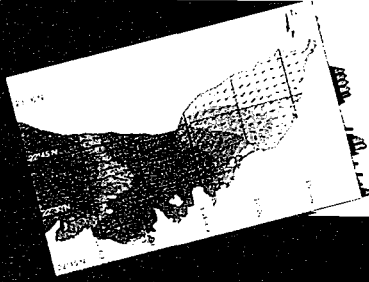
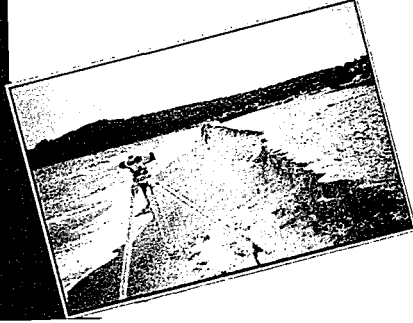
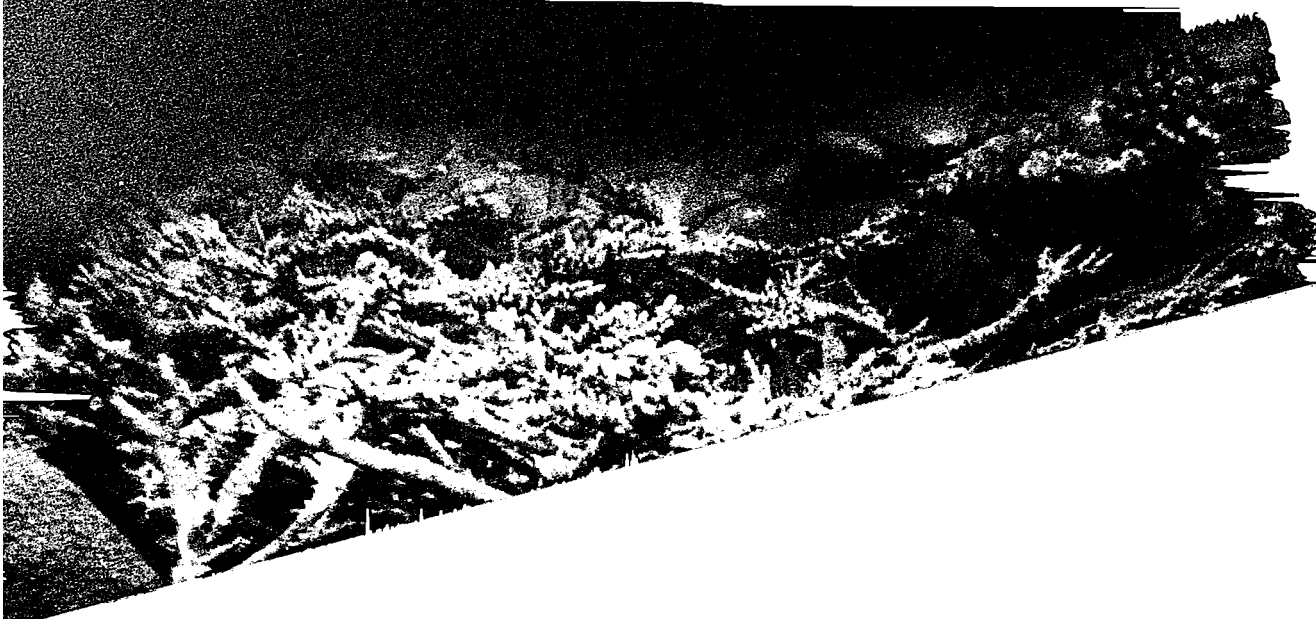


राष्ट्रीय समुद्र विज्ञान संस्थान
national institute of oceanography
goa, india



वार्षिक प्रतिवेदन
annual report
2000-2001





The Institute

The National Institute of Oceanography (NIO) is one of 38 laboratories of the Council of Scientific & Industrial Research (CSIR) and the largest marine research institute in the Indian Ocean region. The institute, established on 1 January, 1966, has head office in Goa and regional centres at Mumbai, Kochi and Visakhapatnam. Its multidisciplinary research programmes fall in four broad areas - coastal environment, engineering & technology, ocean processes and ocean resources



Head Office, Goa

Mission

To continuously improve our understanding of the seas around us and to translate this knowledge to benefit all"

Objectives

to attain excellence in research and generate intellectual property in frontier areas of marine science

to establish linkages with industry and ensure customer satisfaction through cost effective services and technology transfer

to continuously improve techniques for assessment of ocean resources

to develop world class expertise and facilities in the emerging fields of ocean research

to provide the best possible advisories to our stakeholders in the sustainable use of the ocean

to provide an enabling and invigorating working ambience that allows every individual to grow and perform to full potential



NIO

a CSIR laboratory

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वर्ष 2000-2001 निदेशक की रिपोर्ट

इस वर्ष संस्थान में कई महत्वपूर्ण कार्य-कलाप सम्पादित हुए। हमने अवसंरचना तथा क्रिया-कलापों को सुव्यवस्थित किया और महत्वपूर्ण विज्ञान एवं प्रौद्योगिकी कार्यक्रम, बौद्धिक सम्पदा का सृजन, अवसंरचना निर्माण, अनेक नये जोखिमधारियों से सम्पर्क तथा प्रमुख समुद्रवैज्ञानिक सम्बन्धी समारोहों के आयोजन द्वारा संस्थान ने यह एक और वर्ष संतुष्टिपूर्वक पूर्ण किया। इस वर्ष प्रमुखतया तटीय अनुसंधान पोत सागर शक्ति को जलयात्रा के लिए सुसज्जित करने तथा आईएसओ-9001 के प्रमाणपत्र को प्राप्त करने के लिए संस्थान के आंशिक पुनर्गठन में हमारे कई साथियों का काफी समय व्यय हुआ।

इस वर्ष हमने कई क्षेत्रों के कार्य-कलापों को सबकी जानकारी में लाने हेतु विवेकपूर्ण प्रयास किया एवं इससे हमें अतीव प्रसन्नता हुई। इसका एक पहलू यह है कि भविष्य में हम अपनी इसी कार्यशैली पर केन्द्रित रहने का वायदा करें।

हमारे साथियों ने देश के कई उच्च पुरस्कार प्राप्त किए जो कि संस्थान की अनुकूल प्रोफाइल के प्रतीक हैं। इसका प्रभाव कई क्षेत्रों में परिलक्षित हुआ, जैसे - कई अंतर्राष्ट्रीय समुद्र विज्ञान कार्यक्रम, जिनकी हम प्रारम्भिक निर्माण अवस्था में शामिल हुए तथा संस्थान में पी.एच-डी. कार्यक्रम के अंतर्गत पंजीकरण कराने वाले उच्च श्रेणी के युवा अनुसंधान वैज्ञानिकों की संख्या में निरन्तर वृद्धि।

हमारे अनुसंधान की विशिष्टताओं का यहाँ उल्लेख है जिन्हें विस्तृत रूप में पहले की रिपोर्ट के शीर्षों - तटीय पर्यावरण, अभियांत्रिकी एवं प्रौद्योगिकी, महासागरीय प्रक्रियायें एवं संसाधन के अनुसार आगे दिया गया है।

औद्योगिक दृष्टि से महत्वपूर्ण कच्छ की खाड़ी के अधिकतम इस्तेमाल के पैटर्न को वर्णित करने के लिए हमने उसका मॉडल बनाया जिससे हमें ज्ञात हुआ कि कई औद्योगिक संस्थानों की स्थिति उचित स्थान पर नहीं है। पहली बार

हमने निजी क्षेत्र के आंकिक विश्लेषक के साथ साझेदारी भी की।

बौद्धिक सम्पदा के सृजन में समुद्री जैव प्रौद्योगिकी सर्वाधिक विश्वसनीय स्रोत के रूप में उभरी है जिसमें विभिन्न बहुआयामी औद्योगिक एवं औषधीय उपयोग हेतु कवक से लेकर नालाकार केंकड़े तक के जीवों का समावेश है।

अरब सागर की भौति बंगाल की खाड़ी की विस्तृत जाँच-पड़ताल अब शुरू की गई है। भारतीय मौसम अनुसंधान कार्यक्रम (इंडियन क्लाइमेट रिसर्च प्रोग्राम - आईसीआरपी) के अंतर्गत अध्ययन, तलछट प्लूम का बिखराव एवं उत्प्रवाह संबंधी अध्ययनों से खाड़ी में वायु-प्रवाह तथा मृदुजल आगत के महत्वपूर्ण योगदान का पता चलता है।

वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद के आदेशानुसार इसके अंतर्गत सभी प्रयोगशालाओं को केवल उन्हीं योजनाओं को संबल प्रदान करने पर बल है जिनमें बौद्धिक सम्पदा का सृजन हो। प्रारम्भिक हिचकिचाहट तथा इस आदेश के विरोध के बावजूद, जो कि अधिकतर भूवैज्ञानिकों से अपेक्षित था, पेटेंटों की फाइल करने की संख्या में हर वर्ष वृद्धि हो रही है। इससे संस्थान के पेटेंटों के पुलंदे में आशातीत वृद्धि हुई है।

अवसंरचना (इन्फ्रास्ट्रक्चर) संबंधी आवश्यकतायें निरन्तर बढ़ रही हैं और इस वर्ष भाग्यवश वैऔअप से उपकरण अनुदान हमें पहले की अपेक्षा अधिक प्राप्त हुआ। इस वर्ष कई नवीन वैश्लेषिक सुविधायें (तटीय पोत सहित) शामिल की गई हैं जबकि कुछ अन्य का नवीनीकरण किया गया। हमारे कार्यक्रमों के लिए अनुसंधान पोतों के बेड़े को उपलब्ध कराने के लिए हम महासागर विकास विभाग के आभारी हैं। इसी प्रकार तटीय जलपोत सागर शक्ति की प्राप्ति से हमें विशेष रूप से संतुष्टि हुई है और हममें से कई को इसके लिए काफी समय लगाना पड़ा। एक नवीन एवं पूर्ण क्षमतायुक्त अनुसंधान

जलपोत, जो कि हमारे पूर्व अनुसंधान पोत *गवेषणी* का उत्तरवर्ती सिद्ध हो, उसके लिए बातचीत चल रही है। उस जलपोत से हमें जो अवसर प्राप्त होंगे उनसे हम उत्तेजित हैं।

अवसंरचना की भाँति पुनर्रचना एक सतत् प्रक्रिया है और आगामी वर्ष में आईएसओ-9001 प्रमाणपत्र प्राप्त करने के हमारे आवेदन के अनुसार इन मुद्दों पर हमने विशेष ध्यान दिया है।

बोधशील कार्यक्रमों द्वारा समुद्रविज्ञान के प्रसार में भी हम इस वर्ष व्यस्त रहे तथा इनसे हमें शक्ति मिली -

विज्ञान में युवाओं के नेतृत्व के लिए वैओअप कार्यक्रम के अंतर्गत संस्थान में उच्च स्तर के स्कूल तथा कॉलेज विद्यार्थियों को वैज्ञानिकों के साथ अंतर्क्रिया तथा उनके क्षेत्रीय कार्य में भाग लेने का अवसर प्रदान किया गया।

इस वर्ष राज्य सरकार ने मानसून ऋतु में मात्स्यिकी पर रोक लगाने के बारे में हमसे सलाह ली। लोक-निधि से संचालित प्रयोगशाला होने के नाते इस उद्योग से संबंधित कई जोखिमधारियों के मध्य हमने सहर्ष अंतर्क्रिया उत्प्रेरक की भूमिका निभाई। इसके परिणामस्वरूप इसमें भाग लेने के लिए खाद्य तथा कृषि संगठन (फूड एंड एग्रीकल्चरल ऑर्गनाइजेशन) तथा इंडो-ऑस्ट्रेलियन सहयोगीय कार्यक्रम से हमें तुरन्त उनकी रुचि का आशय प्राप्त हुआ। हमें विश्वास हो गया है कि इस प्रकार की सामाजिक अंतर्क्रियायें न सिर्फ जागरूकता पैदा करने में महत्वपूर्ण हैं बल्कि हमारे विज्ञान कार्यक्रमों को प्रखर बनाने में भी महत्वपूर्ण माध्यम हैं।

संक्रियात्मक समुद्रविज्ञान की धारणा को किस प्रकार अंतरसरकारी समुद्रवैज्ञानिक संगठन (आई.ओ.सी. - इंटर-गवर्नमेंटल ओशनोग्राफिक कमीशन) के हिन्द महासागर सार्वभौमिक सागर प्रेक्षण तंत्र के माध्यम से पड़ोसी देशों को अवगत करायें, इसके लिए हम महासागर विकास विभाग के साथ मिलकर काम कर रहे हैं। समुद्र उन देशों के लोगों के जीवन को किस प्रकार प्रभावित करता है, इसके प्रेक्षण तथा जानकारी में हम उनको सहभागी बना रहे हैं।

संस्थान की छवि बढ़ाना इसलिए हमारे हित में है क्योंकि इसके द्वारा निर्णय लेने वालों तथा उद्योगों को हमारी क्षमता ज्ञात होती है। हमारे साथियों द्वारा प्राप्त किए गए पुरस्कार एवं हमारे द्वारा

आयोजित व्यावसायिक समारोह संस्थान की उपस्थिति दिखाने में महत्वपूर्ण हैं। विज्ञान में उत्कृष्टता के लिए जो विशिष्ट पुरस्कार हमारे सहयोगियों को समर्पित किए गए हैं उनसे संस्थान में चलने वाले विभिन्न वैज्ञानिक कार्यक्रमों की उत्कृष्टता प्रतिबिंबित होती है।

पोर्सेक-2000 (पैसिफिक ओशन रिमोट सेंसिंग कॉन्फ्रेंस-2000) गोवा में आयोजित किया गया जिसमें काफी संख्या में विश्व के जाने-माने समुद्रवैज्ञानिकों ने भाग लिया। संक्रियात्मक समुद्रविज्ञान को आगे बढ़ाने में पोर्सेक ने एक मंच प्रदान किया है।

हमारे मानव संसाधन की गुणवत्ता निरन्तर बढ़ रही है जो समुद्र विज्ञान पर वैज्ञानिक कमेटी (साइंटिफिक कमेटी ऑन ओशनिक रिसर्च), आई.ओ.सी. तथा अन्य महत्वपूर्ण विज्ञान संस्थाओं की विज्ञान कमेटियों में हमारे साथियों की निरन्तर बढ़ती संख्या से परिलक्षित होती है।

विशाखापत्तनम के हमारे क्षेत्रीय केन्द्र ने पूर्वी तट पर प्रदत्त सेवाओं की 25वीं वर्षगांठ मनाई। भूभौतिकीय अनुसंधान में यह उत्कृष्ट केन्द्र बन गया है तथा पश्चिमी तट के हमारे दो अन्य क्षेत्रीय केन्द्रों के समान यह केन्द्र भारत के पूर्वी तट की स्थानीय आवश्यकताओं के लिए अपनी सेवायें प्रदान करने में सुव्यवस्थित एवं सक्षम है। पूर्वी तथा पश्चिमी तटों की भिन्न समुद्रवैज्ञानिक प्रवृत्ति होने के कारण हम अपनी तटरेखा पर अतिरिक्त क्षेत्रीय केन्द्रों की स्थापना पर विचार करेंगे।

अन्त में किसी संस्थान का महत्व तभी कायम रह सकता है जबकि इसमें युवा प्रतिभा को आकर्षित करने की क्षमता हो। हाँलाकि, भारत में समुद्रवैज्ञानिकों के लिए स्थिति की रुकावटें तथा सीमित रोजगार के अवसर होते हुए भी यह हमारे लिए प्रसन्नता का बात है कि हम स्पर्धात्मक प्रतिभाशाली विद्वानों की संख्या में त्वरित तथा सतत् वृद्धि करने में सफल हुए हैं। इस आधार पर हम आगामी चुनौतियों का विश्वासपूर्वक तथा पूर्वानुमान द्वारा सामना कर सकते हैं।

इं डेसा



The Institute witnessed a deal of important activity this year. We streamlined structures and functions, and have completed another satisfying year-engaging in important science and technology programs and intellectual property creation, building infrastructure, reaching out to our many stakeholders, and hosting major oceanographic events. Readying the coastal vessel Sagar Sukthi for cruises, occupied the time of many of our colleagues, as did partial restructuring of the institute - in preparation for ISO 9001 certification.

The year also saw us make conscious outreach efforts in several areas - activities that we enjoyed and a facet that promises to be more central to our functioning in future.

Our colleagues were the recipients of top awards of the country, indicative of the favourable profile of the institute and reflected in other areas - through the several international ocean science programs that we are involved in at the 'construction' stage, and the increasing number of top rated young research scholars that are now registered for doctoral programs at the institute.

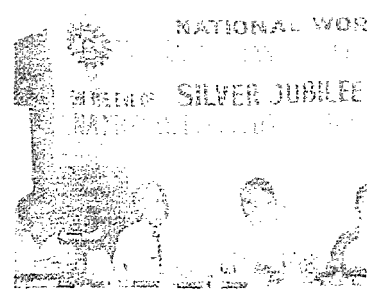
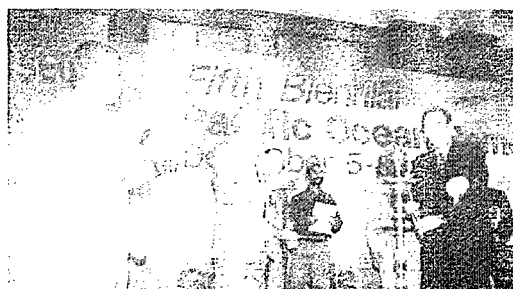
The highlights of our research are mentioned here and elaborated later under the same headings of earlier reportage - the coastal environment, engineering & technology, ocean processes & ocean resources.

We modeled the industrially important Gulf of Kachchh, to define optimum usage patterns, and discovered in the process that the locations of some industrial establishments could be more appropriately sited. This was also the first time that we partnered with a private sector numerical analyst, a partnership that we hope to replicate in other areas.

Marine biotechnology is emerging as our most promising source of intellectual property creation, with organisms from fungi to the horseshoe crab promising multiple industrial and medical applications.

The Bay of Bengal is now beginning to receive the same level of scrutiny as the Arabian Sea, and studies through Indian Climate Research Programme [ICRP], sediment plume dispersion and upwelling studies, show that winds and fresh water inputs play a major role in modifying processes in the Bay.

The Council of Scientific and Industrial Research [CSIR] requires that its labs support projects that have possibilities of



IP creation. After initial hesitation, expected from most earth scientists confronted by such a mandate, the number of patent filings has been increasing annually, dramatically improving the patent portfolio of the institute.

Infrastructure needs are continuously increasing, and this year we were fortunate to have our largest ever equipment grant from CSIR. Several new analytical facilities [including a coastal vessel] have been added and some others modernized. The availability of the Department of Ocean Development's [DOD] Research Vessel Fleet is critical to our programmes and gratefully acknowledged. Even so, our acquisition of the coastal vessel *Sagar Sukthi* has given us a special sense of satisfaction, and many of us have devoted much time to it. A new, full-ocean capability research vessel, as a follow-up to RV *Gaveshani*, is being negotiated, and we are excited at the opportunities this will bring.

Restructuring, like infrastructure, is a continuous process and we have been addressing these issues in the light of our application for ISO 9001 certification in the coming year.

Awareness programmes have occupied and invigorated us.

Through a CSIR Programme for Youth Leadership in Science [CPYLS], high performing school and college students spend up to one month at the institute, interacting with scientists and participating in field trips.

This year the state government consulted us on the scientific need for a closed period of fishing during the monsoons. As a publicly funded laboratory, we were pleased to be given an opportunity to catalyse

interaction between the several stakeholders of this industry, and received almost immediate expressions of interest from the Food and Agricultural Organisation [FAO] and the Indo-Australian Cooperative Programme for participation. We are convinced that such societal interactions are not only of importance in creating awareness, but will be an important mode to sharpen our science programmes.

We are working closely with the DOD on ways to take the concept of operational oceanography to neighbouring countries through the vehicle of IOC's [Intergovernmental Oceanographic Commission] Indian Ocean Global Ocean Observing System - IOGOOS, so that all neighbouring countries can participate in observing and understanding the ocean and the ways that it impacts the lives of their people.

Raising the profile of the institute is useful as a means to inform decision makers and industry of our capabilities. The awards that our colleagues receive, and the professional events that we organise, are important in raising the visibility of the institute. We also consider that the top awards for excellence in science that have been conferred on our colleagues, reflect the excellence of the science that is carried out at the institute.

The Pacific Ocean Remote Sensing Conference - PORSEC 2000, was held in Goa, and a large number of eminent oceanographers participated. PORSEC provided a platform for advancing operational oceanography.

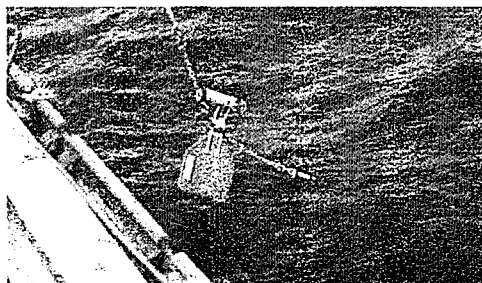
The quality of our human resource is continuously improving as witnessed by the increasing number of colleagues that serve on the science committees of SCOR, IOC and other important science bodies.

Our Regional Center at Visakhapatnam celebrated its 25th year of service on the East Coast of India. It has excelled as a center for geophysical research, and like the other 2 Regional Centers on the West Coast at Mumbai and Kochi, it is well placed to serve evolving local needs. Given the different oceanographic settings of the East and West Coasts, we will be considering additional regional centers along our coastline.

Lastly, continuity of an institute is assured when it can attract young talent. The hurdles of location and limited job openings for oceanographers in India notwithstanding, it is with great pleasure that we report the rapid and continuous increase in competitive-talent scholars that we have been attracting. With such support, we look with confidence and anticipation to the challenges that lie ahead.



(Ehrlich Desa)



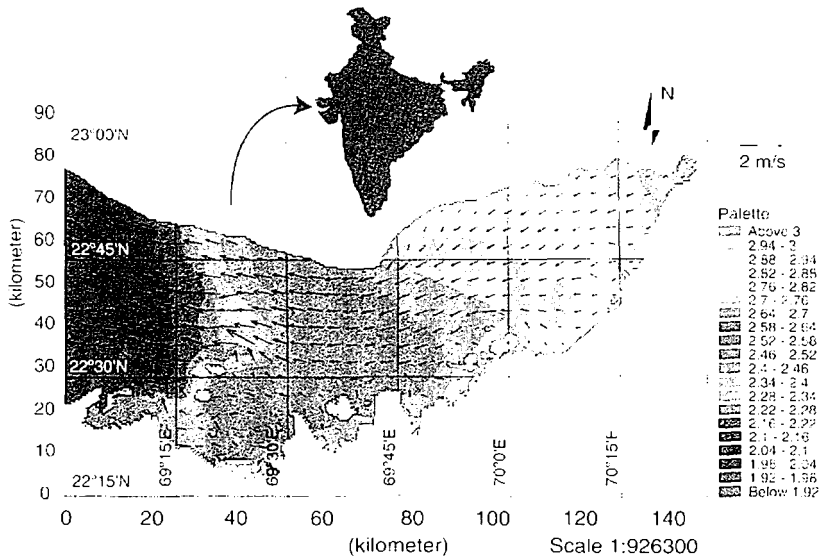
Integrated

Coastal Management

As India's economy and population grow, pressures on coastal waters grow too due to release of industrial waste and sewage, offshore or nearshore construction, recreational activities, etc. The Institute plays a critical role in mediating the various pressures on the coastal zone.

A programme at NIO that is spearheading this aspect of marine research is the programme on Integrated Coastal Management for India (ICMI). Taken up under this programme are a few projects, which involve careful and detailed observations in different coastal areas of India, mathematical modeling, application of modern methods such as GIS databases, satellite imageries and visualization, etc. Highlighted below are two examples of projects undertaken during the year:

Processes in the Gulf could keep pollutants recirculating

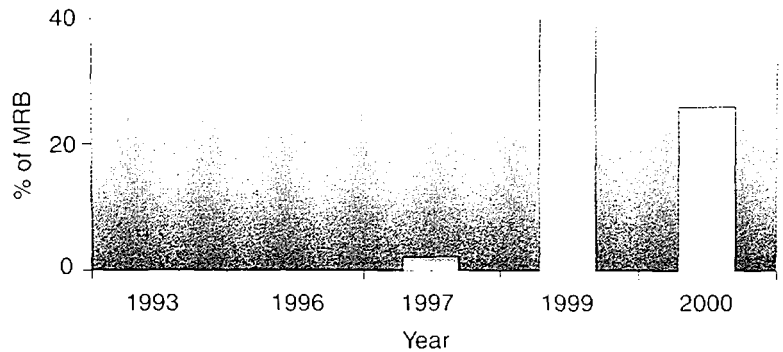


The Gulf of Kachchh is a semi-enclosed embayment where the tidal forcing play a dominant role in driving the waters. Also, the open ocean waters of the Arabian Sea across the western boundary interact with the Gulf significantly. A 2-D hydrodynamical model has been developed to simulate the tides and currents in the Gulf. Several runs of the model have been carried out to test its efficacy in reproducing tides and currents in the computational domain. The model is validated by comparing the simulated currents with the measured currents off Vadinar, Sikka and Mundra.

The results showed good agreement between the measured and simulated tides and currents. The circulation showed a net transport towards Kandla along the northern rim of the Gulf with a tendency to re-circulate, forming a



clockwise circulation. On the other hand, "particles" dropped in the central and western half of the Gulf, showed a net movement towards north, and then towards west along the northern rim of the Gulf, forming an anti-clockwise circulation. These results are in agreement with the overall residual circulation pattern obtained for the period October '94. The western part of the Gulf showed an inflow off Okha (southern Gulf) and outward flow off Chachhi (northern Gulf), forming a cyclonic circulation in the open boundary. The residual circulation also revealed the presence of several eddies in the Gulf.



10 ppm mercury tolerant bacteria in seawater samples

Pollution, coastal vegetation and land form changes impact both coasts

Three coastal districts of India - North Goa, Thane and East Godavari are being impacted by pollution, coastal vegetation and land form changes. In North Goa, sewage effects though still below threshold levels are seen in the Baga-Calangute-Sinquerim belt and its associated streams and creeks. The coastal wetlands in the form of mangroves are giving way to tourism related projects and sand mining is rampant. In Thane (Maharashtra), the network of estuaries and creeks is heavily polluted with industrial effluents.

Do bacteria detoxify pollutants?

For the first time, bacteria from natural coastal waters grew at mercury concentration 20 times higher than they could be cultured five years ago. Are we seeing new mercury-resistant strains?

Until 1997, we could not isolate bacteria at mercury concentrations greater than 2.5 μM . In recent years, almost one-third of all the water samples tested had bacteria capable of growing at high mercury concentrations (~ 50 μM). In samples tested from slightly polluted waters such as those off Mumbai, the metal-resistant bacteria were as numerous as others. It is likely that we are witnessing a

new scenario, with bacteria becoming increasingly metal-tolerant.

Biochemical and morphological tests were carried out, that showed that the strains belong to *Pseudomonas*, *Proteus*, *Xanthomonas*, *Alteromonas*, *Aeromonas* and *Enterobacteriaceae*. Except in one strain where the mercury is intracellularly complexed, all other strains had the capability of detoxifying mercury extracellularly. Such bacteria also grow well in the presence of a variety of xenobiotics. Tolerance to metals therefore appears to enhance the capability of such bacteria to detoxify a variety of toxic pollutants.

The spurt in industrial activities has highlighted NIO's role in providing a reliable assessment of the impact of industrial activity in the environment.

Both the industry and the Institute are benefited as NIO views itself as a partner with industry and not a contractor. Industries in turn view NIO as a "one-stop" point for comprehensive advisories on Environmental Impact Assessment (EIA) projects.

Saving natural habitats for Conservation

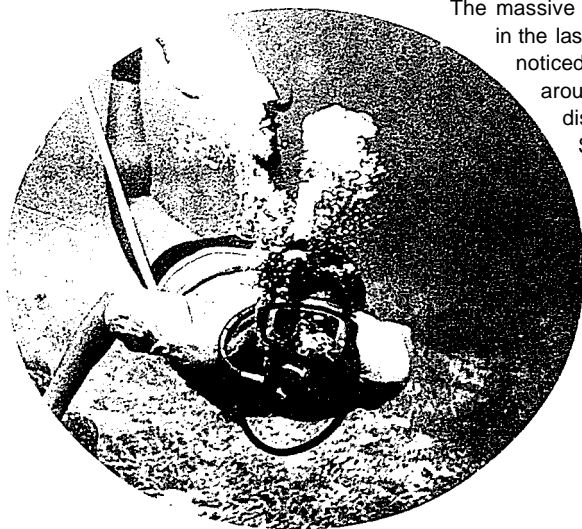
Coral reefs, one of the important ecosystems, are Nature's marvellous gifts to mankind. Famous for rich biodiversity and high productivity, coral reefs deserve our concern as their survival comes under threat in the face of our own activities increasingly making an impact on them.

black band, white band, red band, yellow band
and now pink line disease in corals

Reef-building corals, like all organisms, suffer from diseases. We know to date black band, white band, red band and yellow band diseases that affect corals. NIO scientists now have added one more to this list.

surveyed. The pink line, a pink colouration of the polyps around the dead patch, varies in thickness from few mm to 10 mm. The cyanobacterium *Phormidium valderianum* and the fungus *Curvularia lunata* were often associated with the dead patches. It is suspected that farming practices could be the causative organism of the PLS through the excessive use of fertilisers. Histological evidence such as the presence of filaments of cyanobacterium in the debris of dead tissue, and physiological evidence, such as the induction of pink colour in healthy polyps (by elevating partial pressure of carbon dioxide) supports this hypothesis.

The massive coral, *Porites lutea*, in the last two years often been noticed with a pink border around lesions. This disease, the Pink Line Syndrome (PLS), causes partial mortality and has affected about 10% of the coral colonies



conservation & awareness





Infected corals.



Trained team of islanders.

Coral monitoring goes public

Since the massive bleaching episode of 1998 that laid barren vast stretches of our Lakshadweep Reefs, we have begun monitoring the re-colonization of the reefs and other changes. We started the process three years ago along with the local islanders. Happily this process is now continued by the islanders themselves.

NIO created a societal wing seven years ago, to take science to stakeholders. We also realized that working along with stakeholders is more effective than telling them what is being done for them. Coral reef monitoring was an opportunity to test this assumption. Excellent infrastructure has been created in the

Lakshadweep islands for underwater diving, and 15 islanders have been trained in SCUBA diving and biophysical surveys for corals. A completely autonomous island-divers team has already completed surveys in 10 islands and is in the process of adding new demonstration sites.

During the year we took up 74 new externally funded projects and generated revenue of Rs. 123.7 million. A large portion of our efforts went into providing services to coastal industries

Tracing our heritage through Marine Archaeology

Our submerged Cultural Heritage provides the important links between today and our past maritime activities. Globalisation is forcing the rapid industrialisation of the coastal belt and it is imperative that we focus on the submerged remains before these succumb to the pressure of development. Marine archaeological investigations by NIO have brought to light submerged cities and sunken shipwrecks in Indian waters.

Roman objects such as amphora pottery, lead ingots and stone anchors are like the past peeping through centuries of burial

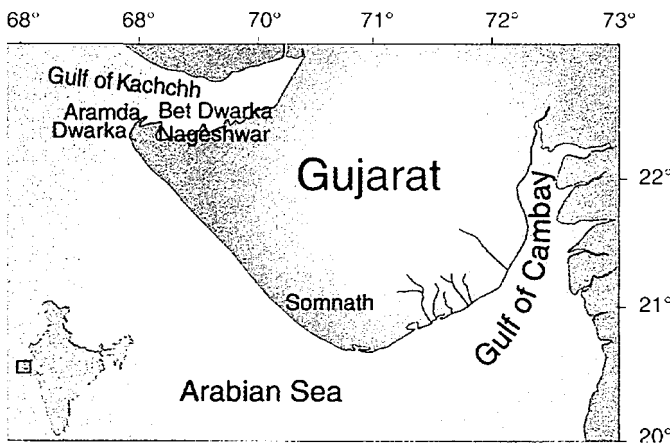
This was the 15th year in succession that our marine archaeologists visited the rich debris ridden waters of Bet Dwarka, Somnath and Dwarka. The group dived, reconnoitred and mapped finds over 30 days in early 2001. Their findings are tabulated overleaf, and the need for completing the surveys acquires a new urgency as the Bet

Dwarka finds were made with sight of a busy local jetty carrying several hundred passengers/devotees from the mainland to the island on pilgrimage.

The urgency is compounded when it becomes apparent that ancient finds are partly exposed through the large tidal range that is a speciality of the Gulf.

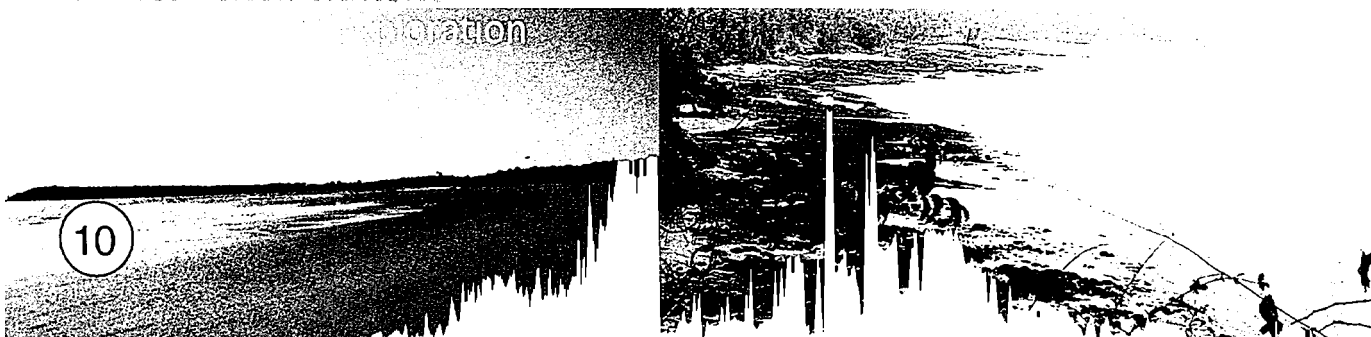
Tusks and potteries tell stories of vigorous and exotic trade

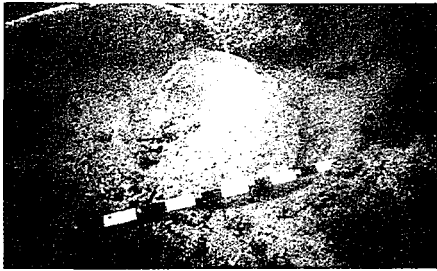
Seven elephant tusks were recovered from a shipwreck in Sunchi Reef, two of these have an inscription "ICM". In addition, two Hippopotamus canines, a metal artefact, and Martaban ceramic were also recovered from the same wreck. For age estimation of Martaban ceramic, the TL dating method was adopted where thermoluminescence is induced by exposure to ionizing radiation. The intensity of emitted light bears a proportional relationship with the amount of irradiation received by the sample and this fact is exploited for age estimation. The TL date of the Martaban ceramic is 360±40 years BP, placing it in during Portuguese Period in Goa.



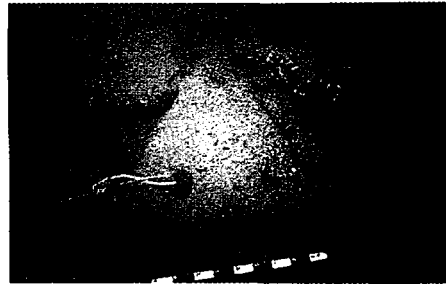
Sites of exploration in Oknamandal region.

Coastal environment
Exploration





Lead ingot from Bet Dwarka waters (6 m depth).



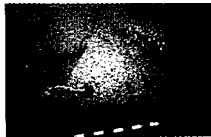
Triangular stone anchor recovered from Somnath.



Pottery from Bet Dwarka waters.



Submerged structure off Dwarka.



Somnath
(6~12 m)

✓
Northwest (~20 no.)

Bet Dwarka
(4~8 m)

✓

✓

✓
Opp. Khuda Dost Dargah

Dwarka
(4~15 m)

✓

✓

Potential of Biological resources

Biological oceanographers are focusing their attention towards conservation of living resources, protection of marine natural habitats and various uses of marine organisms.

Mangroves, sponges, . . . recruits in the battle against human diseases

Biologically active organic compounds from marine biota have great potential for development as novel drugs. The bio-organic chemistry group at NIO has been striving to find such compounds in collaboration with scientists from sister CSIR institutions (Central Drug Research Institute, Lucknow and Indian Institute of Chemical Technology, Hyderabad) and the Institute of Chemistry of Molecules of Biological Interest, Council of National Research (CNR), Italy.

The mangrove *Acanthus illicifolius* has shown that it has properties beyond those usually associated with it such as analgesic and anti-inflammatory activities. Two of its methanolic extracts showed analgesic and anti-inflammatory activities. The sedate gorgonian *Echinomuracea splendens* also showed bioactivity in its larvicidal properties. These are under extraction and isolation. The sponge *Acarnus bicladotylota* and red alga *Chondria armata* showed up novel fatty ester and an orange-red pigment caulerpin usually found in green algae. Lastly, the nudibranch *Jorunna funebris* showed that its skin and mucus were active against various human cancer cell lines.



Mangroves - lot more to know.

engineering & technology tapping the potential



Mussel hydrolysates promise a new range of drugs

Potentially bioactive molecules are numerous in the marine environment, and green mussels appear to be one of the more promising sources.

Extracts of the black clam *Villorita cyprinoids*, mud clam *Polymesoda erosa* and giant oyster *Crassostrea gryphoides* showed strong antiviral activity against Influenza virus strain A (Mississippi/85/HN) and B (Harbin/7/94). Trial treatments of STZ diabetic mice with hydrolysates of mussel *Perna*

viridis showed a decrease in blood glucose levels by more than 50% and a restoration of normoglycemia. What is more interesting is the anti-HIV properties of this extract. Though there is still a long way to go it does seem that, useful biomolecules will ultimately become available from the sea.



Green mussels - yet to reveal full potential.

Patents

Composition containing novel compound Corniculatonin having antifungi properties and a process for preparing the same - S. Wahidullah, S.H. Bhosale & M.L.D. D'Souza (NF-18/01) USA & PCT.

Bioactivity of methyl palmitate obtained from a mangrove plant *Salvadora persica* L. - U. Goswami & N. Fernandes (NF-264/00) PCT. Biologically active chloroform fraction of an extract obtained from a mangrove plant *Salvadora persica* L. - U. Goswami & N. Fernandes (NF-264/00) PCT. Biologically active aqueous fraction of an extract obtained from a mangrove plant *Salvadora persica* L. - U. Goswami & N. Fernandes (NF-264/00) PCT.

A composition for treating white spot syndrome virus (WSSV) infected tiger shrimp *Penaeus monodon* and a process for preparation thereof - U.M. Desai, C.T. Achuthankutty & R.A. Sreepada - (NF-316/00) USA.

An improved process for the preparation of Tachypleus Amoebocyte Lysate (TAL) useful for detection of pyrogens in vitro - A. Chatterji (NF-235/97) India.

Process for the cure and control of diabetes mellitus using natural products from *Perna viridis* - R.R. Bhonde & A. Chatterji (NF-135/2001) USA (provisional).

Indian green mussel (*Perna viridis*) as a source of anti-HIV activity - D. Mitra & A. Chatterji (NF-137/2001) USA (provisional).

Novel terpenoid glycosides from the sea cucumber *Telenata ananas* and their use as inhibitor of CC Chemokine receptor-5 - V.R. Hedge, T.M. Haiyan Pu. M. Patei, P.R. Das, N. Vantuno, P.S. Parameswaran & C.G. Naik (USA provisional).

Antitumor activity of Jorumycin from *Jorunna funebris* - S. Wahidullah & C.G. Naik (Filed by Italian counterpart) PCT.

Ten organisations are involved in this national effort of investigating marine biota for their drug potential. The flora and fauna collections are preserved and housed in the institute's taxonomy reference centre.

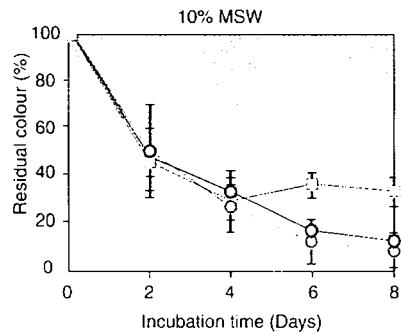
Bleaching makes better sense

A marine fungus can decolourize the molasses spent wash and de-toxify it too !

Molasses spent wash (MSW) is the main effluent from alcohol-producing distilleries that use sugarcane molasses as the raw material. The dark-brownish MSW, when released into receiving waters, increases turbidity, reduces light penetration and thus, reduces the overall biological productivity. It is also toxic and can cause liver damage in fish.

Biotechnologists at NIO have obtained from sea grass detritus an isolate of white-rot fungus *Flavodon flavus* (NIOCC isolate #312) that not only decolourizes the MSW but also reduces its phenolic content by 50% and thus reduces its toxicity in the environment. The novelty of this fungal isolate is that it can decolourize the MSW even under marine conditions.

This isolate could decolourize even primary and secondary treated molasses spent wash, demonstrating a capability to grow in low nutrient and low organic matter situations. The process of using this isolate to decolourize and detoxify the MSW has been patented in India and USA.



Decolourization of molasses spent wash (MSW) used at a concentration of 10%, in \square malt-extract medium \circ low-nitrogen medium \triangle low-nitrogen medium with seawater.



Testing several effluents, this time molasses spent wash.

engineering & technology biotechnological applications

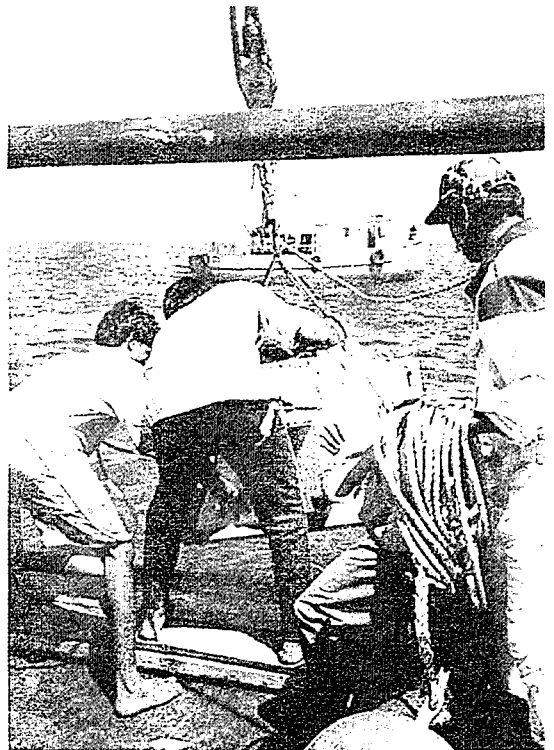


Breakwater layout

Use of models have helped expeditious execution of coastal engineering projects

Gangavaram Port breakwater design

Selection of proper alignment is a significant step in the functional design of breakwater which in turn can be decided through wind-wave diffraction studies. Towards this objective, a model was developed for the determination of diffraction coefficients for given environmental settings. Available data on physical, meteorological and topographical parameters were used in the model for the analysis of the diffraction pattern for coastal waters off Gangavaram, east coast of India. The results made it possible to suggest a suitable layout of the breakwater for the Gangavaram Port.



Oceanic life offers a potential source for industrially useful organisms. Efforts are diverted towards identifying such species, their specific uses and cultivation.

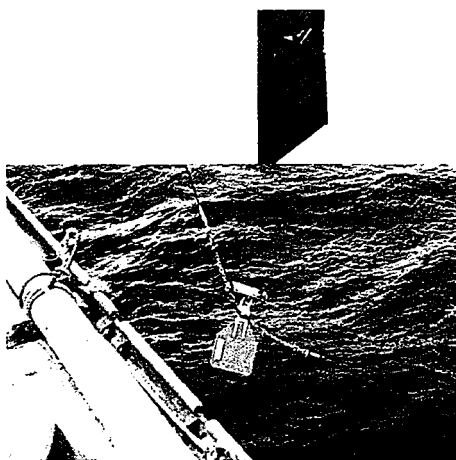
Enhanced Ocean Observing System

NIO, with support of the Department of Ocean Development (Govt. of India), operates an Ocean Observing System (OOS) to routinely observe the North Indian Ocean. The system consists of four components, namely. XBT-surveys using ships of opportunity, data collection using drifting buoys, moored-buoys deployed in the equatorial Indian Ocean, and routine meteorological observations using research vessels. The OOS also supports data analysis of historical data and participation in data collection under ongoing national and international programmes.

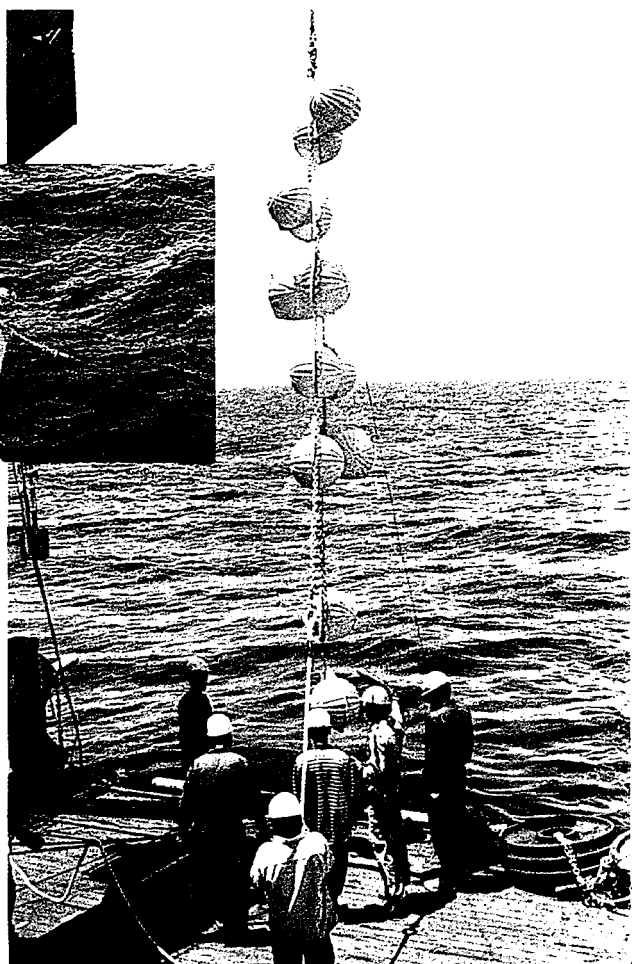
A major milestone for physical oceanographic capability of NIO this year was demonstration of the ability to deploy and retrieve deep-sea moorings:

A mooring at 93°E on the Equator, with Recording Current Meters (RCMs) at the depths of 100, 200, 500, 1000, 2000 and 4000 m was successfully deployed, retrieved and re-deployed during the year. A second deep-sea mooring was deployed on the Equator at 83°E during December, 2000. ORV Sagar Kanya was used in both the operations. In addition to the currents, each mooring had temperature and salinity sensors for time-series measurement. The mooring at 83°E also had an upward looking Acoustic Doppler Profiler (ADCP) to record currents in the top 100 m. It is proposed to use both these mooring monitor currents in the equatorial Indian Ocean.

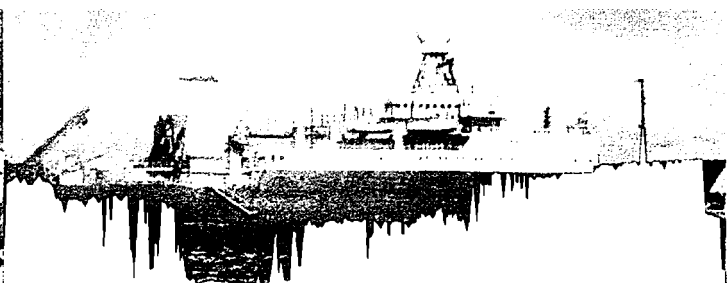
Deployment and monitoring of Lagrangian drifters continued this year. In addition, all available data on drifters in the tropical Indian Ocean were analyzed to document monthly-



Deployment of deep sea current meter mooring.



ocean processes & resources
networking



mean circulation and characteristics of inertial currents in the tropical Indian Ocean:

Shenoi et al. (1999) found that all major features of seasonal circulation observed and confirmed by various models are reproduced in the monthly-mean circulation patterns based on the surface drifters.

In addition, the features such as the widening of the Equatorial Jet in the eastern equatorial Indian Ocean and the westward flow at the equator during July-August reported by the theoretical models, but not observed earlier, were also confirmed through observations.

A comparison of surface currents derived from the buoys with the seasonal mean dynamic topography showed that many current systems (Southwest Monsoon Current, North-east Monsoon Current, Somali Current etc.) are not in balance with geostrophy. The distribution of kinetic energy obtained from the surface velocities suggest that the western boundary along the coast of Africa acts as a source of energy and the northern Arabian Sea, northern Bay of Bengal, and the regions south of 20°S act as sinks. The proximity of the equatorial wave-guide allows the energy to propagate away from the western boundary in the form of equatorial Kelvin waves.

cruises 193 (13-28 March 1988) and 200 (23 August to 7 September 1988) of R.V. *Gaveshani*. Five hydrographic sections were covered during both the seasons and were examined for response to meteorological forcing. Differing scales and intensities in coastal upwelling were documented through the analysis of the data collected along the 5 sections. At all the sections, a decrease in water temperature and an increase in salinity from the offshore stations to the stations closest to the shore indicated coastal upwelling. The influence of the upwelled water could be seen upto a distance of 28 to 53 km from the coast along the sections during the premonsoon season and to a distance of 35 to 46 km during the southwest monsoon season. Variations in the intensity of along shore wind velocity affected the structure and intensity of upwelling off the central east coast of India.

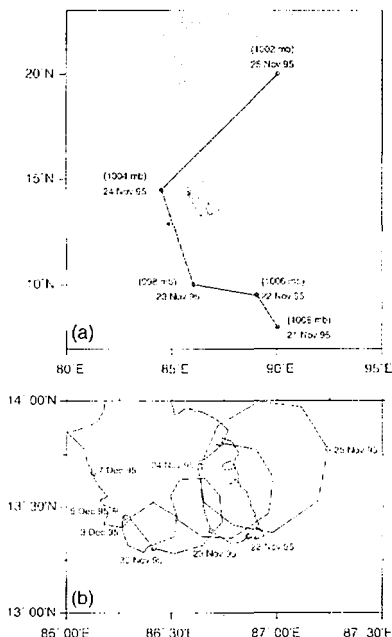
And, some new light was shed on a historical study.....

Col. S.G. Burrard, then Head of the Survey of India, following a careful spirit-leveling across the Indian subcontinent as a part of the Great Trigonometric Survey of India (1858-1909), noted that the sea-level is higher along the east coast of India than along the west coast. Shankar and Shetye (2001) have now shown that this difference arises due to two primary factors: mean winds that impose a northwestward stress on the North Indian Ocean and lower salinity in the Bay of Bengal due to high runoff and precipitation in the bay.

Saji et al. (2000) found that significant amounts of energies are found to be present in the inertial currents in the tropical Indian Ocean. These circular and highly intermittent flows contribute up to 46% of the total kinetic energy of the surface flow field. Inertial activity, triggered by the passage of atmospheric disturbances or by local fluctuations of atmospheric pressure (winds) dissipate within 4 to 5 inertial cycles. Cyclonic storms induced inertial events at locations as far as 300 km.

Recent times have seen considerable focus on the Bay of Bengal because of its importance in sustaining the Indian Summer Monsoon. Historical data in our archives continue to provide food for thought on the peculiarities of the bay:

The spatial distribution of upwelling along the central east coast of India (13° - 18°N) in the premonsoon and southwest monsoon seasons was described using data collected during



Trajectory of the buoy during the passage of a cyclone over the Bay of Bengal. The track of the cyclone is also shown. The numbers in the parentheses indicate the pressure drop during the movement of the cyclone.

While coastal seas around us are our sole responsibility, the open ocean in contrast can be more effectively studied in collaboration with neighbours and the international community.

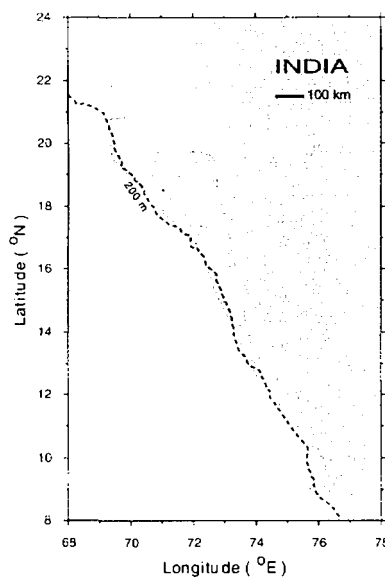
Keeping an eye on the Chemistry of the waters

Seasonal anoxic conditions intensifying

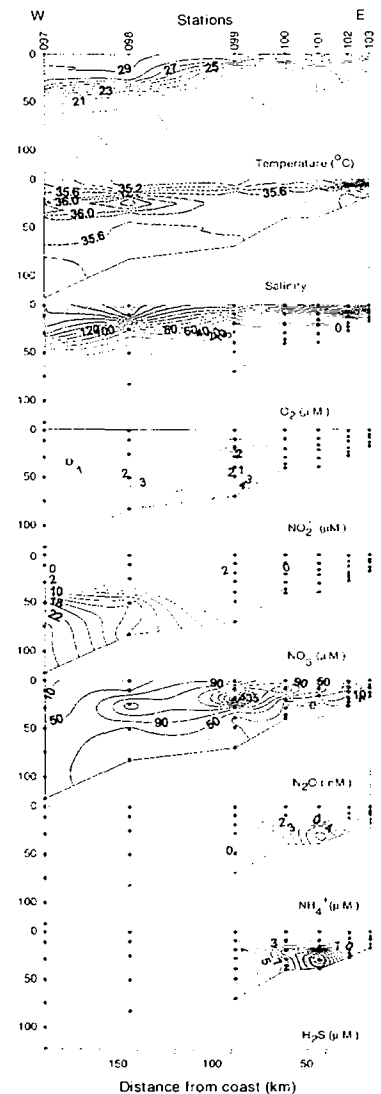
Nearly anoxic conditions are seasonally triggered by upwelled water over western Indian continental shelf resulting in intensification of the emission rate of nitrous oxide in recent years. Nitrous oxide, one of the more potent green house gases responsible for global warming, is produced as a consequence of algal blooms brought about by nutrient abundance in coastal waters. Upwelled waters rich in nutrients are further enriched by monsoonal land runoff. Algal blooms deplete the oxygen, leading to nearly anoxic conditions (<0.5 ml/l) in shelf areas of about 180,000 sq. km making it the largest coastal hypoxic zone in the world.

Close monitoring since 1995, by SWA Naqvi and his team, revealed that conditions were severe in 1998 and 1999 leading to total exhaustion of oxygen, affecting the demersal fish catch.

It is not clear whether the observed intensification of the coastal oxygen-deficient environment has been due to eutrophication (increased inputs of nitrogenous fertilizers from land) or a change in hydrography, but the enhanced efflux of oceanic nitrous oxide may lead to a degenerative cycle: increased global warming, potentially stronger monsoons, an increase in the nitrogen-laden runoff from land, coastal eutrophication, and still higher production of nitrous oxide.



Zone of severe hypoxia during September-October, 1999. Shown by shaded region between coast and 200 m depth.



Distribution of properties along the cross-shelf transect off Bombay.

ocean processes & resources monitoring for better understanding



Probing Geological Processes

The phosphorite story : Is the "present key to the past" ?

Studies carried out on the Quaternary phosphorites of the continental margin off Chennai indicate that the bottom dwelling microbial mats which thrived on the shallow shelf during the low sea level conditions are responsible for phosphatization. Bacteria associated with the decaying microbial mats utilized phosphorus supplied by continental sources and rapidly precipitated phosphate. The availability of a high percentage of phosphorus in seawater seems to be an important controlling factor in the formation of phosphate stromatolites. The composition of these phosphorites differs from modern phosphorites in upwelling regions, but are similar to the ancient Cambrian (~500 Ma) apatite stromatolites. This constitutes evidence that they could have formed under similar conditions. More importantly, this similarity also gives us a valuable insight into the environment of formation of ancient phosphate deposits. While it has been the majority opinion that modern phosphorites are of inorganic origin, our study reveals that the *microorganisms are the key players in both modern and ancient phosphatic deposits.*

The organic carbon debate : New inputs

The importance of understanding the organic carbon accumulation can never be overemphasized considering its pivotal role in petrocarbon accumulation, biogeochemical cycling of carbon, and the food chain. Debate over the years has focussed on whether anoxia or productivity, controls the accumulation of carbon. In recent years the more popular views consider both of these processes in combination to be responsible. But there are other players too.

Rao and Veerayya investigated sediments from the western margin of India and found higher values of organic carbon in the topographic highs when compared with the deeper areas. Their work suggests, topography along with other minor factors such as sedimentation rates, grain size, bacterial degradation, and sediment mixing are also important factors in controlling organic matter accumulation and should be part of genetic modeling.

Deep sea mining simulation : the effects are mixed

Deep sea mining, especially in international waters, has far reaching implications for the local ecosystem

and the risk of causing harm to the coastal areas of adjoining countries. The deleterious effects of the discharges are an unknown entity. The Indian Pioneer Area for manganese nodules exploration in the Central Indian Ocean Basin has been chosen for an experiment involving churning deep seafloor sediments with a Deep Sea Sediment Resuspension System which ploughed the top few cm of the seafloor sediment at water depths >5200 metres. The ploughed material was fluidized and discharged at a height of 5 metres above the seafloor. Three thousand five hundred tons of material was excavated and released in the benthic environment. This constitutes the microcosm of a mining operation.

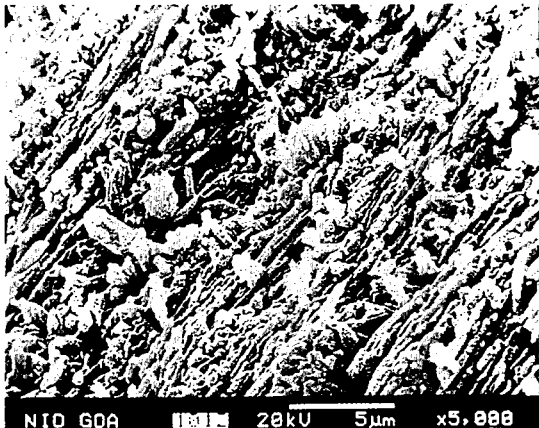
Effects studied immediately after this disturbance were those that impacted the water column, benthic ecosystem (molecular to mega faunal levels), biogeochemistry, nutrient behaviour, engineering properties of the seafloor, sediment dispersal patterns, bottom currents, biostratigraphy, sedimentology and geochemistry.

The preliminary results are a mixed bag : reduction in the benthic biomass and microbial biomass is countered by an increase in biogenic elements - a food source.

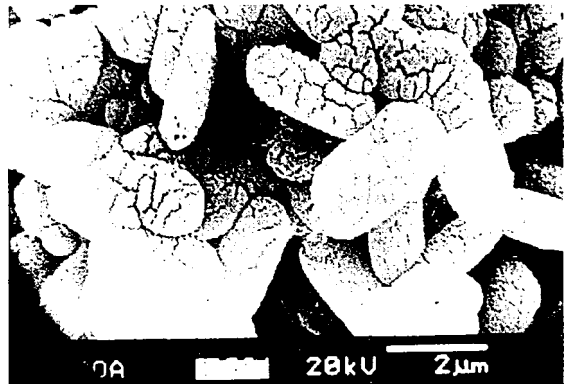
The results were published in a special volume of Marine Georesources and Geotechnology.

The oceans exert an important influence on earth's climate. To this end. "Global change" studies at the institute focus on understanding present day climate trends with reference to past climatic fluctuations.

Do all geochemical tracers trace ?



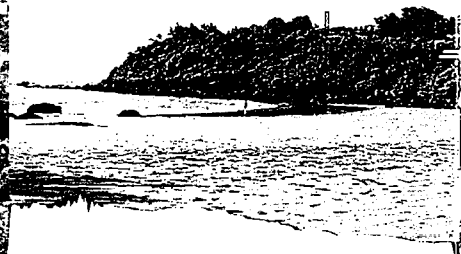
Phosphatized microbial mats.



Phosphatized bacteria.

Many geochemical tracers are used to unravel the sedimentation history, provenance, tectonic setting of the ancient sedimentary sequences and sedimentary rocks. These methods are at best indirect. The ideal conditions for understanding these processes would be to have the presence of all three : sediment source, the transportation medium and the depositional environment. This would enable changes that take place from source to the depositional environment to be monitored. A modern setting where all three are present is the southwestern

margin of India. In a study carried out on the sediments from this area, geochemical tracers such as zirconium, hafnium and thorium behaved ideally and conformed to their usage globally. However, discriminants such as cobalt, chromium and uranium have been found to undergo changes during the sedimentary process. This poses a question as to their reliability as geochemical tracers especially for ancient rocks and sediments.



Outreach activities

Communication events

Such events are the platforms for exchange of ideas and an opportunity to discuss future directions. This year we had the privilege to host PORSEC-2000.

The institute organised a four-day International Ocean Remote Sensing Conference (PORSEC-2000) from 5-8 December, 2000. The theme of the conference was "*interdisciplinary multi-sensor studies of the world oceans*" and was attended by 262 scientists from all over the world who deliberated on 175 technical papers.

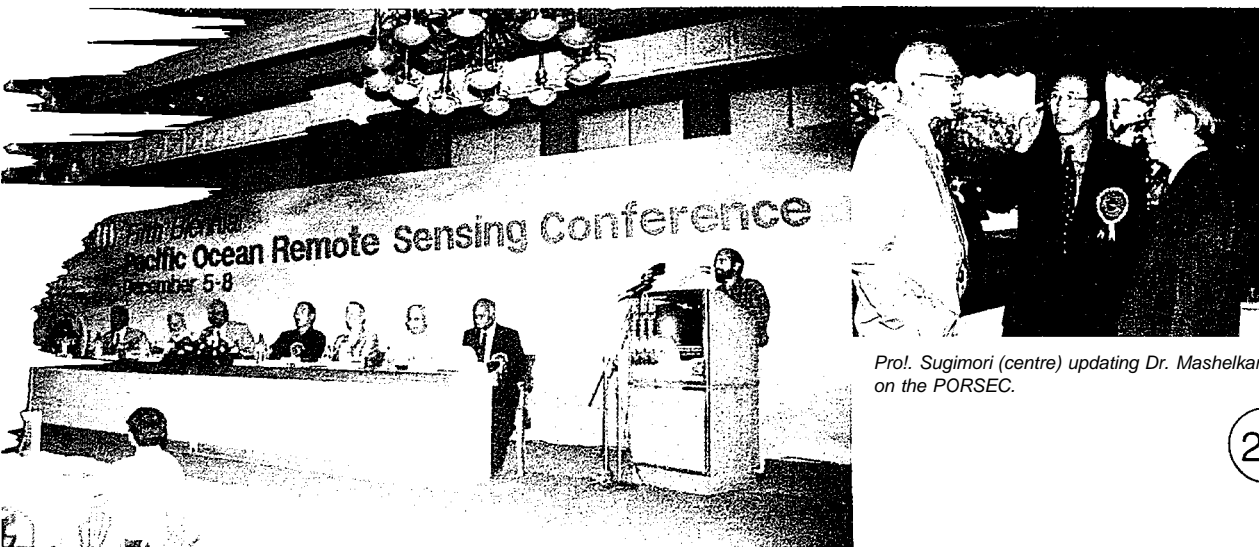
Inaugurating the conference, Dr. R.A. Mashelkar, Director General of CSIR thanked the Organising Committee for bringing PORSEC to India, for the first time outside the Pacific Rim countries. He also lauded the efforts of ISRO for boosting the Indian space programme by launching several satellites. He saw a greater role for the global ocean research community in prediction of the monsoon and environmental monitoring.

Prof. Yasuhiro Sugimori, the President, PORSEC said that the rapid progress in remote sensing has made it necessary to study all the oceans as one for better understanding. He remarked that the Indian Ocean has conditions similar to those in Pacific and Atlantic Oceans and PORSEC can help India with the data available with it for use in various fields of research.

Dr. E. Desa, Director, NIO, pointed out that the Indian Ocean is an important player in the control of monsoons and remote sensing was a cost-effective tool in observing its onset and passage. Collaboration between the remote sensing and observation committees would catalyse efforts in evolving solutions, he added. India's progress and future programmes in space research were presented by Dr. Rangnath Navalgund from ISRO, Bangalore.

Two volumes of the PORSEC 2000 proceedings edited by NIO editorial committee were also released during the conference.

Prior to the PORSEC-2000, a 3-day International Training Course on "Ocean Remote Sensing" was organised from 1 to 4 December, aiming at equipping Indian Ocean rim countries to build up capabilities to utilize the vast potential and opportunity of ocean remote sensing. In all 28 participated in the programme. The faculty was drawn from SAC (Ahmedabad), NRSA (Hyderabad), NIO (Goa), IIRS (Dehradun) and ISRO (Nagpur). Dr. S. Prasanna Kumar coordinated the programme.



Prof. Sugimori (centre) updating Dr. Mashelkar on the PORSEC.

MoU with JAMSTEC

The NIO and Japan Marine Science Technology Agency (JAMSTEC) entered into Collaborative Research Programme in Ocean Sciences. A Memorandum of Understanding to this effect was signed on 31 May 2000 as a outcome of two-days meet at NIO. A four-member Japanese delegation headed by Dr. Hiroshi Hotta, the Executive Director of JAMSTEC and NIO scientists had scientific presentations and discussions on various aspects of climate related ocean research.

The information generated would also form inputs to the ongoing international programmes on Indian Ocean Observing System under Global Ocean Observing System (GOOS). The signatories have agreed to make the data available not only to the weather forecasting agencies but also to other scientific community for research purpose.

Understanding climate variability is one of the thrust areas of NIO's research and The data on atmospheric and oceanic parameters in the upper 750 m from the JAMSTEC TRITON buoys would be invaluable in this respect, as it would supplement the data that are being acquired since February from the subsurface current meter moorings deployed by NIO in the eastern Equatorial Indian Ocean region.



CSIR, NIO & JAMSTEC signatories.

Indo-Italian programme

An Indo-Italian Workshop was organized at NIO on 14-15th March, 2001, to assess the work done in three years under the project "Bioactive metabolites from Opisthobranch molluscs based on their defensive mechanism and their chemical ecology". A proposal for extension of the project for another 3 years has been communicated to CSIR for approval.

BOBMEX - Initial results

A national workshop on "BOBMEX - Initial Results", sponsored by the Department of Science & Technology, New Delhi was conducted during 15-16 February 2001. Besides NIO, participants from IISc, Bangalore, IIT (Delhi), NCMWRF, New Delhi, IITM, SAC, Ahmedabad, SPL, Trivandrum, NPOL, Kochi, NIOT, Chennai, Andhra University and Cochin University attended the workshop. More than 30 scientific papers were presented in three

major areas: Atmospheric Dynamics, Air-Sea Interaction and Ocean Processes. A special lecture on Indian Climate Research Programme (ICRP) in general; and on the Bay of Bengal Monsoon Experiment (BOBMEX) in particular was delivered by Prof. D.R. Sikka, Chairman, DST/PAMC. Keynote addresses were given by Dr. R.R. Rao, NPOL, Kochi, Mr. S.R. Kalsi, IMD, New Delhi and Dr. P.V. Joseph, Emeritus Scientist, CUST Kochi.

Shri L.V.G. Rao, Principal investigator BOBMEX-Ocean Component, welcomed the participants. Opening remarks were made by Dr. P.C. Pandey, Director, NCAOR/DOD and Dr. P. Sanjeeva Rao, Scientist, DST, New Delhi. Dr. E. Desa, Director, NIO inaugurated the workshop.

Towards sustaining fishery Resources

A two-day Workshop on "Sustainable Fishery Management in Goa" (11-12 October, 2000) was inaugurated by the Governor of Goa, Shri Mohammed Fazal. Experts from FAO, CMFRI, FSI, NABARD and NIO participated in theme presentations and a brain storming session. Representatives of fishery co-operatives, traditional fishermen, NGO's and other local groups were involved in discussions. Regulation on the fishing season was considered to be one of the options to conserve and manage fishery resources.

Shri Fazal called for strong measures and efficient management plans to control and regulate fishing activities in Goan waters. He appealed for a wider co-operation amongst scientists, managers, fishing industry, NGOs and also the government to achieve the objectives of a fishing ban period. Dr. Martosubrato of FAO remarked that fishery management in South and Southeast Asia dealt with common problems in fisheries and therefore an efficient management is required for fisheries in India.



Dr. Desa, Director, NIO welcoming the Governor and the participants.

Suggestions and recommendations evolved during the workshop will form a basis of advisory in formulating a fishery policy for sustainable fisheries in Goa.

Supporting basic research in Universities

The policy of our parent body, CSIR has been to support basic research programmes in universities. A two-day seminar on "Supervision of Research in Universities" was organised by the Association of Indian Universities (AIU) from 17-19 Aug. in collaboration with the NIO and Goa University. In his inaugural address, H.E. Shri Mohd. Fazal, Governor of Goa & Chancellor of Goa University, remarked that university education brings about positive changes with changing socio-economic needs. Universities had a primary duty to bring about a synthesis of past and future to improve the quality of teaching and research and promote a scientific outlook in meeting emerging problems. Prof. B.S. Sonde, Vice-Chancellor, Goa University, in his presidential address said that Universities have gained considerable experience in scientific research, however, one needs to prepare for the anticipated major changes of the 21st century.

Welcoming the participants, Dr Ehrlich Desa, Director, NIO said that CSIR's strategy has been to support basic research programmes in universities, It also supports programmes that foster innovative ideas under "New Idea Fund Scheme".

Patent awareness increased

A national workshop on "Patent Information for HSD and Industry" was organised by the Intellectual Property Management Cell of the NIO in association with the National Information System for Science & Technology of the Department of the Science & Technology on 11 -12 January 2001. About 40 participants representing industries, national research laboratories and educational institutions attended the workshop.

The workshop covered basic concepts of patent information, sources of patent information, search methodologies, patent information as a strategic R&D tool, case studies, etc. Various patent search methodologies including online search were demonstrated to the participants. The experts included. Dr P.P. Paranjpe (Patent Information System, Nagpur), Dr. Ruchi Tewari (Patent Office, Mumbai), Mr. N.V. Sathyanarayana (Informatics India Ltd., Bangalore), Dr V.K. Gupta (NISTADS, New Delhi) and Dr. R.K. Gupta (IPMD, CSIR).

Exploring Trends in Ocean Sciences in 21st Century

A 2-days National Workshop on trends in Ocean Sciences in 21st Century (TOS2K+) was organized by our Regional Centre, Visakhapatnam on 25-26 Sept. 2000 to commemorate the Silver Jubilee of the Centre (1976-2000). The workshop was inaugurated by Mr. K. Ratnaprabha, IAS, Development Commissioner, Visakhapatnam Export Processing Zone. The inaugural function was followed by a lecture by Dr. E. Desa, on "Gas Hydrates - A potential fuel resource" under S. Balakrishna Endowment Lecture organized by Andhra Pradesh Academy of Sciences.

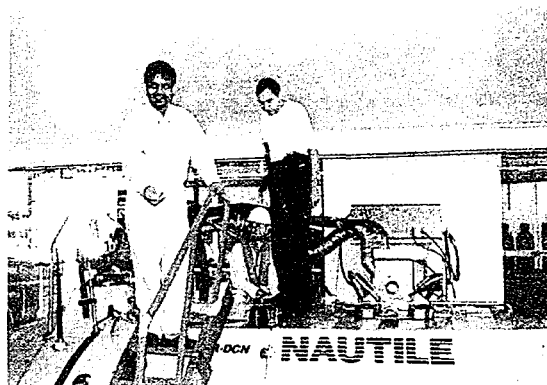


VIPs on dais, Dr. KSR Murty regional centre in-charge is seen on the left.

About 36 lectures covered a variety of topics in ocean sciences. Souvenir volume containing abstracts of 47 invited lectures was released by Prof. P. Sambandhan, Director, NSDR, Visakhapatnam.

Our colleague Dr. Chaubey dives in the Indian Ocean

Dr. Anil Kumar Chaubey became the first Indian scientist to dive in the Indian Ocean, to a depth of 2400 m, onboard the French submersible, NAUTILUS. Participants from different countries, onboard the French vessel L'ATALANTE, surveyed the Central Indian Ridge (CIR) diving down this 0.78 million year old area on the western flank of CIR, to make observations on geological aspects. Dr. Chaubey in his 5 hour dive covered a horizontal distance of 4.5 km. He collected data on recent magnetic anomalies, searched for hydrothermal sources and collected rock samples for dating and magnetic property determination.



Dr. Chaubey (on left), next dive

More information on the activities during the year visit

www.nio.org

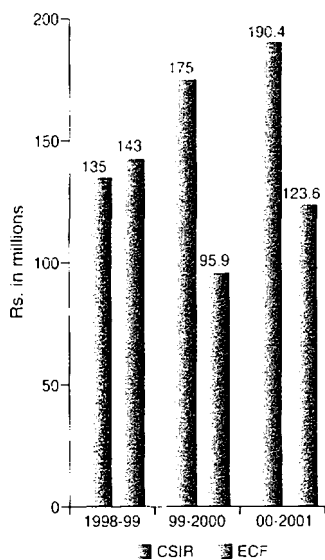
For a copy of CD:

Director
National Institute of Oceanography
Dona Paula, Goa - 403 004, India

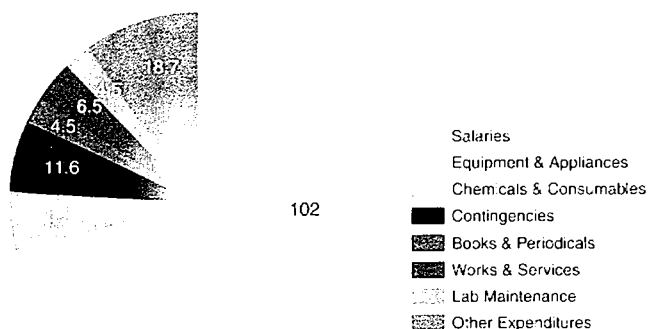
ehrich@darya.nio.org

Finances & Human Resource

Finances



CSIR budget allocation vis-a-vis External Cash Flow (ECF).

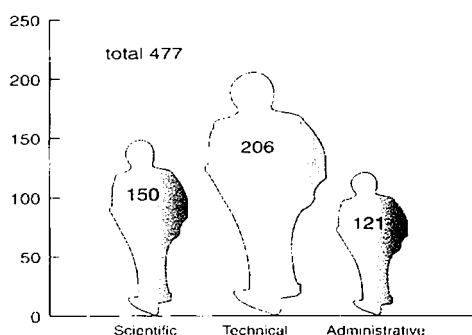


Expenditure break-up (Rs. in millions) (for the year 2000 - 2001)

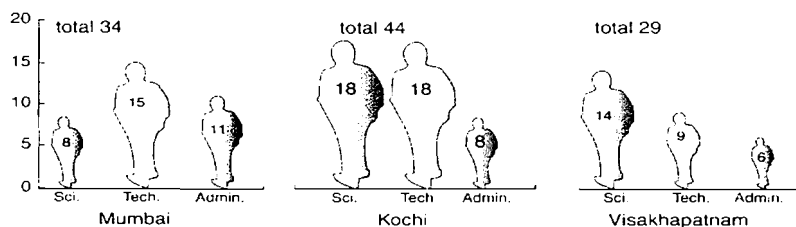
Human Resource

The total staff strength as on 31 March 2001 was 584, comprising 190 scientific, 248 technical and 146 administrative personnel.

Head Office, Goa



Regional Centres



DIRECTOR

Dr Desa Ehrlich
PA to Director
 Mr. Simon TP

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Asst Exe. Engr. - Assistant Executive Engineer

AO - Administrative Officer

Doc Off. - Documentation Officer

MO - Medical Officer

Sr. F&AO - Senior Finance & Accounts Officer

Sc - Scientist

TO - Technical Officer

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CSIR Inc.

Our core values

We believe in

- Team CSIR as a part of Team India
- Transparency and openness
- Adding value to the lives of Indians

We strive for

- Excellence in everything we do
- High science with high technology
- Customer satisfaction

Qualities that distinguish us

- ▲ Innovation
- ▲ Compassion
- ▲ Passion

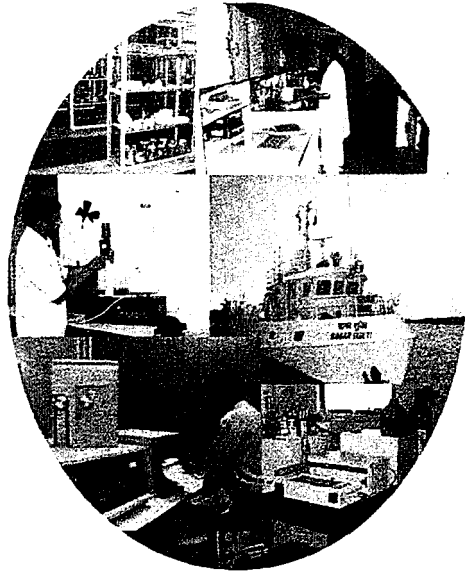


facilities

The institute has well-equipped laboratories and modern communication (Local Area Network) with distributed computing facilities. It has been recognised as a Responsible Oceanographic Data Center by the Intergovernmental Oceanographic Commission (of UNESCO) catering to the information needs of organisations within the country and to those in countries bordering the Indian Ocean.

The institute has a well developed library and information service facility and high speed internet connectivity.

Coastal Research Vessel *Sagar Sukthi*, a recent acquisition of the institution, is equipped with state-of-the-art technology for coastal studies



expertise

Environmental Impact Assessment (EIA)

- Effluent discharge
- Port & Harbour development
- Offshore stockyard & berthing
- Water intake for power plants
- Single Point Mooring & Jetties

Geological & geophysical surveys

- Bathymetry
- Seismic profiling
- River dredging
- Submarine pipeline routing & inspection

Engineering

- Jetty construction
- Wave & Current measurements
- Erosion control

services

The Institute undertakes contract research projects and offers advisories to varied agencies on aspects of coastal zone development, seabed exploration, pollution control, technology development and in other areas of marine sciences.

clientele

- Oil & Natural Gas Agencies
- Chemical & Fertilizer industries
- Oil Refineries
- Indian Navy
- Thermal Power producers
- Shipyards & Harbour works
- Lake Development Authorities
- Beach Resorts

Head Office

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Dona Paula, Goa - 403 004. India

S : 91-(0)832-2456700

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URL : <http://www.nio.org>

Regional Centres

Mumbai, Kochi, Visakhapatnam

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