US Army Corps
of Engineers
Portland District

United States
Environmental Protection
Agency

Office of Water
Criteria and Standards Division
Washington DC 20460

June 1984

EPA-440/5-84-014

EPA

Environmental Impact Statement (EIS)

Draft

Coos Bay, Oregon Dredged Material Disposal Site Designation

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D C 20460

TO ALL INTERESTED GOVERNMENT AGENCIES,
PUBLIC GROUPS, AND CITIZENS

Enclosed for your review is a Coos Bay Dredged Material Ocean Disposal Site Designation Draft Environmental Impact Statement (EIS). The preparation of this EIS has been a joint effort of the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (CE).

A lawsuit filed by the National Wildlife Federation (NWF) challenged EPA's interim designation of ocean disposal sites. The lawsuit resulted in a Consent Agreement between EPA and NWF stipulating the preparation of EIS's covering the final designation of a number of ocean disposal sites, including those offshore of Coos Bay, Oregon. This EIS has been prepared in response to the requirements of the Consent Agreement.

The proposed action under consideration in this EIS is the final designation of Dredged Material Ocean Disposal Sites offshore of Coos Bay, Oregon. The EIS presents the results of environmental studies in connection with the preposed action. The studies were carried out by the Portland District, CE with cooperation of Region X, EPA.

The EIS was prepared by the Portland District, CE with Region X, EPA as a joint lead agency. However, because of the nature of the Consent Agreement, the EIS is being issued by EPA Headquarters as partial fulfillment of its responsibilities under that Agreement.

Patrick Tobin

Patrick Tobin, Director
Criteria and Standards Division

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

FOR

COOS BAY, OREGON DREDGED MATERIAL DISPOSAL SITE DESIGNATION

May, 1984

U.S. ENVIRONMENTAL PROTECTION AGENCY
CRITERIA AND STANDARDS DIVISION
WASHINGTON, D.C. 20460

SUMMARY SHEET

ENVIRONMENTAL IMPACT STATEMENT

COOS BAY DREDGED MATERIAL DISPOSAL SITES

(x) Draft
( ) Final
( ) Supplement to Draft

ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF WATER REGULATIONS AND STANDARDS

CRITERIA AND STANDARDS DIVISION

1. Type of Action

(x) Administrative/Regulatory Action
( ) Legislative Action

2. Background

Except for this summary sheet, this Environmental Impact Statement (EIS) was prepared by the Portland District, U.S. Army Corps of Engineers (CE) in cooperation with Region X, Environmental Protection Agency (EPA). It has been reviewed and accepted by Region X, EPA and the EPA Ocean Dumping EIS Task Force. The EIS is being issued by the Criteria and Standards Division, Office of Water Regulations and Standards, Office of Water, EPA as part of its responsibilities under the Consent Agreement with the National Wildlife Federation.

The Portland District, CE, acting as the lead agency, issued the notice of intent to prepare an EIS, carried out the necessary studies and coordination, and prepared the

Draft EIS. Region X, EPA worked with the Portland District in this effort as a cooperating agency. This joint effort, including EPA Headquarter participation, will continue through the processing of the Draft EIS public review and comment and the preparation and issuance of a Final EIS.

3. Brief Description of the Action and Purpose.

The proposed action described in this EIS is the final designation of two interim designated Ocean Dredged Material Disposal Sites (ODMDS) and the designation of a new ODMDS off Coos Bay, Oregon. The two finally designated existing ODMDSs would be used for the disposal of large grained sediments (dredged material) while the new site further offshore would be used for the disposal of finer sediments with higher volatile solids content. The purpose of the action is to provide environmentally acceptable areas for the disposal of dredged material, in compliance with the EPA Ocean Dumping Regulations and Criteria.

4. Summary of Major Beneficial and Adverse Environmental and Other Impacts.

The principle beneficial effect is the provision of designated environmentally acceptable ocean areas for the disposal of dredged material. Planning for dredged material disposal is enhanced since permanently designated ocean disposal sites are available for comparison with other dredged material disposal alternatives. An adverse impact will result from burial and loss of some bottom organisms within the sites. Burial of bottom organisms outside the site boundaries should not occur. Other adverse environmental effects such as mounding, changes in sediment texture, and disturbance of demersal fish, will be temporary, minor and restricted to the sites.

5. Major Alternatives Considered.

The alternatives considered in the site evaluation studies and presented in this EIS were: (1) no action; (2) final designation of the interim designated sites and one new site; and (3) alternative locations for a new ocean disposal site.

6. Comments have been requested from the following:

<u>Federal Agencies and Offices</u>

Council on Environmental Quality
Department of Commerce
  National Oceanic and Atmospheric Administration (NOAA)
  National Marine Fisheries Service
  Maritime Administration
Department of Defense
  Army Corps of Engineers
Department of Health, Education, and Welfare
Department of Interior
  Fish and Wildlife Service
  Bureau of Outdoor Recreation
  Bureau of Land Management
  Geological Survey
Department of Transportation
  Coast Guard
Water Resources Council
National Science Foundation

State and Municipalities

State of Oregon
City of Coos Bay
Coos County

Private Organizations

American Littoral Society
Audubon Society
Center for Law and Social Policy
Environmental Defense Fund, Inc.
National Academy of Sciences
National Wildlife Federation
Sierra Club
Water Pollution Control Federation

Academic/Research Institutions

Oregon State University

6. The Draft statement was officially filed with the Director, Office of Federal Activities, EPA.

7. Comments on the Draft EIS are due 45 days from the date of EPA's publication of Notice of Availability in the Federal Register which is expected to be SEP ~~2~~ 1984 .
11

Comments should be addressed to:

William C. Shilling
Criteria and Standards Division (WH-585)
Office of Water Regulations and Standards
Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Copies of the Draft EIS may be obtained from:

Criteria and Standards Division (WH-585)
Office of Water Regulations and Standards
Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

The Draft statement may be reviewed at the following locations:

Environmental Protection Agency
Public Information Reference Unit, Room 204 (Rear)
401 M Street, SW
Washington, D.C. 20460

Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, WA 98101

Portland District
U.S. Army Corps of Engineers
319 S.W. Pine
Portland, OR 97204

ENVIRONMENTAL IMPACT STATEMENT

TABLE OF CONTENTS

<u>LIST OF TABLES</u>

LIST OF FIGURES

PREFACE

The proposed action addressed in this Environmental Impact Statement (EIS) is final designation of dredged material ocean disposal sites (DMODS) in the vicinity of Coos Bay, Oregon. The purpose of the site designation process is to identify environmentally acceptable offshore sites for the disposal of dredged material from Coos Bay and vicinity, and to avoid or minimize adverse impacts especially in areas valuable to critical resources. A site designated for continuing use is subject to restrictions listed in 40 CFR 220-229 (Ocean Dumping Regulations). These restrictions include an in-depth environmental review of any proposed disposal activity. Designation in itself does not result in disposal of dredged material. A separate evaluation of the suitability of dredged material for ocean disposal is undertaken for each proposed site. However, ocean disposal cannot be considered in the absence of a designated site. In addition, monitoring of these sites may be required on a case-by-case basis depending upon specific dredged material and/or site characteristics.

This EIS presents information in regard to the acceptability of the DMODS proposed for final designation. The evaluations only compare ocean disposal sites and do not consider comparisons with other disposal options such as upland or in-bay. Upland or in-bay evaluations are conducted for each Section 103 permit disposal as required by the ocean dumping regulations. Present Corps procedures satisfy Section 103 requirements by routinely evaluating dredged material sediments on a 3 to 5 year basis.

The primary data bases for this EIS were disposal site evaluation and monitoring studies conducted by Oregon State University (OSU) under contract to the Corps of Engineers, Portland District (Corps). Additional data were obtained from a reconnaissance survey conducted by Interstate Electronics Corporation (IEC) under contract to the Environmental Protection Agency (EPA).

The OSU study was initiated in January 1979 and will be completed by June 1984. The study was conducted in 5 phases.

Phase I was a 12-month baseline study of the physical, chemical and biological conditions of the nearshore area off Coos Bay (an area of approximately 7,500 x 4,000 meters, extending out to the 40 meter contour and including Interim Ocean Disposal sites E and F) and of the Coos Bay channel from RM 15 to the entrance. The purpose of Phase I studies was to provide information that could be used to select candidate sites for detailed evaluation during Phases II and III. The criteria used in selecting candidate sites were:

a. Physical and chemical similarity (compatibility) of dredged material and site sediment type:

b. Avoidance of impacts on unique or valued biological communities; and,

c. Minimization of onshore transport of fine sediments.

Since the sediments from above RM 12 of Coos River were determined to be incompatible with sediments of the Phase I ocean study site, a need existed to conduct detailed studies at sites located further offshore. Therefore, Phase

II and III studies were conducted between April 1980 and June 1981 in an area of approximately 5,000 x 3,500 meters, and at depths ranging from 40 to 120 meters, which provided additional baseline data for final site designation.

Phase IV and V studies were initiated in July 1981 and are scheduled to be completed by June 1984. These studies investigated the effects of a 1981 test disposal at site H (53-66 meter depths) during and immediately following disposal and re-investigated the site during 1982 and 1983, to document post disposal effects.

The EIS is being prepared in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA), the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), the EPA, Ocean Dumping Regulations and Criteria, 1977 (40 CFR 220-229), and other applicable Federal environmental legislation.

The criteria used to assess the acceptability of proposed DMODS near Coos Bay were those established under Section 102 (a) of MPRSA. The 11 specific criteria established by EPA under 40 CFR 228 are included in Section 2 of this EIS for the comparison of alternative sites.

Although the action to be addressed in this EIS is ocean disposal site designation, the impact evaluation addresses the effects of disposal at or near the proposed sites. The primary use of the sites, in addition to Section 103 disposal permit activities, is anticipated to be disposal of material dredged from the Coos Bay navigation channel. As a result, the studies mentioned above and the EIS were based on the types and quantities of material dredged from the channel and adjacent areas. The sediments found in Coos Bay can be classified into the following three basic types:

1) Type 1 - Predominantly clean sand of marine origin typical of sediments from below Coos Bay river mile (RM) 12.

2) Type 2 - Finer-grained sand and silt containing some volatile solids typical of sediments from between Coos Bay RM's 12 and 14.

3) Type 3 - Highly organic fine material (6 to 20 percent volatile solids) typical of sediments from above Coos Bay RM 14.

These three types of sediments are representative of the types of sediments found throughout the estuary.

I. PURPOSE AND NEED

1.1 PURPOSE

The purpose of final ocean disposal site designation is to identify sites for the disposal of dredged material from the Coos Bay, Oregon vicinity, in accordance with the criteria established by EPA under Section 102 of the MPRSA (See Section 2). On the basis of these criteria, ocean disposal sites can thus be described as areas within the ocean where various physical, chemical, and biological impacts will be accepted. Use of the sites would be for disposal of material dredged for operation and maintenance of the Federally authorized navigation project at Coos Bay, and for disposal of dredged material from other dredging projects authorized in accordance with Section 103 of the MPRSA.

1.2 NEED

Coos Bay is a major center of commerce and industry for the State of Oregon. Within the Coos Bay Region, approximately 50 percent of the 20,000 available jobs are directly or indirectly dependent on shipping activities. In 1980, the volume of trade through Coos Bay was more than 6 million tons. The total number of deep draft vessels using Coos Bay during 1980 was 333. Consequently, maintenance of the navigation channel to authorized depths is critical to keeping the harbor open and sustaining these vital components of the state and local economy.

Approximately 1.5 million cubic yards of sedimentary materials enter Coos Bay annually from the Coos River and adjoining sloughs, and through the Coos Bay entrance channel. The Corps is responsible for planning and conducting the necessary maintenance dredging and disposal operations for the Coos Bay navigation system to its authorized depth. This requires that sediments be removed from the entrance channel and lower reaches annually and from the upper channel (above RM 12) every three to five years. The need for ocean disposal sites has become more critical in recent years as suitable upland disposal sites around Coos Bay are limited and most of these will be filled to capacity within 5-10 years (Channel Maintenance Dredging, Coos Bay, FEIS, 1976; Coos Bay Estuary Management Plan, Coos County, 1983; Personal Communication, L.N. Smith, COE Navigation Division, 1982).

EPA designated two sites off the mouth of Coos Bay in 1977 for interim use pending final site designation. Use of these interim-designated sites has been essential to the Corps' compliance with the MPRSA and its ability to carry out its statutory responsibility for maintaining the nation's navigable waterways. To continue these responsibilities it is essential that environmentally acceptable ocean disposal sites be identified, evaluated, and permanently designated for continued use.

II ALTERNATIVES COMPARISON

2.1 INTRODUCTION

This section discusses the alternative ocean disposal sites considered, including those considered but eliminated from further study, and no action; describes the sites considered with references to the specific criteria for evaluating ocean disposal sites required by MPRSA; provides an impact comparison of the alternative sites based upon their potential use; and outlines the preferred site designations.

Although the purpose of this EIS is to provide information necessary to designate sites for ocean disposal of dredged material at Coos Bay, Oregon, it should be understood that site designation in itself does not result in disposal of dredged material. The site designation process is a statutory requirement which defines ocean areas where disposal of acceptable material may be considered. Actual disposal in these sites can occur only after the requirement of separate evaluations are met. Thus the availability of a designated ocean disposal site is a prerequisite for approval of actual disposal in the ocean.

Section 2.6 presents information comparing the alternative sites using the 11 specific MPRSA site selection criteria. The MPRSA criteria evaluates the relative merits of the sites, however, this format does not lend itself to comparing impacts at the various sites based on their potential use. Section 2.7 provides such a comparison to illustrate the consequences of disposing different materials at the alternative sites. Section 2.8 describes the preferred action.

2.2 ALTERNATIVES CONSIDERED

Several potential ocean disposal sites have been identified during the various studies conducted for offshore disposal at Coos Bay and during preparation of this EIS (see Figure 2.1). These are: (a) the two interim-designated sites, (Sites E and F), located near the 10 fathom (18 m.) contour; (b) Site H located near the 35 fathom (55 m.) contour; (c) Adjusted Site H located near the 25 fathom contour; (d) Site G located at approximately 50 fathoms (91 m.); (e) a continental slope alternative at about 200 fathoms (364 m.); (f) combinations of the above; and (g) no action.

Sites E and F were considered since they are the sites approved by EPA in 1977 to be used on an interim basis pending final site designation. The location and dimensions of these sites were selected based upon reasonable distance from the Coos Bay entrance, depth of water, biological conditions, historical use, and estimated amount and type of dredged material. Sites G and H were considered since they are areas with bottom sediments similar to the finer materials dredged from above RM 12 in Coos Bay. Adjusted Site H was selected as an alternative to Site H to avoid impacts to shellfish beds. In addition, use of these sites reduces the potential for return of incompatible sediments to the estuary or beaches. The deepwater site was selected because EPA site selection criteria requires that a continental slope site be considered.

Ocean disposal effects were considered by evaluating the potential disposal of three types of sediments from the Coos Bay area. These were the clean sands of marine origin found from the Coos Bay Entrance to RM 12 of Coos Bay (referred to herein as Type 1 material), material from above RM 14 characterized by relatively fine grain size and relatively high organic solids contents (Type 3 material) and material from between RM's 12 and 14 that is intermediate in character between Type 1 and Type 3 material. This latter material is referred to as Type 3 material.

2.3 ALTERNATIVES ELIMINATED FROM FURTHER STUDY

The deepwater site has been eliminated from further study for the following reasons:

(a) The relatively clean (predominantly sand) sediments dredged from Coos Bay do not warrant selection of a site a greater distance from shore than is required to comply with MPRSA and related criteria.

(b) The transport cost associated with disposal at this distance would be extremely high and not economically justifiable compared to sites located closer to shore (see Section 4.).

(c) Site sampling and testing costs, and post-disposal monitoring costs, would likewise be extremely high due to distance from shore and depth of water.

2.4 EVALUATION OF THE NO-ACTION ALTERNATIVE

The No-action alternative would be to refrain from designating an ocean site, or sites, for the disposal of dredged material from Coos Bay. Existing sites are currently designated on an interim basis and the interim designation is scheduled to expire December 1984.

By taking no action, present sites would not receive a final designation, nor would an alternative ocean disposal site be designated. Consequently, an EPA recommended ocean disposal site would not be available in the area after December 1984. As discussed earlier, upland disposal sites are severely limited, therefore, without ocean disposal the authorized channel depths at Coos Bay could not be adequately maintained.

2.5 ALTERNATIVES CONSIDERED IN DETAIL

The two interim sites (Site E and F), the 35-fathom site (Site H), the 25-fathom site (adjusted Site H) and the 50-fathom site (Site G), each appear viable and have been considered in detail. These sites have therefore been selected for evaluation using the selection criteria established by the MPRSA.

2.6 COMPARISON OF ALTERNATIVES USING MPRSA SITE SELECTION CRITERIA

This section presents information on sites E, F, G, H, and adjusted site H relative to each of the 11 specific MPRSA site selection criteria. Each of the sites are evaluated, where appropriate, for disposal of Type 1, 2, and 3 dredged material. The information and analysis contained in this section was summarized from the more detailed information in Sections 3 and 4. A summary comparision chart is provided in Table 2.1. Please note that although sections 3 and 4 do not specifically refer to adjusted site H, the data and analysis prepared by OSU and presented in these sections cover an extensive offshore area which includes adjusted site H.

2.6.1 Geographic Location

Sites E and F are located approximately 1.5 statute miles offshore of the entrance to Coos Bay at depths of 10 and 12 fathoms, respectively. Adjusted Site H is located approximately 2.5 miles offshore at a depth of 25 fathoms. Site H is approximately 3.5 miles offshore at a depth of 35 fathoms and site G is located about 5 miles offshore at a depth of 50 fathoms. General locations of these sites are shown in figure 2.1 and centroid locations are given in table 3.1.

2.6.2 Distance from Important Resource Areas

Breeding, spawning, rearing of marine organisms, and passage of commercially important marine species occurs at all sites studied. In addition, a scallop bed is located between the 40 and 52 fathom contours. Species diversity and abundance of benthic invertebrates were directly related to water depth and sediment characteristics within the Coos Bay offshore disposal study area (Section 3). As depth increased and average sediment size became finer, species diversity and abundance of benthic organisms increased.

Sites E and F were characterized by benthic species adapted to high wave energy environments. Seasonal variability of benthic species was large. In contrast, site G had a large number of filter feeding bivalves indicative of a less dynamic environment. The benthic fauna of site G was the most diverse and had the largest numbers of individuals of the areas studies. Site H had species common to both the shallow (10 fathoms) and deeper sites (50 fathoms). Much seasonal variation in diversity and abundance was observed for the benthic community at site H. The benthic fauna of adjusted site H is most similar to sites E and F.

2.6.3 Distance From Beaches

Sites E and F are each located within 1.8 miles of a beach, adjusted site H is within 2.8 miles, site H is within 3.7 miles and site G is within 5.2 miles of a beach. The proximity of sites E & F to the beaches, coupled with the frequency of onshore transport and seasonal ocean currents parallel to the coast, contribute to a potential for onshore transport from these two sites.

Because of the increasing depths, distance from shore, and frequency of offshore currents, onshore transport of sediments from sites H, adjusted H, and G is less likely and dispersion would distribute type 2 and 3 sediments predominately offshore. The fraction of material moving onshore would not reach detectable volumes.

2.6.4 Types and Quantities of Material to be Disposed

As described in the preface to this EIS, there are three basic types of sediments from Coos Bay being proposed for ocean disposal. Type 1 sediments from Coos Bay entrance to RM 12 are predominantly clean sand of marine origin. Median grain size is relatively constant at 0.2-0.3mm and volatile solid content varies between 0.1 and 2.0 percent. Approximately 1.3 million cubic yards of this material are dredged annually. The second category of sediment (Type 2) lies between RM's 12 and 14. Median size here varies between 0.02 and 0.2mm and volatile solids content varies from 2 to 10 percent. Approximately 200,000 cubic yards of material are dredged annually in this area. Type 3 material (above RM 14) is highly organic, varying in median grain size from 0.006 to 0.02mm and from 6 to 20 percent volatile solids. Less than 200,000 cubic yards of this material is dredged every 3 to 5 years.

Future dredged material volumes may exceed present volumes if the navigational safety of the channel necessitates expanded dredging efforts or if other dredged material is disposed at the site. Any materials disposed at the sites must be within the capacity of the sites and must comply with EPA dredged material criteria in §227.13 subpart B of the Ocean Dumping Regulations (40 CFR 220 to 229).

It is anticipated that the dredged material will continue to be transported by hopper dredge equipped with a subsurface release mechanism. However, other means of transportation and release, consistent with the environmental requirements of the sites, may be utilized. None of the dredged material will be packaged in any manner.

2.6.5 Feasibility of Surveillance and Monitoring

Surveillance of sites E, F, H, adjusted H, and G can be made from shore facilities or vessels. Approaches to the estuary entrance, including Sites E and F are currently surveyed at least annually by the Corps with detailed bathymetric maps made available to the public. The surveyed area can be expanded to include sites H, adjusted H and G. Surveillance during heavy weather conditions is expected to be unnecessary since heavy weather curtails ocean disposal operations.

2.6.6 Dispersal, Horizontal Transport, and Vertical Mixing Characteristics of Area

All Sites: Average currents in the region generally flow parallel to bathymetric contours with downslope components predominating over upslope components near the bottom. Local current strength and direction, however, reflect the variability of local winds. Since weather conditions restrict ocean disposal operations to the period April through November, the predominant direction of transport of materials suspended in the water column will be southward at 10 to 30 cm/s in the vicinity of sites E, F, H and G. Northerly transport may occur at these sites in late fall. Current strength and direction of currents at these sites are highly variable in spring and fall. Sediments reaching the bottom would experience resuspension and spreading. Local currents at all sites can resuspend finer Type 3 materials year round. The coarser sediment Type 1 and 2 would be mobile year round near sites E and F. These coarse sediments would have some bedload movement in the vicinity of site H during the dredging season but resuspension during the remainder of the year would be limited to major storm events. These sediments would be stable year round in the vicinity of site G.

Sites E and F: All sediments disposed of at these sites would be rapidly reworked by strong tidal and surface-wave generated currents. Winter reworking would be especially intense, resulting in the erasure of any mounding and the distribution of coarser size fractions over the tidal delta. Finer size fractions would be transported with the mean currents. During the disposal season, there would be a greater tendency for shoreward transport of fines from site F than from site E where downslope transport predominates due to effects of shoreline configuration. Strong upslope transport, however, can occur at site E during late fall and winter.

Sites H, adjusted H, and G: The areal impact of disposal at sites adjusted H, H and G increases in proportion to depths doubling approximately every 20 fathoms. However, thickness would be substantially less and larger fractions of the dredged material would be initially suspended in the water column at the deeper sites. Type 3 sediments would be mobile at each site year round but only the finer fractions of Type 3 sediments would be mobile at site G. Mobilization of the coarser sediments at sites H and adjusted H would occur primarily during summer and winter storm periods.

Dredged material mound height per 100,000 cy of Type 3 sediments reaching the bottom of sites adjusted H, H and G would be measured in inches, with subsequent erosion occuring more slowly than at sites E and F. Portions of the mounds at sites adjusted H, H and G would be covered by local sources of moving sediments (a natural capping phenomena). Thus mounds at these sites would endure longer than a mound at sites E and F.

2.6.7 Effects of Previous Disposals

Sites E and F: Previous disposal at these sites has averaged about 975,000 cubic yards of Type 1 sediments annually. This disposal has produced a seaward extension of the tidal delta as evidenced by the noticeable seaward bulges in the bathymetric contours of the tidal delta in the vicinities of these sites. No topographic mound has developed at either site due to the strong year-round reworking of the disposed sediments. Short term increases in the turbidity of the water column occur, but such an impact has been very minor considering the clean nature of the historically deposited materials. No significant biological impacts have been associated with this disposal. Projected future disposals are shown in Table 2-1, page II-20.

Adjusted Site H: No previous disposal.

Site H: A test dump of approximately 60,000 cy of Type 3 material was made at site H during August 1981. Erosion as moving (capping) and mixing of the dredged material with native sediments was evident in August 1982. Within 19 months of the test dump, the disposal mound has been erased or mixed beyond recognition with native sediments. No acute conditions were observed during disposal for temperature, salinity dissolved oxygen, pH, oxidation-reduction potential or turbidity. Borderline acute toxicity conditions of some water column examples were observed for ammonia-nitrogen, copper and manganese. These conditions were of short duration. Sediment samples obtained one year and 1.5 years after disposal showed a definite trend of return to background conditions. The benthic community was significantly depressed in the area of disposal impact immediately after disposal. A steady recovery to predisposal abundance and diversity levels was observed for the benthic community during the 19 months of the post dump monitoring. No dump effects were observed for the infauna (Sollitt, et.al 1983).

Site G: No disposal has occurred at this site.

2.6.8 Interference with other uses of the ocean.

The only known commercial or recreational use of sites E, F, and adjusted site H is marine navigation. Disposal activities at these sites would have little effect on this use. Commercial fishing occurs in the vicinity of sites G and H but no significant impact would be anticipated. See Sections 3.4 and 4.4.3.

2.6.9 Existing Water Quality and Ecology.

Water quality analysis for surface and bottom water at all sites did not indicate an atypical or polluted condition for seawater of the Pacific Northwest, nor an atypical ecological condition. See Section 3. The ecology of the area is typical of most regions of the Oregon Coast. Distribution and abundance of pelagic fish is closely tied to the influence of the ocean currents, and the distribution and abundance of bottom dwelling organisms is tied to the character of bottom conditions. The group of greatest interest to this EIS is the benthic community since it is the group that would be most directly affected.

The abundance, diversity and species composition of the benthic community is tied to the character of bottom conditions. As water depth increases, sea floor currents and sediment grain size decrease while organic, chemical constituents, and biological abundance tend to increase. This relationship is well illustrated in the OSU Study. The benthic community in the near shore region had the lowest abundance and diversity of the sites studied. In addition, it was dominated by burrowing species and deposit or opportunistic feeders.

Much seasonal variation in distribution and abundance was observed of these species. This is to be expected in an environment characterized by major perturbations in sediment conditions due to high wave energy environments. This adaptation to adverse habitat conditions is however a desirable characteristic for proposing an area for ocean disposal.

In contrast, the region around site G was characterized by the most abundant and diverse benthic community of the sites investigated. The community was dominated by filter and surface feeders. This to to be expected in a habitat with stable sediment conditions and sediments having a high content of finer and volatile solids.

The zone between the nearshore and site G can be classified as a physical and biological transition zone. Species composition in the shallow regions is most similar to that of the nearshore region and vice versa. Seasonal variation in abundance is high.

2.6.10 Potential for Nuisance Species.

There are no known components in the dredged material or consequences of its disposal which would attract or deposit nuisance species to the proposed disposal sites.

2.6.11 Existence of Significant Natural or Cultural Features.

No known significant natural or cultural features exist at or near the alternative sites - see section 4.4.6 and Appendix C.

2.7 IMPACT COMPARISON OF DISPOSAL OPTIONS.

Four disposal options were considered for ocean dumping of dredged material at the alternative sites. These options were: 1) disposal of all types of dredged material at the interim sites E and F; 2) disposal of Type 1 material at sites E and F and disposal of Type 1 and 2 material at site G; 3) disposal of Type 1 material at sites E and F and disposal of Types 1 and 2 material at site H; and 4) disposal of Type 1 material at sites E and F and Type 2 and 3 material at adjusted site H (centroid at 25 fathoms).

The impacts associated with ocean disposal off Coos Bay, Oregon can be reduced to 5 general categories. These impact categories are 1) the volume of the material to be disposed, 2) the nature of the material, 3) the environmental (primarily benthic habitat) sensitivity of the site(s) considered, 4) the incremental increase in impacts over that associated with historical disposal options, and 5) the incremental increase in cost of disposal between sites.

Option 1. Disposal of all dredged material from Coos Bay at sites E and F.

These sites are located within 1.5 miles of the entrance to Coos Bay thus the cost of disposal of this option would be the lowest of the options considered. In addition there are no known features of environmental or historical significance in these two sites. These two sites are characterized by high energy bottom environments and benthic communities that have low species diversity and a high variance in seasonal abundance. These two sites are the least sensitive biological areas of the sites studied.

Disposal of type I material at sites E and F is acceptable because a) type I material is very similar to the native sediments in the areas, b) it meets all criteria of 40 CFR, 227.3(b) for ocean disposal without further testing and c) there is no record of significant impacts associated with historical disposal of type 1 material at these sites.

In addition disposal of type 1 material at any other site would result in long term bottom habitat changes. For these reasons disposal of type 1 material at sites other than E and F was not considered in the best public interest.

The disposal of either type 2 or 3 material at sites E and F is questionable since this material is physically and chemically dissimilar to the sediments of these sites. In addition there is the possibility that ammonia-nitrogen, copper and manganese levels may approach EPA standards of concern. High levels of turbidity could also result from disposal of type 2 and 3 materials at these sites. Toxicity conditions would be measured in hours but turbidity could be measured in days since the sediments would be continually reworked by the high energy bottom currents. Although the turbidity levels may degrade the esthetic environment, the addition of volatile solids to the sediments of sites E and F could result in an enhancement of the benthic community. As demonstrated by the OSU study there is a general correlation between higher volatile solids content and increased diversity of benthic species (Sollitt, et.al. 1983).

Option 2. Disposal of type 1 material at sites E and F and types 2 and 3 material at site G.

The primary difference in effects of this option and those associated with option 1 is the incremental impacts to the benthic communities and differences in turbidity effects. Economic impacts should not be of major concern since the increase in cost of transporting type 2 and 3 material to site G rather than dumping it at sites E and F is 16% (see Figure 4.1). Because of the greater depth of water at site G the possibility of short term (hours) acute toxicity conditions is reduced. Turbidity will be reduced below standards within 4 hours of the dump. Disposal of type 2 and 3 material at this site would be unacceptable because a) the area is characterized by the most abundant, diverse, and stable benthic community of the sites studied, b) the site lies near the scallop bed located between 40 and 52 fathoms and the predominant northerly currents would possibly erode type 2 and 3 sediments into the bed, c) the site is within the zone of commercial fishing and d) the low rate of sediment erosion from the area would result in the development of mounds of dredged material at this site.

Although type 2 and 3 sediments are most similar, of the sites studied, to the bottom sediments of site G, they remain measurably different (see Figures 3.5 and 3.6). Disposal of these materials at site G, coupled with the slow erosion rate at this site, would likely result in long term (months) changes in the substrate habitat of the benthic community. This effect would alter the benthic community composition in this area. Thus benthic impacts would be both direct and indirect.

Option 3. Disposal of type 1 material at sites E and F and disposal of type 2 and 3 material at site H.

The primary differences between this option and options 1 or 2 is biological effects. Economic impacts would not be significant since, the increase in cost of transporting type 2 and 3 material to site H rather than dumping it at sites E and F is 8% (see Table 4.1). Ammonia-nitrogen, copper and manganese effects would approach the standards of concern for short periods and turbidity conditions would dissipate within 4 hours of the dump (Sollitt et.al. 1983). These characteristics satisfy the economic and pollutant concerns of dumping type 2 and 3 material at this site.

Although type 2 and 3 material is dissimilar to the sediments of site H, this is the site the OSU study recommended for disposal of this material. Factors contributing to this recommendation are: a) material of concern would be diluted to below EPA standards; b) the predominant downslope and north-south currents effectively preclude resuspended sediments from being transported shoreward; c) benthic impacts would be substantially less than if the material were disposed of at site G; d) the seasonal and spatial variation of benthic organisms suggest that they are more tolerant to bottom disturbance than are species at site G (similarly species at site F should be even more tolerant) and; e) the downslope currents would contribute to a natural capping of the disposal material.

Although disposal of type 2 and 3 material outside H would appear acceptable, the western edge of the site encroaches into the southern boundary of the scallop fishery bed off Coos Bay. Resource agencies have recommended (meeting of Oct. 4, 1983) that if site H is proposed for use that its location be adjusted so that a buffer region is established between its western edge and the 40 fathom contour. (The ocean bottom between 40 and 52 fathoms is the area that scallops are found in densities high enough to support a fishery). We have therefore developed the following option in response to these concerns.

Option 4. Disposal of type 1 material at sites E and F and type 2 and 3 material at the 25 fathom contour (adjusted site H).

This option was considered in an attempt to avoid potential disposal impacts on the scallop bed located between 40 and 52 fathoms. This section would establish a buffer of approximately one nautical mile between the disposal site and the scallop bed. In addition, this adjustment would reduce benthic impacts since the site would be located in a zone with a benthic community characterized by lower diversity and abundance than at site H. The benthic impacts of disposal of type 2 and 3 material in this area would be similar to those predicted for disposal of the same material at sites E and F. Disposal at this site would also resolve the concerns for aesthetic impacts in that downslope transport of material predominates at this location. The estimated increase in cost of disposal of type 2 and 3 material at this location is approximately 4% greater than the cost of disposal of the same material at site F.

Because of the possibility that disposal of this material at this location will enhance diversity and abundance of the benthic community by introduction of fines and volatile solids into the area, it is difficult to predict a differential benthic impact between disposal here and at sites E and F.

2.8 PREFERRED DISPOSAL SITES AND DISPOSAL OPTIONS

Based upon our review of the available information and assessment of the relative impacts we recommend the designation of three sites off Coos Bay, Oregon for the disposal of dredged material. These sites are the interim disposal sites E and F and an adjusted site H with a centroid at approximately 25 fathoms. The coordinates of these proposed sites are given in Table 3.1. The location of these sites is also illustrated in Figure 2.1. The recommended use of these sites is disposal of type 1 material at sites E and F and disposal of type 2 and 3 material at the adjusted site H location.

Both sites E and F are needed to reduce the possible mounding that would occur from the proposed disposal of approximately 1.3 million cubic yards of type 1 material at one site, to maintain flexibility of disposal when currents change to reduce transport potential of sediments back into the channel entrance, and to reduce sea keeping hazards to the dredges during periods of adverse weather conditions.

The dimensions of the sites are determined by the anticipated spreading pattern of material dumped from hopper dredges in relation to the time required for disposal. These areas are considered to be large enough to encompass the impact zone of disposal. Based upon the expected erosion and dispersal rates associated with bottom currents these dredged materials will be dispersed within 1 to 3 years.

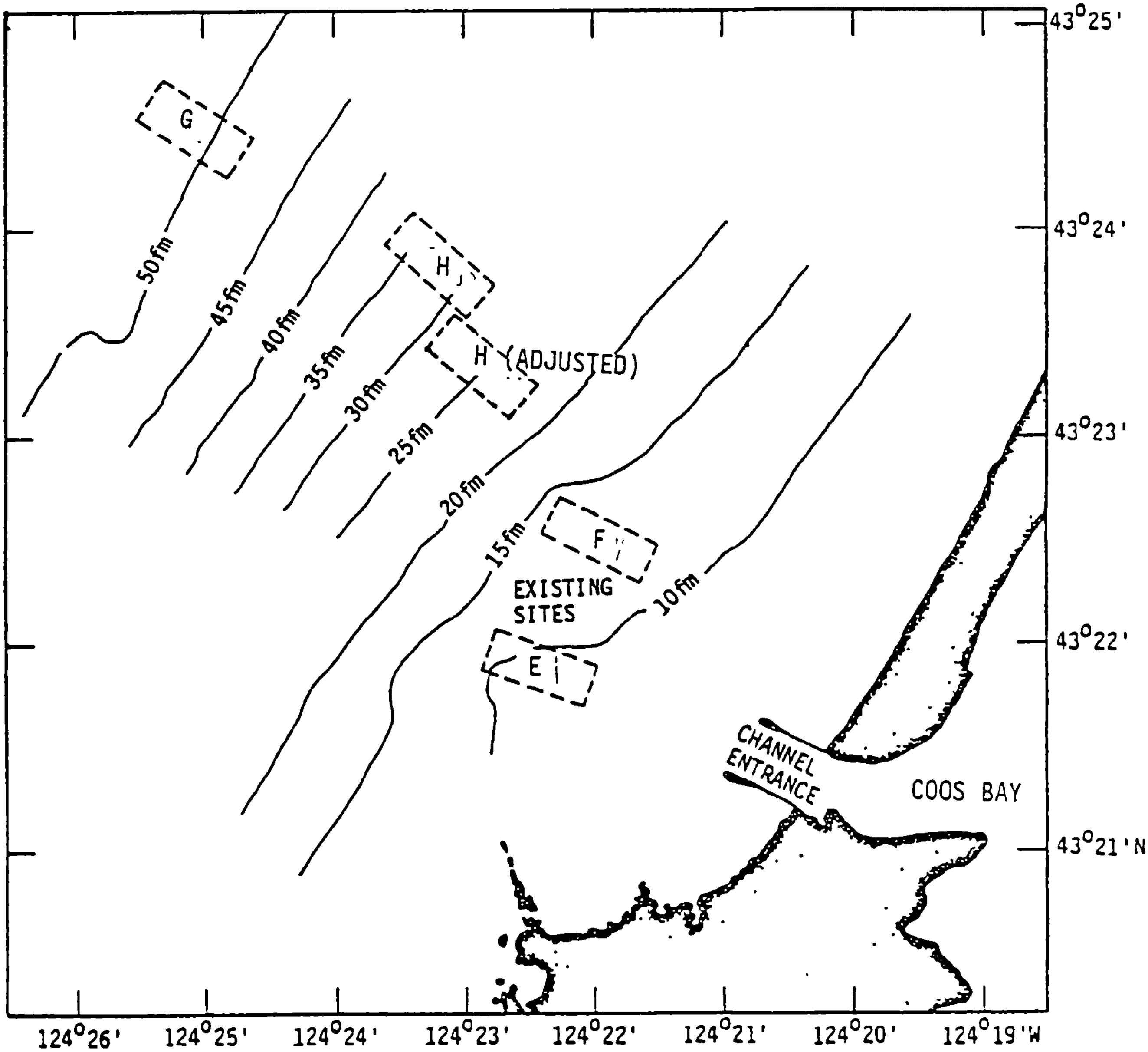


Figure 2.1 Alternative Disposal Sites Considered in Detail.

TABLE 2.1
SUMMARY COMPARISON OF ALTERNATIVE SITES USING MPRSA CRITERIA

Criteria as Listed in 40 CFR §228-6	E & F	G	H	Adjusted Site H
(1) Geographical Location	Within 1.5 s. miles of Coos Bay entrance. See Table 3.1 for centroid locations.	With 5.0 s. miles of Coos Bay entrance. See Table 3.1 for centroid location.	Within 3.5 s. miles of Coos Bay entrance. See Table 3.1 for centroid location.	Within 2.5 s. miles of Coos Bay Entrance. See Table 3.1 for centroid location.
(2) Location Relative to Important Resource Areas	Low density benthic community some breeding, feeding, rearing and passage of motile species over entire area. Little fishing activity.	Most abundant and diverse benthic community of sites studied. Depth corresponds to zone of increased fish activity. Scallop	Similar to E and F, but has a greater diversity of benthic species and some fishing activity occurs in area.	Similar to Site F.
(3) Distance from Beaches	Close to beaches (about 1.8 mi); onshore transport potential is likely.	Major sediment transport is downslope. Little opportunity for upslope transport, onshore transport or impact.	Major sediment transport is downslope. Little opportunity for onshore transport or impact.	Similar to Site H.
(4) Types & Quantities of Materials	Clean sands with average sediment size similar to bottom sediments. Approximately 1.3 million cy annually projected for Sites E & F.	Same as Site H.	Fine grained sands with high organic solids content. Approximately 200,000 cy annually from above RM 12 projected for area on a 4 to 5 year cycle.	Same as Site H.
(5) Surveillance and Monitoring	Surveillance and monitoring easy due to nearness to shore, shallowness of sites, and availability of historical data.	Similar to that for Site H except that monitoring would be more expensive due to distance from shore and greater depths.	Similar to sites E and F.	Same as Site H.
(6) Dispersal, Horizontal transport, vertical mixing.	Rapid settling of sands. No presistent turbidity plume. Resuspension of material will be at a maximum during winter storms. Predominant transport direction will be southward at 10-30 cm/s. Sediments will be mobile year round due to high energy conditions.	Similar to that for Site H.	Similar to that for Sites E and F, except that downslope transport of bottom sediments predominate over upslope transport. Maximum depth averaged suspended sediment concentration expected 0.004 percent by volume.	Similar to Site H.

TABLE 2.1 (Continued)

Criteria as Listed in 40 CFR §228-6	E & F	G	H	Adjusted Site H
(7) Effects of Previous Disposal in Ocean	Some seaward expansion of river delta, no significant long term, effects on fauna of area.	No previous disposal here.	No acute conditions were observed during disposal for temperature, salinity, dissolved oxygen, pH, oxidation-reduction potential, or turbidity. No significant mounding was observed. The benthic community was significantly affected immediately after disposal but recovered to predisposal conditions after about 19 months	No previous disposal.
(8) Interference with other uses of the ocean	No interferences recorded for interim disposal and none expected for future. Areas outside zones of commercial activity except navigation.-	Area is within the zone of major commercial fishing and shellfish beds. No known mineral deposits in area.	Area is outside of major zone of commercial activity. Adjacent to shellfish beds. No known mineral deposits in area.	Similar to Sites E and F.
(9) Existing water quality and ecology	Water quality typical for seawater of the Pacific Northwest. Benthic community characterized by low abundance and diversity and adaption to unstable sediments.	Same as Sites E and F. Most abundant and diverse benthic community of sites studied.	Same as Sites E and F. Ecological transition zone between sites F and G.	Similar to Site F.
(10) Potential for nuisance species	Uncontaminated sand does not contain material which would attract nuisance species.	Same as for Site H.	Contaminants expected to be below standards therefore no nuisance species expected.	Same as for Site H.
(11) Existence of significant natural or cultural features	No known features.	No known features.	No known features.	No known features.

III AFFECTED ENVIRONMENT

3.1 INTRODUCTION.

This section provides a detailed base description of the existing conditions in the areas that would be affected by ocean disposal of material dredged from Coos Bay, and a general description of the Coos Bay socio-economic environment. In addition, this section includes a detailed description of existing sediments typically found in Coos Bay. The primary information base for the physical and biological descriptions is from reports provided to the Corps of Engineers, Portland District (Corps) by Oregon State University (OSU) in compliance with requirements of "The Coos Bay Offshore Disposal Site Investigation", Contract Number DACW57-59-C0040. Chapter 3 tables and figures are included at the end of this section.

The Coos Bay Offshore Disposal Study was initiated in 1979. The study area encompassed the two interim disposal sites (E and F) at the 10 fathom (17-20 meter) and 12 fathom (20-26 meter) contours respectively, (site H) at the 35 fathom (53-66 meter) contour, adjusted site H at the 25 fathom (44-58 meter) contour and site G at the 50 (90-97 meter) fathom contour. Location descriptions of these sites are given in Table 3.1 and Figure 3.1. Please note that although this section does not specifically refer to adjusted site H, the data gathered by OSU and presented in this section covers an extenive offshore area which includes adjusted site H. In general, the physical and biological characteristics of adjusted site H represent a transition between sites F and H.

The study area was divided into two segments based upon depth. The area extending to the 40 meter contour is referred to as the nearshore area, which includes sites E and F, and is approximately 12 square miles in size (7,500 by 3,900 meters). The area extending from the 40 meter contour to the 120 meter contour is referred to as the offshore area. This area includes sites G, H and adjusted site H and is approximately 7 square miles in size (5,100 by 3,600 meters).

The nearshore and offshore study areas are approximately 36 and 23 times larger, respectively, than the area of the two interim disposal sites. This size of a study area provides the opportunity to not only describe the conditions at a proposed disposal site but also its immediate environs. This allows for a better interpretation of the possible effects and a greater flexibility in determining final site locations and sizes.

The OSU study proceeded in distinct phases designed to address the 11 specific and 5 general criteria required in the Federal Register and discussed in this EIS. The objective of the first phase was to obtain a comprehensive description of the physical, chemical, and biological conditions of the study area. The objective of the second phase of study was to concentrate on the collection of physical, chemical, and biological information in the vicinity of the ocean sites. This phase provided baseline data for the evaluation of the effects of a test disposal of dredged material. Results of test disposal monitoring are contained in phases four and five of the OSU study. Data was not collected at site E in the second phase since conditions at sites E and F were so similar. The data collected by OSU duing February 1979 through May 1980 form the principal physical, chemical and biological information base of this EIS.

Interstate Electronics Corporation (IEC) under contract to EPA conducted a single survey of the Coos Bay interim ocean disposal sites and environs during 26 April to 1 May 1980. Data from the IEC Report of Field Survey (1982) is incorporated into the EIS where appropriate.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Bathymetry of Disposal Site Area

The continental shelf off Coos Bay is some 22 km wide. Regional offshore bathymetric contours generally run northeast-southwest parallel to the coastline (Figure 3.2). Nearshore contours bulge seaward off the entrance to Coos Bay, reflecting the presence of the river delta, the disposal of dredged materials, and the Cape Arago landmass (Figures 3.1 and 3.2). The top of the foreslope of the river delta is at about 24 m and its base is at about 42 m, relative to mean lower low water. The two interim sites are located on the oceanward limits of the river delta and are clearly defined by seaward bulges in the foreslope contours to some 42 m depth. Sites G and H lie offshore of the influence of the river delta. The deepwater site lies on the continental slope some 30 km off the entrance to Coos Bay.

3.2.2 Disposal Area Sediments and Sediment Transport

Hancock et al (1981) and Nelson et al (1983) report that nearshore sediments to approximately 70 m depth are clean fine sands of marine origin with median grain diameters of 0.15 to 0.20 mm and less than 1.5 percent of volatile solids (Figures 3.3-3.6). The uniform nature of these highly mobile sands reflects the winnowing action of surface waves and tidal and wind-driven currents. Coarser sediments are found in the river delta to depths of about 42 m. These sediments have median grain diameters in excess of 0.20 mm, volatile solids concentrations are as low as 0.2 percent and owe their character to the combined influences of their nearness to the source of coarser river materials, strong ebb currents from the estuary, and the disposal of river and entrance materials during dredging operations. IEC (1982) reported similar findings. Volatile solids concentrations increase rapidly beyond the river delta to between 2 and 3 percent and gradually increase with increasing depth. Between the foreslope of the tidal delta and 70 m, the sediment is relatively uniform in grain size and volatile solids content. Below 70 m depth, grain size decreases and volatile solids concentrations continue to increase due to the decreasing influence of surface waves and ebb currents from the estuary entrance as depth increases. Mixed sand and mud covers the continental shelf in this region out to the shelf break at about 170 m. Muddy sediments cover the continental slope. (OSU, 1977, p. 17).

Figure 3.6 presents averaged median grain sizes and volatile solids percentages for three seasons of resampling at 5 stations in the vicinity of sites F, G, and H. The error bars indicate the standard deviation of station mean values relative to the overall mean. Also included are graphic boundaries that contain all sample medians for each site. The seasonally-averaged median grain sizes for the areas around sites F, H, and G are 0.26 mm, 0.16 mm, and 0.08 mm, respectively, and volatile solids average 0.53 percent, 1.06 percent, and 2.56 percent by weight. Winter sediments are somewhat more poorly sorted than average due to the presence of fines settled from discharged estuarine waters. The average volatile solids content at all sites is at a minimum in summer and at a maximum in winter with the contrast most clearly developed near site H. Spatial variability in volatile solids content is also highest near site H with the area near site F having least spatial variability. The greater seasonal and spatial changes in volatile solids near site H and various grain size statistics suggest that the area near site H experiences a greater variability in fine-grained material than the area around sites F or G. Site F and G sediments are more poorly sorted than sediments near site H. The variability near site F reflects the nature of the river delta sediments and possibly the effects of dredged material disposal. The variability near site G is in part due to the increasingly quiescent environment that allows a broader spectrum of grain sizes to settle out, and the periodic input of fine sands from shallower regions during periods of heavy wave action coupled with an offshore component of the current. The well sorted nature of material near site H is consistent with the nature of nearshore fine marine sands.

Hancock et al. (1981) performed detailed bulk sediment chemical analysis on offshore sediments. In general, both water and volatile solids fractions increase with distance from the estuary entrance. This correlates with decreasing grain size. Chemical concentrations in these offshore sediments are similar to those of the less contaminated lower estuary sediments and significantly lower than concentrations in upper estuary sediments.

Nelson et al. (1983) present detailed sediment chemical analyses for the three disposal sites F, G, and H (Table 3.6). Parameter levels are consistent within a site and obvious differences exist between sites. No chemical analysis at any site appeared atypical or indicative of a polluted condition. Site F sediments have higher solids content, lower volatile solids, and generally lower levels of all chemical parameters as compared to the other two sites. Volatile solids levels and most chemical parameter levels increase with depth and decreasing grain size such that site H has levels intermediate with sites F and G. Concentrations of copper, iron, lead, manganese, and zinc showed a strong inverse correlation with mean grain size.

3.2.3 Coos Bay Sediment and Sediment Transport

Sedimentation in Coos Bay channel has averaged about 1,300,000 cubic yards annually downstream of RM 12. Entrance sediments comprise some 976,000 cubic yards annually (75 percent of the total). Sedimentation upstream of RM 12 depends upon annual rainfall and runoff impacts on the local drainage basin (Louis Smith, COE, personal communication). Between RM's 12 and 14 some 289,000 cubic yards may accumulate in a given year. Sedimentation above RM 14 is more variable but may be as much as 164,000 cubic yards in a given year (see Table 3.2).

Estuarine sediments are predominantly clean fine sands of marine origin in the lower bay and navigation channel below RM 14 but become finer and more organic in the upper bay and in sloughs. Median grain size in the lower bay is relatively constant at 0.2-0.3 mm between the estuary entrance and the Coos River (Figures 3.5 and 3.7). Sediment above RM 14 (Type 3) is at least one order of magnitude finer - 0.02 to 0.006 mm. Volatile solids content increases from less than 1% at the estuary entrance to about 6-20% at river mile 15 in the Coos River (Figures 3.5 and 3.8). Type 3 sediment organic levels are up to five times the levels in the lower Coos River. The finer grain size and higher organic content of Type 3 sediments reflect the limited tidal exchange between sloughs and the estuary, the lack of significant inflows of fresh water in sloughs, the proximity of clearcut areas that act as sources of fines, and plentiful local sources of organics from log rafts, chip piles, etc. The tidally-induced currents in the main navigation channel are sufficiently strong to transport fine sediments in suspension, thereby maintaining relatively uniform grain size and low organic content over its length.

Hancock et al. (1981) conducted a detailed chemical analysis of sediments in and adjacent to the Coos Bay navigation channel (Figure 3.9). Both bulk sediment (Tables 3.3 - 3.5) and elutriate chemical (Appendix D) analyses were performed. With the exception of total sulfides, there was no apparent consistent chemical difference between sediment in the navigation channel and adjacent subaqueous sediments. The total sulfide level was higher in non-channel sediments, reflecting lower turnover rates in areas removed from the navigation channel (OSU, 1977b) but no free sulfides were detected. One non-channel sample from above RM 14 had elevated total concentrations of cadmium, lead, and zinc. Two other side-channel samples in the mid-estuary had detectable PCB concentrations. Elutriate test results were also generally comparable for adjacent and mid- channel samples. Cadmium was released from several samples in concentrations high enough to exceed EPA's 5 ng/ml criterion. Manganese concentrations from samples of Type 2 and Type 3 sediments were also above the 100 ng/ml maximum for shellfish protection (EPA 1976). Dilution by a factor of 35 would bring cadmium and manganese levels into compliance.

It is clear that the major chemical contamination occurs in the upper reaches of Coos Bay and in sloughs. As shown in Figure 3.8, total and volatile solids increase with distance from the estuary entrance. This correlates with a decrease in median grain size and reflects lower energy regimes for wave, tidal, and river flows in the upper estuary. In fact, nearly all chemical parameters increased as the sediments became finer. Type 3 sediments are clearly more polluted with total sulfides, reduced sulfides capacity, ammonia-nitrogen, oil and grease, petroleum hydrocarbons, and trace metals than are sediments from below RM 14. Figure 3.5 and Tables 3.3 to 3.5 from Hancock et al. (1981) detail sediment chemical characteristics.

Elutriate samples from navigation channel sediments did not exhibit the increase in bulk sediment chemical concentration with increasing distance from the entrance. In fact, there appeared to be a poor correlation between total sediment contaminant levels (Tables 3.3 - 3.5) and their solubility during resuspension as measured by the test (Appendix D).

3.2.4 Hydrography

Coastal waters off Coos Bay may be divided into three watermasses that have typical ranges of salinity and temperature (Conomos et al. 1972, Huyer and Smith 1977). These are the surface oceanic, subsurface oceanic, and Coos Bay watermasses. The subsurface watermass has salinities in excess of 33.4 ppt and temperatures below 8°C. It is overlain by the surface watermass which has salinities lower than 32 ppt and strong seasonal temperature changes of up to 6°C. The boundary between these watermasses is a strong vertical salinity gradient between 100 and 200 m depth. Winter cooling and wind-induced vertical mixing produce a uniform surface watermass of 6°C to depths of about 100 m. Summer warming may then develop a strong seasonal thermocline within the surface watermass which results in an intermediate temperature minimum near the top of the permanent salinity gradient. The Coos Bay watermass consists of the plume of lower salinity water that extends from the estuary mouth. Upwelling during the spring and summer brings subsurface water to the surface along oceanic "fronts" (surfaces defined by strong thermal and salinity gradients). The scale and duration of these events are extremely variable but upwelling keeps surface waters relatively cool (about 10°C) through the summer. With the cessation of upwelling in early fall, surface temperatures rise to 15°C, then decrease to 10°C in the winter. Bottom temperatures also decrease during the upwelling due to the upslope movement of subsurface waters to replace upwelling shelf water.

Turbidity within the water column maximizes near the bottom, at the top of the permanent pycnocline, and in the surface waters (Harlett, 1972). It has been postulated that bottom turbidity results from the resuspension of bottom sediments by surface and internal waves and from the downslope movement of turbid waters from the surf zone. The intermediate turbid layer results from materials settling from surface layers and from the surf zone. The Coos Bay watermass would also contribute turbid waters to surface layers during periods of high runoff as would dredged material disposal operations.

3.2.4.1 Currents and Tides

Coastal circulation reflects the combined influences of seasonally-reversing regional currents and winds, the tides, and other periodic phenomena. The California and Davidson currents determine seasonal transport along the Oregon coast (Sverdrup et al. 1942). The 500-km wide California current flows southward parallel to bathymetic contours over the entire Oregon continental shelf during the spring and summer with average speeds of 10 cm/s. Northerly and northwesterly winds reinforce this flow with maximum current strength in the spring. Strong vertical velocity gradients characterized the lower half of the flow (Huyer et. al. 1975). Under the influence of southeasterly winter winds, this shear layer expands upward and shoreward until northward flow results (Sobey 1977). Ultimately, this northward flow develops into the 150-km wide Davidson current that lies between the shore and the southerly flowing California current. Circulation over the continental shelf is now northward parallel to isobaths and currents are nearly uniform throughout the water column. Upwelling from February through July weakens and ultimately destroys the Davidson Current to some 200 m depth. Net transports above this depth is thereafter southward as an extension of the California current. The Davidson current persists below that depth on the outer continental shelf with speeds up to 20 cm/s and is probably responsible for the strong velocity gradients that develop in the deeper inner shelf waters in summer.

Detailed current measurements in the study area by Hancock et. al. (1981) and Nelson et. al. (1983) conforms to the generalized circulation scheme just presented. Current strength and directional variability reflect the variability of local surface winds. Mid-water currents (those measured at one-third the depth) and near-bottom currents are generally between 10 and 20 cm/s in the vicinity of sites F, H, and G. Mid-depth summer median currents near site F are slightly stronger (20 to 30 cm/s) while median winter and spring currents near sites F and H may be between 30 to 60 cm/s. Comparable currents near site G are 20 to 30 cm/s.

Water transport is generally parallel to bathymetric contours although estuarine circulation and the shoreline configuration tend to produce significant onshore and offshore flow in the upper water column near sites E & F, and between site E and Cape Arago, respectively. Springtime upwelling may also be responsible for shoreward-directed mid-depth mean currents affecting the vicinity of site G and, presumably, site H. Near-bottom currents exhibit higher variability in direction than do mid-water currents but downslope flow components predominate over upslope flow. Downslope flow is clearly present near the bottom in summer along the toe of the river delta and between Cape Arago and site E. Strong downslope movement may also occur in the vicinity of site H throughout the winter and to a lesser extent in the vicinity of site G. Upslope flow can occur between Cape Arago and site E during spring upwelling or winter periods of strong northerly flow of the Davidson Current.

Annual and seasonal variations in atmospheric conditions determine the regional circulation just described. Superimposed upon this slowly-varying circulation are periodic currents due to the tides, inertial currents, internal waves, etc. While variations in wind speed and direction for periods longer than 2.5 days are reflected in surface currents, shorter period variations can give rise to inertial currents (Huyer and Patullo, 1972).

Inertial currents have periods of 17.4 hours and speeds up to 10 cm/s (Cutchin and Smith, 1973). Tidal curents with amplitudes of several tens of cm/s occur at periods of 12.4 and 24.8 hours. Other periodic circulation features include shelf or topographic (Rossby) waves that propagate northward with periods of 4.5 days and, possibly, southward with periods of 7.1 days. Internal waves of varying periods and wavelengths can propagate along the permanent and seasonal pycnoclines, causing short-term current oscillations in the order of an hour. When stratification abruptly decreases, as during upwelling events, internal waves become unstable and cause increased vertical mixing in the water column. It is also probable that breaking internal waves can cause sediment resuspension where the pycnocline intersects the continental shelf.

3.2.4.2 Surface Waves

The prevailing wave direction off Coos Bay is from the west. Summer waves approach from the west-northwest and littoral transport of beach sediments is to the south. During the remainder of the year, waves approach from the west and southwest driving littoral transport to the north. Significant wave heights - the average of the highest one-third of all waves - range from a little over 1 m during the summer to over 3.5 m in winter with corresponding changes in wave period. Detailed observations have shown that wave-induced currents average between 30 and 60 cm/s year-round in the study area (Hancock et al. 1981). Speeds up to 120 cm/s or more were observed during the winter.

3.2.4.3 Wind Direction and Speed

Prevailing winds are from the south-southeast in January, averaging 5.5 m/s, from the north-northeast for June through September at 5.2 m/s, and from the southeast at 4.6 m/s during the remaining months (Figure 3.10). Wind speeds and directions are most variable during March, April and September. Significant geomorphic effects of the Cape Arago headland and different methods of observation cause local wind statistics to differ significantly in direction and speed from observations at the offshore National Oceanic and Atmospheric Administration (NOAA) data buoy. Since the Coos Head records appear more similar to those of earlier observations (Duxbury et al., 1966), the Coos Head observations are considered more appropriate for the study of local processes (Hancock et al 1981). The NOAA buoy records are likewise more appropriate to open ocean studies of wind generated waves and currents.

3.2.4.4 Water Quality

Table 3.6 presents the results of water quality analyses for surface and bottom waters in the vicinity of sites F, G, and H for each of the four seasons (Nelson et al. 1983). Tests for heavy metals and pesticides did not indicate an atypical or polluted condition for any water sample. Salinities characteristic of the surface watermass were observed throughout the water column at all three sites in June 1980, at all but the bottom near site H in August and December 1980, and only in the surface for all sites in April 1981. The occurrence of higher salinities at the bottom in the vicinity of site H as compared to the vicinity of site G is unexplained for August and December 1980. The April 1981 samples imply recent upwelling while the June 1980 samples suggest the development of the surface watermass and the absence of upwelling.

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Introduction

OSU biological studies of the Coos Bay offshore study concentrated on sampling benthic invertebrates, epibenthic macro-invertebrates, and fish of the study area. Benthic invertebrates were sampled with a 0.096-meter squared box core. Sediment samples were taken at the same time. Epibenthic invertebrates and fish were sampled with a Ballon-Otter Trawl and a one-meter beam trawl.

During the first phase of the study, box core sampling locations were randomly located throughout the study area in such a method as to comprehensively cover the area (Figure 3.11). Trawls were taken in a similar manner (Figure 3.12). During the second phase of the OSU study, box core sampling was concentrated in and about the location of the northern interim disposal site (site F) and two possible candidate disposal sites in the offshore area (including sites H and G)(Figure 3.13). Trawl sampling was also concentrated across and near the three study sites (Figure 3.13). Figure 3.14 illustrates the sampling locations established by IEC during April and May 1980.

3.3.2 Benthos

The distribution, abundance and species of benthic invertebrates in the study area were typical of habitats that vary from a coarse-grained sediment with high levels of bottom turbulence in nearshore areas, to a fine-grained/marine mud sediment region with a low level of bottom turbulence. A total of 321 benthic invertebrate species were collected in the study area, and their distribution is associated with the three major sediment patterns of the area.

The nearshore region (depths of 10 to 40 meters), as noted in previous sections, is characterized by high wave energy, high bottom turbulence and coarse-grained sands. Figures 3.15-3.18 illustrate seasonal dynamics of habitat charactertistics of the nearshore region. The benthic fauna in this region, while diverse, show a considerable degree of seasonal variation in abundance.

Dominant benthic invertebrates in the nearshore region during the first phase of the study were carnivorous snails (Olivella spp.), a clam (Tellina modesta) and several species of polychaete worms and amphipods. Figures 3.19 and 3.20 illustrate the variation in the distribution of carnivorous snails (Olivella) and the clam (Tellina modesta) between two sampling periods of the nearshore area. Similar seasonal variations were also observed for the other species mapped (see Hancock, et al., 1980).

Results of the Phase II benthic sampling in the nearshore region showed a low abundance and relatively high variation of polychaete, mollusc, and crustacean species between the five sampling stations in and about site F (Figures 3.21 to 3.23). These abundance patterns are consistent with the data collected in the nearshore area during the Phase I work. Figure 3.24 shows the benthic abundance at 9 stations of the nearshore as sampled by IEC in 1980 (IEC, 1982).

Hancock, et al, 1980, reports that the offshore region lying between the 45- and 65-meter contour is a transition zone for both faunal and sediment characteristics. This area has a high species diversity and a mix of sediment types from coarse to fine sands. Polychaete and mollusc species abundance during the second phase of the study were highly variable between the five sampling stations. This variability was strongly associated with sediment characteristics and location within the sampling area (Figures 3.21 and 3.22). In contrast, the five most abundant crustacean species did not vary greatly between the five sampling stations (Figure 3.23).

The sediments lying between the 70- and 120-meter contours are relatively stable. The sediment types in this area grade from fine sand to marine mud. The distribution of the abundant benthic species collected during the first phase of the study indicate a zonal distribution. (Figures 3.25 and 3.26). These figures also illustrate a separation in abundance of animals between the 45- to 65-meter contour area and that for the 70- to 120-meter contour area. Similar zonal patterns were observed for other species (Hancock, et al., 1980).

Hancock, et al., 1980, reports that those patterns are likely the result of competition between sympatric species, affinities to sediment types, and, in some cases, to volatile solids distribution patterns.

Results of the Phase II benthic sampling in the vicinity of site G showed significant variation between stations for polychaete, bivalve, and crustacean species, but no significant variation for gastropod species (Figures 3.21 to 3.23). The more abundant benthic species in the area of site G differed from those near either site F or H. Total abundance of crustaceans in the site G vicinity was lower than the site H vicinity, but higher than that near site F. Species richness near site G was greater than that observed near sites F or H.

3.3.3 Epibenthos and Fisheries

Seventy-nine epibenthic invertebrates and fish species were collected by OSU during the period of April 1979 through May 1981 (see Hancock et al., 1980, and Nelson, et al., 1983). Fifty-two of these species were vertebrates and 17 were invertebrates. Epibenthic sampling during April 1979 through March 1980 was accomplished using a Ballon-Otter trawl. During the May 1980 through May 1981 period, a beam trawl was used.

Tables 3.7 and 3.8 show the most abundant epibenthic species and the number of species collected at various depths by OSU during 1979-1980 and 1980-1981. Fish were mostly "0" age class suggesting that the study area is used by these species as spawning and rearing areas. The absence of fish of older age classes, however, may reflect more trawl avoidance than absence of these fish in the area. The most common fish caught were flatfish (sanddabs and sole).

The number of species collected during each of the epibenthic sampling periods was relatively constant for all periods and depths sampled (Tables 3.7 and 3.8). Approximately twenty species were collected in each of four trawls during 1979 and 1980, and 25 to 30 species were collected in each of 15 trawls in 1980 to 1981. Because of the low number of individuals for most species, it is difficult to ascertain if there were real differences in use of areas by species.

Hancock, et al. (1980), indicates that the distribution of flatfish within the area may be the result of fish that recently settled out of the plankton in the nearshore area (inside the 40-meter contour) and movement out of the nearshore area as the fish increase in size. Hancock reports that the distribution of shrimp in the study area also reflects a seasonal movement pattern, with these animals moving back and forth between nearshore and offshore areas.

Because the OSU sampling methods did not sample for adult fish effectively, information collected by Oregon Department of Fish and Wildlife (ODFW) is used to illustrate the distribution of some species of commercial importance.

As shown in Appendix B, most of the commercially important species sampled were more abundant at depths greater than 100 fathoms (183 meters) off Coos Bay in September. The exceptions were rockfish, cod, and shrimp which are fished closer inshore. The scallop fishery that developed off Coos Bay was located between the 40 and 50 fathom contours with its southern extent near sites G and H.

3.3.4 Marine Mammals

A number of species of marine mammals occur in the oceanic area near the proposed disposal sites. Most of the species, such as the whales, dolphins and porpoises occur off Oregon only during migrations to and from feeding and breeding areas. Harbor seals and sea lions, however, are residents on the Oregon coast and one population is known from Coos Bay. (Maser, et al., 1981). A list of the marine mammals, their occurrence in Oregon, and their status under the Marine Mammal Protection Act is given in Table 3.9.

3.3.5 Endangered Species

A list of rare and endangered species in the vicintiy of the proposed disposal sites was requested from U.S. Fish and Wildlife Service, Office of Endangered Species. No endangered species or their habitats were indicated for these sites. A letter to this effect from the U.S. Fish and Wildlife Service is included in Appendix C.

3.4 SOCIO-ECONOMIC ENVIRONMENT

3.4.1. Introduction

Coos Bay, an estuary on the Oregon coast about 200 miles south of Columbia River, is the largest water-based exporter of forest products in the United States, by virtue of its natural harbor and its strategic location relative to timber stands along the southwest Oregon coast. This position has been achieved through extensive development of industrial processing and handling facilities around the bay, and through extensive publicly and privately financed improvements to the harbor. The wood products industry relies on waterborne transport both for local log movement and for export trade. The progressive deepening of the Coos Bay Navigation System over the years has permitted successful use of larger export vessels.

3.4.2 Local Economy

Lumber and wood products is by far the dominant basic sector in Coos County and the Coos Bay area. In 1979, it accounted for 20.1% of all employment, and 81% of manufacturing employment. The industry also accounts for approximately two-thirds of the county's basic employment and payrolls. Trucking, warehousing, and waterborne transportation in Coos Bay are primarily involved in handling forest products; the industry's share of the county's basic income exceeds 75% when these activities are included. These statistics clearly illustrate the dominance of the forest and timber processing industries in the Coos County economy. However, long term changes in the industry have placed it and the regional economy in a state of transition. Since 1960, there has been both absolute and relative declines in the county's lumber and wood products employment (CCDEIA, 1980). More recently, market fluctuations have resulted in mill closures and substantial layoffs; Coos County unemployment for January 1982 was reported by the Oregon State Employment Division to be 16.4%. Studies done on trends in the timber industry and its future generally indicate that there will be further declines in employment in this sector. Bueter estimates that job losses in Coos County resulting from a declining timber industry could range from 900-1100 jobs in the 1990's (Bueter, 1976).

Recognition of the potential for declines in timber employment have brought the focus of economic improvement efforts on diversification of products within the lumber industry and expansion/diversification within the area's other basic sectors. Currently the fishing industry is the second most important industry in the county. A good harbor, with relatively safe access during the adverse weather, and proximity to rich fishery resources, has contributed to Coos Bay fisheries development. Historically, Coos Bay has had the second highest landings in Oregon. In recent years, the harvesting and marketing of bottom fish and other previously underutilized species has served to overcome some of the traditional constraints of the industry. Given the new 200 mile fisheries jurisdiction, the large resource off of Coos Bay, and expanding markets for the harvest, expansion of this part of the industry may be expected to continue.

The Coos Bay estuary, in conjunction with port developments, harbor facilities, and improvements in inland waterways, has been primarily responsible for the County's oceanborne transporatation and the related land-side trucking and warehousing, a large share of commercial fishing and fish and seafood processing, and some share of tourism. The natural waterway permits efficient movement and storage of economically important locally-handled bulk commodities. The port and related transportation facilities are a base for a large amount of local outputs to move into world markets. These facilities also facilitate the movement of such incoming commodities as sand, gravel and crushed rock, basic chemicals, distillate fuel oil, and gasoline.

Waterborne traffic in 1977 was 7,599,400 tons. Rafted logs and wood chips accounted for more than five million tons of the traffic. Other commodities included lumber, exported logs, and petroleum. The average annual traffic for the period of 1968-77 was 6,769,400 tons. More recent traffic has continued at about this level.

The major docks in Coos Bay are concentrated along the three to four mile eastern waterfront of Coos Bay/North Bend. New dock facilities are beginning to expand along the north spit. The dock facilities are primarily equipped to export forest products and secondarily are outfitted to receive petroleum imports. Twelve of the sixteen docks manage lumber and forest products. Five of the lumber docks are equipped to export wood chips; two handle wood chips exclusively. Four of the docks receive petroleum products -- two by barge and two by deep draft tankers. Only one dock, Central, handles general cargo, as well as forest products, on a regular basis. Large integrated forest products processing plants are situated next to many of these docks, particularly on the Coos Bay/North Bend waterfront.

3.4.3 Population

Coos County has the largest population of the coastal counties in Oregon. From 1910 through 1980 Coos County area has experienced yearly population growth. However, the percentage change in population growth has been declining since 1950.

Because of the Coos Bay area's dependence upon the building/lumber industries, and since the building/lumber industries have declined, the area population has declined to below 1980 levels (See Table 3.10).

3.4.4 State and Local Coastal Management Plans

Coos Bay is identified in the overall Oregon estuary classification as a deep-draft development estuary. As such, and as stipulated in Goal Number 16, Estuarine Resources, the Oregon Coastal Management Program (OCMP) recognizes that deep-draft port developments, navigation channels, and associated dredging and dredged material disposal are allowed and will continue. In addition, under Goal Number 19, Ocean Resources, the OCMP recognizes the need to "provide for suitable sites and practices for the open sea discharge of dredged materials which do not substantially interfere with or detract from the use of the continental shelf for fishing, navigation, or recreation, or from the long-term protection of natural resources."

The Coos County Comprehensive Plan, which has been locally adopted and is presently being reviewed for approval by The Oregon Department of Land Conservation and Development (DLCD), contains policy statements and estuary management plans for maintaining Coos Bay as a deep-draft development port. In keeping with these plans and policies, Coos County recognizes the need to utilize ocean sites for disposal of material dredged from the navigation channel system.

3.4.5 Navigation Improvements and Dredging Costs

The authorized Coos Bay Navigation project, modified by the River and Harbor Act of 1970, provides for two jetties at the entrance; an entrance channel 45 feet deep and 700 feet wide; a channel 35 feet deep and 300 feet wide to channel mile 9, and from there 35 feet deep and 400 feet wide to mile 15; and with turning basin and anchorage areas along the channel. Deepening of the channel from the entrance to mile 15 was completed several years earlier. Two jetties at the entrance were completed in 1928-29; the small-boat basin at Charleston was completed in 1956; and the south jetty was rehabilitated about 25 years ago. See Figure 3.27. The total Federal construction and maintenance costs through September 1978 was $63,303,000--$29,194,000 for construction, $2,336,000 for jetty restoration, and $31,773,000 for maintenance.

As discussed in Section 3.2, dredging quantities total about 1,500,000 cubic yards annually, and estimated in 1982 dollars, would cost about $2,100,000 for dredging and disposal. The disposal cost ranges from about $1.00 to $3.50 per cubic yard depending upon area dredged, type of equipment used, and upon disposal site. Average disposal cost would be about $1.40 per cubic yard. Presently, most of the material dredged from the entrance (about 976,000 cubic yards) is disposed of in the ocean, and other dredged materials are disposed of at adjacent local upland sites. Corps studies predicted that the upland disposal sites would be filled to design capacity within 5 to 10 years (Channel Maintenance Dredging, Coos Bay, FEIS, 1976). Alternate disposal sites such as ocean disposal will be necessary to maintain the present navigation system.

3.4.6 Commercial and Recreational Activities in the Vicinity of the Disposal Sites

3.4.6.1 Commercial Fishing

The area offshore of Coos Bay is fished commercially for salmon, shrimp, crabs, bottom fish and scallops. Thirty-six million pounds of food fish were landed at Coos Bay in 1981 with a value of 14 million dollars.

Dungeness crab (*Cancer Magister*) fishing is done along most of the coast. Tanner crabs (*Chinocetes* sp.) are also taken incidentally. Crabs are usually fished from December to the middle of August with pots on sand or mud bottoms at depths of 50 to 300 meters. Most commercial vessels used in the crab fishery are also used in other fisheries (combination fishing boats). Approximately 1.3 million pounds of crabs were landed at Coos Bay in 1981.

The pink shrimp (*Pandalus jordani*) is the shrimp species commercially fished along the Oregon coast. They are usually taken during April through September by trawl over mud or sand bottoms at depths of 30-200 meters. Eight million pounds of shrimp were landed at Coos Bay in 1981.

The commercial ocean salmon fishery off Oregon is for chinook (Oncorhynchus tshawytscha) and coho (O. kisutch). Pink salmon (O. garbuscha) are also taken when they are available. One million pounds of salmon were landed at Coos Bay in 1981.

The bottom fish fishery off Oregon is for a number of fish that can be generally divided into 3 groups, flatfish (soles, flounder and halibut), rockfish, and round fish (ling cod, pacific cod, hake, and sable fish). Based upon distribution maps developed by the Oregon Department of Fish and Wildlife (ODFW) for groundfish (ODFW 1976) we concluded that the area within 6 miles of the mouth of Coos Bay had a relatively low abundance of groundfish. (See Appendix B). The highest abundance of commercial groundfish occurred at depths greater than 40 meters. Areas of high abundance of groundfish near Coos Bay were off Cape Arago, a cliff outcrop area just beyond site G, and an area 10-15 miles north of Coos Bay (ODFW, 1976.)
Distribution maps for salmon, crab, and shrimp along the Oregon Coast are also found in Appendix B.

In April 1981 a fishery for the Pacific coast weathervane scallop (Patinopectin caurinus) began in Oregon off Coos Bay. This fishery expanded rapidly, peaking by mid-June with 20 million pounds taken and 16.7 million landed at Oregon ports (7.5 million pounds at Coos Bay.) Oregon imposed a license moratorium in July 1981 and 145 vessels obtained permits. The catch fell off rapidly after July and by the end of 1981 only 5 vessels continued in the fishery. No live scallops were collected by OSU during the 1979-1981 sampling periods. Numerous shells were collected in the vicinity of site G in 1981. Hancock (personnal communication) believes that these shells are from the scallop fishing boats. Scallops were shelled aboard the vessels and the shells were dumped overboard. The scallop fishing beds off Coos Bay were located between the 40 and 50 fathom contours with its southern extent near sites G and H.

3.4.6.2 General Marine Recreation

Marine recreation in the coastal region of Coos Bay, and Oregon in general, is limited due to normally cool atmospheric and water conditions and severe winter weather. Fishing, clamming and beach-combing are the principal activities.

3.4.6.3 Shipping

As discussed in Section 3.4.2, an average of about 6.8 million tons of cargo enter and exit the Coos Bay port facilities annually (Port of Coos Bay, 1981). The Coos Bay region is a major source of lumber and wood chips for domestic and international commerce. During 1980, 333 deep draft vessels used Coos Bay facilites (Port of Coos Bay, Waterborne Statistics, 1980). The fishing industry is the second largest user of port facilities.

3.4.6.4 Oil and Gas Exploration and Mining

Continental shelf lease sale activities have not occurred on the Oregon shelf since 1964, and no oil or gas production occurs at present (1981).

During 1964 and 1965 only a small number of exploratory wells were drilled, and only a portion of those were in the Coos Bay shelf region. The Oregon continental shelf is not included in the present (1981-1986) 5-year lease sale plan (USGS, 1981, personal communication). The earlier exploratory wells indicated the presence of hydrocarbons, but extensive exploration is necessary to more accurately determine the commercial production potential and the locations of such areas. It is very likely that exploration will eventually begin as studies of more favorable areas are completed. No mining or mineral extraction exists or is planned for the vicinity of the disposal sites.

3.4.7 Esthetics

The esthetics of the disposal site area is characterized by relatively clear ocean water, typical marine salt air smells, views of the relatively undisturbed shoreline, and intermittent sounds of breaking waves, buoy bells and horns, and seabirds. The nearby ocean beaches likewise present a pleasing atmosphere with clean sand, weathered driftwood, shorebirds, and breaking surf. Both areas represent high quality esthetic environments.

3.4.8 Cultural Resources

A review of the latest published version of the National Register of Historic Places and addenda shows that the alternative areas do not contain any registered properties or properties determined to be eligible for nomination to the National Register. A clearance letter from the State of Oregon Historic Preservation Office is included in Appendix C.

3.4.8 Cultural Resources

A review of the latest published version of the National Register of Historic Places and addenda shows that the alternative areas do not contain any registered properties or properties determined to be eligible for nomination to the National Register. A clearance letter from the State of Oregon Historic Preservation Office is included in Appendix C.

Table 3.1 Location of Alternative Disposal Sites of the Coos Bay Offshore Disposal Study.

Site	x Depth (m)	Size (m)	Centroid Location
E	17	1097 x 427	43°-21'-47" N 124°-22'-25" W
F	24	1097 x 427	43°-22'-30" N 124°-22'-00" W
H	55	1097 x 442	43°-23'-59" N 124°-23'-14" W
H (adjusted)		1097 x 442	43°-23'-19" N 124°-22'-55" W
G	93	1097 x 442	43°-24'-44" N 124°-25'-15"W

Table 3.2. Sediment Accumulation Within Upper Coos Bay (cubic yards)

Period	Coos River RM 12 to RM 14	Isthmus Slough RM 14 to RM 15
5/80 to 10/80	121,000	149,000
10/80 to 10/81	194,000	21,000
10/81 to 10/82	289,000	164,000

Table 3.3 Chemical characteristics of Coos Bay sediments, May 1979 (from Hancock, et. al. 1981).

Station		Depth (cm)	Solids* (g/g)	VS (mg/g)	Tot.* S (ug/g)	RSC (ug/g)	O & G (ug/g)	NH_4^+-N (ug/g)	Chloro-Insect. (ng/g)	PCB (ng/l)	Cd (ug/l)	Cu (ug/l)	Fe (ug/l)	Mn (ug/l)	Pb (ug/l)	Zn (ng/l)
E1	5.5	00-20	0.86	BD	BD	295	BD	ND	BD	BD	1.2	2.1	5000	45	14	99
		20-60	ND	ND	ND	ND	ND	ND	0.3 DDT	≤ 2	ND	ND	ND	ND	ND	ND
E1s	5.5	00-20	0.80	ND	48	860	BD	0.5	ND	ND	2.5	2.9	4900	48	14	69
		20-51	0.82	BD	66	800	BD	0.5	ND	ND	1.5	3.0	5100	45	17	200
E2	7.5	00-20	0.85	40	BD	340	BD	0.3	ND	ND	0.8	ND	ND	ND	ND	ND
		20-60	0.82	BD	BD	480	BD	0.7	ND	ND	1.7	1.8	4600	56	12	20
E2s	7.5	00-20	0.84	BD	BD	176	BD	ND	BD	≤.4.3	ND	ND	ND	ND	ND	ND
		20-60	0.81	29	BD	290	BD	ND	ND	ND	.7	.9	3200	54	8.6	12
E3	9.0	00-20	0.78	30	BD	530	BD	1.8	BD	BD	2.3	2.3	5600	44	14	45
		20-42	0.77	BD	33	480	BD	1.8	ND	ND	16	1.4	5300	45	5.2	48
E3s	9.0	00-20	0 80	BD	10	390	BD	1.3	ND	ND	1.1	2.9	6000	38	18	31
		20-60	0.76	63	130	420	147	14	ND	ND	1.1	3.9	8400	41	16	50
E4	11.0	00-20	0.80	BD	BD	410	BD	0.6	ND	ND	9.1	2.6	5500	33	12	71
		20-60	0.79	48	BD	350	BD	8.0	ND	ND	2.0	3.3	5800	46	14	65
E4s	11.0	00-20	0.70	59	BD	910	BD	0.05	BD	≤ 5(Ar1260)	0.9	2.7	9300	53	20	81
		20-60	0.76	39	30	760	BD	1.0		≤ 3	11	2.5	7500	46	13	38
E6	13.0	00-20	0.56	81	123	2180	540	28	BD	BD	4.6	13	19500	200	25	540
		20-60	0.61	59	221	2100	385	44	BD	BD	1.6	7.5	14100	190	15	67
E6s	13.0	00-20	0.66	56	1060	1610	282	24	BD	BD	1.5	4.7	10500	61	17	61
		20-60	0.72	50	10	460	144	12	0.5 DDT	BD	1.3	2.1	9200	57	10	49
E7	14.5	00-20	0.38	48	126	4500	ND	45	ND	ND	2.6	26	35300	330	32	290
		20-60	0 39	51	735	3100	1020	92	ND	ND	2 6	5.1	25400	240	26	180
E7s	14 5	00-20	0.49	102	1620	1900	1940	81	BD	BD	19	24	22700	173	45	780
		20-60	0 53	96	2220	2450	1680	90	ND	ND	30	17	17500	155	25	121
LLD				3	10		50		0.1	0.1						

Free sulfides were below detection (0 1 ug/g) in all samples

Table 3.4 Chemical characteristics of Coos Bay sediments, October 1979 (from Hancock, et. al. 1981).

Station	River Mile	Depth (cm)	Solids (g/g)	VS (mg/g)	Tot. S (ug/g)	RSC (ug/g)	O & G (ug/g)	HC (ug/g)
E4	11.0	00-20	0.82	6	BD	560	BD	ND
		20-41	0.80	6	BD	350	BD	ND
E5	12.0	00-20	0.64	44	920	2570	440	ND
		20-60	0.59	65	590	3200	370	ND
E6	13.0	00-20	0.62	49	770	3020	370	ND
		20-60	0.55	94	400	3290	510	ND
E7	14.5	00-20	0.39	105	2150	4240	920	ND
		20-60	0.39	112	850	5110	900	ND
E8	13.8	00.20	0.62	57	400	2360	500	ND
		20-60	0.56	87	750	2655	680	350
E9	15.0	00-20	0.51	155	1600	4210	1600	ND
		20-48	0.41	147	2500	6220	2000	1200
LLD					10		50	

Metal Concentration (ug/g)

	As	Cd	Cu	Fe	Mn	Pb	Zn	Hg
E4	1.2	0.3	2.1	4590	35	5.2	12	.085
	2.0	1.3	2.3	3950	36	5.1	8.4	.125
E5	2.8	1.4	14	21600	105	21	69	.11
	3.4	1.7	17	24600	150	24	70	.12
E6	3.1	1.6	14	22300	117	21	70	.97
	2.9	1.8	23	29500	365	27	85	.2
E7	4.1	3.0	31	29600	142	40	121	.77
	7.7	2.5	33	36800	166	39	154	3.3
E8	1.8	1.5	11	17000	89	16	64	.63
	3.0	1.4	12	21000	125	22	61	.45
E9	5.1	2.3	25	25300	108	31	101	.45
	6.8	2.9	34	32100	164	45	128	.27

Tables 3.4 (Cont)

Pesticide Concentration, ng/g

	Aldrin	DDE	Dieldrin	DDD	DDT	PCB
E4	ND	ND	ND	ND	ND	ND
	BD	BD	BD	BD	BD	BD
E5	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND
E6	ND	ND	ND	ND	ND	ND
	0.2	BD	BD	BD	BD	BD
E7	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND
E8	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND
E9	ND	ND	ND	ND	ND	ND
	1.5	BD	BD	2.5	1.7	BD
LLD	0.1	0.1	0.1	0.1	0.1	1.0

Table 3.5 Chemical characteristics of Coos Bay sediments, March 1980 (from Hancock, et. al. 1981).

Station	River Mile	Depth (cm)	Solids (g/g)	VS (mg/g)	Tot. S (ug/g)	RSC (ug/g)	O & G (ug/g)	HC (ug/g)
E4	11.0	00-20	0.82	3	BD	77	BD	BD
		20-50	0.78	12	BD	1450	BD	BD
E5	12.0	00-20	0.59	48	480	2170	490	200
		20-60	0.70	26	430	1360	300	130
E6	13.0	00-20	0.52	63	690	1570	670	380
		20-60	0.54	64	540	3250	410	180
E7	14.5	00-20	0.38	93	790	3200	1050	670
		20-60	0.38	89	2080	4180	970	650
E8	13.8	00.20	0.60	47	215	1620	320	118
		20-60	0.57	61	600	2400	490	220
E9	15.0	00-20	0.33	199	470	3900	2800	1200
		20-48	0.31	200	1900	6500	1840	880
LLD					10		50	50

Pesticide Concentration, ng/g

	Aldrin	DDE	Dieldrin	DDD	DDT	PCB
E4	ND	ND	ND	ND	ND	ND
	<0.02	0.04	0.05	0.02	0.05	BD
E5	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	BD
E6	ND	ND	ND	ND	ND	ND
	0.7	0.13	ND	0.28	0.07	BD
E7	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	BD
E8	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	BD
E9	ND	ND	ND	ND	ND	BD
	BD	0.3	0.2	2.7	3.0	BD
LLD	0.02	0.02	0.02	0.02	0.02	0.1

Table 3.5 (Cont)

Metal Concentration (ug/g)

	As	Cd	Cu	Fe	Mn	Pb	Zn	Hg
E4	1.3	0.8	1.0	5000	31	3.4	12	.06
	1.2	1.8	2.8	5400	45	13	13	.09
E5	3.6	1.6	14	8500	131	19	77	.15
	2.4	1.1	5.4	10000	58	7.5	29	.04
E6	3.5	1.8	18	26900	150	25	110	.20
	6.1	1.7	18	24500	263	22	87	.39
E7	6.3	2.6	32	33900	209	37	124	.21
	9.5	2.4	29	35000	172	33	121	.45
E8	3.0	1.3	12	18600	102	16	67	.15
	3.7	1.6	17	23600	103	22	87	.12
E9	9.0	2.3	32	34100	203	38	123	.24
	10.6	3.1	34	38700	247	45	129	.39

Table 3.6 Chemical Analysis of Marine Waters at Offshore Sites F, G & H Coos Bay, Oregon
(From Nelson et.al. 1983)

Date	STATION	BOTTOM DEPTH (fathoms)	pH	SALINITY (mg/ml)	NH4-N (ug/ml)	TURBIDITY (NTU)	TSS (ug/ml)	VSS (ug/ml)	As (ug/ml)	Hg (ug/ml)
June 1980	F3B	13	7.85	32	BD	2.9	22	6	BD	ND
	F3T	13	8.00	30	BD	3.7	19	6	ND	BD
	G3B	50	7.70	33	0.10	7.0	52	12	ND	ND
	G3T	50	8.00	31	BD	3.6	26	8	ND	ND
	H3B	33	7.45	33	BD	6.0	27	7	ND	BD
	H3T	33	8.00	31	BD	1.2	26	8	BD	ND
August 1980	F3B	ND	7.70	33	BD	4.2	26	10	ND	BD
	F3T	ND	7.80	33	BD	2.0	23	8	BD	ND
	G3B	ND	7.60	33	BD	1.3	36	9	BD	ND
	G3T	ND	7.90	30	0.03	4.1	20	1	ND	ND
	H3B	ND	7.55	35	BD	2.6	23	8	BD	ND
	H3T	ND	7.70	32	BD	1.2	24	7	ND	BD
December 1980	F3B	13	7.70	33	BD	4.2	26	10	ND	BD
	F3T	13	7.80	33	0.01	2.0	23	8	BD	ND
	G3B	50	7.60	33	BD	1.3	36	9	BD	ND
	G3T	50	7.90	30	0.03	4.1	20	1	ND	ND
	H3B	33	7.55	35	BD	2.6	23	8	BD	ND
	H3T	33	7.70	32	BD	1.2	24	7	ND	BD
April 1981	F3B	13	7.50	35	BD	4.0	ND	ND	BD	ND
	F3T	13	7.50	31	BD	3.8	ND	ND	BD	BD
	G3B	50	7.60	35	BD	2.8	ND	ND	BD	BD
	G3T	50	7.60	32	BD	2.9	ND	ND	BD	ND
	H3B	33	7.50	35	BD	3.2	ND	ND	BD	ND
	H3T	33	ND	ND	BD	ND	ND	ND	BD	BD
LLD					0.03				0.04	0.05

Table 3.6 (Cont)

Date	STATION	METAL CONCENTRATION (ng/ml)						PESTICIDE CONCENTRATION (ng/ml)						
		Cd	Cu	Fe	Mn	Pb	Zn	Aldrin	DDE	Dieldrin	DDD	DDT	Ar1254	Ar1260
June 1980	F3B	ND	ND	ND	ND	ND	ND	0.010	BD	0.005	0.003	0.004	BD	BD
	F3T	1.60	14.00	6	18	3.50	0.50	0.004	BD	0.005	BD	0.010	BD	BD
	G3B	ND	ND	ND	ND	ND	ND	0.005	0.002	0.005	0.002	0.004	BD	BD
	G3T	ND	ND	ND	ND	ND	ND	0.001	0.002	BD	0.002	0.004	BD	BD
	H3B	1.80	8.60	33	14	3.50	7.00	0.005	BD	0.006	0.010	0.008	BD	BD
	H3T	ND	ND	6	5	ND	ND	BD	0.004	BD	0.003	BD	BD	BD
August 1980	F3B	1.40	11.20	18	16	5.00	2.50	0.001	0.001	BD	0.001	0.004	BD	BD
	F3T	ND	ND	ND	ND	ND	ND	0.002	BD	BD	BD	0.005	BD	BD
	G3B	ND	ND	ND	ND	ND	ND	0.001	BD	BD	0.002	0.001	BD	BD
	G3T	ND	ND	ND	ND	ND	ND	0.002	BD	0.001	0.001	BD	BD	BD
	H3B	ND	ND	69	112	ND	ND	0.001	BD	0.001	BD	0.003	BD	BD
	H3T	3.50	18.20	11	21	5.00	7.00	0.001	BD	BD	BD	0.002	BD	BD
December 1980	F3B	2.80	34.00	18	16	7.00	9.00	0.001	0.001	BD	0.001	0.004	BD	BD
	F3T	ND	ND	ND	ND	ND	ND	0.002	BD	BD	BD	0.005	BD	BD
	G3B	ND	ND	ND	ND	ND	ND	0.001	BD	BD	0.002	0.001	BD	BD
	G3T	2.50	28.80	ND	ND	7.00	7.50	0.002	BD	0.001	0.001	BD	BD	BD
	H3B	1.40	12.60	69	112	3.50	5.00	0.001	BD	0.001	BD	0.003	BD	BD
	H3T	3.10	13.00	11	21	7.00	18.50	0.001	BD	BD	BD	0.002	BD	BD
April 1981	F3B	ND	ND	ND	ND	ND	ND	BD	BD	ND	BD	BD	BD	BD
	F3T	1.30	9.70	14	18	3.50	18.50	BD	BD	ND	BD	0.002	BD	BD
	G3B	1.40	9.50	38	76	3.50	15.00	BD	BD	ND	BD	BD	BD	BD
	G3T	ND	ND	ND	ND	ND	ND	BD	0.001	ND	0.002	0.004	BD	BD
	H3B	2.20	12.50	ND	ND	2.70	79.00	BD	ND	BD	0.002	BD	BD	BD
	H3T	4.40	13.50	11	12	3.50	5.00	BD	ND	BD	BD	BD	BD	BD
	LLD							0.020	0.001		0.001	0.002	0.020	0.020

TABLE 3.7 Most abundant epibenthic species found at varying depths during the April 1979 to March 1980 epibenthic sampling period by Oregon State University, Coos Bay Offshore Disposal Study (Ballon-Otter trawl).

Depth (m.)	Species	Taxonomic Family	Number
10-19	Speckled Sanddab	(Pleuronectidae)	414
	Night Smelt	(Osmeridae)	294
	Northern Anchovy	(Engraulididae)	57
	Sand Sole	(Pleuronectidae)	45
	English Sole	(Pleuronectidae)	36
	Bay Pipefish	(Syngnathidae)	29
	Warty Poacher	(Agonidae)	28
	Pacific Tomcod	(Gadidae)	20

(Twenty-two species observed, of which 14 species were represented by less than six individuals each.)

20-29	Speckled Sanddab	(Pleuronectidae)	1,467
	English Sole	(Pleuronectidae)	193
	Pacific Tomcod	(Gadidae)	68
	Rockfish	(Scorpaenidae)	43

(Nineteen species observed, of which 13 species were represented by less than 14 individuals each.)

30-45	Speckled Sanddab	(Pleuronectidae)	2,259
	Hybrid Sole	(Pleuronectidae)	108
	Pacific Sanddab	(Pleuronectidae)	73
	Night Smelt	(Osmeridae)	59
	English Sole	(Pleuronectidae)	44
	Pacific Tomcod	(Gadidae)	26

(Twenty-two species observed, of which 16 species were represented by less than seven individuals each.)

Depth (m.)	Species	Taxonomic Family	Number
46-70	Speckled Sanddab	(Pleuronectidae)	369
	Pacific Sanddab	(Pleuronectidae)	322
	Pacific Tomcod	(Gadidae)	203
	English Sole	(Pleuronectidae)	177
	Pygmy Poacher	(Agonidae)	70
	Hybrid Sole	(Pleuronectidae)	32
	Dover Sole	(Pleuronectidae)	23

(Eighteen species observed, of which 11 species were represented by less than 12 individuals each.)

*75-120	Pacific Sanddab	(Pleuronectidae)	212
	Speckled Sanddab	(Pleuronectidae)	46
	Rockfish	(Scorpaenidae)	26
	Pacific Tomcod	(Gadidae)	21
	Rex Sole	(Pleuronectidae)	17

(Twelve species observed, of which 7 species were represented by less than 6 individuals each.)

* Results of two trawls. All other depths are results of four trawls each.

TABLE 3.8 Most abundant epibenthic species found near sites F, H, and G during the May 1980 through May 1981 epibenthic sampling period by Oregon State University, Coos Bay Offshore Disposal Study (15 trawls each site) (1-m beam trawl).

Depth (m.)	Species	Taxonomic Family	Number
20-40	Speckled Sanddab	(Pleuronectidae)	998
(Site F)	Brown Irish Lord	(Cottidae)	79
	Pacific Sanddab	(Pleuronectidae)	70
	English Sole	(Pleuronectidae)	63
	Cabezon	(Cottidae)	50
	Slim Sculpin	(Cottidae)	43
	Prickelbreast, Poacher	(Agonidae)	35

(Twenty-eight species observed of which there were less than 20 individuals each of 21 species.)

Depth (m.)	Species	Taxonomic Family	Number
45-70	Pacific Sanddab	(Pleuronectidae)	918
(Site H)	English Sole	(Pleuronectidae)	218
	Speckled Sanddab	(Pleuronectidae)	160
	Rockfish	(Scorpaenidae)	55
	Rex Sole	(Pleuronectidae)	31

(Twenty-five species were observed, of which there were less than 20 individuals each of 20 species.)

75-120	Pacific Sanddab	(Pleuronectidae)	754
(Site G)	Slender Sole	(Pleuronectidae)	463
	Slim Sculpin	(Cottidae)	403
	Rex Sole	(Pleuronectidae)	103
	Blackbelly Eelpout	(Zoascidae)	84
	Rockfish	(Scorpaenidae)	36
	Dover Sole	(Pleuronectidae)	34

(Thirty species observed, of which there were less than 20 individuals each of 23 species.)

Table 3.9 A list of the Marine Mammals occuring off the Oregon Coast and their status under the Marine Mammal Protection Act.

FAMILY AND SPECIES	COMMON NAME	PROTECTED	OCCURRENCE OFF OREGON
Balaenidae			
Eubalaena glacialis	North right whale	Yes (endangered)	Along Oregon coast in winter
Eschrichtiidae			
Eschrichtius robustus	Grey whale	No (endangered)	Along Oregon coast during Feb. to May while migrating to and from breeding and feeding grounds
Balaenopteridae			
Balaenoptera musculus	Blue whale	Yes	Off Oregon coast from late May to June and August to October
Balaenoptera physalus	Fin whale	Yes	Occur off Oregon May to September
Balaenoptera borealis	Sei whale	Yes	Summer to early fall
Balaenoptera acutorostrata	Minke whale	No	Late summer to fall
Megaptera novaeangliae	Humpback whale	Yes	April to October
Physeteridae	Sperm whale	Yes	Late summer to fall
Physeter catodon	Sperm whale	Yes	
Kogia breviceps	Pygmy Sperm whale	No	Very rare, one stranding
Ziphiidae	Beaked whale	No	Very rare, one stranding
Mesophodon stejnegeri	N.P. Beaked whale	No	Very rare, one stranding
Mesophodon carlhubbsi	Hubbs Beaked whale	No	Very rare, one stranding

BLE 3.9 (Cont)

MILY AND SPECIES	COMMON NAME	PROTECTED	OCCURRENCE OFF OREGON
Ziphius cavirostris	Cuvier's Beaked whale	No	Rare, three strandings
Berardius bairdii	Giant Bottlenose whale	No	Uncommon June to Oct.
lphinidae			
Globicephala macrorhynchus	Short-finned Pilot whale	No	Winter
Grampus griseus	Grampus dolphin	No	Uncommon, Spring to Summer
Orcinus orca	Killer whale	No	Winter
Pseudorca crassidens	Fabe Killer whale	No	Uncommon
Delphinum delphis	Common dolphin	No	Uncommon, Spring, Summer
Lissodelphis borealis	Northern right whale Dolphin	No	Rare, Spring to Summer
Stenella coeruleoalba	Striped Dolphin	No	Rare, three standings
Lagenorhynchus obliguidens	Pacific white sided Dolphin	No	Common throughout year
hocoenidae			
Phocoenioides dalli	Dall's Porpoise	No	Common, throughout year
Phocoena phocoena	Harbor Porpoise	No	Common, throughout year
ustelidae			
Enhydra lutris	Sea Otter	Yes	Rare, introduction program failed
hocidae			

TABLE 3.9 (Cont)

FAMILY AND SPECIES	COMMON NAME	PROTECTED	OCCURRENCE OFF OREGON
Phoca vitulina	Harbor Seal	Yes	Common, 4,000 in Oregon
Phoca hispida	Ringed Seal	No	Rare, single sighting
Phoca fasciata	Ribbon Seal	No	Rare, single sighting
Mirounga augustirostis	Northern Elephant Seal	Yes	Rare
Otariidae			
Eumetopias jubatus	Steller Sea Lion	No	Common, 3,000 in Oregon
Zalophys californianus	California Sea Lion	No	Common, 3,500 in Oregon, population off Coos Bay
Callorhinus ursinus	Northern Fur Seal	No	Rare

TABLE 3.10 POPULATION OF COOS COUNTY 1981 AND 1982

	1981	1982	% Change
Coos County	63,300	61,750	-2.5
Coos Bay City	14,275	13,710	-4.0
North Bend City	9,670	9,320	-3.6

Source: Center for Population Research and Census, Portland State

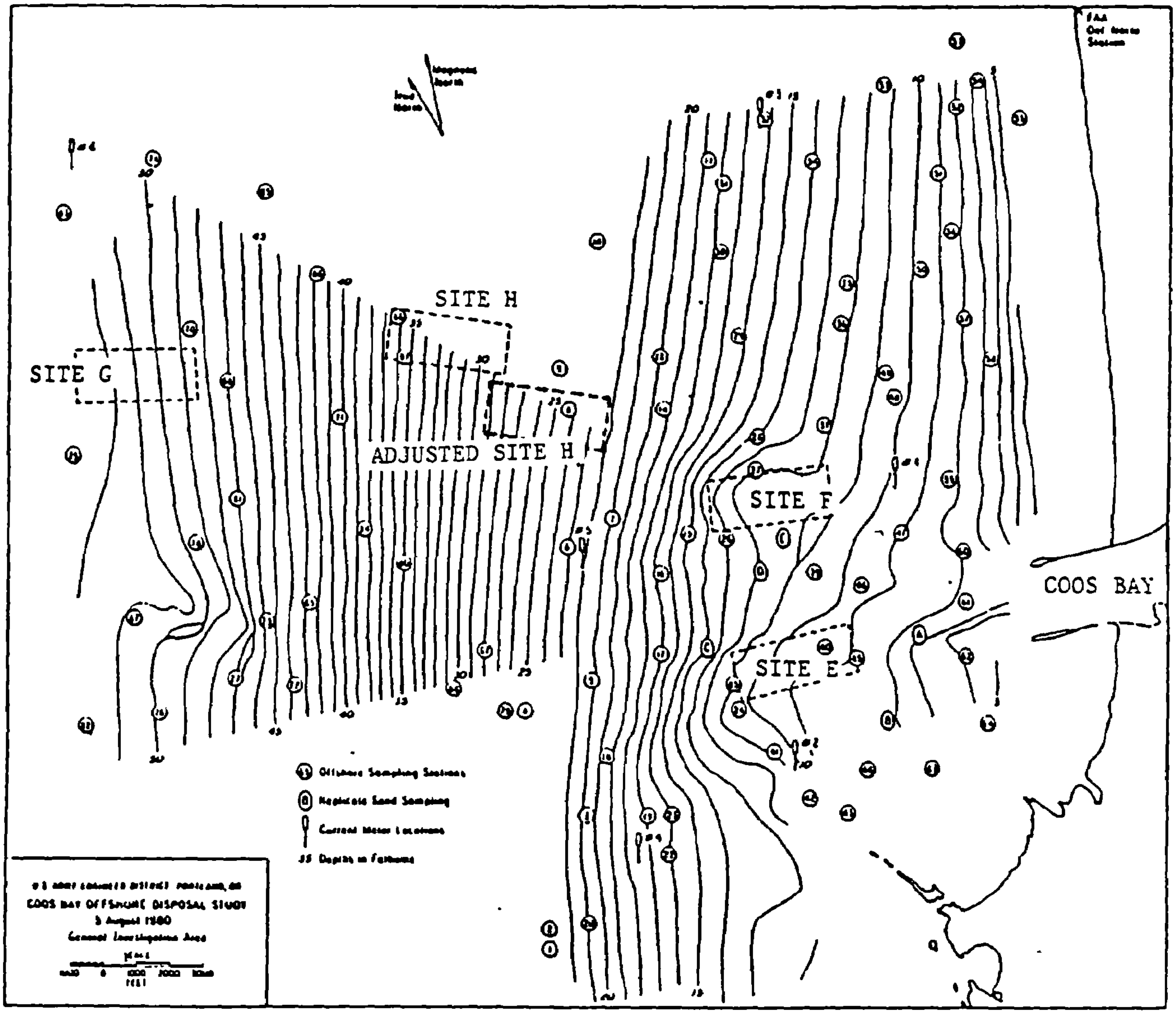


Figure 3.1 Offshore Coos Bay study area.

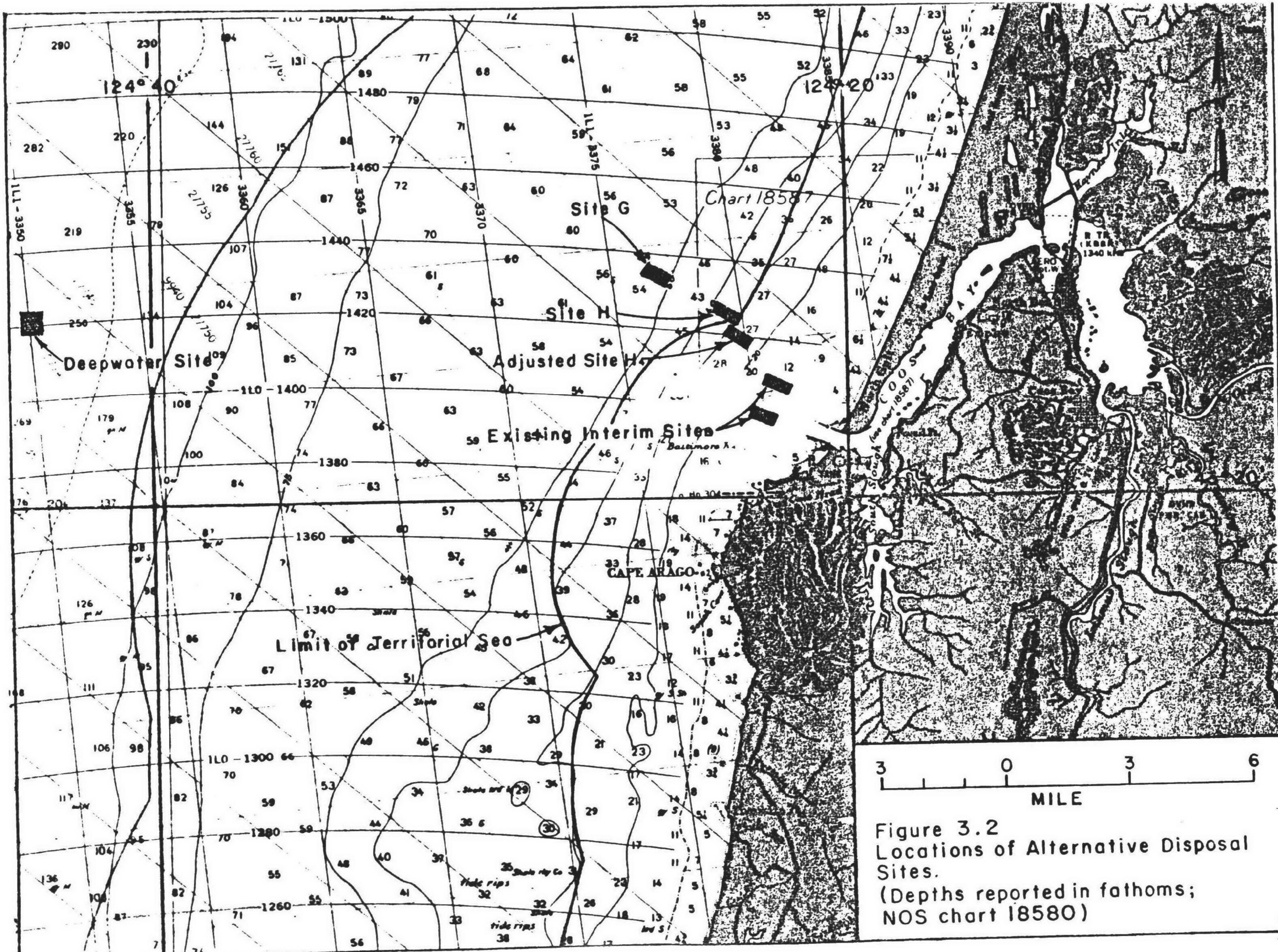


Figure 3.2
Locations of Alternative Disposal Sites.
(Depths reported in fathoms; NOS chart 18580)

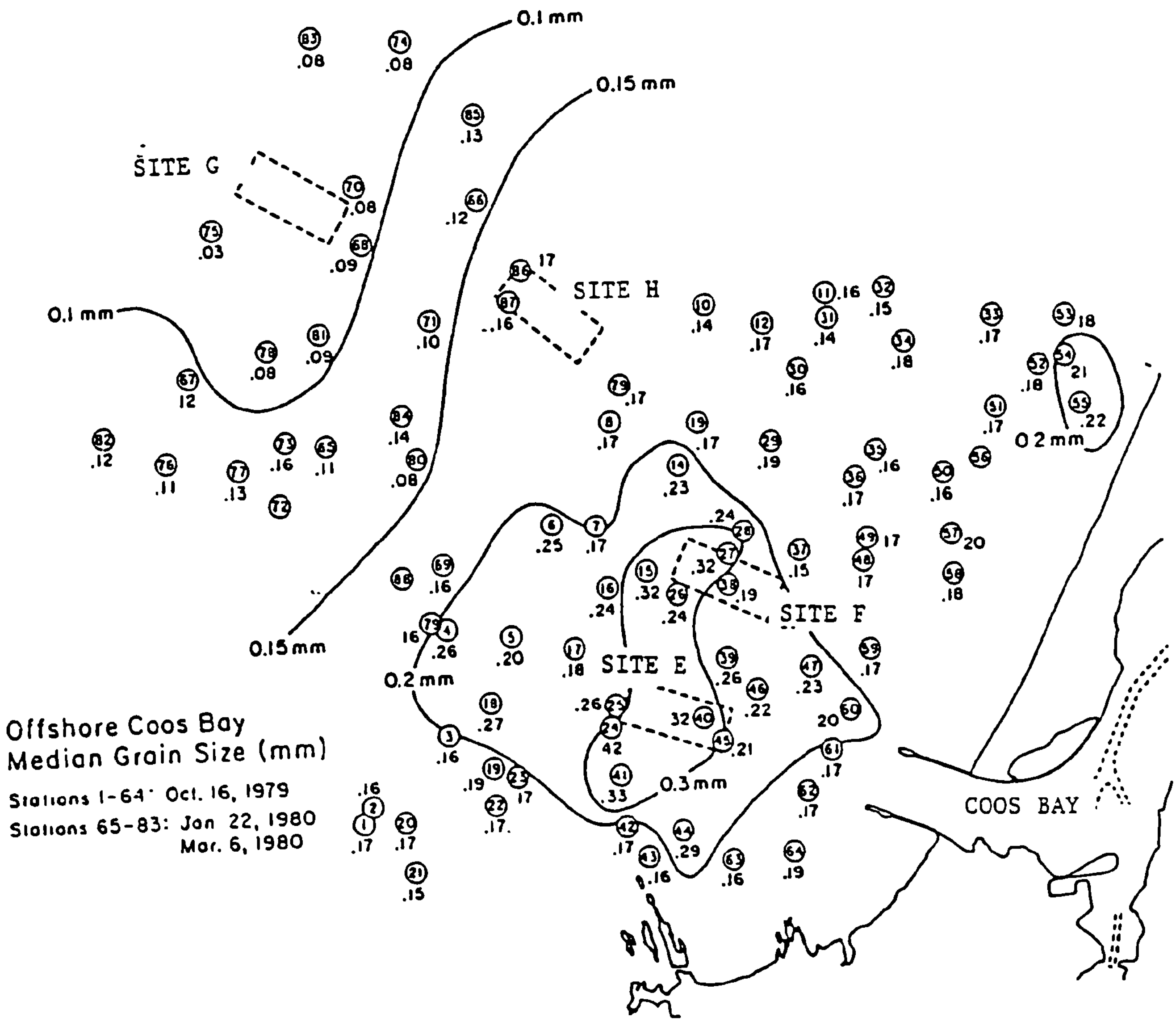


Figure 3.3 Extended offshore area median grain size distribution (Hancock, et al. 1981).

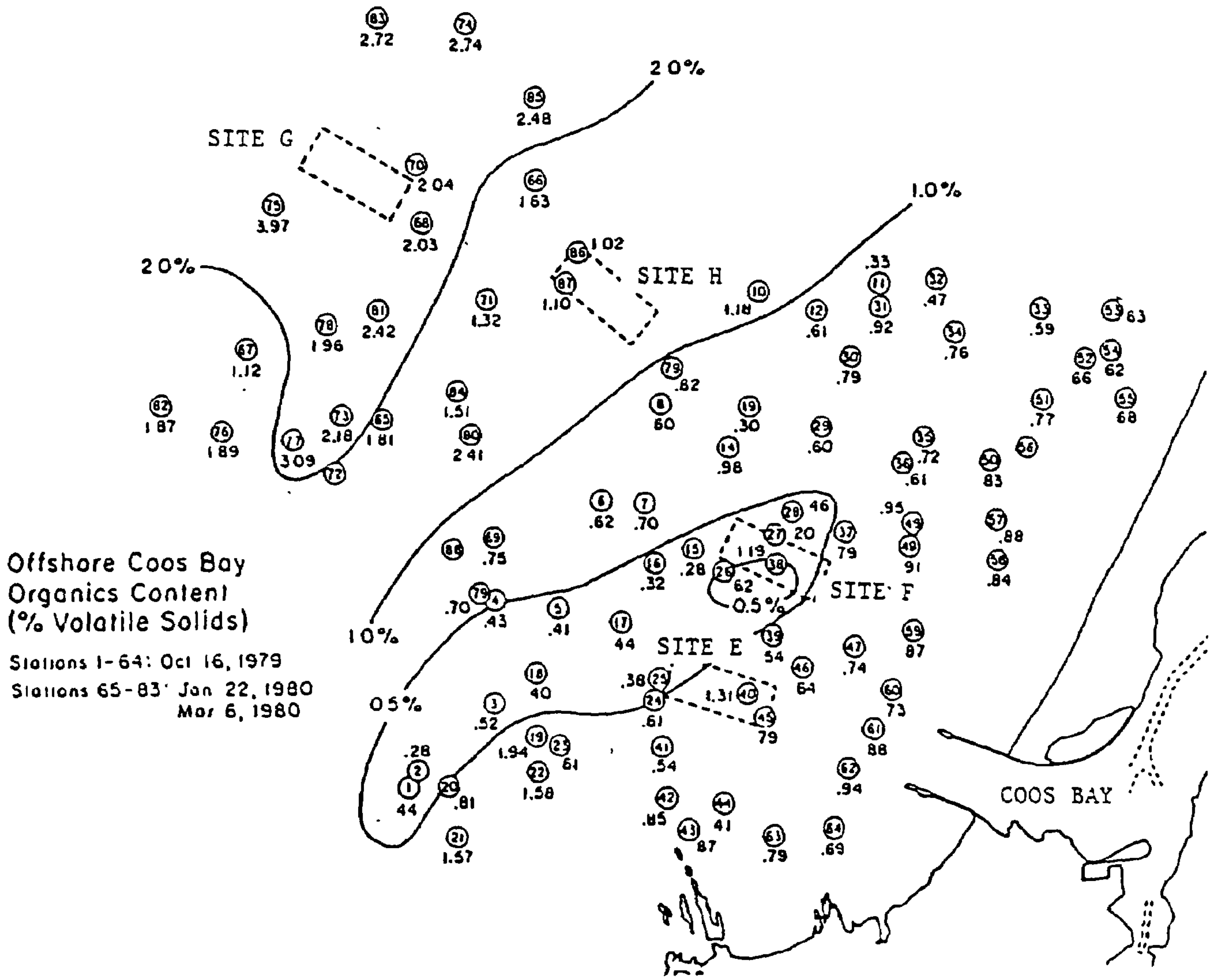


Figure 3.4 Extended offshore area volatile solids (Hancock, et al. 1981).

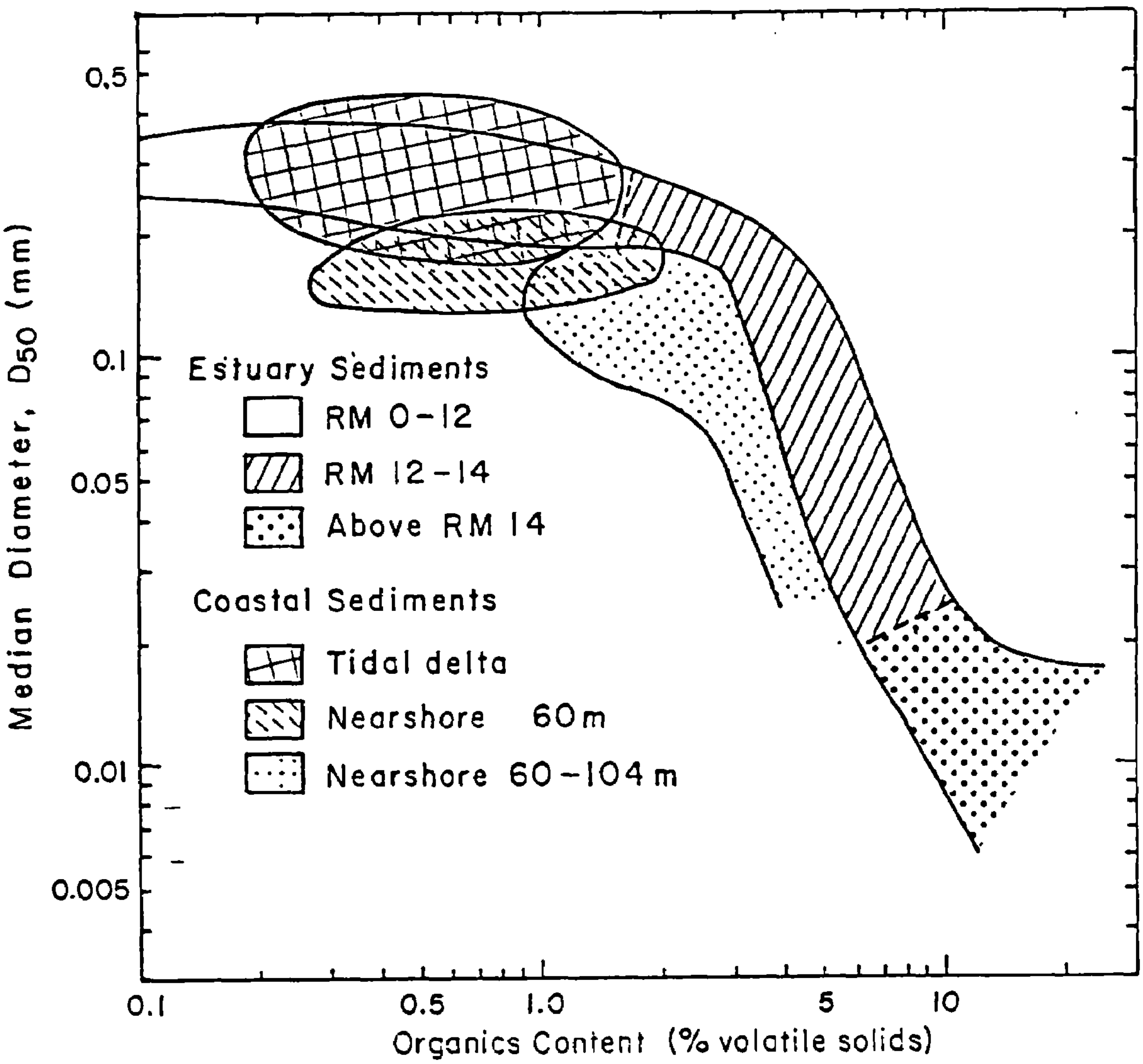


Figure 3.5 Median grain size vs. organics content in estuarine and coastal sediments (Hancock, et al. 1981).

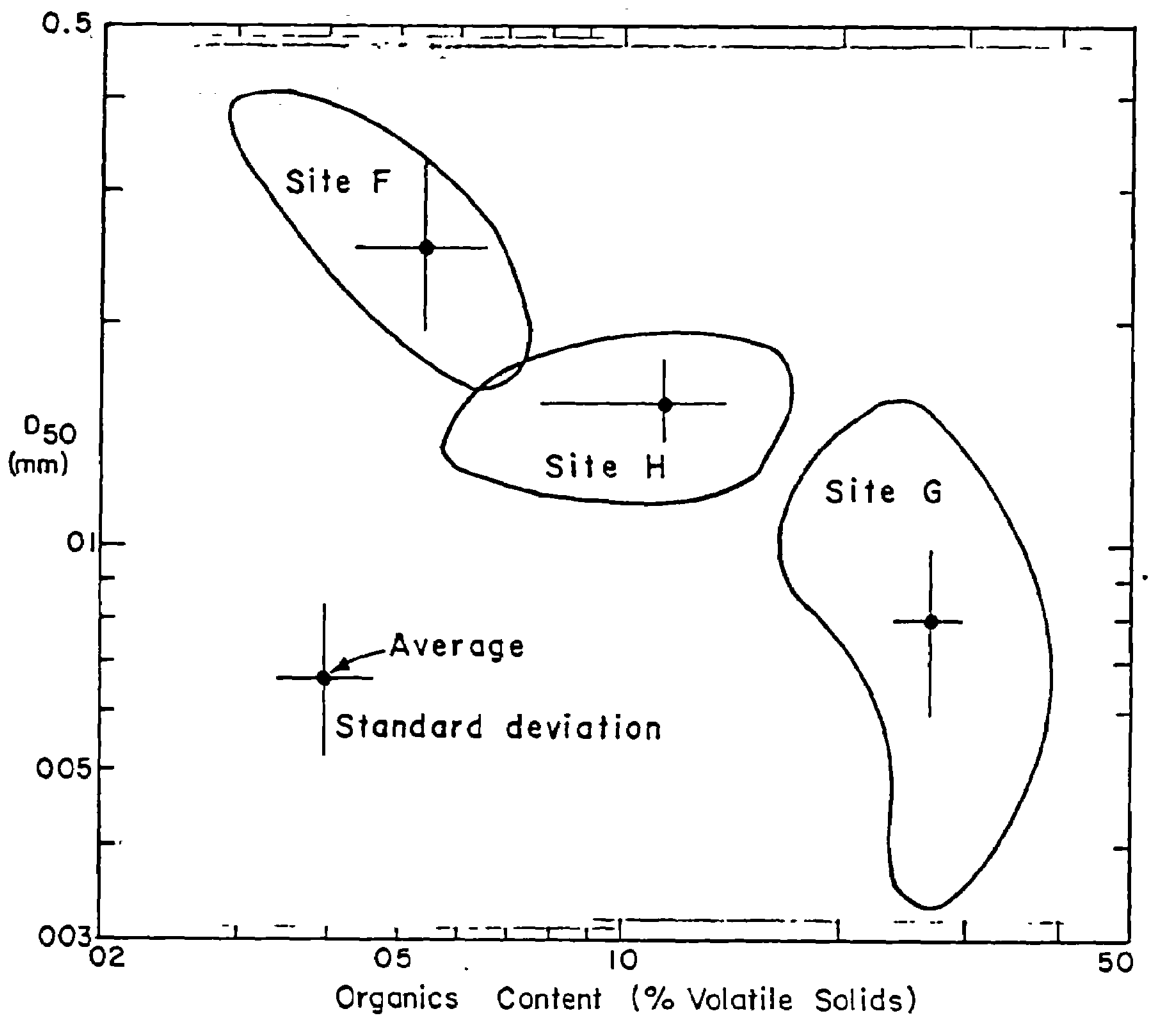


Figure 3.6 Median grain size vs. volatile solids with site average and standard deviation (after Nelson, et. al. 1983).

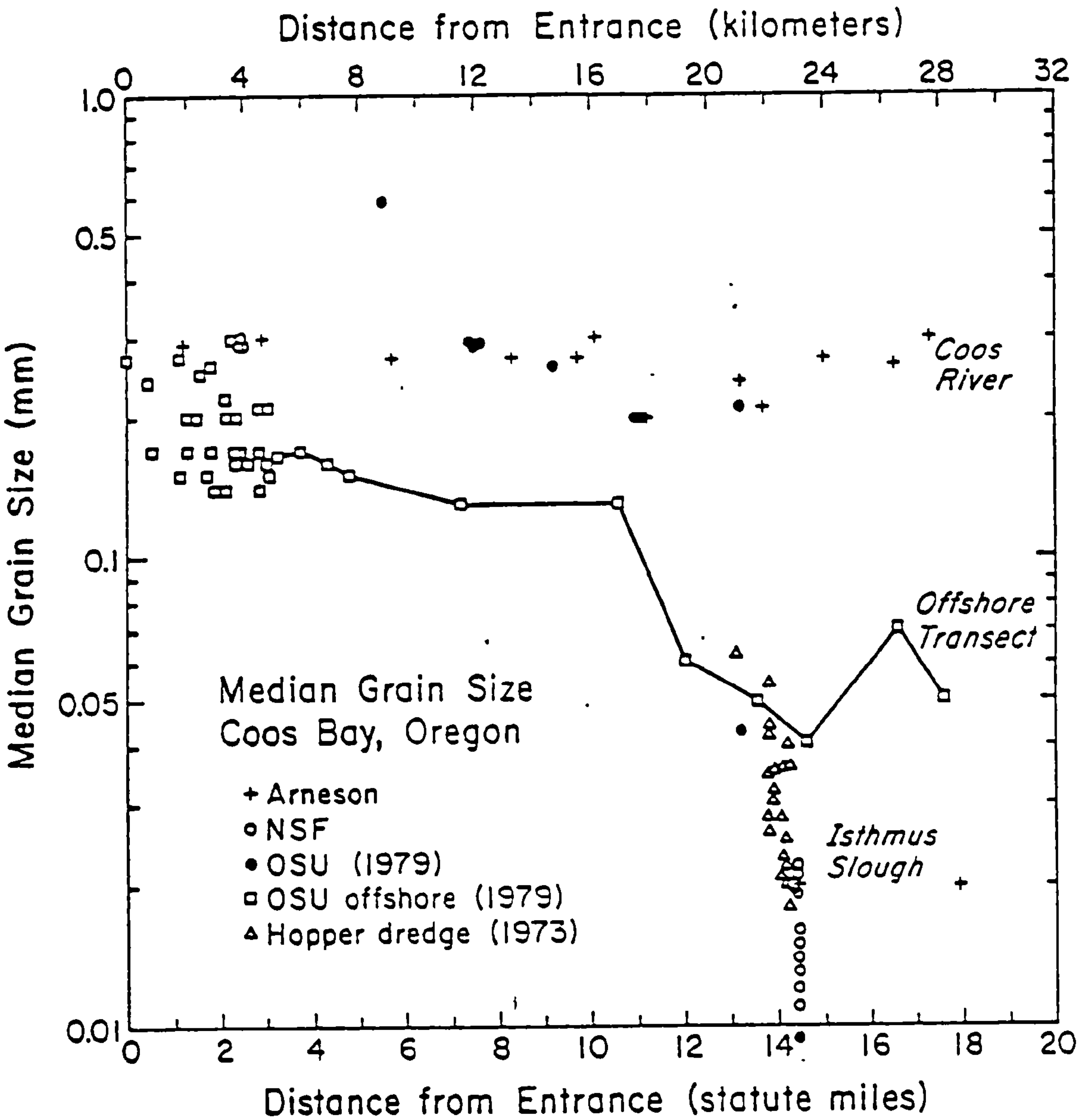


Figure 3.7 Median grain size related to distance from entrance (after Hancock, et al. 1981).

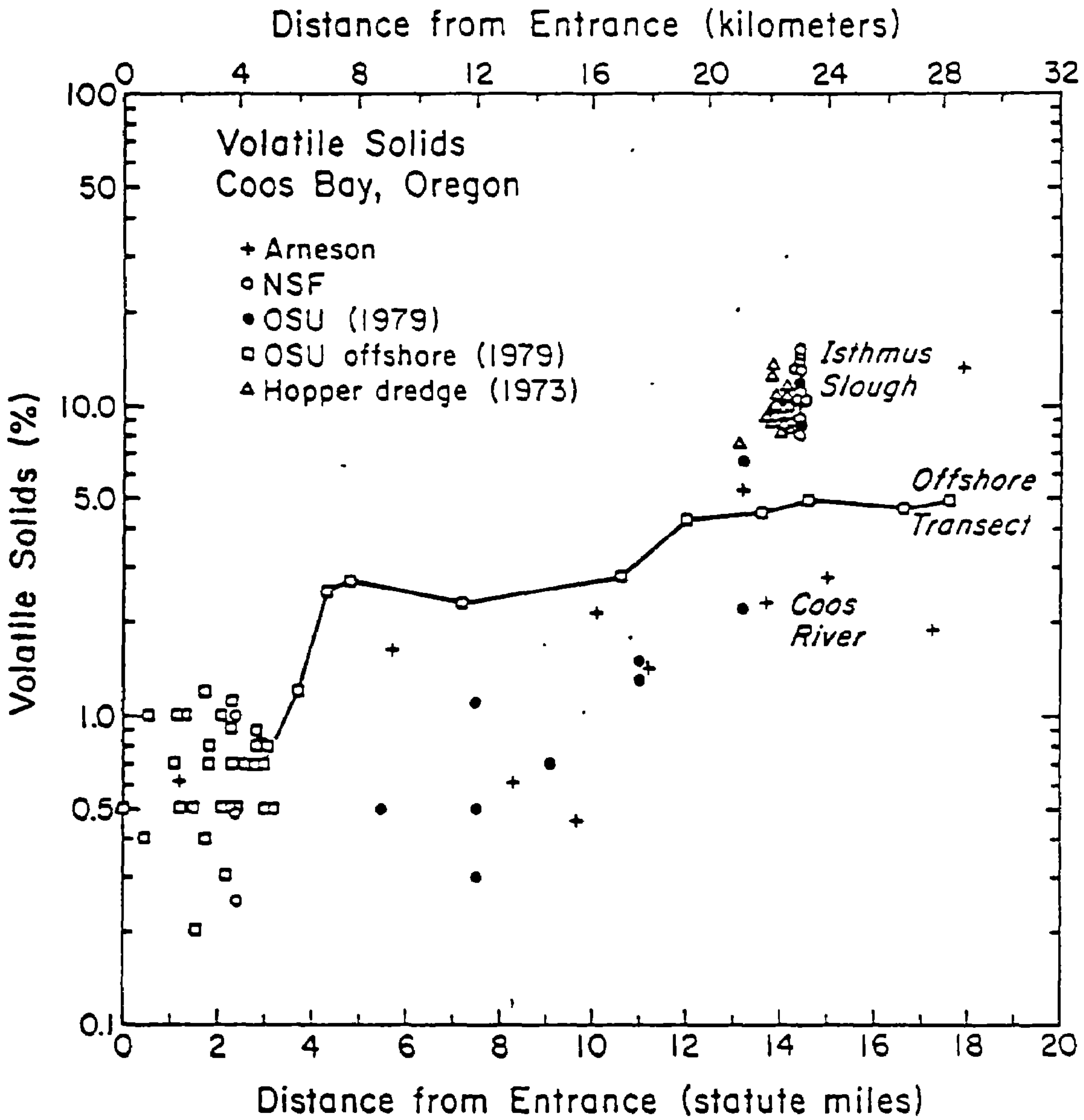


Figure 3.8 Volatile solids related to distance from entrance (Hancock, et al. 1981).

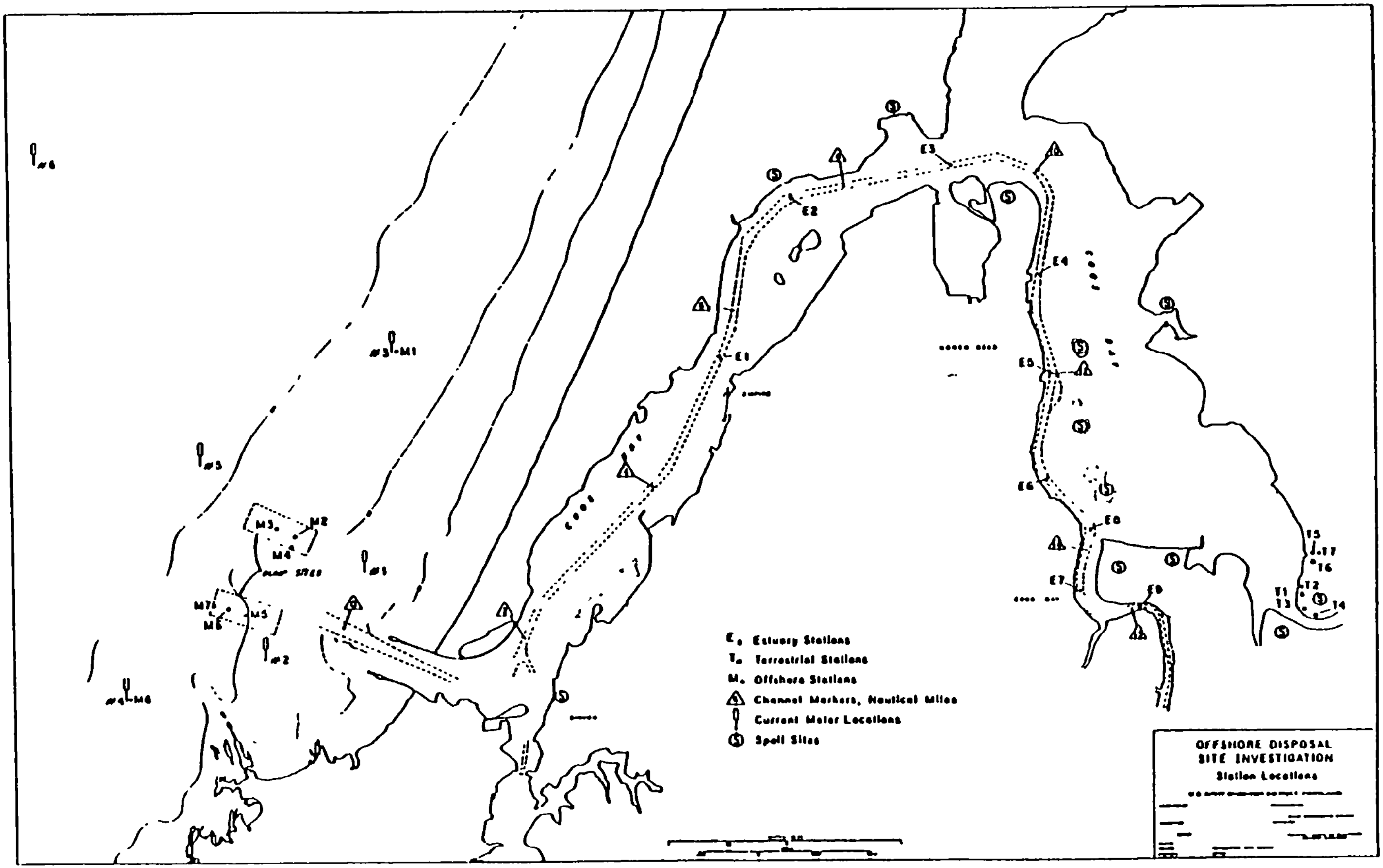


Figure 3.9 Coos Bay sediment sampling sites (Hancock, et. al. 1981).

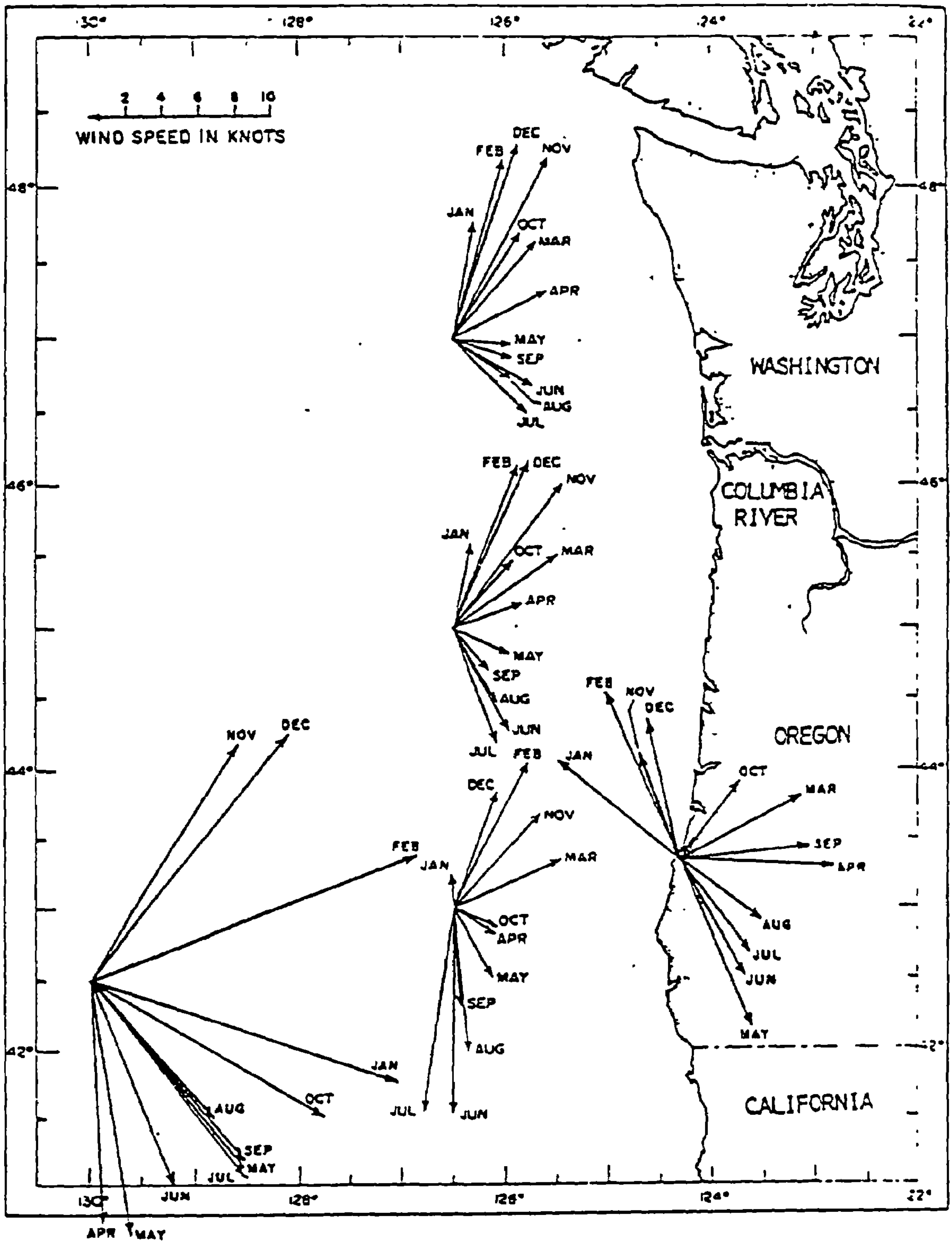


Figure 3.10 Monthly wind vectors observed at North Bend Airport and NOAA offshore data buoys.

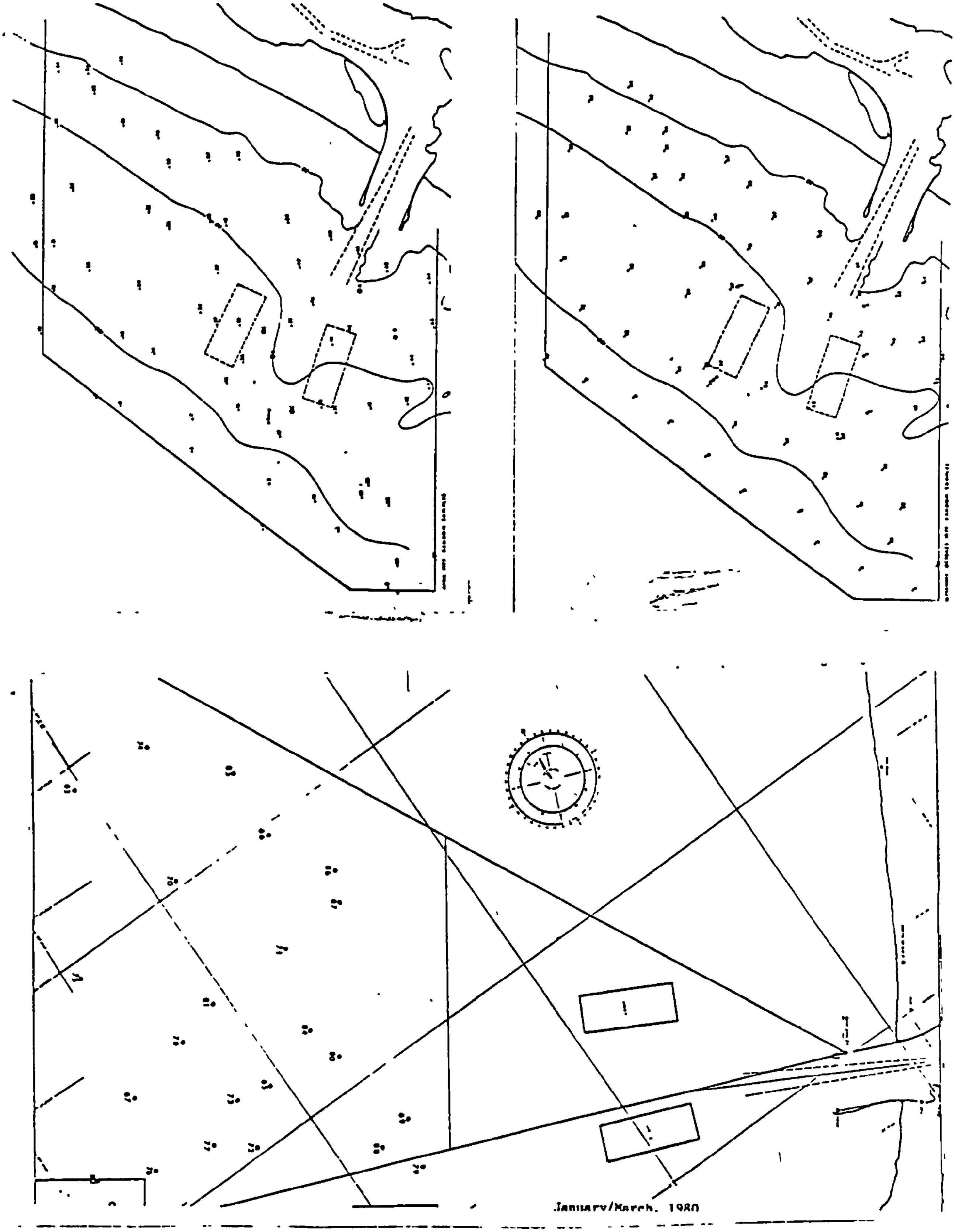


Figure 3.11 Core sampling stations - Phase I of Coos Bay Offshore Disposal Study (Hancock, et al. 1981).

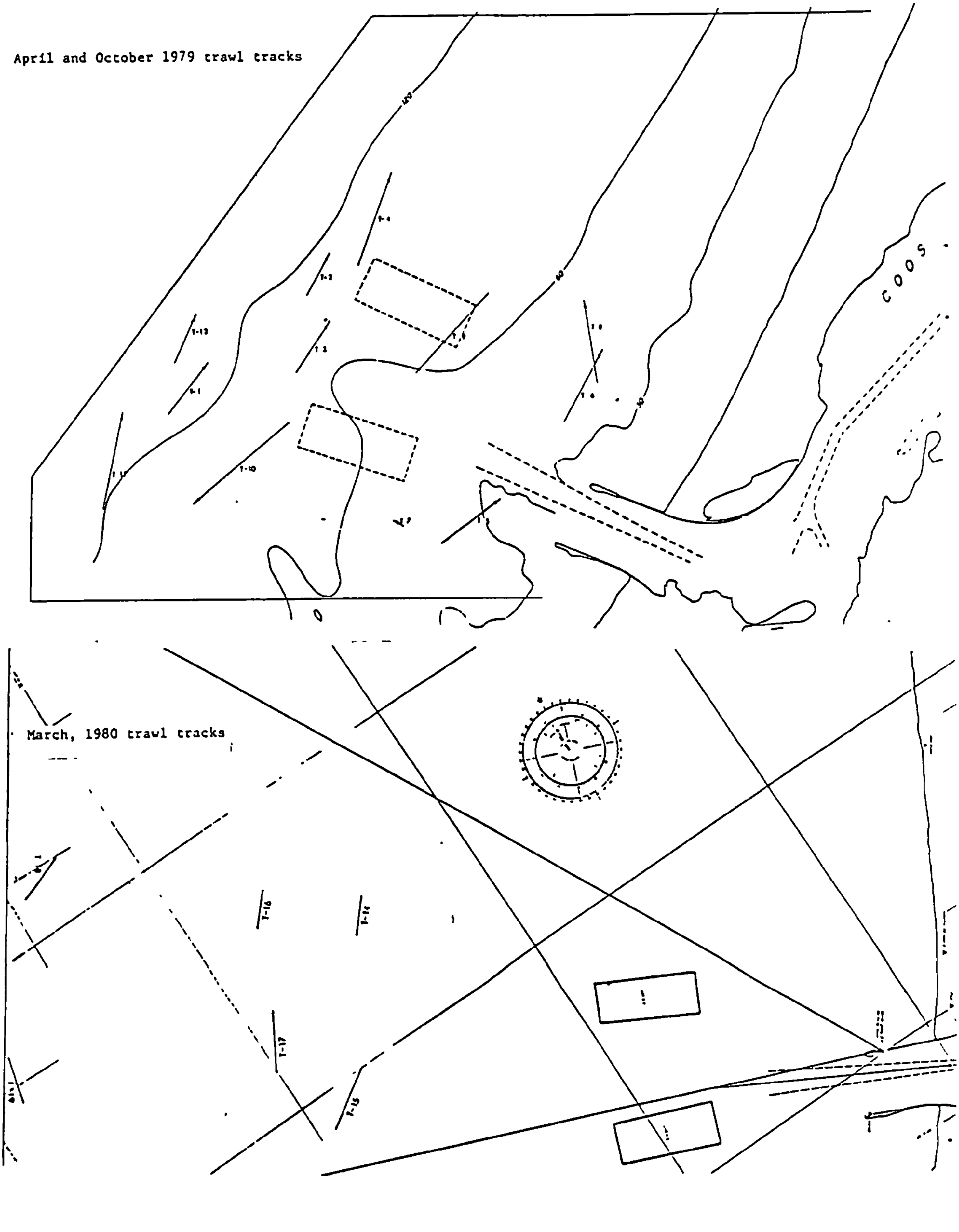


Figure 3.12 Trawl sampling locations - Phase I of Coos Bay Offshore Disposal Study (Hancock, et al. 1981).

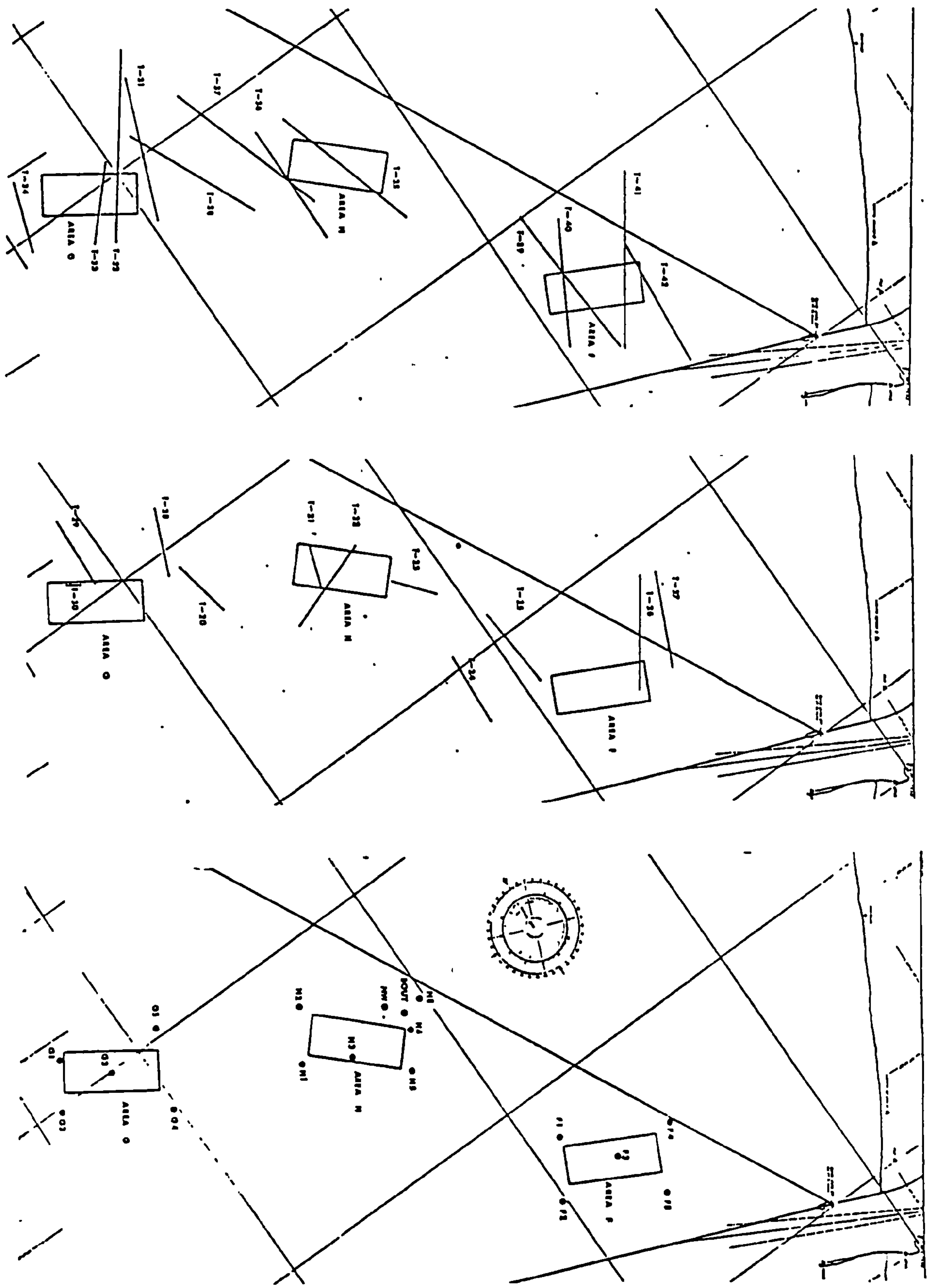


Figure 3.13 Core and trawl sampling locations - Phase II of Coos Bay Offshore Disposal Study (Nelson, et al. 1983).

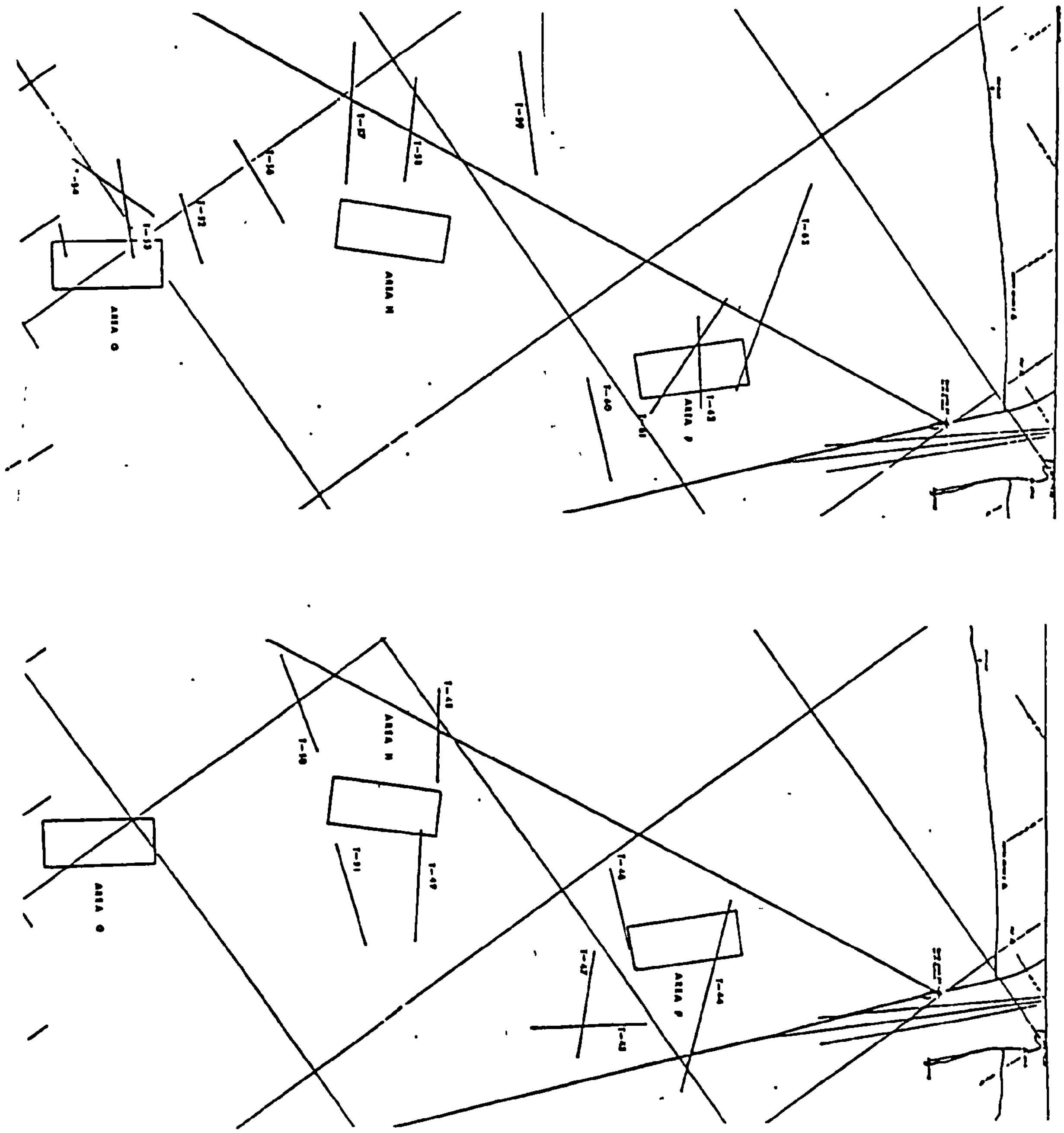


Figure 3.13 Continued

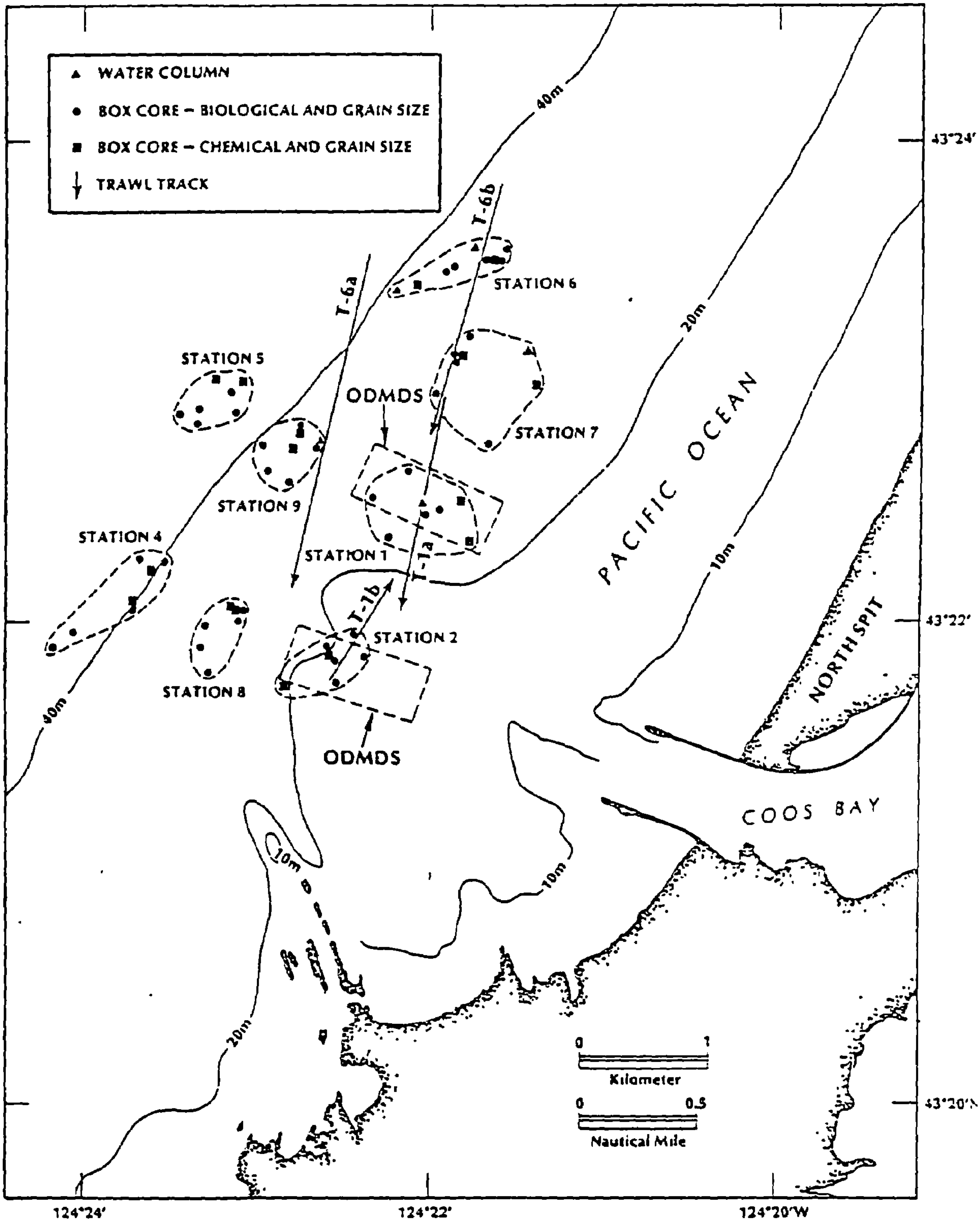


Figure 3.14 IEC survey locations (IEC, 1982).

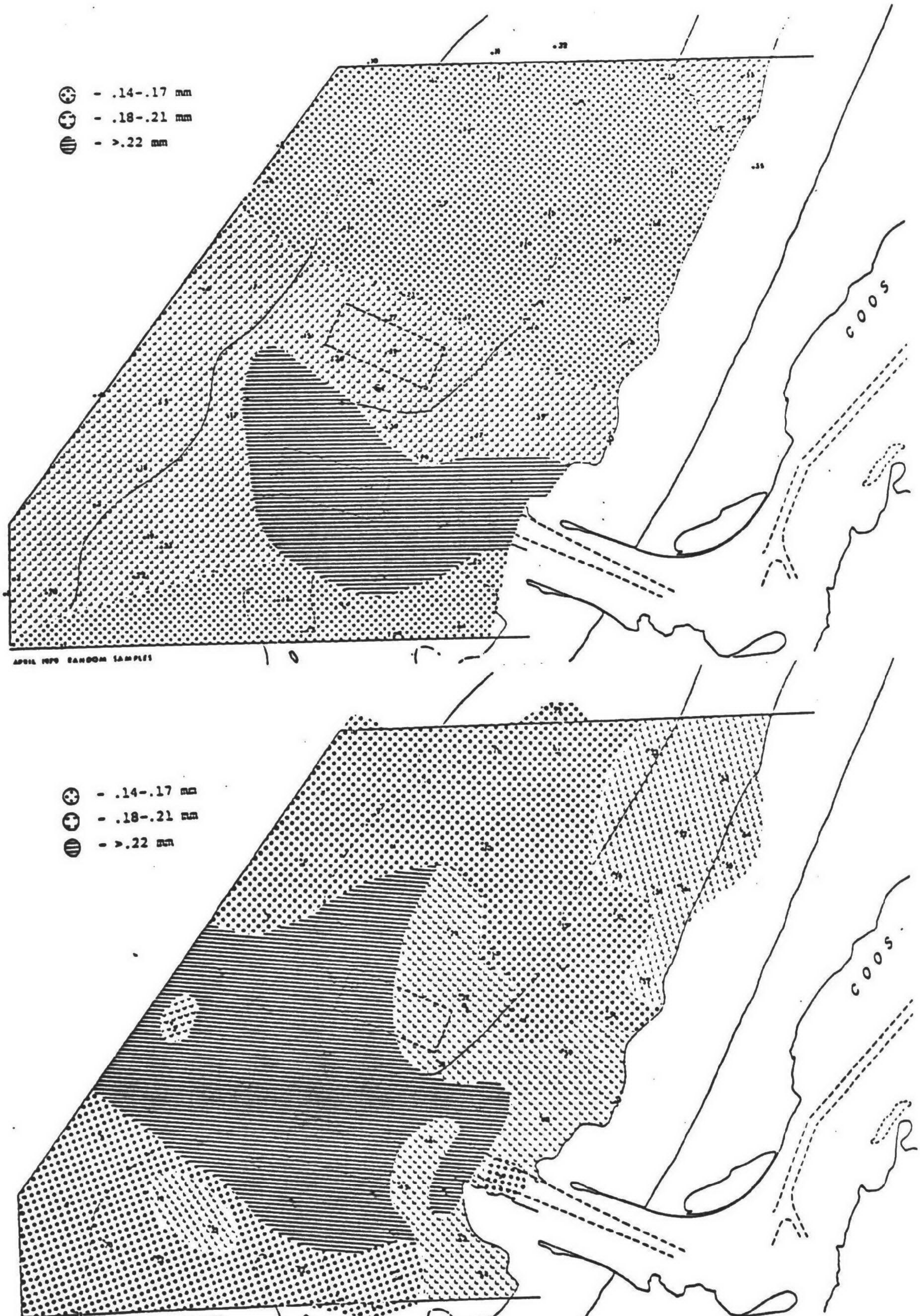


Figure 3.15 Distribution of sediment size; Cruise I & II, 1978 (from Hancock et al., 1981)

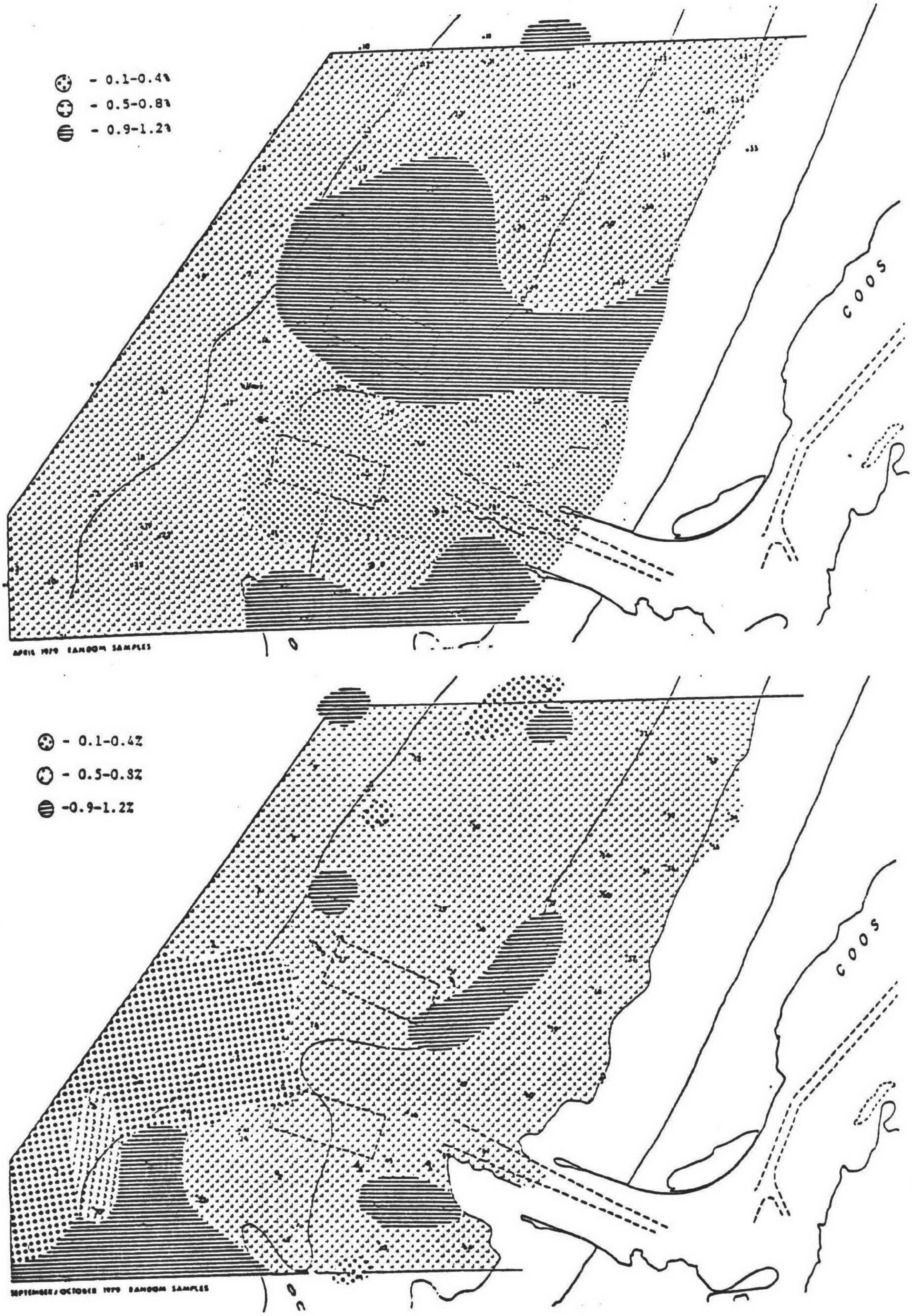


Figure 3.16 Distribution of volatile solids; Cruise I & II, 1979 (from Hancock et al., 1981)

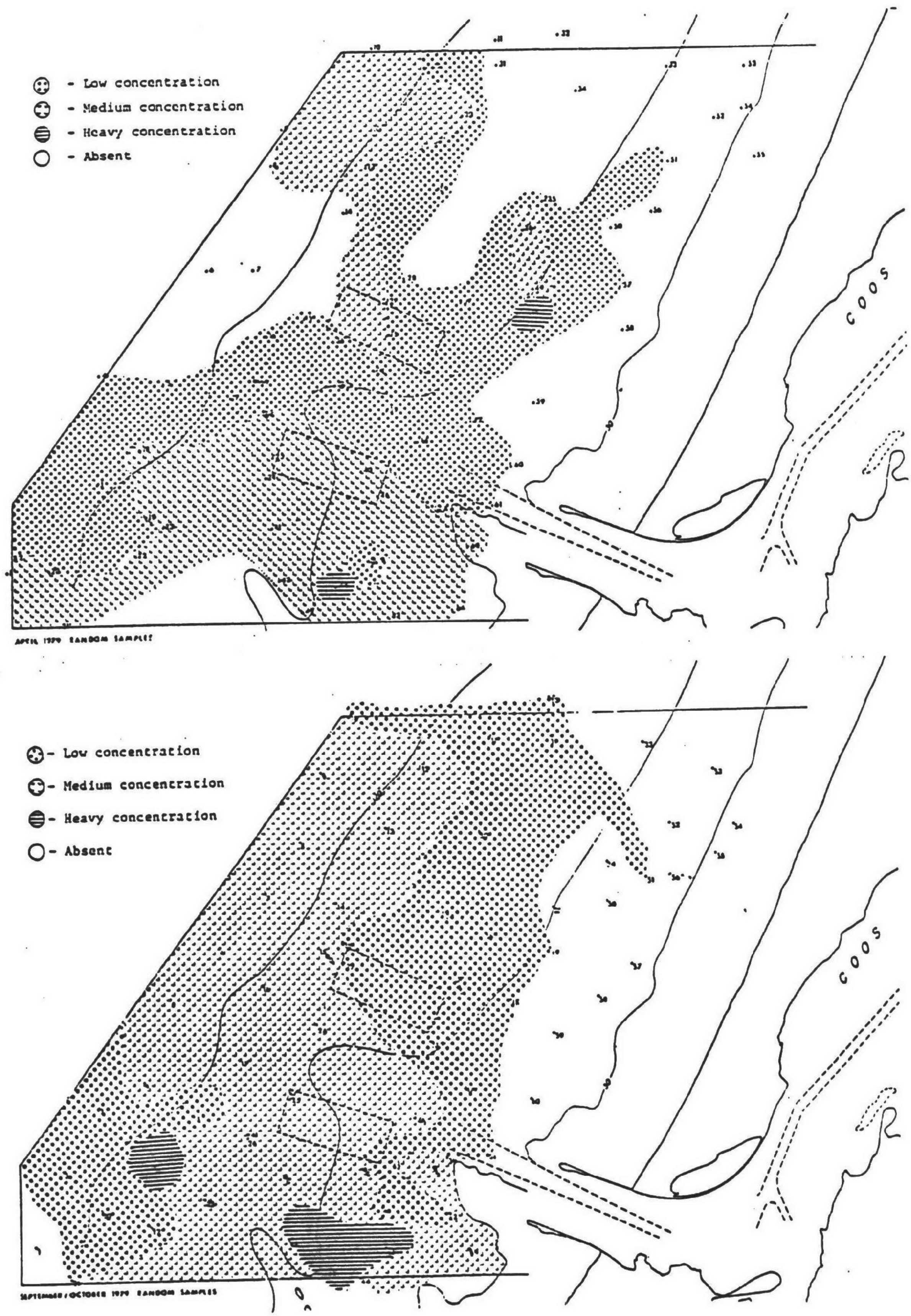


Figure 3.17 Distribution of wood chips; Cruise I & II, 1979 (from Hancock et al., 1981)

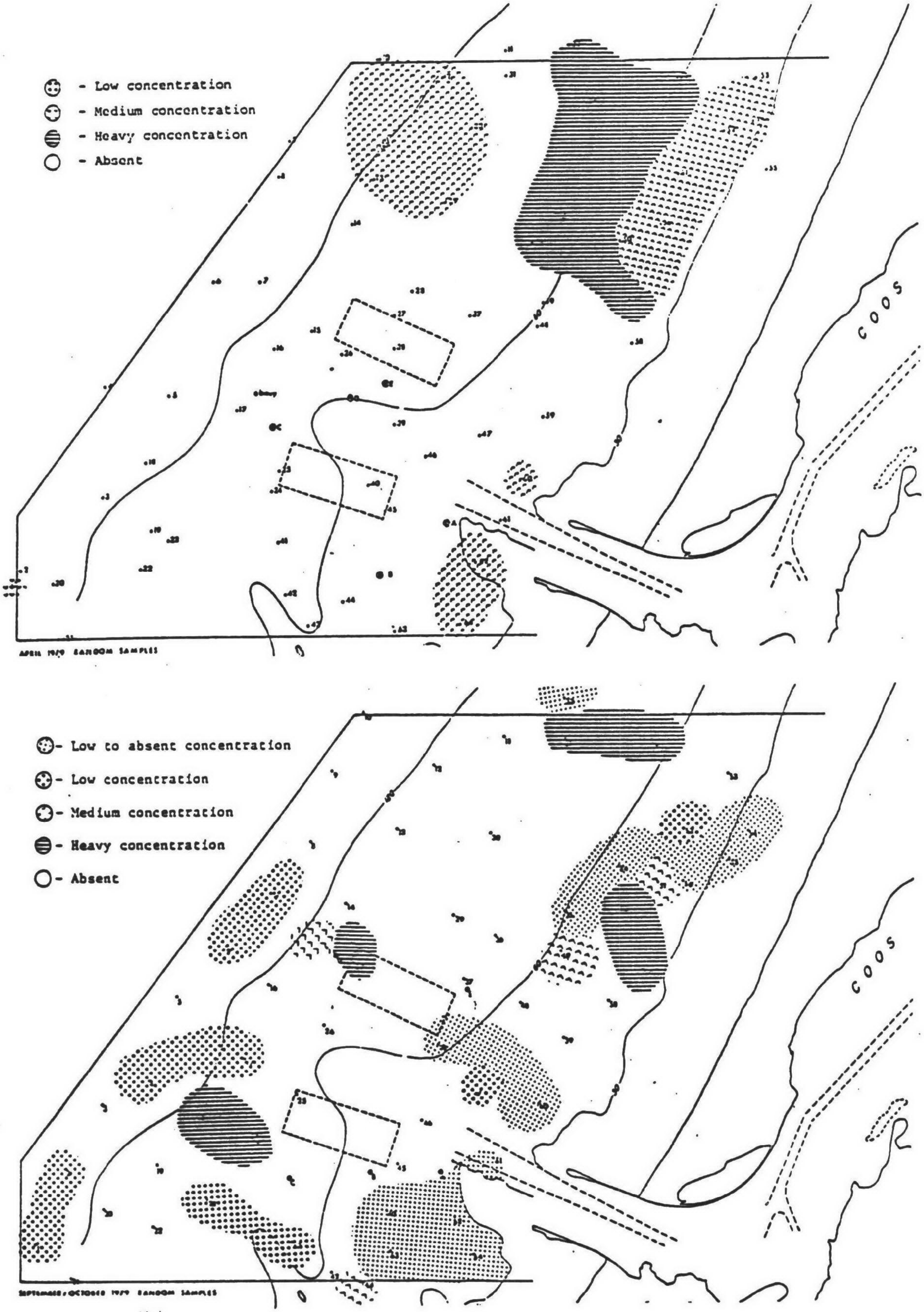


Figure 3.18 Distribution of shells; Cruise I & II, 1979 (from Hancock et al., 1981)

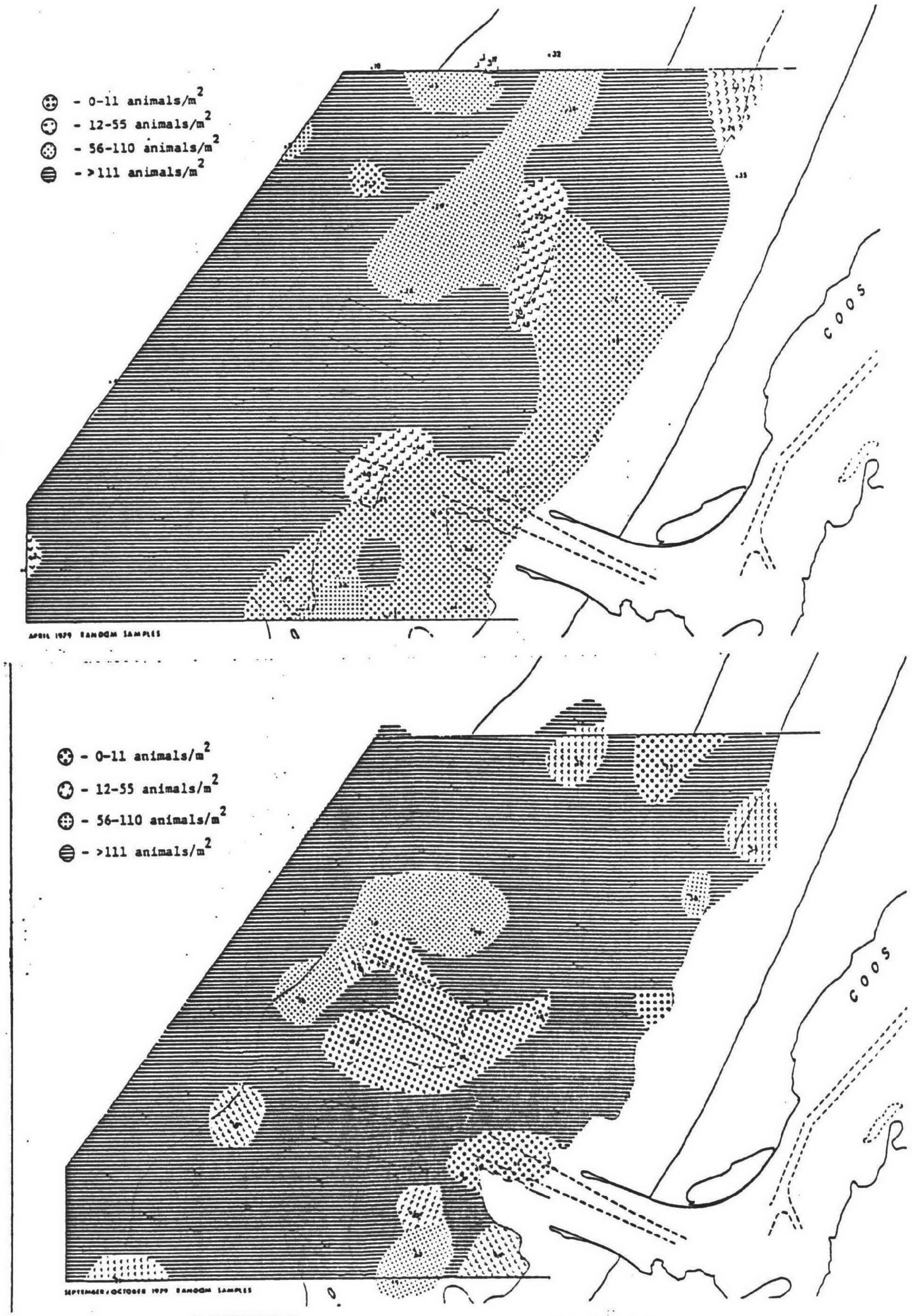


Figure 3.19 Distribution of the carnivorous snail Olivella. sp., in the nearshore region, April and September 1979 (from Hancock et al., 1981).

Figure 3.20 Distribution of the clam, Tellina modesta, in the nearshore region, April and September 1979 (from Hancock et al., 1981)

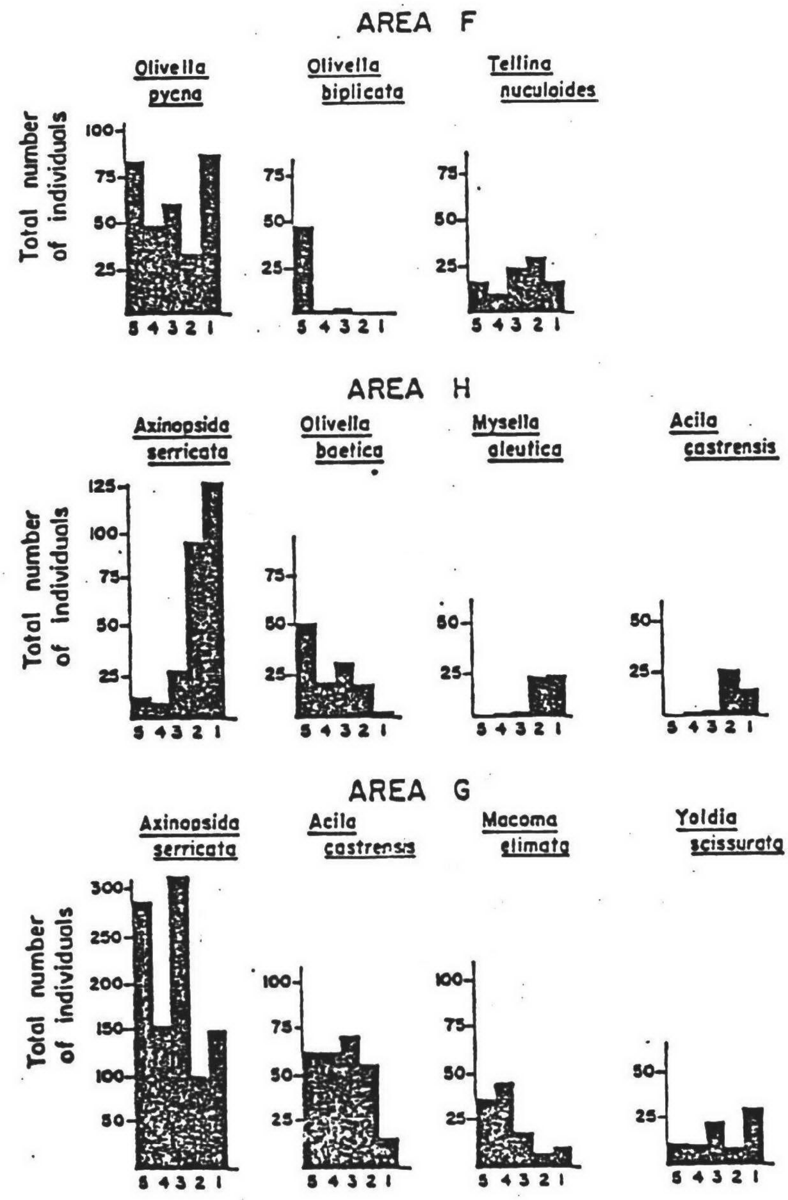


Figure 3.21 Spatial distribution of the most abundant mollusc species in areas F, H, and G; Cruise 4, May 1980

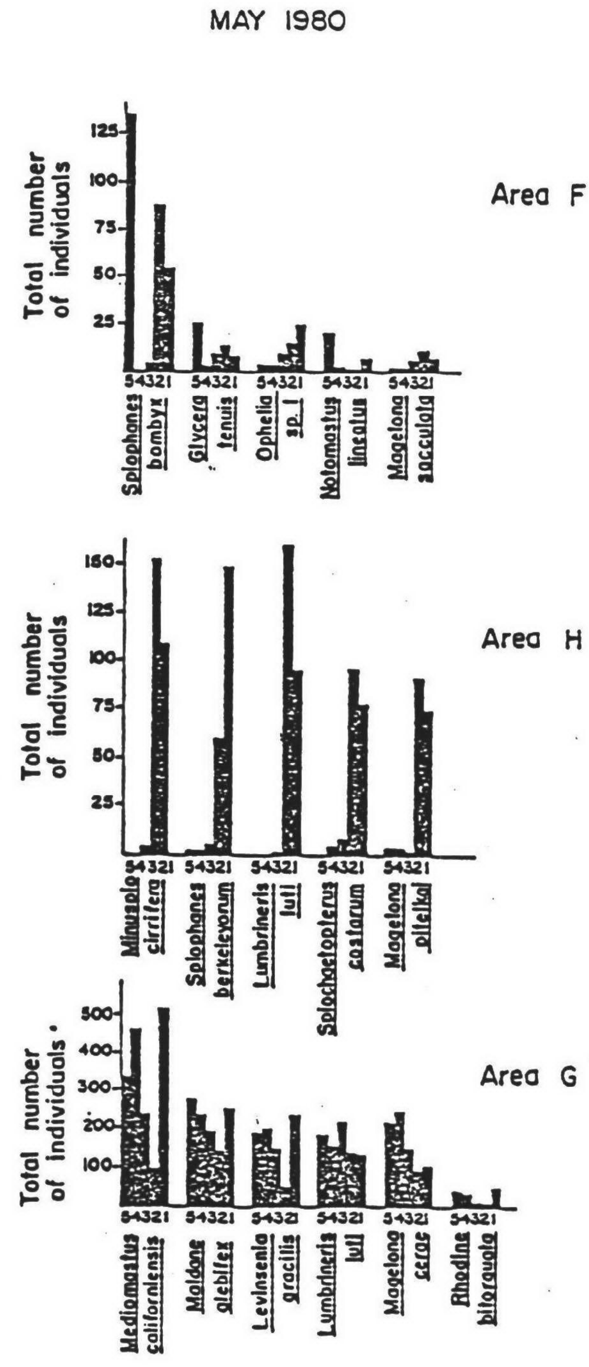


Figure 3.22 Spatial distribution of the most abundant polychaete species in areas F, H, and G; Cruise 4, May 1980

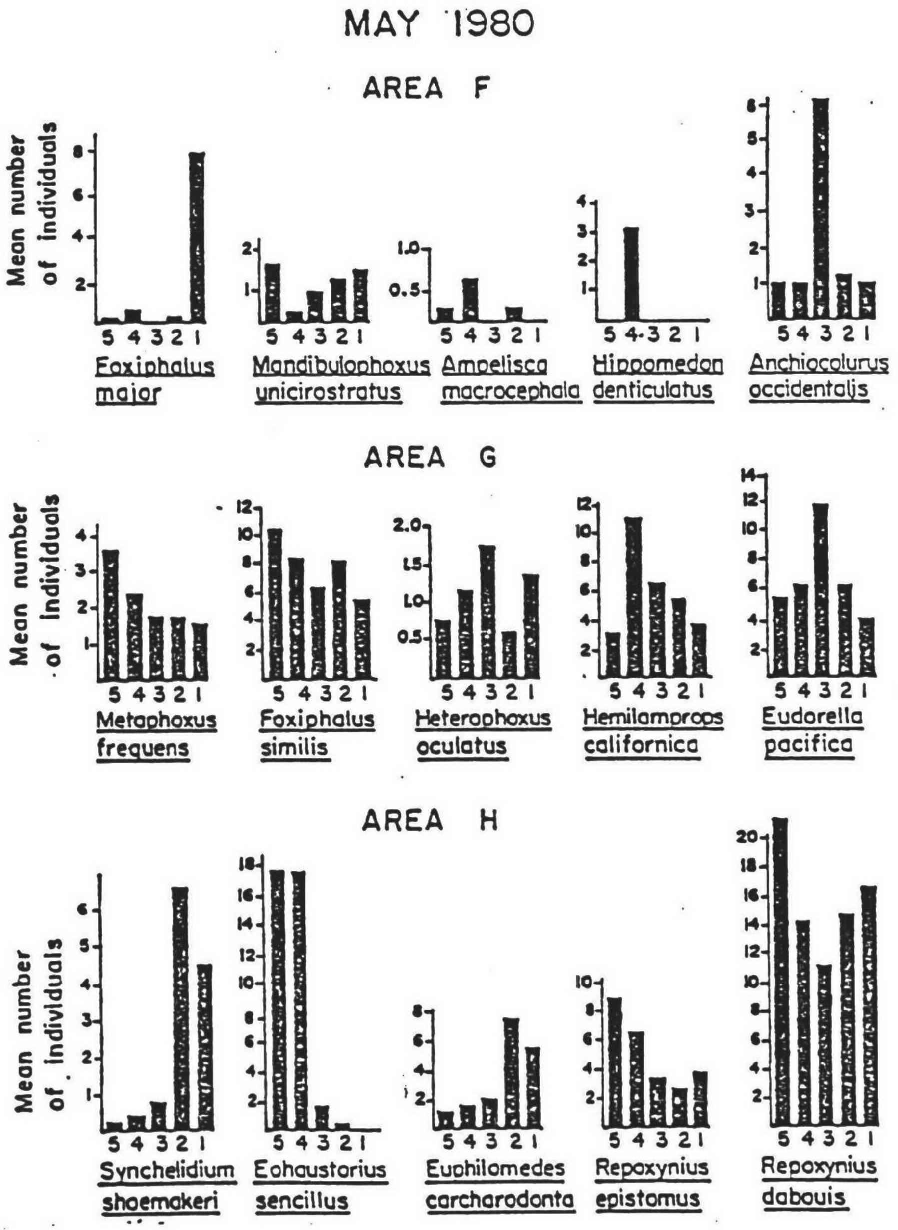


Figure 3.23 Spatial distribution of the five most abundant crustacean species in areas F, H, and G; Cruise 4, May 1980

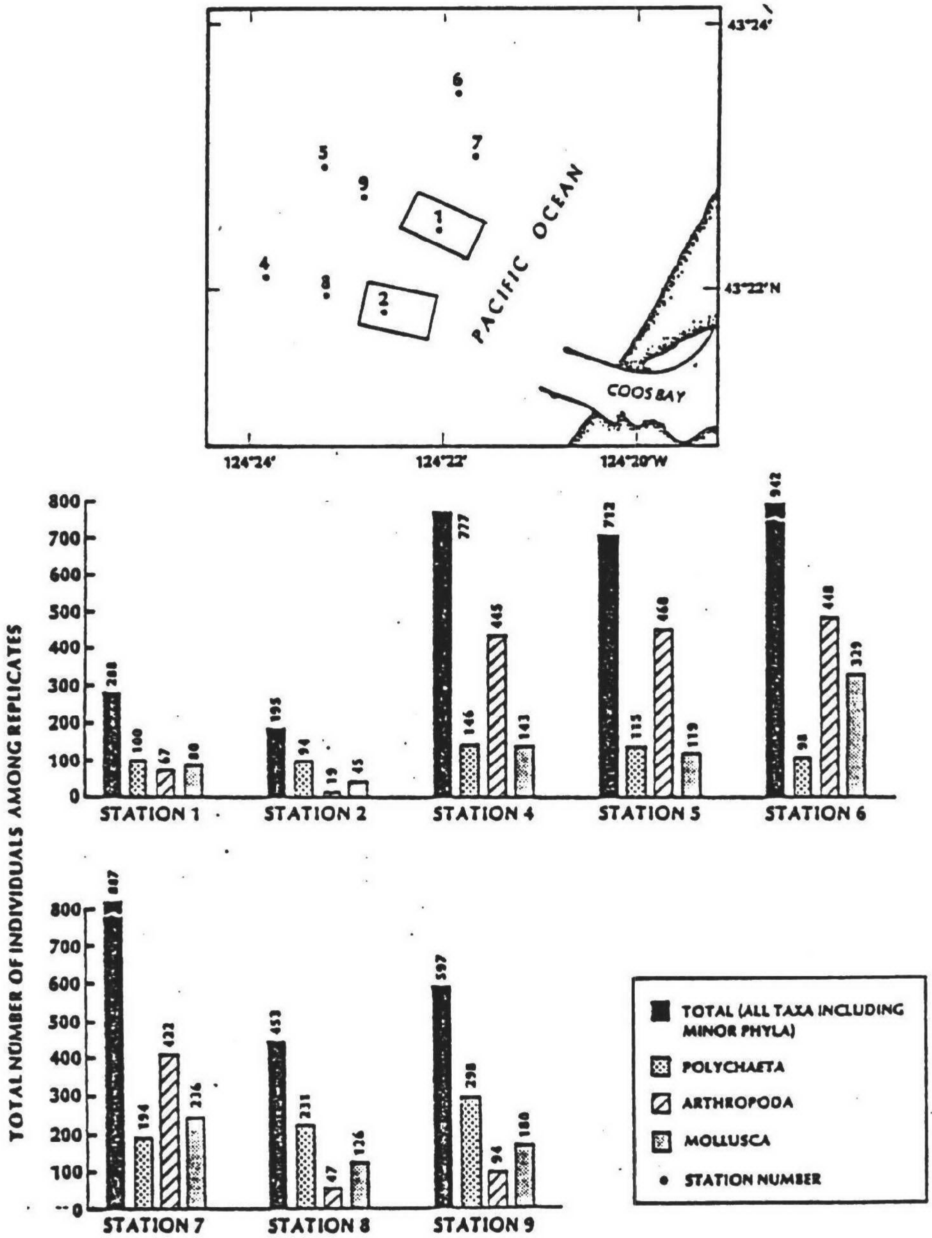
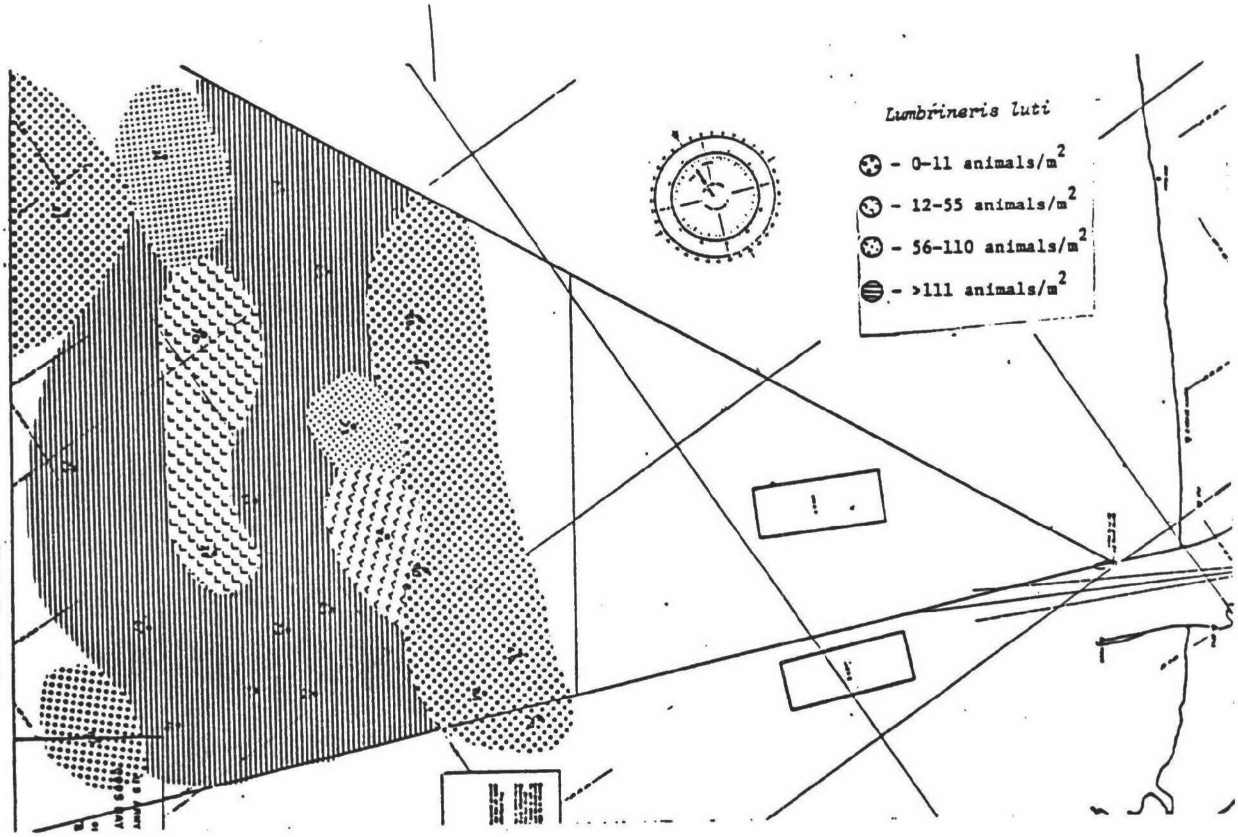


Figure 3.24 Total number of individuals collected by IEC at nearshore region (April-May 1980)



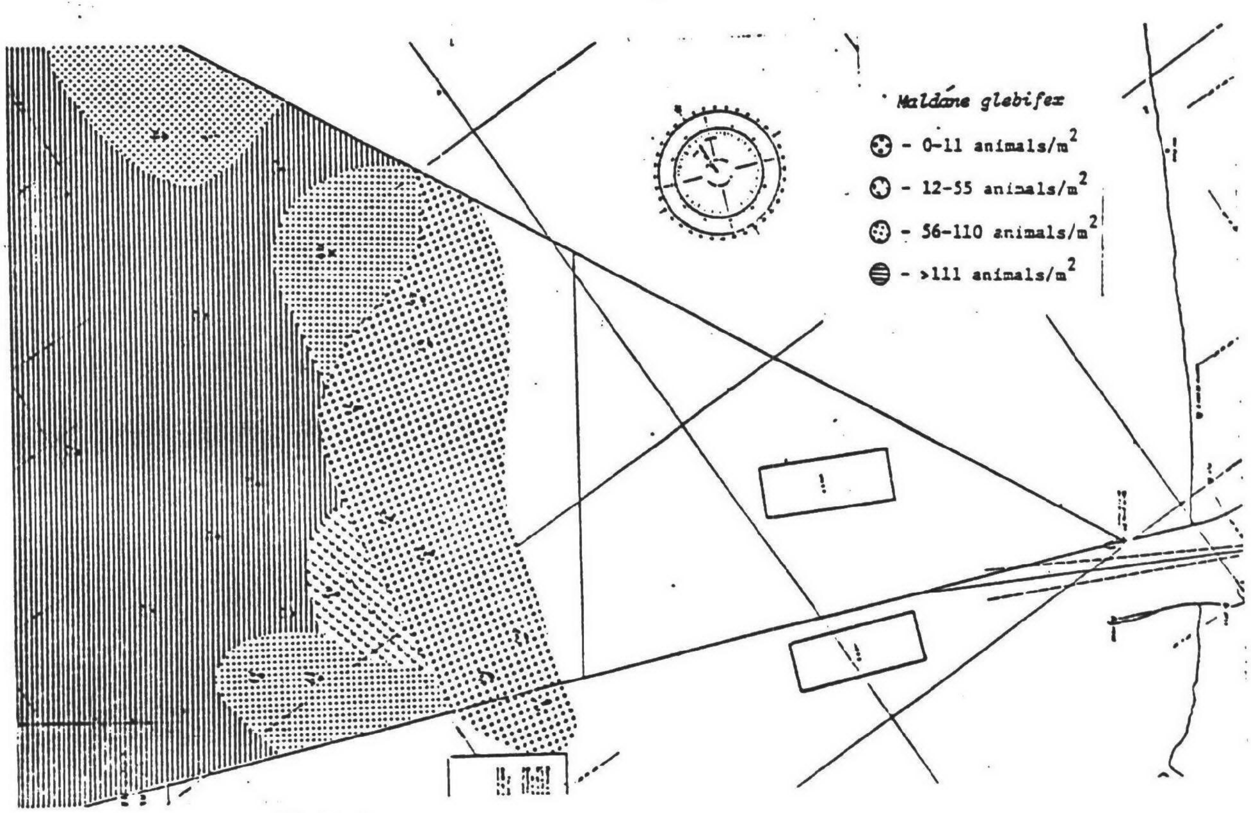


Figure 3.25 Distribution of Lumbrineris luti and Maldane glebifex; Cruise III, 1980 (from Hancock et al., 1981)

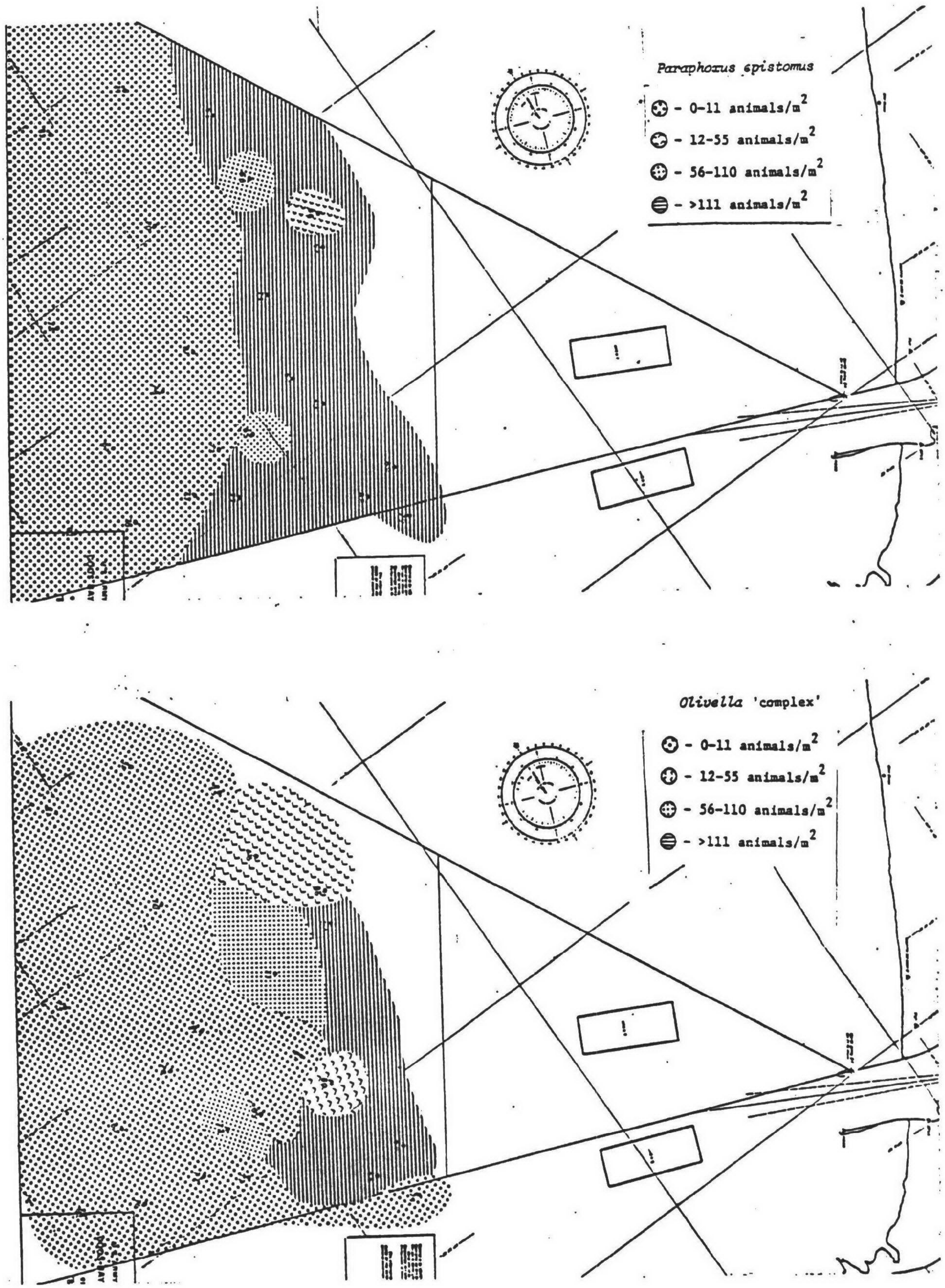


Figure 3.26 Distribution of Paraphoxus epistomus and Olivella sp.; Cruise III, 1980 (from Hancock et al., 1981)

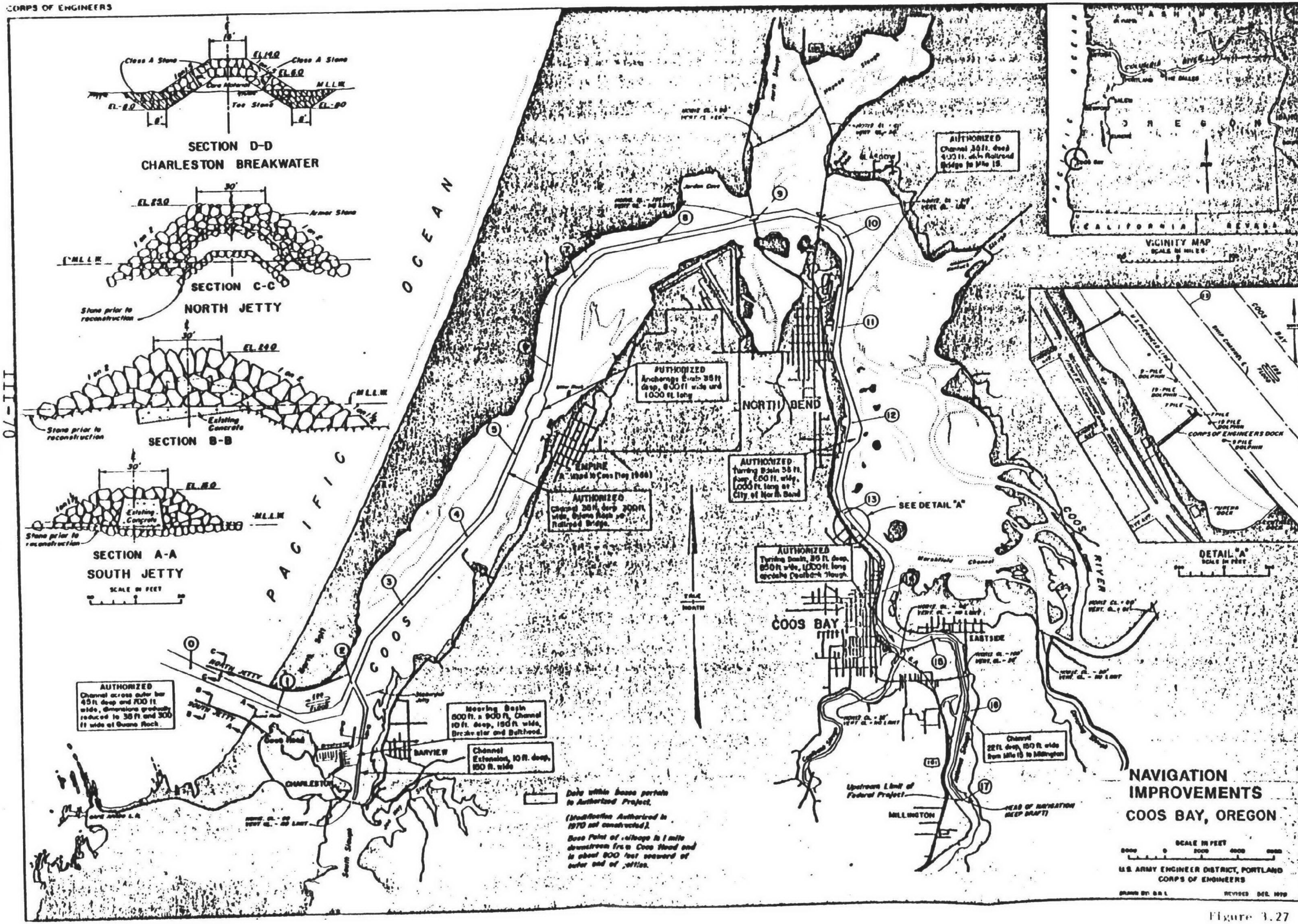

CORPS OF ENGINEERS
U.S. ARMY
SECTION D-D
CHARLESTON BREAKWATER
SECTION C-C
NORTH JETTY
SECTION B-B
SECTION A-A
SOUTH JETTY
PACIFIC OCEAN
COOS
NORTH JETTY
SOUTH JETTY
AUTHORIZED
Channel across outer bar 45 ft. deep and 700 ft. wide, dimensions gradually reduced to 35 ft. and 300 ft. wide at Guano Rock.
EMPIRE
NORTH BEND
COOS BAY
EASTSIDE
CHARLESTON
BARVIEW
MILLINGTON
COOS RIVER
SEE DETAIL "A"
DETAIL "A"
CORPS OF ENGINEERS DOCK
VICINITY MAP
OREGON
CALIFORNIA
NEVADA
Data within boxes pertain to Authorized Project.
NAVIGATION
IMPROVEMENTS
COOS BAY, OREGON
U.S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS

Figure 3.27

IV ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This section evaluates the environmental consequences of ocean disposal of: a) some 1.3 million cubic yards annually of Type 1 material (coarse-grained material from the entrance to RM 12), b) some 289,000 cubic yards annually of Type 2 material (finer material like that found between RM's 12 and 14) and;c) some 164,000 cubic yards on a 3 to 5 year cycle of Type 3 material (fine-grained material like that found above RM 14). Physical and chemical descriptions of these sediments are found in Section 3. These materials represent the physical and chemical range of the most likely materials to be considered for ocean disposal from the Coos Bay area. Neither this section nor this EIS attempts to compare or evaluate impacts of upland or estuarine disposal. The effects analysis developed in this section provides the basis for evaluation and comparisons of the alternatives described in Section 2. Please note that although this section does not specifically refer to adjusted site H, the analysis prepared by OSU and presented in this section covers an extensive offshore area which includes adjusted site H. In general, impacts of disposal of type 2 and 3 material at adjusted site H would be less than disposal of these materials at sites E, F, or H.

4.2 PHYSICAL IMPACTS

4.2.1 Bathymetric Impacts

Disposal of Type 1 sediments at sites E and F would contribute to the natural progradation of the river delta. The finer size fractions would be winnowed from the sediments and transported offshore and alongshore by local mean currents. Some of the fines would also be transported onshore and back into the estuary by tidal currents. Some down-slope movement of suspended fine sediments may also occur in the turbid layer at the bottom but since ocean disposal is limited to the April through November period of south flowing mean currents, most transport of fines would be along contours to the south. Northward transport of fines can be expected during the period of the Davidson Current and winter storms that would completely rework and spread out the disposal mound. Disposal of Type 3 sediments at this site would increase local turbidity both in the short and long term since the majority of the disposed sediment would be unstable in the local energy regime. Increased turbidity levels would be encountered downstream of the disposal site and more fines can be expected to be transported back into the estuary.

Disposal of Coos Bay sediments at deeper sites (H, adjusted H, G, or continental slope) would produce longer-lived but broader bathymetric mounds since these sediments are coarser than the ambient sediment and the greater depth allows more spreading. The mound can be expected to slowly spread parallel to bathymetric contours. Type 3 sediments would be unstable at these sites, but resuspension and erosion of any bathymetric mound would be slower as depth increases since these processes depend on the influence of surface waves. Type 3 sediments would only be stable if disposed of on the muds of the continental slope. Dispersion of sediments during their fall through the water column at the continental slope site would spread the sediments so widely that no bathymetric buildup would be expected. Similar disposal of Type 2 and 3 sediments would produce permanent deposits but again the buildup would likely be minor.

Using a simplified but uncalibrated version of the Koh-Chang (1973) computerized dredged material dispersion model, Nelson et al. (1983) compared plume and bottom deposits at sites F, G, and H for sediments having median grain sizes of 0.015 mm, similar to Type 3 sediments. Under representative summer current conditions, the percentages of dumped material that reached the bottom were about 50, 38, and 34 percent for sites F, H, and G, respectively. Clearly a major fraction of the dumped material remains suspended in the water column and is ultimately deposited over a very great area. The maximum bottom deposit thickness was estimated at 23 cm (9.2 inches) per 100,000 dumped cubic yards at site F, 9 cm (3.6 inches) at site H, and 7 cm (2.7 inches) at site G. The areal impact on the bottom increases with increasing depth due to greater mixing during settling. Areal coverage at site H was about twice that for site F and at site G nearly four times as great, as that for site F. Coverage at the continental slope site was not assessed. Local erosion would quickly rework and erase any mound at site F. It is likely that any mound at sites H and G would erode more slowly and may be covered by mobile ambient sediments, further increasing the time required to erase a mound. After 1 year approximately 50 percent of the test material deposited at site H had been eroded away or covered up by natural bedload movement and after 18 months little remained of the test dump material (Sollitt 1983 pers. com.). The numbers cited from this study are not exact but only indicate relative differences. Future reports currently in preparation at OSU will address the accuracy of the Koh-Chang model.

4.2.2 Sediment Distribution and Transport

Figures 3.5 and 3.6, Section 3, illustrate the natural variability of median grain size and volatile solids for sites F, H, and G, and for the three estuary sediment types. Type 1 sediments are physically and chemically compatible with sediments at site F. Site H sediments are slightly finer than these estuarine sediments and site G sediments are substantially finer and richer in volatile solids. Type 2 sediments are similar in median grain size to site G sediments but these ocean sediments have lower volatile solids. Type 3 sediments are not physically compatible with sediments of any of the three sites since it is very fine and rich in volatile solids. Compatibility for these fine sediments may be found in the mud facies on the upper continental slope.

Sediments that are finer than ambient sediments are expected to be more mobile than ambient sediments. The opposite is expected for coarser sediments. Consequently, all estuarine sediments can be expected to be mobile in the vicinity of site F while only Type 2 and 3 sediments would be mobile at site H. Type 2 sediments would be moderately mobile at site G while Type 3 sediments are mobile at all sites except at the continental slope site. Detailed current measurements by Hancock et al. (1981) support these generalities and suggest that the frequency of resuspension is relatively uniform during spring, summer, and possibly autumn but is significantly greater in winter. It also appears that the differences in resuspension frequency between sites F and H are greater than the differences between Sites H and G. Such generalities are in keeping with the seasonal characteristics of surface waves and their rapidly decreasing influence with increasing depth. Fine Type 1 sands may be expected to be mobilized 75 percent of the time in winter at site F and 30 percent of the time during the rest of the year. Resuspension at sites H and G may be 20 to 30 percent of the time in the winter and 10 and 25 percent during the remainder of the year. Little or no reworking of sediments is expected for the continental slope site. Type 3 sediments would be almost constantly erodible at site F in the winter and mobile in excess of 80 percent and 50 percent of the time at Sites H and G, respectively, during the winter, and in excess of 50 percent of the time for both sites during the rest of the year.

The direction of sediment transport is highly variable with both upslope and downslope transport occurring at all shelf sites during all seasons. Preliminary analysis of detailed near-bottom current measurements by Hancock et al. (1981) suggests that downslope transport is generally more frequent than upslope transport at all three sites and that this tendency is stronger for the non-cohesive fine sands than for Type 3 sediments.

Transport of fine sediment back into the estuary is likely to occur from site F. Onshore transport from the vicinity of sites H and G is less likely and dispersion would scatter the sediments to the point that detectable volumes of material would not reach the coastline. Sediments suspended in the water column are similarly more likely to impact the estuary and coastal shorelines with disposal of Type 3 material at site F.

4.2.3 Water Quality

Water quality impacts may be divided into physical and chemical aspects. Increased turbidity is the principal physical effect. Disposal of the clean Type 1 sands would produce a very local short term increase in water column turbidity which would quickly be dissipated by local currents at all sites under consideration. Reworking of materials in any bottom mound would produce longer term impacts. Reworking of sediments at site F is expected to occur during the dredging season while complete reworking at sites H and G may not be completed until the winter storm period. Consequently, resuspension of fines from site F can be expected to be strong and continuous following disposal, whereas deeper sites may have continual but weaker erosion of fines during the summer but rapid winnowing in the winter. No reworking of sediments would be expected for the continental slope site.

Nelson et al. (1983) applied an experimental version of the Koh-Chang (1973) computer model for dredged material plume dispersion of Type 3 sediments. While their results are yet to be verified, the study suggests that the disposal of 3,000 cubic yards of sediments under summer conditions could produce maximum vertically-averaged suspended sediment concentrations after one hour of 0.04 percent by volume at site F, 0.004 percent at site H, and 0.0001 percent at site G. These values represent dilutions by factors of 500; 5,000; and 200,000, respectively. These levels may be compared to summer field measurements by Plank and Pak (1973) off Newport. Averaging surface, middepth and bottom concentration for three stations less than 110 m deep yields volume concentrations between 0.05 percent and 0.12 percent. The lower figure is approximately equal to the model's highest-projected vertically-averaged concentration after one hour. Consequently, it may be assumed that disposal operations will, under worst case conditions, produce a local turbidity impact comparable to natural events.

Since the majority of chemical contaminants appear to correlate strongly with the finer size fractions, it is reasonable to assume that the dispersal of the chemical contaminants would be proportional to the dispersion of the fine fractions. Adoption of preliminary estimates by Nelson et al (1983) suggests that between 50 and 75 percent of the sediment would remain in suspension when dumped and would be transported from the disposal sites by mean currents. This material would likely contain much of the chemical contaminants with dilution comparable to those just mentioned. Elutriate analysis (Hancock et al., 1981) indicate that only ammonium-nitrogen, manganese, and cadmium may be released to fresh seawater in sufficient concentration to possibly exceed water quality criteria. Considering the dilutions just discussed, it appears likely that these concentrations would be well below the levels of concern prior to exceeding the boundaries established by the four hour mixing zone. In addition, no significant differences were observed between tests and controls of the bioassay tests conducted. Bioaccumulation in test animals was lower than but in proportion to the concentration of chemicals and metals in the sediments (Nelson et. al. 1983).

4.3 BIOLOGICAL IMPACT

4.3.1 Epibenthos and Fisheries.

Since the majority of the material (87%) to be disposed can be classified as clean, non-toxic, organic materials, and since the epibenthic and fish fauna are mobile, we do not expect any measureable effect from ocean disposal of Coos Bay sediments. The greatest impact to these organisms would be the loss of available food organisms due to the loss of benthic invertebrates. Reduction of these food resources may increase competition for food resources in other areas. This impact would reduce in proportion to the rate of recruitment.

4.3.2 Marine Mammals

Although a number of marine mammals are known to occur in the vicinity of the sites, it is unlikely due to their high mobility that they would be impacted by disposal operations at any of the alternative sites.

4.3.3 Rare and Endangered Species

No known rare or endangered species or their critical habitat would be impacted by disposal at any of the alternative sites. See U.S. Fish and Wildlife Service Letter in Appendix C.

4.3.4 Benthos

Disposal of dredged material at any of the proposed sites would result in a loss of some of the benthic invertebrates at the site. This mortality may be direct or delayed. The rate of recruitment of a site by benthic invertebrates would depend upon the frequency of dumping and type of material disposed at a given site.

The nearshore sites (E and F) are the most biologically and physically dynamic of the proposed disposal areas. Bottom turbulence caused by river outflow and tidal and wave induced currents result in extensive sediment movement and dispersion of sediment types in this area.

Dominant benthic species of the nearshore are species that actively burrow vertically or horizontally or are deposit feeders. These species are

(Spiaphanes bombyx) (Olivella pycna), (O. biphlienta), (Ophelia n. Sp.) and (Tellina nucoloides). In general, surface dwelling benthic species were present in very low numbers in the nearshore region or restricted to the deeper portions of the area. Many species groups consisted of juveniles recently settled out of the plankton. Hancock et al. (1980) found no significant post disposal effects on the biological community at sites E and F.

Based upon this information, disposal of Type 1 sediments would likely have a short term impact on the benthic communities of sites E and F. The most immediate effect would be almost total mortality of benthic species in the impact zone with some burrowing benthic species surviving, depending upon their burrowing capabilities and the depth of the disposal mound. Based upon the low content of organic material and fines in Type 1 sediments (Figures 3.5 and 3.6), and the expected rapid dispersion rate of fines at sites E and F, we would not expect any measurable degree of mortality of filter feeding benthic species outside of the impact zone due to turbidity factors.

Disposal of Type 2 and 3 material, however would increase mortality of filter feeding benthic invertebrates at sites E and F. Although an increase in mortality due to turbidity factors may be expected, it is doubtful if this increase would be significant since (a) There are few filter feeding benthic species in the nearshore area; (b) suspended sediment values would be lower than that caused by natural events (see Section 4.1.3); and, (c) sediments would be rapidly dispersed or covered (Hancock et al., 1980, and Nelson et al., 1983).

Based on the above, effects of disposal at sites E and F would be short term and rapid recruitment would occur.

This assessment is based on: (a) no evidence of disposal impacts (Hancock et. al. 1980); (b) the high degree of seasonal variability in distribution of the nearshore species; (c) the adaptation of the dominant benthic species to a high energy environment; and, (d) plankton being the principal source of species recruitment for the surface benthic species.

The offshore zone, represented by site H, between the 45- and 65-meter contours, is a transition zone between the high energy nearshore and the deeper, more stable offshore area represented by site G. Sediment in this transition zone ranges from sand in the shallower areas to silt and clay in the deeper areas. This zone is represented by a high species diversity, high variation in numbers of individuals of a species across the area, and high seasonal variation in species distribution (Nelson, et al., 1983). The numbers of filter feeding and surface dwelling benthic species at site H are higher than that in the nearshore region.

In general, species distribution and abundance of benthic species in the transition zone is directly related to the distribution of sediment types. The shallow areas have a benthic fauna similar to the nearshore region and deeper areas have faunal characteristics more like site G. The filter feeding bivalves and scaphopods are almost exclusively limited to the mud sediments in the deeper regions. Polychaetes and gastropods tend to be limited to the sandy sediments of the shallower zones. Crustaceans were unevenly distributed across the area. Only two species, Repoxynius epistamus and R. debouis hadon were evenly distributed.

Disposal of material from the Coos Bay navigation channel in this transition zone would have varying effects depending upon the type of sediment disposed and the location of the disposal. Disposal of Type 1 material in the shallow sandy bottom area would have impacts similar to disposal of the same material at sites E and F. However, because there tends to be a higher number of species and individuals of species here than at sites E or F, the direct mortality would be greater. This impact would be primarily due to smothering with little mortality due to turbidity.

Although the disposal of Type 1 material in the shallow areas of the transition zone would have direct impacts similar to disposal of this material at sites E and F, there should also be additional long term impacts. These impacts would be due to disposal of coarse-grained material over fine-grained material. These changes in habitat may result in changes in the species composition of the area.

Disposal of Type 1 material in the deeper portions of the transition zone (site H) would result in the mortality of most organisms in the impact area and the change of habitat conditions from fine sands and muds to coarse sands. This change in habitat conditions could result in a change in benthic species distribution and abundance at the site.

Disposal of Type 2 materials into the transition zone (site H) would have similar effects. Because of the similarity of sediment types in the disposal material to that existing at site H, it is doubtful if there would be measurable long-term effects. This is because the fines and organic material would likely be rapidly transported further offshore. It is anticipated that some mortality of filter feeding species would occur due to turbidity factors. As indicated in Sections 4.2.2 and 4.2.3, turbidity impacts would be a short-term event. Reworking and transport of material downslope would be primarily limited to the winter storm period. Turbidity levels would likely be comparable to that occurring naturally.

Disposal of Type 3 material at site H area would also have similar effects. A larger area would be impacted, however, since the finer-grained materials would be transported downslope. A long term change in sediment type and habitat could occur at site H if Type 3 materials are routinely deposited there. This change could enhance the site since a more diverse biological fauna are associated with sediments having higher organic content.

Site G, at depths of 70 to 120 meters with mud sediments, is the more stable and productive environment of the three sites for benthic infauna. Large numbers of mollusca, scaphopod, and crustacean species were present in the area. Filter feeding bivalves were the most abundant species here. The polychaete group, while numerous, varied significantly between sampling stations. Gastropod species were present, but in low numbers. The carnivorous snail (Mitrella gouldi) was the only gastropod that consistently exceeded 1 percent of the total molluscan numbers.

Disposal of any of the materials from Coos Bay at site G would result in the greatest biological impact of the three areas studied. Two factors contributing to this are the high numbers of species and individuals that occupy the area, and the large impact area that would result from disposal. As noted in Section 4.2.1, the areal coverage at site G would be nearly four times larger than disposal of the same kind and amount of material at a nearshore site and twice the size of a similar disposal at site H.

Disposal of Type 1 material would have the greatest biological impact of the three sediment types on site G due to: (a) Dissimilarity of disposal and bottom sediments, and (b) the low rate of sediment transport that could eventually change the species composition and productivity in the area if disposal occurs here.

Disposal of Type 2 material at site G, because of the similarity of sediment types, would likely have the least long-term biological impact of the three sediment types. However, the initial impact would be larger than that of coarser-grained Type 1 sediments due to the larger impact area resulting from disposal of the finer sediments.

Disposal of Type 3 material at site G would cause an immediate loss of existing benthic communities in the impact areas. Long-term disposal of this material at site G would alter the habitat character of the area. Because Type 3 material is finer, the areal coverage would also be larger than that for coarse-grained sands. In addition, the high organic and volatile solids content of this material would result in a change in character of the bottom sediments. This could result in indirect mortality of existing species and a change in species composition.

In summary, disposal of any of the Coos Bay sediments at sites E and F would result in the least immediate impact on benthos of the three sites. The primary reasons for this are the unstable environment, the low abundance and diversity of species (relative to the other areas) and the adaptability of the existing benthic species to an unstable environment.

Disposal at site H of any Coos Bay sediments would have greater benthic impacts than at sites E or F. Although species diversity was high in this area there was also large seasonal variation in species abundance. This suggests that benthic recovery should be relatively rapid. Preliminary observations of the 1981 test dump support this assessment (Jones pers. comm. 1983).

Disposal of coarse-grained or highly organic materials at site H would modify sediment (habitat) characteristics of the area, and change species composition. Disposal of Type 2 and 3 material at site H may increase the abundance of species common to site G.

Disposal at site G would result in a greater loss of species and individuals than disposal at sites E, F, or H. In addition, disposal of coarse-grained sand or Type 3 material would result in long-term changes in habitat characteristics with a probable reduction in species diversity and abundance.

4.4 SOCIO-ECONOMIC IMPACTS

4.4.1 Local Area Economy

Maintenance of the Coos Bay navigation system is necessary to support Coos Bay's current economic base, maintain the area's important competitive advantage, and allow it to handle reasonable future expansion. Ocean disposal is important to the present channel maintenance program, and, as stated in Section 3, future navigation channel maintenance will depend upon ocean disposal. Without adequate channel depths, Coos Bay would possibly lose a large share of its export market and would have to absorb the high transfer costs to other ports. The ultimate result would be a significant adverse impact upon the local economy.

4.4.2 Analysis of Comparative Transfer Costs

Historically, only entrance channel sediments, averaging about 975,000 cubic yards annually, have been disposed at sea (sites E and F). Yet, because of the probable future lack of upland or in-channel sites, ocean disposal of all dredged material is considered in this analysis. The following channel reaches would be involved:1/

a. Entrance channel (RM 0.0 to 2.0), consisting of about 975,000 cubic yards annually of fine entrance sands.

1/ These figures were taken from U.S. Army Corps Engineers, Portland District, Coastal Projects Operation and Maintenance, 1982 (pages 84 through 94).

b. Lower channel (RM 2.0 to 12.0), consisting of about 360,000 cubic yards annually of sands, silts, and clays.

c. Upper channel (above RM 12.0), consisting of approximately 200,000 cubic yards annually of fine sediments.

Available data and present conditions indicate that the following assumptions would be appropriate in this case: the average dredge cost would be $40,000 per 8-hour day, and it would take one hour to load the dredge; the dredge travels at 10 miles per hour, and holds 4,000 cubic yards; it would take 5 minutes to dump the dredge, and all dredged material would be dumped in one site only and the dredge will be operated 24 hours a day. For these estimates, base points to ocean sites were: Entrance channel at RM 1.0; Lower channel at RM 7.0; and Upper channel at RM 13.5.

Using these assumptions, Table 4.1 displays the comparative cost summaries for each of the alternative disposal sites.

The data presented in Table 4.1 shows that disposal costs are a direct function of the proportionate increase in distance needed to transport the material and the amount of material to be transported. For example, it is 24, 43 and 280 percent more expensive to dispose of the material from the entrance at sites H, G, and the continental shelf respectively than at sites E and F. Correspondingly it is 13, 31, and 156 percent more expensive to dispose of the material from the Lower Bay at sites H, G, and the continental shelf than at sites E or F. Similar cost increases for the upper bay material would be 8, 15, 108 percent, respectively.

If we assume that a 10 percent increase in costs is the level of significant economic difference than disposal of material from the entrance and lower bay is acceptable only at sites E and F. Correspondingly, there would be no significant difference in disposal costs of material from the upper bay between sites E, F, and H (Table 4.1).

Costs of disposing any of the Coos Bay material at the continental shelf location varies from 100 to 300 percent more expensive than disposal of the same kind and amount of material at sites E, F, or H (Table 4.1).

4.4.3 Commercial and Recreational Activites

Commercial and recreational activities would not be significantly affected by the proposed disposal site location and use. No gas, oil, or mineral exploration is anticipated in the vicinity of the disposal sites. As discussed in Section 4.3, commercial fishing activities would not be affected by the use of the disposal sites.

4.4.4 State and Local Coastal Management Plans

As stated in Section 3.4.4, the Oregon Coastal Management Program (OCMP) and the Coos County Comprehensive Plan recognize the need to provide for suitable offshore sites for disposal of dredged materials. The OCMP stipulates that the location of the sites and disposal practices must not substantially impact fishing, navigation, or recreation activities, or the natural resources of the continental shelf. The previous discussions on impacts of dredged material disposal in the proposed disposal sites (Sections 4.1 and 4.2) indicate that no substantial impacts on these uses or resources are anticipated.

A statement of consistency with the OCMP has been prepared and is included in Appendix A.

4.4.5 Esthetics

The esthetics of the disposal sites would be impacted primarily by short term turbidity during and after a disposal operation (See discussion in Section 4.2.3). Finer sediments would remain in suspension for longer periods and are more susceptible to resuspension by current and wave activity. Disposal of finer sediments at the nearshore sites would create more turbidity than disposal in the offshore area. Additional discussion of sediment suspension and transport is included in Section 4.2.2.

4.4.6 Cultural Resources

As stated in Section 3.4.8, no known significant cultural resources exist in the Coos Bay offshore area. Therefore, no cultural resources of historic or archeologic significance would be affected by the proposed site designations or resultant ocean dumping.

4.5 MITIGATION AND SITE MONITORING

Specific mitigation actions to offset disposal impacts have not been identified. However, use of adjusted site H for disposal of fine sediments is a proposed action designed to minimize potential adverse effects to local beaches and the Lower Coos Bay estuary. In addition, extensive monitoring of existing ocean disposal activities has been conducted to determine potential adverse impacts (see Section 3). These actions, designed to determine any adverse effects and/or minimize those effects, are considered mitigation actions.

Due to the unique compatability of type 1 material for sites E and F, monitoring, if done, should be limited to periodic bathymetric surveys. If monitoring is initiated we recommend that it be concentrated at adjusted site H. In addition, we recommend that if monitoring be conducted, it be based on a hierarchical system of progressive complexity. That is, first, concentrate on monitoring the physical and chemical characteristics of the sediments and proceeding on to the more complex and difficult biological characteristics if it can be established that EPA sediment and water quality standards are exceeded.

4.6 ADVERSE ENVIRONMENTAL EFFECTS WHICH ARE UNAVOIDABLE

The permanent designation of ocean disposal sites at Coos Bay would allow continued disposal of dredged material in these sites with the following effects:

The bottom topography of the sites would be altered (may or may not be adverse);

Disposal operations would create temporary turbidity in the vicinity of the disposal site(s);

Volatile solids and chemical contaminants found in upper bay sediments would temporarily impact water quality in the vicinity of the disposal site(s).

Benthic organisms would be smothered by disposal operations. Benthic habitat would be altered by disposal activity perturbations and changes in bottom sediment;

Loss of benthic organisms would at least temporarily remove a food source for organisms higher in the food chain.

4.7 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Disposal of dredged material in the proposed ocean sites would have a very minor short- and long-term effect on the productivity of the marine environment. Use of the sites would have a long-term beneficial effect on the economy of Coos Bay and Coos County.

4.8 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Permanent designation of the proposed sites for disposal of dredged material would commit the sites and their resources primarily to that use. Other uses such as oil and gas exploration, and to varying degrees, mining, fishing, and use by certain aquatic species, would be precluded.

TABLE 4.1 COST* COMPARISON FOR DISPOSAL OF MATERIAL FROM THREE DIFFERENT LOCATIONS IN COOS BAY AT FIVE DIFFERENT OCEAN SITES

Dredging Location	Sites				
	E (1.5)	F (1.5)	H (3.5)	G (5.0)	Continental Shelf (24)
Entrance (RM 1.0, 975,000 cu. yd.)					
#8 hour work days	49	49	61	70	186
Estimated Cost (millions)	1.96	1.96	2.44	2.80	7.44
Lower Bay (RM 7.0, 360,000 cu. yd.)					
#8 hour work days	32	32	36	42	82
Estimated Cost (millions)	1.28	1.28	1.44	1.68	3.28
Upper Bay (RM 13.5, 200,000 cu. yd.)					
#8 hour work days	26	26	28	30	54
Estimated Cost (millions)	1.04	1.04	1.12	1.20	2.16

* These costs are for comparison purposes only. Costs are based upon the assumptions outlined on pages IV-16.

** Statute miles from the entrance into Coos Bay.

V COORDINATION

5.1 General. Preparation of this Draft EIS has been coordinated with several Federal, state, and local agencies, and the public. Federal agencies contacted include EPA, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Coast Guard. State agencies include DLCD, Oregon Division of State Lands, and ODFW. Local agencies included Coos County and the Cities of Coos Bay and North Bend.

5.2 Scoping. The EIS scoping process has provided the basis for coordination. The purpose of the scoping process under current NEPA regulations is to identify the pertinent issues which need to be addressed in the EIS. The scoping process was initiated through public notice which identified the proposed actions and preliminarily identified significant issues. The public notice, which was distributed to government agencies, environmental groups, news media, and other interested public, requested input on issues considered significant and warranting in-depth analysis.

The issues identified in response to the public notice include the following:

Effects on local beaches

Effects on marine biota

Effects on commerical fishing

Effects on Coos Bay estuary

Effects on the local economy

Effects on ocean bottom topography

Effects on water quality

These specific environmental issues identified through EIS scoping correspond with the EPA criteria for evaluation of sites proposed for site designation. These issues and criteria were utilized in outlining the significant issues addressed in detail in this EIS.

Contacts with the agencies have been maintained throughout the drafting of the Environmental Impact Statement. Adequate opportunity has been provided for the agencies to identify the significant issues and potential for impacts to be evaluated in this impact statement.

VI LIST OF PREPARERS

Principal Authors:	Experience:	Contribution to EIS
Steven J. Stevens BS, Landscape Architecture	Land use planning, EIS preparation (12 years)	Purpose and need, alternatives comparison, land use/CZM consistency, esthetics, EIS coorination
Thomas E. Morse BS, MS Wildlife Management Ph.D Ecology	Wildlife research bio, resource planner, biol. assessment (12 years)	Physcial/biological description and assessment alternatives comparision study coordination.
William Boodt MS, Ph.D. Economics	Industrial, regional and resource economic analysis feasibility and impact studies (22 years)	Socio-economic environment and impacts; cost analysis.
Patricia Hodge BA, MA Letters and Science Economics Specialist	Economics assistant/ regional economics (6 years)	Socio-economic environment; cost analysis.

David Askren BS Geology MS Oceanography MS Civil Engineering	Physical and geological oceanography (10 years) Coastal navigation project planning and maintenance (4 years)	Physical environment description and impacts assessement.
Kim Larson BS Zoology, MS Fishery Biology	Biological (fisheries) studies; environmental impact assessment (7 years)	Biological environment description and impacts assessment.
Robert A. Freed MA Anthropology	Archeological investigation and cultural resources management (8 years)	Cultural resources

VII BIBLIOGRAPHY

PHYSICAL/BIOLOGICAL

Conomos, T.J., M.G. Gross, C.A. Barnes, F.A. Richards. 1972. River-Ocean Nutrient Relations in Summer in the Columbia River Estuary and Adjacent Ocean Waters, A.T. Pruter and D.L. Alverson, eds., University of Washington Press, Seattle WA, 868 pp.

Cutchin, D.L. and R.L. Smith. 1973. Continental Shelf Waves: Low Frequency Variations in Sea Level and Currents over the Oregon Continental Shelf, Journal of Physical Oceanography, 3 (1), 73-82.

Duxbury, A.C., P.A. Morse, N. McGary. 1966. The Columbia River Effluent and Its Distribution at Sea, 1961-1963. Technical Report No. 156, University of Washington, Dept of Oceanography, Seattle WA.

EPA. 1976. Quality Criteria for Water, EPA-440/9-76-023, U.S. Environmental Protection Agency, Washington, D.C.

Hancock, D.R., P.O. Nelson, C.K. Sollitt, K.J. Williamson. 1981. Coos Bay Offshore Disposal Site Investigation Interim Report Phase I, Feburary 1979-March 1980. Report to U.S. Army Corps of Engineers, Portland District, Portland, OR for contract No. DACW57-79-C0040. Oregon State University, Corvallis, OR.

Harlett, J.C. 1972. Sediment Transport on the Northern Oregon Continental Shelf. PHD thesis, Oregon State University, Corvallis, OR.

Huyer, A and J.G. Patullo. 1972. A Comparison Between Wind and Current Observations over the Continental Shelf off Oregon, Summer, 1969. Journal of Geophysical Research, 77 (18), 3215-3220.

Huyer, A, R.D. Pillsbury, R.L. Smith. 1975. Seasonal Variation of the Alongshore Velocity Field Over the Continental Shelf off Oregon. Limnology and Oceanography, 20 (1), 90-95.

Huyer, A and R.L. Smith. 1977. Physical Characteristics of Pacific Northwestern Coastal Waters, in the Marine Plant Biomass of the Pacific Northwest Coast, R.W. Krauss, ed., Oregon State University Press, Corvallis, OR, 397pp.

Interstate Electronics Corporation. 1983. Appendixes to Coos Bay, Oregon Ocean Dredged Material Disposal Site Designation. Report of Field Survey. U.S. Environmental Protection Agency, Wahsington D.C.

Koh, R.C.Y., Y.C. Chang. 1973. Mathematical Model for Barged Ocean Disposal of Wastes, Environmental Protection Technology Series EPA 660/2-73-029, December 1973, U.S. Environmental Protection Agency, Washington, D.C.

Nelson, P.O., C.K. Sollitt, K.J. Williamson, D.R. Hancock, 1983. Coos Bay Offshore Disposal Site Investigation Interim Report Phase II, III, April 1980-June 1981. Report Submitted to the U.S. Army Corps of Engineers, Portland District, Portland, OR, under contract No. DAW57-79-C0040, Oregon State University, Corvallis, OR.

Oregon Dept. of Fish and Wildlife. 1976. Marine Resource Surveys on the Continental Shelf Off Oregon, 1971-74. State of Oregon.

OSU 1977a. The Marine Plant Biomass of the Pacific Northwest Coast. R.W. Krauss, ed., Oregon State University Press, Corvallis, Oregon, p. 17 of 397.

OSU 1977b. Environmental Impact of Dredging in Estuaries, Department of Engineering and Oceanography, Oregon State University, Corvallis, Oregon.

Plank, W.S. and H. Pak. 1973. Observations of Light Scattering and Suspended Particulate Matter off the Oregon Coast, June - October 1972. OSU School of Oceanography Data Report 55, Corvallis, Oregon.

Sobey, E.J.C. 1977. The Response of Oregon Shelf Waters to Wind Fluctuations: Differences and Transition between Winter and Summer PhD thesis, Oregon State University, Corvallis, Oregon.

Sverdrup, H.U., M.W. Johnson, R.H. Fleming. 1942. The Oceans. Prentice Hall, Inc., Englewood Cliffs, N.J. 1058 pp.

SOCIO-ECONOMIC

Beuter, J.H. 1976. Timber for Oregon's Tomorrow. Oregon State University Forestry Research Laboratory, Corvallis, Oregon.

Coos County. 1982. Coos County Comprehensive Plan. Coos County Board of Commissioners. Coquille, Oregon.

Coos-Curry-Douglas Economic Improvement Association 1980. Comprehensive Economic Development Strategy, 1980-81. Action Program. Roseburg, Oregon.

Oregon Dept. of Fish and Wildlife. 1976. Marine Resource Surveys on the Continental Shelf Off Oregon, 1971-74.

Oregon Land Conservation and Development Commission. 1976. Statewide Planning Goals and Guidelines. Salem, Oregon.

Port of Coos Bay. 1980. Waterborne Statistics. Coos Bay, Oregon

Portland State University. 1983. Center for Population Research and Census. Portland, Oregon.

U.S. Army Corps of Engineers, Portland District. 1982. Coastal Projects Operations and Maintenance, pp. 84-94. Portland, Oregon

APPENDIX A

OCMP CONSISTENCY STATEMENT

OREGON STATEWIDE GOALS	CONSISTENCY STATEMENT
1. CITIZEN INVOLVEMENT. To develop a citizen involvement program that insures the opportunity for citizens to be involved in all phases of the planning process.	The Corps has included citizens in the planning of this proposed porject through distribution of the EIS "scoping" letter. Citizens will have the additional opportunity to review and comment through the Draft EIS and and Final EIS review processes.
2. LAND USE PLANNING. To establish a land use planning process and policy framework as a basis for all decisions and to assure an adequate factual base for such decisions and actions.	Land use planning is a state and local function. The Corps has coordinated the site designation alternatives will all agencies that have planning responsibility for the affected area. The proposed project is conistent with Oregon's Coastal Management Program and other applicable statewide goals, the Coos County comprehesive plan and with the Coos Bay Estuary Management plan.
3. AGRICULTURAL LANDS. To preserve and aintain agricultural lands.	This goal is not applicable.
4. FOREST LAND. To Conserve forest lands for forest uses.	This goal is not applicable,
5. OPEN SPACES, SCENIC AND HISTORIC AREAS AMD NATURAL RESOURCES. To conserve open space and protect natural and scenic resources.	There are no known historic and cultural resources in the area (see Appendix C). The proposed site designation and resulting ocean disposal would not detract from the area's scenic quality or significantly impact natural resouces.
6. AIR, WATER AND LAND RESOURCES. To maintain and improve the quality of the air, water, and land resources of the tate.	Turbidity would increase slightly above background levels during disposal operations. Any increase in turbidity would be temporary. The proposed action will not affect air and land resources.
7. AREAS SUBJECT TO NATURAL DISASTERS & HAZARDS. To protect life and property from natural disasters and hazards.	Ocean disposal would indirectly reduce risks of ship grounding in the entrance bar.
8. RECREATION NEEDS. To satisfy the recreational needs of the citizens of the state and visitors.	Recreation boating and sport fishing are expected to continue in the area with or without the proposed site designation.

OREGON STATEWIDE GOALS	CONSISTENCY STATEMENT
9. ECONOMY OF THE STATE. To diversify and improve the economy of the state.	Maintenance of the Coos Bay Navigation System is considered vitally important to local regional and state economic vitality. Ocean disposal site designation is an integral part of the navigation system maintenance plan.
10. HOUSING. To provide for housing needs of citizens of the State.	The proposed site designation would not affect local planning or implementation of plans which provide for the housing need of citizens.
11. PUBLIC FACILTIES AND SERVICES. To plan and develop a timely, orderly and efficient arrangement of public facilities and services to serve as a developoment	Facilities and services associated with the Coos Bay Navigation channel are already in place. Ocean disposal site designation would help insure the continued use of these facilities and services.
12. TRANSPORTATION. To provide and encourage a safe, convenient and economic transportation system.	The continued use of a safe convenient and economical water transportation system in Coos Bay is at least partially dependent upon the use of ocaen disposal sites for channel maintenance.
13. ENGERGY CONSERVATION. To conserve engergy.	The use of close-in disposal sites would provide for more efficient channel maintenance, resulting in net energy savings.
14. URBANIZATION. To provide for an orderly and effieicent transition from rural to urban land use.	Ocean disposal site designation is not expected to have any effect on the or patterns of urbanization.
15. WILLAMETTE RIVER GREENWAY. To protect, conserve, enhance and maintain the natural, scenic, historical, agricultural, economic and recreational qualities of lands along the Willamette River as the Willamete River Greenway.	Not applicable.

OREGON STATEWIDE GOALS	CONSISTENCY STATEMENT
16. ESTUARINE RESOURCES. To recognize and protect the unique environmental, economic and social values of each estuary and associated wetlands; and to protect, maintain, where appropriate develop and where appropriate restore the long-term environmental, economic and social values, diversity and benefits of Oregon's estuaries.	Ocean disposal site designation would help alleviate the need for disposal in or adjacent to the estuary. The proposed use of the ocean disposal sites would have not significant impact on estuarine resources.
17. COASTAL SHORELANDS. To conserve protect, where appropriate develop and where appropriate restore the resources and benefits of all coastal shorelands, recognizing thier value of protection and maintenance of water quality, fish and wildlife habitat, water-dependent uses, economic resources and recreation and esthetics. The management of these shoreland areas shall be compatible with the characteristics of the adjacent coastal waters; and to reduce the hazard to human life and property, and the adverse effects upon water quality and fish and wildlife habitat, resulting from the use and enjoyment of Oregon's coastal shorelands.	Ocean disposal site designation would help alleviate the need for disposal on coastal shorelands.
18. BEACHES AND DUNES. To conserve protect, where appropriate develop, and where appropriate restore the resources and beneifts of coastal beach and dune areas; and to reduce the hazard to human life and property from natural or man induced actions associated with these areas.	Dredged material disposed of at sites E and F may be carried ashore by wave-induced currents. The material deposited at these sites would be essentially clean and sand and would have a primarily positive effect of beach nourishment.

OREGON STATEWIDE GOALS	CONSISTENCY STATEMENT
19. OCEAN RESOURCES. To conserve the long-term values, benefits, and natural resources of the nearshore ocean and the continental shelf.	The general productivity of the area may be negatively affected due to continuous disposal of material from maintenance dredging. Benthic organisms at the sites would be impacted by smothering. No other natural resources are expected to be significantly affected by the disposal of dredged material.

APPENDIX B

Fish Distribution Data
From Marine Resource Surveys on
the Continental Shelf Off Oregon
1971-1974 Oregon Department
of Fish and Wildlife 1976

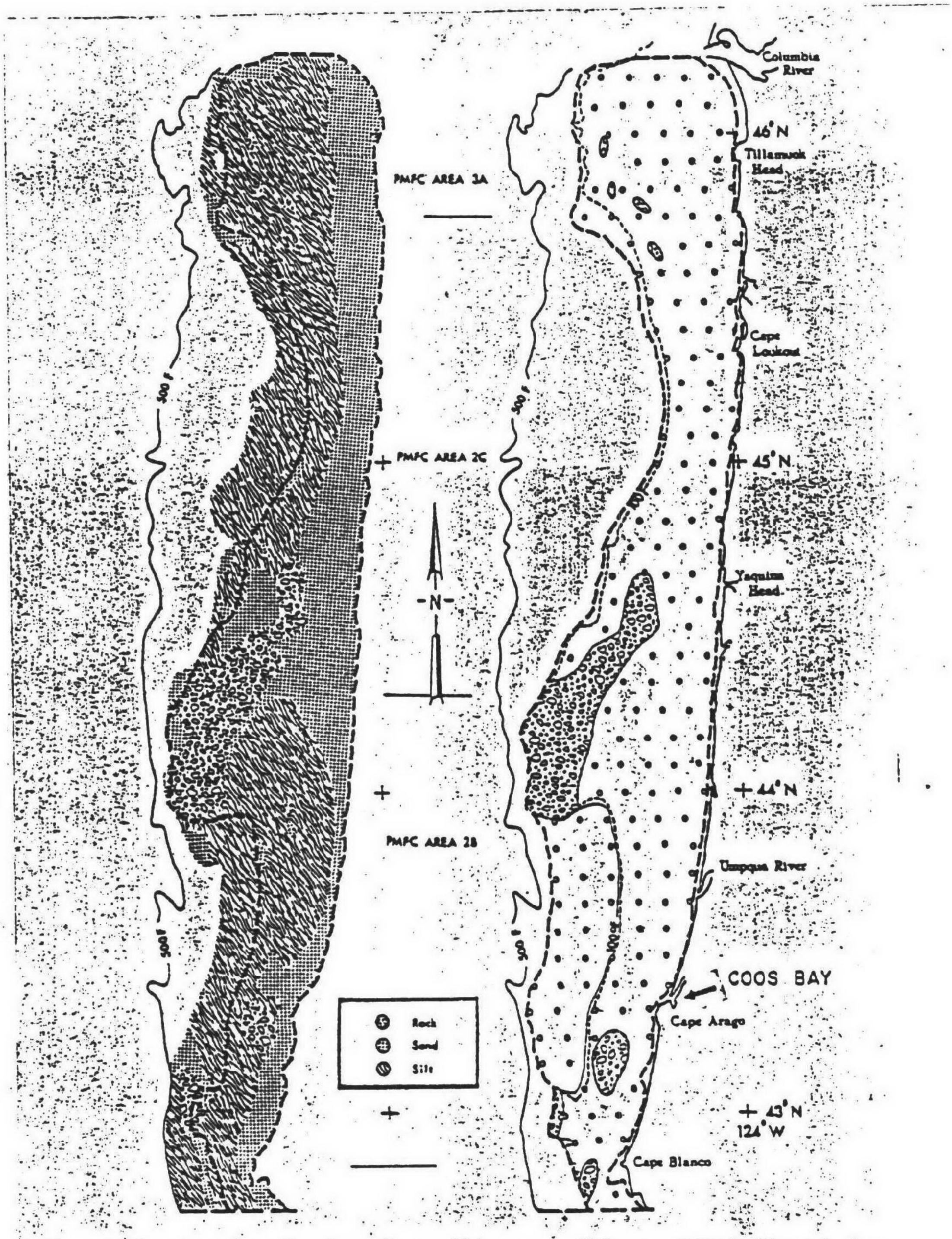


Figure 1. Location of trawl stations of groundfish surveys off Oregon, 1971-74. Heavy broken line defines survey limits (deep-water limit, lower portion, 1974 only). Sediment types after Byrne and Panshin (1972). PMFC statistical areas are indicated.

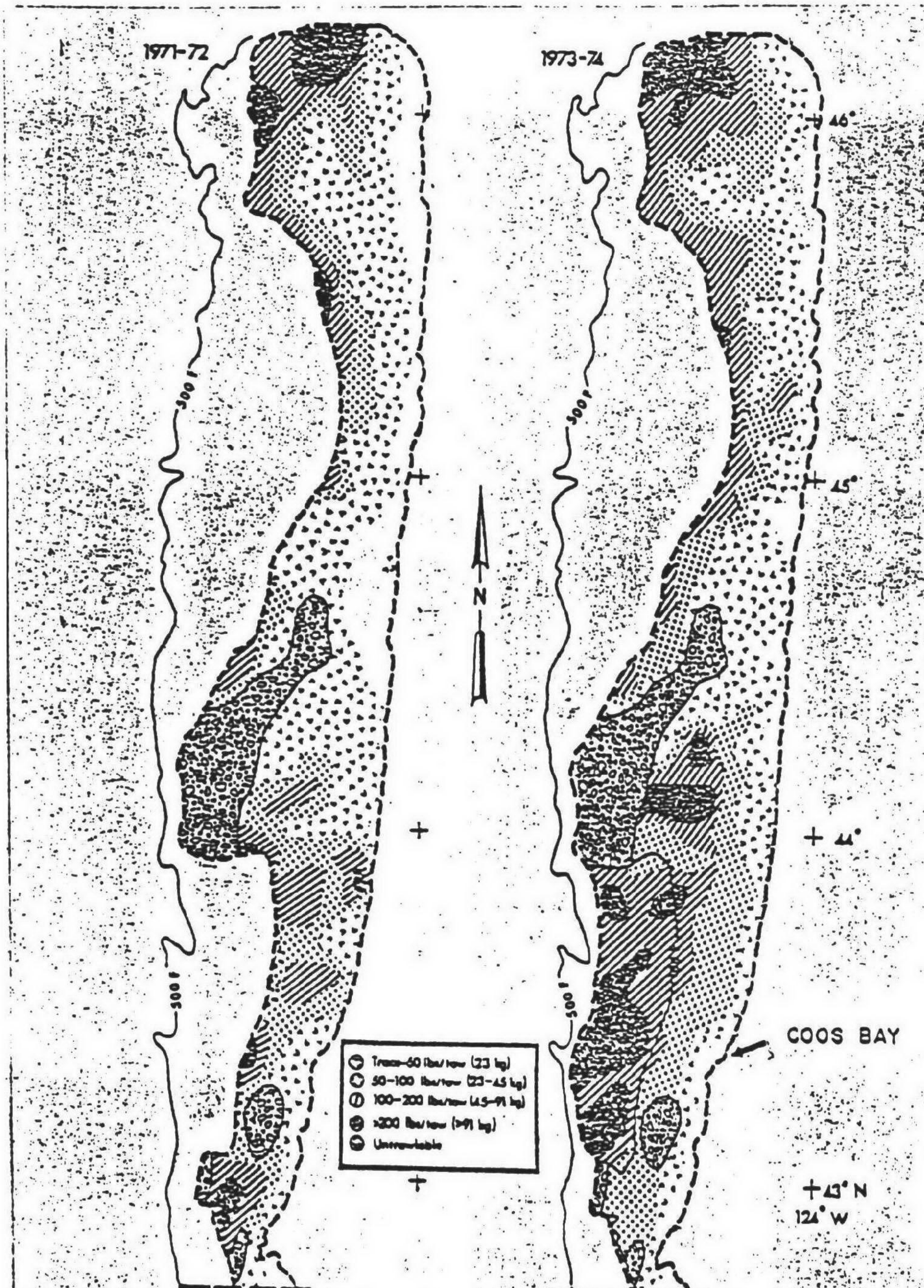


Figure 2. Distribution and relative abundance (weight) of Dover sole in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

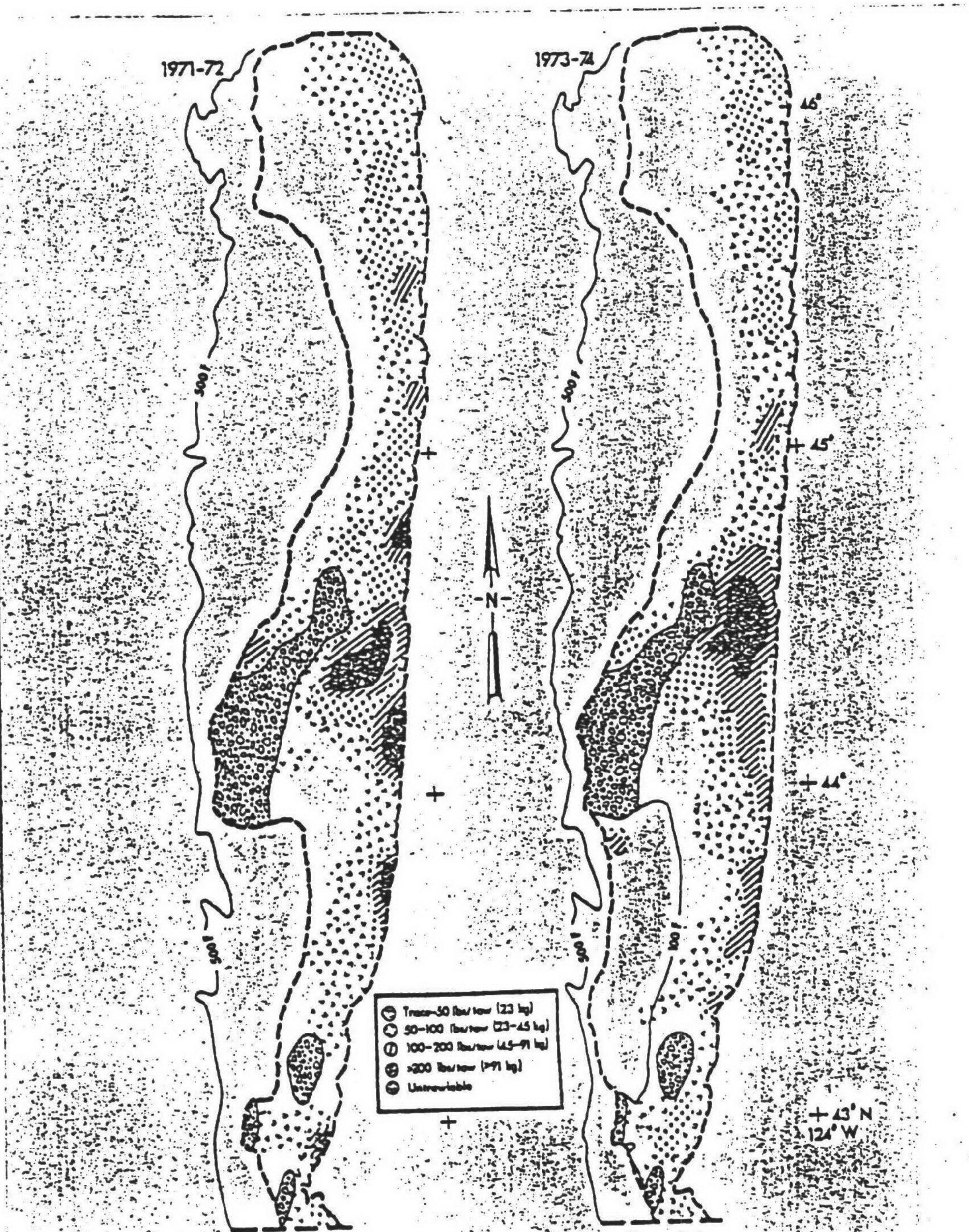


Figure 3. Distribution and relative abundance (weight) of English sole in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

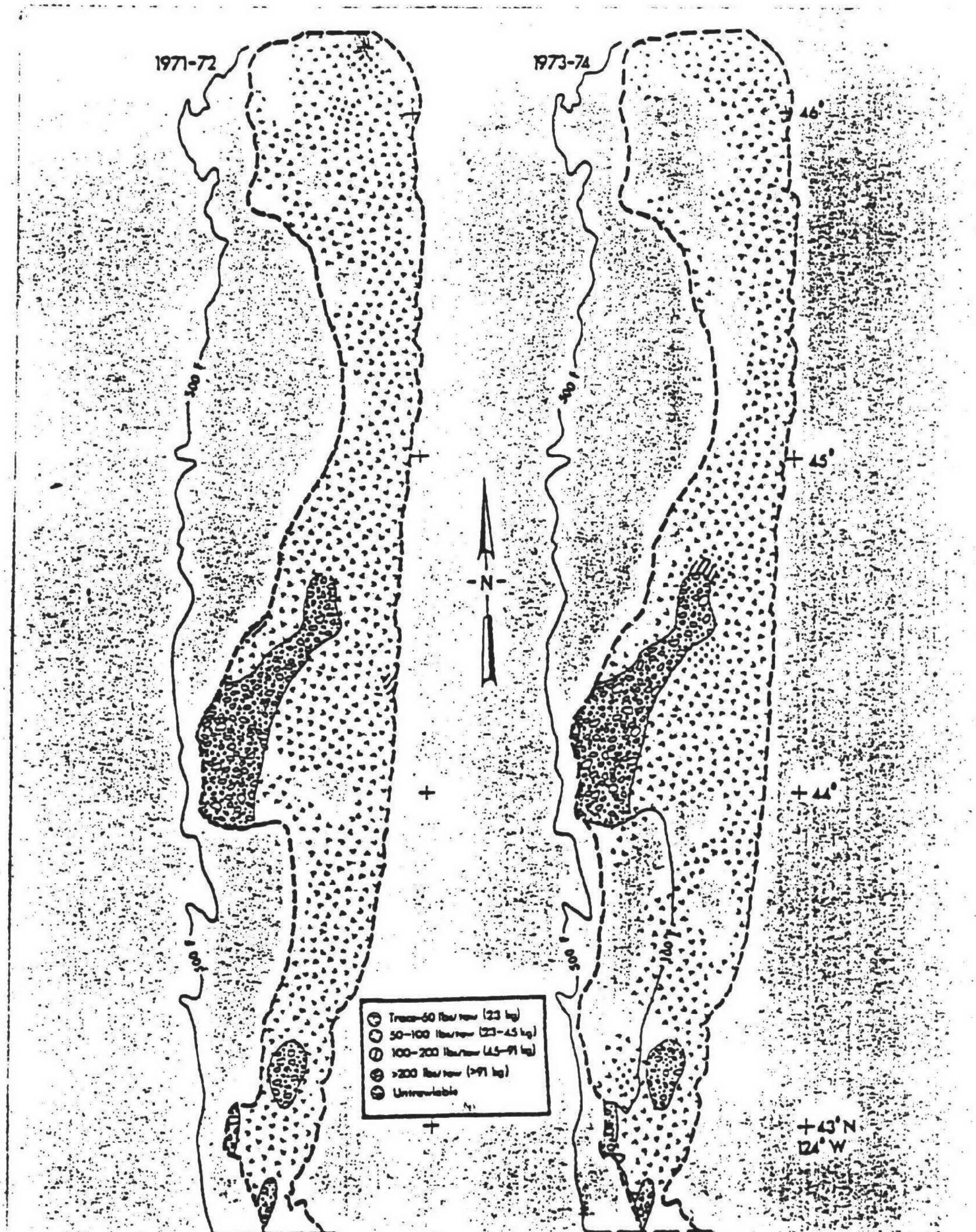


Figure 4. Distribution and relative abundance (weight) of petrale sole in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

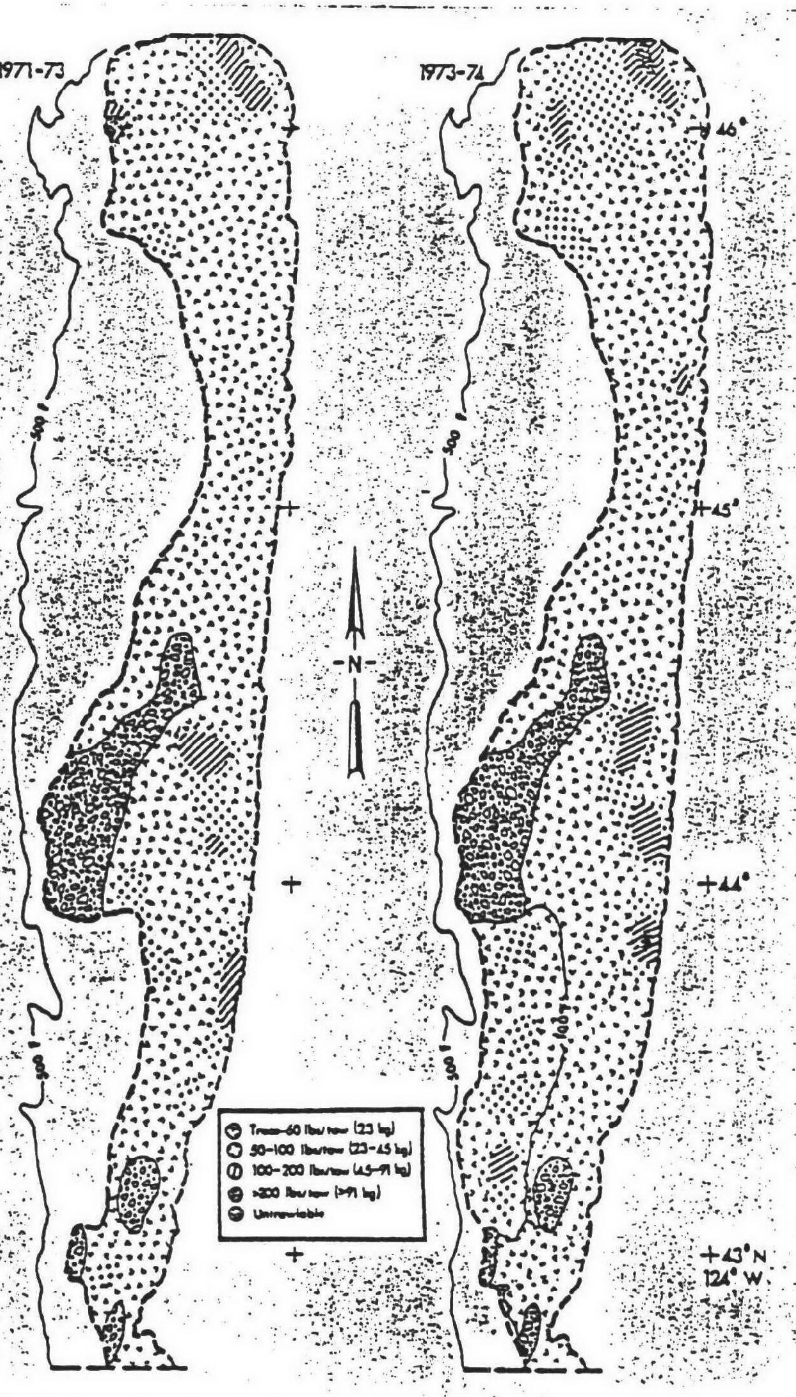


Figure 5. Distribution and relative abundance (weight) of Rex sole in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

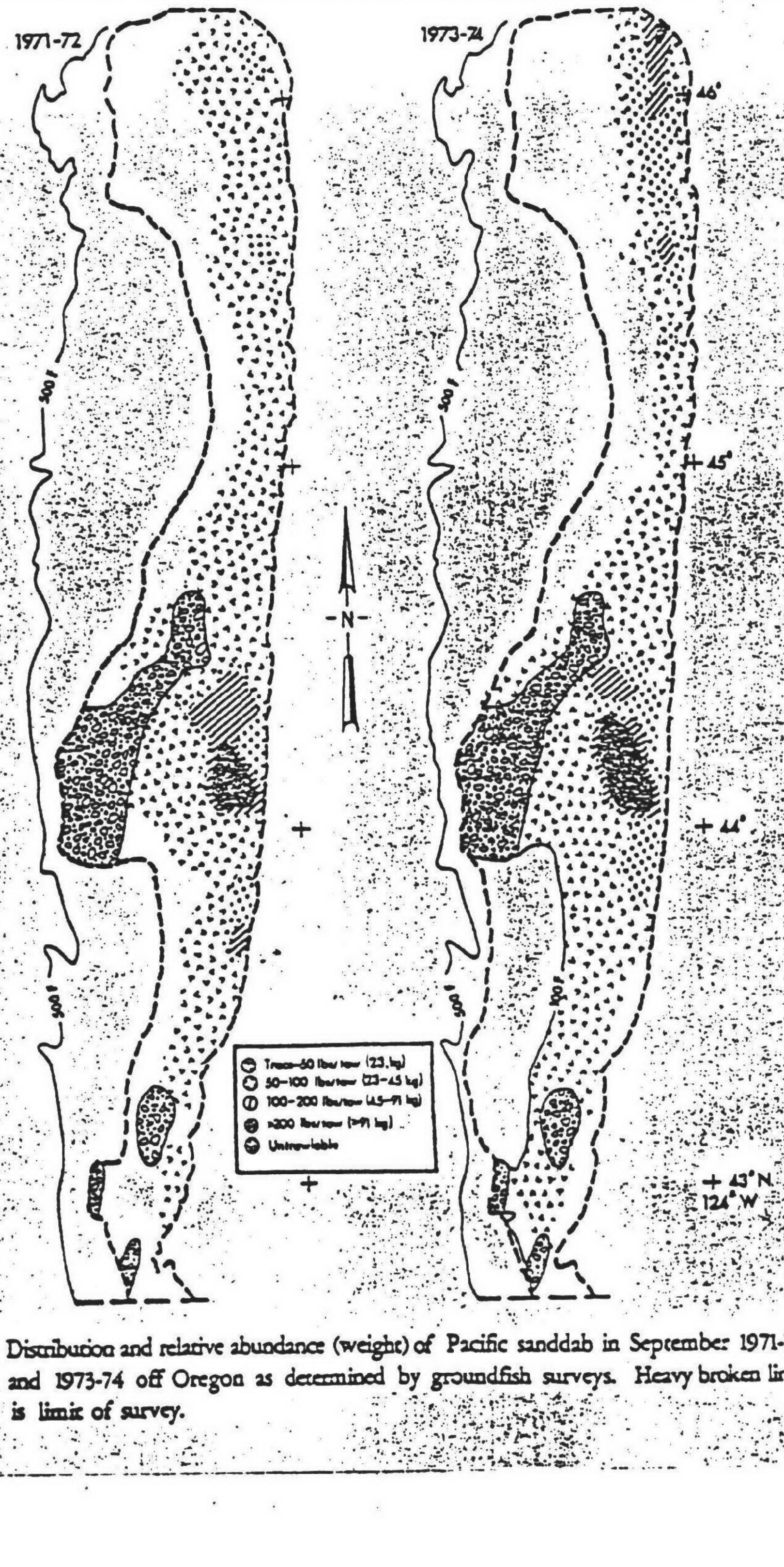


Figure 6. Distribution and relative abundance (weight) of Pacific sanddab in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

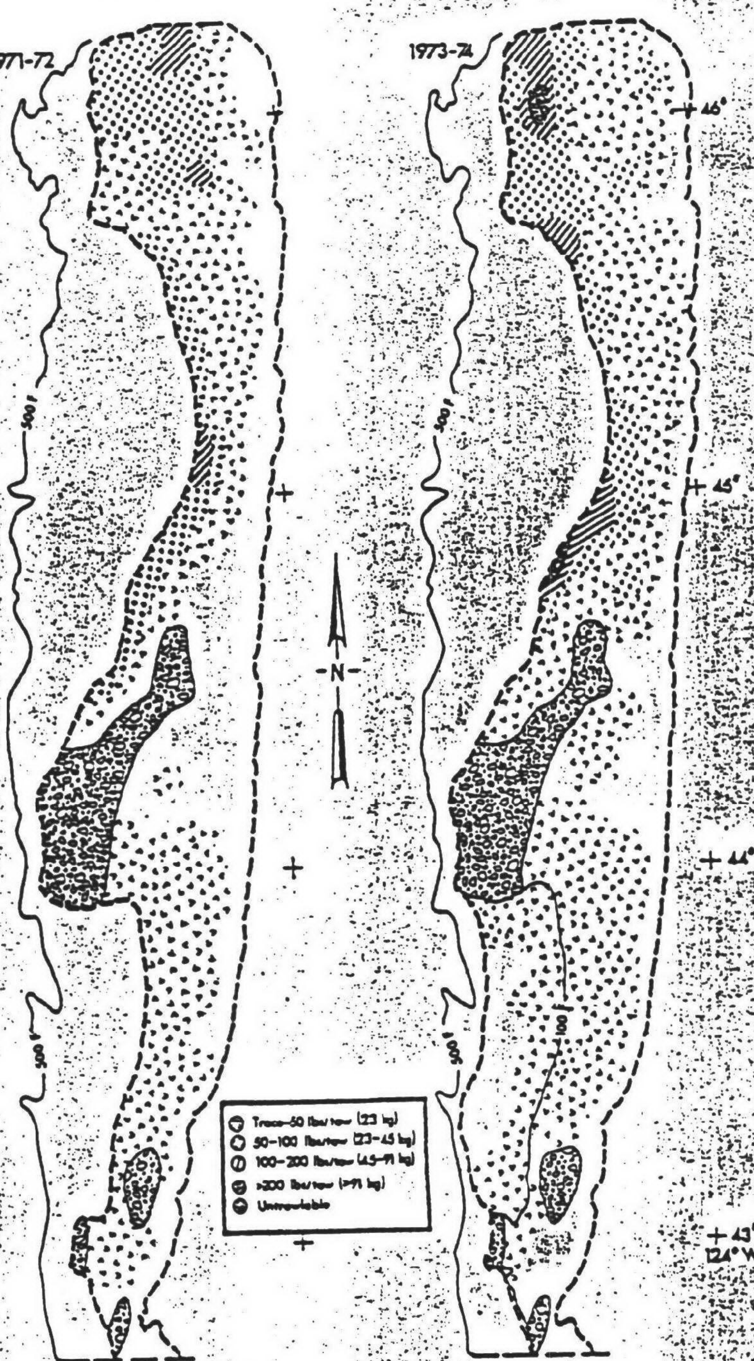


Figure 7. Distribution and relative abundance (weight) of arrowtooth flounder in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

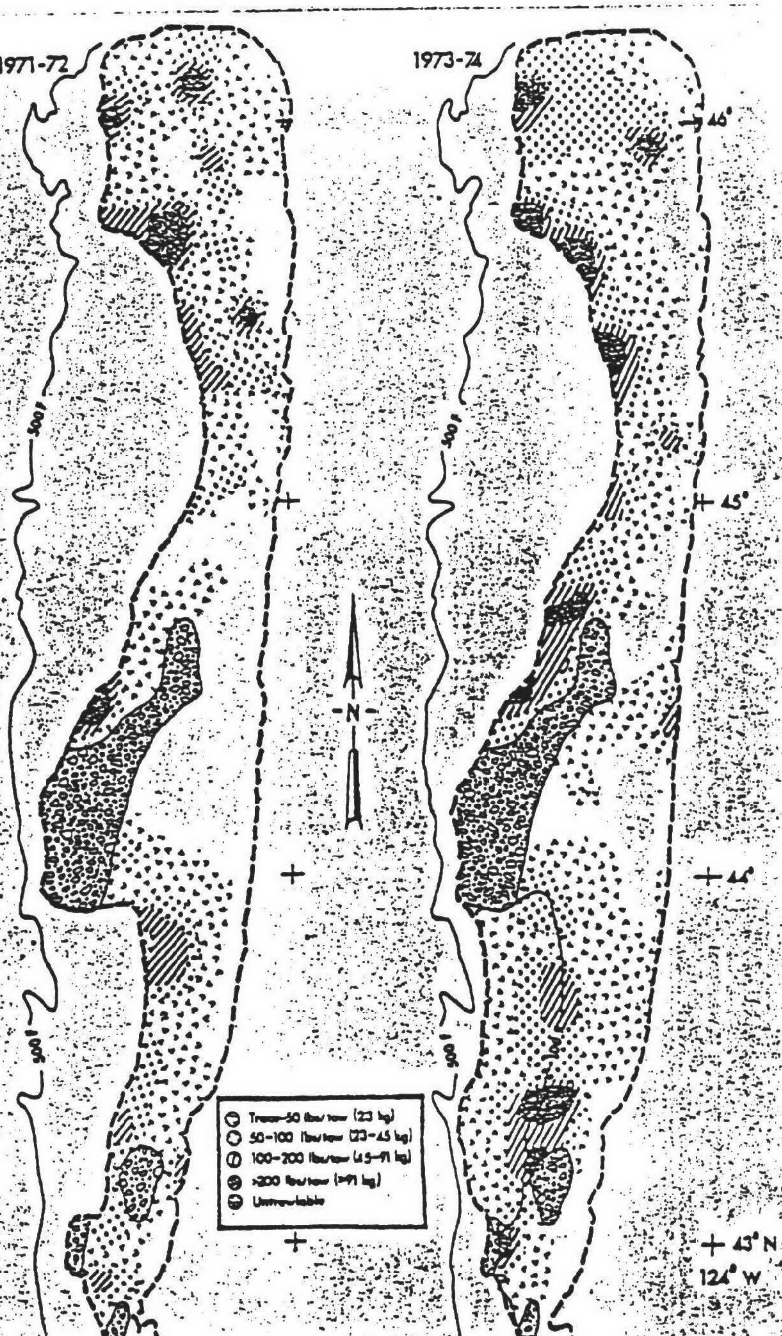


Figure 8. Distribution and relative abundance (weight) of rockfish in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

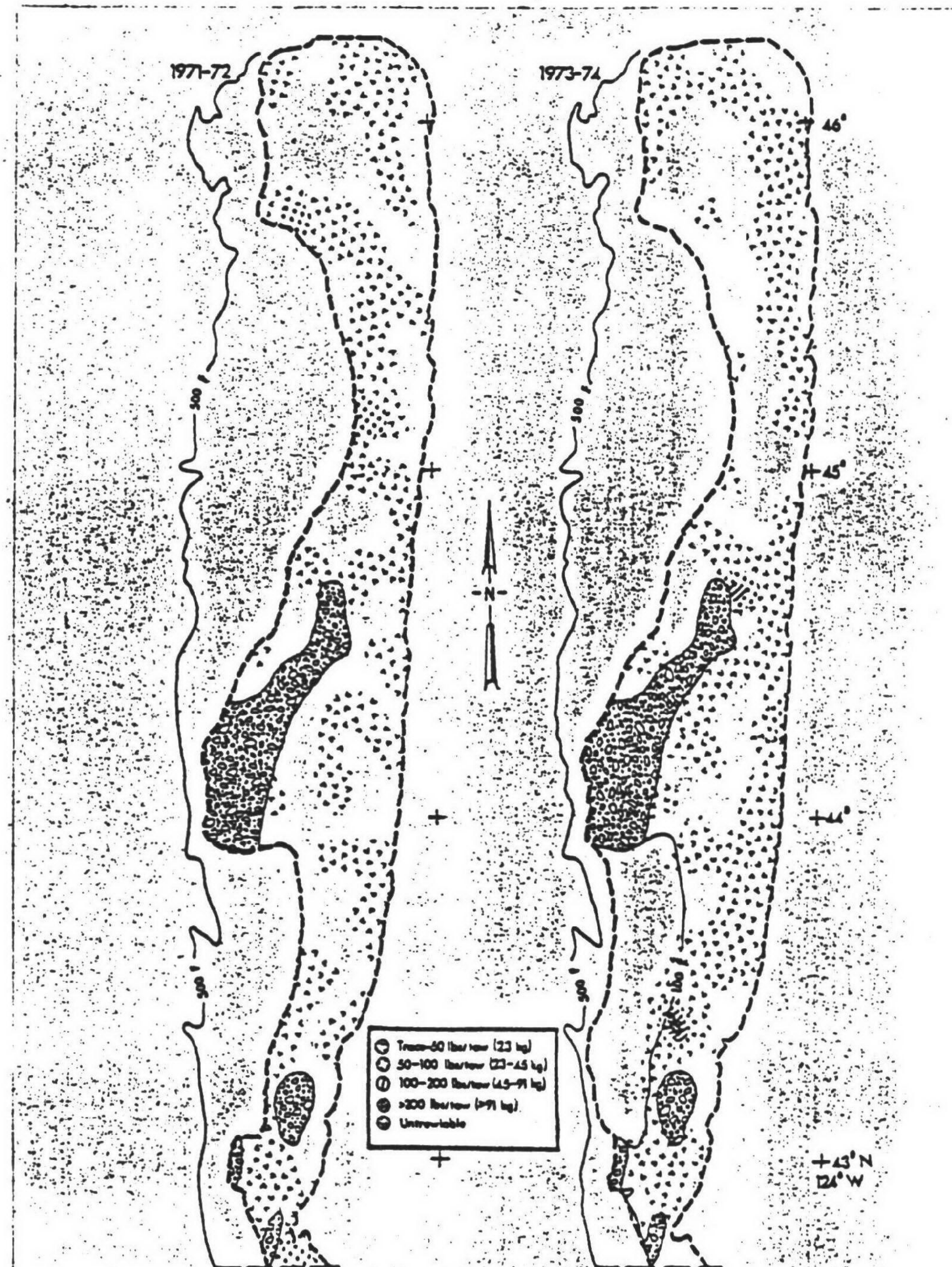


Figure 9. Distribution and relative abundance (weight) of lingcod in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

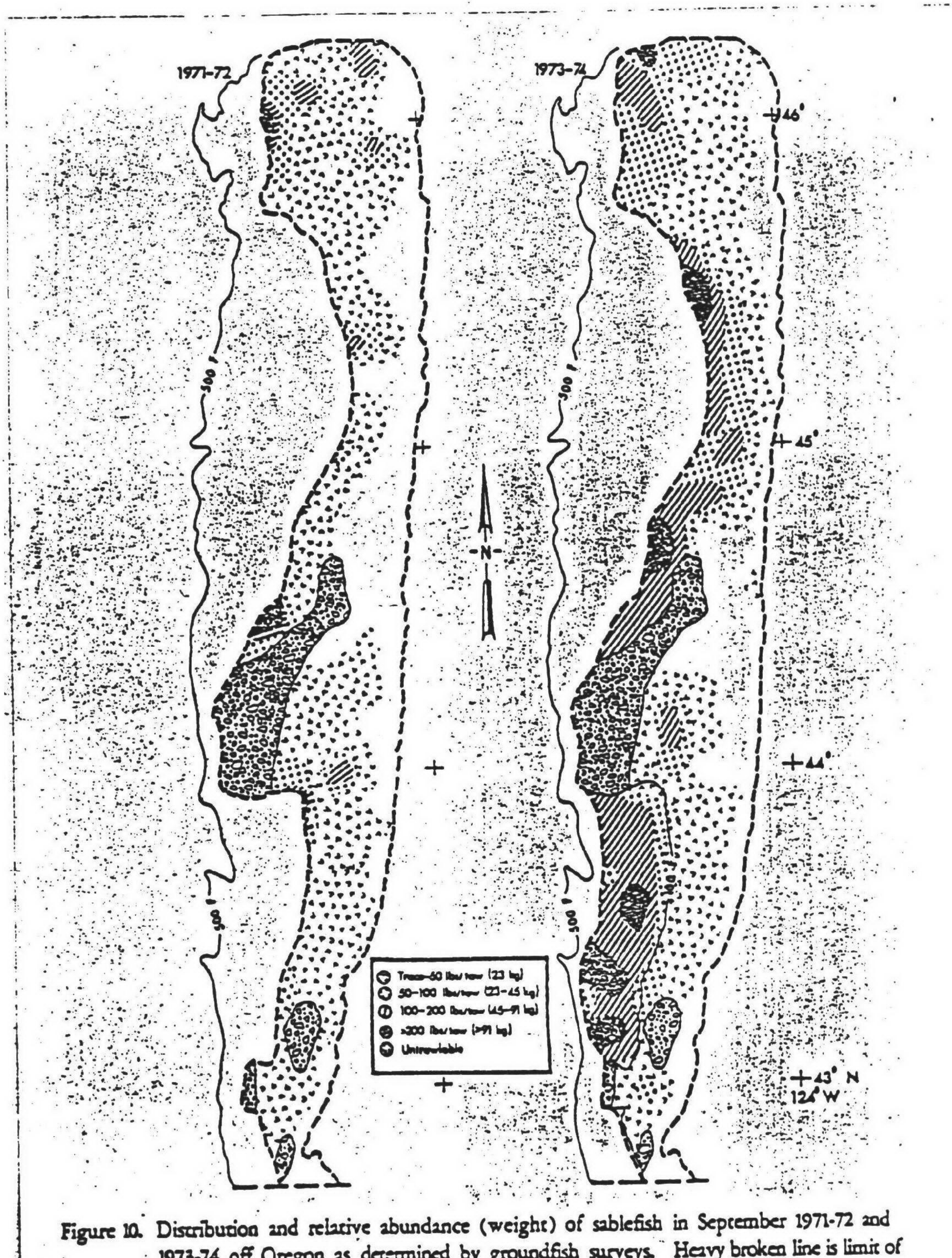


Figure 10. Distribution and relative abundance (weight) of sablefish in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

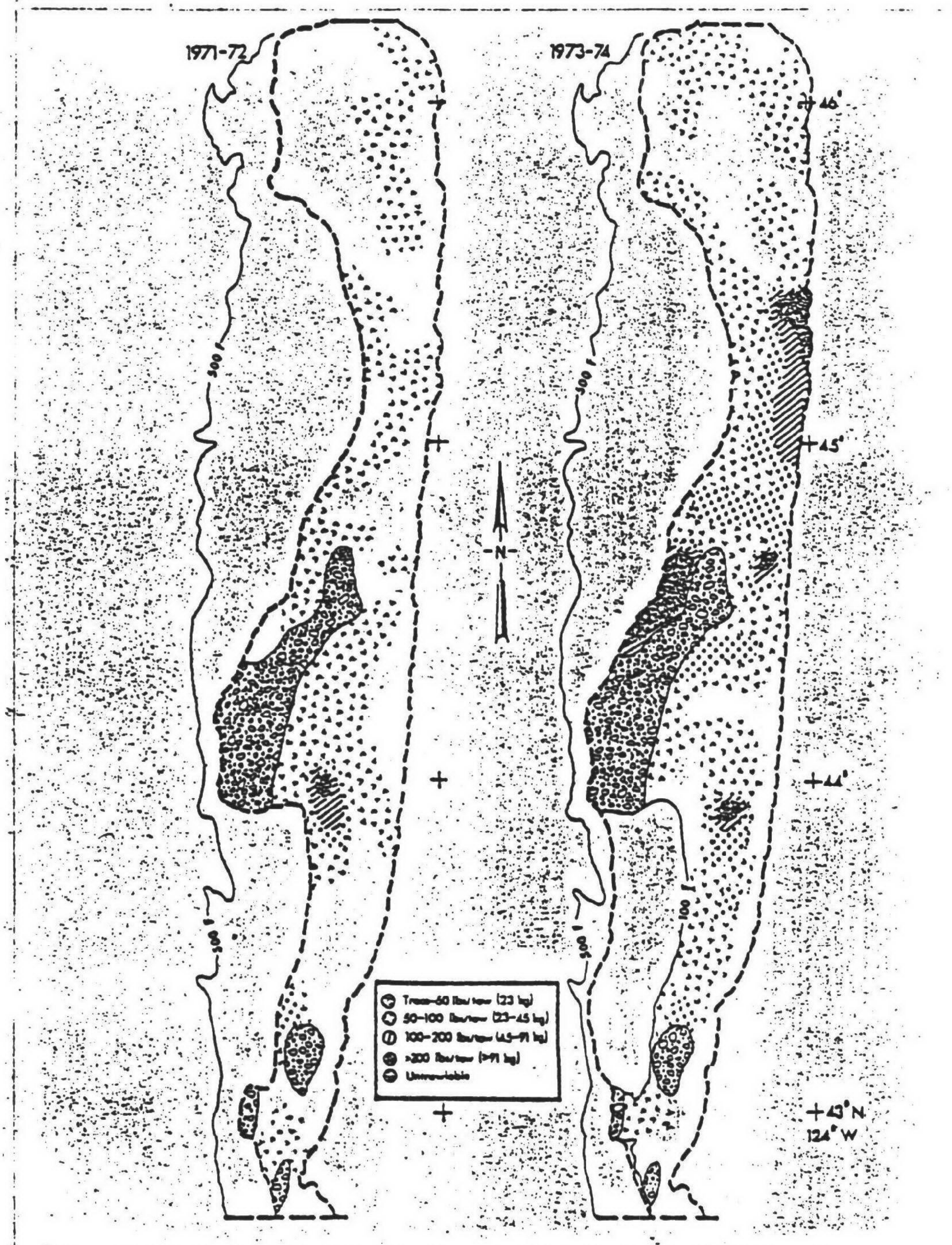


Figure 11. Distribution and relative abundance (weight) of spiny dogfish in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

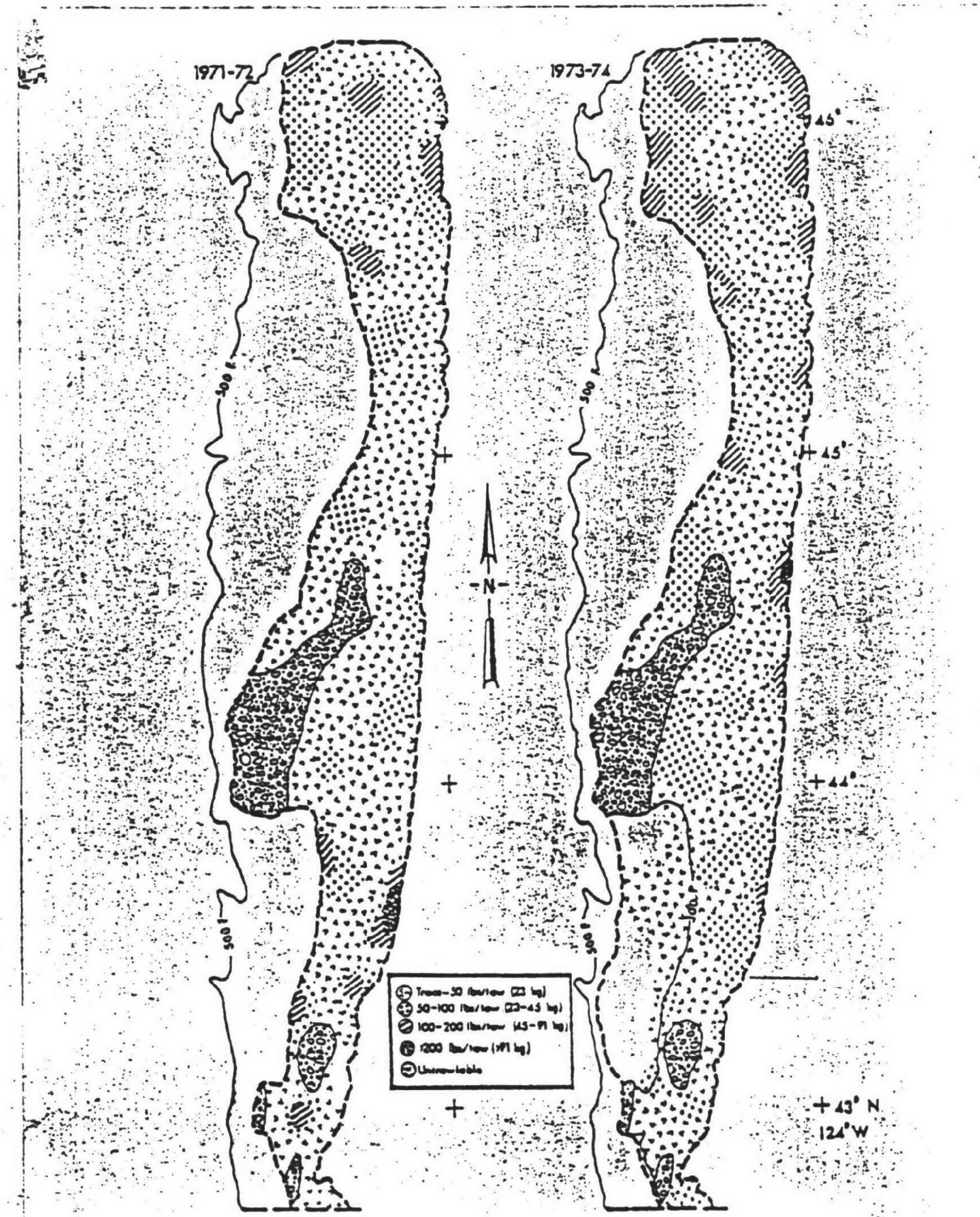


Figure 12. Distribution and relative abundance (weight) of skates in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

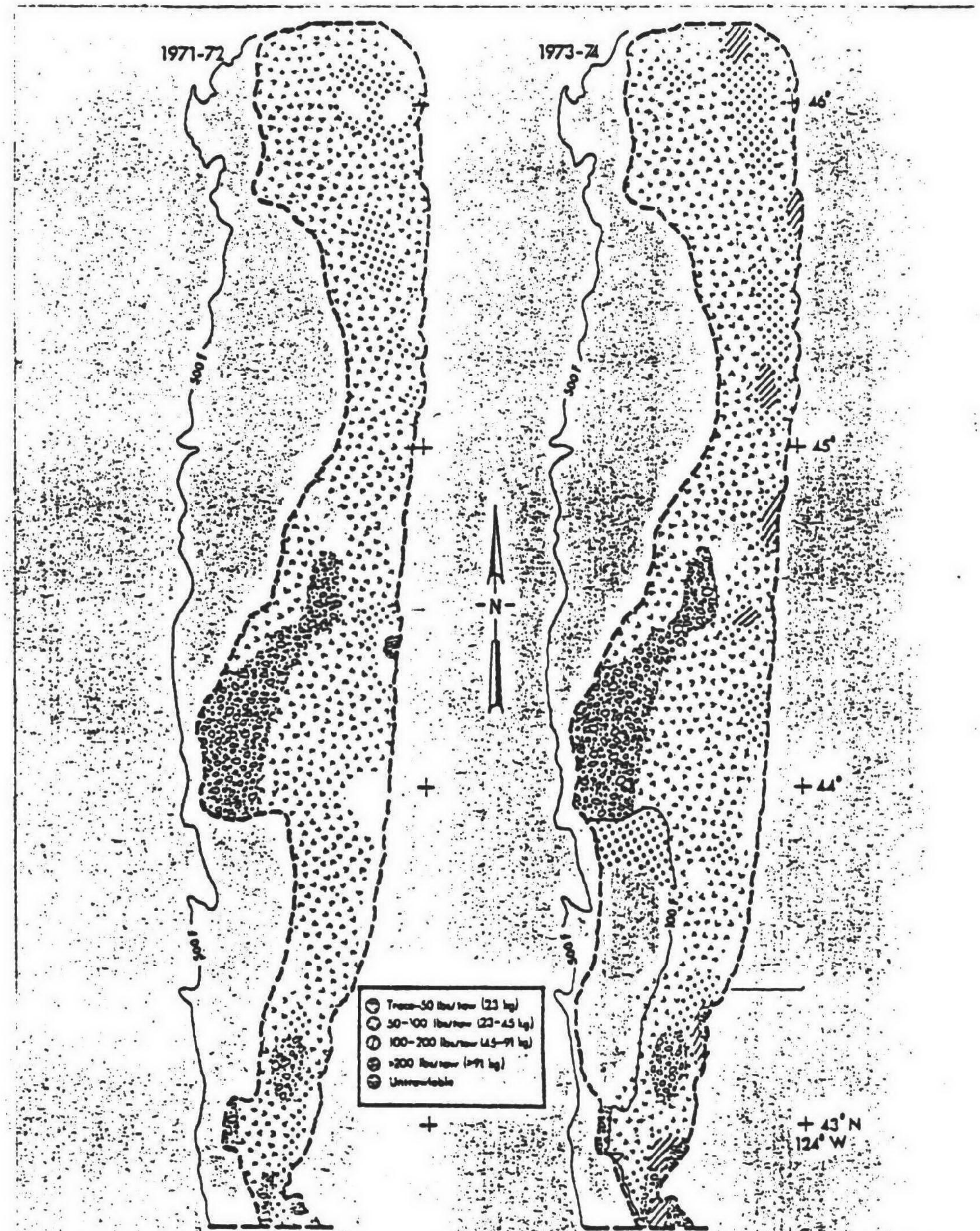


Figure 13. Distribution and relative abundance (weight) of ratfish in September 1971-72 and 1973-74 off Oregon as determined by groundfish surveys. Heavy broken line is limit of survey.

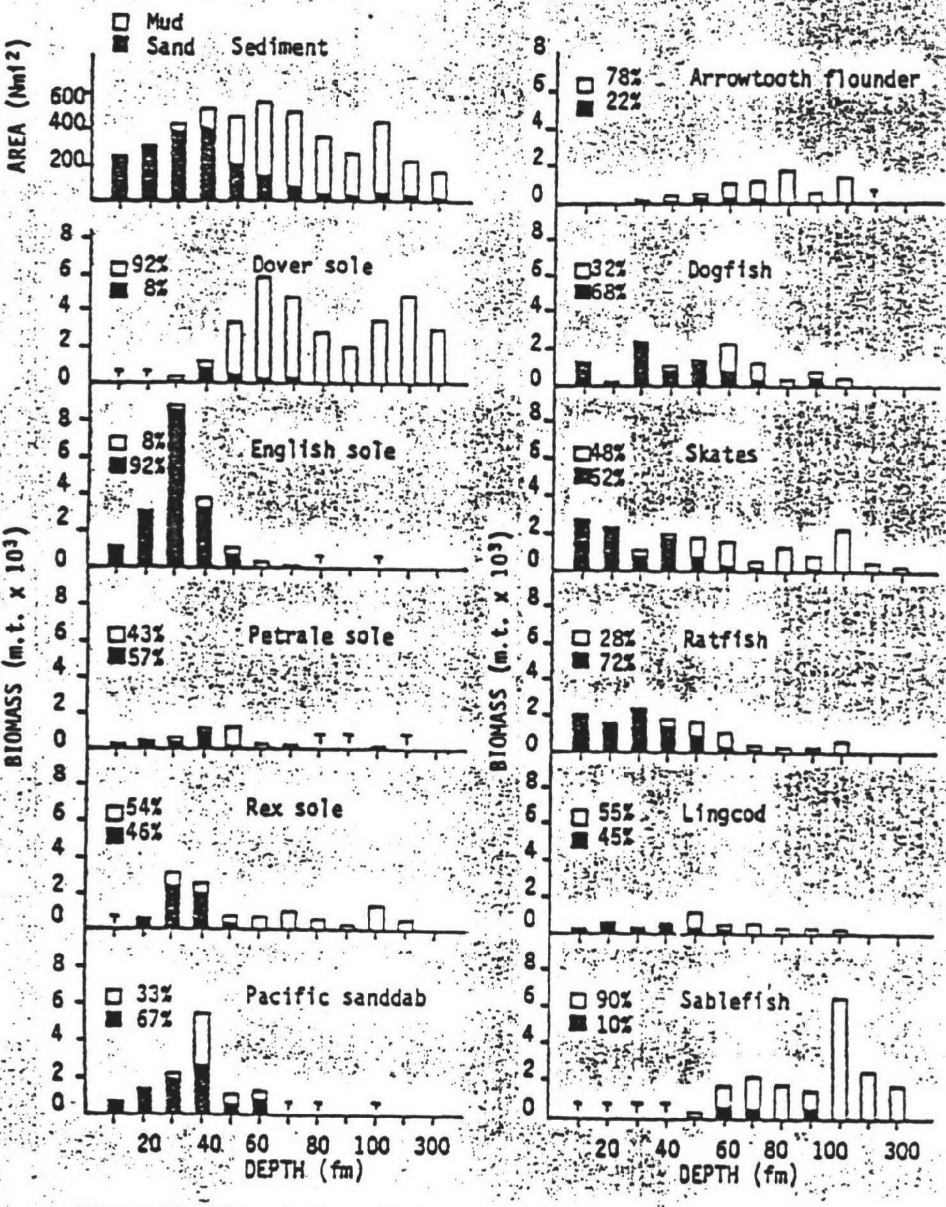


Figure 14. Correlation of abundance of selected species with depth and sediment type within depth 1973-74. Percent shows abundance related to sediment type. Note change in strata at 100 fm. T = <100 m.t.

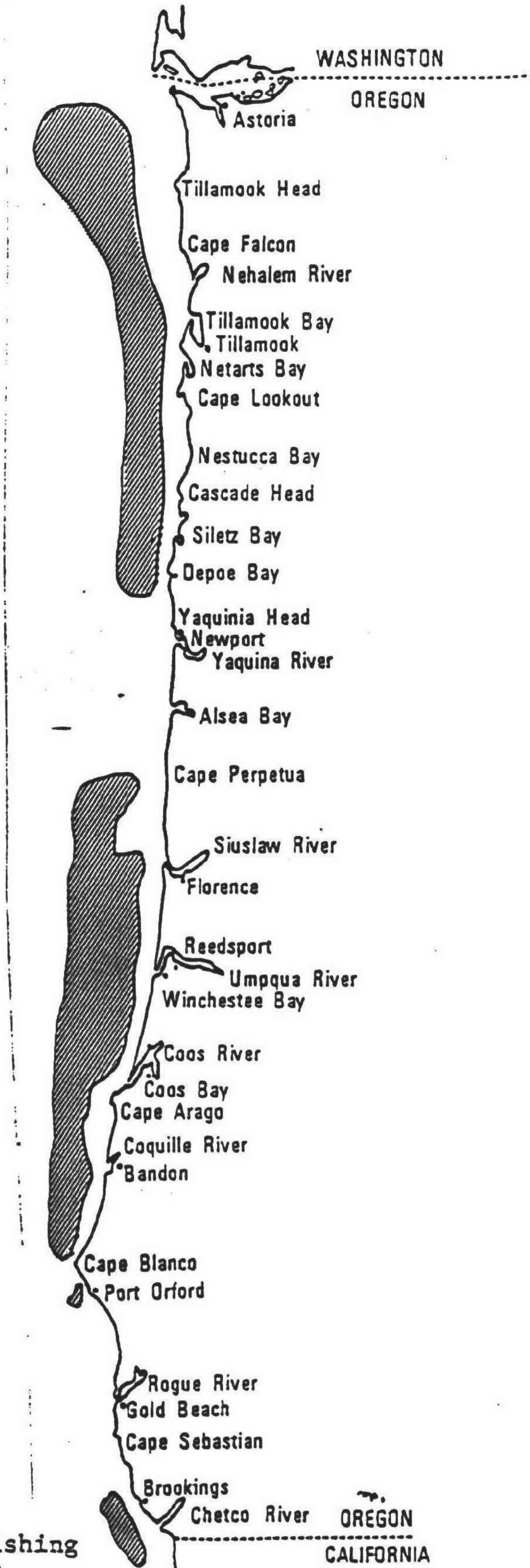


Figure 16. Principal Shrimp Fishing Grounds along the Oregon Coast.

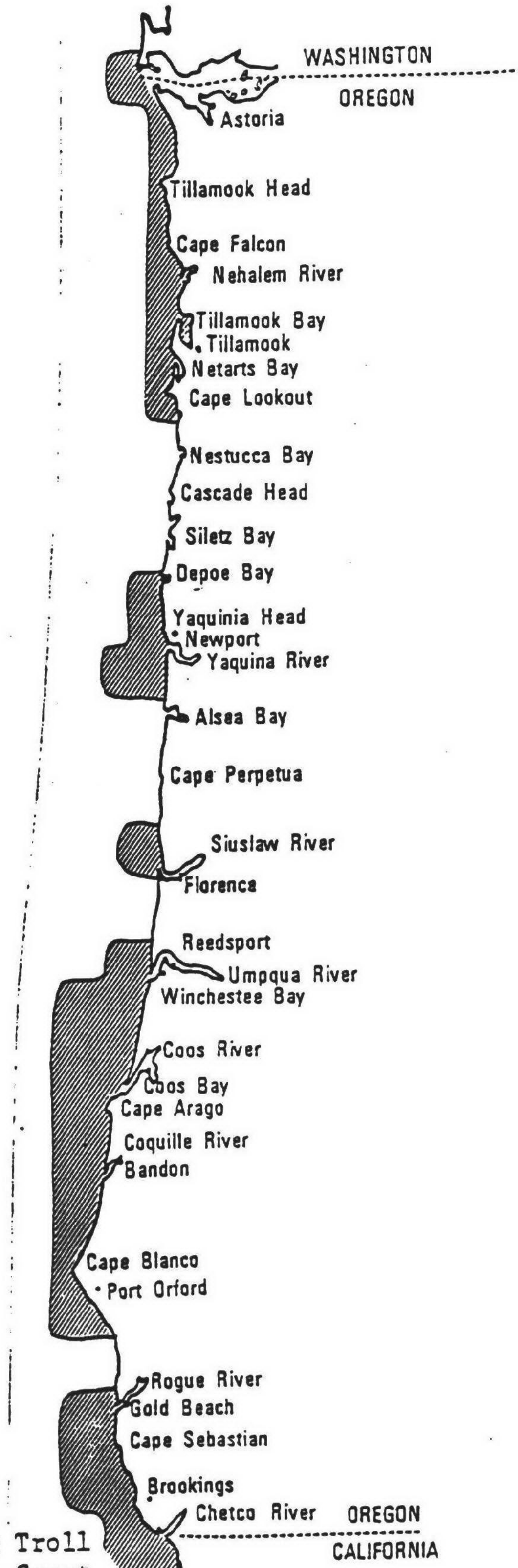


Figure 17 Major Chinook and Coho Troll Areas along the Oregon Coast. (1967-68 data. Source: ODFW 1976)-(includes only major, very good, and good categories)

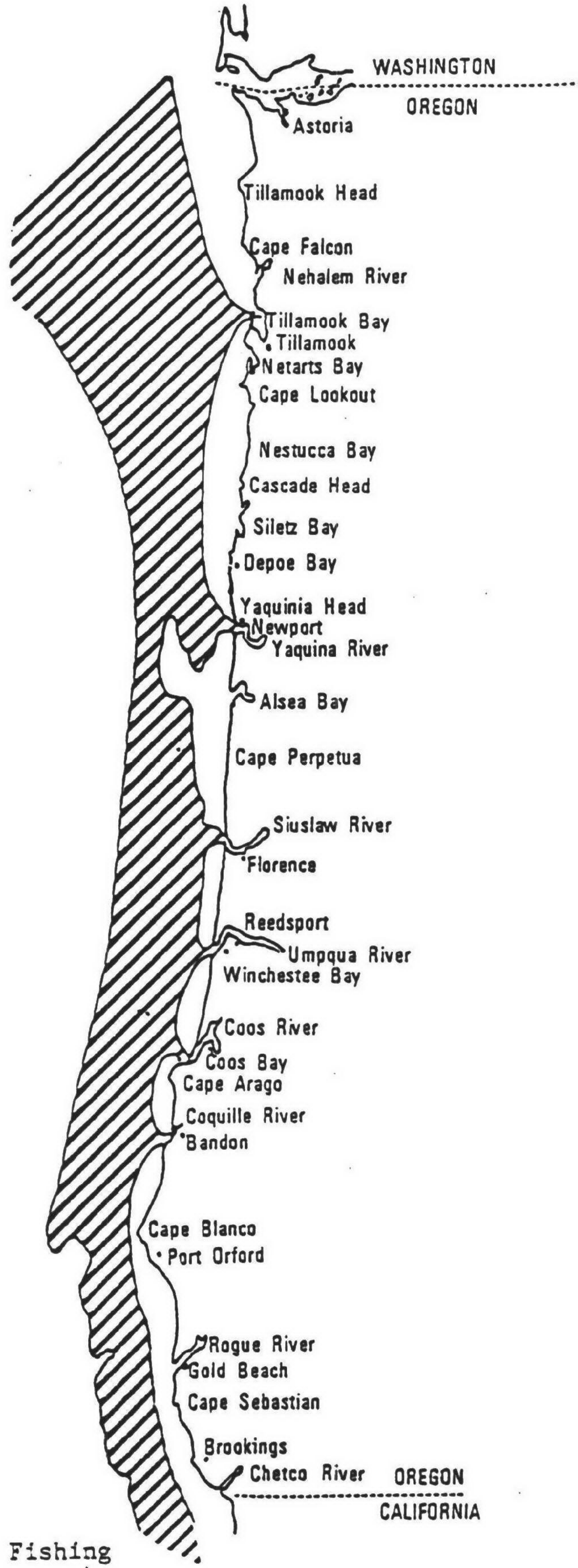


Figure 18. Major Inshore Crab Fishing Areas.

APPENDIX C

LETTERS OF CLEARANCE

VICTOR ATIYEH
GOVERNOR

Department of Transportation
STATE HISTORIC PRESERVATION OFFICE
Parks and Recreation Division
525 TRADE STREET S.E., SALEM, OREGON 97310

Novmeber 16, 1982

DAVIS G MORIUCHI
PORTLAND DIST CORPS OF ENGINEERS
PO BOX 2946
PORTLAND OR 97208

Dear Mr. Moriuchi:

RE: Ocean Disposal
Coos Bay Area
Coos County

This letter is in response to your request for official comment from the State Historic Preservation Office regarding impact of your federally funded project on cultural resources.

After a careful review of your proposed project, our office can offer the following comments. We feel the area of the project is not of historic significance and since ground disturbance of previously undisturbed ground is minimal, this office feels that there will be no likely impact to archeological resources. We therefore feel no cultural resource surveys are required and that the project is in compliance with Public Law 89-665 and Executive Order 11593.

For further information regarding projects, contact Leland Gilsen, state preservation archeologist, at 378-5023.

Sincerely,

D.W. Powers III
Deputy SHPO

DWP/LG:kc

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Endangered Species
2625 Parkmont Lane S.W., B-2
Olympia, WA 98502

February 14, 1983

Mr. Richard N. Duncan
Chief, Fish and Wildlife Branch
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Refer to: 1-3-83-SP-133

Dear Mr. Duncan:

This is in response to your letter, dated January 17, 1983, for information on listed and proposed endangered and threatened species which may be present within the area of the proposed Ocean Disposal Site(s) near Coos Bay, Oregon. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973, 16 U.S.C. 1531, et seq.

To the best of our present knowledge there are no listed or proposed species occurring within the area of the subject project. (See attachments) Should a species become officially listed or proposed before completion of your project, you will be required to reevaluate your agency's responsibilities under the Act. We appreciate your concern for endangered species and look forward to continued coordination with your agency.

Sincerely,

Jim A. Bottorff
Endangered Species Team Leader

Attachments

cc: RO (AFA-SE)
ES, Portland
ODFW, Non-Game Program

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR WITHIN THE AREA OF THE PROPOSED OCEAN DISPOSAL SITE(S) NEAR COOS BAY, OREGON
1-3-83-SP-133

LISTED:

None

PROPOSED:

None

CANDIDATE:

None

Attachment A

APPENDIX D

SEDIMENT ELUTRIATE ANALYSES
FROM
HANCOCK et.al. 1981

Table 3-5

Sediment Elutriate Analyses (May 1979)

Station	Depth (cm)	pH	$S^=$ (μg/ml)	NH_4^+-N (μg/ml)	TOC (μg/ml)	Chloro-Pesticides (ng/ml)	PCB (ng/ml)
E1	00-20	7.7	BD	ND	4.7	ND	ND
	20-60	7.6	BD	ND	4.4	ND	ND
E1s	00-20	7.6	BD	BD	4.2	ND	ND
	20-51	7.55	BD	BD	5.1	ND	ND
E2	00-20	7.6	BD	BD	3.1	BD	BD
	20-60	7.6	BD	0.14	4.2	ND	ND
E2s	00-20	7.5	BD	ND	4.0	ND	ND
	20-60	7.6	BD	ND	4.4	ND	ND
E3	00-20	7.65	BD	0.38	5.9	BD	BD
	20-42	7.6	BD	0.36	6.4	ND	ND
E3s	00-20	7.5		0.25	5.9	ND	ND
	20-60	7.6	BD	BD	7.1	ND	ND
E4	00-20	7.5	BD	0.1	4.0	BD	BD
	20-50	7.5	BD	BD	7.1	ND	ND
E4s	00-20	7.4	BD	BD	4.6	BD	BD
	20-60	7.4	BD	BD	5.2	BD	BD
E6	00-20	7.2	BD	3.7	12	BD	BD
	20-80	7.1	BD	5.0	6.9	0.007 DDE	ND
E6s	00-20	7.7	BD	3.9	9.7	ND	ND
	20-60	7.5	BD	2.0	12	BD	BD
E7	00-20	7.5	BD	3.9	10.8	BD	BD
	20-60	7.5	BD	6.5	49	BD	BD
E7s	00-20	7.4	BD	7.1	8.7	BD	BD
	20-60	7.1	BD	9.4	11.7	ND	ND
LLD			0.1	0.1		0.001	0.003

Note: Salinity = 26-28 mg/ml for all samples.

Table 3-5 (continued)

Sediment Elutriate Analyses (May 1979)

Station	Depth (cm)	Metal Concentration (ng/ml) Cd	Cu	Fe	Mn	Pb	Zn
E1	00-20	68	8.5	105	90	BD	65
	20-60	2.4	20.2	55	20	BD	59
E1s	00-20	80	14	10	55	BD	81
	20-51	15	17	60	30	5.5	53
E2	00-20	16	9.5	35	56	BD	97
	20-60	ND	ND	9	28	ND	14
E2s	00-20	4	10	BD	8	BD	75
	20-50	17	4	BD	10	2	71
E3	00-20	17	5	BD	40	5.6	57
	20-42	0.2	13	BD	26	2	55
E3s	00-20	5.2	20	60	11	BD	52
	20-60	15	10	10	63	BD	65
E4	00-20	0.6	12.3	2	22	2	85
	20-50	3.7	20.5	70	70	9	75
E4s	00-20	BD	21.6	7	43	BD	48
	20-60	0.6	24	15	70	6	48
E6	00-20	BD	9.5	2040	1200	2	ND
	20-80	BD	6	4840	665	BD	ND
E6s	00-20	14.6	15.3	BD	335	BD	114
	20-60	2.0	13.6	60	20	BD	114
E7	00-20	4.6	13.5	20	230	BD	118
	20-60	7.8	16	40	85	BD	75
E7s	00-20	BD	7	3550	1450	BD	3
	20-60	BD	4	3880	2720	BD	6
LLD		0.3		0.5		0.2	

Table 3-6

Sediment Elutriate Analysis (October 1979)

Station	Depth (cm)	pH	Sal. (mg/ml)	$S^=$ (μg/ml)	TOC (μg/ml)	NH_4^+-N (μg/ml)	Chloro-Insect. (ng/ml)	PCB (ng/ml)
E4	00-20	7.7	24	BD	11	BD	BD	BD
	20-41	7.5	25	BD	2	BD	ND	ND
E5	00-20	7.3	24	BD	8	5.0	BD	BD
	20-60	7.1	24	BD	10	9.1	BD	BD
E6	00-20	7.2	24	BD	12	6.8	BD	BD
	20-60	6.8	24	BD	15	18.0	BD	BD
E7	00-20	7.3	27	BD	15	7.0	BD	BD
	20-60	7.3	27	BD	22	16.0	BD	BD
E8	00-20	7.4	23	BD	15	4.6	BD	BD
	20-60	7.4	24	BD	8	7.8	BD	BD
E9	00-20	7.3	29	BD	4	5.3	BD	BD
	20-48	7.2	24	BD	12	19	BD	BD
	Seawater Blanks	7.5	27	BD	4	BD	BD	BD
		7.5	26	BD	2	BD	BD	BD
		7.8	25	BD	5	BD	BD	BD
LLD				0.1		0.1	0.001	0.003

Table 3-6 (continued)

Sediment Elutriate Analyses (October 1979)

Station	Depth (cm)	Metals Concentration (ng/ml)							
		As	Cd	Cu	Fe	Mn	Pb	Zn	Hg
E4	00-20	ND	3	2.5	10	40	3	2	BD
	20-41	BD	2	2	20	20	2	2	1
E5	00-20	ND			1100	1600			BD
	20-60	ND			700	1300			BD
E6	00-20	ND	66	1	1900	960	3	23	2
	20-60	BD	57	1	6500	3300	2	29	3
E7	00-20	ND			1300	1300			BD
	20-60	ND			680	790			BD
E8	00-20	ND			690	160			BD
	20-60	ND			740	250			BD
E9	00-20	ND	8.5	0.5	500	980	3	18	[illegible]
	20-48	BD	17	0.5	950	420	2	24	[illegible]
Seawater Blank		BD	BD	BD	110	20	BD	BD	BD
LLD		20	0.3	0.3			0.2	0.1	0.5

Table 3-7

Sediment Elutriate Analyses (March 1980)

Station	Depth (cm)	pH	DO (μg/ml)	Sal. (mg/ml)	Turb. (NTV)	$S^=$ (μg/ml)	TOC (μg/ml)	NH_4-N (μg/ml)	AS (ng/ml)	Hg (ng/ml)
E4	00-20	ND	6.3	27	53	BD	5	0.1	ND	BD
	20-50	7.5	7.0	28	86	BD	5	0.4	BD	BD
E5	00-20	7.5	2.7	ND	83	BD	9	11	ND	BD
	20-60	ND	4.4	29	101	BD	5	7	ND	BD
E6	00-20	7.5	2.7	26	81	BD	9	11	ND	BD
	20-60	7.2	4.7	26	165	BD	11	11	BD	BD
E7	00-20	7.0	2.8	ND	120	BD	19	20	ND	BD
	20-60	7.2	2.5	28	66	BD	5	11	ND	BD
E8	00-20	7.3	3.4	28	107	BD	5	4	ND	BD
	20-60	7.4	3.0	28	115	BD	4	4	ND	BD
E9	00-20	7.4	5.6	28	56	BD	5	6	ND	BD
	20-60	7.7	5.4	ND	75	BD	5	4	BD	BD
Seawater Blank #1		7.7	7.9	26	1.8	BD	1	0.1	ND	BD
Seawater Blank #2		7.7	7.7	31	0.8	BD	4	0.3	BD	BD
LLD						0.1			20	0.5

Table 3-7 (continued)

Sediment Elutriate Analyses (March 1980)

Station	Depth (cm)	Pesticide Concentration (ng/ml)					
		Aldrin	DDE	Dieldrin	DDD	DDT	PCB
E4	00-20	0.006	0.002	BD	0.03	0.009	BD
	20-41	0.004	0.005	BD	0.03	0.02	BD
E5	00-20	0.003	BD	BD	0.01	0.004	BD
	20-60	0.002	0.005	BD	0.02	0.02	BD
E6	00-20	0.007	BD	BD	0.02	BD	BD
	20-60	0.06	0.002	BD	0.02	0.01	BD
E7	00-20	0.003	BD	BD	0.015	0.009	BD
	20-60	0.016	0.0006	0.004	0.003	0.005	BD
E8	00-20	0.02	0.006	0.002	0.003	0.001	BD
	20-60	0.002	ND	BD	0.01	0.01	BD
E9	00-20	0.02	BD	BD	0.02	0.007	BD
	20-60	0.01	0.004	BD	0.03	0.01	BD
Seawater Blank #1		0.01	BD	ND	0.02	0.01	BD
Seawater Blank #2		BD	0.003	0.003	0.03	0.02	BD
Distilled Water Blank #1		ND	BD	0.004	0.006	0.01	BD
Distilled Water Blank #2		ND	BD	0.003	0.006	0.008	BD
LLD		0.001	0.001	0.001	0.002	0.003	0.003