Faculty of Marine Sciences.

M.F.Sc.

- 10 students have successfully completed their M.F.Sc. Mariculture Programme under the Central Institute of Fisheries Education, Mumbai.
- 20 M.F.Sc. Mariculture students are currently progressing with their research/ course work under the Central Institute of Fisheries Education.

Honours/Awards to students

- Ms. V. Thushara, former M.F.Sc. student was awarded the University Gold Medal and Merit Certificate and Dr. C.V. Kulkarni Merit Medal and Merit Certificate by the CIFE (Deemed University), Mumbai for academic achievements in M.F.Sc. Mariculture for 1996-98.
- Shri John Joseph Raj, M.F.Sc. Mariculture student 17th batch was awarded gold medal by the Central Institute of Fisheries Education (Deemed University) for academic achievements in M.F.Sc. Mariculture for 1998-2000.



KRISHI VIGYAN KENDRA

The *Krishi Vigyan Kendra* conducted 97 training programmes during 2001 and the details are given below:

Sl.No	Discipline/ Subject	Duration (days)	No. of courses conducted	No. of persons trained			SC
				Male	Female	Total	
1.	**Fisheries**						
	Shrimp farming	1	4	102	48	150	13
	Shrimp farming	2	6	85	31	116	19
	Shrimp farming	5	1	19	1	20	-
	Ornamental fish culture	2	13	57	170	227	18
	Ornamental fish culture	1	2	8	26	34	-
	Fish farming	2	1	5	17	22	-
	Seaweed farming	3	1	13	12	25	-
2.	**Agriculture**						
	Mushroom cultivation	1	13	70	270	340	5
	Coconut cultivation	1	2	24	37	61	3
	Coconut cultivation	2	9	22	141	163	7
	Kitchen gardening	2	11	49	157	206	14
	Kitchen gardening	1	2	27	35	62	5
	Medicinal plant cultivation and its uses	1	2	4	50	54	3
	Medicinal plant cultivation and its uses	2	2	2	38	40	1
	Jasmine cultivation	1	1	-	22	22	-
	Banana cultivation	1	1	5	1	6	-
	Casava cultivation	1	1	1	3	4	-
3.	**Animal Production**						
	Poultry farming	1	4	35	41	76	2
	Dairy farming	1	2	17	25	42	-
4.	**Home Science Preparation of**						
	Pine apple jam	1	5	2	80	82	2
	Mango jam	1	1	-	17	17	-
	Mixed fruit jam	1	7	5	147	152	-
	Fish papadam	2	1	-	20	20	6
	Grape squash	1	1	-	22	22	-
	Orange squash	1	2	-	42	42	-
	Fish pickle	1	1	1	18	19	-
	Pine apple squash	1	1	-	22	22	5
	TOTAL		**97**	**553**	**1493**	**2046**	**116**

TRAINERS' TRAINING CENTRE

During the period twelve training courses were organised availing the expertise at CMFRI. The courses were conducted at Cochin, Calicut and Tuticorin. Rs. 1,86,000.00 was collected towards the course fee during the year. The details of training programmes conducted are given below:

Sl. No.	Title of the course	Month	No. of days	No. of participants
1.	Scuba diving	April 2001	37	6
2.	Low cost shrimp production	May	6	18
3.	Application of statistical methods in fisheries research	June	6	17
4.	Live feed culture	June	3	2
5.	Ornamental fish culture	July	6	13
6.	Ornamental fish culture	August	6	10
7.	Edible oyster culture	September	5	8
8.	Ornamental fish culture	October	6	16
9.	Mushroom culture	December	1	18
10.	Ornamental fish culture	February 2002	6	14
11.	Mussel farming	March	2	20
12.	Ornamental fish culture	March	6	16
	Total number of courses conducted	**12**		
	Total number of participants	**138**		

Distribution of certificates to the trainees of TTC

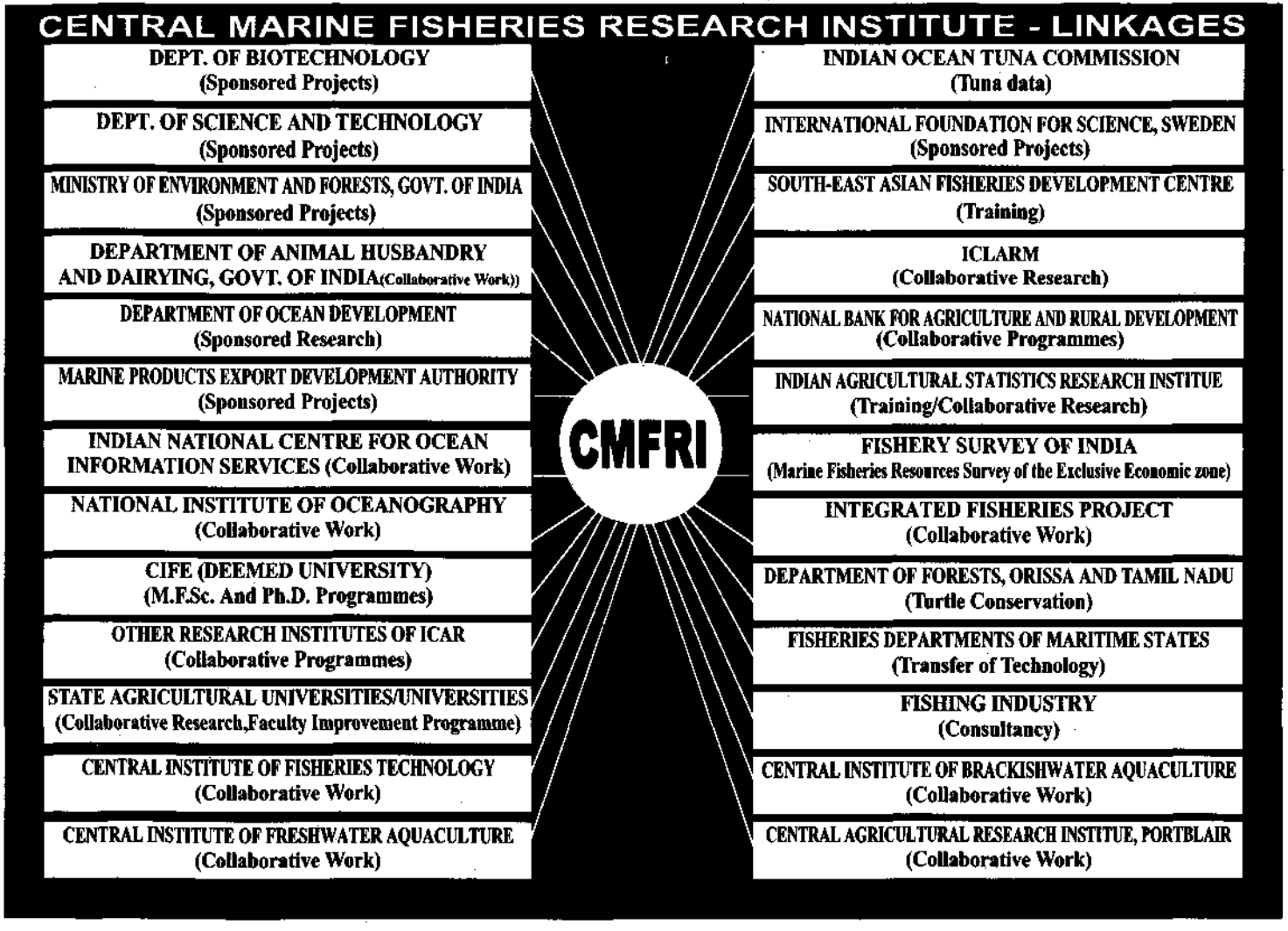
AWARDS AND RECOGNITIONS

1. Dr. Gulshad Mohammed, Scientist has been awarded the Dr. Hiralal Chaudhuri, Best Young Scientist Award, 2001 by Dr. Hiralal Chaudhuri Fisheries Foundation on 11-9-2001 at CIFE, Mumbai.

2. Dr. E. Vivekanandan, Principal Scientist received the Fisheries Technocrats Forum Award 2001 for outstanding research on Coastal Fisheries Management.

Dr. N.G.K. Pillai, HOD receiving the first prize from Hon'ble Justice Cyriac Joseph, for the best stall in the All India Aquarium Show 2002

Shri. N. Viswambharan, AAO receiving the Rolling Trophy for the best OL implementation from Shri. Revatha Chandrasekhar IPS, Cochin City Police Commissioner


CENTRAL MARINE FISHERIES RESEARCH INSTITUTE - LINKAGES
DEPT. OF BIOTECHNOLOGY (Sponsored Projects)
DEPT. OF SCIENCE AND TECHNOLOGY (Sponsored Projects)
MINISTRY OF ENVIRONMENT AND FORESTS, GOVT. OF INDIA (Sponsored Projects)
DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING, GOVT. OF INDIA(Collaborative Work))
DEPARTMENT OF OCEAN DEVELOPMENT (Sponsored Research)
MARINE PRODUCTS EXPORT DEVELOPMENT AUTHORITY (Sponsored Projects)
INDIAN NATIONAL CENTRE FOR OCEAN INFORMATION SERVICES (Collaborative Work)
NATIONAL INSTITUTE OF OCEANOGRAPHY (Collaborative Work)
CIFE (DEEMED UNIVERSITY) (M.F.Sc. And Ph.D. Programmes)
OTHER RESEARCH INSTITUTES OF ICAR (Collaborative Programmes)
STATE AGRICULTURAL UNIVERSITIES/UNIVERSITIES (Collaborative Research,Faculty Improvement Programme)
CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY (Collaborative Work)
CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE (Collaborative Work)
CMFRI
INDIAN OCEAN TUNA COMMISSION (Tuna data)
INTERNATIONAL FOUNDATION FOR SCIENCE, SWEDEN (Sponsored Projects)
SOUTH-EAST ASIAN FISHERIES DEVELOPMENT CENTRE (Training)
ICLARM (Collaborative Research)
NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT (Collaborative Programmes)
INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUE (Training/Collaborative Research)
FISHERY SURVEY OF INDIA (Marine Fisheries Resources Survey of the Exclusive Economic zone)
INTEGRATED FISHERIES PROJECT (Collaborative Work)
DEPARTMENT OF FORESTS, ORISSA AND TAMIL NADU (Turtle Conservation)
FISHERIES DEPARTMENTS OF MARITIME STATES (Transfer of Technology)
FISHING INDUSTRY (Consultancy)
CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE (Collaborative Work)
CENTRAL AGRICULTURAL RESEARCH INSTITUE, PORTBLAIR (Collaborative Work)

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CONSULTANCY, PATENTS, COMMERCIALISATION OF TECHNOLOGY

Completed consultancy projects during 2001-2002

Sl.No	Client	Amount in Rs.	Type of projects
1	Kuderemukh Iron Ore Co.Ltd, Mangalore (PhaseIV)	3,80,000	Consultancy
2	Centre for Marine Analytical Reference & Standards, Trivandrum	2,77,000	Contract service
3	Mangalore Refinery & Petrochemicals Ltd., Mangalore. (Phase V)	6,64,000	Consultancy
4	Mangalore Refinery & Petrochemicals Ltd, Mangalore (Emergency)	15,00,000	Consultancy
5	Indian Tropical Agro products(P)Ltd,Tuticorin	96,000	Consultancy
6	Andhra University, Visakhapatanam	20,000	Contract service
7	Aquaculture Authority of India, Krishibhavan, New Delhi	3,50,000	Consultancy
8	Department of Fisheries and Fishermen Welfare, Pondicherry	2,34,480	Consultancy

New projects taken up during 2001-2002

Sl.No.	Client	Amount in Rs.	Type of projects
1	Kuderemukh Iron Ore Co.Ltd., Mangalore (Phase V)	4,30,000	Consultancy
2	Mangalore Refinery & Petrochemicals Ltd., Mangalore (Phase VI)	8,14,000	Consultancy
3	Mangalore Refinery & Petrochemicals Ltd., Mangalore (Weekly monitoring)	18,04,000	Consultancy

PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS, SYMPOSIA AND TRAINING IN INDIA AND ABROAD

Name & Designation	Symposium/ Seminar/ Workshop/ Conference	Organised by	Place	Date/s
Dr. Mohan Joseph Modayil Director	Fisheries Division meeting for preparation of X Plan Document for CMFRI	SMD, ICAR	New Delhi	January 31 & February 1, 2001
	4th Executive Development Programme in Agricultural Research Management	NAARM	Hyderabad	February 2-5, 2001
	Meeting of the Coastal Zone Regulatory Authority	Dept. of Forest & Environment	Delhi	February 14, 2001
	Edible Oyster Farmers' Meet	Brackishwater Fish Farmers Development Agency, Kollam & CMFRI, Cochin	Dalava-puram	March 23, 2001
	Scientific Panel meeting of SMD (Fy.)	ICAR	New Delhi	June 12-14, 2001
	ICAR Directors' Conference	ICAR	NBPGR, New Delhi	July 23-24, 2001
	Project proposal on Marine Pearl Demonstration-cum-sales Module (SAIF ZONE)	SAIF ZONE	Sharjah Airport	July 24-30, 2001
	86th Academic Council Meeting of Kerala Agricultural University	KAU	Vellani-kkara	August 7, 2001

	National Symposium on Marine Algal Research in India and delivered the keynote address		Bharathi-dasan University, Thiruchira-ppally	August 16, 2001
	XXIX meeting of the Academic Council of CIFE	CIFE	Mumbai	October 8, 2001
	XVIII Meeting of ICAR Regional Committee No. VIII	ICAR	CTCRI, Thiruvana-nthapuram	December 14-15, 2001
	ICAR Directors' Meeting	ICAR	NBPGR, New Delhi	December 27-28, 2001
Dr. V. Sriramachandra Murty, Head of Division	ICAR-ICLARM meeting on Research Collaboration	ICAR	NBFGR, Lucknow	April 12-13, 2001
	Institute Management Committee Meeting	CMFRI	Cochin	May 30, 2001
	Taskforce meeting on midterm appraisal of the DOD-MLR Project on Resource assessment and biology of deep-sea fishes along the continental slope of the Indian EEZ	FSI	Cochin	June 1, 2001
	Seventh and Eighth meetings of the Committee for Formulation of Comprehensive Marine Fisheries Policy	DAHD	Mumbai	June 7, 2001 and June 26, 2001
	Meeting of the Group Leaders of the DBT-DOD Project on Inventory of Marine Bioresources	Department of Marine Sciences	Cochin	June 27, 2001

	Meeting of the Core Group for preparing the final report of the DOD-MLR Project on Resource assessment and biology of deep-sea fishes along the continental slope of the Indian EEZ	FSI	Mumbai	August 14, 2001
	Training "Workshop on Sustainable Fisheries"	IUCN-Sustainable Use Specialist Group, South Asia	Goa	September 27-30, 2001
	Meeting on the Fisheries Development in the Islands	Ministry of Agriculture	New Delhi	October 29, 2001
	Institute Management Committee meeting	CMFRI	Cochin	November 7, 2001
	Meeting convened by the Hon'ble Minister for Environment & Forests, Govt. of India, to discuss matters relating to the Elasmobranch fisheries	MoE&F	New Delhi	November 28, 2001
	Academic Council Meeting of the Cochin University of Science and Technology	CUSAT	Cochin	December 12, 2001
	Meeting on Strengthening the database and information networking in Fisheries	Joint Secretary, Fisheries, Govt. of India	New Delhi	January 9, 2002
	Institute Management Committee Meeting	CMFRI	Cochin	January 24, 2002

Dr. N.G.K. Pillai Head of Division	Inception Workshop on Fish Supply and Demand in Asia (ADB-RETA 5945)	ICLARM, The World Fish Centre	Penang	August 21-24, 2001
	IUCN-SUSG Sustainable Fisheries	IUCN-SUSG South Asia Regional Office, New Delhi	Goa	September 27-29, 2001
	International Workshop on Aquaculture and Environment	The Centre for Integrated Management of Coastal Zones in association with Cochin University of Science and Technology and Technical University Delft, The Netherlands	Cochin	July 12, 2001
	Institute Management Committee	CMFRI	Cochin	January 24, 2002
	Project Finalisation Meeting on Elasmobranchs	CMFRI	Cochin	February 17-18, 2002
	Meeting of Entrepreneurs and Industries in Marine Fisheries	CMFRI	Cochin	March 13, 2002
Dr.K.K. Appukuttan Head of Divsion	NATP/SAP meeting	AED & CMFRI	Mangalore	April 20-21, 2001
	Harvest *Mela* of Mussel	Vallikunnu Gramapanchayath Committee	Balathu-ruthi	May 22, 2001
	Prawn Farmers' Meet and presented a talk on 'Feasibility of oyster farming'	BFFDA	Kollam	July 10, 2001

	International Workshop on Aquaculture and Environment and presented a paper on Bivalve farming in India with special reerence to possibilities of integration with shrimp Aquaculture	CUSAT	Cochin	July 13-14, 2001
	Preliminary discussions on the project proposal on Marine Pearl Demonstration-cum-sales Module (SAIF ZONE)	SAIFZ	Sharjah Airport	July 24-31, 2001
	Meeting on ban on fishery of Shark, Rays, Molluscs, etc.	MoE&F	Delhi	November 28, 2001
Dr. P.N.R. Nair Principal Scientist	7th meeting of the VIII IJSC of CMFRI	CMFRI	Cochin	September 6, 2001
	8th meeting of the VIII IJSC of CMFRI	CMFRI	Mumbai	February 11, 2002
Dr. M. Rajagopalan Head, FEMD	Brain storming session on Marine Fishery Resources and Mariculture of Tamil Nadu	CMFRI	Chennai	May 11, 2001
	International Workshop on Aquaculture and Environment	The Centre for Integrated Management of Coastal Zones, Cochin University	Cochin	July 12, 2001
	Study tour under GOI-UNDP Sea Turtle Project to Malaysia and Australia	GOI-UNDP	Malaysia & Australia	September 3-15, 2001

	Workshop on the operation of TED at State Institute of Fisheries Technology	Govt. of Andhra Pradesh	Kakinada	January 24-25, 2002
	Project finalisation meeting on Elasmobranchs	Min. of Environment & Forests, Govt. of India	New Delhi	February 17-18, 2002
	National Workshop on Breeding, farming and management of ornamental fishes	School of Industrial Fisheries, Cochin University	Cochin	February, 2002
	Meeting of Entrepreneurs and Industrialists in Marine Fisheries	CMFRI	Cochin	March 13, 2002
Dr. R. Paul Raj Head of Division	Meeting of the Academic Council of Central Institute of Fisheries Education	CIFE	Mumbai	May 14, 2001
	NATP Coastal Agro-Ecosystem Review Workshop		Bangalore	July 30 to August 2001
	Expert Committee meeting for fixing standards for aquaculture inputs	MPEDA	Cochin	September 17, 2001
	National Official Language Seminar on Use of Hindi in ICAR Fisheries Institutes – Issues and Prospects	CMFRI	Cochin	October 12, 2001
	Postgraduate Programme co-ordinators meet	CIFE	Mumbai	November 26-28, 2001

	International Symposium of fish for Nutritional Security in the 21st Century	CIFE	Mumbai	December 4-6, 2001
	National Workshop on Aquaculture Drugs	CFDDM, CUSAT	Cochin	January 17-19, 2002
	Project Finalisation Meeting on Elasmobranchs	CMFRI	Cochin	February 17-18, 2002
	Meeting of Entrepreneurs and Industrialists in Marine Fisheries	CMFRI	Cochin	March 13, 2002
Dr. P.C. Thomas Principal Scientist	National Workshop on Aquaculture Drugs	Centre for Fish Disease Diagnosis and Management, CUSAT	Cochin	January 18-20, 2002
Dr. K.C. George Principal Scientist	National Workshop on Aquaculture Drugs	Centre for Fish Disease Diagnosis and Management, CUSAT	Cochin	January 18-20, 2002
Dr. P. Jayasankar Sr. Scientist	International Conference on Advanced Technologies in Fisheries and Marine Sciences	Marine Biotechnology Laboratory, ICAS, Manonmaniam Sundaranar University and N.I. College of Engineering	N.I. College of Engineering, Thuckalay	February 2-4, 2001
Dr. C.P. Gopinathan Principal Scientist	Working Group Meeting on Data Management	National Institute of Oceanography	Goa	August 17, 2001
	3rd Workshop on An Integrated Approach for Potential Fishery Zone using Ocean Colour and SST	Space Application Centre	Ahmed-abad	February 1, 2002

Smt. T.S. Naomi Scientist (SG)	Training on Application of statistical methods in Fisheries Research	Trainers' Training Centre of CMFRI	Cochin	June 11-30, 2001
	Winter School Training on advances in microbiological and biotechnological methods for the detection of pathogenic micro-organisms and their toxins in fishery environments	Central Institute of Fisheries Technology	Cochin	November 5-25, 2001
Dr. P. Kaladharan Sr. Scientist	Workshop on Remote Sensing and GIS application	Centre for Environmental Development	Trivan-drum	June 18, 2001
	Attended 3rd Task Force Meeting of DBT and presented the Final Report of the Investigations on Genetic Manipulation of red seaweeds through protoplast fusion and somatic hybridization	Dept. of Biotechnology	New Delhi	July 3, 2001
	Summer Institute on Environmental Impact Assessment in relation for coastal zone management	CIFE	Mumbai	August 7-27, 2001
	Training programme on coastal zone management – An integrated approach	CIFE	Mumbai	February 12 to March 4, 2002
Dr. Reeta Jayasankar Sr. Scientist	National Workshop on *Gracilaria* species from Indian shores	Krishnamurthy Institute of Algology and Dept. of Botany, Vivekananda college	Chennai	May 14-19, 2001

	Summer School on Environmental Impact Assessment and Management of Coastal Zone : An integrated approach	CIFE	Mumbai	August 7-27, 2001
	Training on Computer Office Automation	CMFRI	Cochin	March – April, 2001
Dr. (Mrs.) S. Sivakami Principal Scientist	Project Finalisation Meeting on Elasmobranchs	CMFRI	Cochin	February 17-18, 2002
Dr. R. Sathiadhas Head of Division	State level workshop on fisheries development	NABARD	Trivan-drum	March 13, 2001
	Annual review workshop of IVLP Centres of Coastal Agro-Eco system under NATP	CRIJAF	Barrackpur	May 24-26, 2001
	National Review Workshop on the World Bank aided project entitled "Environmental Management Capacity Building in India"	CMFRI & IGIDR	Cochin	December 14-15, 2001
Dr. R. Narayana Kumar Scientist	Training on Agricultural development and policy	Centre of Advanced Studies in Agricultural Economics	IARI, New Delhi	March 13 to April 2, 2001
Smt. Sheela Immanuel Scientist	Review Workshop on ATIC		Dharward	October 18-19, 2001
Dr. S. Ashaletha Scientist	International Conference on "Women in Fisheries"	Indian Society of Fisheries Professionals	Mumbai	December 11-12, 2001

Dr. C. Ramachandran	Annual Review Workshop of IVLP/ATIC		Ambalava-yal, Wayanad	October 11-12, 2001
	Seminar on 'Crisis in higher education'	Zoological Society of Kerala	SH College, Thevara	October 21, 2001
Dr. V.P. Vipin Kumar Scientist	Winter school on 'Recent Advances in Extension management	IARI	New Delhi	September 26 to October 16, 2001
Dr. E.V. Radhakrishnan Head, CFD	Twenty first and twenty third meeting of the Aquaculture Authority and presented the consultancy Project Proposal and Inception Report	Aquaculture Authority, Chennai	Chennai and Cochin	April 9, 2001 & September 8, 2001
	National Workshop on Aquaculture Drugs	Centre of Fish Disease Diagnosis and Management	Cochin	January 18-20, 2002
	Project Finalisation meeting on Elasmobranchs	CMFRI	Cochin	February 17-18, 2002
	National Workshop on NATP (CGP) project "Broodstock development, breeding, hatchery production and restocking of mud crabs"	NATP/CCS Haryana Agricultural University	Hisar, Haryana	March 1-2, 2002
	Meeting of Entrepreneurs and Industrialists in Marine Fisheries	CMFRI	Cochin	March 13, 2002
Dr.V. Kripa Sr. Scientist	Meeting on Biodiversity strategy and Action plan	Mangalore Fisheries College	Cochin	April\ 28, 2001

Dr.K. Sunilkumar Mohamed, Senior Scientist	Workshop on Aquaculture Medicine	Cochin University of Science and Technology	Cochin	January, 2001
Smt. Josileen Jose Scientist (SS)	National Symposium on Physiology and Biochemistry of cultivable crustaceans	Dept. of Zoology, University of Madras	Chennai	February 18-19, 2002
Shri P. Vijayagopal Scientist (Sr. Scale)	Summer School on Exploring and Evaluation of Newer feed Resources to optimise the cost of production of feed for livestock and poultry	Tamilnadu Veterinary College and Research Institute	Namakkal	June 21 to July 11, 2001
Dr. (Mrs.) K.S. Sobhana Scientist	National Workshop on Potential of Artificial substrate based Microbial Biofilm in Aquaculture	Department of Aquaculture, College of Fisheries	Mangalore	October 15-16, 2001
	Winter School on Advances in Microbiological and Biotechnological methods for the detection of Pathogenic microorganisms and their toxins in fish and fishery environments	CIFT	Cochin	November 5-25, 2001
	National Workshop on Aquaculture Drugs	Centre for Fish Disease Diagnosis and Management, CUSAT	Cochin	January 18-20, 2002
Dr. (Mrs.) Imelda Joseph Scientist	Summer School on Advances in fish and crustacean nutrition and aquafeed biotechnology	CMFRI	Cochin	June 6-26, 2001

	Training course on Fermentation Technology for production of Biomolecules	IVRI	Izatnagar	August 1 to September 5, 2001
	National Official Language Seminar on Use of Hindi in ICAR Fisheries Institutes – Issues and Prospects	CMFRI	Cochin	October 12, 2001
Dr. H.M. Kasim Principal Scientist	FRAD Workshop	CMFRI	Visakha-patnam	February 25 to March 2, 2001
	National Workshop on Biotechnology based programmes for Women and Rural Development		Kakinada	January 29-30, 2001
	National Seminar on Environmental Problems and Perspectives		Visakha-patnam	June 4-5, 2001
	Hindi Official Language Implementation Committee (OLIC) meeting	CMFRI	Visakha-patnam	July 10, 2001
	First meeting of the PI and CCPI of the NATP project "Studies on Fisherwomen in the Coastal Ecosystems of Andhra Pradesh, Tamilnadu, Kerala and Karnataka"		A.N.G.R. A.U, Campus, Hyderabad	July 13, 2001
Dr. V.D. Deshmukh Principal Scientist	Meeting on "Scientific manpower planning in ICAR Fisheries Research Institutes"	CIFE	Mumbai	September 21-22, 2001

	Delivered a lecture on 'Fish population dynamics fisheries management' for U.G.C. sponsored refresher course in biological sciences	Ramnarain Ruia College	Mumbai	October 29, 2001
	International symposium on fish for nutritional security	CIFE	Mumbai	December 4-6, 2001
	Delivered a lecture and conducted a practical session on 'Decapod taxonomy' at National training course on "Taxonomy, genetics and gene banking"	NDDB/DBT	CIFE, Mumbai	January 17, 2002
	Brainstorming session on fisheries legislation and co-chaired a session	CIFE	Mumbai	February 12, 2002
Shri M.Z. Khan Principal Scientist	Consultative Group Meeting	FSI	Mumbai	May 21, 2001
Dr. V.V. Singh Principal Scientist	Training programme on "Essentials of EIA studies related to aquaculture products"	CIFE	Mumbai	October 19, 2001
	International Symposium on Fish for nutritional Security	CIFE	Mumbai	December 4-6, 2001
	Delivered a guest lecture to the participants of short course on Environmental Management in Fisheries	CIFE	Mumbai	December 7, 2001

	International Conference on Women in Fisheries	CIFE	Mumbai	December 11-12, 2001
	Working Group Meeting for development of "Apprenticeship Training Modules in Marine Fisheries and Fish Processing Technology	PSS Central Institute of Vocational Education	Bhopal	February 11-15, 2002
	Delivered lectures as invited faculty for DBT/NBDB sponsored training programme on "Integrated Coastal Zone Management"	CIFE	Mumbai	February 25, 2002
Dr. Rani Mary George Principal Scientist	Workshop on Breeding, Farming and Management of ornamental fisheries	Cochin University	Cochin	February 8, 2002
Dr. P.K. Krishnakumar Sr. Scientist	Winter School on Geographic Information System for land resource data management	National Bureau of Soil Survey and Land Use Planning (ICAR), Regional Centre	Bangalore	October 3-23, 2001
	Technical Advisory Committee meeting	Karnataka State Pollution Control Board	Bangalore	January 19, 2002
Shri S.G. Raje Scientist (SG)	World Fishermen Day		Wadrai, Thane	November 21, 2001
	International symposium on Fish for nutritional security in the 21st century	CIFE	Mumbai	December 4-6, 2001

Shri K.P. Said Koya Scientist (SS)	Participated and delivered a talk on the need and method to protect the environment to support "the sustained existence of living being" on the World Environment Day	Department of Science & Technology and Environment and MDS-Minicoy	Minicoy	June 6, 2001
Shri Joe K. Kizhakudan Scientist	CAS Training Programme on Immunological Advancements in Finfishes and Shellfishes	CIFE	Mumbai	January 15 to February 2, 2001
	FRAD Zonal Workshop	CMFRI	Mumbai	February 25 to March 1, 2001
Shri K. Vijayakumaran Scientist (Sr. Scale)	Workshop on the Report of the World Commission on *Dams and Development: A new framework for decision making*	Centre for Resource Education	Hyderabad	June 16-17, 2001
	Consultative Workshop of the project on Globalization and Seafood Legislation: the impact on poverty in India	Natural Resource Institute (NRI) UK, Catalyst Management Services (CMS), Bangalore and South Indian Federation of Fisheries Societies, Thiruvananthapuram	Visakhapatnam	June 21-22, 2001
	Trainers Training Workshop on Ecology restoration and participatory Management of Mangroves	M.S.Swaminathan Foundation	Kakinada	July 25-27, 2001

	Faculty Upgradation Programme in Environmental Economics	World bank aided Envionmental Management Capacity Building Technical Assistance Project of Govt. of India	Institute for Social and Economic Change, Bangalore	September 10 to October 9, 2001
Dr. N. Kaliaperumal Principal Scientist	Brainstorming session on Marine Fisheries of Tamil Nadu	Madras RC of CMFRI	Chennai	May 11, 2001
	National Workshop on *Gracilaria* species from Indian shores	Krishnamurthy Institute of Algology and Dept. of Botany, R.M. Vivekananda College	Chennai	May 14-16, 2001
	National Symposium on Marine Algal Research in India – Prospect & Retrospect	National Facility for Marine Cyanobacteria	Tiruchira-palli	August 16-18, 2001
	National Seminar on Marine and Coastal eco-system; Coral and Mangrove -Problems and Management Strategies	Suganthi Devadasan Marine Research Institute	Tuticorin	September 26-27, 2001
Dr.A.K.V.Nassar Sr. Scientist	Regional Workshop on Application of Remote Sensing	NRSA, Hyderabad and Dept. of Geology, Andhra University	Visakhapa-tnam	September 28, 2001
Dr.Chandrakant Tayade Scientist	Programme on "Recombinant DNA Technology in Vaccine Production"	IVRI	Izatnagar	November 20-29, 2001

M. Sivadas Scientist (Sr. scale)	Sensitisation workshop	NATP	Agricultural University, Bangalore	August 30-31, 2001
K.K. Philipose Scientist (Sr. scale)	Consultancy core group meeting of Kannur Ocean Park	Kannur Collectorate	Kannur	September 13, 2001
	Participated in Science fest	Calicut University	Calicut	October 30 to November 1, 2001
Gulshad Muhammed Scientist (Sr. scale)	National Workshop on Basic Sciences and Fisheries	CIFE	Mumbai	September 1-12, 2001
Dr. P.K. Martin Thompson Technical Officer	Meeting convened by Dr. M.A. Kuttappan, Minister for Backward classes and Rural Development	Block Development Office	Kuzhup-pilly	June 22, 2001
	Annual Review meeting of the KVKs, TTCs and ZARs in Kerala and Lakshadweep	KVK	Ambalav-ayal	October 11-12, 2001
Dr. E. Vivekanandan Principal Scientist	Participated in the meeting as a Member in the Thematic Working Group of Biodiversity of Aquatic Resources Action Plan, MOE&F, New Delhi		Chennai	June, 2001
	Participated and chaired a session in the Bioresources meeting	M.S.Swaminathan Research Foundation	Chennai	September, 2001
	DFID Workshop "Post harvest loss and control"	Dept, of Fisheries, Tamil Nadu	Chennai	October, 2001

	International Conference "Sea Safety"	BOBP	Chennai	October, 2001
	International Conference	ICSF	Chennai	October, 2001
	Participated in the meeting as a member of X Plan Working Group (Fisheries), Govt. of Tamil Nadu		Chennai	December, 2001
Shri D. Kandasami	Regional Brainstorming session on marine fishes of Tamil Nadu	CMFRI	Chennai	May 15, 2001
	Fish Farmers' Day	CMFRI	Chennai	July 10, 2001
	Summer School on Advances in fish and crustacean nutrition and aqua feed biotechnology	CMFRI	Cochin	June 6-26, 2001
Dr. M. Vijayakumaran Principal Scientist	NATP workshop on nutrition and pathology in Mariculture	CMFRI	Cochin	March 26-27, 2001
	Brainstorming session on Marine Fisheries of Tamil Nadu	Madras R.C. of CMFRI	Chennai	May 2, 2001
	Regional Workshop on Sea Safety	BOBP and FAO	Chennai	October 8-12, 2001
	Summer School on Advances in fish and crustacean nutrition and aqua feed biotechnology	CMFRI	Cochin	June 6-26, 2001
Dr. P. Nammalwar Principal Scientist	Regional Brain-storming session on marine fisheries of Tamil Nadu	CMFRI	Chennai	May 15, 2001

	Seminar on Aquaculture and Coastal Environment	Dept. of Environment, Govt. of Tamil Nadu and Indian Council of Agricultural Research, New Delhi	Dept. of Economics, University of Madras, Chennai	July 26, 2001
	Management Training programme on "Application of GIS in the management of coastal marine critical habitats"	Integrated Coastal and Marine Area Management, Project Directorate, Chennai under Dept. of Ocean Development, New Delhi	Chennai	October 8-13, 2001
	Workshop on "GIS and its Application"	Dept. of Applied Geology, University of Madras and NIIT GIS Ltd., Chennai	Chennai	October 16, 2001
	National Symposium on Physiology and Biochemistry of cultivable crustaceans	Dept. of Zoology, University of Madras	Chennai	February 18-19, 2002
Smt. P.S. Asha Scientist	DAE BRANS National Seminar on Thermal Ecology	M.S. University	Thirunel-veli	February 1-2, 2002
Shri T.S. Velayudhan, Principal Scientist and Dr.K. Sunilkumar Mohamed, Senior Scientist	NATP review meeting		Bangalore	February 28-29, 2001
Dr.K.K. Appukuttan and Dr.V. Kripa	Meeting of Entrepreneurs and industrialists in Marine Fisheries	CMFRI	Cochin	March 13, 2002
Dr.G.Syda Rao, Dr.G.Maheswardu, Dr.A.K.V.Nasser and Dr.U.Rajakumar	Presentation on Threat posted by Ballast water discharge	Visakhapatnam Port Trust	Visakhapa-tnam	August 30, 2001

Dr.G.Syda Rao, Dr.G.Maheswardu, Dr.A.K.V.Nasser, Mrs.Miriam Paul and Dr.U.Rajkumar	Meeting on impact of WTO agreement on fisheries sector	Commissioner of Fisheries, Govt. of Andhra Pradesh	Visakhapa-tnam	October 12, 2001
Dr.G.Maheswarudu, Dr.A.K.V.Nasser, Mrs.Miriam Paul and Dr.U.Rajakumar	Seminar on "Larval nutrition and Health Management"	Tropical Biomarine System Pvt. Ltd.	Visakhapa-tnam	September 10, 2001
Dr.G.Maheswarudu, Dr.A.K.V.Nassar, Shri K.Vijayakumaran Mrs.Miriam Paul and Dr.U.Rajkumar	World Fisheries Day function	Dept. of Fisheries, Govt. of Andhra Pradesh	Visakhapa-tnam	November 21, 2001
Shri S.G. Raje, Dr. G. Mohanraj, Dr. V. Gandhi, Grace Mathew, Dr. K.K. Joshi, Shri P.P. Manojkumar, and Mrs. Rekha J. Nair	Project Finalisation Meeting on Elasmobranchs	CMFRI	Cochin	February 17-18, 2002

Dr.G.Syda Rao, Dr.G.Maheswardu, Dr.A.K.V.Nasser, Mrs.Miriam Paul and Dr.U.Rajkumar	Meeting on impact of WTO agreement on fisheries sector	Commissioner of Fisheries, Govt. of Andhra Pradesh	Visakhapa-tnam	October 12, 2001
Dr.G.Maheswarudu, Dr.A.K.V.Nasser, Mrs.Miriam Paul and Dr.U.Rajakumar	Seminar on "Larval nutrition and Health Management"	Tropical Biomarine System Pvt. Ltd.	Visakhapa-tnam	September 10, 2001
Dr.G.Maheswarudu, Dr.A.K.V.Nassar, Shri K.Vijayakumaran Mrs.Miriam Paul and Dr.U.Rajkumar	World Fisheries Day function	Dept. of Fisheries, Govt. of Andhra Pradesh	Visakhapa-tnam	November 21, 2001
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WORKSHOPS, SUMMER SCHOOL, SYMPOSIA, SEMINARS ETC. ORGANISED

National Workshop

CMFRI, Kochi, in association with the Indira Gandhi Institute for Development Research (IGIDR) Mumbai, organised a National Review Workshop of the World Bank aided Projects - 'Environmental Management Capacity Building in India' on 14 & 15 December at CMFRI Headquarters Cochin.

The Zonal Workshop of FRAD staff was conducted at Tuticorin Research Centre during 12th to 15th February, 2001.

A training programme on Artificial Reefs for a period of five days from 3.12.2001 to 7.12.2001 was conducted for the benefit of local fishermen and members of Non-Government Organisation at Tuticorin Research Centre of CMFRI in collaboration with MSSRF, Chennai under the scheme "Promotion of alternative livelihood for the poor in the Biosphere of Gulf of Mannar".

Organized a 21 day Summer School on "Advances in Fish and Crustacean Nutrition and Aquafeed Biotechnology at CMFRI, Cochin from 6th to 26th June 2001.

Brain storming sessions to identify researchable issues

Brain storming sessions with fishers, farmers, entrepreneurs, state officials and other personnel related to Marine Fisheries and Mariculture were held at different centres of the Institute to identify regional/location specific problems related to marine fisheries and mariculture.

The Mumbai Research Centre organized two exhibitions on Institute's activities and achievements during following symposia: (1) International symposium on fish for nutritional security at Central Institute of Fisheries Education during 4-6th December, 2001 and (2) International conference on women in fisheries at Central Institute of Fisheries Education during 11-12th December 2001.

CMFRI celebrates Fishfarmers' day on 10th July

The fish farmers' day was celebrated at HQ and at different Regional and Research Centres of CMFRI with active interaction with the fishers and farmers. A seminar on Mariculture was conducted at Kakinada Research Centre of CMFRI on 10th July. The need for establishment of hatcheries for supplying crab seeds to farmers was also highlighted. At Mandapam/Veraval Regional Centres, Research Centres at Tuticorin and Vizhinjam, various activities were carried out. At Vizhinjam Research Centre of CMFRI twenty-five fish farmers sponsored by *Matsyafed*, Fish Farmers Cooperative Societies and private fish farmers participated in the function.

Foundation Day

The birthday of CMFR Institute falling on 3rd February was celebrated with great enthusiasm and spirit at the Institute campus on 4th February in a befitting manner. The Institute was open for the public on the day. Students of local schools and colleges were invited and were familiarized with our activities. Dr. K. Gopakumar, Deputy Director General (Fy.), ICAR was the chief guest of the public meeting held on the occasion. The function, presided over by Dr. Mohan Joseph Modayil, Director and followed by cultural programmes presented by the staff and their family members was graced by former Directors, retired staff members and dignitaries from all walks of the society. Dr. E.G. Silas, former Director, CMFRI released the first issue of the in-house magazine "Tharangam" and Dr. P.S.B.R. James, former Director, CMFRI launched the CMFRI website **www.cmfri.com.**

Project finalisation meeting on Elasmobranchs

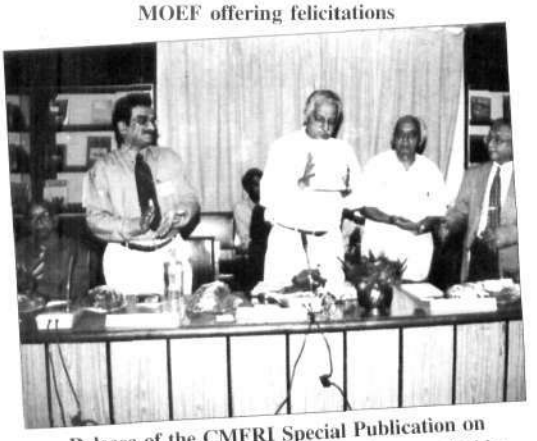
Dr. Mohan Joseph Modayil, Director welcoming the participants

Shri.P.V. Jayakrishnan IAS, Secretary, MOEF giving the inaugural address

Dr. E.G. Silas, former Director, CMFRI giving the keynote address

Shri S.C. Sharma, Additional Director General (WL), MOEF offering felicitations

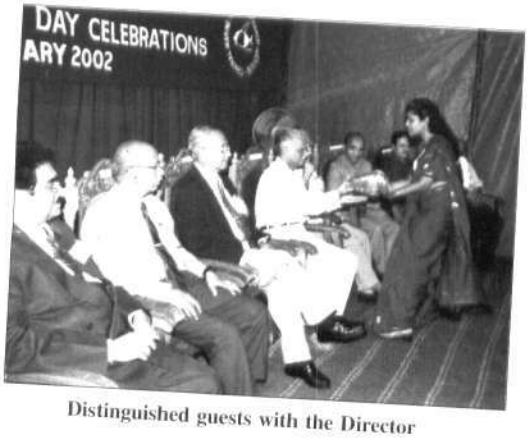
Dr. P.S.B.R. James, former Director, CMFRI offering felicitations



Release of the CMFRI Special Publication on *Elasmobranch Fisheries of India - An appraisal* by Shri. P.V. Jaya Krishnan IAS

CMFRI Foundation Day Celebrations

Laboratory cum office building at HQs on the Foundation Day



Distinguished guests with the Director

Inauguration of CMFRI website

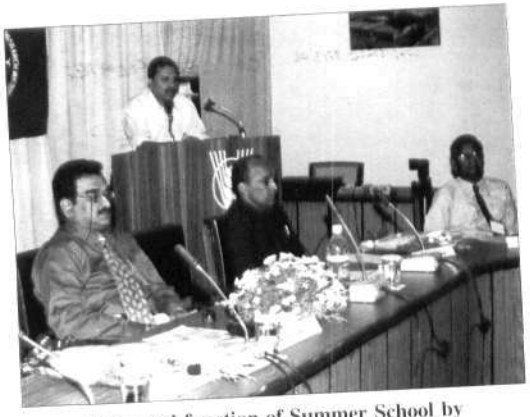
Release of souvenir *Tharangam*

Cultural programme

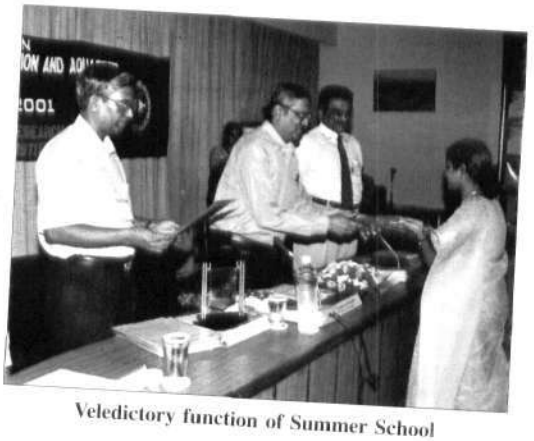
Open House on the Foundation Day

Glimpses of Events

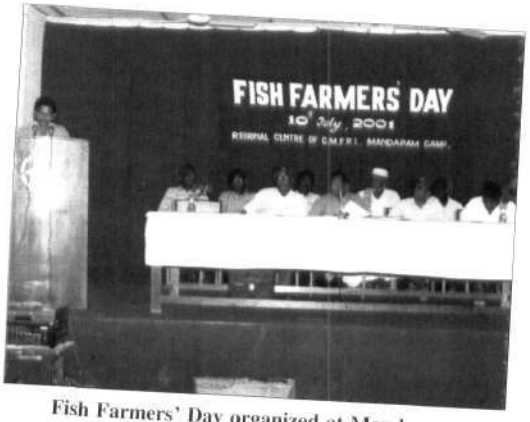
Institute - Industry - Entrepreneurs Meet at HQ



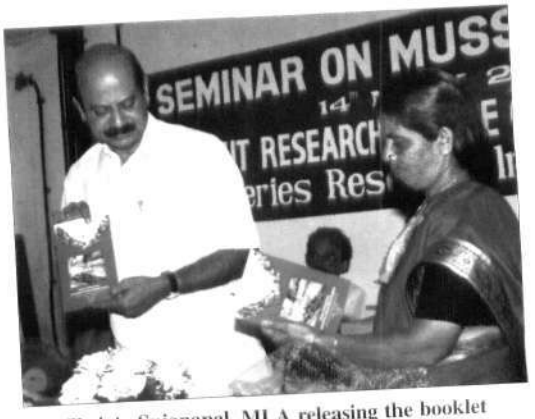
Inaugural function of Summer School by Shri Jose Cyriac IAS, Chairman, MPEDA



Veledictory function of Summer School



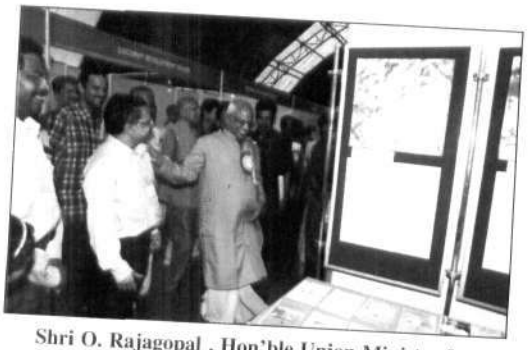
Fish Farmers' Day organized at Mandapam



Shri A. Sujanapal, MLA releasing the booklet on Mussel culture by giving a copy to Smt. M.M. Padmavathi, Former Mayor of Calicut

Visit of dignitaries

Shri A.K. Antony, Hon'ble Chief Minister of Kerala and Shri K.V. Thomas, Minister for Fisheries and Tourism alongwith Shri George Eden, M.P. visit our stall in the All India Aquarium Show 2002



Shri O. Rajagopal , Hon'ble Union Minister for Railways appreciates our stall at the *Swadeshi Vigyana Mela* Industrial Fair 2002

Dr. Panjab Singh, Director General, ICAR along with Dr. K. Gopakumar, DDG (Fy.) visiting the Marine Aquarium at Vizhinjam centre

Shri P.V. Jayakrishnan IAS inaugurates the Project Review Workshop of EERC at CMFRI

Dr. Bhaskar Balakrishnan, Ambassador (Desig.) to Cuba, Ministry of External Affairs at the Institute HQ

Dr. K. Gopakumar, DDG (Fy.) viewing the Lobster Culture facilities at Veraval Centre

DISTINGUISHED VISITORS

Cochin

Shri R.S. Prasad, Financial Adviser, DARE/ ICAR, New Delhi

Dr. S.A.H. Abidi, Member, ASRB, Krishi Anusandhan Bhavan, Pusa, New Delhi

Dr. Bhaskar Balakrishnan, Ambassador (Desig.) to Cuba, Ministry of External Affairs, New Delhi

Shri Vicki Poole, ACIAR Manager, South Asia, Australian High Commission, New Delhi

Karwar

Shri. M.R. Upare, General Manager, National Bank for Agriculture and Rural Development, Bombay

Shri J.S.M. Achar, Director, Institute for Catchment studies and Environmental Management, Central College Campus, Bangalore

Minicoy

The Hon'ble second sub-committee of the Committee of Parliament on Official Language under the convenorship of Shri Ram Ragunath Choudary, Hon'ble M.P. (Lok Sabha)

Tuticorin

Shri K.G. Bhattacharya, IPS, I.G. of Police, CISF, Mumbai

Dr. A. Venkataraman, IAS, Member, State Planning Commission, Chennai

Visakhapatnam

Shri Ravindranathan, Director, Centre for Marine Living Resources and Ecology, Kochi

Mandapam

Shri S. Vijayakumar, IAS, District Collector, Ramanathapuram.

Kakinada

Shri Sudhir K. Jain, Lecturer, Cooperative Training Centre, Hanumantal, Jabalpur

Shri D. Avinandan, Loyala Academy, Secunderabad

Veraval

Dr. Bhatt, Professor, Bhavnagar University, Bhavnagar, Dept. of Marine Sciences, Bhavnagar University.

Shri. S.B. Joshi, Dalal Consultants and Engineers Ltd., Ahmedabad

Shri. N.A. Vohra, Commissioner of Fisheries, Gandhinagar, along with Dr. M.I. Patel, Dr. Choudhary, Dr. H.B. Dave, Dr. Upadhyay, Shri. I.C. Jadeja and Shri. V.J. Thakar, Senior Fisheries Officers, Gujarat State Fisheries dept.,

Shri. K.P. Thomas, President, Seafood Exporters Association

Shri. Ramesh Chopadkar, Secretary, SSI, Veraval

Dr. S.K. Patel and Dr. Bhatt, Professors, Bhavnagar University

Dr. Shailesh Nayak, Group Director, Marine and Water Resources, Space Applications Centre, Ahmedabad

Shri. V.J. Thakar, Dy. Director of Fisheries, Veraval

Dr. Manoj, E., Ananthsree Ecocare Consultants, Surat

Dr. T.K. Ghosh, National Environment Engineering research Institute, Nagpur

Shri. Arun Patil, National Institute of Water Sports, Goa

Dr. A.D. Diwan, ADG, Marine Fisheries, ICAR

Shri. Pathak, Director, Finance, ICAR

Dr. M. Vijayan and Dr. Brahmaiah, Scientists, CPCB, Vadodara

Dr. Ravindra Chopade, Professor, Barkatullah University, Bhopal

Shri. S.M. Nayyar, Dy. Director (OL), ICAR

Dr. S.K. Patel, Professor, Dept. of Life Sciences, Bhavnagar University, Bhavnagar

Dr. K. Gopakumar, DDG (Fisheries), ICAR

Dr. K. Devadasan, Director, CIFT

Mangalore

Mr. Richard Fuchs, Head of Programme, IFS, Grev Turegatan 19, Stockholm, Sweden

Dr. E.G. Silas, former Director, CMFRI and former Vice Chancellor, Kerala Agricultural University, Kerala

Dr. D.G. Dhandar, Agro-Ecosystem Director, NATP (Coastal), National Research Centre for Oil Palm, Pedavegi, Andhra Pradesh

Shri D.S. Bhat, Deputy General Manager, NABARD, Mangalore

Shri Madhav Gadgil, Centre for Ecological Sciences, Indian Institute of Science, Bangalore

Dr. Aditya Chowdary, Calcutta University

Vizhinjam

Shri K.K. Gupta, DIG, SIW, New Delhi

Shri S. Mohandas, Sub Judge, Neyyattinkara, Kerala

Lt. Gen. M.A. Tutakne, VSM, Commandant, Army, Pune

Major General T.R.S. Bedi, Armed Forces, New Delhi

Dr. Panjab Singh, Director General, ICAR, New Delhi

Justice S.B. Sakrikar, M.P. High Court, MP.

Prof. (Dr.) Kevin, Pro-Vice Chancellor, University of Kerala

PERSONNEL (MANAGERIAL POSITION ONLY)

1.	**Director**	- **Dr. Mohan Joseph Modayil**
2.	**Heads of Divisions**	
	Fishery Resources Assessment Division	- Dr. M. Srinath
	Pelagic Fisheries Division	- Dr. N. Gopalakrishna Pillai
	Demersal Fisheries Division	- Dr. V. Sriramachandra Murty
	Crustacean Fisheries Division	- Dr. E.V. Radhakrishnan
	Molluscan Fisheries Division	- Dr. K.K. Appukuttan
	Fishery Environment Management Division	- Dr. M. Rajagopalan
	Physiology, Nutrition and Pathology Division	- Dr. R. Paul Raj
	Socio-Economic Evaluation & Technology Transfer Division	- Dr. R. Sathiadhas
3.	**Sr. Administrative Officer**	- Shri Charles Ekka
4.	**Sr. Finance & Accounts Officer**	- Shri A.V. Joseph
5.	**Administrative Officer**	- Shri P.S. Sudersanan
6.	**Scientists-in-Charge of Regional/Research Centres**	
	Mandapam Camp	- Dr. N. Kaliaperumal Principal Scientist
	Chennai	- Dr. R. Sarvesan Principal Scientist
	Tuticorin	- Shri D.C.V. Easterson Principal Scientist
	Kakinada	- Dr. H. Mohamed Kasim Principal Scientist
	Karwar	- Dr. V.S. Kakati Principal Scientist
	Mangalore	- Dr. C. Muthiah Principal Scientist
	Veraval	- Shri Joe K. Kizhakudan Scientist

Vizhinjam	-	Dr. P.P. Pillai Principal Scientist
Mumbai	-	Dr. V.D. Deshmukh Principal Scientist
Minicoy	-	Shri K.P. Said Koya Scientist (Sr. Selection Grade)
Visakhapatnam	-	Dr. G. Syda Rao Principal Scientist
Calicut	-	Dr. T.M. Yohannan Principal Scientist
Krishi Vigyan Kendra	-	Dr. P.K. Martin Thompson Technical Officer
Trainers' Training Centre	-	Dr. A. Laxminarayana Chief Training Officer
Fisheries Harbour Laboratory, Cochin	-	Mrs. Grace Mathew Principal Scientist