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The distribution, abundance, diversity and productivity of the western Beaufort. Sea benthos.

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I. Summary of Objectives, Conclusions, and Implications with Respect to OCS Oil and Gas Development.

Extensive exploration and development for oil and gas on the Alaskan and Canadian continental shelf have the potential to significantly influence the marine environment of the Beaufort Sea. It is impossible with our present knowledge to accurately predict the consequences of petroleum development on the marine benthos.

The past and continuing goal of this project has been to acquire the knowledge of the ecology of benthic invertebrate faunas of the Beaufort Sea continental shelf necessary to evaluate the consequences of offshore oil and gas development. The distribution and abundance of the fauna has been examined in detail with studies of the spatial and temporal variability of these. These data will provide a baseline against which future changes in the benthic environment and community structure can be evaluated. Of current importance are: (1) the definition of temporal changes in sublittoral community structure, (2) the determination of the life histories and secondary production estimates of dominant and ecologically important species, (3) the description of the benthic food web, and (4) the study of the ecology of benthic invertebrates important as prey organisms to the marine mammals, birds, and fishes. Now that broad ecological patterns of benthic invertebrates on the Beaufort Sea shelf are becoming fairly well known, it is imperative to define the dynamic processes maintaining temporal and spatial structure.

II. Introduction

A. General nature and scope of the study.

The ecological studies of the shelf benthos include functional, process-oriented research that is built on a strong base of descriptive work on ecological patterns and their relationship to the environment. Seasonal changes in the numerical abundance and biomass of the large macro-infauna (>1.0 mm) are defined at stations across the continental shelf. The benthic food web and its relationship to bird, fish and mammalian predators are under investigation.

The species composition, distribution and abundance of the benthos are being defined in the southwestern Beaufort Sea. Species and station groupings are statistically analyzed and the relationships to the bottom environment explored. Dominant species are identified. These patterns provide an insight into the relative importance of various features of the environment in determining the distribution and abundance of the benthic invertebrate fauna.

B. Specific Objectives.

The specific objectives of the 1977/78 proposed research are listed in order of priority. The major emphasis will be on the delineation of the benthic food-web and description of the coastal benthos. Efforts to characterize the composition of the Beaufort Sea fauna to the species level will continue since this is a critical step toward understanding the dynamics of the benthic ecosystem.

a) Objective 1 - Beaufort Sea benthic foodweb analysis

1. The numerical density, biomass, and gross taxonomic composition of the the benthic macro-infauna at selected water column foodweb stations will be obtained.

2. The identification of prey species important in the benthic foodweb will be undertaken.

3. The gut contents of selected species of benthic invertebrates will be analyzed as far as possible to determine the foodweb links within the benthic communities.

Justification

Foodweb "studies are important because these feeding links are the routes by which energy, elements and pollutants are transferred from one trophic level to another. Such studies are necessary to identify the keystone species and important feeding areas on the Beaufort Sea continental shelf.

b) Objective 2 - Beaufort Sea coastal benthos

The numerical density, biomass, and gross taxonomic composition of the coastal benthic macro-infauna will be obtained from grab samples taken at stations on the inner continental shelf and coastal zone. These samples were collected during the summer of 1976 on the R/V. ALUMIAK. This research is in large part supported by supplemental funds from NOAA/BLM in response to a letter proposal of April 5, 1977. This research will continue throughout the FY-78 contract year.

Justification

The coastal region has been designated by the. Beaufort Sea synthesis meeting as a critical zone of foodweb interactions that could be impaired by oil pollution from planned petroleum exploration and production. At the present time little is known of the species composition, distribution, abundance and environmental interactions of the benthic fauna.

Research on coastal benthic invertebrates is proposed to fill the designated data gap that now exists in the southwestern Beaufort Sea within the depth zone of 5 to 25 meters. Because of the large standing stocks of benthic fauna in this shallow continental shelf environment, it is an important feeding ground for the shallow-water fish, diving birds, and marine mammals. The taxonomic composition and abundance of the benthos are strongly correlated with depth and distance from shore. The environmental effects of bottom water and sedimentary characteristics on the benthic communities in this transitional zone are not known at the present time.

c) Objective 3 - Benthic macro-infaunal ecology

1. Further identifications of abundant species will be undertaken from samples collected in the southwestern Beaufort Sea during the WEBSEC and OCS field trips and cruises.

2. Statistical analyses of species and station groups will be run, and correlations between these and various characteristics of the benthic environment will be made.

Justification

A complete description of the benthic fauna of the Beaufort Sea at the species level is needed to establish a baseline from which future faunal changes can be evaluated. Multivariate analysis of the spatial patterns of the benthic fauna will be useful in gaining insight into which environmental factors are important in controlling animal distributions in this area. This type of knowledge is critical to predicting the impact of environmental perturbations.

d) Objective 4 - Summary and synthesis of benthic environment characteristics.

1. Sediment samples from OCS benthos stations will be analyzed for particle size, organic carbon, and Kjeldahl nitrogen by Oregon State University or a subcontractor.

2. The bottom water characteristics of the southwestern Beaufort Sea continental shelf will be summarized as far as possible with the available information.

Justification

It has been demonstrated that sediment type is one of the key factors in controlling the distribution of benthic infaunal organisms. Therefore, it is useful to map the distribution of sediment characteristics in conjunction with the patterns of faunal distribution. The Beaufort Sea continental shelf is characterized by sediments which are patchy in distribution and of a broad range of types, and it is, therefore, essential that the sediments be defined as completely as possible at each sampling location.

C. Relevance to Problems Associated with Petroleum Development.

Extensive exploratory and production drilling for petroleum on the Alaskan and Canadian continental shelf has the potential to significantly influence the marine benthic environment and its associated biota. It is impossible with the present state of our knowledge of the benthos and the Arctic environment to accurately predict either the long or short term consequences of oil and gas development on the marine invertebrate benthos and the benthic food web. Only recently has descriptive baseline data on species distribution, composition , and abundance become available with estimates of variability in space and time.

II. C. (continued)

These data can be used as comparisons against which to assess the extent of major impacts on the benthic environment. These are a first step toward understanding the role of the sea floor fauna in the Beaufort Sea ecosystem and effects they might suffer from a major oil spill.

The objective of the second phase of the benthic ecological research is oriented toward the elucidation of energy pathways within the benthic food web, and the maintenance of community structure through the population dynamics of dominant species. When the major pathways of carbon flow within the benthic food web and to major marine mammal, bird and fish predators are known then critical pathways (e.g. dominant prey species) can be evaluated for their sensitivity to oil and other forms of pollution caused by man's activities off the northern Alaskan coast.

The measurement of rates and processes within the food web is ultimately a more difficult task but one that would allow more accurate estimates of environmental impacts. Changes in the metabolism, assimilation, growth and reproductive rates of species populations can be used to determine the extent of chronic effects of pollution (Widdows 1978). The partitioning of energy production and use in the benthos and ecosystem would provide a clearer understanding of the functioning of the ecological units and the degree to which they may be imparted by oil exploration and production.

Our (RU#6) benthic research on year-round reproductive activity of dominant benthic species on the continental shelf on the benthic food web, particularly in regards to marine mammals, birds, and fishes seeks to define some of the functional interactions among the community components. These must be known before the effects of environmental impacts can be predicted.

The benthic invertebrates constitute a major source of food for the top level carnivores, including birds, seals, and occasional walrus. Any decrease in benthic populations caused by oil pollution might eventually be reflected in the populations of these larger animals. Nearshore areas would be most sensitive since it would be in these regions that pollutants would be most likely to mix to the benthic boundary.

The timing of environmental disturbances in this strongly seasonal, environment may be extremely critical in determining the stresses experienced by the benthic community. For example, an oil spill in the winter on top of the pack ice could be cleaned up with little or no resultant damage to the marine benthos, while a spill of the same magnitude during a summer of open water might have significant impact. It remains to be determined if the bottom-dwelling invertebrates are more or less sensitive to oil related pollution during the summer months, but the pelagic larvae and juvenile stages of the benthic organisms would be vulnerable to spill's during periods of open water conditions.

It seems likely that the development of the oil and gas resources will bring about changes in the marine environment, but the extent of degradation in the benthic environment cannot be predicted. There remains a great scientific need

II. C. (continued)

for long term studies on the dynamics of the benthic populations, including year-round sampling with measurements on growth, metabolism, and reproductive activity.

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Widdows, J. 1978. Physiological indices of stress in Mytilis edulis. J. mar. biol. Ass. U.K. 58:125-142.

III. Current State of Knowledge

Since intensive sampling of the benthos of the southwestern Beaufort Sea beginning in 1971, ample collections have been made to define the broad ecological patterns of the bottom invertebrate organisms. These data have been submitted as part of the Final Report of NOAA/BLM-OCSEAP Contract No. 03-5-022-68, Task Order No. 4 submitted to NOAA by the Benthic Ecology Group at Oregon State University under Dr. Andrew G. Carey, Jr. in Quarterly and Annual Reports for Task Order No. 5 of RU #6, and in publications (Carey, Ruff, Castillo and Dickinson, 1974; Carey and Ruff, 1977).

Temporal and spatial variability are also fairly well defined, but the processes involved in maintaining these are not know. In some areas the scoring of the sea floor by ice gouging appears to increase the patchiness of the large infauna (Carey et al., "1974 and Carey and Ruff, 1977). It is suggested that the temporal variability of the outer continental shelf communities are seasonal and caused by reproductive cycles, but no data are yet available to test this hypothesis (Carey, Ruff, and Montagna, unpublished M.S.).

Benthic invertebrates that are important as food sources of marine mammals and birds have been designated by other research groups (UR's 230, 232, 172 and 196), but the ecology of these particular prey species are not well known. Research has just been initiated on the benthic food web itself; it's structure and rates are not known at the present time.

In summary, most of our information about the benthic invertebrates is descriptive in nature, and the studies of the processes that cause the described 'patterns are only just in the beginning stages.

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IV. Study Area

The Beaufort Sea is an integral part of the Arctic Ocean (Coachman and Aagaard, 1974). Normally the sea ice melts and is advected seaward during July and August in the southern fringe of the sea over the continental shelf. This is a response to regional wind stresses which are variable from year to year. For example, in some years the polar pack ice can remain adjacent to the coastline throughout the entire season. The extent of ice cover during the sunlit summer months affects wind mixing of surface waters and the penetration of light into the water column. These factors affect the onset and intensity of phytoplankton production which is highly variable and of low magnitude (Homer, 1976;

IV. Study Area (Continued)

Clasby, Alexander, and Homer, 1976). The keels of sea ice pressure ridges ploughing through the sediments cause significant disturbance of the benthic environment in water depts between 20 and 40 meters (Barnes and Reimnitz, 1974; Reimnitz and Barnes, 1974) . They gouge the bottom as they are transported across the inner shelf by the Beaufort Sea gyral circulation and by wind stress.

Generally the bottom water masses of the southwestern Beaufort Sea are stable, and except for the shallow coastal zone, differ little in thermohaline characteristics throughout the year (Coachman and Aagaard, 1974) . However, the outer shelf region from Point Barrow to about 150°W is influenced by Bering-Chukchi water that is advected as a subsurface layer and moves around Point Barrow throughout the year in pulses controlled in part by atmospheric pressure gradients (Hufford et al., 1977) . Coastal upwelling was observed in the Barter Island region on the shelf near 143°W during the summer of 1971 when the pack ice had moved relatively far offshore (Mountain, 1974) .

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Barnes, P.W. and E. Reimnitz. 1974. Sedimentary processes on arctic shelves off the northern coast of Alaska. In: 'I'he Coast and Shelf of the Beaufort Sea, PP. 439-476. J.C. Reid and J.E. Sater (Eds.). Arctic Institute of North America.

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Coachman, L.K. and K. Aagaard. 1974. Physical oceanography of Arctic and Subarctic seas. In: Marine Geology and Oceanography of the Arctic Seas; pp. 1-72. Y. Herman (Ed.). Springer-Verlag, New York.

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V. Sources, Methods and Rationale of Data Collection

In general, two areas of continuing benthic ecological research are: (1) the extension of research into a food web project which is designed to elucidate the biological interactions within the benthos and between the benthic organisms and other portions of the ecosystem; and (2) the further accumulation of data from existing samples to provide a more complete understanding of the patterns of distribution and abundance of benthic invertebrates across the continental shelf. This descriptive detailing will provide baseline data with more accurate estimates of natural spatial and temporal variability.

To date, the experimental design has included a description of the benthic macro-infaunal and mega-epifaunal communities based on the WEBSEC and OCS samples. Numerical densities, total biomass, and major taxonomic composition have all been examined. As the species within the taxonomic groups have been identified, statistical anaylses have delimited species and station groupings, and these groups have been correlated with the environmental characteristics of the benthic boundary. Estimates of natural spatial variability have been of major concern, and the descriptive phases of the research have been extended through a twelve month period to provide estimates of temporal variability and to provide initial information of the life histories of the arctic invertebrates. The study of interactive pathways with other portions of the ecosystem through the food web is a logical extension of the current benthic research.

A. WEBSEC

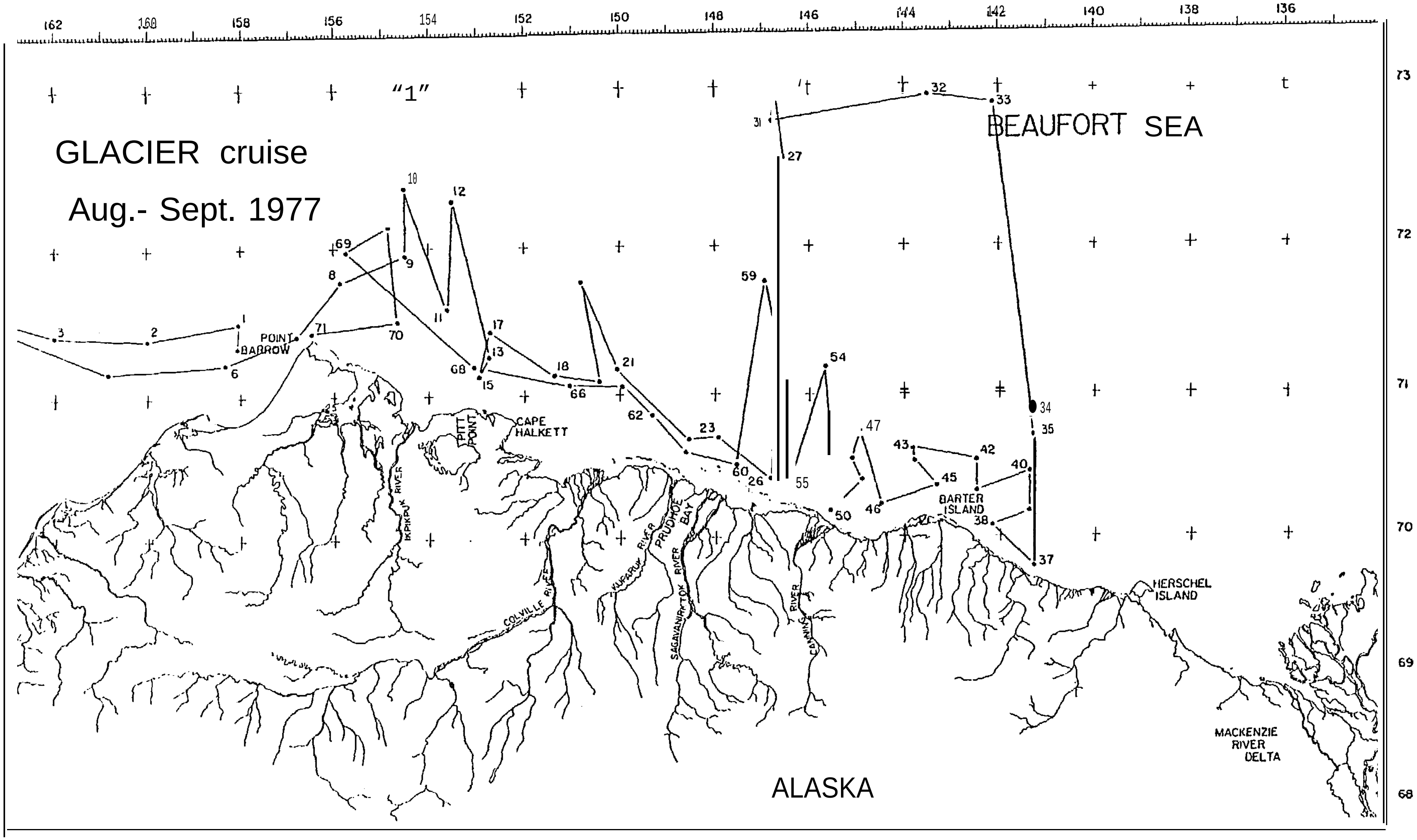
A large series of Smith-McIntyre 0.1 m^2 grab samples were collected during the 1971 and 1972 WEBSEC cruises of the U.S. Coast Guard. These formed the basis for our initial survey of the large benthic infauna (>1.0 mm) and mega-epifauna (>1.3 cm) . Five grab samples were collected per station. Details of methodology may be found in the 1977 Final Report for RU #6 Task Order #4, and in Carey and Ruff (1977). These samples form the source of much of the polychaete results reported here. Gordon R. Bilyard under support of the National Science Foundation and NOAA/BLM is analyzing these collections as part of his Ph.D. "dissertation.

B. Ocs - Coastal and Shelf

Continued sampling of the benthos for the OCS program has added survey information critical to the description and understanding of species distributions and abundances and ecological patterns. A minimum of 5 quantitative grabs per station has been adherred to as a sampling strategy whenever possible.

The OCSEAP-sponsored foodweb cruise in the Beaufort Sea during the 1977 summer sampling season allowed the sampling of further stations in previously unsurveyed areas (Figure 1) on the continental shelf and continental slope. The coastal areas sampled from the R\V ALUMIAK are summarized in Figure 2 and Table 1.

Figure 1: Station locations of the summer 1977 foodweb cruis~-



Figure, 2: Locations of coastal stations taken aboard R/V ALUMIAK, summer 1976.

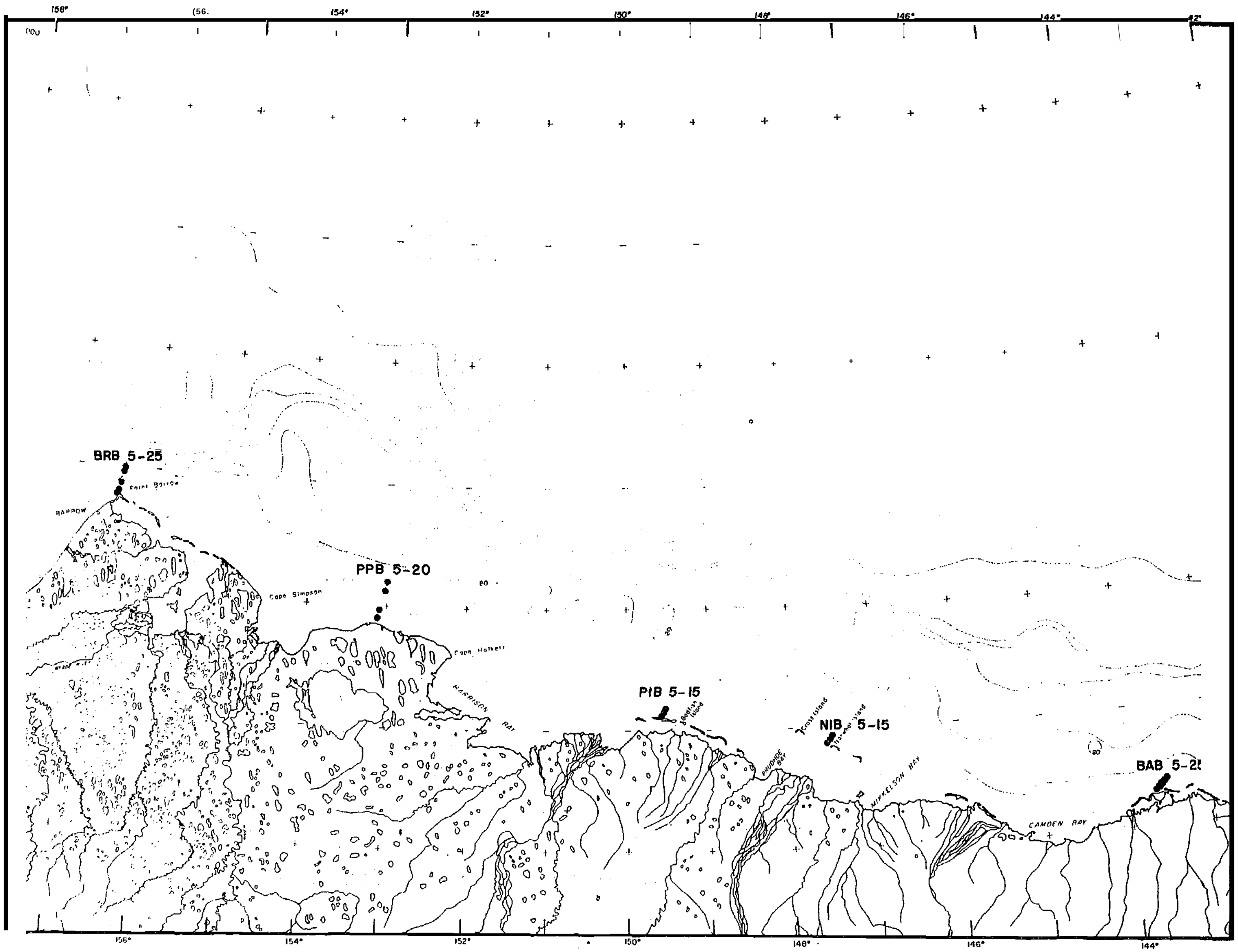


Table 1: Results of the R/V ALUMIAK cruise, summer 1976.

Transect	Date (1976)	Station	Position	Depth (m)		Salinity (‰)	Temperature (°C)	No. Biol. Samples	No. Seal.
Point Barrow	19 Aug.	BRB-25	71°27.3'N 156°22.3'W	25.9				5	1
		BRB-20	71°28.0'N 156°18.6'W	19.5				5	1
		BRB-15	71°28.2'N 156°13.1'W	15.5				5	1
		Bin-lo	71°24.9'N 156°23.8'W	9.8				5	1
		BRB-5	71°23.4'N 156°27.1'W	5.2	25.00	27.00	3.50	5	1
Pitt Point	20 Aug.	PPB-20	71°05.2'N 152°58.7'W	19.2	11.10	12.70	-1.60	5	1
		PPB-15	71°04.4'N 153°01.5'W	14.9	25.50	31.20	-1.30	5	1
		PPB-10	70°59.1'N 153°08.8'W	9.9	25.10	27.77	-0.80	5	1
		PPB-5	70°56.4'N 153°12.9'W	5.5	23.20	25.10	-1.90	5	1
Pingok Island	22 Aug.	PIB-15	70°33.2'N 149°34.6'W	14.9	24.87	31.45	1.88	5	1
		PIB-10	70°34.8'N 149°32.3'W	10.2	23.00	22.32	2.15	5	1
		PIB-5	70°34.9'N 149°32.0'W	4.5	20.65	22.08	2.0s	5	1
Narwhal Island	28 Aug.	NIB-15	70°26.0'N 147°26.2'W	16.2	24.93	31.76	-1.98	5	1
		NIB-10	70°24.3'N 147°29.2'W	9.8	24.50	31.02	-1.96	5	1
	27 Aug.	NIB-5	70024.9'N 147°30.5'W	5.0	24.09	30.10	-0.88	5	1
Barter Island	31 Aug.	BAB-25	70°11.3'N 143°31.5'W	24.6	24.82	31.88	-2.00	5	1
		BAS-20	70°10.8'N 143°33.7'W	20.3	24.46	31.33	-2.00	5	1
	3 Sept.	BAB-15	70°09.5'N 143°36.2'W	15.1	24.24	30.7B	-1.98	5	1
		BAS-10	70°09.0'N 143°32.2'W	10.1	24.28	30.75	-1.86	5	1
		BAB-5	70°08.4'N 143°37.7'W	5.0	23.47	28.40	-0.98	5	1
TOTALS									
5 Transects		20 stations						100 Biol. samples	20 Seal. samples

V. C. Temporal variability study methods

In October 1975 we initiated year-round sampling at standard stations across the southwestern Beaufort Sea continental shelf. Our major objectives were: (a) to determine the degree and timing of changes, if any, in the numerical abundance, biomass, and species composition of the benthic communities, and (b) to determine the size distribution and reproductive activity of dominant species throughout the year. Five stations at 15 meter depth intervals from 25 to 100 meters were sampled on five occasions over a 13-month period off Pitt Point, Alaska (Figure 3). Sampling was accomplished from an icebreaker during the summer field season and with the aid of a helicopter during the remainder of the year. A minimum of five standard 0.1 m^2 Smith-McIntyre grab samples were taken at each station occupied.

Navigation was by DEW station radar, depth sounder, and sometimes aided by OMEGA during ice field trips and by satellite navigator, Loran-C and depth sounder on the summer cruise. New techniques and lightweight gear were developed' for use of the grab through the ice on airborne trips. The basic station set-up consisted of a steel pipe tripod positioned over a 1.2 m square hole in the ice and a p rtable gasoline hydro winch hauling 3/16" cable rigged through blocks.

The collected sediment was initially washed through 0.42 and 1.0 mm sieves, and the larger infaunal organisms (>1.0 mm) were sorted into major taxonomic groups, counted and weighed (wet) in the laboratory. Numerical density is based on all taxa (>1.0 mm) except foraminiferans and nematodes. Wet-preserved weight includes soft-bodied organisms (>1.0 mm) ; for greater accuracy and fidelity shelled molluscs, ophiuroids and 5 large, rare specimens weighing more than 3.0 g each were excluded. Significance of seasonal difference (P) was' determined by the Kruskal-Wallis one-way analysis by ranks: J.M. Elliot, Some Methods for the Statistical Analysis of Samples of Benthic Invertebrates. (Freshwater Biological Association, Scientific Publication No. *25,* Ambleside, England 1971) , p. 118.

VI. Results

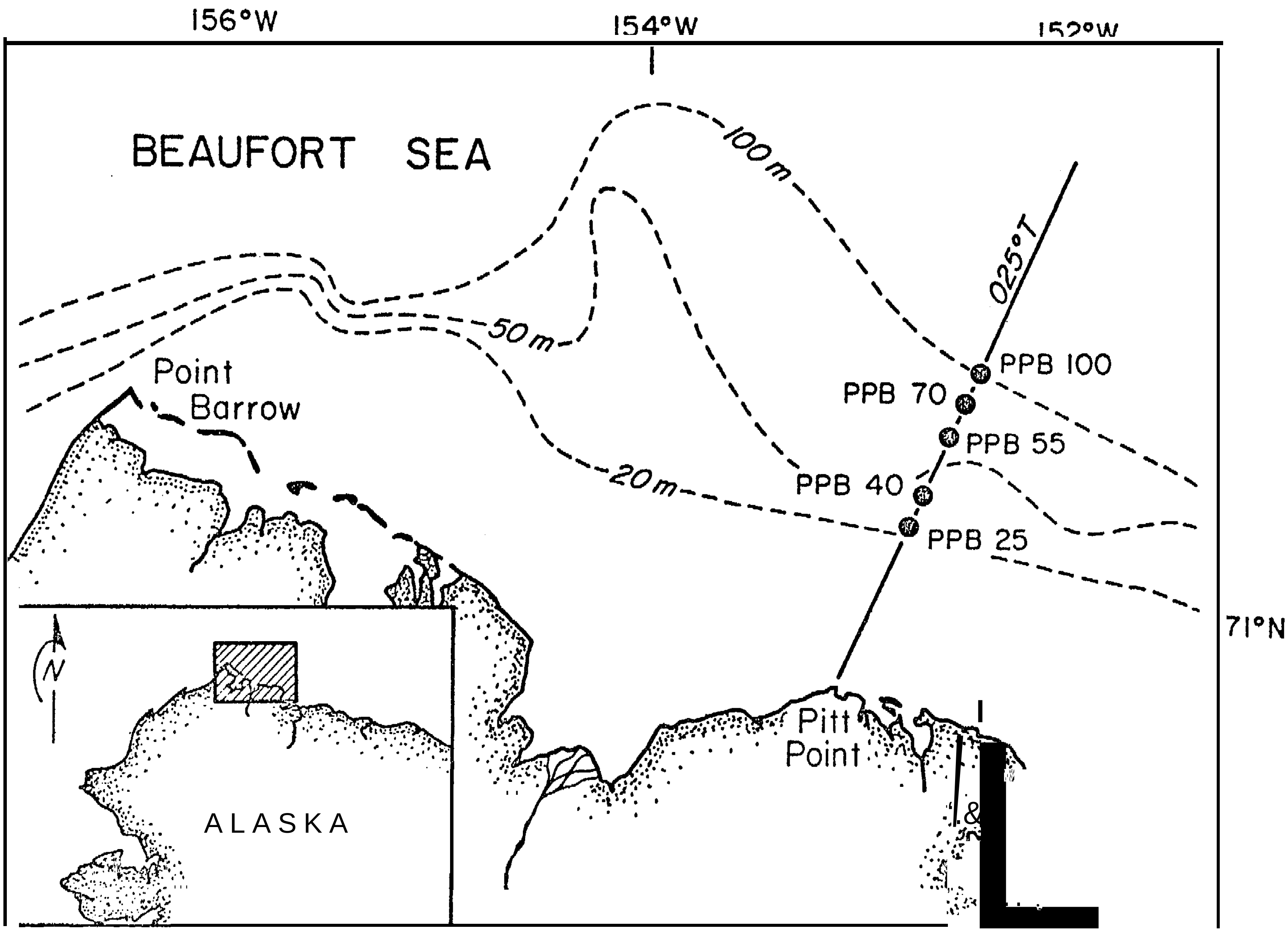
A. Polychaeta

The polychaete worms are among the dominant groups of infauna collected in the Beaufort Sea. Two major series of collections being studied are the WEBSEC-71 and 72 and the OCSEAP (1975-78) samples.

1. OCS - Polychaetous Annelids

The polychaetous annelids have been sorted to the family level from 125 grab samples obtained during the OCS-5 and OCS-7 cruises. The OCS-5 samples were taken from the ALUMIAK in 1976 in water depths between 5 and 25 meters along five transects between Barrow and Barter Island. In 1977, the standard benthic stations off Pitt Point were reoccupied by the"GLACIER between 25 and 100 meters. Summary counts of the polychaetes by family from these grab samples are presented in the Current Quarterly report.

Figure 3. Southwestern Beaufort Sea: Point Barrow to Pitt Point, AK illustrating station locations.



VI. A. (continued)

The three most numerous families at each station were ranked in terms of percentage of the total polychaete fauna for three depths along the transects between Barrow and Barter Island (Table 2). From this compiled data, a few preliminary inferences can be drawn. Representatives of the family Spionidae tend to be ubiquitous across the Alaskan arctic shelf, as indeed they are worldwide. Members of the Pectinariidae dominate the polychaete fauna off Barrow, but are only rarely encountered elsewhere in the Beaufort Sea. This may be a reflection of differing environmental conditions due to proximity to the Chukchi Sea. It is of interest to note that fourteen different polychaete families are represented in the rankings. This is indicative of a heterogeneity of habitats occurring within a fairly confined depth range. Further conclusions, however, will have to await more detailed species information.

2. WEBSEC - Polychaetous Annelids

In addition to the use of gammarid amphipod data to further understand the Beaufort Sea ecosystem, data on the polychaetous annelids has served to elucidate many aspects of interactions between organisms and environment. Accumulation of data on the polychaetes requires concise taxonomic work. Dr. Kristian Fauchald (Allan Hancock Foundation, University of Southern California) has been most gracious in extending his help, including his personal expertise, use of the Allan Hancock Foundation Library, and use of the Allan Hancock Foundation biological collections. The desired level of taxonomic expertise could not have been achieved without his help.

Species found to date are listed in Table 3. Taxa bearing a letter designation (examples: Eclysippe sp. A, Genus A) have been confirmed as undescribed taxa. A taxonomic review of the Beaufort "Sea polychaetous annelids is presently in the early stages of preparation, and will, when published, include descriptions of the letter-designated taxa.

Among the polychaete data being collected are the numerical abundances of the polychaete species found at stations across the Beaufort Sea continental shelf and elope. Five transects, consisting of 119 Smith-McIntyre Grab samples (divided into 24 stations) were selected for analysis. Three transects (Figure 4) have been completed to date; the remaining two transects are very near completion. The numbers of species with depth and the numbers of polychaete specimens with depth are plotted in Figures 5 and 6.

Maximum numbers of species along the three transects are found between 75 and 150 m depth (Figure 5). Although reasons for the observed general shape of the species curves remain unclear, certain factors have been suggested which may influence species richness (number of species) at a given site. Inshore stations (20-40 m) are within the ice gouge zone (Kovacs and Mellor, 1974), where continual sediment disturbance may prohibit certain species from establishing populations. At depths greater than 400 m species richness decreases with increasing depth, possibly a consequence of decreasing nutrient supply. Hence, the observed species maximum on the outer continental shelf and upper continental slope in the Western Beaufort Sea may result from a minimum of bottom disturbance, coupled with a relatively high nutrient input.

Table 2: The most numerous families arranged in terms of percentage of the total polychaete fauna. The percentages are derived from grab samples taken along transects occupied by the ALUMIAK in 1976. Five grab samples were taken at each of the stations represented.

	5 - meters	10 - meters	15 - meters
BARROW TRANSECT :	49%-Spionidae 18%-Nephtyidae 12%-Hesionidae	77%-Pectinariidae 5%-Flabelligeridae 3%-Capitellidae	77%-Pectinarii dae 6%-Polynoidae 4%-Spionidae
PITT POINT TRANSECT :	41%-Spionidae 16%-Ampharetidae 13%-Orbiniidae	34%-Sabellidae 17%-Spionidae 14%-Cirratulidae	86%-Spionidae 4%-Capitellidae 3%-Paraonidae
PINGOK ISLAND TRANSECT :	31%-Maldanidae 14%-Cirratulidae 11%-Spionidae	80%-Spionidae 7%-Sabellidae 4%-Sphaerodori dae	56%-Spionidae 28%-Ampharetidae 6%-Sabellidae
NARWHAL ISLAND TRANSECT :	40%-Spionidae 21%-Hesionidae 13%-Sabellidae	53%-Spionidae 27%-Ampharetidae 6%-Cirratulidae	25%-Cirratulidae 13%-Spionidae 7%-Capitellidae
BARTER ISLAND TRANSECT :	27%-Spionidae 24%-Ampharetidae 15%-Sphaerodori dae	66%-Spionidae 7%-Ampharetidae 6%-Cirratulidas	17%-Cirratulidae 17%-Spionidae 15%-Nephtyidae

Table 3

POLYCHAETOUS ANNELIDS OF THE WESTERN BEAUFORT SEA
(Family and genus designations follow Fauchald, 1977. The Polychaete Worms. Definitions and Keys to the Orders, Families and Genera, Science Series 28. Natural History Museum of Los Angeles County.)

AMPHARETIDAE
- Amage auricula Malmgren, 1866
- Ampharete acutifrons (Grube, 1860)
- Ampharete arctica Malmgren, 1866
- Ampharete vega (Wirén, 1883)
- Amphicteis gunneri (Sars, 1835)
- Eclysippe sp. A
- Glyphanostomum pallescens (Théel, 1879)
- Lysippe labiata Malmgren, 1866
- Melinna cristata (Sars, 1851)
- Sabellides borealis Sars, 1856
- Genus A

APISTOBRANCHIDAE
- Apistobranchus tullbergi (Théel, 1879)

CAPITELLIDAE
- Barantolla americana Hartman, 1963
- Capitella capitata (Fabricius, 1780)
- Heteromastus filiformis (Claparède, 1864)
- Parheteromastus sp. A

CHAETOPTERIDAE
- Spiochaetopterus typicus Sars, 1856

CIRRATULIDAE
- Chaetozone setosa Malmgren, 1867
- Cirratulus ‘us (Müller, 1776)
- Tharyx ? acutus Webster and Benedict, 1887

COSSURIDAE
- Cossura longocirrata Webster and Benedict, 1887
- Cossura sp. A

DORVILLEIDAE
- Schistomeringos caecus (Webster and Benedict, 1887)
- Schistomeringos sp. A

FLABELLIGERIDAE
- Brada incrustata Støp-Bowitz, 1948
- Brada inhabilis (Rathke, 1843)
- Brada villosa (Rathke, 1843)
- Diplocirrus hirsutus (Hansen, 1879)
- Diplocirrus longisetosus (v. Marenzeher, 1890)
- Pherusa plumosa (Müller, 1776)

GONIADIDAE
- Glycinde wireni Arwidsson, 1899

HESIONIDAE
- Nereimyra aphroditoides (Fabricius, 1780)

LUMBRINERIDAE
- Lumbrineris fragilis (Müller, 1776)
- Lumbrineris impatiens (Claparède, 1868)
- Lumbrineris minuta Théel, 1879
- Lumbrineris sp. A
- Lumbrineris sp. B

MAGELONIDAE
Magelona longicornis Johnson, 1901
MALDANIDAE
Clymenura polaris (Théel, 1879)
Lumbriclymene minor Arwidsson, 1907
Maldane sarsi Malmgren, 1865
Notoproctus oculatus var. arc-tics Arwidsson, 190?
Petaloproctus tenuis (Théel, 1879)
Praxillella praetermissa (Mal_mgren, 1865)
NEPHTYIDAE
Aglaophamus malmgreni (Théel, 1879)
Micronephtys minuta (Théel, 1879)
Nephtys cilia-her, 1776)
Nephtys paradoxa Maim, 1874
NEREIDAE
Nereis zonata Malmgren, 1867
Nicon sp. A
ONUPHIDAE
Nothria conchylega (Sars, 1835)
Onuphis quadricuspis Sars, 1/372
OPHELIIDAE
Ophelina acuminata Oersted, 1843
Cphelina cylindricaudatus (Hansen, 1879)
Ophelina sp. A
Ophelina abranchiata Støp-Bowitz, 1948
ORBINIIDAE
Scoloplos acutus (Verrill, 1873)
OWENIIDAE
Myriochele heeri Malmgren, 1867
Owenia fusiformis delle Chiaje, 1841
PARAONIDAE
Allis suecica (Elaison, 1920)
Allia sp. A
Aricidea ushakovi Zachs, 1925
Paraonis sp. A
Tauberia gracilis (Tauber, 1879)
PECTINARIIDAE
Cistenides hyperborea (Malmgren, 1865)
PHYLLODOCIDAE
Anaitides citrina (Malmgren, 1865)
Anaitides groenlandica (Oersted, 1843)
Eteone flava (Fabricius, 1780)
Eteone longa (Fabricius, 1780)
Mysta barbata (Malmgren, 1865)
Mystides borealis Théel, 1879
Paranaitis wahlbergi (Malmgren, 1865)
PILARGIIDAE
Sigambra tentaculata (Treadwell, 1941)
POLYNOIDAE
Antinoella badia (Théel, 1879)
Antinoella sarsi (Malmgren, 1865)
Arcteobia anticostiensis (McIntosh, 1874 j
Enipo gracilis Verrill, 1874
Eucranta villosa Malmgren, 1865

POLYNOIDAE - CONT.
Eunoe oerstedi (Malmgren, 1865)
Gattyana cirrosa (Pallas, 1766)
Harmothoe imbricata (Linneus, 1767)
Lagisca extenuata (Grube, 1840)
Melaenis loveni Malmgren, 1865

SABELLIDAE
Branchiomma infarcta (Kröyer, 1856)
Chone duneri Malmgren, 1867
Chone murmanica Lukasch, 1910
Euchone papillosa (Sars, 1851)
Jasmineira schaudinni Augener, 1912

SCALIBREGMIDAE
Polyphysia crassa (Oersted, 1843)
Scalibregma inflatum Rathke, 1843

SERPULIDAE
Apomatus globifer Théel, 1879

SIGALIONIDAE
Pholoe minuta (Fabricius, 1780)

SPHAERODORIDAE
Sphaerodoridium claparedii (Greef, 1866)
Sphaerodoridium sp. A
Sphaerodoropsis minuta (Webster and Benedict, 18$7)
Sphaerodoropsis sp. A
Sphaerodoropsis sp. B
Sphaerodoropsis sp. C
Sphaerodorum gracilis (Rathke, 1843)

SPIONIDAE
Laonice cirrata (Sars, 1851)
Minuspio cirrifera (Wiren, 1883)
Polydora caulleryi Mesnil, 1897
Prionospio steenstrupi Malmgren, 1867

SPIRORBIDAE
Dexiospira spirillum (Linneus, 1758)
Spirorbis granulatus (Linneus, 1767)

STERNASPIDAE
Sternaspis fossor Stimpson, 1854

SYLLIDAE
Autolytus alexandri Malmgren, 1867
Autolytus fallax Malmgren, 1867
Exogone dispar (Webster, 1879)
Exogone naidina Oersted, 1843
Sphaerosyllis erinaceus (Claparède, 1863)
Typosyllis cornuta (Rathke, 1843)
Typosyllis fasciata (Malmgren, 1867)

TEREBELLIDAE
Artacama proboscidea Malmgren, 1866
Axionice flexuosa (Grube, 1860)
Lanassa nordenskioldi Malmgren, 1866
Lanassa venusta Maim, 187.4
Laphania boecki Malmgren, 1866
Leaena abranchiata Malmgren, 1866
Nicolea zostericola Oersted, 1844
Polycirrus medusa Grube, 1855
Proclea graffii (Langerhans, 1884)

TRICHOBRANCHIDAE

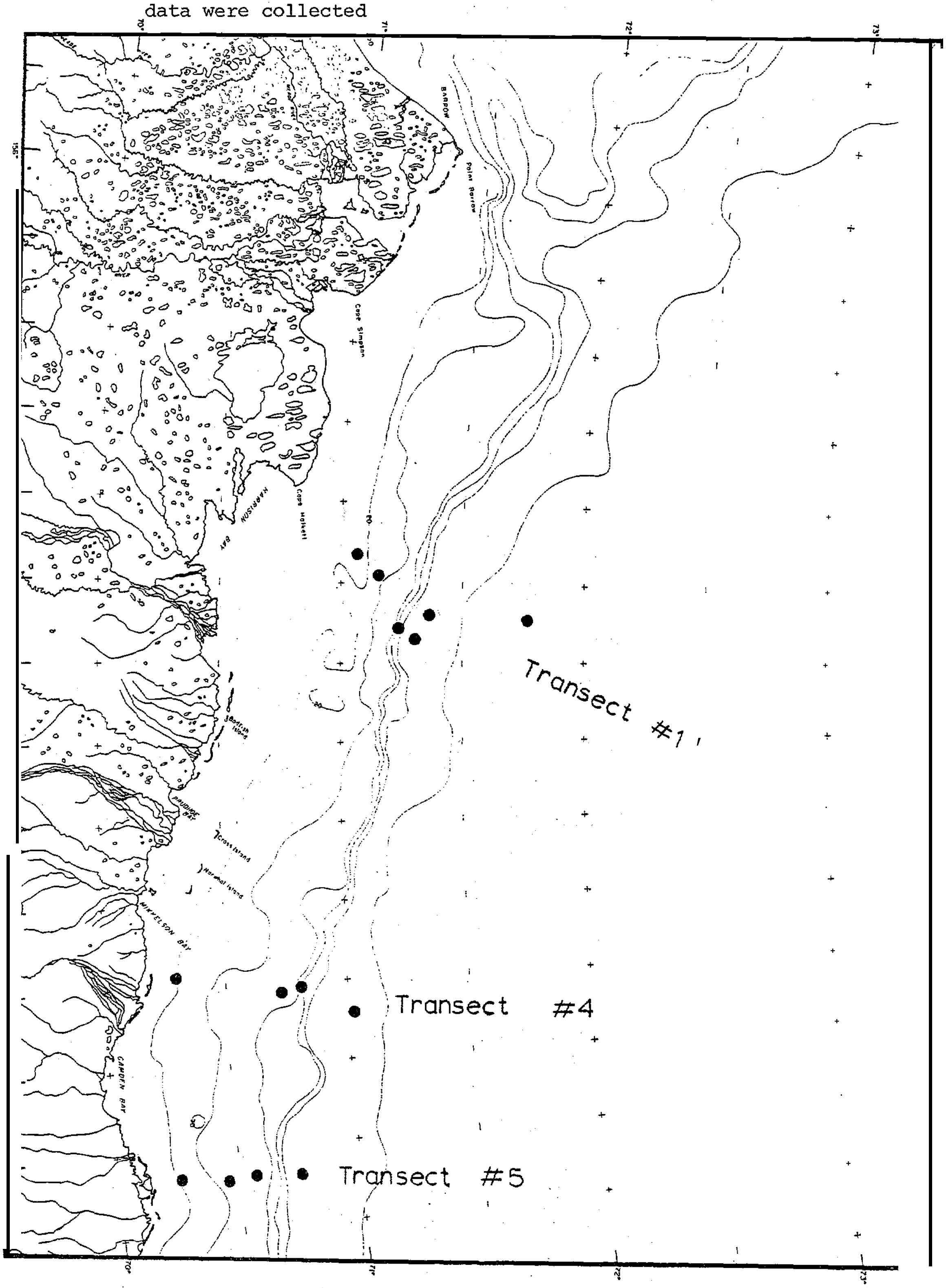
Terebellides stroemi Sars, 1835

Trichobranchus glacialis (Malmgren, 1866)

TROCHOCHAETIDAE

Trochochaeta carica (Birula, 1897)

Figure 4: Chart of station and transect locations at which polychaete data were collected



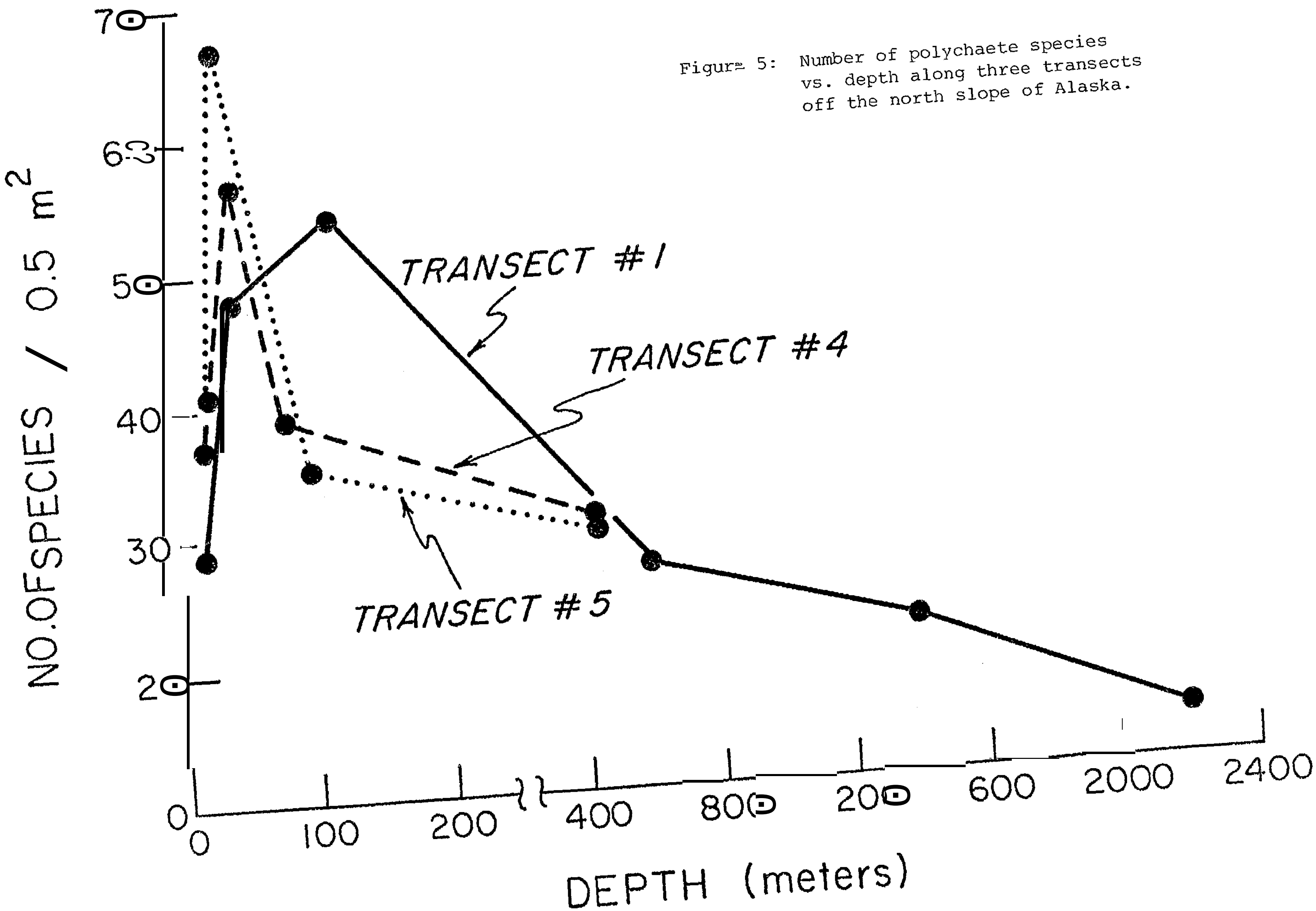


Figure 5: Number of polychaete species vs. depth along three transects off the north slope of Alaska.

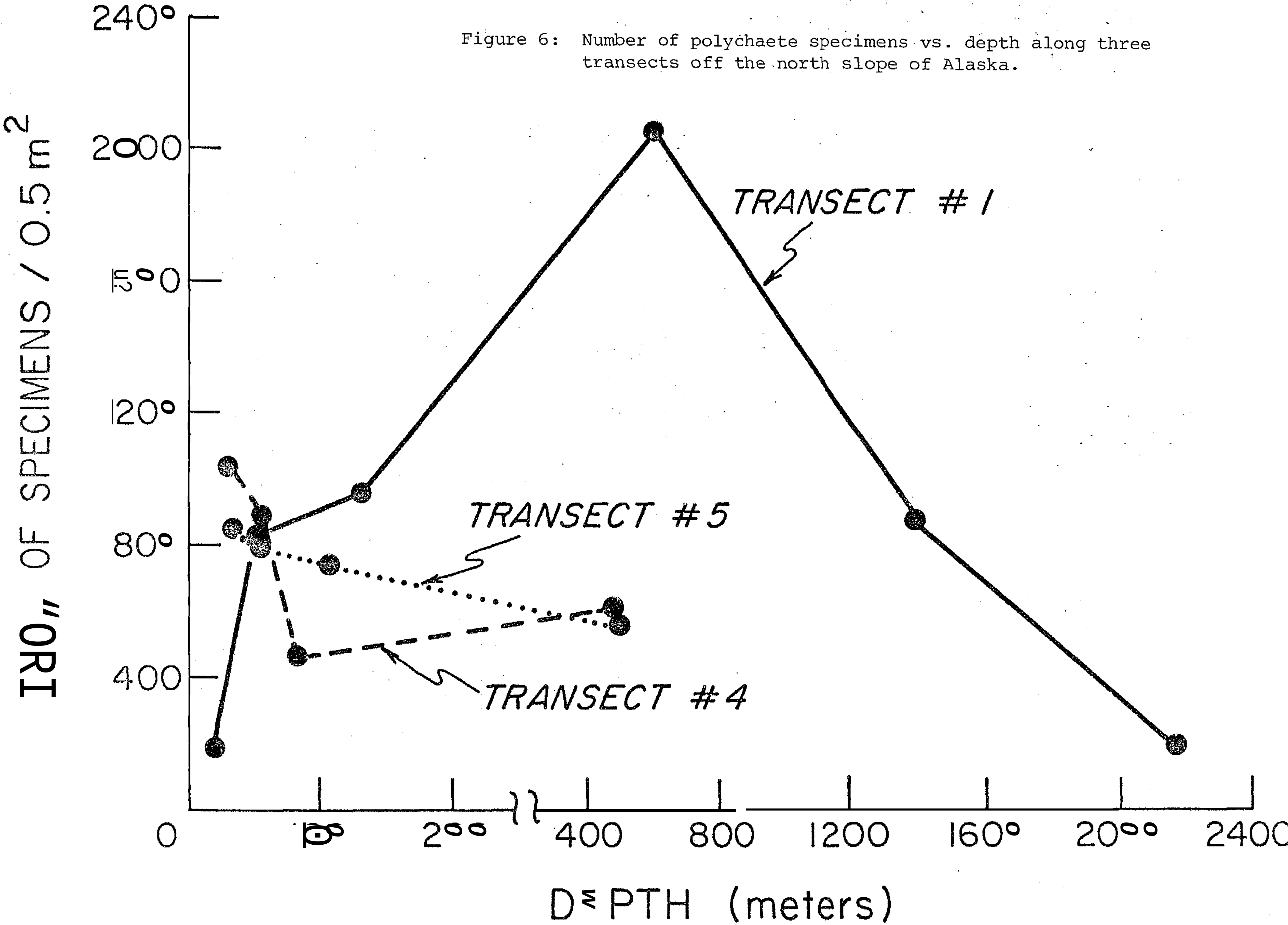


Figure 6: Number of polychaete specimens vs. depth along three transects off the north slope of Alaska.

VI. A. 2 (continued)

The decrease in total abundance of polychaetes in Transects 4 and 5 (Figure 6) with increasing depth may also be attributed to decreasing nutrient supply offshore. Transect 1, however, exhibits a large, distinct abundance peak at depths of 400 to 800 m. Moving inshore and offshore from this upper continental slope abundance peak, the numerical abundances of the polychaetous annelids fall to very low values. The suggestion that particulate matter entrained with Bering Sea water is falling out of the water column and enriching the benthic community in this depth zone (Carey and Ruff, 1977) is supported by these polychaete data.

Minuspio cirrifera, a surface deposit feeder, and Owenia fusiformis, a filter feeder (Jumars and Fauchald, 1977) dominate the high abundance zone in Transect 1 by contributing 64% of the individuals found in this benthic community. The cominance of these two feeding types suggests a steady influx of particulate entering the benthic layer from the overlying water column. Completion of Transects 2 and 3 should provide additional information by which the hypothesis of nutrient input from Bering Sea water may be evaluated.

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Jumars, P.A. and K. Fauchald. 1977. Between Community Contrasts in Successful Polychaete Feeding Strategies. In: Ecology of the Marine Benthos, B Coull, editor. University of South Carolina Press. pp. 1-20.

Kovacs, A. and M. Mellor. 1974. Sea Ice Morphology and Ice as a Geologic Agent in the Southern Beaufort Sea. In: The Coast and Shelf of the Beaufort Sea, J.C. Reed and J.E. Sater, editors. Arctic Institute of North America. pp. 113-161.

B. Gammarid Amphipoda

The gammarid amphipods from 125 Smith-McIntyre grabs collected seasonally along a transect across the Beaufort Sea Continental Shelf were identified to species. Over 100 species were found including representatives of 21 gammarid families (Table 4). The samples from five stations ranging between 25 and 100 meters were obtained during four separate cruises covering all seasons. The amphipod assemblages at each station were rather homogeneous in their species composition and relative abundance throughout the year. However, detailed analyses of reproductive activities and population size (age) structures need to redetermined at the stations across the continental shelf environments to ascertain the degree of seasonality.

There was clear evidence of depth zonation in the amphipod fauna across the shelf with three distinct assemblages being identifiable from inner-, mid-, and outer-shelf depths (Table 5; Figures 7-10).

Detailed listings of the gammarid species identified from each sample and their abundances can be found in the 1976-77 quarterly reports.

Table 4 : Gammarid Amphipoda collected in the Southwestern Beaufort Sea during the OCSEAP Benthic Ecology Program from 1975-1977.

Acanthonotozoma inflatum (Kroyer, 1842)
Acanthonotozoma serratum (Fabricius, 1780)
Acanthostepheia behringiensis (Lockington, 1877)
Acanthostepheia malmgreni Goes, 1866
Aceroides latipes G. Sars, 1892
Acidostoma laticorne G. Sars, 1879
Ampelisca birulai Bruggen, 1909
Ampelisca eschrichti Kroyer, 1842
Ampelisca latipes Stephensen, 1925
Ampelisca macrocephala macrocephala Liljeborg, 1852
Anonyx debruynii (Hock, 1882)
Anonyx nugax (Phipps, 1774)
Apherusa glacialis (Hansen, 1887)
Apherusa retovskii Gurjanova, 1934
Apherusa sarsi Shoemaker, 1930
Argissa hamatipes (Norman, 1869)
Aristias tumidus (Kroyer, 1846)
Arrhinopsis longicornis Stappers, 1911
Arrhis luthkei Gurjanova, 1936
Arrhis phyllonyx (M. Sars, 1858)
Atylus bruggeni (Gurjanova, 1938)
Atylus smitti (Goes, 1866)
Bathymedon obtusifrons (Hansen, 1887)
Boeckosimus affinis (Hansen, 1886)
Boeckosimus normani (G. Sars, 1895)
Boeckosimus plautus (Kroyer, 1845)
Byblis arcticus Just, 1970
Centromedon fumilus (Liljeborg, 1865)
Corophium acherusicum Costa, 1857
Corophium clarencense Shoemaker, 1949
Dulichia abyssi Stephensen, 1944
Dulichia bispina Gurjanova, 1930
Dulichia falcata (Bate, 1857)
Dulichia tuberculata Boeck, 1871
Epimeria loricata G. Sars, 1879
Ericthonius megalops (G. Sars, 1879)
Ericthonius tolli Bruggen, 1909
Eusirus cuspidatus Kroyer, 1845
Gammaracanthus loricatus (Sabine, 1821)
Gammaropsis melanops (G. Sars, 1882)
Gammarus locusts (Linnaeus, 1758)
Gammarus oceanicus Segerstrale, 1947
Gitana abyssicola G. Sars, 1892
Gitana rostrata Boeck, 1871
Goesia depressa (Goes, 1866)
Guernea nordenskjoldi (Hansen, 1887)
Halirages quadridentatus G. Sars, 1876
Haploops laevis Hock, 1882
Haploops setosa Boeck, 1871
Haploops sibirica Gurjanova, 1929

Table 4 (continued)

Haploops tubicola Liljeborg, 1855
Harpinia kobjakovae Bulycheva, 1936
Harpinia mucronata G. Sars. 1879
Harpinia pectinata G. Sars, 1981
Harpinia serrata G. Sars, 1879
Hippomedon abyssi (Goes, 1866)
Hippomedon denticulatus (Bate, 1857)
Hippomedon holbolli (Kroyer, 1846)
Hippomedon robustus Sars, 1894
Ischyrocerus chamissoi Gurjanova, 1951
Ischyrocerus commensalis Chevreux, 1900
Ischyrocerus latipes Kroyer, 1842
Ischyrocerus megacheir (Boeck, 1871)
Ischyrocerus megalops G. Sars, 1894
Lembos arcticus (Hansen, 1887)
Lepidepecreum eoum Gurjanova, 1938
Lepidepecreum umbo (Goes, 1866)
Liljeborgia fissicornis (M. Sars, 1858)
Maera danae (Stimpson, 1854)
Melita dentata (Kroyer, 1842)
Melita formosa Murdoch. 1866
Melita quadrispinosa Vosseler, 1889
Metopa robusta G. Sars, 1892
Metopa spinicoxa Shoemaker, 1955
Metopa tenuimana G. Sars, 1892
Metopella carinata (Hansen, 1887)
Metopella nasuta (Boeck, 1871)
Monoculodes borealis Boeck, 1871
Monoculodes carinatus (Bate, 1862)
Monoculodes diamesus Gurjanova, 1936
Monoculodes latimanus (Goes, 1866)
Monoculodes longirostris (Goes, 1866)
Monoculodes packardi Boeck, 1871
Monoculodes schneideri G. Sars, 1895
Monoculodes tesselatus Schneider, 1883
Monoculodes tuberculatus Boeck, 1871
Monoculopsis longicornis (Boeck, 1871)
Neohela monstrata (Boeck, 1861)
Neopleustes boecki (Hansen. 1887)
Neopleustes pulchellus (Kroyer, 1846)
Odius carinatus (Bate, 1862)
Odius kelleri Bruggen, 1907
Oediceros saginatus Kroyer, 1842
Onisimus litoralis (Kroyer, 1845)
Opisa eschricti (Kroyer, 1842)
Orchomene gronlandica (Hansen, 1887)
Orchomene minuta (Kroyer, 1846)
Orchomene serrata (Boeck, 1861)
Paradulichia typica Boeck, 1870
Paralibrotus setosus Stephensen, 1923
Parampithoe hystrix (Ross, 1835)

Table 4 (continued)

Parampithoe polyacantha (Murdoch, 1885)
Paraphoxus oculatus G. Sars, 1879
Parapleustes assimilis (G. Sars, 1882)
Parapleustes gracilis (Buchholz, 1874)
Pardalisca cuspidata Kroyer, 1842
Pardalisca tenuipes G. Sars, 1893
Pardaliscella lavrovi Gurjanova, 1934
Pardaliscella malygini Gurjanova, 1936
Paroediceros lynceus (M. Sars, 1858)
Paroediceros propinquus (Goes, 1866)
Paronesimus barentsi Stebbing, 1894
Perioculodes longimanus (Bate & Westwood, 1868)
Photis reinhardi Kroyer, 1842
Photis tenuicornis G. Sars, 1895
Photis vinogradova Gurjanova, 1953
Pleustes medius (Goes, 1866)
Pleustes panopla (Kroyer, 1838)
Pleusymtes karianus (Stappers, 1911)
Podoceropsis inaequistylis Shoemaker, 1930
Podoceropsis lindahli (Hansen, 1887)
Pontoporeia affinis (Lindstrom, 1855)
Pontoporeia femorata Kroyer, 1842
Priscellina armata (Boeck, 1861)
Protomedeia fasciata Kroyer, 1842
Protomedeia grandimana Bruggen, 1905
Rhachotropis aculeata (Lepechin, 1778)
Rhachotropis helleri (Boeck, 1871)
Rhachotropis inflata (G. Sars, 1882)
Rhachotropis oculata (Hansen, 1887)
Rozinante fragilis (Goes, 1866)
Socarnes bidenticulata (Bate, 1858)
Stegocephalus inflatus Kroyer, 1842
Stenopleustes eldingi Gurjanova, 1930
Stenopleustes malmgreni (Boeck, 1871)
Syrrhoe crenulata Goes, 1866
Tiron spiniferum (Stimpson, 1854)
Tmetonyx cicada (Fabricius, 1780)
Tryphosella gronlandica (Schellenberg, 1935)
Tryphosella pusilla (G. Sars, 1869)
Tryphosella rusanovi (Gurjanova, 1933)
Unciola leucopis Kroyer, 1845
Westwoodilla caecula (Bate, 1857)
Westwoodilla megalops G. Sars, 1882
Weyprechtia heuglini (Buchholz, 1874)
Weyprechtia pinguis (Kroyer, 1838)

Table 5 : Comparison of dominant amphipod species at PPB-25 and PPB-100.

	PPB-25	PPB-100
1.	Aceroides latipes	Unciola leucopis
2.	Gammarus sp. A	Tiron spiniferum
3.	Rozinante fragilis	Guernea nordenskioldi
4.	Ampelisca eschricti	Harpinia serrata
5.	Haploops tubicola	Photis vinogradova
6.		Podceropsis lindhaldi
7.		Photis rheinhardi
8.		Podoceropsis inaequistylis
9.		Hippomedon abyssi
10.		Protomedeia fasciata

Figure 7: The average distribution of two amphipod species on the Pitt Point Transect.

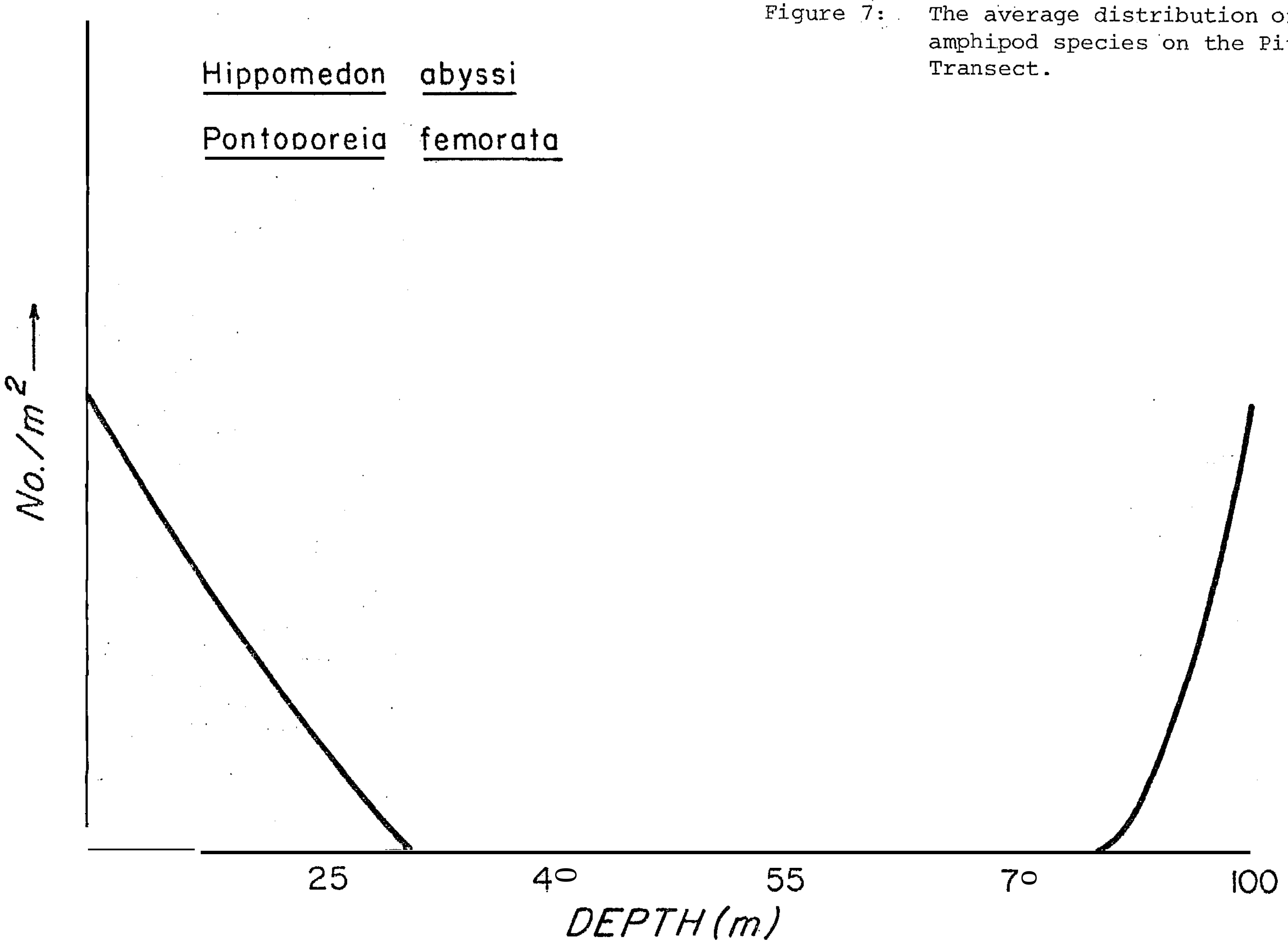


Figure 8: The average distribution of two amphipod species on the Pitt Point Transect.

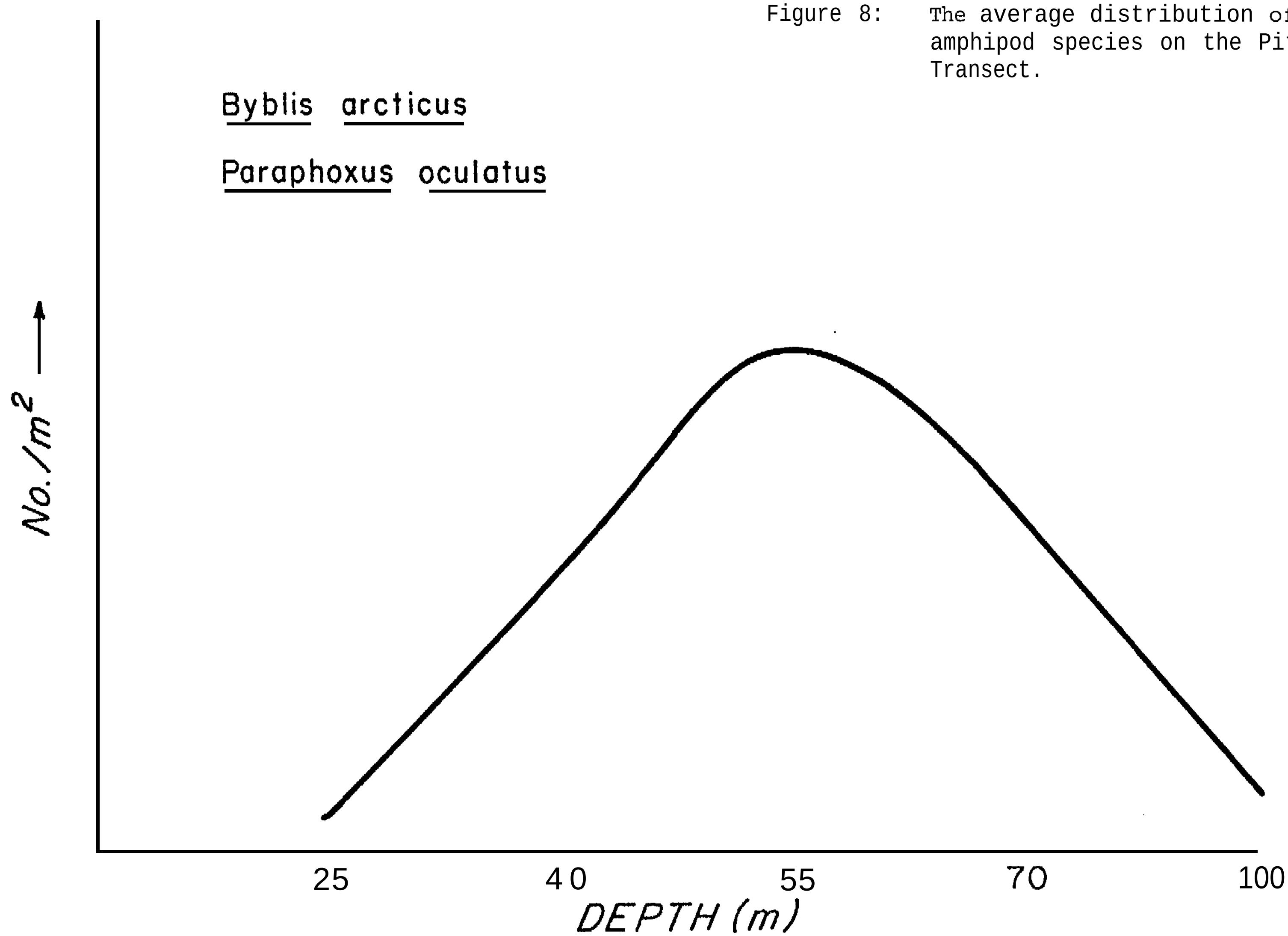


Figure 9: The "average distribution of three amphipod species on the Pitt Point Transect.

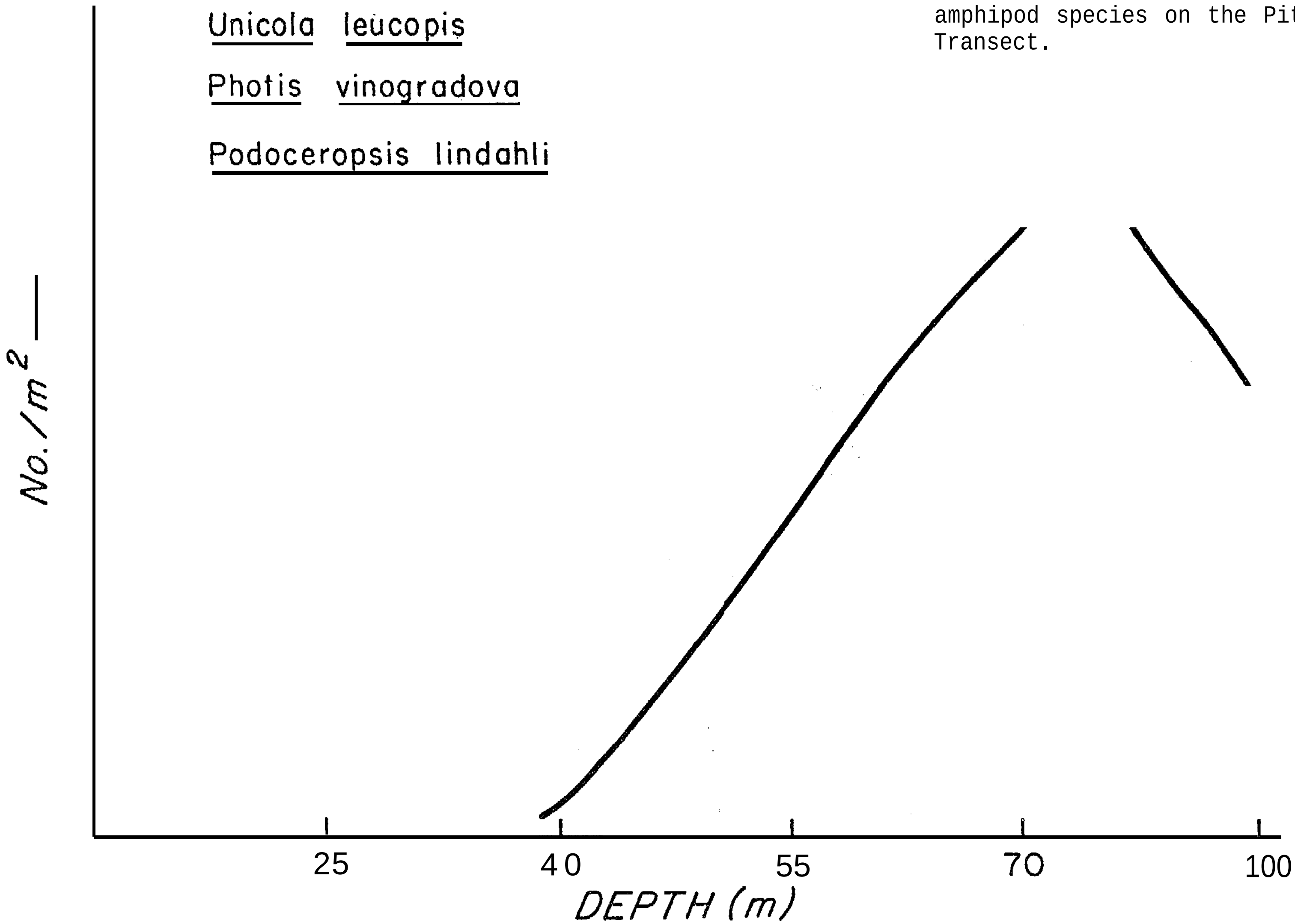
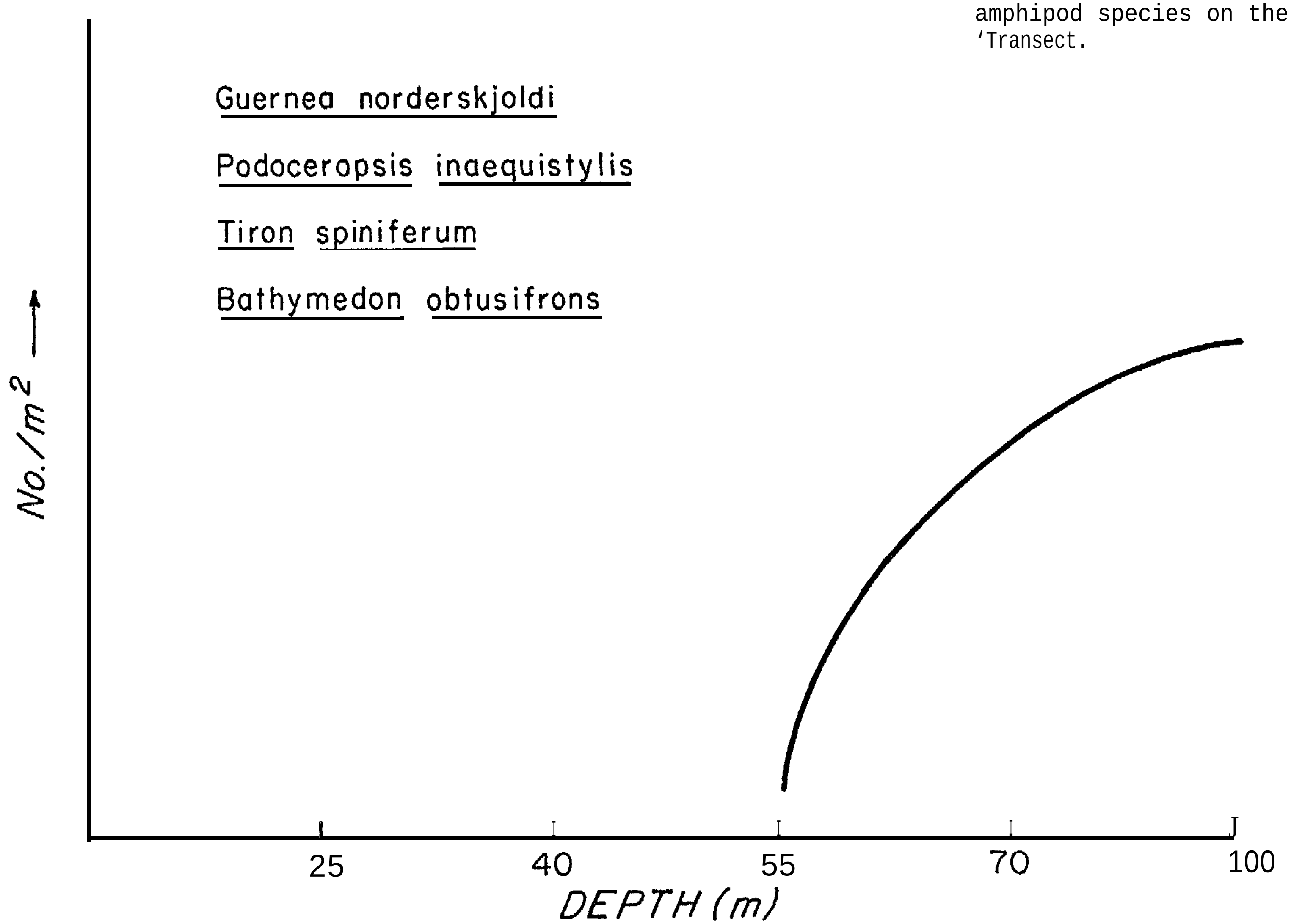


Figure 10: The average distribution of four amphipod species on the Pitt Point Transect.



VI. C. Coastal Fauna (5-25 meters depth)

The coastal large macrofauna (>1.0 mm) are generally more abundant inshore at 5 or 10 meters depth (Figures 11-15) . Polychaetes comprise 70-85% of the total infauna in this zone. Biomass, in contrast, does not peak with density indicating that these organisms are small in size on the average (Figures 16-20).

The minimum numerical abundance zone at 15-25 meters depth coincides with the sea ice shear zone between the landfast ice and the moving polar pack. However, detailed studies of the effects of ice gouging on the benthic community are necessary before causality is assigned to this physical phenomenon.

When a grab sample contains a high concentration of peat, it often has a large number of organisms associated with it. Perhaps the peat acts as a source of detritus and organic materials for the benthic food web.

The range and variability of the biomass of the large macro-infauna (>1.0 mm) across the continental shelf off Pitt Point are similar to the remainder of the southwestern Beaufort Sea observed from grab samples taken in 1971. The numerical density on the Pitt Point Transect has a much greater variability. Perhaps the observed seasonal cycles are the cause for this greater range.

Figure 11. Coastal Zone. The abundance of large benthic infauna (1.0mm +) on the Point Barrow Transect.

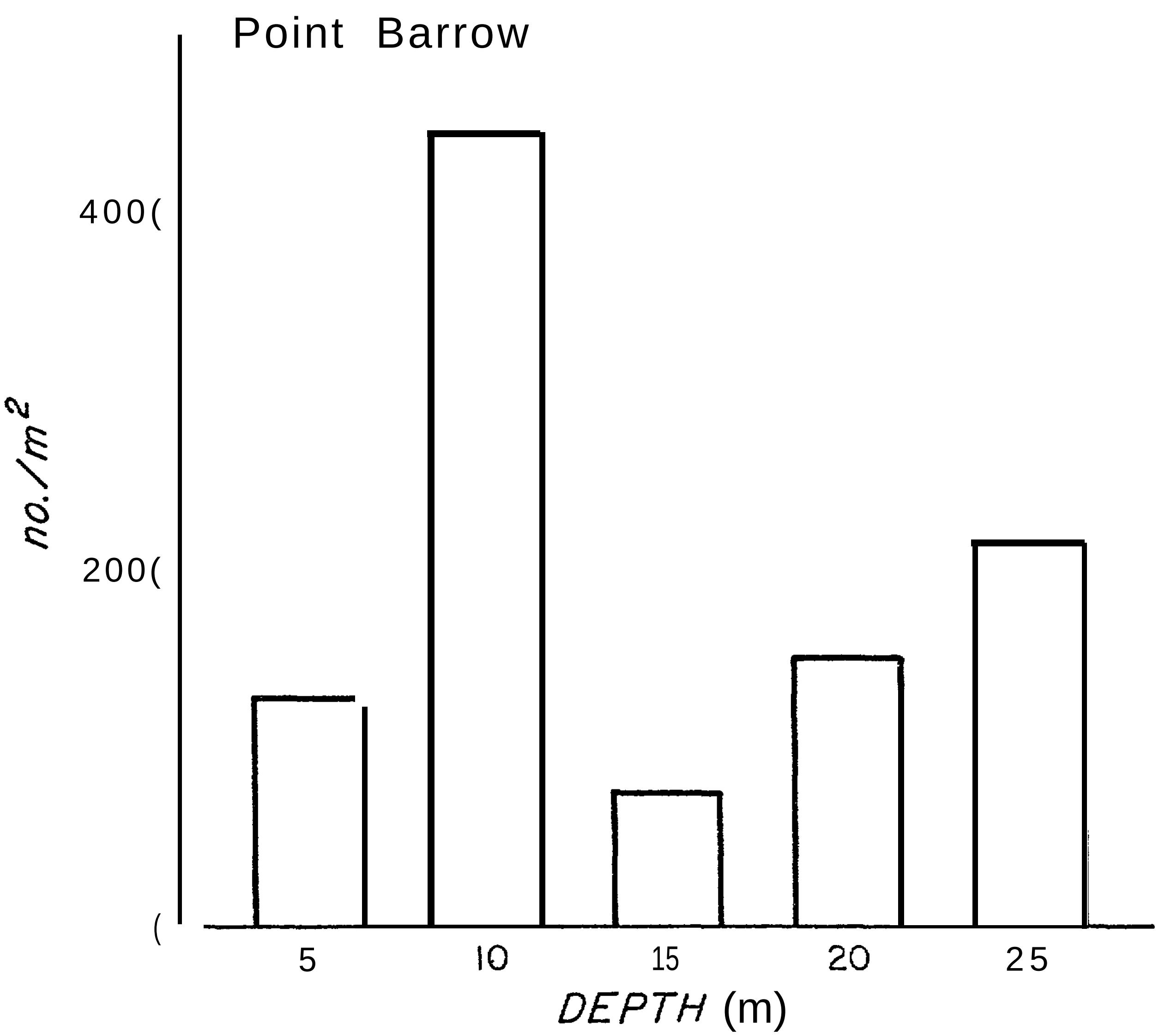


Figure 12. Coastal Zone. The abundance of large benthic infauna (1.0mm +) on the Pitt Point Transect.

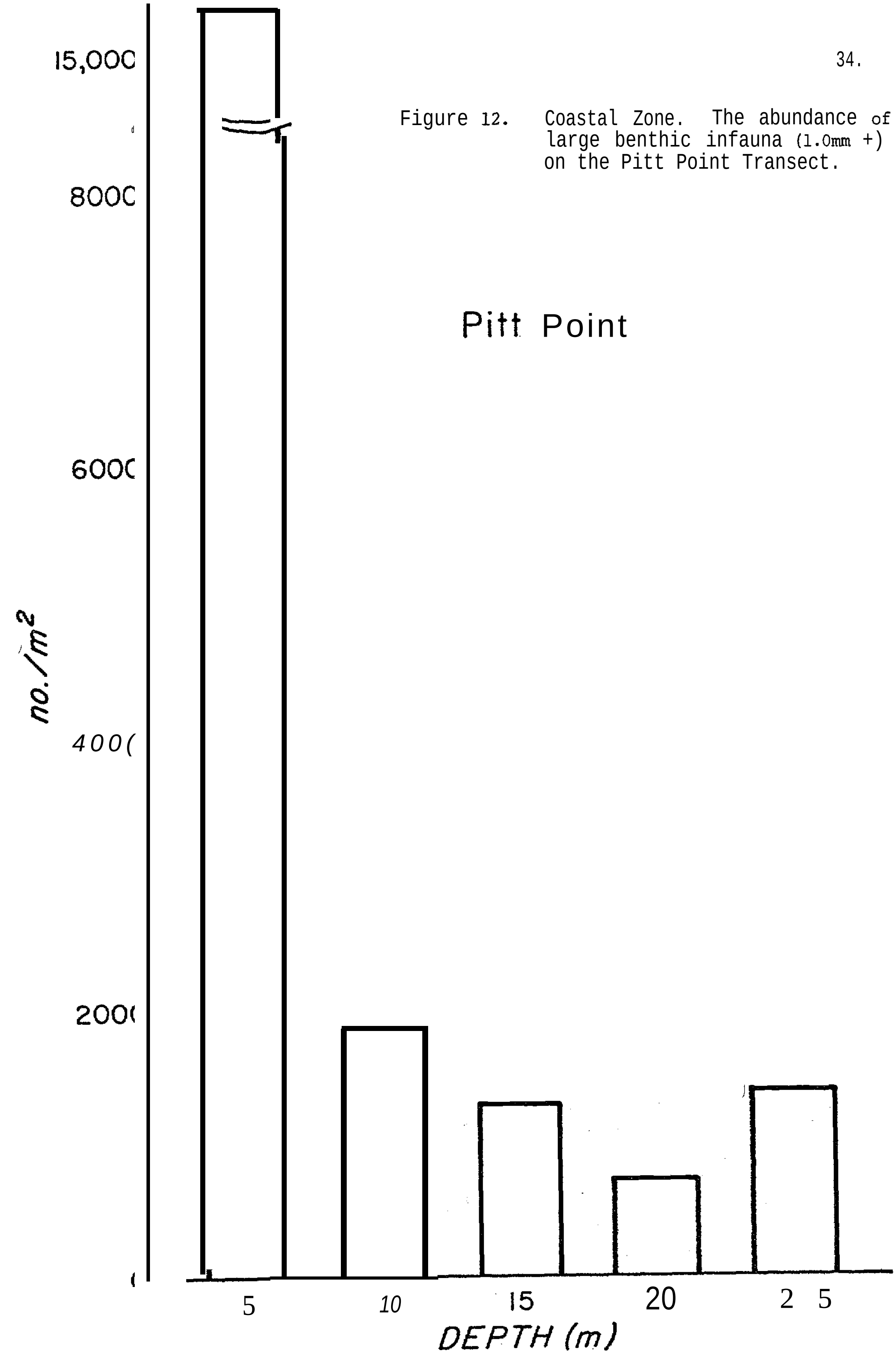


Figure 13. Coastal Zone. The abundance of large benthic infauna (1.0mm +) on the Pingok Island Transect.

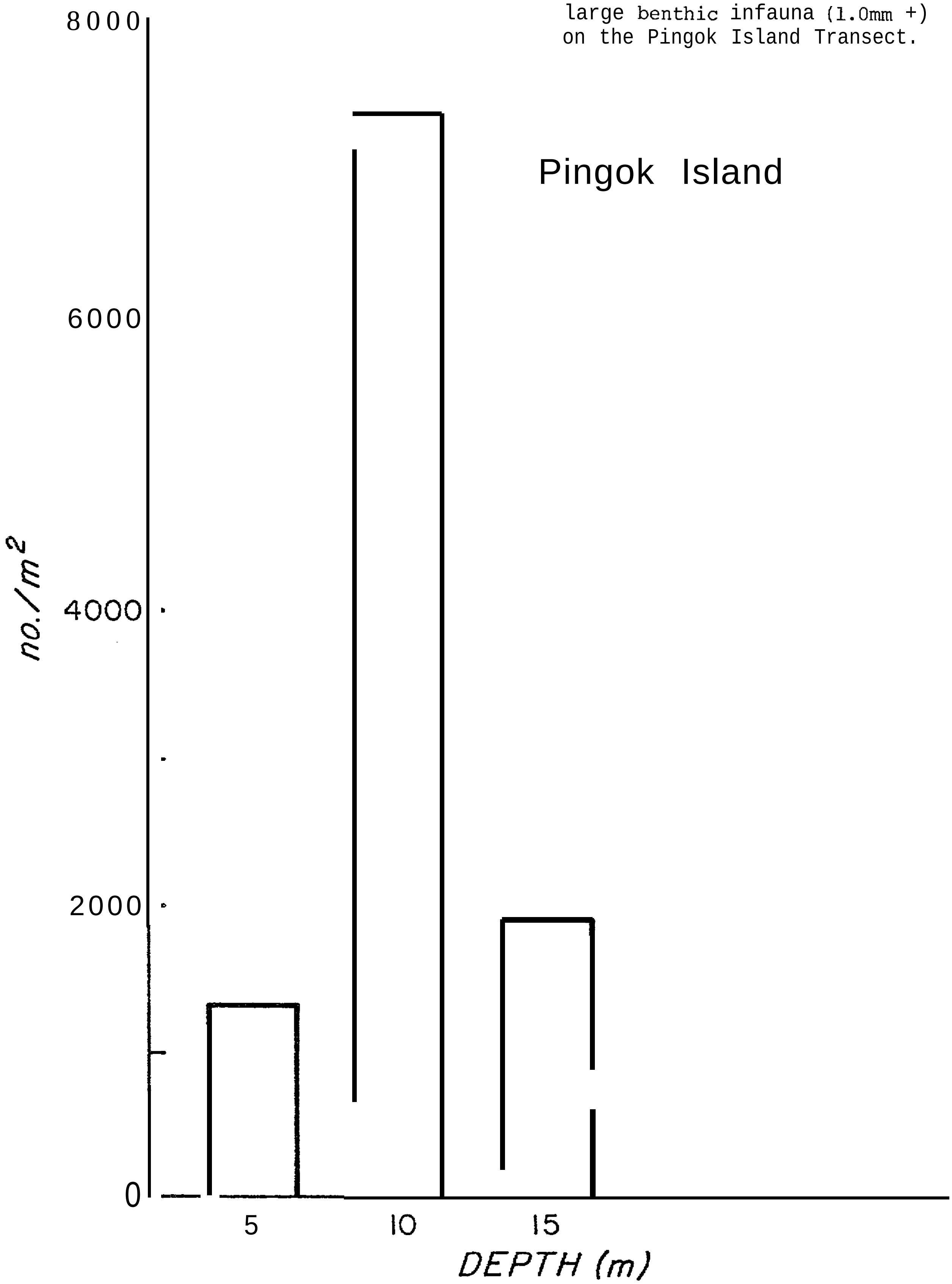


Figure 14. Coastal Zone. The abundance of large benthic infauna (1.0mm +) on the Narwhal Island Transect.

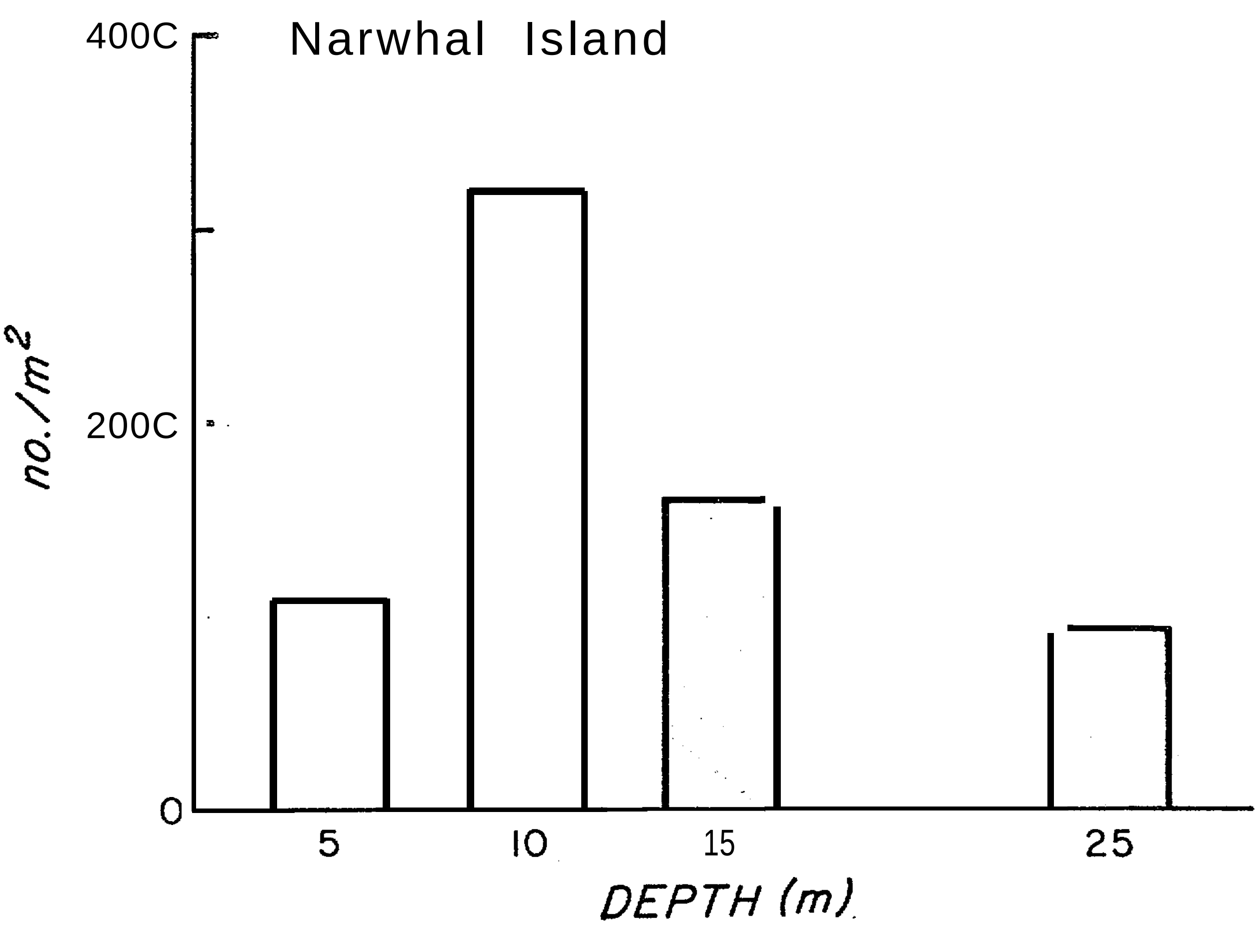


Figure 15. Coastal Zone. The abundance of large benthic infauna 1.0mm +) on the Barter Island Transect.

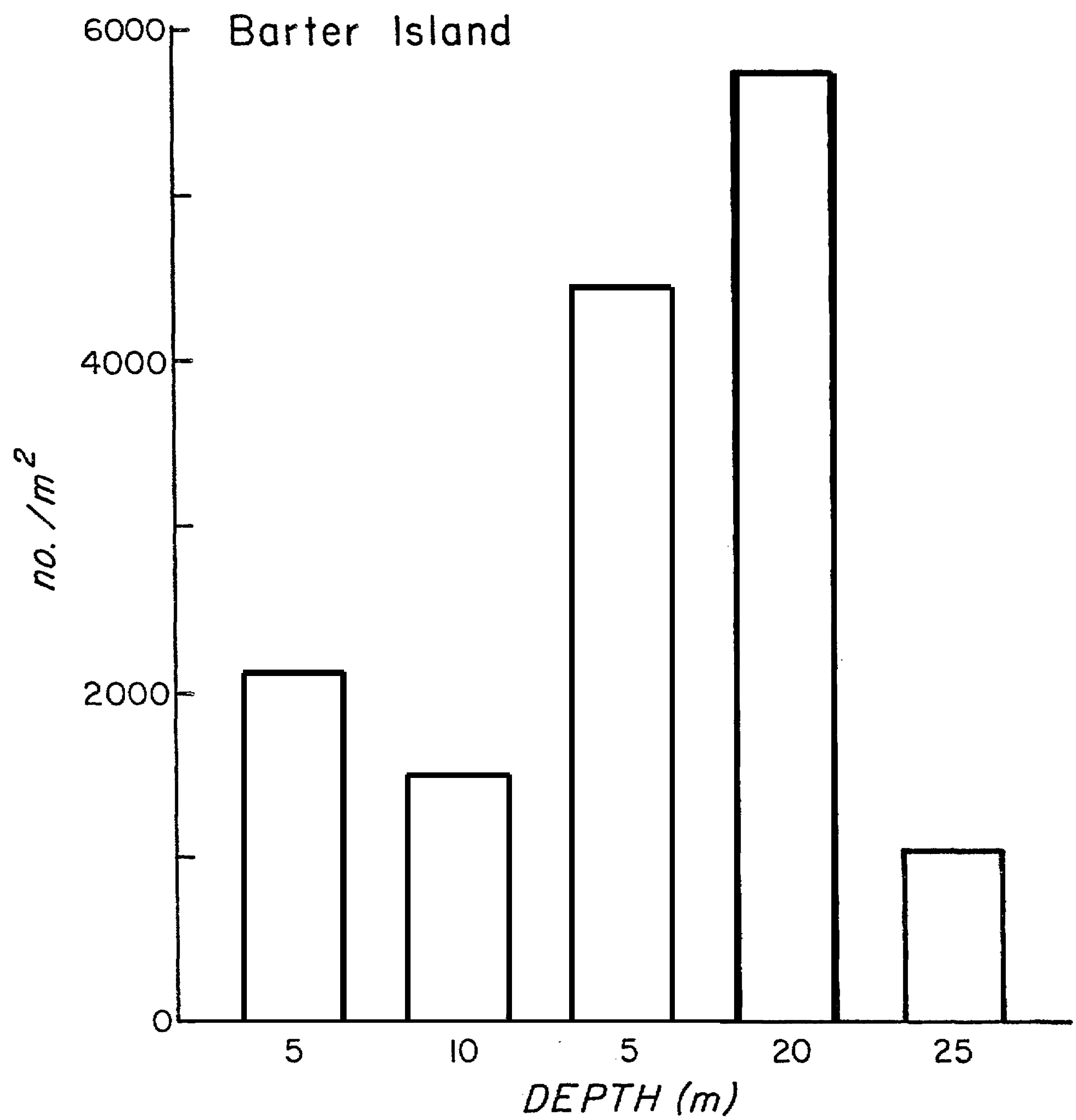


Figure 16: Coastal Zone. Biomass (grams preserved wet weight/m^2) of large soft-bodied benthic infauna (1.0mm +) on the Point Barrow Transect.

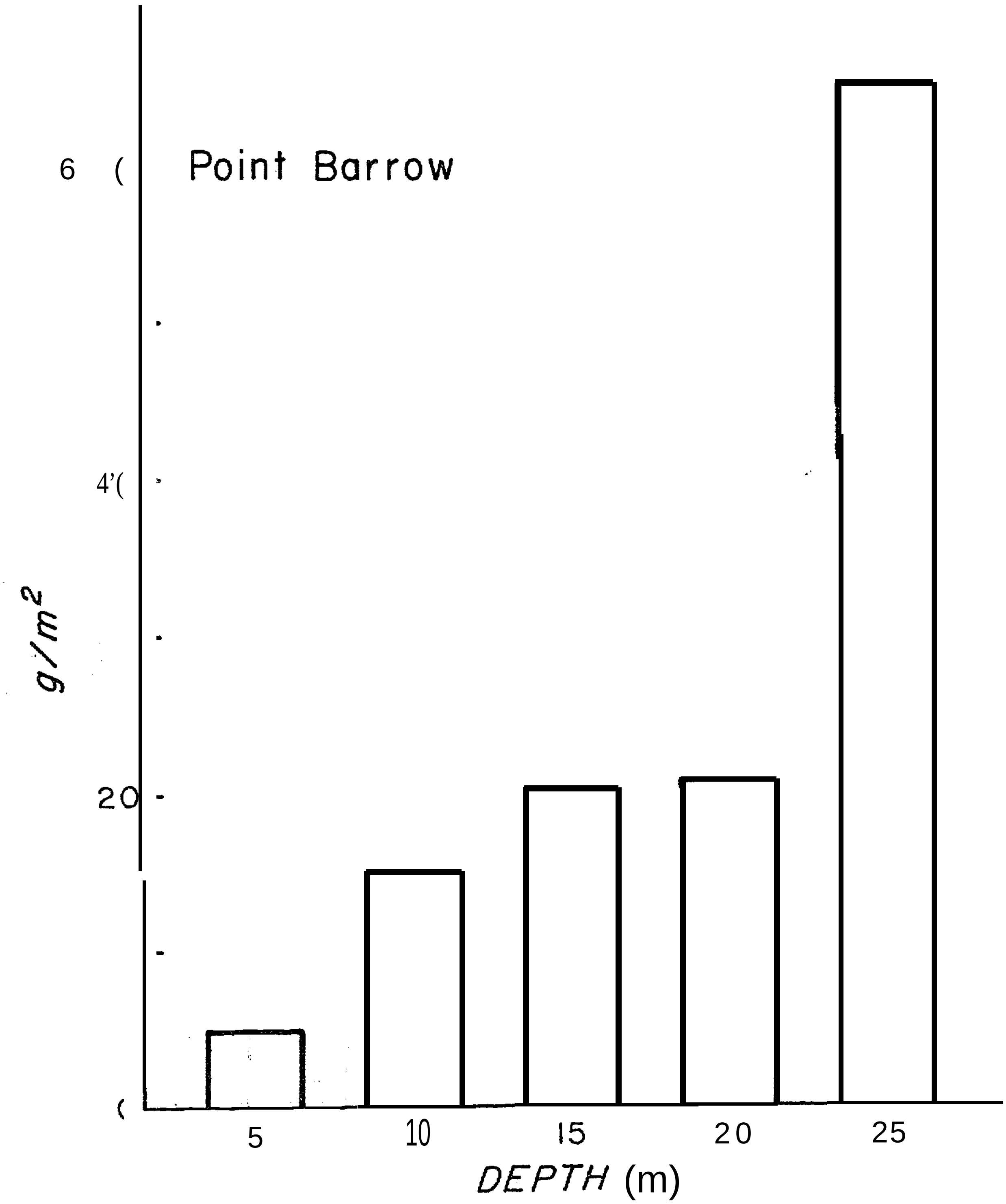


Figure 17. Coastal Zone. Biomass (grams preserved wet weight/m^2) of large soft-bodied benthic infauna (1.0mm +) on the Pitt Point Transect.

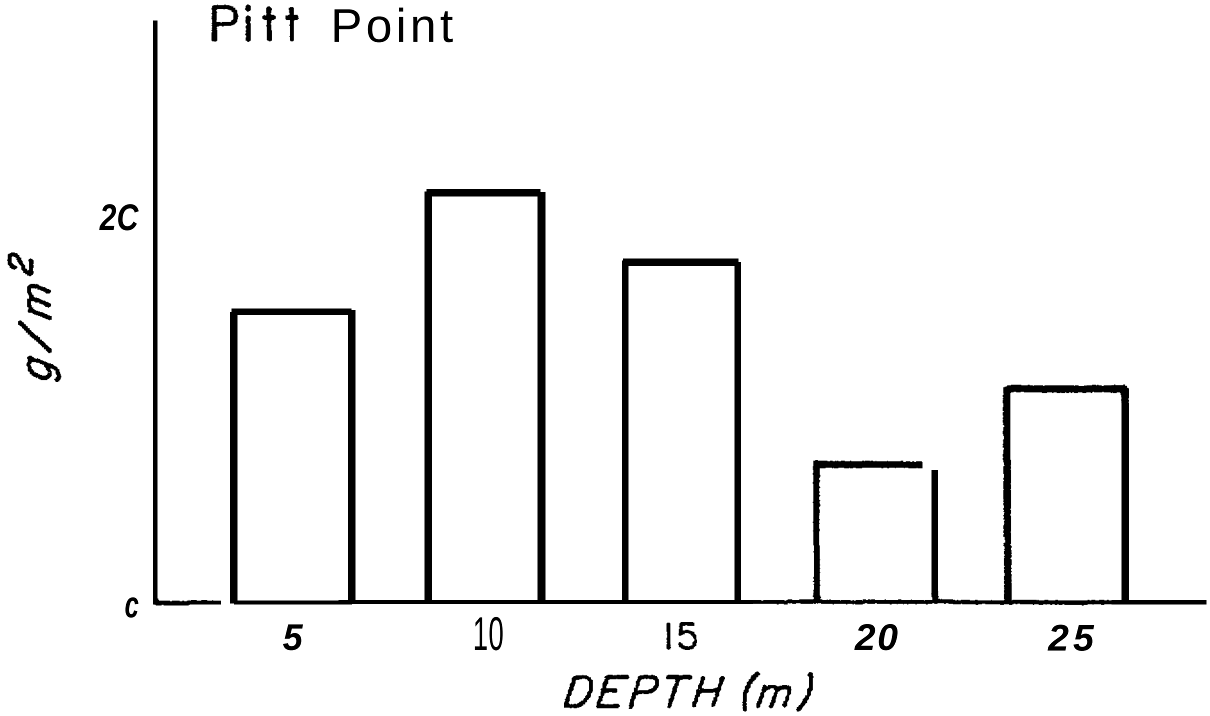


Figure 18. Coastal Zone. Biomass (grams preserved wet weight/m^2) of large soft-bodied benthic infauna (1.0mm +) on the Pingok Island Transect.

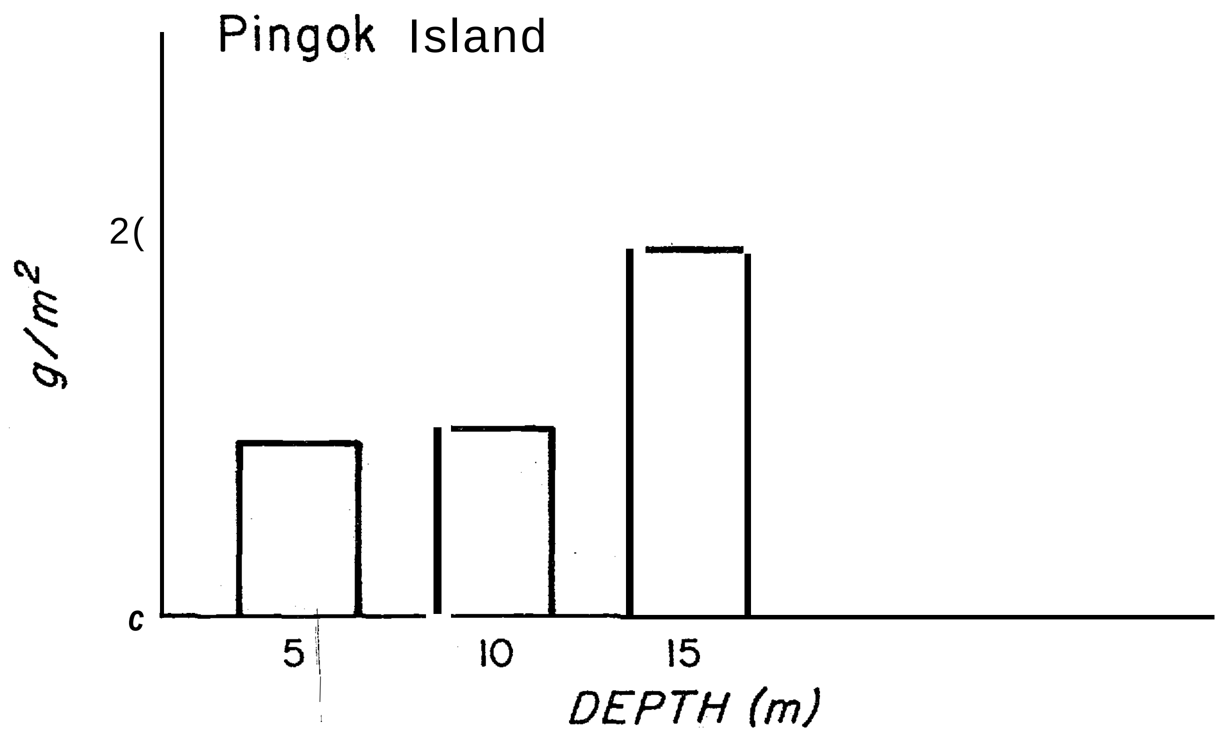


Figure 19. Coastal Zone. Biomass (grams preserved wet weight/m^2) of large soft-bodied benthic infauna (1.0mm +) on the Narwhal Island Transect.

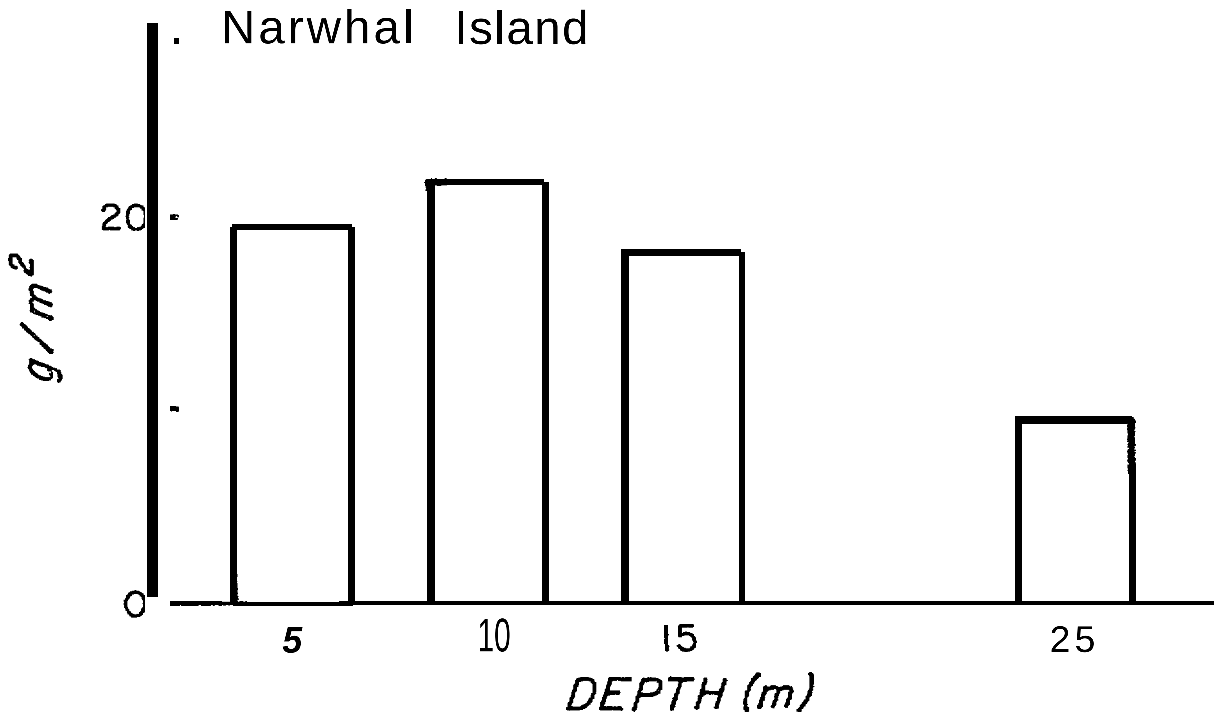
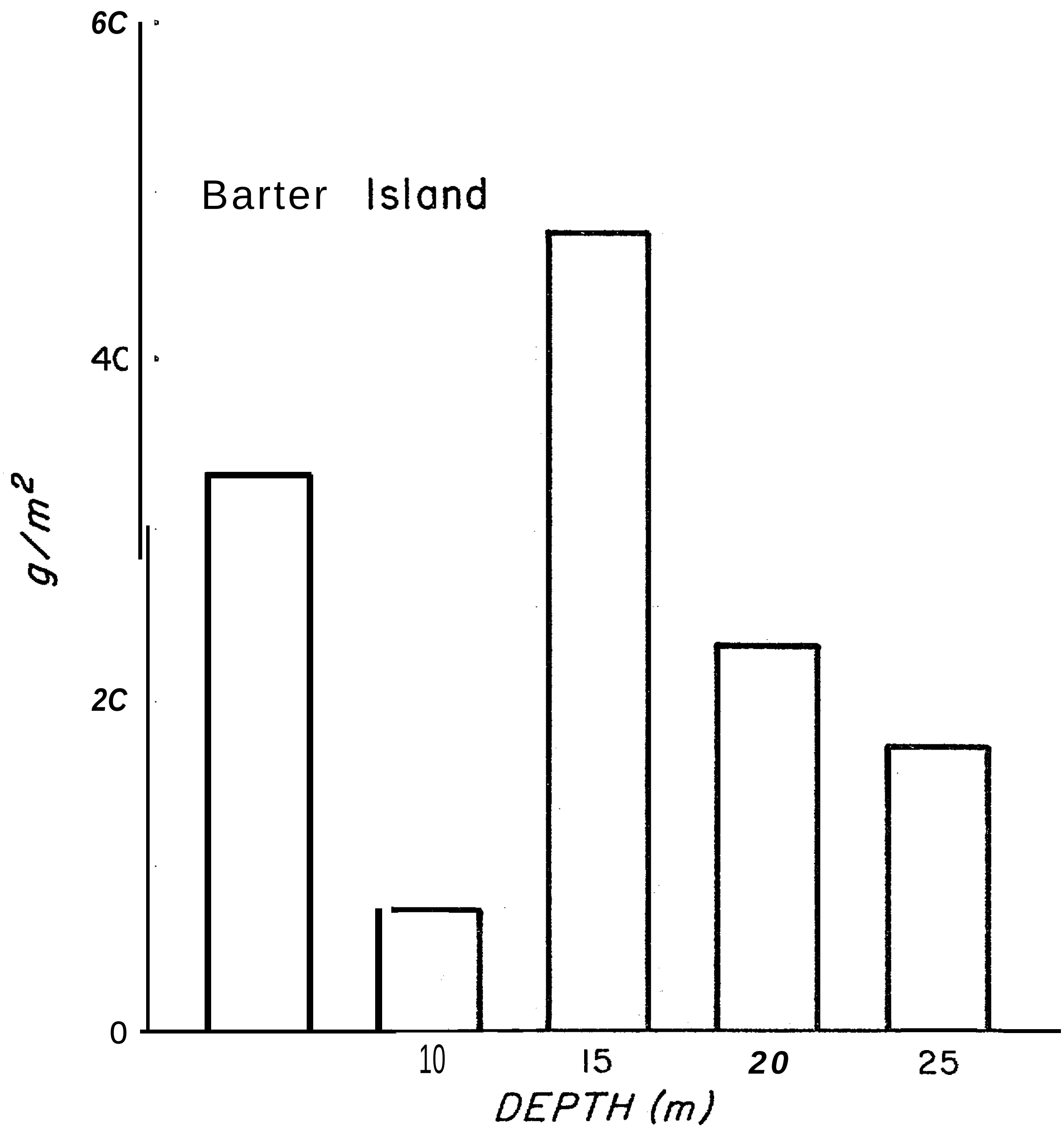


Figure 20. Coastal Zone. Biomass (grams preserved wet weight/m^2) of large soft-bodied benthic infauna (1.0mm +) on the Barter Island Transect.



VI. D. Shelf Fauna (5-100 meters depth)

By compiling stations taken during the two summer 1976 cruises (OCS-4 and OCS-5), two shore to shelf-break transects can be constructed (Figure 21). On the Pitt Point Transect, the trends in numerical density of the large macro-infauna indicate a maximum in abundance at the shallowest and the deepest depths (Figure 22). A bimodal pattern is also evident on the shorter transect off Narwhal Island near Prudhoe Bay (Figure 23). These two transects accentuate a minimum numerical density occurring at intermediate depths around 15-20 meters.

It is evident that several processes are probably in operation across the shelf. The nearshore zone often has concentrations of peat-like detritus. The minimum lies within the sea ice shear zone, the most active area of ice pressure ridging and bottom gouging. Ice encroachment on barrier islands may also depress the abundance of the nearshore fauna. The Narwhal Island data may be a result of this scour, as the pack ice generally rides up over the shoreline of the island.

E. Bathyal Fauna

Eleven deep-sea stations were occupied during the 1977 summer cruise (OCS-7) on board the USCGC GLACIER (Figure 1).

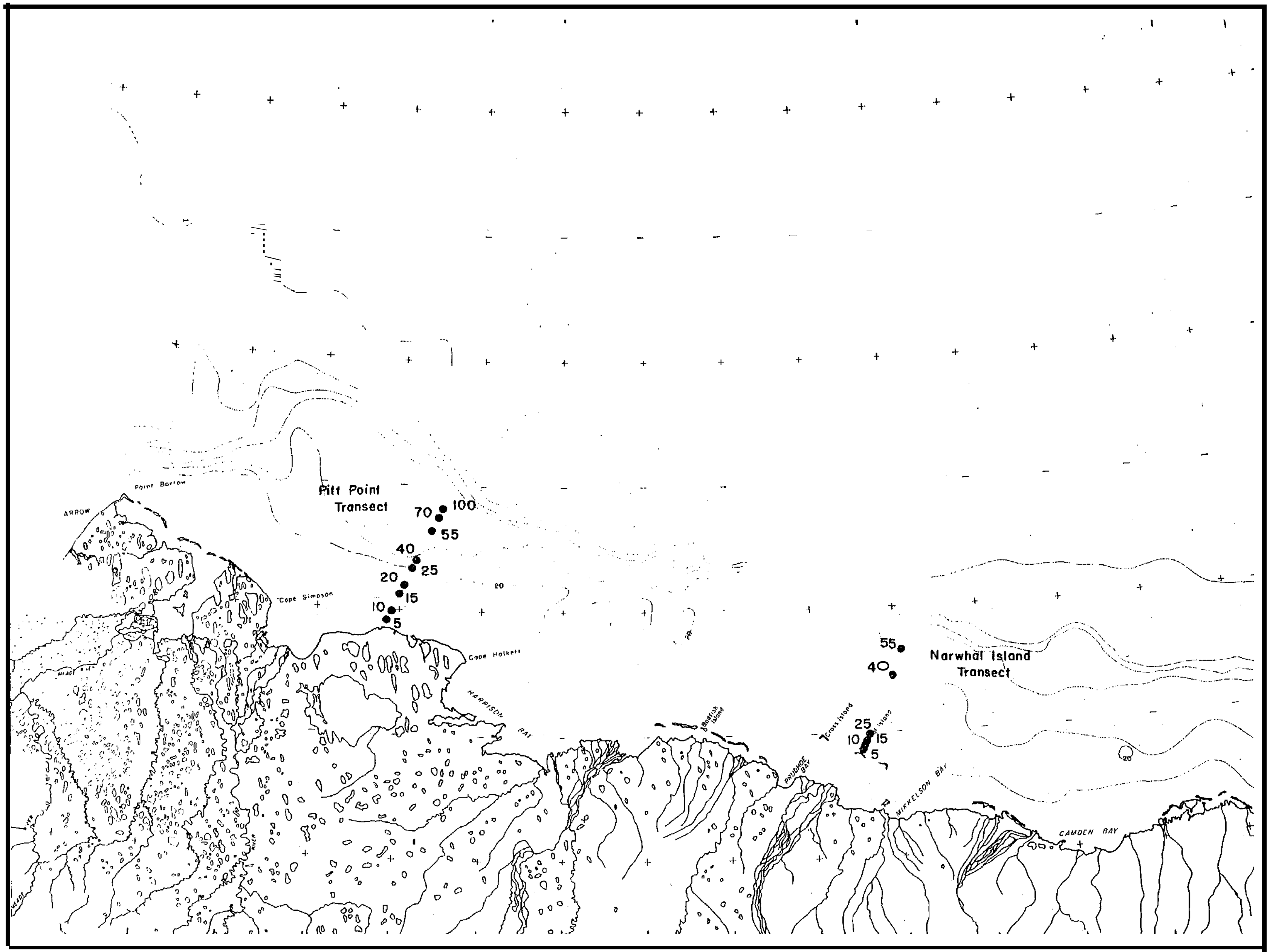
The numerical density of the benthic infauna (0.5mm +) decreases markedly with depth from $2400/m^2$ at 650 meters to $120/m^2$ at the four deepest stations (3300-3800 meters). There is a general trend toward a decrease in the size of the organisms with depth (Figure 24).

Over the depth range sampled the biomass of the larger infauna (1.0mm +) spans three orders of magnitude. The standing stocks decrease markedly with depth from 10 g (wet preserved weight)/m^2 at stations shallower than 1000 meters, to 1-5 g/m^2 between 1000-3000 meters depth, to 0.1-0.7 g/m^2 at depths greater than 3000 meters (Figure 25).

F. Temporal variability of benthic infauna across the continental shelf on the Pitt Point Transect (Extracted from unpublished manuscript: Carey, Ruff, and Montagna. Submitted to SCIENCE).

Large standing stocks of macro-infauna, equivalent to those of many temperate environments, have been found across much of the Beaufort Sea continental shelf off the Alaskan north coast (1). It has been generally assumed that this arctic environment, in contrast to analagous regions in the shallow Chukchi Sea to the west and in the Antarctic, supports a very low energy ecosystem. Low standing stocks and production rates have been recorded previously in the Beaufort Sea for both phytoplankton and zooplankton (2). The large populations of benthic invertebrates encountered on the shelf were, therefore, expected by us to exhibit low biological activity and to be in energetic equilibrium with the low inputs of nutritive material (l). It was anticipated that the biomass and total numerical abundance of the benthic community would not vary significantly throughout the year.

Figure 21. Sample locations occupied during the summer of 1976. The station designation is indicative of the water depth. Stations at 25 meters or deeper were occupied by the USCGC GLACIER (OCS-4), while those between 5-20 meters were occupied by the R/V ALUMIAK (OCS-5).



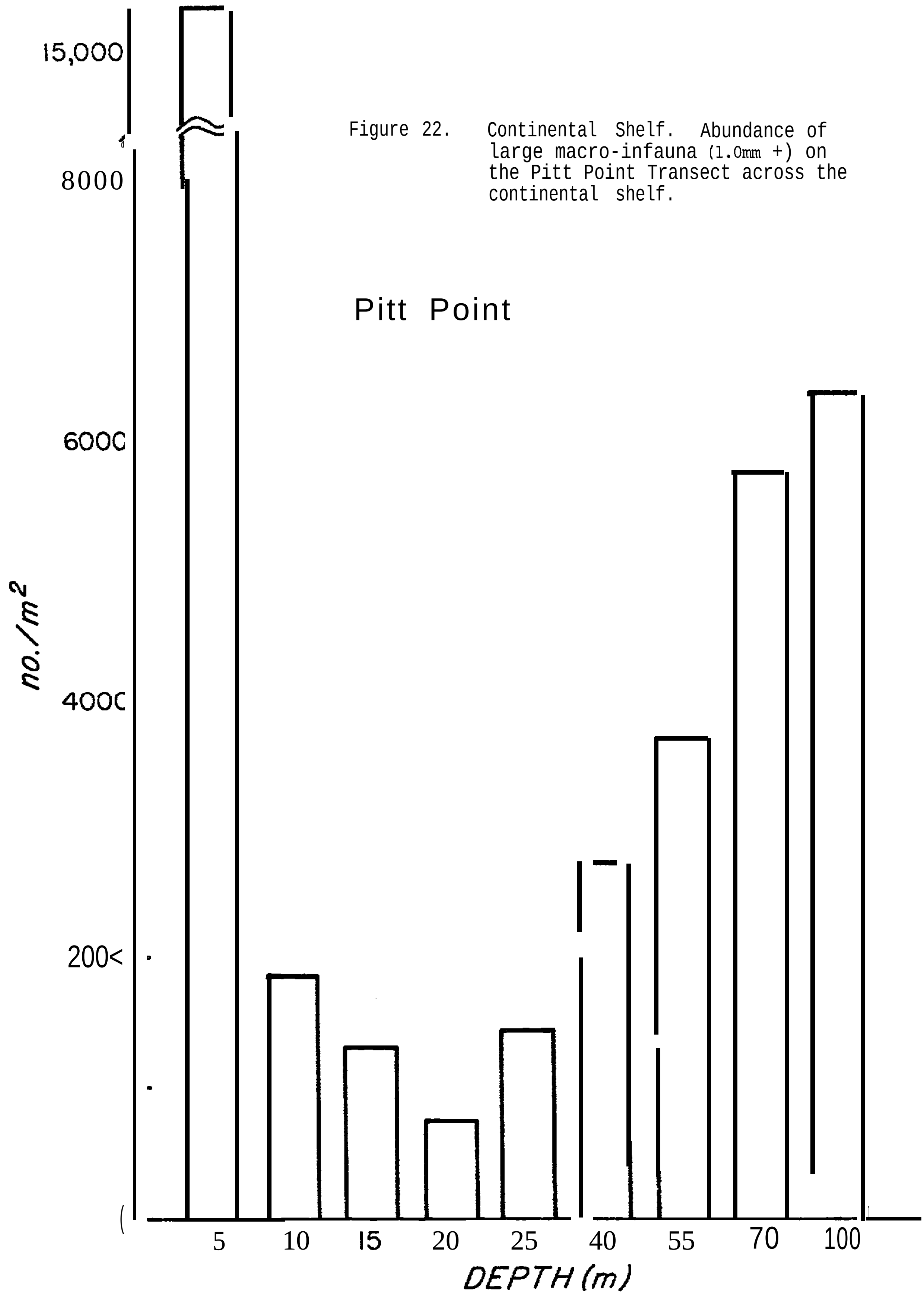


Figure 22. Continental Shelf. Abundance of large macro-infauna (1.0mm +) on the Pitt Point Transect across the continental shelf.

Figure 23'. Continental Shelf. Abundance of large macro-infauna (].0mm +) on the Narwhal Isalnd Transect across the inner half of the continental shelf.

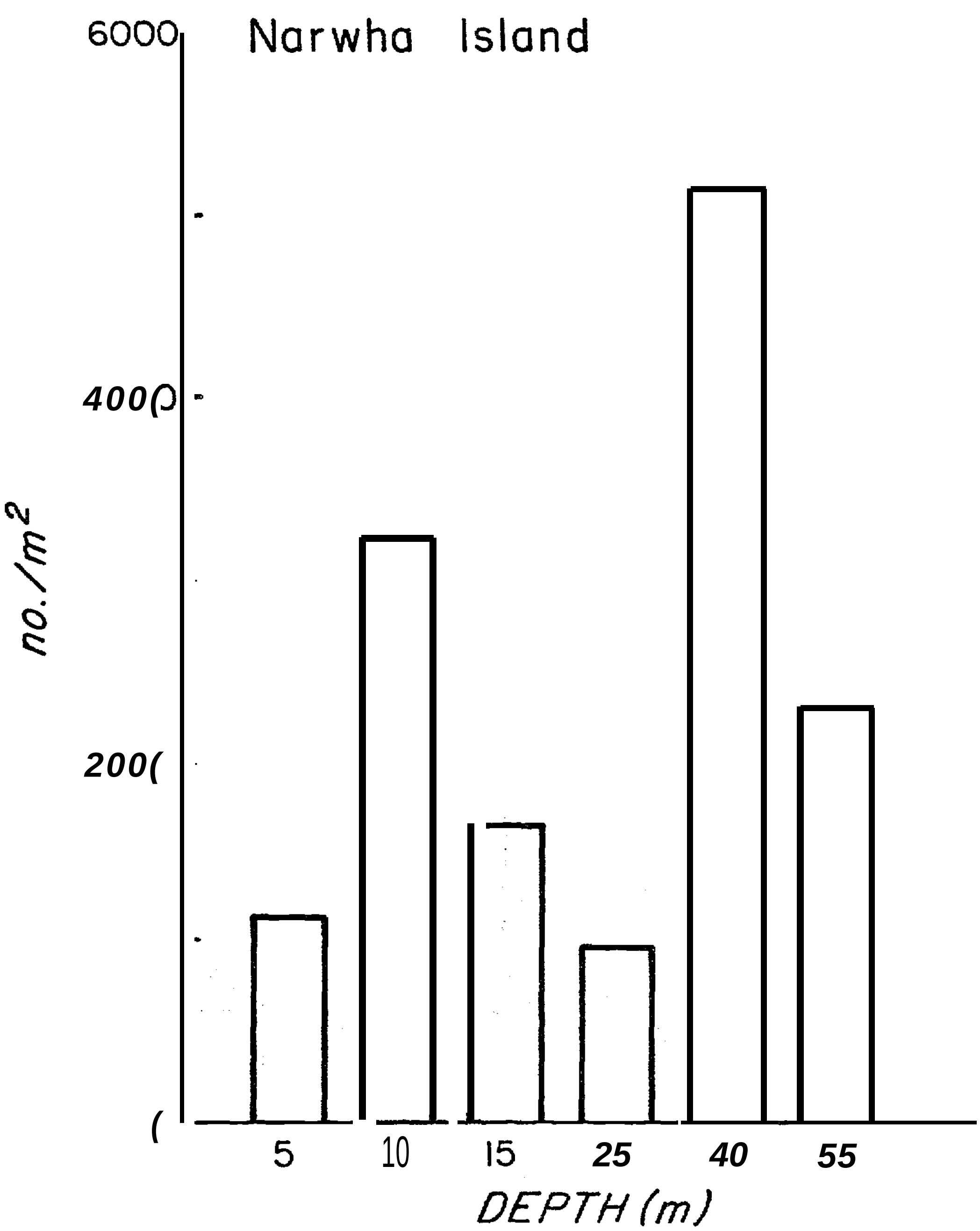


Figure 24. Bathyal. Abundance of the macro-infauna on the Demarcation Point Transect down the continental slope. Note the importance of the small macrofauna (0.5-1.0mm) .

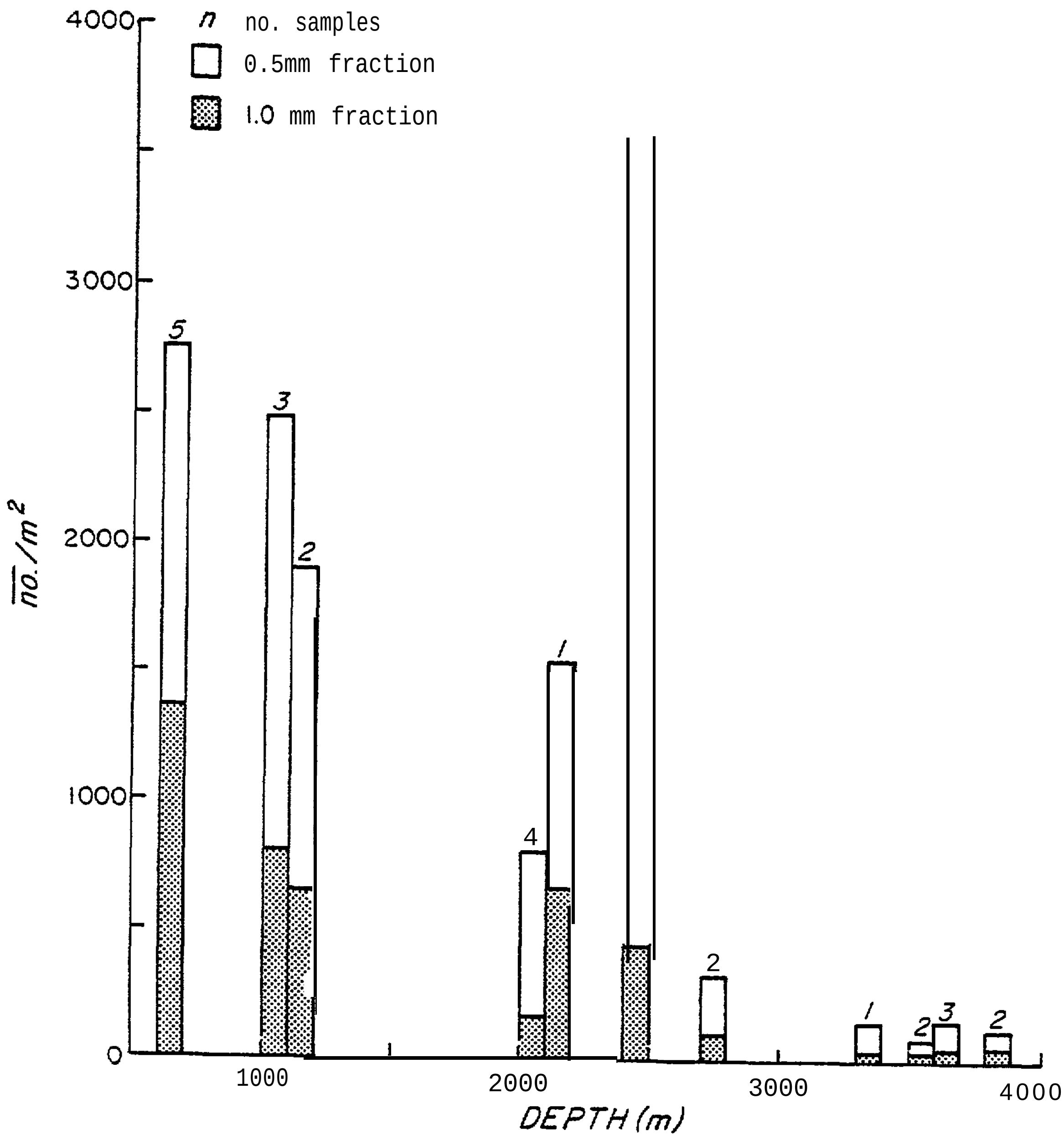
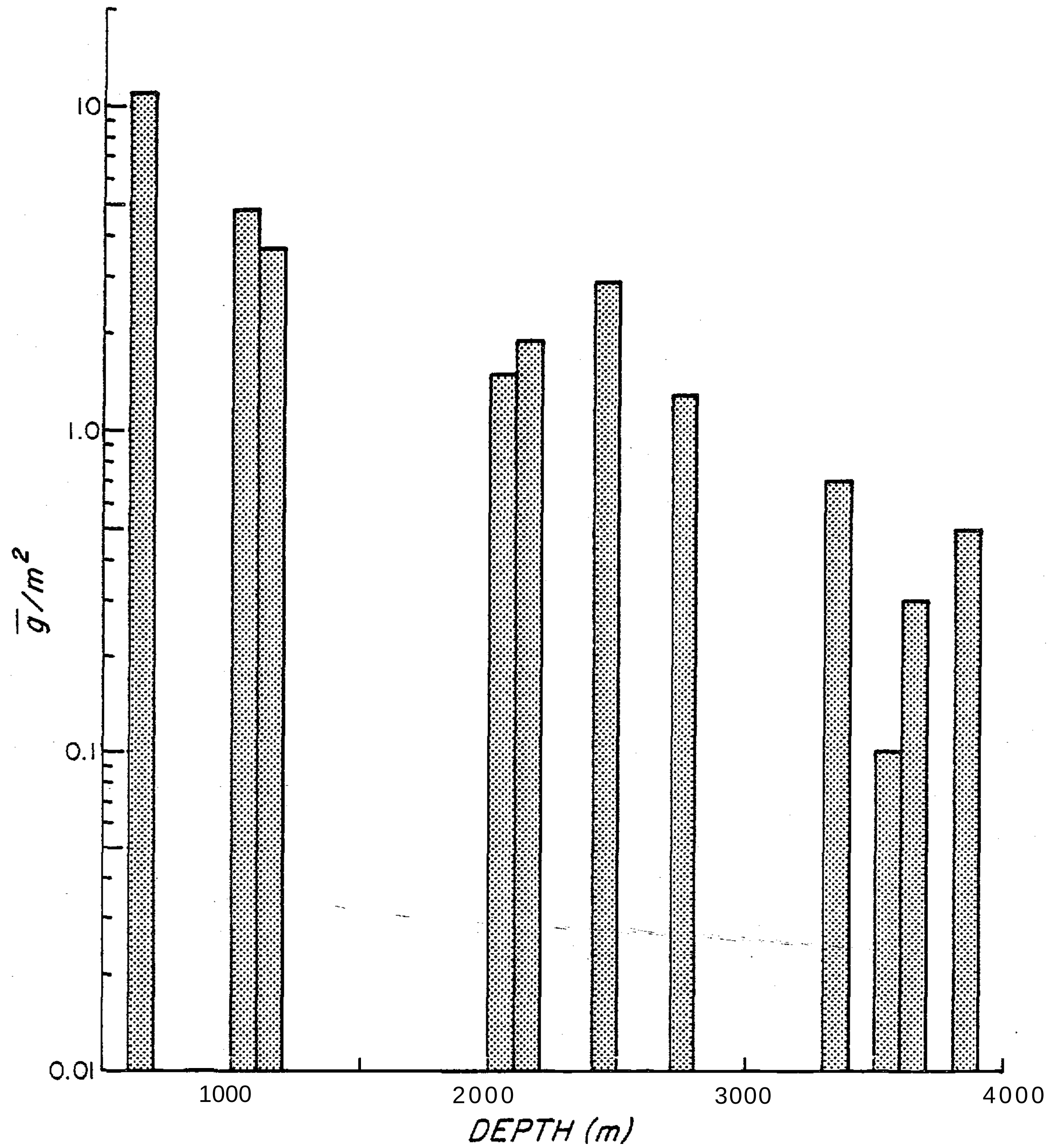


Figure 25. Bathyal. Biomass of the large macro-infauna (1.0mm +) on the Demarcation Point Transect down the continental slope.



VI. F. (continued)

Findings from samples taken seasonally across the Beaufort Sea continental shelf in 1975-76 strongly contradict these expectations. Changes in both the total numerical density and the soft-bodied infaunal biomass within the benthic population at stations on the middle and outer shelf were encountered. The magnitude and periodicity of fluctuations in numerical abundance are indicative of an annual reproductive cycle with a large peak in recruitment, and the temporal variability in biomass suggests possible seasonality. Similar changes are not found at the shallowest shelf station, indicating that different processes are operating there. The seasonal changes exhibited by the Beaufort Sea benthic community have compelled us to re-evaluate our concept of the productivity of this Arctic ecosystem.

At Stations PPB-55, PPB-70, and PPB-100 on the outer portion of the continental shelf the benthic assemblages showed marked variations in numerical density (Figure 26 and Table 5). Though these are not synchronous trends at all three depths, they appear to be periodic and are indicative of annual reproductive cycles. The average trends for these stations demonstrate an increase in animal numbers through the spring with a maximum of $8,500/m^2$ reached in May and a subsequent decline occurring through the summer and fall. Presumably the spring increase in density is caused by recruitment to the (>1.0 mm) benthic community beginning early in the season. During the picking/sorting phase in the laboratory, we observed a much greater proportion of small individuals in the May samples than at any other time of the year. The summer-fall decrease in numerical abundances implies high mortality rates, caused perhaps by predation and/or competition.

Temporal changes in biomass were not as marked as those in numerical abundance, but the trends were strongly suggestive of seasonality (Table 5 and Figure 27). The biomass maximum appeared in August, not in May when peak densities occurred. This increase could be caused by growth of individuals after their recruitment to the benthic populations in the spring. The high growth rates that would have to exist to cause this seasonal increase are in contrast to the slow growth rates reported for Antarctic invertebrates (5).

Average trends in gross structure suggest that the benthic communities on the outer continental shelf of the Beaufort Sea are dynamic and undergo distinct seasonal cycles. Numerical density and biomass return to similar levels from one year to the next. Previous ideas concerning the benthos and their role in the ecosystem should now be questioned and further hypotheses suggested. From our data and observations we conclude that temporal cycles on the scale of seasons exist for infaunal numerical density.

In contrast to the outer shelf, the total yearly range in infaunal abundance at the shallowest station PPB-25 varies within narrow limits (Table 5). The amplitude of range for both indices is low, variances are high, and no seasonal trends are evident. The numerical densities of macro-infauna at the 40=meter station are similar to those at PPB-25, but because of the lack of fall samples from either year, it is difficult to determine whether these changes in gross structure are random or cyclic at this depth.

Figure 26. Numerical density of macro-infauna (1.0mm +) at standard stations at 5 sampling periods. Station PPB-40 is considered transitional and consists of 3 data points; it has been omitted for clarity. Each point represents an average of 5 samples. The solid line is the mean trend for the 3 outer stations.

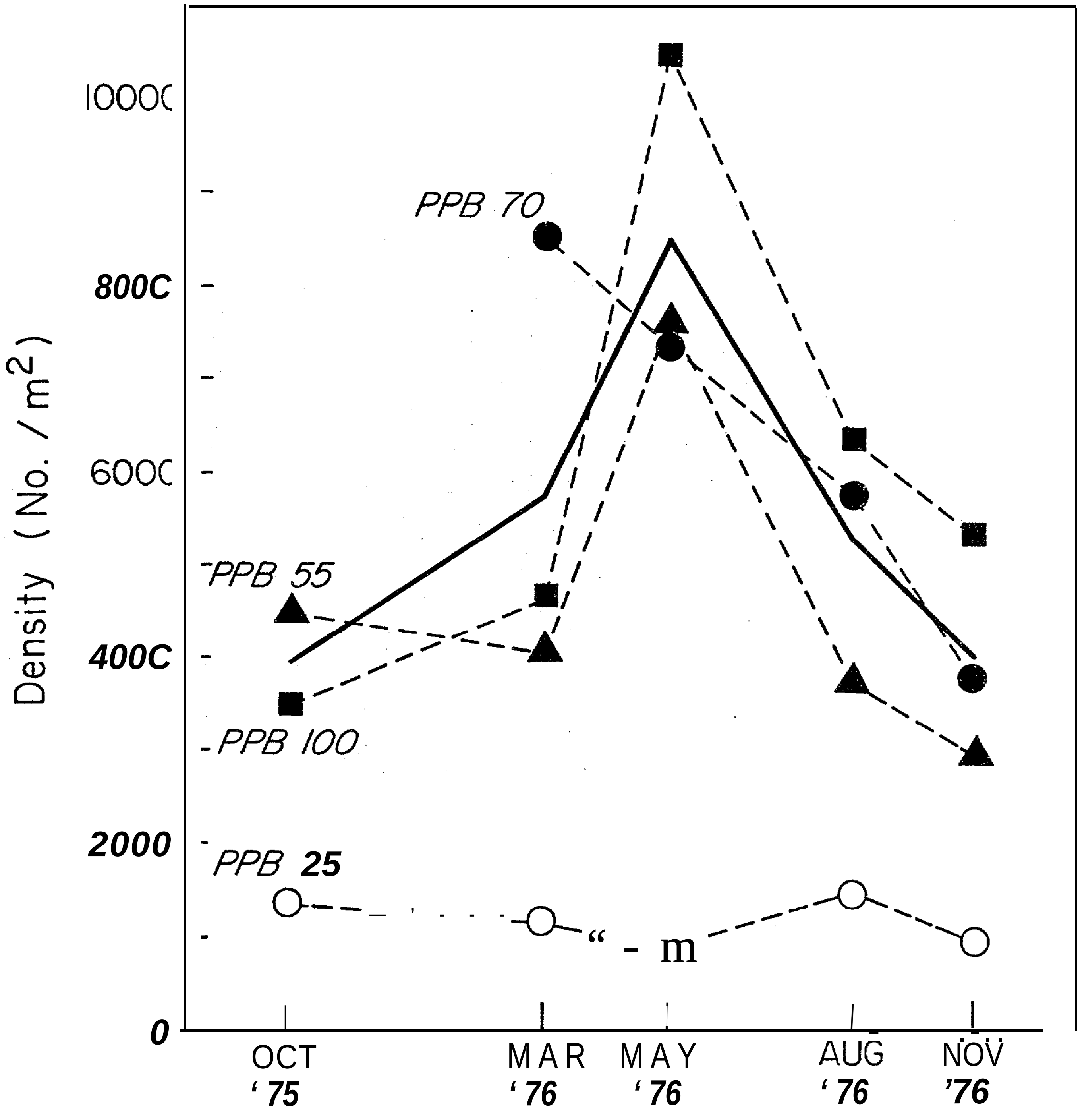


Table 5. Numerical density and biomass (g wet-preserved wt.) of benthic infauna at standard seasonal stations across the southwestern Beaufort Sea continental shelf. Data are averages with standard deviation of 5 samples per station. P is the probability that the seasonal means for a station are not equal (one-way analysis of variance). PPB = Pitt Point Benthos; station numbers designate depth in meters.

Shelf Sta.	Oct. 75 (no/m^2) (g/m^2)	Mar. 76 (no/m^2) (g/m^2)	May 76 (no/m^2) (g/m^2)	Aug. 76 (no/m^2) (g/m^2)	Nov. 76 (no/m^2) (g/m^2)	P
Inner	1,342+577	1,140+556	882+471	1,468$397	924+68	0.94
PPB-25	20.4+16.6	8.3+4.9	22.1+19.0	11.0+2.5	25.2+8.1	0.85
Trans.	---	632+319	936+197	2,768+478	---	1.00
PPB-40	---	4.7+3.3	27.8+8.5	59.5+21.5	---	1.00
outer	4,472+1,831	4,044+2,352	7,654+4,620	3,722+927	2,942+1,400	1.00
PPB-55	31.4+10.6	20.9+5.8	21.1+5.9	67.8+13.3	25.4+11.0	0.94
PPB-70	---	8,526+5,528	7,382+3,410	5,772+1,092	3,756+496	1.00
	---	32.3+5.8	44.7+20.8	71.4+19.1	29.4+5.9	0.84
PPB- 100	3,490+3,346	4,616+2,238	10,466+2,740	6,368+1,014	5,332+424	0.92
	40.2+35.3	34.8+10.4	61.2+32.0	39.6+6.5	57.5+5.8	1.00

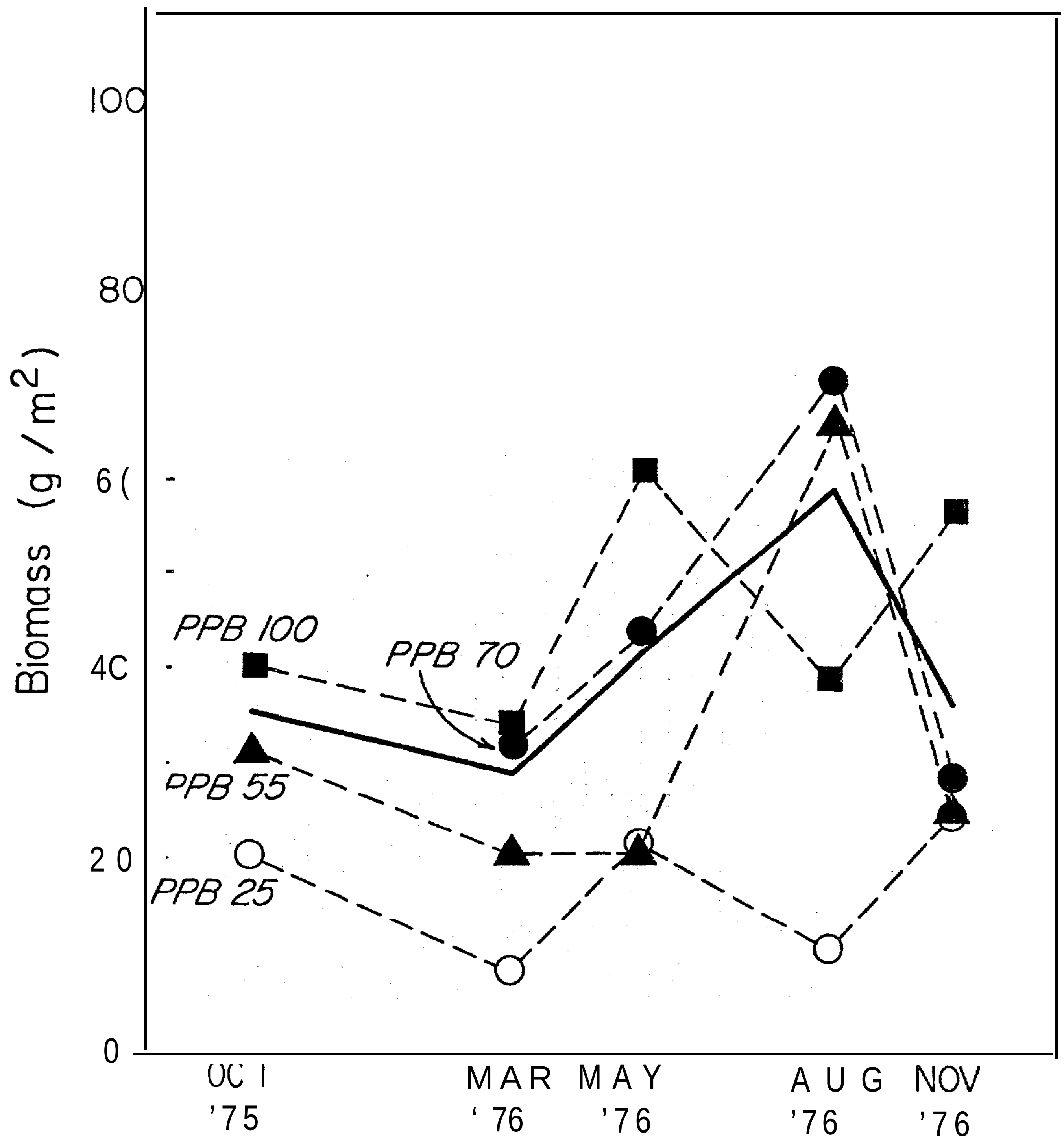


Figure 27. Biomass of soft-bodied infauna (grams wet-preserved weight) at standard stations at 5 sampling periods. Station PPB-40 is considered transitional and consists of 3 data points; it has been omitted for clarity. Each point represents an average of 5 samples. The solid line is the mean trend for the 3 outer stations.

VI. F. (continued)

Based on the amplitude and temporal pattern of total numerical abundance we can classify the benthic communities along the Pitt Point line into an inner- and an outer-shelf group. This abundance index varies within narrow limits at the inner-most station while it exhibits a broader range with distinct seasonal maxima and increasing statistical significance at the three deepest stations. Since the shallowest station lies within the active ice gouging zone, we suggest that this inner-shelf community is adapted to episodic destruction and is characterized by the presence of opportunistic species with asynchronous reproductive cycles that are not closely coupled to the other biological cycles around them. We suggest that the reproductive capacity of animals at the shallow station is influenced by the physical disturbances and that at the deeper stations it is accommodated to a seasonal food input. The benthic community at PPB-40 at the outer edge of the ice gouging zone is a transitional environment and could be expected to be comprised of a spectrum of species with a mix of life histories.

Food sources available to the continental shelf ecosystem could include: coastal benthic diatom production (6), tundra and peat erosion and continental run-off (1, 6), localized phytoplankton blooms induced by occasional coastal upwelling (8), diffuse and low level meritic phytoplankton production (4), advection of fauna and organics with the Bering Sea-Chukchi Sea water mass (8); and underice epontic diatoms (3, 4, 6). Except for the intrusion of the southern water mass, the neritic phytoplankton and the ice algae, these food sources are localized and influence only shallow lagoon or nearshore coastal environments. Though its areal extent and overall contribution to the ecosystem are unknown, carbon fixation by ice algae appears to be a likely energy source for the outer shelf biotic system. To account for the dynamic trends encountered within the benthic community, both a seasonal cue and an energy source capable of supporting annual benthic reproduction and recruitment are required. These conditions are met by ice algae. In the nearby Chukchi Sea, populations of these epontic diatoms begin to increase in April under very low ambient light intensities, reach maximum population densities and productivity in May, and decrease during the early summer. This underlayer of diatoms and associated biota sloughs off during the initial stages of ice melt and possibly sinks to the sea floor (6). Carbon fixation of ice algae per unit area during May can be ten times that of the later phytoplankton bloom in the water column (4, 7). Annual production is about 5 g C/m^2 off point Barrow. Though not high when compared with more southern coastal areas, this may represent a major portion of the primary production in the offshore Beaufort Sea (4). Rapid sinking of the "inverted benthos" ice epontic community could carry much of this food rapidly through the pelagic zone and make it available to sea floor organisms during their period of recruitment.

In this report (submitted to SCIENCE) we have demonstrated significant average seasonal changes in basic community structure in the benthos that are probably caused by the collective annual reproductive cycles of the fauna. To drive these dynamics of offshore benthos, larger sources of energy are required than have been previously reported for the Beaufort Sea. We suggest ice algae as a likely cyclic food source that could make this Arctic ecosystem productive.

VI. l?. (continued)

References

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G. Oregon State University Benthic Invertebrate Reference Museum

As part of the research program directed at the benthic infaunal organisms encountered on the Beaufort Sea continental shelf, efforts have been made to upgrade and consolidate the Oregon State University Benthic Invertebrate Reference Museum. This collection of arctic and North Pacific invertebrates is now housed in a separate, air-conditioned room adjacent to the benthic ecology laboratory, and is equipped with a dissecting scope, some pertinent arctic literature, and a desk to provide working space. In its present configuration, the collection has become an invaluable resource as a "biological library" for confirming or differentiating many of the difficult arctic invertebrate species being sorted from OCSEAP grab samples.

As of the last computer update (11 Jan 1978), the arctic portion of the benthic reference collection contains a total of 314 described species representing seven different phyla. Most of the identified specimens belong to the annelids, arthropods, or molluscs, since these three groups tend to predominate across the continental shelf in the Alaskan arctic. Efforts are now being initiated to examine some of the lesser groups, although a majority of taxonomic work still involves the identification of members of the three previously mentioned phyla. Generally, invertebrate species new to the collection are cataloged as soon as they are identified at Oregon State or are received from specialists. In addition, duplicates and other specimens representative of variations in morphology, depth, and range are entered into the collection whenever practical. Multiple specimens of each species make the reference museum a much more flexible and useful tool.

With this expansion of the invertebrate reference collection, the difficulties inherent in maintaining accurate cataloging have grown increasingly complex. To cope with the mounting bookkeeping problems, computer data bases were developed to maintain the information pertinent to each specimen, mold this data into a standardized format which could be easily and routinely interpreted, and accommodate the expansion anticipated with continuous additions to the collection. These data bases are explained in specific detail in Appendix I. Generally, however, they allow us to store and retrieve all the relevent information for any specimen housed in the reference museum. All collection data and any secondary environmental data can be easily accessed. The correct scientific name, the reference to the original description, current or older synonyms, and the zoogeographic regions from which each species has been collected is maintained for every cataloged specimen. In addition, an index is provided which summarizes these specimens by taxa, keeping track of the number of species in the collection and listing internal checks which have detected any errors introduced into the system (Table 6). Room has been built into the data bases to allow for additional specimen information, which in the future will include data on sexual development, the names of specialists confirming particular identifications, and a bibliography of works specifically relevent to each species.

Where possible, species identifications have been made or confirmed by taxonomic specialists. The following authorities have had an input into upgrading the benthic invertebrate collection; or have agreed to examine particular groups:

Table 6 Computer data base summary index showing the number of identified taxa contained in the Benthic Reference Museum. When this index was compiled, there were 314 arctic species representing seven different phyla. Internal checks within the data base also revealed two catalogued specimens for which collection information was missing.

OREGON STATE UNIVERSITY BENTHIC ECOLOGY GROUP
DATE: 78/01/11 18.23.24 PAGE 32

OSU CODE	OSUBI CAT. NUMBERS	ARCTIC TAXA	N. PAC. TAXA	TOTAL TAXA	TOTAL NO. SPECIMENS
AA	632	145	120	259	1994
AB	33	a	15	15	208
AC	5	3	G	3	7
AD	2	G	G	1	17
AH	23	20	1	21	165
AI	2	2	0	2	32
AR	'24	0	10	10	84
AU	91	34	0	34	268
DA	1	1	0	1	1
EA	4	2	c	2	42
EC	1	1	0	1	1
EE	31	1	3	ii	93
EH	59	4	27	30	170
EO	95	12	12	43	575
FL	4	4	0	4	17
MA	5	0	5	5	8
MG	104	19	10	65	400
MO	8	3	4	7	20
MP	148	22	84	104	413
MS	24	0	8	8	169
TH	2	2	0	2	25
WM	205	39	152	152	796
XA	45	10	4	16	125
XC	1	0	0	1	1
XE	6	1	4	5	27
XM	Ii	2	i	6	34
TOTAL	1566	327	460	808	5692
DESCRIBED SPECIES	1503	314	451	730	5505

HIGHEST CATALOG NUMBER TO DATE: 1572

MISSING CATALOG NO.	DUPLICATE CATALOG NO.
1) 1500	
2) 1501	

VI. G. (continued)

Dr. Charles E. Cutress University of Puerto Rico	-- anthozoa
Dr. Kristian Fauchald Allan Hancock Foundation	-- polychaetous annelids
Dr. Meredith L. Jones Smithsonian Institution	-- polychaetous annelids
Mr. Christer Erseus University of Goteborg, Sweden	-- oligochaetous annelids
Dr. Jean Just Universitets Zoologiske Museum, Denmark	-- gammarid amphipods
Dr. Diana Laubitz Museum of Natural Sciences, Ottawa, Canada	-- caprellid amphipods
Dr. Bruce C. Coull University of South Carolina	-- harpacticoid copepods
Dr. Norman S. Jones University of Liverpool, England	-- cumacea
Dr. Joel Hedgpeth Oregon State University (Emeritus)	-- pycnogonida
Dr. James H. McLean Natural History Museum, Los Angeles	-- gastropoda
Dr. Frank R. Bernard Pacific Biological Station, Nanaimo, Canada	-- pelecypoda
Ms. Amelie Scheltema Woods Hole Oceanographic Institution	-- solenogaster
Dr. G. Arthur Cooper Smithsonian Institution	-- brachiopoda
Dr. Leonard Soroka St. Cloud State University, Minnesota	-- bryozoa

With more identified specimens being returned from taxonomic specialists, the function and value of the benthic reference museum has expanded. The collection room provides a centralized location where the specimens can be properly stored and maintained. Temperature control, periodic curation, and removal of specimens from the collection can be routinely monitored. The collection also provides a nucleus of well-preserved specimens which will be valuable for anticipated reproductive studies. The major advantage of the benthic reference museum, however, is in its service as a working taxonomic library which

VI. G. (continued)

is readily available to the members of the Oregon State benthic group. It is a high-powered research tool which permits the examination of a variety of difficult questions concerning the taxonomy and ecology of the arctic invertebrate fauna. As such, the Oregon State University Benthic Invertebrate Reference Museum is an indispensable resource which continues to expand in scientific value.

VII. Discussion

From the data accumulated during the past year, it is evident that there are seasonal, offshore-onshore, and geographic patterns in the structure of the southwestern Beaufort Sea benthic infaunal communities.

Perhaps the most significant and surprising finding is the seasonality observed in the outer continental shelf communities. The abundant fauna appears to have a significant increase in numerical abundance in May with less marked change in biomass by the end of the summer. Because of the observed increase in small organisms with the communities in the late spring, recruitment to the populations (>1.0 mm) is a reasonable explanation for this phenomenon. Growth individuals would explain the increase in biomass observed in the August samples. There would also have to be high rates of mortality to explain the decrease during the late summer-early fall.

The implications to be derived from these results describing a biologically active fauna in an arctic region with low primary production are intriguing. These results imply a more productive Beaufort Sea ecosystem than previously thought. The average results point to the need for detailed life history studies of the most abundant species now on hand. Further field research to describe these seasonal changes in more detail and to measure usable carbon inputs to the ecosystem are also called for. Ice algae production and tundra peat detritus inputs are potential sources that should be defined throughout the year.

The abundance patterns of the larger benthic infauna (>1.0 mm) in the coastal zone demonstrate a nearshore maximum in numerical density with an intermediate low and an offshore maximum. Hypotheses for processes that maintain these patterns are suggested by the bimodality of numerical density and correlations with environmental festures. The abundance peak nearshore may be caused by inputs of detrital peat from coastal erosion and river run-off, while that near the edge of the shelf may be the region where the lower current energies allow oceanic detritus and fine sedimentary particles to settle out. The abundance low is strongly correlated with the sea ice shear zone region. It is not known how long-lasting the destructive effects of ice. scour are; it is possible that such scours would take a long time to recover previous sedimentary cover and characteristics owing to the low sedimentation rates on the arctic Alaskan shelf.

VII. Discussion (continued)

Preliminary analysis of the distribution and abundance of polychaete species indicate that the eastern and western regions of the research area are different ecologically. The numbers of species and number of specimens at each station along the 3 transects summarized to date demonstrate a striking similarity between the 2 eastern transects and the contrast in pattern of the transect off Cape Halkett. Previous research (Carey 1977 Final Rpt. T.O. #4) has shown the uniqueness of the Barter Island area.

VIII. Conclusions

1. The benthic communities on the outer continental shelf undergo seasonal changes in numerical density and biomass. (Reasonably Firm)
2. The benthic infauna (>1.0 nun) are at maximum abundance nearshore and on the outer shelf with a minimum at 15-25 meters depth. (Reasonably Firm)
3. Gammarid amphipod species are influenced by depth; an inner, middle, and outer shelf fauna can be distinguished across the continental shelf off Pitt Point. (Reasonably Firm)
4. Polychaete worms are more abundant nearshore near the Barter Island region, and offshore to the west near Cape Halkett. (Reasonably Firm)
5. Environmental features most influencing the benthic invertebrate communities on the Beaufort Sea continental shelf include sediment type, depth, nearshore salinity, river and lagoon detritus export, organic inputs, ice gouging, and predation. (Preliminary)

Documentation of computer programs for Data Base Management
(DBM System)

INTRODUCTION

The primary purpose of this document is to teach people how to code field and laboratory data on to computer cards, and how to organize these cards to satisfy the input requirements of the data base management (DBM) system. The DBM system is comprised of two data bases (BUG and MUD) and one computer program to manage each data base (programs STUFF and CRAM).

Before learning to code data some basic understanding of the structure common to data bases, and how the data bases and DBM programs interact is needed. Following that discussion each DBM program will be discussed in detail where the coding procedure will be specified. The documentation is not intended to give a thorough description of the programs STUFF and CRAM. Information about these programs is only given to help the coding procedure along.

After reading this manual one should be able to create and edit the information in either of the data bases using the directive cards read by the DBM programs.

GENERALIZED DATA BASE STRUCTURE

Terminology used to explain the structure of a data base can be confusing, but with the aid of Figure I and the glossary the following description will hopefully be understandable. A data base has a beginning, a middle, an end, and a primary key, only the latter may not be obvious. The primary key performs the same function for a data base as the Library of Congress number plays in a library. Without the Library of Congress number the library would be a hopelessly confused collection of books, with no systematic way of finding a book or reshelving a borrowed book. The primary key has two crucial characteristics: 1) it has a defined minimum and maximum value that specifies its range, and 2) it has an implicit order (e.g. numerically increasing). The analogue to books in a library are sections, whose order in the data base is determined by the value of its primary key. The first section of the data base is called the header section, which has a primary key equal to the key's defined minimum value. This section contains only a primary key. The next zero to many sections is where data is stored in the data base. Each section represents some independent entity (e.g. sample, or species] and contains the primary key in addition to other information collected. The last section in the data base is called the trailer section, which has a primary key equal to its maximum value. The trailer section signals the end of the data base and does not contain any other information. The header and trailer sections define the bounds of the data base and together form the minimum requirements to be called a data base.

THE ROLE OF DBM PROGRAMS

Now that the basic structure of a data base has been explained the next question is how does the DBM program use this structure? The purpose of the DBM programs is to create an edited data base (NEW data base) by combining the information in an existing data base[1] (OLD data base) , with the card input read by the DBM program. The manual's prime concern is describing how the input cards are coded, and organized. To be more specific NEW is generated in roughly the following

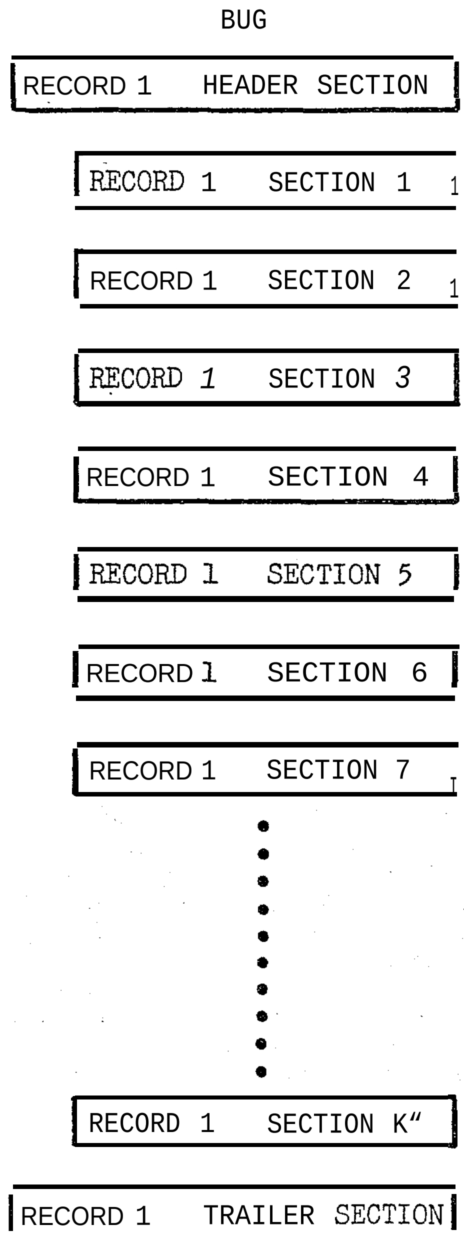

BUG
RECORD 1 HEADER SECTION
RECORD 1 SECTION 1
RECORD 1 SECTION 2
RECORD 1 SECTION 3
RECORD 1 SECTION 4
RECORD 1 SECTION 5
RECORD 1 SECTION 6
RECORD 1 SECTION 7
RECORD 1 SECTION K"
RECORD 1 TRAILER SECTION

FIGURE I

manner. The header section is read from OLD and transferred to NEW. DBM program then begins to read input cards (also called directive cards) which contain: 1) a primary key, 2) a directive character, and 3) information to be stored. Sections are transferred from OLD to NEW until a primary key is found in OLD that equals or is greater than the primary key read on the input cards. A decision is made to determine if the section last read from OLD should be modified (primary keys equal) or a new section be inserted in NEW. The directive character signals what information is on the input card, which is stored into the appropriate variables in the section. The sequence of events is then repeated for the next input card, starting with the search for a primary key greater than or equal to the primary key on the input card. After all the input cards have been read the remaining sections in OLD, including the trailer section, are written on NEW. In the end you have two data bases. The original data base (OLD) has not been changed, but the second data base (NEW) is identical to OLD except for those sections that were modified, created or deleted by the directive cards.

PROGRAM STUFF

The taxonomic data base (BuG) can now be discussed in more detail. It has the simplest structure, each section is composed of one record that contains all the information about a taxonomic group. The term "taxonomic group" is purposely broad, it can refer to a described species, organisms lumped together at a higher classification (e.g. phylum, class, order, etc.) or even gross qualitative labels (e.g. detritus, unknown, eggs, etc.), any category that is judged to be necessary to sort and identify a sample. Each taxonomic group is assigned a unique OSU code which is the primary key for the BUG data base and is used to identify which section (taxonomic group) you want information about. The Sample data base (MUD) uses BUG as a repository of the most up-to-date information about a taxonomic group. This allows many minor taxonomic changes such as name changes, range extensions, addition of auxillary codes, or addition of OSUBI catalog numbers to be incorporated into the BUG data base when necessary but requiring no changes in the MUD data base. The following paragraphs describe the procedures and formats required by STUFF to manage the information in BUG. Information about the various codes, directive cards, file names, input structure, and diagnostic error statements will be covered to assure an adequate working knowledge necessary to use program STUFF.

CONVENTIONS AND CODES

The OSU code is the primary key for the BUG data base. The code consists of a two letter initial and a three digit number that are combined to form the five character OSU code. The initial protion of the code contains taxonomic information, a two letter combination is assigned each category of a rather arbitrary, but specified, taxonomic classification system. As an example, all amphipods would be given "OSU codes that start with AA, and all polychaetes have codes that start with the two letter combination WM. To make the two letter

---

'These programs can insert new sections into a data base, but cannot create a data base from scratch. The programs require an existing data base as input.

combinations unique a three digit integer is added to produce a code that conveys some taxonomic information but avoids many of the shortcomings of pure taxonomic codes. The OSU code has several limitations on how it is written. The code contains no blanks, is always five characters long, and the integer number must be right justified with zero fill if necessary.

OSU CODE EXAMPLES

Valid codes	Illegal codes
AB132	A A 3
AA001	ABC02
XA042	A0003
XX008	AB0004
	$C001

One of the characteristics of a primary key is an implicit order.[2] The order is determined alphabetically by the first two characters of the code and then numerically by the last three characters.

The program places several other constraints on the input. Taxon names and the original describing references can be no longer than 40 characters each. When these two data items are entered on the "*" directive card, the taxon is written first starting in the first column of the field. The name cannot have more than two consecutive blanks, the reason will be evident shortly. After the last character of the taxon name, two blanks must follow before the original describing reference is started. The field is only 60 characters long so a problem can occur if the number of characters in the two data items is greater than 58, they simply will not fit on one "*" directive card. To solve this dilemma two "*" directive cards must be used. One card has only the taxon name in the field starting in the first column, and the other card leaves the first two columns of the field blank, followed by the original describing reference.

There are other conventions used in coding that should be mentioned. Some of the taxonomic groups have representative individuals in the Oregon State University Benthic Invertebrate (OSUBI) reference collection, for which the BUG data base acts as a catalog. Two types of data are stored in a section that deals with the OSUBI reference collection, the OSUBI catalog number and the total number of specimens of the taxa present in the reference collection. For the purpose of programming, a taxa is considered in the collection if it has at least one catalog number stored in the section. Therefore, if you wish to remove a taxa from the reference collection (from the data base's point of view at least), all the catalog numbers must be deleted from the section with the "D" directive card. Catalog numbers must also conform to some limitations to guarantee smooth interfacing with other programs. Numbers are read and stored in BUG as hollerith data, but other programs that use the BUG data base may read them as integers.

---

[2]The implicit order is not obvious when viewed as five characters, but when the OSU code is stored into a real variable with a R5 format the resulting computer word looks identical to an integer constant, composed of the display codes for the five characters in the OSU code. Once the code has been transferred to an integer variable with a logical masking expression, to prevent normalization, the code can be compared to other codes with simple arithmetic tests. The implicit order of the code is now obvious.

These limitations require that they are always coded as five digit integers with leading zeros. A maximum of 490 numbers can be stored in each section. Duplicate catalog numbers are not allowed within a section, but no checks are made to assure that a catalog number in one section does not exist in other sections. The total number of specimens in a taxa present in the OSUBI reference collection is also stored in each section. The variable acts as a simple accumulator and it is the user's responsibility to verify that the value is accurate. The value for the number of specimens is divided into three categories. It may be empty, positive, or less than or equal to (≤) zero. The empty condition indicates no information is available. The latter category applies when specimens have not been exactly counted, which is represented in the printout as three plus signs. If the variable is positive it is the number of specimens in the collection. The value of the variable in the data base is changed by adding to it the number (positive *or* negative) in its field on the "/" directive card. However, there are exceptions. When the data base variable is less than or equal to zero it is simply set equal to the value on the "/" directive card, or if the value on the directive card is -0.0 the data base variable is set to an empty condition. STUFF coordinates these section variables (catalog numbers and number of specimens) to avoid conflicts. When no catalog numbers are stored in a section, but the number of collection specimens is not empty, steps are taken to eliminate the conflict. Before the section is written onto the new data base, an informative diagnostic is printed, and the number of specimens is forced to an empty condition.

Three remaining codes should be briefly discussed to complete this topic. Zoogeographic information is stored in the data base through the use of location codes. Many geographic and depth zones have been established (Table I). When an organism is collected in one of these zones its presence is recorded in the data base by placing the appropirate location code on a "/" directive card. Location codes are three digit integers which must be right justified in any field.[3] Table I also contains Taxon Level codes, which are used to specify the taxonomic level the organism has been identified to. The code is self-explanatory and is entered as a two digit value on the "/" directive card. The remaining code is the NODC taxonomic code. This code is supported by the National Oceanographic Data Center (NODC) and may also be referred to as the VIMS code. The code is twelve digits long and left justified with no trailing zeros. Although the code is numeric it is treated as hollerith information.

[3]Locations are stored as a bit map. Each location is assigned a bit, if this bit is on, the organism has been collected at the location, conversely if the bit is off it has not. The program must be changed to include additional location code descriptions if they are not found in Table I.

TABLE I

TAXONOMIC LEVEL CODE

Code	Taxon
94	Superphylum
90	Phylum
86	Subphylum
82	
78	Superclass
74	Class
70	Subclass
66	Series
62	Superorder
58	Order
54	Suborder
50	Section
46	Superfamily
42	Family
38	Subfamily
34	
30	Supergenus
26	Genus
22	Subgenus
18	
14	Superspecies
10	Species
6	Subspecies

LOCATION CODES

Code	Location
1	Beaufort Sea
2	Chukchi Sea
3	Bering Sea
4	N. Pacific, abyssal
5	N. Pacific, slope
6	N. Pacific, shelf
7	Estuarine
8	Arctic Basin
9	N. Pacific, pelagic
10	N. Pacific, intertidal
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Directive Cards

Information in the BUG data base can be manipulated using any of 5 directive cards, which are identified by the directive character in the first column of the card. These directive cards can be divided into functional groups which will be described separately. The "*", "/", and "D" directive cards will be discussed first, followed by the "=", and "#" directive cards which have a much more limited use. An example of how these cards are used can be found in Appendix C.

Creation, and modification of sections

Sections can be created or modified through the use of the "*", "/", and "D" directive cards. If a section is being modified you can add new information into it or make corrections to existing information in the section. To illustrate the use of directive cards consider some hypothetical organism that we wish to enter into the data base. Since this organism does not exist in the data bases a new section must be created. The first task is to assign the organism a unique OSU code which will be the primary key. Each card must include a directive character and the OSU code. The OSU code controls where the new section is written in the new data base, and the 'directive character specifies what information is expected on the card. The information describing the organism is coded using the directive card formats summarized in Appendix B. The name, original describing reference, and phylum of the organism are the the 3 variables entered on the "*" directive card, with the name and original describing reference sharing a field (col. 2-67) as described above in "Codes and Conventions." The OSU code is placed in column 63-67, followed by the phylum in columns 71-80. "/" directive card has the OSU code in column 2-6. NODC Taxonomic code is the second field (col. 8-19) followed by the taxon level code (col. 21-22), situation code (col. 24-26) and the OSUBI collection specimens field (col. 27-32). The next 5 fields are reserved for OSUBI catalog numbers, followed by 3 fields used for zoogeographic location codes. These two directive cards contain all the information that can be stored in the BUG data base. The "*" directive card stores the OSU code into the new section, therefore, when a new section is being created a "*" directive card with the OSU code is the minimum requirement.

If the hypothetical organism was already in the data base and you wished to supplement the information stored in past executions of program STUFF, you would be modifying the organism's section in the data base. Information in the section can be added (changed from an empty state) , changed (replace existing information), or deleted (change to an empty state) . HOW these modifications are performed depends on the information.

Taxon name and original describing reference, phylum, and NODC code are stored as hollerith information and are added or changed in the same manner. The new information may be added to a section by placing it in the appropriate fields on the directive cards. Program STUFF replaces the information in the data base, whether empty, or not empty, with the information on the directive cards. Information is deleted by placing a semi-colon in the first column of the field, on the appropriate directive card, that corresponds to the variable you wish to delete.

The taxon level code and situation code are numeric codes and may be added or changed in the same manner as hollerith information, but to delete these numeric codes you place a -O in the right most columns of the appropriate field.

The variable containing the number of OSUBI collection specimens is handled differently. How the information on the directive card is used depends on the value stored in the section. If the value in the section is empty or less than or equal to zero (represented as +++ on output) the value on the directive card replaces the value in the section. When the value in the data base is positive the value on the directive card is added to the value in the section. The value on the directive card may be negative but if the resulting value is less than or equal to zero it will be represented on the output as "+++." The value may be deleted by placing a -0.0 in the field.

OSUBI Catalog numbers and location codes are stored in lists within a section. They can be viewed as being present or absent in the list, so they are technically never changed only added or deleted. These codes are added by placing the codes in their respective fields on the "/" directive card, but they are deleted from the lists in the section in different ways. The location codes can be deleted from the list by entering the code on one of its fields on the "/" directive card preceded by a minus sign. Both positive (adding location codes) and negative (deleting location codes) location codes can be placed on the same "/" directive card. OSUBI Catalog numbers are added by entering the number in one of its fields on the "/" directive card. "D" directive cards are used to delete catalog numbers from the list. To delete catalog numbers you must include the OSU code for the target section and enter the catalog numbers to be deleted in the remaining fields on the card.

EDITING DIRECTIVE CARDS

The "*", "/", and "D" directive cards are the most commonly used but two more directive cards remain. The "=", and "#" directive cards have specialized editing functions. The "#" directive card contains only the directive character and an OSU code. This card prevents the section from being written on the new data base, effectively deleting the entire section. The remaining directive card should be used cautiously. The "=" directive card simply changes the. OSU code in a section from its-present value to a second prescribed value. The OSU code is the primary key for the BUG data base and the "=" directive card does not check the new data base to guarantee that the implicit order of the primary keys within the data base is maintained. It is the responsibility of the user to be sure that the use of the "=" directive card will not destroy this order. If the implicit order would be destroyed it is necessary to delete the entire section with the old OSU code and recreate the section with the new OSU code using the "*" and "/" directive cards as described above.

The directive cards are read by program STUFF sequentially and must be arranged in increasing order of OSU codes, although cards with the same OSU codes may be in any order. The program assumes the cards are so ordered and any cards out of order will be ignored and a diagnostic statement printed. Appendix C gives an example of a directive card deck, and the changes they create in a data base.

FILES

PROGRAM STUFF (INPUT,OUTPUT,TAPE1,TAPE2)

Four files are used by the program. INPUT contains the directive cards described in the previous discussion, sorted by OSU code, and terminated by an End-of-File (EOF) card. TAPE1 is a previous data base which is merged with the information on the directive cards and written on TAPE2. TAPE1 is referred to as the "OLD" data base, and TAPE2 is the "NEW" data base. OUTPUT (see Appendix C) contains 1) listing of data base information, 2) diagnostic statements, and 3) execution summaries. As the program reads directive cards it prints any diagnostic statements as problems arise. When a new, modified, or deleted section is processed the contents are printed (example in Appendix C) with an informative label (≡NEW≡, ≡MODE≡, ≡DEL≡ respectively) which indicates the action taken. An execution summary is printed when the program ends. This summary is often useful to determine if any diagnostic statements are buried in the preceding printout and as a tally of the number of section created, modified, or deleted.

DIAGNOSTICS

Appendix A gives many of the diagnostic statements the program prints along with an example of how the statements look on the printout. Most diagnostics list the number of the last directive card read which gives the user an idea where the error occurred, but is not necessarily the card in error. The errors not included in Appendix A mainly deal with parity errors while reading or writing the data bases orthe unexpected occurrence of an EOF on any of the files. These errors have informative massages about the general cause of the error but often these errors will require the help of a programmer to uncover the problem. These situations should be rare.

APPENDIX A

STUFF ERROR MESSAGES

APPENDIX A

ERROR NUMBER	DIAGNOSTIC MESSAGES
1	IS AN INVALID RECORD TYPE. CARD IGNORED.
2	OSU CODE IS BLANK. CARD IGNORED.
3	MAXIMUM NO. OF INPUTED CATALOG NO. REACHED. EXTRA NO. IGNORED.
4	DUPLICATE CATALOG NUMBER FOUND.
5	FILE PROTECT POINTER VIOLATED. ALL CAT. NO. NOT STORED.
6	IS FIRST RECORD NUMBER OF DATA BASE. SHOULD BE ZERO.
7	IS WRONG DATA BASE PASSWORD. SHOULD BE OCSEAP.
8	FILE PROTECT POINTER OUT OF RANGE.
9	COULD NOT BE FOUND IN DATA BASE. REQUEST IGNORED.
10	INPUT CARDS NOT PROPERLY SORTED.
11	YOU CANNOT HAVE SPECIMENS W/O CATALOG NUMBERS. NUMBER PURGED.
12	EMPTY OSU CODE, SECTION NOT WRITTEN ON NEW DATA BASE.

COMMENTS

Error Number	
1	The directive character (Record type) is not one of the directive characters (*, /, D, =, #) described in this documentation. The card is ignored.
2	The OSU code on the directive card is blank. The card is ignored.
3	The inputed OSUBI catalog numbers would exceed the maximum number that can be stored in a section (490). Catalog numbers are stored until space is exhausted. The remaining catalog numbers are not stored. To increase the storage capacity would require reprogramming.
4	An OSUBI catalog number found on the "/" directive card already exists in the section. Duplicate catalog numbers are not allowed within a section so the catalog number is not stored.
5	This error is similar to error 3. The program attempted to exceed the dimension assigned to OSUBI catalog numbers. This error should be brought to the attention of a programmer.
6	The header section should have a primary key of zero, but the header section read from TAPE1 does not have the expected primary key. It is possible TAPE1 contains the wrong data base, or a file that is not in the BUG data base format.
7	The header section contains a password that is used to be sure the proper data base is accessed. The program expects the password to be "OCSEAP" but it is not. It is possible TAPE1 contains the wrong data base, or a file that is not in the BUG data base format.
8	The third variable in the header section contains a value that defines the dimension allowed to store OSUBI catalog numbers. This value is" either less than or equal to zero or greater than the maximum number of variables per section. This error should be brought to the attention of a programmer.
9	The old data base OSU code on a "=" directive card cannot be found in the old data base. The card is ignored.
10	The directive cards are not sorted in increasing order by OSU code. The card is ignored. The cards that are out of order should be run in the next modification of the BUG data base or all the directive cards should be ordered properly and re-run.
11	OSUBI catalog specimens variable is not empty, but there are no catalog numbers stored in the section. This conflicting condition is solved by forcing the OSUBI catalog specimens variable to an empty condition before the section was written on the new data base.

COMMENTS (continued)

Error
Number

12 A section with an empty OSU code was not allowed to be written on the new data base. This condition can occur when a section is created but a "*" directive card was not included. If it was the user's true intention to create this new section, a "*" directive card must be included with the other directive cards (even if no other information is on it other than the "*" directive character and OSU code). Often it was not intended that a new section be created, but simply a keypunch error on the OSU code of a directive card. In this case the directive card is effectively ignored.

APPENDIX B

DIRECTIVE CARD FORMATS

* DIRECTIVE CARD — TAXON INFORMATION

COLUMN	DESCRIPTION	FORMAT
1	"*"	R1
2-61	Taxon name and original description	6A10
63-67	OSU code	R5
71-80	Phylum	A10

/ DIRECTIVE CARD — CODED INFORMATION

COLUMN	DESCRIPTION	FORMAT
1	"/"	R1
2-6	OSU code	R5
8-19	NODC taxonomic code	A10,A2
21-22	Taxon level code	F2.0
24-25	Situation. code	F2,0
27-32	OSUBI Collection specimens	F6.0
34-38	OSUBI Catalog number (1)	A5
40-44	OSUBI Catalog number (2)	A5
46-50	OSUBI Catalog number (3)	A5
52-56	OSUBI Catalog number (4)	A5
58-62	OSUBI Catalog number (5)	A5
63-66	Location code (1)	F4.0
67-70	Location code (2)	F4.0
71-74	Location code (3)	F4.0

= DIRECTIVE CARD — REPLACE OSU CODE

COLUMN	DESCRIPTION	FORMAT
1	"="	R1
2-6	OSU code (OLD DATA BASE)	R5
8-12	OSU code (NEW DATA BASE)	R5

DIRECTIVE CARD — DELETE SPECIES (SECTION)

COLUMN	DESCRIPTION	FORMAT
1	"≠"	R1
2-6	OSU code to be deleted from data base	R5

D DIRECTIVE CARD — DELETE OSUBI CATALOG NUMBERS

COLUMN	DESCRIPTION	FORMAT
1	"D"	R1
2-6	OSU code	R5
8-12	Catalog number '(l)	A5
14-18	Catalog number (2)	A5
20-24		A5
26-30		A5
32-36		A5
38-42		A5
44-48		A5
50-54		A5
56-60	:	A5
62-66	:	A5
68-72	Catalog number (11)	A5
74-78	Catalog number (12)	A5

APPENDIX C

This appendix contains an execution of program STUFF, to illustrate what the output looks like. The first page has specific sections taken from the data base printed, showing what information is in the data base before the information on the directive cards (the following page) are merged. The next two pages are the actual output from program STUFF when executed with the previous directive cards. The output shows how the information in the OLD data base has been modified and gives examples of two error diagnostic statements. The information on the directive cards was chosen to show how sections are created, modified, and deleted as well as how to delete, add and modify variables within a section.

There are two areas on the output that have not been discussed. The "MODIFY DATE/TIME" area contains the date {year/month/day) and time (hour/minute\ second] that the section was created or last modified, which ever date and time is more recent. The second area is labeled "COLLECTION". This area is blank unless there are OSUBI Catalog numbers stored in the section, in which case the area has the word "YES" printed.

SPECIES DATA BASE
78/01/18. 17.16.55.

AA176

TAXON NAME	ORIGINAL DISCRIPTION REFERENCE	PHYLUM	VIMS CODE	MODIFY DATE/TIME
ONISIMUS NANSENI	(G. SARS, 1900)	ARTHROPODA		76/11/23 23.56.36

ZOOGEOGRAPHIC INFORMATION
1)BEAUFORT SEA

AA253

TAXON NAME	ORIGINAL DISCRIPTION REFERENCE	PHYLUM	VIMS CODE	MODIFY DATE/TIME
LEPECHINELLA ECHINATA	(CHEVREUX, 1914)	ARTHROPODA	0000000000	77/11/28 22.53.01

LEVEL	COLLECTION STATUS	COLLECTION SPECIMENS	OSUBI CATALOG NUMBERS
10	YES	3	01456 01457

ZOOGEOGRAPHIC INFORMATION
1) N. PACIFIC, ABYSSAL

AB001

TAXON NAME	ORIGINAL DISCRIPTION REFERENCE	PHYLUM	VIMS CODE	MODIFY DATE/TIME
MITELLA POLYMERUS	(SOWERBY, 1833)	ARTHROPODA		77/11/16 18.05.43

LEVEL	COLLECTION STATUS	COLLECTION SPECIMENS	OSUBI CATALOG NUMBERS
10	YFS	15	00838 00839

ZOOGEOGRAPHIC INFORMATION
1) N. PAC., INTERTIDAL

AU002

TAXON NAME	ORIGINAL DISCRIPTION REFERENCE	PHYLUM	VIMS CODE	MODIFY DATE/TIME
BRACHYDIASTYLIS RESIMA	($(ROVER, 1846)	ARTHROPODA	6154050301	77/11/28 22.53.01

LEVEL	COLLECTION STATUS	COLLECTION SPECIMENS	OSUBI CATALOG NUMBERS
10	YES	9	00447 00448 00449

ZOOGEOGRAPHIC INFORMATION
1) BEAUFORT SEA

(Listing of information from OLD DATA BASE (TAPE1))

AN EXAMPLE OF A
DIRECTIVE CARD SEQUENCE

```
           12345678901234567890123456789012345678901234567890123456789012345678901234567890 (Column index)

CARD 1     /AA176 00000000000010    17                          3  8  4
CARD 2     ≠AA253
CARD 3     /AUO02 ;        -o 3     -5 01367                   -1  5  6
CARD 4     /AUO02                                               4 10
CARD 5     DAUO02 00447
CARD 6     *ASABELLIDES SIBIRICA (WIREN, 1883)                WMOO4  ANNELIDA
CARD 7     /WMOO4 5001670801 10     -1 00345 01645 01646
CARD 8     /ABOO1                   17 00013

           l234567890l234567890l234567890l234567890l234567890l234567$90l234567890l234567890 (Column index)
```

SPECIES OATA BASE
78/01/18. 15.18.36,

AA176 =MODE=
TAXON NAME: ONISIMUS NANSENI
ORIGINAL DISCRIPTION REFERENCE: (G. SARS, 1900)
PHYLUM: ARTHROPODA
VIMS COOE: 000000000000
MODIFY DATE/TIME: 78/01/18 15.18.36

LEVEL	COLLECTION	STATUS	COLLECTION SPECIMENS	OSUBI CATALOG NUMBERS
10				

ZOOGEOGRAPHIC INFORMATION
1) BEAUFORT SEA 2) BERING SEA 3) N. PACIFIC, ABYSSAL 4) ARCTIC BASIN

ERROR NUMBER 11 CALLED FROM MAIN. INPUT CARDNUMBER 2 WAS LAST CARD READ.
YOU CAN NOT HAVE SPECIMENS H/O CATALOG NUMBERS.NUMBER PURGED.

AA253 =DELE=
TAXON NAME: LEPECHINELLA ECHINATA
ORIGINAL DESCRIPTION REFERENCE: (CHEVREUX, 1914)
PHYLUM: ARTHROPODA
VIMS CODE: 000000600000
MODIFY DATE/TIME: 78/01/18 15.16.36

LEVEL	COLLECTION	STATUS	COLLECTION SPECIMENS	OSUBI CATALOG NUMBERS
10	YES		3	01456 01457

ZOOGEOGRAPHIC INFORMATION
1t N. PACIFIC. ABYSSAL

AU002 =MODE=
TAXON NAME: BRACHYDIASTYLIS RESIMA
ORIGINAL DISCRIPTION REFERENCE: (KROYER, 1846)
PHYLUM: ARTHROPODA
VIMS COOE:
MODIFY DATE/TIME: 78/01/18 15.18.36

LEVEL	COLLECTION	STATUS	COLLECTION SPECIMENS	OS'(JBI CATALOG NUMBERS
	YES	3	4	00448 00449 01367

ZOOGEOGRAPHIC INFORMATION
1) N. PACIFIC, ABYSSAL 2) N. PACIFIC, SLOPE 3) N. PACIFIC, SHELF 4) N. PAC., INTERTIDAL

ERROR NUMBER 10 CALLEO FROM MAIN. INPUT CARDNUMBER 8 WAS LAST CARD READ.
INPUT CARDS ARE NOT PROPERLY SORTED.

WM004 =NEWE=
TAXON NAME: ASABELLIDES SIBIRICA
ORIGINAL DISCRIPTION REFERENCE: (WIREN, 1383)
PHYLUM: ANNELIDA
VIMS CODE: 5001670001
MODIFY DATE/TIME: 78/01/18 15.18.36

LEVEL	COLLECTION	STATUS	COLLECTION SPECIMENS	OSUBI CATALOG NUMBERS
10	YFS		+++	00345 01645 01646

(STUFF Output)

```
   8 CARDS READ.
2196 RECORDS IN OLD DATABASE.
2195 RECORDS IN NEW DATABASE.

   1 RECORDS CREATED.
   2 RECORDS MODIFIED.
   1 RECORDS DELETED.

   2 ERRORS DETECTED.
```

(STUFF output)

GLOSSARY

GLOSSARY

Bit	The bit is the basic unit of a computer word. These programs depend on a 60 bit word, numbered from left to right. The left most bit (commonly called the sign bit) is the number one bit. The right most bit is the 60th bit in a computer word.
[1]Block	This term refers to a collection of 1 to many records.
Database -	A computer file containing 2 to many sections. The first section of the file must be a header section, and the last section must be a trailer section.
[1]Date	This refers to the year, month, day, and time a sample was taken. The date is written in the following format: YYMMDDHHMM. The date forms the prefix of the Date-Level key used by the sample database (MUD).
Directive Character -	A character on the input cards used by the DBM programs to identify the type of information coded on it.
Empty	A variable is empty if it is equal to a -0.0 (77777777777777777777B).
Key	A computer word that controls the processing of one or more records associated with the key.
[1]Level	A group of one to six records whose key is a level number.
[1]Level Number -	A consecutive two digit number that is unique within a section. 00 is always the level number for the first record of a section, and 99 is the level number for the last record in a section.
Primary Key -	A computer word (i.e. variable) that is used to order sections in a database.
Record	A collection of parameters that are transmitted to and from the databases as a unit (i.e. each BUFFER OUT or BUFFER IN) . A record can contain from one to many computer words.
Section	A group of records, which may be organized into a smaller group of blocks, that are associated with a primary key.
Variable	A computer word(s) associated with a specific class of data (e.g. salinity, temperature, NODC code, etc.) , but whose value may change.
Word	This refers to a string of 60 bits, which are manipulated by the computer, and can store data.

---

[1]This term pertains only to the Sample database (MUD).

IX. Summary of 4th Quarter Operations (Fish-Benthos, RU #6)

A. Ship or Laboratory Activities

1. Ship or field trip schedule.
No field work was undertaken this quarter

2. Scientific personnel.

a. Andrew G. Carey, Jr. — Principal Investigator, Associate Professor

Responsibilities: coordination, evaluation, analysis, and reporting

b. James B. Gish — Research Assistant

Responsibilities: data management, statistical analysis. NB: Gish resigned from the position on 9 March 1978; a search is underway for a replacement.

c. Paul Montagna — Research Assistant

Responsibilities: sample processing, biomass measurements, harpacticoid copepod and crustacean systematic, and field collection.

d. R. Eugene Ruff — Research Assistant

Responsibilities: species list compilation, sample processing, reference museum curation, polychaete systematic, field collection, and laboratory management.

e. Paul Scott — Research Assistant

Responsibilities: sample processing, data summary, molluscan systematic and sample collection.

3. Methods: laboratory analyses.

Laboratory methods have not been altered this quarter. The addition of a phase contrast compound microscope from a complementary NSF research program has greatly aided our identifications of invertebrate fauna.

4. Sample localities

Listed in previous reports.

5. Data collected or analyzed.

a) Number and types of samples/observations.

No samples were collected this quarter.

b) Number and types of analyses.

1. Animal density and biomass

Sixty-five 0.1 m^2 Smith-McIntyre grab samples from OCS-5 (August-September 1976) have been picked and sorted to major taxa in the laboratory. The biomass of major phyla was estimated by preserved, wet weights and is summarized in Tables 1-13. Animal densities for the sixty-five grab samples are listed in Tables 14-26.

2. Pelecypod Molluscs

All pelecypod molluscs from the OCS-2 cruise (March 1976) have been sorted to family. This material includes 36 grab samples from five stations between 25 and 100 meters. Representatives of sixteen pelecypod families were found. The results including counts for each family within a grab sample are listed in Table 27. Families represented by shells only are also noted.

3. Polychaetous annelid worms.

All polychaetes from the coastal samples (5-25 meters depth) collected on the 1976 R/V ALUMIAK cruise and the Pitt point transect line across the shelf have been sorted to family. Specimens from the 125 grab samples from 25 stations have been processed through this next stage of sorting and identification. The results including the number of individual specimens per family are summarized in Table no's 28 through 32.

4. Harpacticoid copepod crustaceans have been identified from 19 stations. These species and the abundance data are listed in Table 33. A total of 31 species have been identified to date (see Table 34).

6. Milestone chart and data submission schedule

a. No changes in the schedules for research work and data transmission are anticipated.

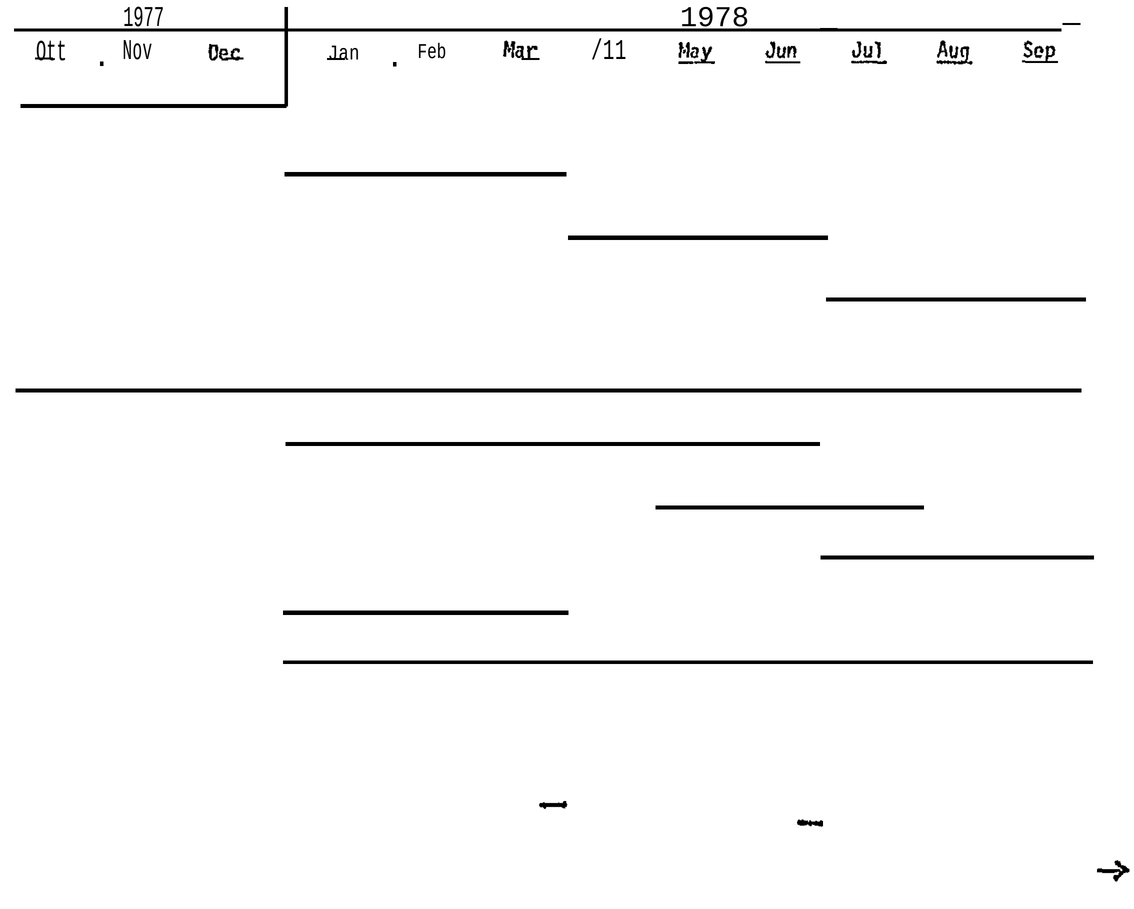
b. The 1977-78 laboratory schedule is shown in Figure 1.

B. Problems encountered/recommended changes.

The lack of time to work up the small macro-infauna from our samples continues to be a basic problem. Continuation of this objective for next contract year is recommended.

Figure 1.

1977-78 Laboratory Schedule - Contract No. 03-5-022-68, Task Order 5.



1. 0$ S-7 continental slope infauna (>1.0 mm) basic picking/sorting.
2. OCS-5 coastal infauna (>1.0 nun) basic picking/sorting (BAB and DPB)
3. OCS-5 coastal infauna (>1.0 mm) basic picking/sorting (BRB+PIB)
4. OCS-7 Pitt Point standard station (PPB) fauna (>1.0 mm) basic picking/sort ing
5. Dominant species identifications (selected groups.
6. Sediment analyses (OCS 1-7)
7. WEBSEC-OCS epi fauna 1 photo survey summary
8. WEBSEC-OCS infaunal survey summary
9. PPB seasonal community analysis - prel imi nary summary
10. Benthi c food web analysis and synthesis
11. Quarterly Reports
12. Data transmission (magnetic tape)
    - a. OCS-7 station data
    - b, Continental slope infauna
    - c. Coastal infauna (BAB and DPB)
    - d. Coastal infauna BRB and PIB)
    - e. Pitt Point (PPB) standard stations
13. Yearly Report

NOTE: OCS-5 = 1976 R/V ALUMIAK coastal cruise; OCS-7 = 1977 USCGC GLACIER summer cruise; WEBSEC = Western Beaufort Sea Ecological Cruise - USCG 1970-73; PPB.Pitt Point Benthos transect line; BAB = Barter kind Benthos transect line; DPB = Demarcation Point Benthos transec t line ; BRB = Barrow Benthos transect line; PIB = Pongok Island Benthos transect line.

Table 1 : Biomass, preserved wet weight in grams per 0.1 m^2 from BRB-5 (OCS-5), collected on 19 August 1976.

Group	1389	1390	1392	1393	1394	Total weight per m^2	% of biomass
	Grab Number						
Anthozoa							
Sipuncula "							
Annelida	.98	.22	.04	.11	.35	3.40	67.5
Arthropods	.17	.04	.02	.02	.01	.52	10.3
Mollusca	.02	.01	.02	.01	.04	.20	4.0
Echinodermata							
Misc. Phyla	.04	.34	.04	.01	.03	.92	18.3
TOTAL	1.21	.61	.12	.15	.43	5.04	100.0

– = absence

Table 2 : Biomass, preserved wet weight in grams per 0.1 m^2 from BRB-10 (OCS-5), collected on 19 August 1976.

Group	1384	1385	1386	1387	1388	Total weight per m^2	% of biomass
	Grab Number						
Anthozoa		.26	-			.52	1.1
Sipuncula							
Annelida	.87	.77	1.39	.25	.45	7.46	15.6
Arthropods	.07	.65	.45	.83	.04	4.08	8.5
Mollusca	2.92	3.64	6.44	2.14	1.14	32.56	68.1
Echinodermata		+	+				
Misc. Phyla	.54	.26	.34	.33	.12	3.18	6.7
TOTAL	4.40	5.58	8.62	3.55	1.75	47.80	100.0

+ = presence, not weighable
– = absence

Table 3 : Biomass, preserved wet weight in grams per 0.1 m^2 from BRB-15 (OCS-5), collected on 19 August 1976.

Group	1377	1378	1379	1381	1382	Total weight per m^2	% of biomass
	Grab Number						
Anthozoa			1.59			3.18	14.8
Sipuncula							
Annelida	.22	.11	.09	.02	.01	.90	4.2
Arthropoda	.54	3.97	.06	3.10	.36	16.06	74.8
Mollusca	.05	.01	.05	.47	.03	1.22	5.7
Echinodermata	.01	-	+			.02	.1
Misc. Phyla	.01	.03	+	+	+	.08	.4
TOTAL	.83	4.12	1.79	3.59	.40	21.46	100.0

+ = presence, not weighable
- = absence

Table 4 : Biomass, preserved wet weights in grams per 0.1 m^2 from BRB-20 (ocs-5), collected on 19 August 1976.

Group	1371	1372	1374	1375	1376	Total weight per m^2	% of biomass
	Grab Number						
Anthozoa	.28					.56	2.4
Sipuncula							
Annelida	5.04	.39	.11	.34	1.05	13.86	58.8
Arthropoda	.62	.13	1.67	.11	.33	5.72	24.3
Mollusca	1.29	.05	.13	.02	.06	3.10	13.1
Echinodermata							
Misc. Phyla	.02	.02	.05	.03	.05	.34	1.4
TOTAL	7.25	.59	1.96	.50	1.49	23.58	100.0

-= absence

Table 5 : Biomass, preserved wet weight in grams per 0.1 m^2 from BRB-25 (OCS-5), collected on 19 August 1976.

Group	Grab Number 1365	1366	1367	1368	1369	Total weight per m^2	% of biomass
Anthozoa	6.52	-	.01	.38	-	13.82	11.4
Sipuncula							
Annelida	4.93	1.06	2.10	1.69	.52	20.60	17.1
Arthropoda	8.25	3.51	.86	1.40	.23	28.50	23.6
Mollusca	13.70	.02	9.05	1.46	3.67	55.80	46.2
Echinodermata	.03	-				.06	0.1
Mist. Phyla	.49	.11	-	.05	.37	2.04	1.7
TOTAL	33.92	4.70	12.02	4.98	4.79	120.82	100.0

-= absence

Table 6: Biomass, preserved wet weight in grams per 0.1 m^2 from PIB-5 (ocs-5), collected on 22 August 1976.

Group	Grab Number 1419	1420	1421	1423	1424	Total weight per m^2	% of biomass
Anthozoa							
Sipuncula							
Annelida	.58	.60	.49	.84	1.16	7.34	83.2
Arthropoda	.03	.47	.06	.05	.02	1..26	14.3
Mollusca	.03	-	.01	-	+	.08	0.9
Echinodermata			+				
Misc. Phyla	.01	.02	.02	.02	+	.14	1.6
TOTAL	.65	1.09	.58	.91	1.18	8.82	100.0

+ = presence, not weighable
- = absence

Table 7 : Biomass, preserved wet weight in grams per 0.1 m^2 from PIB-10 (ocs-5), collected on 22 August 1976.

Group	Grab Number 1425	1426	1427	1429	1430	Total weight per m^2	% of biomass
Anthozoa							
Sipuncula							
Annelida	.87	.78	.87	.77	1.20	8.98	50.7
Arthropods	.04	.04	.03	.07	.12	.60	3.4
Mollusca	.19	-	1.90	1.12	.70	7.82	44.2
Echinodermata	+						
Misc. Phyla	.07	.01	.04	.02	.01	.30	1.7
TOTAL	1.17	.87	2.84	1.98	2.03	17.70	100.0

+ = presence, not weighable
– = absence

Table 8 : Biomass, preserved wet weight in grams per 0.1 m^2 from PIB-15 (OCS-5), collected on 22 August 1976.

Group	Grab Number 1432	1433	1434	1435	1436	Total weight per m^2	% of biomass
Anthozoa							
Sipuncula							
Annelida	1.92	3.65	1.20	1.12	.61	17.00	12.8
Arthropoda	.29	.13	.07	.18	.19	1.72	1.3
Mollusca	4.71	10.24	5.10	9.21	11.44	81.40	61.6
Echinodermata	.02	.12	.04	.08	-	.52	.4
Misc. Phyla	.74	2.73	5.87	3.27	3.19	31.60	23.9
TOTAL	7.68	16.87	12.28	13.86	15.43	132.24	100.0

- = absence

Table 9 : Biomass, preserved wet weights in grams per 0.1 m^2 from BAB-5 (ocs-5) collected on 3 September 1976.

Group	Grab Number 1479	1480	1481	1482	1483	Total weight per m^2	% of biomass
Anthozoa							
Sipuncula							
Annelida	.86	1.77	.58	2.18	.96	12.70	37.6
Arthropoda	.04	2.61	.92	.69	5.05	18.62	55.2
Mollusca		.26	.02	.02	-	.60	1.8
Echinodermata	-						-
Misc. Phyla	.02	.01	.04	.05	-79	1.82	5.4
TOTAL	.92	4.65	1.56	2.94	6.80	33.74	100.0

- = absence

Table 10: Biomass, preserved wet weights in grams per 0.1 m^2 from BAB-10 (OCS-5), collected on 3 September 1976.

Group	Grab Number 1473	1475	1476	1477	1478	Total weight per m^2	% of biomass
Anthozoa							
Sipuncula							
Annelida	1.15	.17	.47	.67	.26	5.44	46.1
Arthropoda	.06	.01	.10	.03	.04	.48	4.1
Mollusca	.22	.26	.58	.64	.62	4.64	39.3
Echinodermata							
Mist. Phyla	.24	.05	.15	.03	.15	1.24	10.5
TOTAL	1.67	.49	1.30	1.37	1.07	11.80	100.0

- = absence

Table 11: Biomass, preserved wet weights in grams per 0.1 m^2 from BAB-15 (OCS-5), collected on 31 August 1976.

Group	Grab Number 1467	1468	1469	1470	1471	Total weight per m^2	% of biomass
Anthozoa	1.25	-		.01	.07	2.66	3.5
Sipuncula		+		.03		.06	0.1
Annelida	1.92	1.63	1.93	1.25	1.12	15.70	20.8
Arthropoda	.14	.08	.06	.06	.03	.74	1.0
Mollusca	1.55	3.07	1.24	6.50	1.46	27.64	36.6
Echinodermata		.04	+	+	.02	.12	0.2
Misc. Phyla	.03	3.16	6.30	4.26	.53	28.56	37.8
TOTAL	4.89	7.98	9.53	12.11	3.23	75.48	100.0

+ = presence, not weighable
- = absence

Table 12: Biomass, preserved wet weights in grams per 0.1 m^2 from BAB-20 (OCS-5), collected on 31 August 1976.

Group	Grab Number 1461	1462	1463	1464	1466	Total weight per m^2	% of biomass
Anthozoa				.81		1.62	5.1
Sipuncula		+		.02		.04	0.1
Annelida	.73	.20	.21	2.33	2.82	12.58	39.3
Arthropoda	.12	.19	.19	.11	.11	1.44	4.5
Mollusca	.17	.19	.12	1.60	1.63	7.42	23.2
Echinodermata	.53	+	+		.22	1.50	4.7
Misc. Phyla	.08	2.44*	.03	.21	.94	7.40	23.1
TOTAL	1.63	3.02	.55	5.08	5.72	32.00	100.0

+ = presence, not weighable
- = absence
*Biomass biased by rare, large specimen

Table 13: Biomass, preserved wet weights in grams per 0.1 m^2 from BAB-25 (OCS-5), collected on 31 August 1976.

Group	Grab' Number 1455	1456	1457	1459	1460	Total weight per m^2	% of biomass
Anthozoa							
Sipuncula							
Annelida	1.46	2.38	.09	2.49	.68	14.20	64.1
Arthropoda	.05	.08	.10	.15	.20	1.16	5.2
Mollusca	.25	.81	.81	.14	.66	5.34	24.1
Echinodermata	.12	.03	.01	.01	.28	.90	4.1
Misc. Phyla	.03	.03	.01	.10	.10	.54	2.4
TOTAL	1.91	3.33	1.02	2.89	1.92	22.14	100.0

- = absence

Table 14: Animal densities for BRB-5 (OCS-5) collected on 19 August 1976.

Phylum	Class	Order	Grab Number 1389	1390	1392	1393	1394	Total per m^2	% of fauna
Nematoda			5	2	3	9	8	54	4.1
Nemertinea			--	4	--	2	1	14	1.1
Annelida:	Polychaeta		124	98	78	104	98	1004	76.2
Echiura			10	3	2	3	11	58	4.4
Priapulida			--	--	--	1	--	2	0.2
Arthropoda:	Crustacea:	Amphipoda	8	4	5	7	6	60	4.6
		Harpacticoida	1	1	--	8	--	20	1.5
		Ostracoda	--	--	--	2	--	4	0.3
		Cumacea	--	1	--	--	--	2	0.2
Mollusca:	Pelecypoda		10	5	10	12	10	94	7.1
	Gastropod		--	2	--	--	--	4	0.3
Echinodermata:	Holothuroidea		1	--	--	--	--	2	0.2
TOTAL			159	120	98	148	134	1318	100.0

Table 15: Animal densities for BRB-10 (OCS-5) collected on 19 August 1976.

Phylum	Class	Order	Grab Number 1384	1385	1386	1387	1388	Total per m^2	% of fauna
Cnidaria:	Anthozoa		--	2	1	--	--	6	0.1
Nematoda			46	9	46	10	17	256	5.8
Nemertinea			--	3	3	2	6	28	0.6
Annelida:	Polychaeta		807	107	229	178	298	3238	72.9
Echiura			--	--	--	2	2	8	0.2
Priapulida			6	--	--	--	--	12	0.3
Arthropoda:	Crustacea:	Amphipoda	19	11	26	18	8	164	3.7'
		Harpacticoida	--	--	--	--	6	12	0.3
		Isopoda	--	--	1	1	--	4	0.1
		Ostracoda	--	1	--	--	3	8	0.2
		Cumacea	1	5	2	4	7	38	0.9
Mollusca:	Pelecypoda		34	81	58	15	17	410	9.2
	Gastropoda		18	17	7	5	5	104	2.3
Echinodermata	:Ophiuroidea		--	2	1	--	--	6	0.1
	Holothuroidea		--	--	--	1	--	2	--
Chordata:	Ascidacea		27	12	21	14	--	148	3.3
TOTAL			958	250	395	250	369	4444	100.0

Table 16: Animal densities for BRB-15 (OCS-5) collected on 19 August 1976.

Phylum	Class	Order	Grab Number 1377	1378	1379	1381	1382	Total per m^2	% of fauna
Cnidaria:	Anthozoa		--	--	1	--	--	2	0.3
Nematoda			--	--	1	6	--	14	1.8
Nemertinea			1	--	--	--	--	2	0.3
Annelida:	Polychaeta		196	13	16	1	1	454	58.1
Echiura			11	--	5	1	--	34	4.3
Priapulida			--	--	1	--	--	2	0.3
Arthropoda:	Crustacea:	Amphipoda	21	32	6	31	10	200	25.6
		Cumacea	2	1	2	--	--	10	1.3
Mollusca:	Pelecypoda		4	2	10	8	3	54	6.9
	Gastropoda		--	--	1		--	2	0.3
Echinodermata	:Ophiuroidea		2	--	1	--	--	6	0.8
	Holothuroidea		--	--	1	--	--	2	0.3
TOTAL			237	48	45	47	14	782	100.0

Table 17. Animal densities for BRB-20 (OCS-5) collected on 19 August 1976.

Phylum	Class	Order	Grab Number 1371	1372	1374	1375	1376	Total per m^2	% of fauna
Cnidaria:	Anthozoa		2		--	--	--	4	0.3
Nematoda			3	1	--	--	--	8	0.5
Nemertinea			--	1	--	--	--	2	0.1
Annelida:	Polychaeta		444	25	11	15	16	1022	68.1
Echiura			2	14	21	9	9	110	7.3
Arthropods:	Crustacea:	Amphipoda	13	18	80	5	11	254	16.9
		Harpacticoida	1	--	--	--	--	2	0.1
		Tanaidacea	1	--	--	--	--	2	0.1
		Cumacea	9	6	2	1	2	40	2.7
Mollusca:	Pelecypoda		22	--	--	1	1	48	3.2
	Gastropod		1	2	--	--	--	6	0.4
Echinodermata:	Holothuroidea		--	--	--	1	--	2	0.1
TOTAL			498	67	114	32	39	1500	100.0

Table 18: Animal densities for BRB-25 (OCS-5) collected on 19 August 1976.

Phylum	Class	Order	Grab Number 1365	1366	1367	1368	1369	Total per m^2	% of fauna
Cnidaria:	Anthozoa		3	--	4	1	--	16	0.6
Nematoda			21	5	--	--	5	62	2.3
Nemertinea			2	3	--	--	--	10	0.4
Annelida:	Polychaeta		196	155	23	69	33	952	35.3
Echiura			26	18	13	5	186	496	18.4
Arthropoda:	Crustacea:	Amphipoda	127	244	27	32	27	914	33.9
		Ostracoda	2	--	--	--	--	4	0.1
		Tanaidacea	3	5	--	--	--	16	0.6
		Cumacea	16	7	5	9	3	80	3.0
	Pycnogonida		3	3	--	--	--	12	0.4
Mollusca:	Pelecypoda		32	10	11	8	4	130	4.8
	Gastropoda		--	1	--	--	--	2	0.1
Chordata:	Ascidacea		1	--	--	--	--	2	0.1
TOTAL			432	451	83	124	258	2696	100.0

Table 19: Animal densities for PIE-5 (OCS-5) collected on 22 August 1976.

Phylum	Class	Order	Grab Number					Total per m^2	% of fauna
			1419	1420	1 4	21423	1424		
Nematoda			1	--	2	1	4	16	1.2
Nemertinea			1	2	3	--	--	12	0.9
Annelida:	Polychaeta		71	110	104	112	176	1146	87.2
Priapulida			4	5	7	3	2	42	3.2
Arthropoda:	Crustacea:	Amphipoda	17	5	2	4	4	64	4.9
		Isopoda	--	1	1	2	--	8	0.6
		Cumacea	1	--	1	6	---	16	1.2
Mollusca:	Pelecypoda		2	--	1	--	2	10	0.8
TOTAL			97	123	121	128	188	1314	100.0

Table 20: Animal densities for PIB-10 (OCS-5) collected on 22 August 1976.

Phylum	Class	Order	Grab Number 1425	1426	1427	1429	1430	Total per m^2	% of fauna
Nematoda			2	8	33	30	12	170	2.3
Annelida:	Polychaeta		475	683	606	436	860	6120	82.9
Priapulida			1	1	4	7	--	26	0.4
Arthropoda:	Crustacea:	Amphipoda	--	1	1	21	3	52	0.7
		Harpacticoida	--	--	6	--	--	12	0.2
		Isopoda	2	--	1	--	4	14	0.2
		Ostracoda	--	16	17	6	--	78	1.1
		Tanaidacea	--	--	1	4	1	12	0.2
		Cumacea	1	2	2	4	3	24	0.3
Mollusca:	Pelecypoda		39	67	109	104	101	840	11.4
	Gastropod		--	6	6	3	3	36	0.5
TOTAL			520	784	786	615	987	7384	100.0

Table 21: Animal densities for PIE-15 (OCS-5) collected on 24 August 1976.

Phylum	Class	Order	Grab Number 1432	1433	1434	1435	1436	Total per m^2	% of fauna
Cnidaria:	Anthozoa		2	1	1	--	--	8	0.4
Nematoda			--	1	2	2	--	10	0.5
Nemertinea			--	3	3	1	3	20	1.1
Annelida:	Polychaeta		53	73	86	107	83	804	42.2
Priapulida			--	--	--	--	1	2	0.1
Arthropoda:	Crustacea:	Amphipoda	4	9	17	12	14	112	5.9
		Isopoda	--	--	3	1	1	10	0.5
		Ostracoda	--	--	4	2	--	12	0.6
		Tanaidacea	--	--	7	--	--	14	0.7
		Cumacea	8	4	1	14	3	60	3.2
	Pycnogonida		--	--	--	--	1	2	0.1
Mollusca:	Pelecypoda		25	53	31	53	58	440	23.1
	Gastropoda		5	3	1	7	7	46	2.4
Echinodermata	:Holothuroidea		2	3	2	1	--	16	0.8
Hemichordata			1	--	--	--	--	2	0.1
Chordata:	Ascidacea		10	47	60	16	40	346	18.2
TOTAL			110	197	218	216	211	1904	100.0

Table 22: Animal densities for BAB-5 (OCS-5) collected on 2 September 1976.

Phylum	Class	Order	Grab Number 1479	1480	1481	1482	1483	Total per m^2	% of fauna
Nematoda			1	14	11	15	1	84	3.9
Nemertinea			3	1	6	1	3	28	1.3
Annelida:	Polychaeta		82	307	136	228	187	1880	87.1
	Oligochaeta		--	--	1	1	--	4	0.2
Priapulida			2	2	1	5	2	24	1.1
Arthropoda:	Crustacea:	Amphipoda	3	4	5	5	7	48	2.2
		Isopoda	--	3	1	1	3	16	0.7
		Ostracoda	1	9	2	4	1	34	1.6
		Cumacea	1	1	--	1	--	6	0.3
Mollusca:	Pelecypoda		--	10	2	5	--	34	1.6
	Gastropoda		--	1	--	--	--	2	0.1
Chordata:	Ascidacea		--	--	--	--	1	2	0.1
TOTAL			93	352	165	265	204	2158	100.0

Table 23: Animal densities for BAB-10 collected on 2 September 1976.

Phylum	Class	Order	Grab Number 1473	1475	1476	1477	1478	Total per m^2	% of fauna
Nematoda			5	9	1	1	10	52	3.4
Nemertinea			2	3	4	5	3	34	2.2
Annelida:	Polychaeta		159	193	75	36	88	1102	71.6
	Oligochaeta		--	--	1	1	--	4	0.3
Priapulida			1	--	--	--	1	4	0.3
Arthropoda:	Crustacea:	Amphipoda	4	1	5	2	5	34	2.2
		Harpacticoida	1	5	--	--	--	12	0.8
		Ostracoda	1	2	2	--	2	14	0.9
		Tanaidacea	--	--	--	1	--	2	0.1
		Cumacea	--	2	--	--	--	4	0.3
Mollusca:	Pelecypoda		14	4	30	11	39	196	12.7
	Gastropod		4	12	4	5	7	64	4.2
Chordata:	Ascidacea		2	--	2	3	1	16	1.0
TOTAL			193	232	124	65	156	1540	100.0

Table 24: Animal densities for BAB-15 (OCS-5) collected on 31 August 1976.

Phylum	Class	Order	Grab Number 1467	1468	1469	1470	1471	Total per m^2	% of fauna
Cnidaria:	Anthozoa		1	--	--	1	1	6	0.1
Nematoda			44	38	22	21	8	266	6.0
Nemertinea			6	4	5	10	4	58	1.3
Annelida:	Polychaeta		268	272	211	111	117	1958	44.1
	Oligochaeta		2	5	--	--	1	16	0.4
Sipuncula			--	1	--	13	--	28	0.6
Priapulida			2	1	1	1	3	16	0.4
Kinorhyncha			--	--	--	2	--	4	0.1
Arthropoda:	Crustacea:	Amphipoda	20	6	2	3	3	68	1.5
		Harpacticoida	92	77	10	33	2	428	9.6
		Isopoda	1	--	--	2	1	8	0.2
		Ostracoda	54	52	20	31	3	320	7.2
		Tanaidacea	7	3	21	16	1	96	2.2
		Cumacea	5	3	5	1	1	30	0.7
Mollusca:	Pelecypoda		37	123	57	94	83	788	17.7
	Gastropoda		16	20	16	19	13	168	3.8
Echinodermata	:Ophiuroidea		--	19	3	1	3	52	1.2
Chordata:	Ascidacea		5	11	8	27	16	134	3.0
TOTAL			560	635	381	386	259	4442	100.0

Table 25: Animal densities for BAB-20 (OCS-5) collected on 31 August 1977.

Phylum	Class	Order	Grab Number 1461	1462	1463	1464	1466	Total per m^2	% of fauna
Cnidaria:	Anthozoa		--	--	--	5	1	12	0.2
Nematoda			80	--	3	21	415	1038	18.1
Nemertinea			10	1	6	5	10	64	1.1
Kinorhyncha			--	--	--	--	7	14	0.2
Annelida:	Polychaeta		131	50	42	104	973	2600	45.2
	Oligochaeta		17	--	--	1	27	90	1.6
Sipuncula			1	1	--	4	1	14	0.2
Priapulida			5	2	1	4	5	34	0.6
Arthropods:	Crustacea:	Amphipoda	5	17	19	12	20	146	2.5
		Harpacticoida	8	--	2	--	225	470	8.2
		Isopoda	--	--	“2	--	19	42	0.7
		Ostracoda	,9	--	--	--	82	182	3.2
		Tanaidacea	41	2	11	8	89	302	5.3
		Cumacea	9	8	10	18	13	116	2.0
Mollusca:	Pelecypoda		25	16	11	25	196	546	9.5
	Gastropoda		2	2	3	4	14	50	0.9
Echinodermata	:Ophiuroidea		1	--	--	1	1	6	0.1
	Holothuroidea		--	--	2	--	1	6	0.1
Hemichordata			--	. -	--	--	2	4	0.1
TOTAL			344	99	113	213	21134	5746	100.0

Table 26: Animal densities for BAB-25 (OCS-5) collected on 31 August 1976.

Phylum	Class	Order	Grab Number 1455	1456	1457	1459	1460	Total per m^2	% of fauna
Cnidaria:	Anthozoa		1	--	--	--	--	2	0.2
Nematoda			8	10	--	6	57	162	15.9
Nemertinea			2	1	1	5	8	34	3.3
Annelida:	Polychaeta		27	33	26	12	76	348	34.2
	Oligochaeta		--	--	--	--	2	4	0.4
Priapulida			2	4	--	1	5	24	2.4
Arthropoda:	Crustacea:	Amphipoda	4	2	6	6	5	46	4.5
		Isopoda	--	1	--	--	--	2	0.2
		Tanaidacea	--	1	--	--	--	2	0.2
		Cumacea	2	4	5	5	28	88	8.6
Mollusca:	Pelecypoda		25	30	28	7	32	244	24.0
	Gastropoda		4	2	2	3	9	40	3.9
Echinodermata	:Ophiuroidea		1	--	--	--	3	8	0.8
	Holothuroidea		3	1	1	1	1	14	1.4
TOTAL			79	89	69	46	226	1018	100.0

Table 27: Counts of individual specimens in each family of pelecypod molluscs from OCS-2, collected in March 1976. * Denotes presence of shell only.

STATION: PPB-25

Grab Number	Family	Count of live specimens
1103	Nuculanidae	*
	Pandoridae	*
	Nuculidae	*
	Veneridae	*
	Tellinidae	*
		0
1104	Nuculanidae	12
	Thyasiridae	4
	Nuculidae	1
	Pectinidae	*
	Lyonsiidae	*
	Veneridae	*
	Cardiidae	*
		17
1105	Nuculanidae	6
	Thyasiridae	3
	Pandoridae	*
	Nuculidae	*
	Cardiidae	*
	Myidae	*
		9
1106	Nuculanidae	1
	Nuculidae	*
		1
1107	Nuculidae	3
	Thyasiridae	1
	Nuculanidae	*
	Cardiidae	*
	Tellinidae	*
	Myidae	*
		4

STATION: PPB-40

Grab Number	Family	Count of live specimens
1115	Nuculanidae	3
	Thyasiridae	2
	Lyonsiidae	1
	Nuculidae	*
	Astartidae	*
	Tellinidae	*
		6

Table 27: (continued)

STATION: PPB-40 (cont.)

Grab Number	Family	count of live specimens
1116	Thyasiridae	1
	Tellinidae	1
	Nuculidae	*
	Nuculanidae	*
	Pectinidae	*
		2
1117	Thyasiridae	1
	Nuculidae	*
	Nuculanidae	*
	Tellinidae	*
	Astartidae	*
	Pectinidae	*
		1
1118	Nuculidae	1
	Nuculanidae	*
	Astartidae	*
	Tellinidae	*
	Pectinidae	*
		1
1119	Nuculanidae	*
	Astartidae	*
		0
1120	Nuculidae	2
	Thyasiridae	1
	Nuculanidae	*
	Astartidae	*
	Tellinidae	*
		3

STATION: PPB-55

Grab Number	Family	count of live specimens
1121	Nuculidae	1
	Nuculanidae	16
	Astartidae	22
	Tellinidae	1
	Pectinidae	6
	Mytilidae	2
	Veneridae	2
	Hiatellidae	*
	Pandoridae	*
	Cardiidae	*
		50

Table 27: (continued)

STATION: PPB-55 (cont.)

Grab Number	Family	Count of live specimens
1122	Nuculidae	2
	Nuculanidae	14
	Astartidae	7
	Pectinidae	6
	Cardiidae	1
	Pandoridae	1
	Veneridae	2
	Tellinidae	*
	Carditidae	*
	Lyonsiidae	*
		33
1123	Nuculidae	2
	Nuculanidae	8
	Astartidae	17
	Tellinidae	1
	Pectinidae	3
	Cardiidae	2
	Pandoridae	1
	Carditidae	1
	Veneridae	5
	Mytilidae	*
		40
1124	Nuculanidae	*
	Astartidae	*
	Pectinidae	*
	Veneridae	*
		0
1125	Nuculanidae	2
	Astartidae	1
	Nuculidae	*
	Carditidae	*
		3
1126	Nuculidae	4
	Nuculanidae	6
	Astartidae	8
	Tellinidae	4
	Pectinidae	2
	Cardiidae	1
	Veneridae	3
		28

Table 27: (continued)

STATION: PPB-55 (cont.)

Grab Number	Family	Count of live specimens
1127	Nuculidae	1
	Nuculanidae	1
	Astartidae	4
	Tellinidae	1
	Veneridae	2
	Pectinidae	*
	Cardiidae	*
	Pandoridae	*
		9
1128	Nuculidae	*
	Nuculanidae	*
	Astartidae	*
	Pectinidae	*
	Cardiidae	*
	Tellinidae	*
	Veneridae	*
		0
1129	Nuculanidae	1
	Astartidae	4
	Carditidae	1
	Nuculidae	*
	Tellinidae	*
	Pectinidae	*
	Cardiidae	*
	Veneridae	*
	Mytilidae	*
		6
1130	Nuculidae	3
	Nuculanidae	6
	Astartidae	9
	Tellinidae	1
	Veneridae	1
	Carditidae	2
	Pandoridae	*
	Mytilidae	*
		22

STATION: PPB-70

Grab Number	Family	Count of live specimens
1108	Nuculidae	5
	Nuculanidae	6
	Pectinidae	1
	Cardiidae	1

Table 27: (continued)

STATION: PPB-70 (cont.)

Grab Number	Family	Count of live specimens
1108 (cont.)	Astartidae	14
	Mytilidae	2
	Lyonsiidae .	1
	Pandoridae	1
	Tellinidae	*
	Veneridae	*
		31
1109	Nuculidae	5
	Nuculanidae	12
	Astartidae	18
	Tellinidae	6
	Pectinidae	1
	Cardiidae	2
	Pandoridae	2
	Mytilidae	5
	Veneridae	1
		51
1110	Nuculidae	2
	Nuculanidae	11
	Astartidae	8
	Pectinidae	2
	Cardiidae	1
	Thraciidae	1
	Lyonsiidae	2
	Veneridae	1
	Myidae	*
	Tellinidae	*
		28
1111	Nuculidae	4
	Nuculanidae	8
	Astartidae	15
	Tellinidae	2
	Cardiidae	1
	Pandoridae	1
	Lyonsiidae	1
	Hiatellidae	1
		33
1114	Nuculidae	3
	Nuculanidae	3
	Astartidae	8
	Tellinidae	1
	Pectinidae	3

Table 27: (continued)

STATION: PPB-70 (cont.)

Grab Number	Family	Count of live specimens
1114 (cont.)	Cardiidae	2
	Mytilidae	5
	Hiatellidae	1
		26

STATION: PPB-100

Grab Number	Family	Count of live specimens
1131	Nuculidae	8
	Nuculanidae	2
	Astartidae	13
	Tellinidae	2
	Thyasiridae	1
	Pectinidae	1
	Mytilidae	1
	Veneridae	1
	Hiatellidae	1
	Carditidae	*
		30
1132	Nuculidae	3
	Astartidae	6
	Tellinidae	1
	Thyasiridae	1
		11
1133	Nuculidae	6
	Astartidae	7
	Pectinidae	1
	Veneridae	1
	Carditidae	2
		17
1134	Nuculanidae	1
	Astartidae	5
	Thyasiridae	1
		7
1135	Nuculidae	2
	Nuculanidae	1
	Astartidae	2
	Veneridae	1
	Carditidae	*
		6
1136	Nuculidae	5
	Astartidae	6
	Veneridae	2
	Nuculanidae	*
		13

Table 27: (continued)

STATION PPB-100 (cont.)

Grab Number	Family	count of live specimens
1137	Nuculidae	4
	Nuculanidae	2
	Astartidae	9
	Veneridae	1
	Carditidae	*
		16
1138	Nuculidae	5
	Nuculanidae	1
	Astartidae	6
	Tellinidae	1
	Veneridae	1
	Malletidae	*
		14
1139	Nuculidae	1
	Nuculanidae	2
	Astartidae	7
	Tellinidae	1
	Mytilidae	1
	Lyonsiidae	1
	Veneridae	1
	Cardiidae	*
		14
1140	Nuculidae	3
	Nuculanidae	1
	Astartidae	11
	Thyasiridae	1
	Carditidae	*
		16

Table 28: Polychaete totals by family from grab samples taken off Barrow, Alaska. Five Smith-McIntyre grabs were obtained at each station, and the counts represent 0.5 m^2 of ocean bottom. The station designations are indicative of the water depth in meters.

	BRB 5	BRB 10	BRB 15	BRB 20	BRB 25
AMPHARETIDAE :	6	13		7	22
APISTOBRANCHIDAE:					
CAPITELLIDAE :	13	47	3	7	36
CHAETOPTERIDAE :					
CIRRATULIDAE :	14	24	2	9	18
COSSURIDAE :				1	
DORVILLEIDAE :	1	4			
FLABELLIGERIDAE :	1	70	2	2	
GONIADIDAE :					
HESIONIDAE :	51	1			4
LUMBRINERIDAE :				1	1
MAGELONIDAE :		1			
MALDANIDAE :					
NEPHTYIDAE :	81	38	6	158	44
NEREIDAE :					
ONUPHIDAE :					
OPHELIIDAE :		1			
ORBINIIDAE :	17	30	1	2	12
OWENIIDAE :					
PARAONIDAE :		1			
PECTINARIIDAE :	6	1150	175	244	173
PHYLLODOCIDAE :	18	45	7	19	48
POLYNOIDAE :	5	7	14	13	24
SABELLIDAE :	12	10			
SCALIBREGMIDAE :		1			
SERPULIDAE :					
SIGALIONIDAE :		7	2	1	25
SPHAERODORIDAE :					
SPINTHERIDAE :					
SPIONIDAE :	215	33	9	24	5$
STERNASPIDAE :				4	2
SYLLIDAE :		4	4		
TEREBELLIDAE :		2			
TRICHOBRANCHIDAE :		4	1		
TROCHOCHAETIDAE :					
unidentified :					
TOTALS :	440	1493	226	492	467

Table 29: Polychaete totals by family from grab samples taken off Pitt Point, Alaska. Five Smith-McIntyre grabs were obtained at each station, and the counts represent 0.5 m^2 of ocean bottom. The station designations are indicative of the water depth in meters.

	PPB 5	PPB 10	PPB 15	PPB 20
AMPHARETIDAE :	296	2		5
APISTOBRANCHIDAE :	5	1	1	
CAPITELLIDAE :	35	26	11	38
CHAETOPTERIDAE :				
CIRRATULIDAE :	40	59	2	18
COSSURIDAE :	1		4	8
DORVILLEIDAE :	10			
FLABELLIGERIDAE :		1		
GONIADIDAE :				
HESIONIDAE :			2	5
LUMBRINERIDAE :				
MAGELONIDAE :				
MALDANIDAE :		1		1
NEPHTYIDAE :	1	7	7	9
NEREIDAE :				
ONUPHIDAE :				
OPHELIIDAE :	1		1	2
ORBINIIDAE :	243	20		
OWENIIDAE :				
PARAONIDAE :		13	8	28
PECTINARIIDAE :				4
PHYLLODOCIDAE :	39	16	2	4
POLYNOIDAE :		4		4
SABELLIDAE :	185	142		
SCALIBREGMIDAE :		6		
SERPULIDAE :				
SIGALIONIDAE :	13			1
SPHAERODORIDAE :	98	3	1	
SPINTHERIDAE :				
SPIONIDAE :	769	70	243	19
STERNASPIDAE :		6		1
SYLLIDAE :	1		1	1
TEREBELLIDAE :	4	24		1
TRICHOBRANCHIDAE :	151	14		
TROCHOCHAETIDAE :				2
unidentified :				
TOTALS :	1892	43.5	283	151

Table 29: (cont.) Polychaete totals by family from grab samples taken off Pitt Point, Alaska. Five Smith-McIntyre grabs were obtained at each station, and the counts represent 0.5 m^2 of ocean bottom. The station designations are indicative of the water depth in meters.

	PPB 25	PPB 40	PPB 55	PPB 70	PPB 100
AMPHARETIDAE :	2	27	101	59	33
APISTOBRANCHIDAE :	36	4	7		15
CAPITELLIDAE :	1	54	49	12	180
CHAETOPTERIDAE :					33
CIRRATULIDAE :	52	125	6$	105	164
COSSURIDAE :	22			1	57
DORVILLEIDAE :	1	10	15	10	6
FLABELLIGERIDAE :		1	41	26	1
GONIADIDAE :			6		1
HESIONIDAE :		2	5	20	6
LUMBRINERIDAE :	4	38	45	53	119
MAGELONIDAE :		6			
MALDANIDAE :	1	115	44	27	42
NEPHTYIDAE :	66	14	53	31	201
NEREIDAE :					
ONUPHIDAE :		38	25	2	42
OPHELIIDAE :	8	2	26	6	7
ORBINIIDAE :	2	14	6		64
OWENIIDAE :		1	51	35	14
PARAONIDAE :	65	111	47	45	97
PECTINARIIDAE :	4		1		
PHYLLODOCIDAE :		12	21	14	14
POLYNOIDAE :	2	12	20	12	7
SABELLIDAE :	4	49	97	158	15
SCALIBREGMIDAE :			3	6	
SERPULIDAE :		2			
SIGALIONIDAE :	1	34	117	199	60
SPHAERODORIDAE :	11		6	6	8
SPINTHERIDAE :			1		
SPIONIDAE :	15	66	120	267	22
STERNASPIDAE :	46	12			2
SYLLIDAE :	1	13	26	31	5
TEREBELLIDAE :	14	7	15	31	5
TRICHOBRANCHIDAE :		17	120	78	12
TROCHOCHAETIDAE :		1	3		2
unidentified :					
TOTALS :	35$	787	1139	1234	1231

Table 30: Polychaete totals by family from grab samples taken off Pingok Island, Alaska. Five Smith-McIntyre grabs were obtained at each station, and the counts represent p.5 m^2 of ocean bottom. The station designations are indicative of the water depth in meters.

	PIB 5	PIB 10	PIB 15
AMPHARETIDAE :	22	11	158
APISTOBRANCHIDAE :	1		
CAPITELLIDAE :	6	26	15
CHAETOPTERIDAE :			
CIRRATULIDAE :	55	75	16
COSSURIDAE :		39	
DORVILLEIDAE :	3	7	
FLABELLIGERIDAE :	8		
GONIADIDAE :			
HESIONIDAE :	17		
LUMBRINERIDAE :			
MAGELONIDAE :			
MALDANIDAE :	123	1	
NEPHTYIDAE :	18	43	1
NEREIDAE :			
ONUPHIDAE :			
OPHELIIDAE :	4		
ORBINIIDAE :	25		3
OWENIIDAE :			
PARAONIDAE :	2	1	
PECTINARIIDAE :			
PHYLLODOCIDAE :	9	23	7
POLYNOIDAE :	4	1	
SABELLIDAE :	16	212	33
SCALIBREGMIDAE :	5	1	
SERPULIDAE :	1		
SIGALIONIDAE :	29		
SPHAERODORIDAE :	1	127	16
SPINTHERIDAE :			
SPIONIDAE :	43	2369	322
STERNASPIDAE :	4	7	
SYLLIDAE :			
TEREBELLIDAE :			
TRICHOBRANCHIDAE :	2	5	1
TROCHOCHAETIDAE :			
unidentified :	1		
TOTALS :	399	2948	572

Table 31: Polychaete totals by family from grab samples taken off Narwhal Island, Alaska. Five Smith-McIntyre grabs were obtained at each station, and the counts represent 0.5 m^2 of ocean bottom. The station designations are indicative of the water depth in meters.

	NIB 5	NIB 10	NIB 15
AMPHARETIDAE :	35	385	14
APISTOBRANCHIDAE :			1
CAPITELLIDAE :	37	9	24
CHAETOPTERIDAE :			
CIRRATULIDAE :	29	90	87
COSSURIDAE :			
DORVILLEIDAE :	5	2	19
FLABELLIGERIDAE :	5	8	10
GONIADIDAE :			
HESIONIDAE :	130	25	16
LUMBRINERIDAE :			1
MAGELONIDAE :			
MALDANIDAE :	3	5	20
NEPHTYIDAE :		2	24
NEREIDAE :			
ONUPHIDAE :			
OPHELIIDAE :		3	9
ORBINIIDAE :		2	5
OWENIIDAE :			
PARAONIDAE :			1
PECTINARIIDAE :			
PHYLLODOCIDAE :	2	25	26
POLYNOIDAE :	2	5	5
SABELLIDAE :	79	8	15
SCALIBREGMIDAE :	5	45	4
SERPULIDAE :			
SIGALIONIDAE :			9
SPHAERODORIDAE :		15	1
SPINTHERIDAE :			
SPIONIDAE :	249	752	47
STERNASPIDAE :			
SYLLIDAE :		5	8
TEREBELLIDAE :	11	2	
TRICHOBRANCHIDAE :	32	37	5
TROCHOCHAETIDAE :			
unidentified :		1	
TOTALS :	624	1426	352

Table 32: Polychaete totals by family from grab samples taken off Barter Island, Alaska. Five Smith-McIntyre grabs were obtained at each station, and the counts represent 0.5 m^2 of ocean bottom. The station designations are indicative of the water depth in meters.

	BAB 5	BAD 10	BAB 15	BAB 20	BAB 25
AMPHARETIDAE :	225	40	12	48	1
APISTOBRANCHIDAE :		10	16	90	2
CAPITELLIDAE :	20	13	38	75	43
CHAETOPTERIDAE :					
CIRRATULIDAE :	27	32	168	332	43
COSSURIDAE :				31	6
DORVILLEIDAE :	3	3	72	19	3
FLABELLIGERIDAE :		3	42	173	5
GONIADIDAE :					
HESIONIDAE :	5	1	88	54	4
LUMBRINERIDAE :			1	1	
MAGELONIDAE :					
MALDANIDAE :		1	125	49	1
NEPHTYIDAE :		18	143	151	14
NEREIDAE :					
ONUPHIDAE :					1
OPHELIIDAE :			7	47	14
ORBINIIDAE :	117	16	2	17	4
OWENIIDAE :					
PARAONIDAE :		1	25	79	
PECTINARIIDAE :			1	5	
PHYLLODOCIDAE :	8	15	15	7	7
POLYNOIDAE :	3		6	5	5
SABELLIDAE :	12$		20	14	
SCALIBREGMIDAE :		7	3	6	
SERPULIDAE :					
SIGALIONIDAE :			6	25	3
SPHAERODORIDAE :	137	4		3	
SPINTHERIDAE :					
SPIONIDAE :	252	365	167	21	17
STERNASPIDAE :				16	
SYLLIDAE :	1		- 1	3	
TEREBELLIDAE :	3	4		3	
TRICHOBRANCHIDAE :	11	18	7	21	1
TROCHOCHAETIDAE :					
unidentified :			14	6	
TOTALS :	940	551	97'9	1301	174

Table 33: Harpacticoid copepods found during seasonal sampling of the Pitt Point transect.

Cruise	Station	Species	No. /m^2
OCS-1 Oct. '75	PPB-55	Tisbe furcata	6
		Harpacticus superflexus	4
		Pseudocervinia magna	2
		Typhlamphiascus lamellifer	2
		Halectinosoma neglectum	2
		Total	16
	PPB-100	Tisbe furcata	50
		Halectinosoma neglectum	32
		Pseudocervinia magna	26
		Parananopus echinipes	24
		Harpacticus superflexus	12
		Typhlamphiascus lamellifer	12
		Danielssenia fusiformis	8
		Thalestris figida	4
		Bradya typica	2
		Total	170
OCS-2 Mar. '76	PPB-25	Pseudocervinia magna	2
	PPB-25	Paramphiascopsis giesbrechti	2
	PPB-55	Pseudocervinia magna	7
		Paramphiascopsis giesbrechti	7
		Harpacticus superflexus	1
		Thalestris frigida	1
		Halectinosoma neglectum	1
		Total	17
	PPB-70	Pseudocervinia magna	20
		Bradya typica	2
		Halectinosoma neglectum	2
		Total	24
	PPB-100	Pseudocervinia magna	10
		Paramphiascopsis giesbrechti	7
		Bradya typica	3
		Typhlamphiascus lamellifer	2
		Parathalestris jacksoni	2
		Parananopus echinipes	1
		Cervinia synarthra	1
		Total	26

Table 33: (continued)

Cruise	Station	Species	No. /m²
OCS-3 May '76	PPB-25	Pseudocervinia magna	1
		Paramphiascopsis giesbrechti	1
		Total	2
	PPB-40	Typhlamphiascus lamellifer	4
		Halectinosoma neglectum	4
		Total	8
	PPB-55	Pseudocervinia magna	30
		Paramphiascopsis giesbrechti	11
		Bradya typica	10
		Paranannopus echinipes	5
		Argestes mollis	4
		Eurycletodes arcticus	4
		Eurycletodes serratus	2
		Halectinosoma neglectum	2
		Zaus sp. 'A	2
		Zosime sp. A	2
		Total	72
	PPB-70	Paramphiascopsis giesbrechti	8
		Pseudocervinia magna	2
		Typhlamphiascus lamellifer	2
		Sarsameira elongata	2
		Total	14
	PPB-100	Paranannopus echinipes	30
		Paramphiascopsis giesbrechti '	26
		Pseudocervinia magna	10
		Bradya typica	8
		Eurycletodes arcticus	4
		Halectinosoma neglectum	2
		Total	80
OCS-4 Aug. '76	PPB-25	Pseudocervinia magna	6
	PPB-55	Paranannopus echinipes	12
		Pseudocervinia magna	10
		Harpacticus superflexus	2
		Typhlamphiascus lamellifer	2
		Total	26
	PPB-70	Harpacticus superflexus	2
	PPB-100	Harpacticus superflexus	18
		Paranannopus echinipes	10
		Pseudocervinia magna	2
		Paramphiascopsis giesbrechti	2
		Bradya typica	2
		Proameira dubia	2
		Total	36

Table 33: (continued)

Cruise	Station	Species	No. \m²
OCS-6 NOV. '76	PPB-55	Paranannopus echinipes	10
		Harpacticus superflexus	2
		Zaus sp. A	2
		Total	14
	PPB-70	Pseudocervinia magna	2
		Harpacticus superflexus	2
		Total	4
	PPB-100	Paranannopus echinipes	2
		Pseudocervinia magna	2
		Total	4

Table 34: Updated List for the Beaufort Sea Harpacticoida (Copepoda), 31 species found.

Ameiridae
- Proameira dubia (Sars, 1920)
- Sarsameira elongata (Sars, 1909)

Cerviniidae
- Cervinia bradya Norman, 1878
- Cervinia synarthra Sars, 1903
- Pseudocervinia magna (Smirnov, 1946)

Cletodidae
- Argestes mollis Sars, 1910
- Eurycletodes arcticus Lang, 1936
- Eurycletodes serratus Sars, 1920
- Mesocletodes 'monensis (I.C. Thompson, 1893)
- Paranannopus echinipes Smirnov, 1946

Diosaccidae
- Amphiascus propinqvus Sars, 1906
- Paramphiascella fulvofasciata Rosenfield and Coull, 1975
- Paramphiascopsis giesbrechti (Sars, 1906)
- Stenhelia proxima Sars, 1911
- Stenhelia nuwukensis M.S. Wilson, 1965
- Stenhelia sp. B
- Stenhelia sp. C
- Typhlamphiascus lamellifer (Sars, 1911)

Ectinosomidae
- Bradya confluens Lang, 1936
- Bradya typica Boeck, 1872
- Halectinosoma neglectum (Sars, 1940)
- Halectinosoma sp. A

Harpacticidae
- Harpacticus superflexus Willey, 1920
- Harpacticus uniremis Kroyer, 1842
- Zaus sp. A

Tachidiidae
- Danielssenia fusiformis (Brady and Robertson, 1875)
- Thompsonula hyaenae (I.C. Thompson, 1889)

Thalestridae
- Parathalestris jacksoni (.T.Scott, 1898)
- Thalestris frigida T. Scott, 1898

Tisbidae
- Tisbe furcata (Baird, 1837)
- Zosime sp. A