1. INTRODUCTION

The need to develop capacity in collection, analysis and distribution of data and information from the oceans and all seas was one of the components of Chapter 17 Agenda 21 of UNCED. This was to be done through strengthening of national scientific capabilities for data collection and analysis, creation of national databases, linking of these databases to existing data and information services and mechanisms, and cooperation with a view to the exchange of data and information and its storage and archiving through global and regional data centres. This strategy is perfectly in line with the IODE programme.

It has been observed that the participation of IOCINCWIO Member States in IODE programme activities is minimal: no NODCs or RNODCs have been established in this region; only one DNA is registered in Tanzania. At the Third Session of IOCINCWIO, held in Mauritius in December 1992, it was noted that regional capabilities to interpret and use the results from large scale experiments like TOGA and WOCE are very limited. The Regional Committee identified a need to enhance this capability and train human resources to both use the data and interpret the results so as to provide advice on actions to the governments. RECOSCIX-WIO was identified as a centre through which such data could be delivered.

It is stated that, in order to ensure increased participation of IOCINCWIO Member States in the IODE programme, two major activities have to be undertaken: (i) strengthen national capabilities and assist in the development of NODCs; (ii) develop a regional data and information network for the IOCINCWIO region.

It is noted that a regional information exchange network is already operational through the RECOSCIX-WIO (Regional Co-operation in Scientific Information Exchange in the Western Indian Ocean region) project. The existing network can be adapted to include data exchange.

In response to the request formulated by IOCINCWIO-III, the IOC Secretariat has drafted this proposal which is submitted to the IODE Committee. The Committee is requested to consider the proposal and decide on further action.
2. CAPACITY AVAILABLE FOR COLLECTION/STORAGE/ANALYSIS AND INTERPRETATION OF DATA IN THE INSTITUTIONS*1

2.1 COMORES

There is no institution engaged in oceanographic research as such. Several collect data from the marine environment in the course of other projects. These include: Centre National de Documentation et de Recherche Scientifique (CNDRS), Directorate of Environment, Fisheries Department and the Geological Survey department. Shortage of trained personnel is a major hindrance to development of any research/studies capability. CNDRS has been involved in collaborative work with the Oceanography department of the University of La Réunion. They have several PCs (386) but no CD-ROM reader.

2.2 ERITREA

Two institutions are involved in the study of the marine environment: University of Asmara and the Research and Environment Division of the Ministry of Marine Resources. Apart from fisheries statistics, little oceanographic data is available. Both institutions have 286 and 386 PCS. The university's computer section also has several 486 PCs. The University library has a CD-ROM reader which is not functioning. Assistance is required in provision of training for data management, and in identifying and collecting data from Eritrean waters which might be available in other places.

2.3 FRANCE

SISMER - the french NODC is a service of IFREMER for the National Scientific Community, based in Brest. The major activities of the centre are: (i) to design software for scientific data management; (ii) to assist french scientific teams in data management; (iii) to archive data; and (iv) to answer data requests. The centre has developed a TOGA/WOCE upper layer thermal dataset containing worldwide temperature data. It also operates the SISMER SERVER: an information server for information on catalogues, cruises, chief scientists, laboratories, access to data files, software library, data processing, data management, etc. The french NODC operates many data banks. Since 1952, 190 cruises to the Indian Ocean were undertaken. As a result data from these cruises are available. (See also under 4.)

2.4 KENYA

Several institutions are involved in measurement of oceanic parameters. They are involved in various marine science database projects initiated in the region. These include: Kenya Marine and Fisheries Research Institute (KMFRI) - Coastal Atlas database of UNEP, National Museum of Kenya (NMK) - Biodiversity database, Kenya Wildlife Services (KWS), University of Nairobi (UON), Kenyatta University (KU), Moi University (MU), Kenya Meteorological Services, Fisheries Department, Kenya Ports Authority. KMFRI has PCs (386 and 486), and CD-ROM readers. It is involved in a variety of projects within which oceanographic observations are made. KMFRI also has a collection of data collected from international oceanographic expeditions in the Indian Ocean, TOGA data on CD-ROM, and NODC (USA) temperature and Salinity profiles on CD-ROM. The institute has already developed a Coastal and Marine Environment Database within the framework of the UNEP Eastern Africa Coastal Database and Atlas project. KMFRI hosts the Regional Dispatch Centre of the RECOSCIX-WIO project.

2.5 MADAGASCAR

The institutions involved in the study of the marine environment are the Centre Nationale des Recherches Océanographiques (CNRO), Institut Halieutique Science Marines (IH.SM), Institute for Geography and Hydrography (FTM), Centre Nationale de Recherche sur l’Environnement (CNRE).

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*The information was obtained by Mr. M. Odido (KMFRI, Kenya) during his fact-finding mission to Comores, Eritrea, Kenya, Madagascar, mauritius, Mozambique, Seychelles and Tanzania, undertaken between November 1994 and January 1995. Additional information was found in IOC Workshop Report N° 107 (GODAR-III) and from other sources.
FTM has substantial facilities for data management including PCs (486), several Sun workstations, a digitizer, and CD-ROM readers. However, the only oceanographic data which they collect (sea-level) is sent to CNRO for analysis. CNRO has 4 PCs (286 and 386) while IHSM has several 486 PCs. CNRO has a collection of data from international cruises, data from tuna project, etc. Spreadsheet programmes are used for data storage and analysis.

2.6 MAURITIUS

The institutions involved in collection of oceanographic data are Albion Fisheries Research Centre, Meteorological Services and the University of Mauritius. The Meteorological Services keep sea-level and sea-surface temperature (satellite) data. 12 PCs are available (386, 486DX). Neither institution has CD-ROM readers.

Albion Fisheries Research Centre has been collecting oceanographic data regularly (daily) at several locations in Mauritius over the last 3 years. The parameters covered include water temperatures, salinities, pH, BOD. The data is stored using QUATTRO and EXCEL. The project was initiated by ICOD, and CIDA will provide assistance for data analysis at the end of the project. Two PCs are available (386), and a 486 is expected in 1995. The Faculty of Science of the University of Mauritius has been collecting water quality data (dissolved \(O_2\), pH, nitrates, phosphates, coliforms, etc) on a weekly basis for the last 3 years. The faculty has several 486 PCs with CD-ROM readers but has yet to develop a centralized data archiving system. Both the TOGA dataset and OceanPC software are available, but are not in use.

2.7 MOZAMBIQUE

The institutions involved in oceanographic data collection are Instituto de Investigacao Pesqueira (IIP), Instituto Nacional d’Hydrografia e Navigacao (INAHINA), Eduardo Mondlane University and to some extent the Environment Ministry. IIP has PCS and a CD-ROM reader. It also has a good collection of data from international expeditions. INAHINA is involved in collection of bathymetric and sea-level data. There are 6 PCs (486) but no CD-ROM reader.

2.8 SEYCHELLES

The national institutions involved in ocean data collection and archiving in Seychelles are: Seychelles Fishing Authority (SFA), Brigade Hydrographic, Department of the Environment, and the Meteorological Department. A fair amount of fisheries data is available. The quality of oceanographic data is good with few gaps since 1992. The lack of personnel is a major problem in Seychelles. SFA and DOE have PCs (286 and 386 for SFA and 486 for DOE) but no CD-ROM readers. Seychelles participates in regional programmes.

The ORSTOM branch, hosted by SFA has substantial data holdings. They have also developed software and data products (see also under regional initiatives).

2.9 SOUTH AFRICA

South Africa has identified a NODC at the South African Data Centre for Oceanography (1995). The South African Data Centre for Oceanography (SADCO) archives marine data within its target area (the southern hemisphere between 30°W-70°E), and disseminates this data mainly to the organizations providing financial support for the data centre’s existence (including virtually all the marine scientists of South Africa and Namibia). The data are mainly physical (sea temperature from XBT, CTD, etc., salinity, nutrients) and a large amount of sea-surface observations (from voluntary observing ships).

The largest producer of ocean data is the Sea Fisheries Research Institute in Cape Town, but most of their data are from the Atlantic ocean. All oceanographic data collected by South Africans in the adjacent oceans as far north as the equator is eventually and in principle housed in SADCO where it can be interactively accessed through Internet. Tidal data are kept by the Hydrographic office of the South African navy.
Tanzania has identified a DNA at the Ministry of Natural Resources, Tourism and Environment (1971). This Ministry includes Tanzania Fisheries Research Institute (TAFIRI), Tanzania Fishing Co-operation, Zanzibar Fishing Co-operation, Fisheries Training Institutes, Fisheries Division (Fisheries Statistics Section, Zanzibar and Dar-es-Salaam), National Environment Management Council (NEMC), and National Meteorological Department. There are also the Ministry of Science and Technology and University of Dar-Es-Salaam which includes the Institute of Marine Sciences (IMS). Most of the data is held by individual scientists. Apart from the Fisheries department, none of the institutions has a centralized data storage system. IMS has 8 PCs (286 and 386), but no CD-ROM readers.

3. GENERAL CONCLUSIONS ON DATA AVAILABILITY IN NATIONAL INSTITUTIONS*

The oceanographic data available in the different institutions in the region vary widely in volume, type and quality. They range from data collected in programmes lasting as short as one day to long-term programmes going on for years. They include data collected in inshore, coastal and even deep sea during international expeditions. The data can be categorized as (i) data stored by individual scientists (usually in hard copy, diskettes or computer hard disk); (ii) data in report form (usually available in the libraries of the institutions); (iii) data stored in institutional data bases; and (iv) data acquired from international centres.

The first category of data is by far the most common. A lot of data are collected by scientists either for preparing a publication or writing a dissertation. Unfortunately, most of the data are lost when the scientists leave the institutions or discard the data after using them for the purpose for which they were collected. There are also scientists who have taken measurements of some parameters for long periods but do not know what to do with the data. Such scientists usually fear to part with their data because other people might use these before them. Data available in report form are mostly collected within the framework of multi-disciplinary programmes involving several scientists, or cruise reports from international expeditions undertaken within the region.

A few of the institutions have electronic databases. These however, contain only a small fraction of data available in those institutions. The databases are usually in a spreadsheet format (LOTUS) or DBASE. None of the institutions is using the OceanPC software.

The most widely and readily available data in the institutions visited are fisheries statistics and meteorological data. In all the countries, measurements of atmospheric parameters are carried out on a regular basis for weather predictions. All the countries have set up weather stations for this purpose. The data collected are transmitted to World Data Centres and also stored locally, either in hard copy or electronic format. All the countries also have in place a system for collecting fisheries statistics for both artisanal and commercial fish landings. Some statistical analysis is carried out using software packages from FAO or Association Thonière. Other ocean data like water quality, nutrients, currents, sea-level and waves are available in smaller volumes. Frequently, these data are kept by individual scientists, making it more difficult to assess qualitatively and quantitatively. A few institutions archive these data at institutional level. This is more likely when the data are collected within the framework of multi-disciplinary projects involving several scientists.

Albion Fisheries Research Institute (Mauritius) has started a database using EXCEL with assistance of the Canadian government. Kenya Marine & Fisheries Research Institute (Kenya) is already implementing the Coastal Database and Atlas project of UNEP. Other institutions from the region will be participating in the project from this year (1995). Instituto de Investigação Pesqueira (Mozambique) is trying to establish a database with data collected from various visiting research vessels which have worked in Mozambican waters.

4. ONGOING REGIONAL INITIATIVES ON DATA MANAGEMENT*
Several organizations have developed initiatives for management of data collected from the marine environment in the region. Some of these are described below:

4.1 ORSTOM

By gathering, validating and compiling into standard formats oceanic measurements collected by different institutions from the beginning of this century, ORSTOM has set up 4 oceanographic databases for the Indian ocean. These are:

(i) Oceanographic cruise measurements: consisting of hydrographic stations of cruises carried out in the Western Indian Ocean from 1906. Most of the data are from the WDC-A, Oceanography;

(ii) Vertical profiles of sea temperature: contains temperature profiles from oceanographic cruise measurements - BT, XBT and CTD casts. The data cover the period 1906-1991;

(iii) Sea-surface parameters: contains - ship data transmitted through the meteorological network; from tuna purse seiners; from log sheets and specific forms filled by shipping masters from water samples taken by observers on board purse seiners and analyzed at SFA-ORSTOM laboratory. The data cover 1977-1992;

(iv) Remote sensing satellite measurements: A satellite receiving and processing station was set up in La Reunion under a programme named 'Survey of Environment Assisted by Satellite' (SEAS) in 1989. It archives and processes high resolution data received by the stations antennae (NOAA satellite), or through international remote sensing nets (ERS-1 satellite).

ORSTOM has also developed a software called ‘GAO’ for oceanographic data management combined with mapping and advanced calculations. The package runs under WINDOWS and also works with CROISIERES - a special data format developed by Atelier Informatique, ORSTOM, Brest. ORSTOM, in collaboration with the USA Government, intended to produce a CD-ROM containing the data and a software package. The ORSTOM database and software can be made freely available to scientists working on IOC programmes. ORSTOM staff in Seychelles are willing to provide training on the use of these packages to scientists from the region.

4.2 BIODIVERSITY PROGRAMME

The IUCN Eastern Africa Regional Office initiated the Eastern Africa Marine and Coastal Conservation Programme (EAMCP) in order to catalyze a Western Indian Ocean marine biodiversity programme that would comprise initiatives in coral reefs, threatened species, marine protected areas and integrated coastal zone management. IUCN has worked with several national institutions and international/intergovernmental agencies to implement programmes which include marine data management in the region.

4.3 EASTERN AFRICAN COASTAL DATABASE AND ATLAS PROJECT

The Eastern African Coastal and Marine Environment Resource Database and Atlas is a project co-ordinated and funded by the Regional Seas Programme of UNEP, with support from the leading institutions in the region and the Belgian government. Designed to enhance the achievement of the main objectives of the Eastern African Action Plan, the task of the project will be to collate existing information on natural resources and to summarize this in country map sheets. Information relevant to the country will be stored in a geographic information system (GIS) database, allowing regular updating and handling of queries from regional and national institutions. The individual country sheets will be bundled together into the Regional Resources Atlas for Eastern Africa at a later stage. Work on the Kenyan portion is almost complete. The other countries of the region will be covered between now and 1998.

4.4 EASTERN AFRICA ACTION PLAN PROJECTS EAF 5 AND 6

The Eastern Africa Action Plan, developed in the early 1980’s and adopted by representatives of countries of the region in 1985, provided several activities and actions aimed at improving the management of
the marine environment and resources in countries of the region. Programmes initiated within the framework of the action plan include: EAF5 - Protection and management of the marine and coastal areas of Eastern African region; and EAF6 - Assessment and control of pollution in the coastal marine environment.

Training on GIS and coastal zone management has been provided to institutions in all countries of the region. Equipment - computers and digitizers have also been provided to some of the institutions for developing coastal resources database.

4.5 CELLS FOR MONITORING AND ANALYSIS OF SEA-LEVELS

During the Third session of IOC/INCWIO, a proposal for initiation of a pilot activity on 'Sea-level changes and associated coastal impacts' was adopted. Under this programme Cells for Monitoring and Analysis of Sea-level were to be formed in countries of the region. There activities would be:
(i) Overseeing/assisting in sea-level data collection and data transmission in collaboration with appropriate national agencies; and

(ii) Sea-level data storage and analyses to generate products aimed at understanding the data; and products useful for coastal zone management. The project was launched at a subsequent meeting held in Zanzibar in January 1994.

4.6 REGIONAL CENTRE FOR SERVICES IN SURVEYING MAPPING AND REMOTE SENSING

The centre which began operating in 1975 is an intergovernmental institution operating under the auspices of UNECA and OAU mandated to serve 22 countries in the subregion: Botswana, Burundi, Comores, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, Somalia, Swaziland, Sudan, Tanzania, Uganda, Zambia and Zimbabwe. The main objectives of the centre are to:

(i) provide natural resource and environmental data through the use of techniques such as: surveying, mapping, remote sensing, geographic information systems;

(ii) provide training for nationals of Member States in the fields covered above;

(iii) carry out studies and research in surveying, mapping, remote sensing and Geographic Information Systems and make available to member states the results of the studies and researches;

(iv) provide advisory services to Member States, upon requests on problems relating to natural resource and environmental information.

The centre has arranged several training courses on the use of remote sensing for oceanographic studies in collaboration with other agencies including UNESCO and ORSTOM. There are also plans to establish an Hydrographic Information Centre.

5. DEVELOPMENT OF A REGIONAL OCEAN DATA AND INFORMATION NETWORK IN THE IOCINCWIO REGION

As said before, in order to ensure increased participation of IOCINCWIO Member States in the IODE programme, two major activities have to be undertaken: (i) strengthen national capabilities and assist in the development of NODCs; (ii) develop a regional data and information network for the IOCINCWIO region.

We therefore now outline the proposed Network objectives and structure.

5.1 PURPOSE OF THE NETWORK

Within the framework of IODE, the network shall:

• provide a regional co-operative structure linking national oceanographic data centres (NODC). This linkage will ensure access of all scientists in the region to the data collected by national stations.

• ensure active involvement of national institutions in the IODE programme.

• adhere to the IODE data management procedures and ensure the use of standard methods for data collection and storage in the region.

• ensure access of scientists in the region to datasets not located in the region including satellite datasets.

• develop and disseminate data products for the benefit of scientists and policy makers in the region.

• establish exchange of data and information with the WDCs Oceanography.
5.2 THE NETWORK COMPONENTS

The rationale behind the development of a regional network of NODCs is the need for co-ordinated capacity building. During IOCINCWIO-III as well as the mission it was stressed that, in order to achieve sustainable operational data management activities at the national and other levels, substantial efforts need to be made to building infrastructural, as well as human capacity. A regional network is considered as a suitable mechanism to achieve these objectives.

5.2.1 National Oceanographic Data Centres (NODC)

Each participating Member State should strive towards the development of a National Oceanographic Data Centre (NODC). Its Terms of Reference are defined within IODE. It will be one of the major objectives of the project to assist Member States in the setting up of the NODC, training its staff, and developing the operational activities of the NODC.

5.2.2 The Regional Dispatch Centre: An RNODC for IOCINCWIO

In order to provide an appropriate co-ordinating structure for the Network project it is suggested to develop a ‘Regional Dispatch Centre’. The Draft Terms of Reference for the Regional Dispatch Centre are defined as follows:

The regional dispatch centre’s role will be:

(i) to provide support to the Member States in their setting up of NODCs. This support will include organization of consultative expert missions to Member States, distribution of guidelines in NODC setup procedures, etc.;

(ii) to promote the IODE programme and its activities amongst marine scientists in the IOCINCWIO region and ensure their participation in the programme;

(iii) to collect and disseminate in the region, information on the IODE programme, its components and programme activities;

(iv) to organize regional training courses for NODCs staff;

(v) to organize relevant training activities in data and information management for scientists, data and information managers;

(vi) to develop a regional data holdings catalogue (MEDI-WIO);

(vii) to co-ordinate the dataflow NODCs - WDCs;

(viii) to promote data management activities.

During IOCINCWIO-III, it was agreed to implant this centre, on an experimental basis, at the Regional Dispatch Centre of RECOSCIIX-WIO, based at the **Kenya Marine and Fisheries Research Institute** (Mombasa, Kenya). By virtue of its 6 years experience hosting the regional dispatch centre of RECOSCIIX-WIO and the substantial training undertaken by the RDC staff this institution is considered as a suitable location for the Network RDC.
Figure 1
6. NETWORK SERVICES AND ACTIVITIES

The project will carry out a development phase and an operational phase. The development phase will include activities related to the building of the network and its components, the latter including NODCs and the RDC. During the development phase all project services will be developed including substantial capacity building both in terms of infrastructure as well as training. The operational phase will include the provision of all services and continuous development and updating of data and information products.

The project will focus on both data and information, integrating both in all products. The term 'database' should be interpreted as numerical as well as information 'database'.

6.1 DEVELOPMENT PHASE

This includes:

(i) setting up of the Regional Dispatch Centre;

-This will include the modification of the current RECOSCIX-WIO Regional Dispatch Centre to include the Network Terms of Reference. In consultation and co-operation with KMFRI, (additional) staff will be identified for the RDC operations.

(ii) analysis of national requirements for the NODCs and identification of NODCs by the Member States;

- Member States will be requested to identify national institutions to host the NODC. Upon request advisory missions can be undertaken to assist the Member States. Guidelines to identify suitable institutions (and minimum requirements) for NODC will be developed.

- Member States will identify infrastructure, as well as training requirements for the NODCs.

(iii) setting up of the NODCs (infrastructure and staff training);

- Member States will be assisted, if required, with some infrastructure (equipment) to enable their participation in the project.

- A regional training course for NODC managers will be organized.

(iv) development of capacity catalogues;

- national data holdings catalogue: MEDI-WIO. This catalogue will provide information on national data holdings in MEDI format.

- national marine science programme activities catalogue: NOPS-WIO, MSCP.

- national marine science human and infrastructure capacity: WIODIR (Directory of Marine Science Institutions and Scientists).

(v) development of national databases;

- distribution of standard data management procedures and software.

- organization of regional data and information management courses.

(vi) development of a regional data query service;

This service will assist national scientists in locating and obtaining datasets either from within or outside the region.

The development phase is estimated to take 3 years.
6.2 OPERATIONAL PHASE

The operational phase, following the successful implementation of the development phase will concentrate on the sustained provision of services and development of products. In terms of products it is essential to highlight that scientists must be able to fully benefit from the network by having access to data products as well as data. The project will therefore need to make special efforts to develop such products.

7. ESTIMATED BUDGET

DEVELOPMENT PHASE (3 years)

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>- setting up of the Regional Dispatch Centre</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>= supplementary equipment</td>
<td></td>
</tr>
<tr>
<td>- identification of NODCs by the Member States</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>= advisory missions (maximum 10 countries)</td>
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<tr>
<td>- setting up of the NODCs by the Member States</td>
<td>$50,000.00</td>
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<tr>
<td>= NODC equipment support (10 countries)</td>
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<tr>
<td>= Regional Training Course for NODC Managers</td>
<td>$30,000.00</td>
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<tr>
<td>- communication costs (10 countries incl. RDC) (3 years)</td>
<td>$40,000.00</td>
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<tr>
<td>- regional training course on data management</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>- regional training course on information management</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>- data products development and distribution</td>
<td>$20,000.00</td>
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<td>TOTAL</td>
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OPERATIONAL PHASE (4 years)

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<tr>
<td>- Communication costs</td>
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<tr>
<td>- regional training course data management</td>
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<tr>
<td>- regional training course information management</td>
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<tr>
<td>- data product development and distribution</td>
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<tr>
<td>TOTAL</td>
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TOTAL BUDGET : US$ 410,000