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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

(of Unesco)

SCIENTIFIC ADVISORY BOARD REPORT ON THE REVIEW OF INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE

Executive Summary and Recommendations

This document which was adopted by the Scientific Advisory Board at its fourth session (Unesco, Paris, 26-30 March 1979) contains an Executive Summary and recommendations.

The Board started a review of international oceanographic data exchange at its third session (SAB-III, Unesco, Paris, 29 May - 2 June 1978) and set up a review group under Dr. N. Nasu (discussion leader) and Dr. A. Ramirez-Flores. The full text of the review undertaken by the Board has been attached as an Appendix.

Executive Summary and Recommendations of the Scientific Advisory Board's Review of International Oceanographic Data Exchange (IODE)

The Scientific Advisory Board (SAB) has completed its review of International Oceanographic Data Exchange (IODE) which was initiated at its third session (SAB-III, Unesco, Paris, 29 May - 2 June 1978), upon request of the Chairman IOC.

The Board's review group under Dr. N. Nasu (discussion leader) and Dr. A. Ramirez-Flores in correspondence with all Members of the Board, started its work by commenting on the document "Status of International Oceanographic Data Exchange" (doc. IOC/EC-XI/14) and later by considering the Executive Summary of the ninth session of IODE (doc. IOC/IODE-IX/3S).

At its fourth session (SAB-IV, Unesco, Paris, 26-30 March 1979), the Chairman SAB invited Mr. T. Winterfeld, Chairman WC/IODE, to present his views on the current status of oceanographic data exchange activities following the considerations and recommendations of IODE-IX (UN, New York, 15-19 January 1979).

The Board in particular took note of resolutions EC-XI.13 and 14 adopted by the Executive Council at its eleventh session (Mexico City, 26 February - 3 March 1979) on matters related to the Comission's programmes co-ordinated by the Working Committee on IODE.

In summarizing the discussion at SAB-IV, the Board recognized the efforts carried on within the IODE programme for its own internal evaluation and critical assessment of progress and expressed its concurrence with the aims, objectives and specifics of the Commission's ongoing activities on data exchange and information management. The Board further recommended to the Executive Council to assign a high priority status to all IODE activities and emphasized the need to strengthen and intensify three programme elements of the IODE in adopting relevant recommendations on ASFIS, TEMA and CLIMATE as follows.

RECOMMENDATION SAB-IV (IODE).1 - ASFIS

Realizing that the IOC's primary mechanism for fulfilling its obligation to Member States in the provision of information on and resulting from marine science and international oceanographic programmes is through participation in ASFIS of which FAO is the lead agency,

Calls upon the IOC Secretariat and IOC Member States to continue to strengthen support to the ASFIS in order to:

a) further increase the scope of subject matter coverage responding to the needs of the oceanographic community and to encompass a greater spectrum of available information sources;

b) broaden the range of services available from the ASFIS.

Recommendation SAB-IV (IODE).2 - TEMA

Being convinced that developing countries can reap the full benefits and potential of IODE and its services only through a comprehensive TEMA programme,

Requests the Member States who require training in data processing, data management and information services to specify their needs in regard to IODE;

Calls upon the WC/IODE to seek ways and means by which such training can be provided as a contribution to the IOC's overall TEMA activities.

RECOMMENDATION SAB-IV (IODE).3 - OCEANOGRAPHIC DATA REQUIREMENTS FOR CLIMATE STUDIES

Anticipating the broad-scale implementation over the coming decade of studies of the world's climate,

Being convinced that a wide variety of oceanographic data will be essential for the conduct of these studies,

Acknowledges with appreciation the efforts by France and the United States of America in establishing a RNODC for oceanographic data collected during the FGGE (RNODC-FOY), and in particular noting the Global Ocean Data Inventory and Flobal Ocean Climate Data Base activities in support of climate research by the RNODC-FOY,

Requests the WC/IODE to :

a) work closely with SCOR and WMO to determine what kinds of data are required (and in what form) from data banks and ongoing programmes;

b) identify all available long-time series of various types of marine data including both oceanic and coastal data and to make such an index available through the WDC system (noting also in this regard the information contained in the IOC's continuing maintenance of the International Catalogue of Ocean Data Stations);

c) review the experience of the RNODC-FOY towards these objectives, and consider establishing this as a longer term activity.

Recommends the IOC Executive Council to :

i) take note of the great importance and unique service rendered by the Permanent Service for Mean Sea Level (PSMSL), a specialized Data Centre in the ICSU World Data Centre system, in providing monthly sea level data on a global basis;

ii) recall the repeated requests of the PSMSL for supplemental financial support in order to continue, expand and modernize its holdings and publications;

iii) take positive steps to identify additional sources of funding for the PSMSL;

iv) publicize the role and functions of the PSMSL among IOC Member States.

REVIEW OF THE INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE (IODE)

In noting the excellent summary of the development of the international oceanographic data exchange as presented in document IOC/EC-XI/14, attached hereto, the Scientific Advisory Board fully concurs with the Working Committee for International Oceanographic Data Exchange. This document, entitled "Status of international oceanographic data exchange", was prepared by the Director of WDC-A, in consultation with the Chairman WC/IODE and the Secretariat in response to resolution EC-X.13.

This document, attached hereto, is extremely useful to an understanding of the development of the World Data Centres in relation to the Commission's programmes, the current status of oceanographic data exchange, the anticipated demands and the future trends in this important field of the Commission's activities.

In resolution I-9 (October 1961), the Commission recognised the WDC (Oceanography) as focal points for the international exchange of oceanographic data, and recommended the continuation of the WDC data-exchange system, which had been established during the International Geophysical Year (IGY, 1957-58). At the first session, the Assembly also recommended the establishment of an IOC Working Group on the Organization of Data Exchange (now the Working Committee for International Oceanographic Data Exchange). This subsidiary body of the Commission has held nine sessions (1962, 1964, 1966, 1968, 1970, 1971, 1973, 1975 and 1979), and, among other things, recommended a series of manuals and guides, as well as new concepts, within the international system of oceanographic data exchange.

At the ninth session (UN, New York, 15-19 January 1979), the WC/IODE adopted ten recommendations which the Executive Council, in resolution EC-XI.14, decided to act upon.

The Scientific Advisory Board, in reviewing the scientific aspects of international oceanographic data exchange, wish to commend the WC/IODE on its thorough preparation of the ninth session, and its critical assessment of progress in this field based upon its own internal evaluation. Therefore, SAB agrees with the Recommendations and Resolutions contained in document IOC/IODE-IX/3S, and wishes to summarize its comments only briefly:

(i) USE OF EXISTING IODE SYSTEMS AND PROCEDURES

Attention should be called to the need to optimize the distribution of documents and reports on IODE procedures, activities and services. It is hoped that this measure will increase the use of IODE systems and procedures by IOC subsidiary bodies and international organizations, and improve their co-operation.

(ii) FORMAT DEVELOPMENT AND IMPLEMENTATION

The extensive acceptance and use of the General Format for Exchange of Oceanographic Data (GF-3) by all Member States and international organizations should be reinforced. Recommendation IODE-IX.6 is of special importance in this context. It is also important to note the need for standardization of data formats and procedures for magnetic data storage and retrieval.

On this subject, the establishment of the recommended Group of Experts could be a most effective step.

(iii) PILOT PROGRAMME FOR RESPONSIBLE NATIONAL OCEANOGRAPHIC DATA CENTRES (RNODC's)

Special attention and emphasis should be given to the recommendations and resolutions on RNODC's. The increase in number under the pilot programme, and the diversification of the orientation of these Centres, should be considered in future developments.

(iv) AQUATIC SCIENCES AND FISHERIES INFORMATION SYSTEM (ASFIS), AND MARINE ENVIRONMENTAL DATA INFORMATION REFERRAL SYSTEM (MEDI)

Attention should be called to the importance of both ASFIS and MEDI systems in the development of international oceanographic data exchange. IOC activities should be strengthened and Member States should be encouraged to provide regular input, particularly into MEDI.

(v) RAPPORTEURS AND CO-ORDINATORS

In several recommendations and resolutions, the appointment of Rapporteurs and co-ordinators is requested for the various IODE activities and disciplines. After their appointment, it would be convenient to print a directory of them, and to distribute it widely among Member States.

(vi) DECLARED NATIONAL PROGRAMMES (DNP's)

The developing countries should be actively encouraged to prepare Declared National Programmes (DNP's), and to use the WDC's, since the latter are an important source of valuable information accessible without recourse to expensive facilities or techniques.

(vii) TEMA COMPONENTS WITHIN IODE

The importance of TEMA in IODE has been often emphasized. It is desirable that Member States in need of specific expertise to enable them to make use of IODE systems and services be encouraged to propose specific training and exchange programmes.

(viii) It appears that IODE will be important in the development of future programmes on both climate and ocean climate, and the Working Committee on IODE should ascertain the requirements of these programmes.

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UNITED NATIONS EDUCATIONAL,
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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

Eleventh session of the Executive Council
Mexico City, 26 February-3 March 1979

STATUS OF INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE

This report has been prepared by the Director of WDC-A (Oceanography), in consultation with the A/Chairman of WC/IODE and the Secretariat in response to resolution EC-X.13 of the tenth session of the IOC Executive Council. It is suggested that this report be considered, together with the outcome of the ninth session of WC/IODE (15-19 January 1979), at which IODE developments will be reviewed and recommendations made on further activities under this programme.

(SC-79/CONF.202/COL.13)

STATUS OF INTERNATIONAL OCEANOGRAPHIC DATA EXCHANGE

Introduction

The Tenth Session of IOC Executive Council in its Resolution EC-X.13 "instructed the Working Committee on IODE to examine the question of the status of international oceanographic data exchange and to submit a report to the Eleventh Session of the Executive Council." Subsequently the IOC Secretariat requested that the Directors of WDC's A and B prepare a summary of the status of international oceanographic data exchange.

This report is intended to examine the historical relationship between the WDC's and the IOC, present the current status of oceanographic data exchange; examine trends, and anticipate future demands.

Relationships Between the IOC and the WDC System

The historical association between the Intergovernmental Oceanographic Commission (IOC) and the World Data Centers (WDC's) A and B, Oceanography dates from the First Session of the IOC (Paris, October 1961). Resolution 9 of the First Session recognized the WDC's, Oceanography as focal points for the international exchange of oceanographic data and recommended the continuation of the WDC data exchange system, which had been established during the International Geophysical Year (IGY, 1957-58) under guidelines set forth in the International Council of Scientific Union's (ICSU) Guide to IGY World Data Centers. Resolution 9 further recommended the establishment of an IOC Working Group on the Organization of Data Exchange whose mission included the facilitating of exchanges of oceanographic data and the encouragement of the preparation of data catalogues.

As a result, the First Meeting of the Working Group was convened in Washington (August 1962) with various representatives of WDC's A and B, Oceanography, as well as representatives of permanent specialized WDC's, present. Discussion at this Meeting centered around the role of the WDC's in international data exchange and their relative effectiveness in that endeavor. The Group recommended that all data resulting from international cooperative investigations organized or sponsored by IOC, as well as data from certain cruises of international interest reported to the IOC should be exchanged internationally through the WDC's in accordance with the Guide. The Group further recommended that the WDC's, Oceanography continue to publish catalogues of data on a permanent basis.

The Recommendations of the Second Meeting of the Working Group (Paris, January 1964) were again concerned with the data exchange relationships between World, Regional, and National data centers. The Group, which included representatives of both WDC-A and WDC-B, reaffirmed earlier IOC recommendations regarding the importance of national data centers as focal points for the

submission of data to the WDC's. The Group also recognized that ultimate responsibility for quality of data entering the World Data Center system rests with the originators of the data, not the WDC's. It was agreed that permanent regional data centers and centers serving temporarily as regional centers in connection with international cooperative investigations, have responsibility to make such regional data collections available to the WDC's. It was noted that the primary responsibility of WDC's is the collection and distribution of data. Responsibility for the processing of oceanographic data is at the national level. It was agreed that normally the exchange of data should take place in the following sequence:

1. Declaration of national programs.
2. Submission of preliminary reports soon after completion of cruises showing positions, types of observations, and preliminary results of the cruise.
3. Submission of data and indices of observations to WDC's.
4. Exchange of scientific publications resulting from the data.

The Working Group also approved a revision of the "Provisional Guide for Exchange of Oceanographic Data."

Subsequently, the IOC's Manual on International Oceanographic Data Exchange was published by UNESCO in early 1965. In December 1964, the Comite International de Geophysique, the ICSU organization responsible for the operation of the WDC's, had issued Chapter X, Supplement No. 1 to the CIG Guide to International Data Exchange through the World Data Centers (for the period 1960-onwards), which was essentially identical to the IOC Manual.

In response to IOC Resolution IV-9, the Secretariat convened the Third Meeting of the Working Group (including representatives of both WDC's) at Charlottenlund, Denmark (31 March-2 April 1966). The status of exchange of IHP data through the WDC's was discussed and means were sought whereby the flow of data to the WDC's could be increased and speeded up. It was suggested by the Group that the WDC's issue a comprehensive catalogue listing the types and amounts of available IIOE data. The proposal of the IOC WG on Ocean Data Stations that the WDC's and regional centers assist the Secretariat in revising the list of Ocean Data Stations, was accepted. Revisions to the IOC Manual (for preparation of the second edition) were approved. A revised format for the WDC-A Catalogue of Data was reviewed and approved by the Group.

The second edition (revised) of the Manual on International Oceanographic Data Exchange was published by UNESCO in 1967. Most of the basic guidelines for data exchange remained consistent with those in the CIG Guide.

The Fourth Meeting of the Working Group (Paris, September 1968) was chaired by Dr. Thomas S. Austin, Director of NODC and WDC-A,

Oceanography. An exhaustive reappraisal of the existing international data exchange system in view of the problems that would soon be experienced in the handling and storage of data from continuously recording instruments was undertaken. The Group recommended that the international exchange of data should continue for the foreseeable future in accordance with the existing Manual, taking into account the increasing role and importance of NODC's. Modifications, however, were recommended in certain areas. It was decided that primary recordings and primary data from high density sampling devices should be retained at the originating activity or national or regional data centers; corresponding reduced data should be transmitted to the World Data Centers. Further, bearing in mind the rapid proliferation of continuously recorded data to be expected in the next few years, it was suggested that WDC's, Oceanography would gradually need to move towards becoming automated documentation centers with regard to such high resolution data. At this meeting a proposal by WDC-A, Oceanography (NODC) to establish "International Data Banks" (IDB's) in support of the WDC's, Oceanography was tabled.

The Fifth Meeting of the Working Group was held in Geneva in September 1970. The discussions of the Group were concerned mainly with the continuing review and reappraisal of the existing system for data exchange taking into account new programs such as LEPOR/IDOE, IGOSS, and Marine Pollution Monitoring. In this context, the Group recommended adoption of the WDC-A-proposed Report of Observations/ Samples Collected by Oceanographic Programs (ROSCOP) as an interim marine data inventory form to facilitate the initial exchange of marine data and to keep this form under constant review and revision. The use of the International Geological/Geophysical Cruise Inventory (IGGCI) form proposed by IUGS/CMG was also endorsed by the Group as an aid in exchange of gelogical and geophysical data through the WDC's. The Group called upon the Directors of the WDC's, Oceanography in coordination with the ICSU Panel on WDC's to prepare a revision of the IOC Manual. In addition to ad hoc Groups on Format Standardization and Development of Marine Geological/Geophysical Data Management previously constituted under the Working Group, Task Teams on; (1) Inventories of Marine Data and Samples, (2) Exchange of Subsurface Current Data, and (3) Manual for Non-Real-Time Exchange and Storage of IGOSS data were established.

At this time WDC-A was involved in a number of IOC-related projects. The Center was serving with NODC as the regional data inventory and processing center for the CICAR program. WDC-A was cooperating with the IOC and IUGS in maintaing the IGGCI file. With three other regional centers, WDC-A was assisting the IOC in a comprehensive updating of the International Catalogue of Ocean Data Stations. The international marine data inventory/referral system ROSCOP (proposed by WDC-A) was well underway.

During the period following the Fifth Meeting, the WDC's were involved in several Working Group projects. Staff members

provided major input to the Task Team on Marine Data Inventories in the development of the ROSCOP II format. The WDC staffs prepared a first draft of the IOC Manual (third edition). Considerable staff input was provided to a number of task teams.

The Sixth Meeting was held from 20-24 September 1971 in Rome. The Directors, WDC's A and B, Oceanography were requested to complete the revision of the Manual, taking into account the suggestions of the Working Group. Further, they were requested to coordinate the preparation of the oceanography portion of the revised ICSU Guide to Data Exchange with the ICSU Panel. New task teams established were the Task Team on International Exchange, Marine Biological Data and the Task Team on the Development of Arrangements for International Oceanographic Data Exchange. Both task teams are concerned with strengthening and expanding data exchange within the WDC framework.

The Seventh Meeting of the Working Group was held in New York from 9-13 July 1973. Reports were given concerning WDC-A participation in the ROSCOP system, CICAP, the IGGCI system, the Catalogue of Ocean Data Stations, and preparation of the revised Manual. The concept of Responsible National Oceanographic Data Centers (RNODC's) was introduced by the Task Team on Arrangements. RNODC's would complement and support the WDC's, but would in no way replace them as the central archives for internationally exchangeable data. A Task Team on Declared National Programs was established to evaluate DNP practices and outline such new practices as were desirable, including the possibility of discarding the concept entirely.

The Eighth Meeting of the Working Committee met in Rome on May 12-16, 1975 and resulted in several important recommendations with regard to exchange of data through the WDC System. Perhaps the most significant of these was the establishment of a pilot programme leading to the establishment of a Responsible National Oceanographic Data Center (RNODC) System by 1980. The RNODC's would "as their primary function, aid the World Data Centers (Oceanography) by providing various types of readily available services (i.e. statistical data summaries, data displays, etc.) at minimal costs for either specific projects, specific regions or specialized types of data. To this end, the WDC's will, under guidelines established by ICSU and the IOC Manual on IODE, arrange for the provision of data as required by the various RNODC's." The Pilot Program is currently underway. Other major recommendations included; 1) the continuation of the DNP for the present and wider participation on submissions subject to future review by the WC/IODE, 2) resumption of an NOP publication in a suitable form which would include the descriptions "Planned" and "Completed", and the preparation of a brochure describing NOP/DNP and ROSCOP schemes to be prepared by the IOC Secretariat with the assistance of the Directors of the WDC's. The IODE resolutions on DNP and NOP were subsequently widely publicized by IOC C.L. No. 645.

The Working Committee also established an ad hoc Group on Marine Information Management and two "Information" Components, Aquatic Sciences and Fisheries Information System (ASFIS) and the Marine Environmental Data Information (MEDI) Referral System.

Also adopted at the meeting was an experimental format, IOC General Format 2 (GF.2). Considerable work has been done on this format during the intersessional period following the meeting so that this format or its successor may well be the major media of exchange within the WDC's in the future.

Some of the effect of the most recent recommendations of IODE may not yet be completely apparent in terms of increased availability of data for international exchange; however, as shall be shown, the overall positive effect of IODE actions has been quite remarkable.

Data Exchange Statistics

Each year the WDC subcenters for oceanography present complete statistics of data exchange in annual and semi-annual reports. These reports are available for anyone desiring a detailed knowledge of data exchange. This report will examine only a few general considerations.

Since the inception of the WDC System more than 1.2 million observations have been exchanged. These include various physical measurements, chemistry, biology, geology, and geophysics. In addition, about 15,000 documents and ROSCOP formatted descriptions of data collected by more then 6,000 cruises have also been submitted. Figure 1 summarizes annual data receipts for all types of data for the past eight years. Annual statistics for previous years are not readily available; however, it is significant that the average number of annual observations for the period 1957-70 was about 42,500. Since 1970, the average number of annual observations received is more than 95,000 per year. There is a good deal of variability from year to year; for example, the number of observations received in 1976 was about double that received in 1975.

In order to assess the impact of the IOC/IODE program on volumes of data exchanged, we have used the figures for oceanographic serial stations as depicted in Figure 2. These data were selected because they have the longest continuous record for exchange and represent a class of data for which standard observational methods have existed for some time. Included in these figures are both bottle casts and a relatively small number of C/STD observations. As with the figures for total observations, the number of stations have varied considerably from year to year, but there has been a significant rise in the average number of stations received during the past 11 years over the first 10 years. From 1957-66, an average of about 10,000 stations a year were received, while for the period 1967-77 more then 40,000 stations per year were received. Note that 1977

showed a marked drop in receipt of data for oceanographic stations. Thus far, figures for 1978 have not been tabulated but the number of stations already catalogued exceeds 1977 by a small amount with a number still uncounted. It appears that 1978 will exceed 1977 by a substantial amount but probably will not reach the 1967-77 average.

Another measure of the inpact of IOC/IODE programs on data exchange through the WDC's is the Report of Observations/Samples Collected by Oceanographic Programs (ROSCOP) Inventory System. As noted above, ROSCOP was designed and developed by the WC/IODE in order to provide better access to information on contemporary oceanographic programs and as a data management tool for countries to be used in connection with their National Oceanographic Programs (NOP's) and preparation of the Declared National Programs (DNP's.) Figure 3 shows the number of ROSCOP forms received by the WDC's since inception of the program. The low numbers in the early years represent primarily an experimental format which in more recent years has virtually disappeared and been replaced with the latest IOC approved version, ROSCOP II.

Yet another method for assessing the status of international exchange and its relationship to IOC is to examine the percentage of data received from NOP/DNP Declarations, from IGY/IGC (1957-59) and from voluntary contributions. Table 1 lists the percentages of oceanographic serial stations received in these three categories for the past 12 years.

Table 1. Percentage of data received.

Year	IGY-IGC (1957-59)	NOP/DNP (1960 Onward)	Other Data	Total
1966	21.3	20.4	58.3	100.0
1967	18.8	28.0	53.2	100.0
1968	0.9	28.0	71.1	100.0
1969	5.9	28.8	65.3	100.0
1970	2.3	26.2	71.5	100.0
1971	0.5	23.5	76.0	100.0
1972	0.0	25.8	74.2	100.0
1973	8.2	15.3	76.5	100.0
1974	0.0	29.5	70.5	100.0
1975	1.7	30.3	68.0	100.0
1976	21.1	37.1	41.8	100.0
1977	0.1	53.9	46.0	100.0

Note that there does appear to be a slight increase in NOP/DNP receipts for the past two years but generally only 1/4 to 1/3 of

the stations received are listed in DNP/NOP declarations distributed by the IOC.

Since the DNP is a declaration of intent to exchange data internationally one may also look at what percentage of the data that have been declared are actually sent to the WDC's. Table 4 is a year by year percentage of these receipts and shows clearly that considerably less than 50% of the cruises which have been declared as DNP are actually sent to the WDC's for international exchange. Of course, not all cruises declared are actually taken and not all Cruises taken yield data suitable for exchange.

Analysis and Future Trends

An examination of Figures 1 and 2 indicates that there has been a general increase in data exchange internationally in the past eight to ten years. Comparing this increase with activities and recommendations of the IOC through its Working Committee on IODE there does appear to be a correlation between efforts of that group and increased data flow. Of course, other factors such as Cooperative Investigations, Large-Scale Experiments and increased national programs are contributing factors which must also be considered. The drop in serial observations noted in 1977 should be watched as it may be indicative of a trend. The advent of STD and other electronic instrumentation which results in large volumes of data but without internationally accepted methods for data reduction, as well as increases in biological and chemical pollution studies, which again have few international standards may result in net decreases in data to be exchanged unless IOC, SCOR, and other international organizations actively pursue methods for exchange of such data. With such activity and with the development of RNODC's to aid the WDC's in the processing of high volume and complex data sets, data exchange should continue to grow. It is hoped that the IOC and its subsidiary bodies will continue to encourage complete freedom of exchange of data without restriction. Some recent developments may indicate a trend toward confidentiality of certain data types.

The ROSCOP Inventory appears to be producing a considerable amount of information. It is being used not only for national data management but in the management of large international and multinational programs. It does not appear, however, to have had much influence on the addition of increased NOP/DNP declarations or on the amount of data actually exchanged. ROSCOP's may also be used as an acquisition tool for studies requiring data not normally archived in the WDC's. Current usage of ROSCOP information by the scientific community appears to be quite limited.

The use of the DNP as a method for obtaining data for international exchange appears to be only partially effective. Little progress seems to have been made in substantially increasing the number of DNP's submitted, increasing the percentage of DNP data received versus voluntary data or

increasing the percentage of data received versus that which has been declared. DNP's seem to be poorly understood or accepted by many IOC Member States although they have been in existence for nearly 18 years. Nevertheless, this has not stopped the flow of data, and, as has been noted, increased data flow internationally has actually occurred. The full implementation of IODE VIII recommendations concerning the issuance of a brochure and publicationzof NOP/DNP lists should result in more NOP/DNP announcements from more Member States and in an increase in the percentage of DNP data received by the WDC's.

Large ocean experiments begun in the 1970's are almost sure to continue into the 1980's utilizing new methods for data acquisition such as satellites and automatic recording devices. International exchange of such data through the WDC's can be accomplished using techniques now under development by the IOC/IODE provided that these are given sufficient backing by all Member States. It will be most important, especially for the developing countries, to have easy access, not only to these high volume data, but to resulting data products which can be used without recourse to costly processing equipment.

Summary

In general, the WDC System for international exchange of oceanographic data has dramatically increased the availability of data and information to the worldwide user community. A major part of this increase is attributable to the close cooperation of the WDC's (Oceanography) with the IOC and in particular with the its Working Committee on International Oceanographic Data Exchange. There are, however, changes taking place in the nature of oceanographic experiments due to technical and scientific advances, the increased interest in the oceans as a source of natural or energy resources, and because of increased awareness of the dangers of pollutants in the oceans. These changes will necessitate new and innovative data management techniques and standards in order to maintain the viability of the WDC's for Oceanography. Among the high priority items that will need to be coordinated between the WDC's and the IOC are establishment of formats for biological, chemical and biochemical data, standard magnetic tape exchange formats, a coordinated WDC/RNODC scheme, and improvement of the DNP/NOP method for acquisition of internationally exchangeable data. The IOC and WDC's will also need to work jointly with other international regional programs such as the World Climate Program, Regional Seas and Open Ocean Programs, and cooperative investigations of large ocean areas. A strong, positive program should lead to increases in data and in data services that are available to requesters throughout the international community.

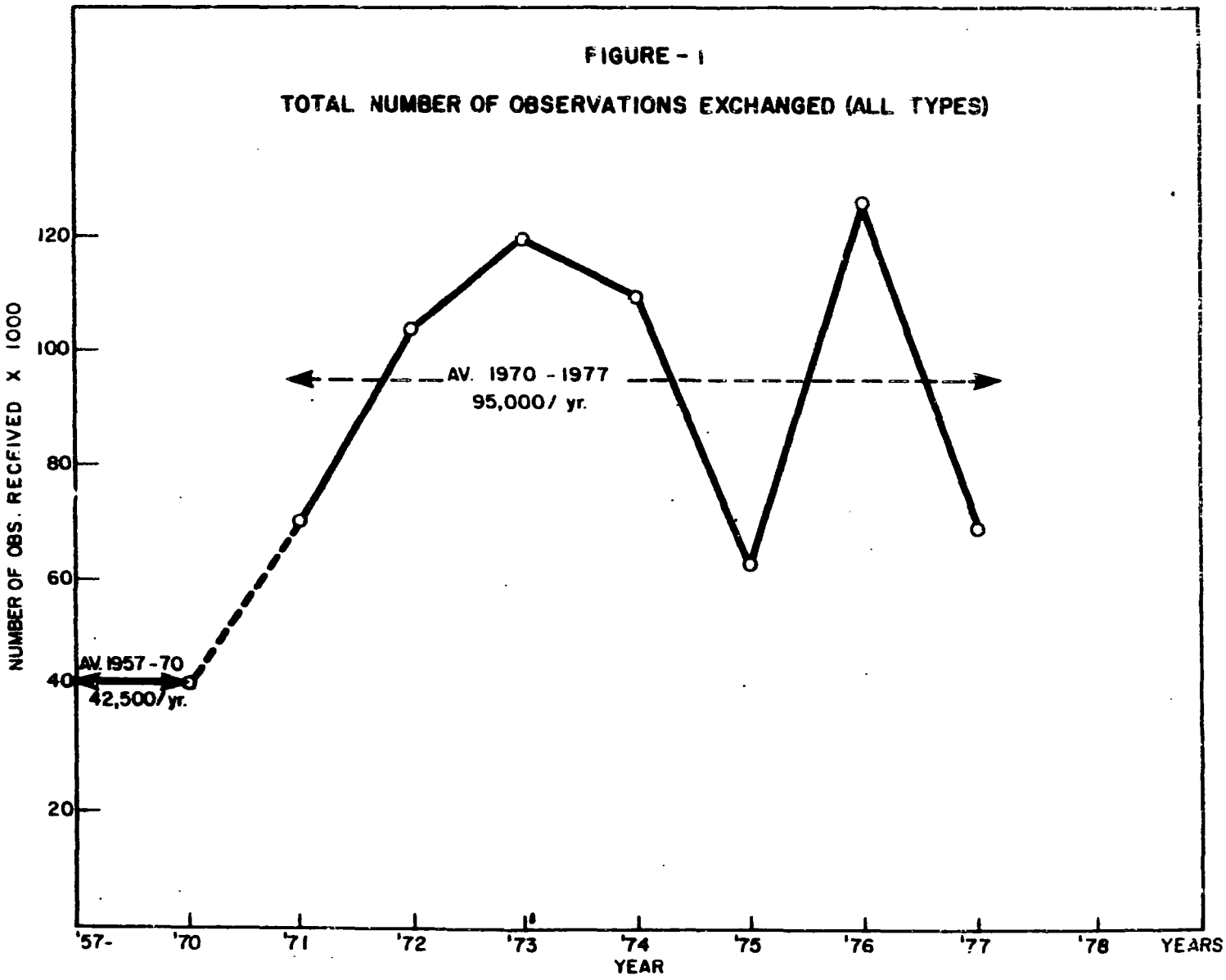
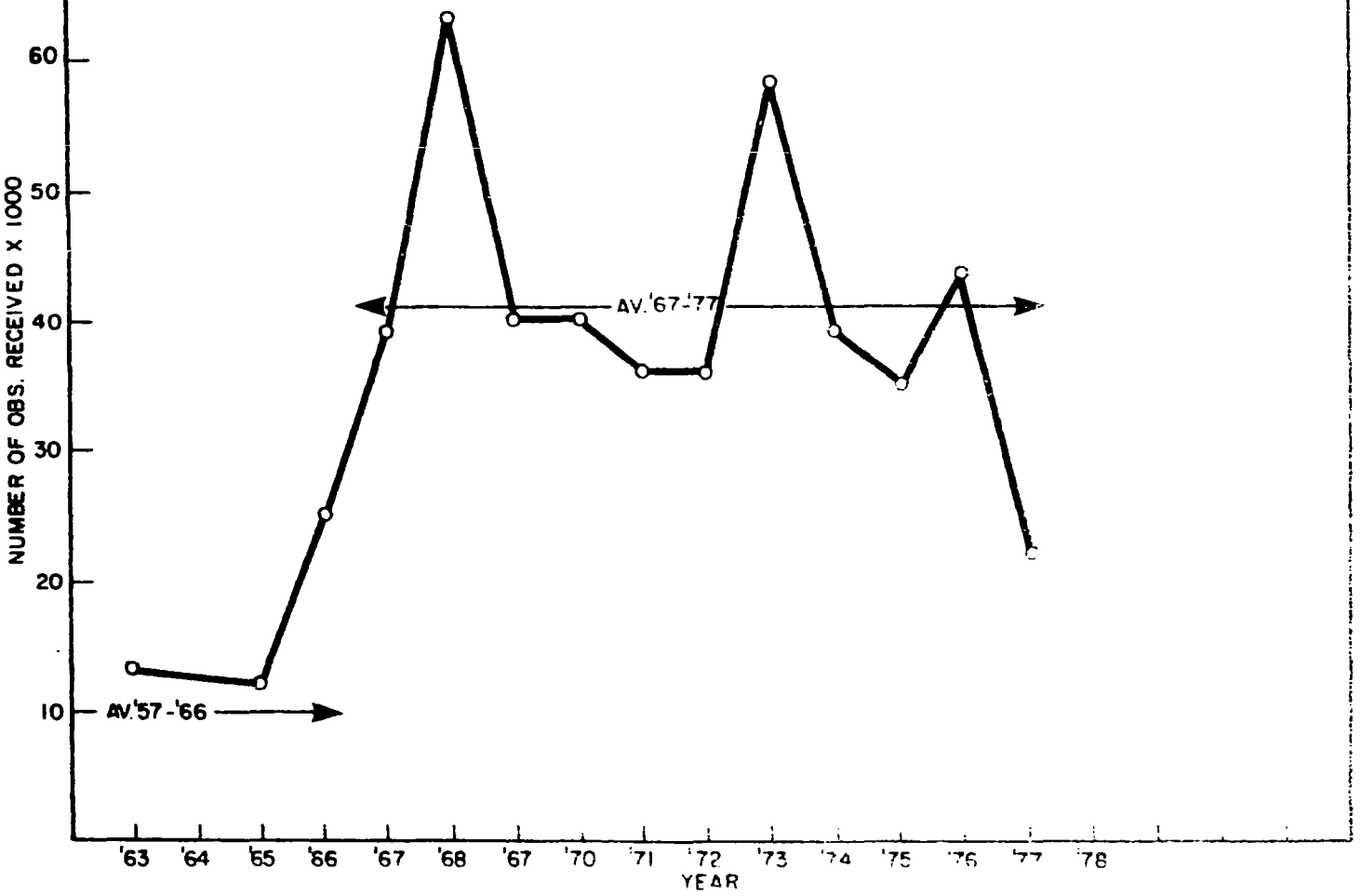


FIGURE - 1
TOTAL NUMBER OF OBSERVATIONS EXCHANGED (ALL TYPES)
NUMBER OF OBS. RECEIVED X 1000
120
100
80
60
40
20
AV. 1970 - 1977
95,000/ yr.
AV. 1957 - 70
42,500/ yr.
'57-
'70
'71
'72
'73
'74
'75
'76
'77
'78
YEARS
YEAR

FIGURE -2

NUMBER OF OCEANOGRAPHIC SERIAL STATIONS EXCHANGED



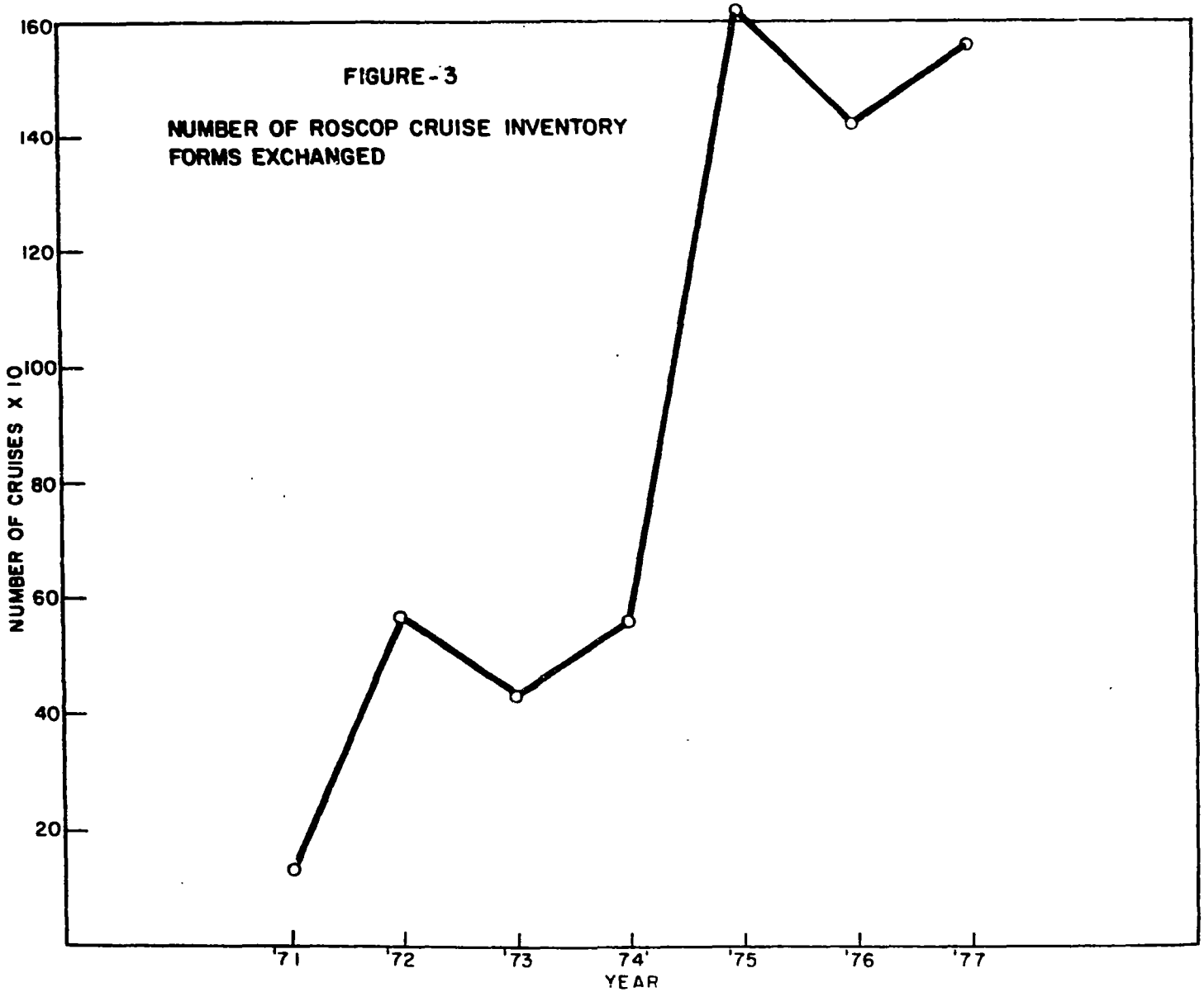


FIGURE - 3
NUMBER OF ROSCOP CRUISE INVENTORY FORMS EXCHANGED
NUMBER OF CRUISES X 10
160
140
120
100
80
60
40
20
'71
'72
'73
'74
'75
'76
'77
YEAR

FIGURE-4

PERCENTAGE OF CRUISES LISTED AS DNP vs. CRUISES RECEIVED BY WDC-A