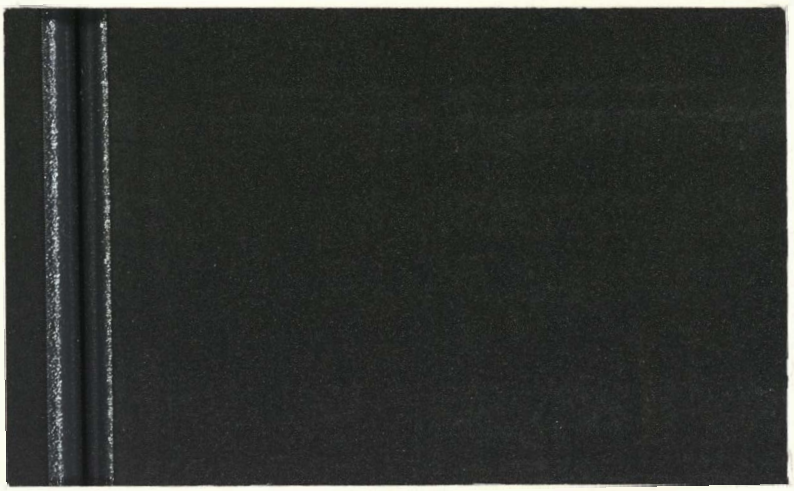
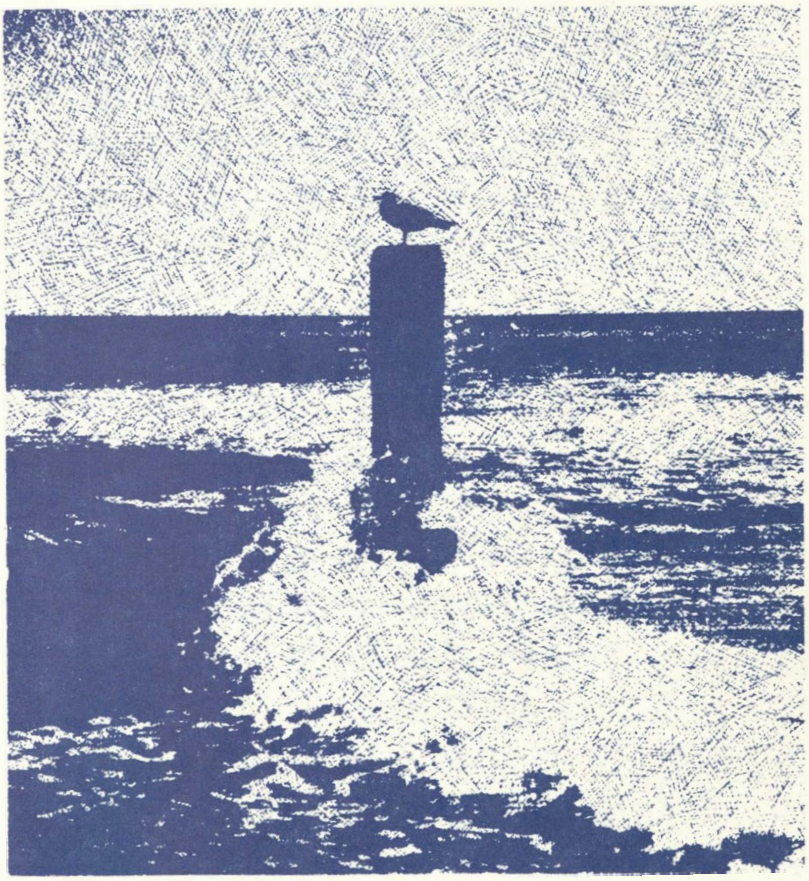


NODC

National
Oceanographic
Data
Center



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Environmental Data Service

NODC Capabilities for Ocean Pollution Data Collection, Storage, and Distribution

by

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1. INTRODUCTION

The National Oceanographic Data Center (NODC) provides data base management, project management, data product development, and related supporting services to marine environmental assessment studies and marine pollution monitoring projects of both national and international scope. The largest and most important of the U.S. projects from which the NODC is receiving, processing, and disseminating environmental quality data are NOAA's Marine Ecosystems Analysis (MESA) project and the Outer Continental Shelf Environmental Assessment Project (OCSEAP) being conducted jointly by NOAA and the Bureau of Land Management (BLM). The MESA studies have focused on three geographical regions: the New York Bight, Puget Sound, and the central Pacific manganese nodule areas that are of interest to MESA's Deep Ocean Mining Environmental Study (DOMES). Because development of new petroleum resources and facilities on the Alaskan continental shelf is farther advanced than in other proposed lease areas around the "lower 48," most of the BLM Environmental Studies Program effort has been concentrated on the Alaskan Outer Continental Shelf. Work with BLM is also underway, however, in the Mid-Atlantic, S. Atlantic, S. Texas, S. California, and other OCS areas.

On the international level the NODC receives and processes data collected by researchers and observers working under the auspices of two major pollution-related projects, the Environmental Quality Program that is part of the International Decade of Ocean Exploration (IDOE)

and the Marine Pollution Monitoring Pilot Project (MAPMOPP) that was organized by the UN Intergovernmental Oceanographic Commission (IOC) and World Meteorological Organization (WMO) within the Integrated Global Ocean Station System (IGOSS). The IDOE Environmental Quality Program data accessioned by the NODC is primarily physical and chemical baseline study data that will enable scientists to elucidate the mixing and transport processes that control the movement and dispersion of manmade pollutants in the oceans. The IGOSS/MAPMOPP data consist of actual observations and analyses of a specific pollutant -- petroleum. Petroleum was selected as the test substance for this project both because it is a major pollutant and because it is capable of being monitored by nations of widely varying degrees of expertise. Four specific parameters are being monitored: (1) oil slicks and floating pollutants, (2) floating particulate petroleum residues (tar balls), (3) tar on beaches, and (4) dissolved/dispersed hydrocarbons. Although this project was originally scheduled to terminate at the end of 1976, at the Second IOC/WMO Workshop on Marine Pollution (Petroleum) Monitoring held in Monte Carlo, Monaco, June 1976, an agreement was reached to extend the Pilot Project for two more years through the end of 1978.

2. POLLUTION DATA PRODUCTS

Because it is one of the farthest advanced of the multidisciplinary data projects, the OCSEAP project serves to illustrate the NODC's

marine pollution data capabilities. The kinds of products and systems developed to support OCSEAP are representative of those that have been or could be developed to support other marine environmental studies.

2.1. NODC Catalog of OCSEAP Data

OCSEAP data available from the NODC are documented in the NODC Catalog of OCSEAP Data, which was given an initial limited printing and distributed primarily to OCSEAP scientists. Part I of this Catalog (Distribution of Digital Data) contains computer-generated plots showing the locations and numbers of observations of different kinds of data collected in and around the nine proposed oil lease areas. Figure 1 shows one of these location plots for hydrocarbon observations. Part II (Inventory of Digital Data by Lease Area) is a detailed list of information about the individual data sets. Each entry gives the Principal Investigator, survey dates and platform, the number of stations or observations within designated limits surrounding each lease area, and identifying numbers. Parts I and II include all data received by the Environmental Data and Information Service (EDIS) data centers through May 31, 1978.

Parts III and IV of the Catalog are scheduled for publication in late 1978 and in 1979 respectively. Part III will consist of descriptions of the digital data formats, or "file types," that have been devised for use by the Principal Investigators and the NODC for recording and archiving the OCSEAP data. Part IV will contain examples of data summaries and graphic plots that can be generated from data in various individual file types. This Catalog will be revised and updated as required as new OCSEAP data is received by the NODC.

2.2. Computerized Data Products

Over the years the NODC has developed a Generalized Applications System (GAS) for preparing computerized data products from its standard oceanographic data bases. Data products now available include various statistical data summaries such as thermocline and mixed layer analyses, and graphic data displays such as vertical section plots and horizontal contour plots. This integrated set of computer programs exploits the fact that most NODC data bases have a common structure -- measured parameters versus depth taken at a fixed time and place. Data products are created by extracting the required data from one of the archive files and converting it to a common GAS format before passing it to the required applications program. In this way a single set of applications programs can access data in a variety of different formats from any number of archive data files.

Although OCSEAP and other kinds of multidisciplinary data cannot yet be directly accessed by GAS, these same kinds of data products can be produced from this data with varying amounts of special programming. Figure 2, for example, shows a horizontal contour plot of the concentration of a single hydrocarbon (ethane) in the NEGOA (Northeast Gulf of Alaska) lease area. In this case the tightly focused contour lines do not pinpoint an accidental oil spill, but rather a natural hydrocarbon seep. Figure 3 shows a computer plot of a Lagrangian drifter, a device that can be used to follow both ocean currents and ice movements. This kind of information is of particular interest to researchers concerned about the transport of spilled oil by wind and water. Further examples and details about computer data products such as these will be made available in Part IV of the NODC Catalog of OCSEAP Data.

3. POLLUTION DATA FORMATS

3.1. OCSEAP and Other Multidisciplinary Data Formats

OCSEAP and other multidisciplinary data -- from marine mammal sightings to trace metal concentrations -- are recorded and archived in over 50 specifically designed digital data formats, or file types. A file type is defined as a digital format for coding, processing, and archiving a specific category of environmental data. Each file type has been agreed upon by the OCSEAP project office, one or more Principal Investigators, and the EDIS Data Centers as an acceptable exchange format for submitting multidisciplinary data to the Centers. A list of the file types now in use or under development is given in the Appendix.

While many of the file types contain data directly or indirectly related to pollution studies, some are almost exclusively concerned with direct pollution measurements or pollution baseline data. Examples of these are: Metals in Organisms, Sediment, and Water (File Type 001); Trace Metals (File Type 021); Light Hydrocarbons (File Type 043); Heavy Hydrocarbons (File Type 044); and Trace Elements (Fily Type 061).

3.2. IGOSS/MAPMOPP Log Forms

The U.S. NODC and the Japan Oceanographic Data Center have been designated as the two Responsible National Oceanographic Data Centers for the IGOSS Marine Pollution Monitoring Pilot Project. These two Centers collect and exchange the observations made worldwide and provide archival and retrieval services for these data. Four log forms have been adopted by the IOC and WMO for recording and reporting these observations:

(1) Log for Observation and Reporting of Oil Slicks and other Floating Pollutants

(2) Log # for Sampling and Reporting Particulate Petroleum Residues (Tar Balls)

(3) Log for Sampling and Reporting Tar on Beaches

(4) Log for Sampling, Analysis, and Reporting Dissolved/Dispersed Hydrocarbons

When these log sheets arrive at the NODC, they are first recorded in the NODC Accessions Production Information System (NAPIS), the system used to keep track of all incoming data at the NODC. The log sheets are checked for gross errors and keypunched. After the punched cards are error-checked, these data are transferred to magnetic tape where they are available for exchange and for data product generation. To date the NODC has received approximately 60,000 oil slick observations, 3,000 tar ball observations, 3,000 observations of tar on beaches, and 500 observations of hydrocarbons dissolved or dispersed in the water column.

4. DATA MANAGEMENT AND INVENTORY SYSTEMS

4.1. OCSEAP Data Tracking System

The complexity of a multidisciplinary environmental data collection effort such as OCSEAP -- with dozens of Principal Investigators collecting dozens of different kinds of data from ships, on the ground, and in the air -- requires that a great deal of care and attention be devoted to overall project management. If complete records are to be maintained of the history and current status of each subtask and if the data sets are to be adequately documented, some sort of project reporting system must be used.

The NODC developed a Data Tracking system to perform all of these functions for the BLM OCSEAP project. This system, which can be brought online and queried interactively, tells who has collected what and where it is. Each data set is assigned a unique identifier called a "track number" so it can be identified and monitored as it flows through the system from the Principal Investigator through the project manager to its processing and final disposition at the NODC or one of the other designated Data Centers. Each entry in the OCSEAP Data Tracking system includes the title of the task and the research unit number assigned by the OCSEAP project office; the name, address, and phone number of the Principal Investigator; the data file type; the start and end dates of the survey; the lease area in which the data was gathered; and the dates that the data was received, accepted, and final processed by the relevant Data Center. For data archived by the NODC, each entry also includes the NODC NAPIS number so that this system interfaces with the NODC's internal data management system.

4.2 Detailed Inventory for Projects

Almost without fail, the first question that a data requester asks the NODC is "How much data do you hold in my area of interest?" Providing a quick answer to this question became much more difficult when the NODC began to receive the bewildering variety of data being collected by OCSEAP, MESA, DOMES, and the other multidisciplinary data projects. The relatively simple world of bathythermograph data, Nansen Casts, and surface current observations was complicated by an influx of observations of diseased fish, herring spawnings, and marine bird colonies.

As an interim measure, the NODC created a Detailed Inventory for Projects (DIP). This online search system permits NODC personnel to determine how many observations have been received for a data set of a given file type and track number and tells whether that data set has been final processed. Inverted files for geographic area and data file type are available so selections can be made quickly to answer the kinds of questions most often asked by outside requesters. Using a capability developed for inventorying the NODC's standard oceanographic data bases, location plots of these observations can be produced on CRT computer terminals. Although this system is a very useful tool for responding to data requests, it is far from providing a completely systematic, automated data retrieval capability like that available for NODC's standard oceanographic data bases.

4.3. Multidisciplinary Data Archival and Retrieval System (MULDARS)

The system being developed at the NODC to provide this capability has been designated the Multidisciplinary Data Archival and Retrieval System (MULDARS). The final design of this system has not yet been completely determined, but it should make the dissemination of multi-disciplinary project data -- including pollution data -- much simpler and more straightforward than at present.

5. REFFERAL SERVICES

Besides providing marine environmental quality data and pollution monitoring data from its own files, the NODC can also refer users to other data collections and to the published literature by means of the Environmental Data and Information Service's ENDEX/OASIS system.

5.1. Environmental Data Index (ENDEX)

ENDEX is a set of data bases containing descriptions of environmental data collections held by Federal, State, municipal, academic institutions, and by private companies throughout the United States. The Bottom Photograph Camera Station file, for example, contains descriptions of ocean-floor photographs taken at over 7,500 locations around the world. The ENDEX data bases particularly relevant to pollution studies are the Environmental Data Base Directory (EDBD), and the Report of Observations/ Samples Collected by Oceanographic Programs (ROSCOP).

Online searches of EDBD can be used to answer questions such as "Who holds water quality for the Gulf coast of Louisiana for 1976 and 1977?" All fields in each record -- institution, dates of observations,

platform type, measured parameter, method of measurement, and so on -- are searchable, so the selection can be as specific or as general as the user requires. While the NODC's data collections are of global or national scope, many of the data collections described in EDBD are of regional or local significance. Data collected by a power company or a State environmental agency, for example, could provide useful data to a researcher who needs a finer degree of resolution than could be provided by NODC data alone.

The ROSCOP form has been recommended for use by the Intergovernmental Oceanographic Commission's Working Group on International Oceanographic Data Exchange as a mechanism for providing timely information about oceanographic projects that are collecting data that are not yet archived and available from one of the World Data Centers or National Data Centers. The NODC receives the ROSCOP forms and keys them into an online searchable file. The form specifically includes various categories of marine pollution studies among the disciplines and types of measurements that can be reported.

5.2. Oceanic and Atmospheric Scientific Information System (OASIS)

OASIS provides access to numerous bibliographic data bases. Online literautre searches can be made on dozens of scientific and technical data bases including Oceanic Abstracts, Pollution Abstracts, and Enviroline. Searches are very flexible and can be tailored to the user's requirements.

Figure 1. Sample location plot of hydrocarbon data from NODC Catalog of OCSEAP Data (Part I).

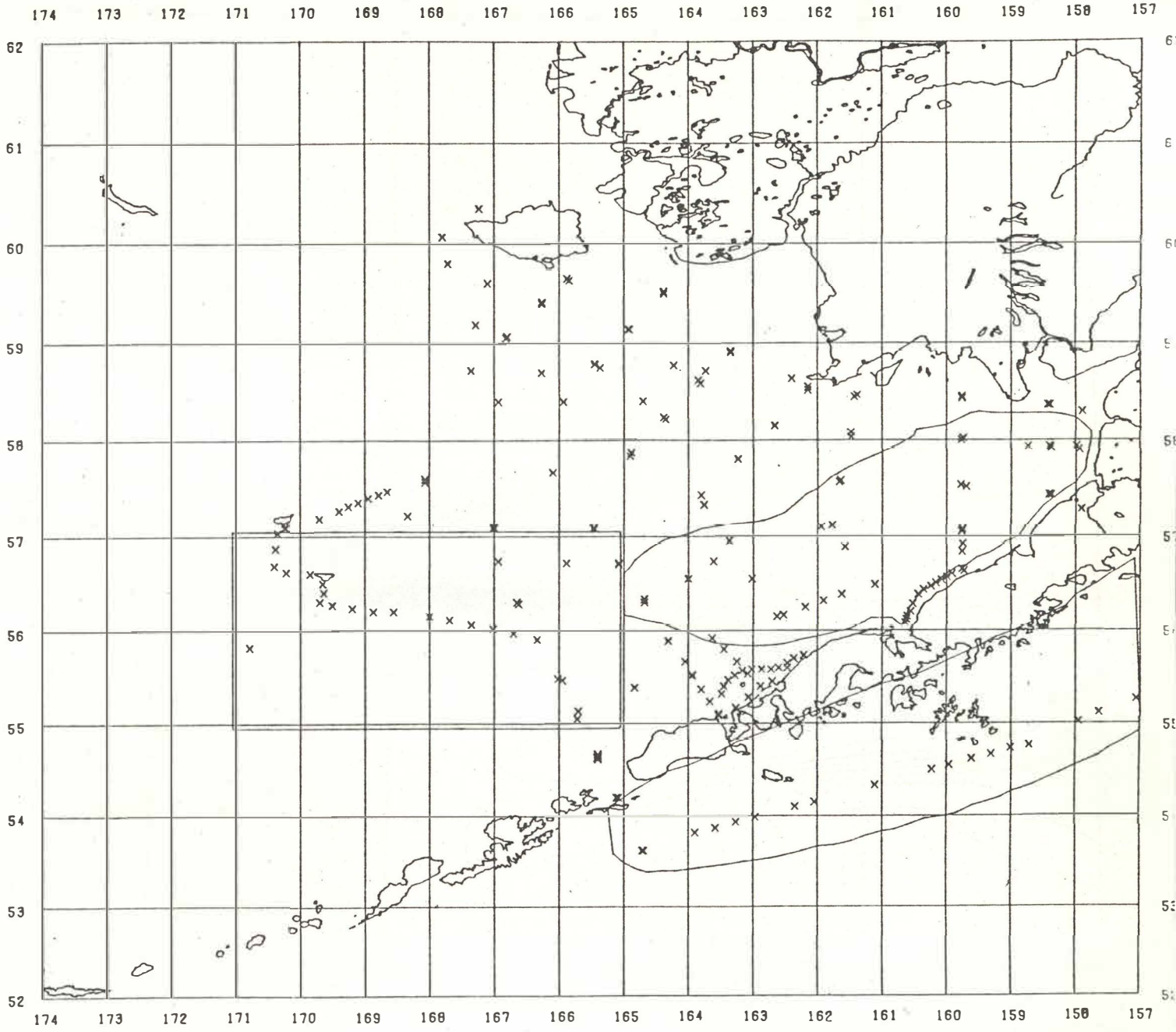


Figure 2. Contour plot of ethane concentration over a natural hydrocarbon seep. Produced by NODC from OCSEAP data.

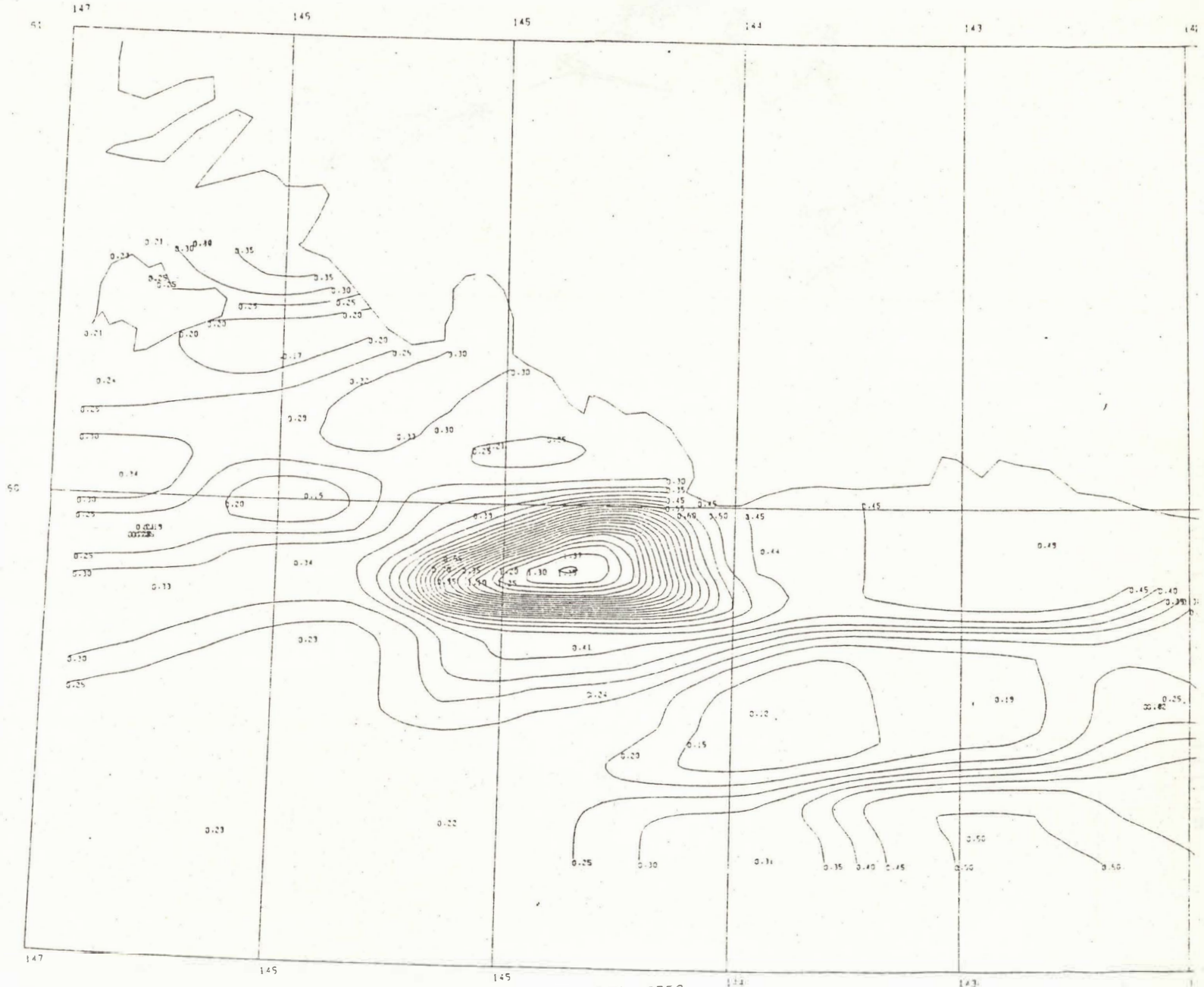
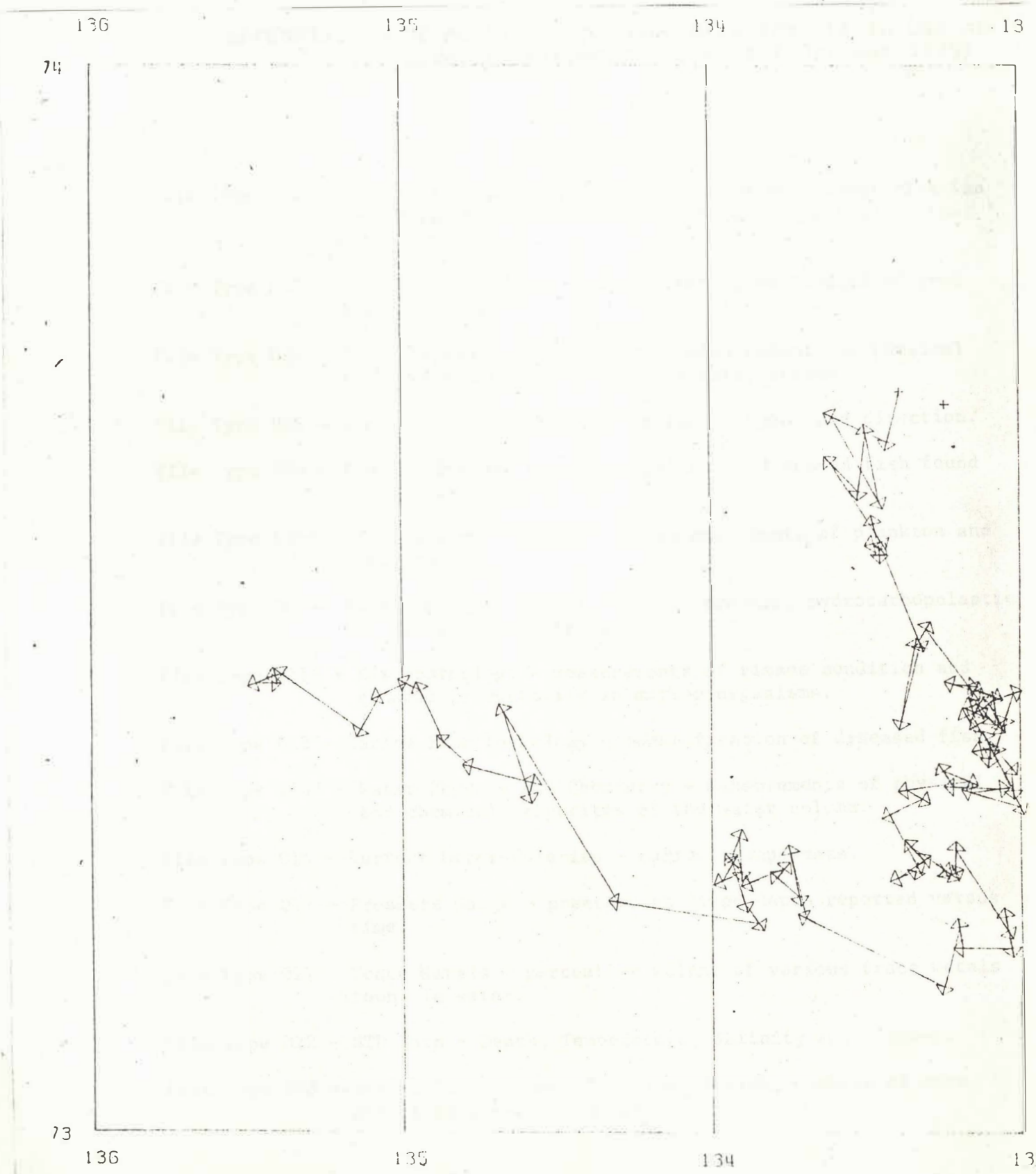


Figure 3. Track plot of Lagrangian drifter in Beaufort Sea.



APPENDIX. NODC Multidisciplinary Data Formats in Use or Under Development* (as of 2 October 1978)

File Type 001 - Metals in Organisms, Sediment and Water - identification of a metal in a particular sphere and specifics of that metal.

File Type 002 - Benthic Macrofauna - identification and counts of grab sampled fauna.

File Type 004 - Water Physics and Chemistry - measurements of physical and chemical properties of the water column.

File Type 005 - Aanderaa Current Meter Eulerian -- speed and direction.

File Type 006 - Fin Rot Disease - identification of diseased fish found and specifics of disease.

File Type 008* - Zooplankton - identification and counts of plankton and neuston.

File Type 009 - Bacteriology - counts of heterotrophic, hydrocarbonclastic and halophilic bacteria.

File Type 011* - Histopathology - measurements of tissue condition and gonadal productivity in marine organisms.

File Type 013 - Marine Fish Pathology - identification of diseased fish.

File Type 014* - Water Physics and Chemistry - measurements of physical and chemical properites of the water column.

File Type 015 - Current Meter-Eulerian - current components.

File Type 017 - Pressure Gauge - pressure at fixed depth reported versus time.

File Type 021 - Trace Metals - percent by weight of various trace metals found in water.

File Type 022 - STD Data - Depth, Temperature, Salinity and Sigma-t.

File Type 023 - Ground Fish - identification of fish, numbers of same and other descriptive data.

File Type 024 - Zooplankton - identification of zooplankton and associated measurements.

File Type 025 - Mammal Specimen - morphological measurements of mammals.

File Type 026 - Marine Mammal Sighting 2 - aircraft or shipboard sighting of marine animals.

File Type 027 - Mammal Sighting 1 - shipboard sighting of marine mammals.

File Type 028 - Phytoplankton Species - identification of phytoplankton and associated measurements.

File Type 029 - Primary Productivity - Carbon-14 assimilation and nutrient measurements.

File Type 030 - Intertidal Data - biological/geological measurements of the intertidal zone.

File Type 031 - Specimen and feeding studies - bird measurements and prey/predator relationships.

File Type 032 - Benthic Organisms - identification of organisms and related bottom measurements.

File Type 033 - Bird Sighting 1 - ship and aircraft census.

File Type 034 - Bird Sighting 2 - land census.

File Type 035 - Bird Colony - physiological and morphological measurements.

File Type 036 - Ship Follower - identification of aggregations of birds feeding on a concentrated food source.

File Type 038 - Migratory Bird Sea Watch - identification of migratory birds.

File Type 041 - Marine Bird Survey - counts and identification of birds and related environmental measurements.

File Type 043 - Hydrocarbon 1 - measurements in the water column.

File Type 044 - Hydrocarbon 2 - measurements in ogranisms and sediment.

File Type 049 - Primary Productivity II - Carbon-14 assimilation and nutrient measurements.

File Type 050 - Seabed and Water Column Respiration - measure oxygen uptake in seabed, water column and in organisms.

File Type 051 - Photosynthetically Active Radiation - experimental measurements at a fixed location.

File Type 052 - Mutagenesis - Cellular and related environmental measurements.

File Type 056 - Lagrangian Current Measurements - at surface and at depth.

File Type 057 - Herring - spawning and morphological measurements of herring.

File Type 059 - Microbiological Degradation - measurements of microbiological degradation of petroleum hydrocarbons.

File Type 061 - Trace Elements - identification of concentrations of elements found in organisms, sediment or water.

File Type 063 - Marine Invertebrate Pathology - identification of diseased invertebrates.

File Type 069 - Chemistry - measurements of biological/water column chemical parameters for DOMES Project.

File Type 072 - Beach profile - measure gradients from fixed reference point.

File Type 073 - Surficial Sediment Characteristics - description of sediment and size distribution.

File Type 074 - Mass Physical Properties of Sediment - description of bulk properties of sediment.

File Type 091 - Wave Spectra - measures properties of waves.

File Type 100 - Intertidal/Subtidal - identification of organisms in this zone.

File Type 101 - Wind Format - wind component measurements.

File Type 410 - Index of Relative Importance - information from publications on organisms and the prey they consume.