INFAUNA OF THE NORTHEASTERN BERING AND SOUTHEASTERN CHUKCHI SEAS

by

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I. SUMMARY OF OBJECTIVES, CONCLUSIONS, AND IMPLICATIONS WITH RESPECT TO OCS OIL AND GAS DEVELOPMENT

The objectives of this study were: (1) a quantitative inventory of dominant infaunal invertebrates (inclusive of small, slow-moving epifaunal species) at selected stations in the study areas, (2) a description of spatial distribution patterns of species in the designated study areas, and (3) limited observations of biological interrelationships, emphasizing trophic interactions, between selected segments of the benthic biota.

A total of 47 widely dispersed stations for quantitative grab sampling were established in the eastern Bering and southeastern Chukchi Seas and were analyzed for this report. The stations were primarily located within or adjacent to the sites of four oil lease areas: the Zhemchug Basin, the Navarin Basin, the St. Matthew Basin, and the Hope Basin. Stations were also occupied within and near the Chirikov Basin.

Six hundred and forty-seven taxa were identified. It is probable that all taxa with numerical and biomass importance have been collected in the areas of investigation and that only rare taxa will be added in future sampling.

Criteria established for Biologically Important Taxa (BIT) delineated 128 taxa, with 62 of these identified as important in biomass at one or more stations.

Multivariate techniques were employed to examine groupings of stations and taxa in the study areas. In order to use multivariate techniques, a significant reduction in the number of taxa to be used in the analyses was necessary. Only those taxa identified to at least the generic level, occurring at three or more stations, and designated as BIT, were included in the numerical analyses; 189 such taxa were included.

The combined use of the multivariate techniques of cluster and principal coordinate analyses led to generalizations concerning station groups and species assemblages in the study areas:

1. A normal cluster analysis of transformed density data produced eleven station groups at the 21% similarity level. Three large station groups

(A′, B, and D) were identified within and adjacent to the Navarin Basin lease area. One major station group (B) and two minor single-station groups (Station 74 [Group F] and Station 73 [Group C]) made up the Zhemchug Basin lease area. One small station group (Group E) described the St. Matthew Basin lease area. Two small station groups (Groups C and H) were identified within and adjacent to the Hope Basin lease area. A distinctive station (Group I; Station 31) occurred north of Etolin Strait and Nunivak Island. Two small station groups occurred adjacent to Cape Nome (Group A") and north of St. Lawrence Island (Group J). One station (Group G; Station 56) characterized Bering Strait, and a small station group (Group F) was located just north of the strait.

2. Forty-two species groups were identified by an inverse cluster analysis of transformed density data at the 23% similarity level. The distribution of twenty of these groups showed a good association with the major station groups.

3. A normal cluster analysis of untransformed density data produced ten station groups at the 22% similarity level. This analysis , which places emphasis on the dominant species, resulted in one major station group (A′1) encompassing most of the Navarin Basin and Zhemchug Basin lease areas; all of the stations in these lease areas deeper than 100 m were included in this group. The status of none of the other station groups changed with this analysis.

The percent frequency of occurrence of motility and feeding classes in station groups that were formed by cluster analysis of *ln*-transformed density was calculated. The most frequent type of motility in each station group was of taxa that were motile. Deposit-feeding organisms dominated the feeding classes in all station groups.

Knowledge of species composition within the station groups in the eastern Bering and southeastern Chukchi Seas made it possible to make a preliminary assessment of the ecological consequences of damage to or loss of any of the known or prospective food species within the stations or station groups. Many of the more common deposit-feeding infaunal species in the Zhemchug and Navarin Basin lease areas were actual or potential food resources for bottom-feeding species (e.g., Tanner crab and bottom fishes), and loss of any or all of these food organisms could disrupt the trophic system involving these species. The dense populations of infaunal species in the vicinity of the St. Matthew Basin lease area comprised many organisms commonly taken by benthic predators elsewhere in the Bering Sea, and damage to large numbers of these organisms could negatively affect as yet unknown biological interactions in the region. In addition, the large numbers of tubes of the polychaete *Myriochele oculata* in the area just north of Etolin Strait and Nunivak Island (and adjacent to the St. Matthew Basin lease area) stabilize the bottom sediments there. Loss of or damage to a large segment of this polychaete population could destabilize the bottom sediments, resulting in the establishment of a new complement of dominant species. Obvious ecological changes might be expected if such damage occurred. A similar major ecological alteration of the bottom could occur in the Chirikov Basin, where large populations of tube-dwelling ampeliscid amphipods occurred. The latter problem could be compounded if recovery of the amphipod population did not take place prior to the annual summer feeding migration of gray whales *(Eschrichtius robustus)* to the area. The amphipods are a major food of the whales at this time, so depletion of the resource could be detrimental to these mammals. The Chirikov Basin and the region in the vicinity of St. Lawrence Island also contain dense populations of bivalve mollusks and other benthic food species that are used intensively at various periods of the year by bearded seals *(Erignathus barbatus)* and walruses *(Odobenus rosmarus divergent).* contamination or loss of these food items would negatively affect a sizable percent of the populations of these mammals. The high benthic biomass characteristically observed in the Bering Strait and the southeastern Chukchi Sea in the vicinity of the Hope Basin lease area represents both a reservoir of food used by bottom-feeding fishes in warm years and a year-round food resource for the Tanner crabs *(Chionoecetes opilio)* resident in this region. The latter area is relatively shallow and could be easily contaminated by petroleum. Damage or loss of the high standing stocks of benthic food organisms could be critical to the predatory species that frequent the region, some of which (e.g., Tanner crab and flatfishes) are near the northern limits of their range.

Initial assessment of all data for the study areas suggests that: (1) sufficient station group uniqueness exists to permit development of monitoring programs based on taxon composition within the groups, using grab sampling, multivariate analysis, and selected statistical techniques; and (2) adequate numbers of biologically relatively well-known, abundant~ and/or large species are available to permit nomination of likely monitoring candidates for the areas if oil-related activity is initiated.

II. INTRODUCTION

General Nature and Scope of Study

The operations connected with oil exploration, production, and transportation in the Bering and Chukchi Seas present a wide spectrum of potential dangers to the marine environment (see Olson and Burgess, 1967, for general discussion of marine pollution problems). Adverse effects on the marine environment of these areas cannot be quantitatively assessed, or even predicted, unless background data are acquired prior to industrial development.

Insufficient long-term information about an environment, and the basic biology and recruitment of species in that environment, can lead to erroneous interpretations of changes in types and density of species that might occur if the area becomes altered (see Pearson, 1971, 1972, 1975; Nelson-Smith, 1973; Rosenberg, 1973; and Pearson and Rosenberg, 1978, for general discussions of benthic biological investigations in industrialized marine areas). Populations of marine species fluctuate over a time span of a few to 30 years (Lewis, 1970; personal communication). Such fluctuations are typically unexplainable because of absence of long-term data on physical and chemical environmental parameters in association with biological information on the species involved (Lewis, 1970; personal communication).

Benthic organisms (primarily the infauna, but also the sessile and slow-moving epifauna) are particularly useful as indicator species for a disturbed area because they tend to remain in place, typically react to long-range environmental changes, and, by their presence, generally reflect the nature of the substratum. Consequently, the organisms of the infaunal benthos have frequently been chosen to monitor long-term pollution effects and are believed to reflect the biological health of a marine area (see Pearson, 1971, 1972, 1975; Rosenberg, 1973; and Pearson and Rosenberg, 1978, for discussion on long-term usage of benthic organisms for monitoring the effects of pollution).

The presence of large numbers of benthic epifaunal species of actual or potential commercial importance (crabs, shrimps, snails, finfishes) in the Bering Sea further dictates the necessity of understanding benthic communities, since many commercial species feed on infaunal and small epifaunal residents of the benthos (see Zenkevitch, 1963; Feder *et al.*, *1980a,* b; and Feder and Jewett, 1981a, for discussions of the interaction of commercial species and the benthos). Any drastic changes in density of the food benthos could affect the health and numbers of these commercially important species.

Experience in pollution-prone areas of England (Smith, 1968), Scotland (Pearson, 1972, 1975; Pearson and Rosenberg, 1978), and California (Straughan, 1971) suggests that, at the completion of an initial exploratory study, selected stations should be examined regularly on a long-term basis to determine whether any post-development changes in species content, diversity, density, and/or biomass have taken place. Such long-term data acquisition should make it possible to differentiate between normal ecosystem variation and pollutant-induced biological alteration. Intensive investigations of the benthos of the Bering and Chukchi Seas are also essential for an understanding of both the trophic interactions involved in these areas and of the potential changes that could take place once oil-related activities are initiated. The benthic macrofauna of the Bering and Chukchi Seas is relatively well known taxonomically, and some data on distribution, density, general biology, and feeding mechanisms are reported in the literature (Feder and Mueller, 1977; Feder *et al.,* 1978; Stoker, 1978; Feder and Jewett, 1978, 1980). The relationship of specific infaunal feeding types with certain substrate conditions has been documented (although in a limited fashion) as well (Haflinger, 1978; Feder et al., 1980b). However, detailed information on the temporal and spatial variability of the benthic fauna is sparse, and the relationship of benthic species with the overlying seasonal ice cover is not known. Some of the macrofaunal benthic species may be negatively affected by oil-related activities. An understanding of these benthic species and their interactions with each other and with various aspects of the abiotic features of their environment are essential to the development of environmental predictive capabilities for the Bering and Chukchi Seas.

The benthic biological program in the northeastern Bering Sea and the southeastern Chukchi Sea during this project emphasized development of an inventory of species as part of the overall examination of the biological, physical, and chemical components of those portions of the shelf slated for oil exploration and drilling activity. In addition, computer programs developed for use with data collected in the northeast Gulf of Alaska, and designed to quantitatively assess assemblages of benthic species on the shelf there, were applicable to this study (Feder and Matheke, 1980). The resultant computer analysis expands the understanding of distribution patterns of species in the study area.

The research program was designed to survey the benthic fauna on the northeastern Bering Sea and southeastern Chukchi Sea shelf in regions of offshore oil and gas concentrations. During the first phases of research, emphasis was placed on the collection of data on faunal composition and abundance of shelf infauna to develop baselines to which potential future changes could be compared. Future development of long-term studies on life histories and trophic interactions should clarify which components of the various species groups are vulnerable to environmental damage, and should ultimately help to determine the rates at which damaged environments can recover.

Specific Objectives

1. To quantitatively inventory of dominant infaunal invertebrates at selected stations in the study areas.
2. To describe spatial distribution patterns of species in the designated study areas.
3. To make limited observations of biological interrelationships, emphasizing trophic interactions, among selected segments of the benthic biota.

Relevance to Problems of Petroleum Development

The effects of oil pollution on subtidal benthic organisms have been seriously neglected, although a few studies, conducted after serious oil spills, have been published (see Boesch et al., 1974) for a review of these papers). Thus, lack of a broad data base elsewhere makes it difficult at present to adequately predict the effects of oil-related activity on the subtidal benthos of the Bering and Chukchi Seas. However, research activities in Alaska OCSEAP areas should ultimately enable us to point with some confidence to certain species or regions that might bear closer scrutiny once industrial activity is initiated. It must be emphasized that a considerable time frame is needed to understand long-term fluctuations in density of marine benthic species. Thus, it cannot be expected that short-*term* research programs will result in predictive capabilities: assessment of the environment must be conducted on a continuing basis.

As indicated previously, infaunal benthic organisms tend to remain in place and, consequently, have been useful as an indicator species for disturbed areas. Thus, close examination of stations with substantial complements of infaunal species is warranted. Changes in the environment at stations with relatively large numbers of species might be reflected in a decrease in species diversity, with increased dominance of a few (see Nelson-Smith, 1973, for further discussion of oil-related changes in diversity). Likewise, stations with substantial numbers of epifaunal species should be assessed on a continuing basis (Feder and Jewett, 1978, 1980). The potential effects of loss of specific species to the overall trophic structure in the Bering and Chukchi Seas cannot be fully assessed at this time, but the problem can probably be better addressed using preliminary information on benthic food studies now available in Feder and Jewett (1978, 1980, 1981a), Smith et al. (1978) and Jewett and Feder (1980).

Data indicating the effect of oil on subtidal benthic invertebrates are fragmentary; however, echinoderms are “notoriously sensitive” to any reduction in water quality (Nelson-Smith, 1973). Echinoderms (ophiuroids, asteroids, and holothuroids) are conspicuous members of the benthos of the Bering and Chukchi Seas (Feder and Jewett, 1978, 1980; Jewett and Feder, 1981) , and could be affected by oil activities there. Asteroids (sea stars) and ophiuroids (brittle stars) are often important components of the diet of large crabs (for example, the king crab feeds on sea stars and brittle stars: Feder and Jewett, 1981a, b; Jewett and Feder, in press) and demersal fishes (Jewett and Feder, 1980; Feder, unpubl. data). The Tanner or snow crab *(Chionoecetes opilio)* is a conspicuous member of the shallow shelf of the Bering and Chukchi Seas. Laboratory experiments with C. *bairdi* have shown that postmolt individuals lose most of their legs after exposure to Prudhoe Bay crude oil (Karinen and Rice, 1974); obviously, this aspect of the biology of the snow crab must be considered in the continuing assessment of this species. Little other direct data based on laboratory experiments are available for subtidal benthic species (Nelson-Smith, 1973).

A direct relationship between trophic structure (feeding type) and bottom stability has been demonstrated by Rhoads (1974). A diesel-fuel oil spill resulted in oil becoming adsorbed on sediment particles, with the resultant mortality of many deposit-feeders living on sublittoral muds. Bottom stability was altered with the death of these organisms, and a new complex of species became established in the altered substrate. The most common members of the infauna of the eastern Bering and southeastern Chukchi Seas are deposit-feeders (data of present report); thus, oil-related mortality of these species could result in a changed near-bottom sedimentary regime, with subsequent alteration of species composition.

As suggested above, upon completion of initial baseline studies in pollution prone areas, selected stations should be examined regularly on a long-term basis. Cluster analysis techniques discussed below, supplemented by principal coordinate analysis, should provide information useful for selection of stations to be used for continuous monitoring of infauna. In addition, these techniques should provide insight into normal ecosystem variation (Williams and Stephenson, 1973; Stephenson *et al., 1974;* Clifford and Stephenson, 1975). Also, future examination of the biology (e.g., age, growth, condition, reproduction, recruitment, and feeding habits) of selected species should offer clues to possible effects of environmental alteration.

111. CURRENT STATE OF KNOWLEDGE

Data on distribution, density, and feeding mechanisms for infaunal species from the Bering and Chukchi Seas are reported in the literature (Neiman, 1960; Filatova and Barsanova, 1964; Kuznetsov, 1964; Rowland, 1973; Stoker, 1973; Feder and Mueller, 1977; Stoker, 1978; Feder and Jewett, 1980). The relationship of specific infaunal feeding types with certain hydrographic and sediment conditions has been documented (Neiman, 1960, 1963; Stoker, 1973, 1978). However, the direct relationship of these feeding types with the overlying winter ice cover and its contained algal material and with primary productivity in the water column is not known. Preliminary insights into the mechanisms that might integrate the water column and the benthos of the southeastern Bering Sea are included in Alexander and Cooney (1979) and Alexander and Niebauer (1981).

Neiman (1963) discussed the distribution of the benthic biomass in the Bering Sea. She found that the biomass was highest in the western and northern parts of the shelf, reaching a maximum average of 905 g/m^2 in the Chirikov Basin, north of St. Lawrence Island. The primary productivity of the Bering Sea is quite high, averaging 1.46 mg C/m^3-hr in Bristol Bay and 1.71 mg C/m^3-hr over the major part of the northern shelf in summer (Taniguchi, 1969). Summer productivity in the Chirikov Basin be even higher, with 18.2 mg C/m^3-hr recorded at one station sampled (McRoy *et al.*, 1972). This productivity compares favorably with the highest values encountered in the world's oceans (Stoker, 1978).

The biomass and productivity of microscopic sediment-dwelling bacteria, diatoms, microfauna, and meiofauna have not been determined for the Bering and Chukchi Seas, and their roles should ultimately be clarified. It is probable that these organisms are important agents for recycling nutrients and energy from sediment to the overlying water mass (see Fenchel, 1969, for a general review),

Until the initiation of OCSEAP investigations, the epifauna of the eastern Bering and Chukchi Seas had been little studied since the trawling activities of the Harriman Alaska Expedition (Merriam, 1904). Limited information can be obtained from the report of the pre-World War II king crab investigations (Anonymous, 1942) and from the report of the *Pacific Explorer* fishing and processing operations in 1948 (Wigutoff and Carlson, 1950). Some information on species found in areas is included in reports of the U.S. Fish and Wildlife Service Alaska exploratory fishing expedition to the northern Bering Sea in 1949 (Ellson et al., 1949). Neiman (1960) has published a quantitative report on the molluscan communities in the eastern Bering Sea. A phase of the research program conducted by the King Crab Investigation of the Bureau of Commercial Fisheries (now known as National Marine Fisheries Service) for the International North Pacific Fisheries Commission included an ecological study of the eastern Bering Sea during the summers of 1958 and 1959 (McLaughlin, 1963). Sparks and Pereyra (1966) have presented a partial checklist and general discussion of the benthic fauna encountered during a marine survey of the southeastern Chukchi Sea during the summer of 1959. Their marine survey was carried out in the southeastern Chukchi Sea from Bering Strait to just north of Cape Lisburne and west to 169°W longitude. Some species described by them in the Chukchi Sea extend into the Bering Sea and are important there. An intensive survey of the epifauna of the northeastern Bering Sea and southeastern Chukchi Sea is reported in Feder and Jewett (1978) and Jewett and Feder (1981). Epifauna collected by them is described in terms of numbers and biomass trawled. They also include data on the food of several species of benthic invertebrates and fishes.

Crabs and bottom-feeding fishes of the Bering and Chukchi Seas exploit a variety of food types, with benthic invertebrates most important (see Feder and Jewett, 1980; Feder and Jewett, 1981a). Some marine mammals of the Bering Sea also feed on benthic species (Lowry and Burns, 1976; Lowry *et al.*, 1979, in press; Frost and Lowry, 1981; Lowry and Frost, 1981). Walruses and bearded seals feed predominantly on what appear to be slow-growing species of mollusks, but most species of seals prefer the more rapidly growing crustaceans and fishes in their diets (Fay et al., 1977; Lowry and Frost, 1981). Gray whales primarily eat amphipod crustaceans, many of them infaunal species; they are also reported to eat a variety of other benthic organisms. Marine mammals, although showing food preferences, are opportunistic feeders. As a consequence of the broad spectrum of foods utilized and the exploitation of secondary and tertiary consumers, marine mammals are difficult to place in a trophic scheme and to assess in terms of energy cycling. Intensive trawling and oil-related activities on the Bering Sea shelf may have important ecological effects on infaunal and epifaunal organisms used as food by marine mammals. If benthic trophic relationships are altered by these industrial activities, the food regimes of marine mammals may be altered.

Bibliographies of northern marine waters, emphasizing the Bering Sea, are included in Feder and Mueller (1977), Feder and Jewett (1978), Feder et al. (1980b), and Jewett and Feder (1981).

IV. STUDY AREAs

A series of van Veen grab stations were occupied in or near four prospective OCS petroleum lease areas in the northeastern Bering Sea and southeastern Chukchi Sea: Navarin Basin, Zhemchug Basin, St. Matthew Basin, and Hope Basin; stations were also occupied in the Chirikov Basin (Fig. 1; Table I).

V. SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

Field and Laboratory

Benthic infauna were collected on two cruises on the USCGC *Polar Star*, one in *1979* and the other in 1980. The April 1979 cruise occurred in the northeastern Bering and southeastern Chukchi Seas. A total of 18 stations were sampled during this cruise. The 1980 cruise consisted of two segments (legs). The first leg (2-29 May 1980) yielded collections from 33 stations, 25 in the top-priority Navarin Basin lease area and 8 in the St. Matthew Basin lease area. Leg II took place between 1 and 26 June 1980. Samples came from 12 stations between St. Lawrence Island and Bering Strait (Chirikov Basin), 7 stations in or near the Hope Basin, and 7 stations in or near the Zhemchug Basin. An additional 14 benthic stations were occupied for Mary Nerini, National Marine Fisheries Service, Seattle, in the Chirikov Basin; her data will be reported elsewhere.

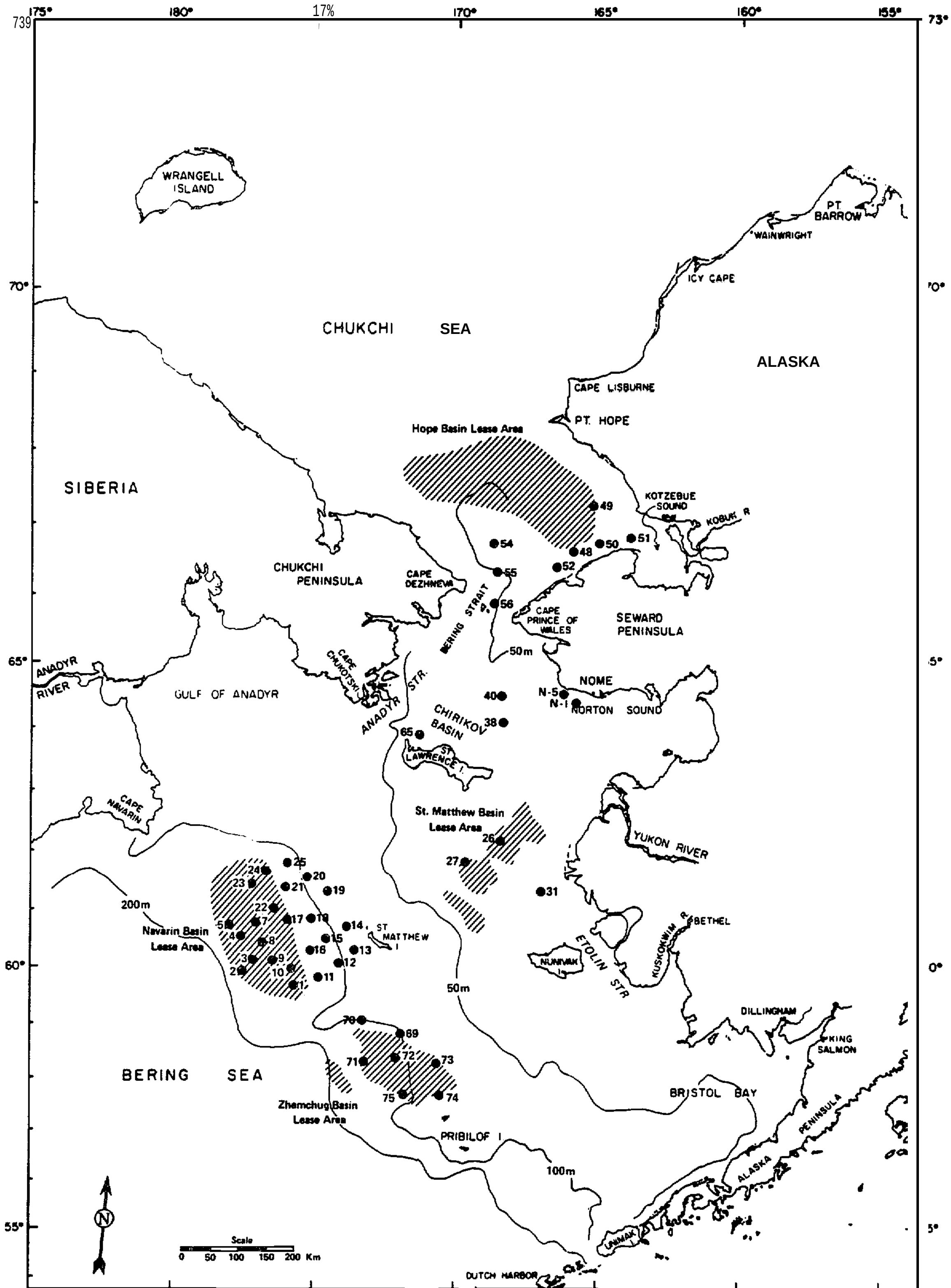

Figure 1. Map showing the location of stations occupied in this study.

TABLE I

BENTHIC STATIONS ANALYZED FROM THE NORTHEASTERN BERING SEA AND THE SOUTHEASTERN CHUKCHI SEA, APRIL 1979 AND MAY-JUNE 1980

Station No.	Date	Total Grab Vol.[a] (ℓ)	Depth[b] (m)	Coordinates[c] Latitude	Coordinates[c] Longitude
<u>Navarin Basin</u>					
1	4 May 1980	73	135.6	59°31.6'N	176°08.9'W
2	5 May 1980	36	162.6	59°44.2'N	177°49.2'W
3	5 May 1980	64	136.4	60°00.1'N	177°30.8'W
4	6 May 1980	35	165.6	60°26.6'N	178°17.6'W
5	6 May 1980	32	193.8	60°38.6'N	178°41.1'W
7	8May 1980	69	144.2	60°43.5'N	177°38.3'W
8	8May 1980	71	147.0	60°25.8'N	177°16.5'W
9	9 May 1980	73	141.8	60°01.8'N	176°55.2'W
10	9 May 1980	69	140.8	59°47.2'N	176°11.6'W
11	10 May 1980	66	122.6	59°43.7'N	175°01.2'W
12	10 May 1980	69	103.0	59°58.5'N	174°11.7'W
13	11 May 1980	36	78.2	60°14.6'N	173°44.3'W
14	11 May 1980	95	85.2	60°42.8'N	174°06.0'W
15	12 May 1980	80	102.6	60°30.2'N	174°45.1'W
16	12 May 1980	73	117.8	60°13.3'N	175°28.0'W
17	13 May 1980	74	116.0	60°49.5'N	176°16.3'W
18	13 May 1980	75	101.8	60°59.4'N	175°30.1'W
19	14 May 1980	76	81.4	61°29.8'N	174°44.4'W
20	14 May 1980	85	90.8	61°42.9'N	175°34.3'W
21	15 May 1980	83	103.2	61°31.9'N	176°15.5'W
22	15 May 1980	65	121.4	61°01.9'N	177°03.5'W
23	16 May 1980	62	124.4	61°30.2'N	177°27.7'W
24	16 May 1980	73	115.0	61°48.1'N	177°07.3'W
25	17 May 1980	77	102.4	62°00.2'N	176°22.3'W
<u>St. Matthew Basin</u>					
26	22May 1980	18	34.6	62°10.4'N	168°59.1'W
27	23 May 1980	49	46.4	61°44.8'N	170°22.3'W
31	25 May 1980	18	22.4	61°14.8'N	167°08.9'W
<u>St. Lawrence Island to Bering Strait</u>					
38	5 Jun 1980	39	34.0	64°01.6'N	168°31.4'W
40	6 Jun 1980	34	39.8	64°23.7'N	168°31.2'W
56	16 Jun 1980	9	51.6	65°46.0'N	168°35.0'W
65	18 Jun 1980	33	23.0	63°50.9'N	171°23.2'W
1	19 Apr 1979	-	22.0	64°17.4'N	165°56.3'W
5	21 Apr 1979	-	22.0	64°30.7'N	166°23.6'W

TABLE I

CONTINUED

Station No.	Date	Total Grab Vol.[a] (ℓ)	Depth[b] (m)	Coordinates[c] Latitude	Longitude
Hope Basin					
48	8 Jun 1980	12	18.6	66°35.5'N	165°58.9'W
49	9 Jun 1980	61	29.8	67°08.7'N	165°12.8'W
50	11 Jun 1980	55	22.8	66°48.1'N	165°00.0'W
51	12 Jun 1980	65	24.0	66°50.0'N	163°52.0'W
52	13 Jun 1980	13	12.8	66°21.2'N	166°36.0'W
54	15 Jun 1980	22	32.2	66°46.0'N	168°41.0'W
55	15 Jun 1980	39	53.2	66°19.2'N	168°35.0'W
Zhemchug Basin (N.W. of Pribilof Islands)					
69	21 Jun 1980	61	102.0	58°45.3'N	172°19.4'W
70	21 Jun 1980	40	134.4	58°50.8'N	173°55.5'W
71	22 Jun 1980	19	122.4	58°00.0'N	173°45.0'W
72	22 Jun 1980	56	103.4	58°16.4'N	172°21.3'W
73	23 Jun 1980	50	79.6	58°13.9'N	170°41.6'W
74	23 Jun 1980	20	72.2	57°29.6'N	170°28.3'W
75	24 Jun 1980	49	109.4	57°31.0'N	172°18.1'W

[a] Total volume from five grabs

[b] Mean depth of five grabs

[c] Mean coordinate of five grabs

Quantitative samples were taken with a 0.1 m^2 van Veen grab with bottom penetration facilitated by addition of 31.7 kg (70 pounds) of lead weight to each grab. Two 1.0 mm mesh screen doors on top of the grab served to decrease shock waves produced by bottom grabs (see Feder and Matheke, 1979, for discussion of grab operation and effectiveness of the van Veen grab). Five replicate grabs were typically taken at all stations on all cruises (see discussion of optimum number of replicates that should be taken in a grab-sampling program in Feder and Matheke, 1979). Material from each grab was washed on a 1.0 mm mesh stainless steel screen and preserved in 10% formalin buffered with hexamine. Samples were stored in plastic bags.

Forty-seven stations were analyzed in the laboratory (Institute of Marine Science, University of Alaska, Fairbanks). Time limitations necessitated a reduction in the number of stations examined. However, station selections were based on the need for adequate biological coverage in and adjacent to each of the OCS petroleum lease areas addressed by this report. Samples were rinsed to remove the last traces of sediment, spread on a tray, covered with water, and rough-sorted by hand. The biotic material was then transferred to fresh preservative (buffered 10% formalin), and identifications were made. All organisms were counted and wet-weighed after excess moisture was removed with absorbent towel.

Numerical Analysis

Criteria developed by Feder and Matheke (1980) to recognize Biologically Important Taxa (BIT) were applied to the data. By use of these criteria, each species was considered independently (items 1, 2, and 3 below) , as well as in combination with other benthic species (items 4 and 5; adopted from Ellis, 1969). Each taxon classified as a BIT in this study meets at least one of the four conditions below:

1. It is distributed in 50% or more of the total stations sampled.

2. & 3. It comprises over 10% of either the composite population density or biomass collected at any one station.

4. Its population density is significant at any given station. The significance is determined by the following test:

a. A percentage of the total density of all taxa is calculated for each taxon, with the sum of percentages of the total population density of all taxa at each station equaling 100%.

b. These percentages are then ranked in descending order.

c. The percentages of the taxa are summed in descending order until a cut-off point of 50% is reached. The BIT are those taxa whose percentages are used to reach the 50% cut-off point. When the cut-off point of 50% is exceeded by the percentage of the last taxon added, this taxon is also included.

Station groups and species assemblages were identified using cluster analysis. Cluster analysis can be divided into three basic steps:

1. Calculation of a measure of similarity or dissimilarity between entities to be classified.
2. Sorting through a matrix of similarity coefficients to arrange the entities in a hierarchy or dendrogram.
3. Recognition of classes within the hierarchy.

Data reduction prior to calculation of similarity coefficients consisted of elimination of both taxa that could not be identified to genus and taxa that occurred at fewer than three stations. If a taxon was a Biologically Important Taxon (Appendix A) , it was retained, however. Taxa which could be identified to genus but which may have included more than one species were also eliminated from the analysis. This treatment reduced the number of taxa to 189 (Table II).

The Czekanowski coefficient was used to calculate a similarity matrix for cluster analysis. The Czekanowski coefficient is a quantitative modification of the Sørenson coefficient, which is based on the presence or absence of particular attributes.

Sørenson

$$Cs_{1,2} = \frac{2C}{A + B}$$

where A = total number of attributes of entity one
B = total number of attributes of entity two
C = total attributes shared by entities one and two

[1]The Czekanowski coefficient is synonymous with the Motyka (Mueller-Dombois and Ellenberg, 1974) and Bray-Curtis (Clifford and Stephenson, 1975) coefficients.

TABLE II

SPECIES SELECTED FOR NUMERICAL ANALYSIS OF GRAB DATA

Polychaeta

Antinoella sarsi
Arcteobea anticostiensis
Arcteobea spinelytris
Gattyana ciliata
Gattyana cirrosa
Gattyana treadwelli
Harmothoe imbricata
Hesperone complanata
Tenonia kitsapensis
Nemidia tamarae
Pholoe minuta
Anaitides groenlandica
Anaitides mucosa
Eteone longa
Typosyllis alternata
Eusyllis blomstrandi
Nephtys assimilis
Nephtys ciliata
Nephtys caeca
Nephtys punctata
Nephtys rickettsi
Nephtys longosetosa
Glycinde picta
Onuphis sp.
Onuphis conchylega
Onuphis geophiliformis
Onuphis iridescens
Drilonereis filum
Drilonereis falcata minor
Haploscoloplos elongatus
Scoloplos armiger
Aricidea lopezi
Aricidea minuta
Tauberia gracilis
Apistobranchus tullbergi
Laonice cirrata
Polydora socialis
Prionospio cirrifera
Prionospio steenstrupi
Spio filicornis
Spiophanes bombyx
Magelona pacifica
Spiochaetopterus typicus
Spiochaetopterus costarum
Tharyx secundus
Chaetozone setosa
Brada villosa

Polychaeta (continued)

Flabelligera mastigophora
Scalibregma inflatum
Ammotrypane aulogaster
Ophelia limacina
Travisia forbesii
Travisia pupa
Sternaspis scutata
Capitella capitata
Heteromastus filiformis
Heteromastus giganteus
Mediomastus capensis
Barantolla americana
Maldane sarsi
Maldane glebifex
Axiothella catenata
Praxillella gracilis
Praxillella praetermissa
Rhodine gracilior
Owenia fusiformis
Myriochele heeri
Myriochele oculata
Amphictene moorei
Cistenides granulata
Ampharete acutifrons
Ampharete finmarchica
Amphicteis gunneri
Lysippe labiata
Melinna cristata
Asabellides sibirica
Neoleprea spiralis
Pista cristata
Pista elongata
Pista brevibranchiata
Artacama conifera
Terebellides stroemi
Chone infundibuliformis
Chone cincta
Euchone analis
Euchone longifissurata
Potamilla neglecta
Laonome kroyeri
Aphrodita negligens

Aplacophora

Chaetoderma robusta

TABLE II

CONTINUED

Bivalvia

Nucula tenuis
Nuculana pernula
Nuculana fossa
Yoldia amygdalea
Yoldia hyperborea
Yoldia myalis
Yoldia thraciaeformis
Astarte borealis
Cyclocardia sp.
Cyclocardia crebricostata
Axinopsida serricata
Axinopsida viridis
Thyasira flexuosa
Diplodonta aleutica
Mysella tumida
Mysella aleutica
Odontogena borealis
Clinocardium ciliatum
Serripes groenlandicus
Liocyma sp.
Liocyma fluctuosa
Psephidia lordi
Macoma calcarea
Macoma brota
Hiatella arctica

Gastropod

Lepeta caeca
Solariella obscura
Solariella varicosa
Tachyrhynchus erosus
Natica clausa
Polinices pallidus
Fusitriton oregonensis
Buccinum sp.
Neptunea lyrata
Oenopota excurvata
Retusa obtusa
Cylichna alba

Copepoda

Calanus plumchrus
Metridia lucens

Cirripedia

Balanus crenatus

Cumacea

Hemilamprops pectinata
Leucon nasica
Eudorella emarginata
Eudorella pacifica
Eudorella dentata
Eudorellopsis integra
Eudorellopsis deformis
Eudorellopsis uschakovi
Diastylis alaskensis
Diastylis bidentata
Diastylis paraspinulosa
Campylaspis umbensis

Isopoda

Synidotea bicuspids
Pleurogonium rubicundum
Pleurogonium spinosissimum

Amphipoda

Ampelisca macrocephala
Ampelisca birulai
Ampelisca eschrichti
Ampelisca furcigera
Byblis gaimardi
Corophium crassicornis
Ericthonius hunteri
Melita dentata
Melita quadrispinosa
Pontoporeia femorata
Urothoe sp.
Urothoe denticulata
Photis spasskii
Protomedeia fasciata
Protomedeia chelata
Anonyx nugax
Anonyx *laticoxae*
Anonyx sarsi
Opisa eschrichti
Bathymedon nanseni

TABLE II

CONTINUED

Amphipoda (continued)

Machaironyx muelleri
Paroediceros lynceus
Westwoodilla caecula
Nicippe tumida
Harpinia kobjakovae
Harpinia gurjanovae
Paraphoxus robustus
Paraphoxus oculatus
Tiron biooulata

Decapoda

Argis lar
Pagurus trigonocheirus
Chionoecetes opilio

Sipunculida

Golfingia margaritacea

Echiuroidea

Echiurus echiurus alaskanus

Priapulida

Priapulus caudatus

Ectoprocta

Alcyonidium disciforme

Asteroidea

Ctenodiscus crispatus

Echinoidea

Echinarachnius parma

Ophiuroidea

Diamphiodia sp.
Diamphiodia craterodmeta
Ophiura sarsi

Holothuroidea

Cucumaria sp.

Teleostei

Ammodytes hexapterus

Czekanowski

$Cs_{1,2} = \frac{2W}{A + B}$ where A = the sum of the measures of attributes of entity one
B = the sum of the measures of attributes of entity two
W = the sum of the lesser measures of attributes shared by entities one and two

The Czekanowski coefficient has been used effectively in marine benthic studies by Field and MacFarlane (1968), Field (1969, 1970, and 1971), Day *et al.* (1971), Stephenson and Williams (1971), Stephenson *et al.* (1972) and Feder and Matheke (1980). This coefficient emphasizes the effect of dominant species on the classification, and is often used with some form of transformation. The Czekanowski coefficient was used to calculate similarity matrices for normal cluster analysis (with stations as the entities to be classified and species as their attributes) and inverse cluster analysis (with species as entities and stations as attributes), using both *ln*-transformed and untransformed density data (individuals/m^2). The natural logarithm transformation, $Y = ln(X+1)$, reduces the influence that dominant species have on the similarity determination. Dendrograms were constructed from the similarity matrices using a group-average agglomerative hierarchical cluster analysis (Lance and Williams, 1966).

As an aid in the interpretation of dendrograms formed by cluster analysis, two-way coincidence tables comparing site groups formed by normal analysis and species groups formed by inverse analysis were constructed (Stephenson *et al.*, 1972). In each table, the original species x station data matrix was rearranged (based on the results of both normal and inverse analysis) so the stations or species with the highest similarities were adjacent to each other. The two-way coincidence table was then divided into cells whose elements are the abundance of each of the species in a species group at each of the stations in a station group. The two-way coincidence tables were then reduced to create a table of average cell densities (De) by summing the values of all the elements (n) in each cell and dividing the resulting sums by the product of the number of species (Nsp) in the appropriate species group and the number of stations (Nst) in the appropriate station group, as in

$$Dc = \frac{\Sigma n}{(Nsp)\ (Nst)}$$

Principal coordinate analysis (Gower, 1967, 1969) was used as an aid in interpreting the results of the cluster analysis (Stephenson and Williams, 1971; Boesch, 1973) and in identifying misclassifications of stations by cluster analysis. Misclassifications in an agglomerative cluster analysis can occur by the early fusion of two stations and their subsequent incorporation into a group whose stations have a high similarity to only one member of the original pair (Boesch, 1973). In principal coordinate analysis, an interstation similarity matrix is generated as in normal cluster analysis. The similarity matrix generated can be conceived of as a multi-dimensional space in which the stations are arranged in such a way that they are separated from one another according to their similarities, with the most similar stations being closest. An ordination is then performed on the matrix to extract axes from this multidimensional space, so that stations' relationships can be depicted in two or three dimensions. The first axis extracted coincides with the longest axis and accounts for the largest amount of variation in the similarity matrix; subsequent axes account for successively smaller amounts of variation in the data. The Czekanowski coefficient was used to calculate the similarity matrices used in principal coordinate analysis.

Diversity

Species diversity can be thought of as a measurable attribute of a collection or a natural assemblage of species and consists of two components: the number of species, or "species richness", and the relative abundance of each species, or "evenness". The two most widely used measures of diversity that include species richness and evenness are the Brillouin (1962) and Shannon (Shannon and Weaver, 1963) information measures of diversity (Nybakken, 1978). There is still disagreement on the applicability of these indices, and results are often difficult to interpret (Sager and Hasler, 1969; Hurlbert, 1971; Fager, 1972; Peet, 1974; Pielou, 1966a, b). Pielou (1966a, b, 1977) has outlined some of the conditions under which these indices are appropriate.

The Shannon function

$$H' = -\sum_i p_i \log p_i$$

where $p_i = \frac{n_i}{N}$

n_i = number of individuals in the ith species
N = total number of individuals

assumes that a random sample has been taken from an infinitely large population, whereas the Brillouin function

$$H = \frac{1}{N} \log \frac{N!}{n_1!n_2!\cdots n_s!}$$

is appropriate only if the entire population has been sampled. Thus, if we wish to estimate the diversity of the fauna at a station, the Shannon function is appropriate. The Brillouin function is merely a measure of the diversity of the five grab samples taken at each station and makes no predictions about the diversity of the benthic community from which the samples were drawn. The evenness of samples taken at each site can be calculated using the Brillouin measure of evenness, $J = H/H_{maximum}$, where H = Brillouin diversity function. $H_{maximum}$, the maximum possible diversity for a given number of species, occurs if all species are equally common and is calculated as:

$$H_{maximum} = \frac{1}{N} \log \frac{N!}{\{[N/s]!\}^{s-r}\{([N/s]+1)!\}^{r}}$$

where [N/s] = the integer part of N/s
s = number of species in the censused community
r = N - s[N/s]

Theoretically, the evenness component of the Shannon function can be calculated from the following:

$$J' = \frac{H'}{\log s^*}$$

where H′ = Shannon diversity function
s* = the total number of species in the randomly sampled community

However, s*, the total number of species in a randomly sampled community, is seldom known for benthic infaunal communities. Therefore, the evenness component of the Shannon diversity index was not calculated (for a discussion, see Pielou, 1977). Both the Shannon and Brillouin diversity indices were calculated in a study by Feder and Matheke (1980), and they were closely correlated (r = 0.97), indicating that either index would be acceptable, as both Loya (1972) and Nybakken (1978) have suggested. Species richness (Margalef, 1958) was calculated *as*

$$SR = \frac{(S-1)}{\ln N}$$

where S = the number of species
N = the total number of individuals

The Simpson index (Simpson, 1949) was also calculated:

$$D = 1-\Sigma \frac{n_i(n_i-1)}{N(N-1)}$$

where N = total number of individuals
n_i = number of individuals in the i^{th} species

These indices were calculated for all stations sampled.

The Simpson Index is an indicator of dominance, since the maximum value, one, is obtained when there is a single species (complete dominance); values approaching zero are obtained when there are numerous species, each of which is a very small fraction of the total (no dominance). The Shannon and Brillouin indices are indicators of diversity in that, the higher the value, the greater the diversity and the less the community is dominated by one or a few kinds of species.

Trophic Structure

The trophic structure of each of the station groups formed by cluster analysis was determined by classifying the 50 most abundant species in each station group into five feeding classes: suspension-feeders, deposit-feeders, predators, scavengers, and unknown. All species used in the determination of trophic structure were assigned to feeding classes based on available literature (MacGinitie and MacGinitie, 1949; Morton, 1958; Fretter and Graham, 1962; Jørgensen, 1966; Day, 1967; Hyman, 1967; Mills," 1967;

Purchon, 1968; Stanley, 1970; Eltringham, 1971; Feder *et al.*, 1973; Abbott, 1974; Barnes, 1974; Feder and Mueller, 1975; Trueman, 1975; Yonge and Thompson, 1976; Jumars and Fauchald, 1977; Haflinger, 1978; Feder and Matheke, 1979; Fauchald and Jumars, 1979; Feder and Matheke, 1980; Feder *et al.*, 1981a) and personal observation. Since species are distributed along a continuum of feeding types and many organisms utilize several feeding modes, it is often difficult to place a species in a specific class. For example, protobranch mollusks, generally regarded as deposit-feeders, may also feed on particles in suspension (Stasek, 1965; Stanley, 1970). However, since these mollusks probably obtain most of their nutritional requirements from the sediment, they were classified as deposit feeders. Species whose feeding behavior was unknown or uncertain were classified as "unknown". The percentage of individuals belonging to each feeding classification was calculated for each station group. When a species was assigned to two roughly equal feeding classes, we arbitrarily assigned a value of one-half to each class. Species were also classified into three classes of motility: sessile, discretely motile (generally sessile but capable of movement to escape unfavorable environmental conditions (after Jumars and Fauchald, 1979), and motile. The percentage of individuals belonging to each motility class was also calculated for each station group.

VI. RESULTS

General

Benthic infaunal data were collected at 91 stations during the April 1979 and May-June 1980 cruises. A total of 47 stations was subsequently selected for analysis (Fig. 1; Table I).

Biologically Important Taxa (BIT)

From the 47 stations, 647 taxa were identified and the Biologically Important Taxa (according to Feder and Mueller, 1975 and Feder and Matheke, 1979) were designated (see Appendix A). The criteria for the Biologically Important Taxa (BIT) delineated 128 taxa (Appendix A). Sixty-two of the BIT were identified as important in terms of biomass at one or more stations.

Some of the latter taxa were widely distributed throughout the study area, for example *Heteromastus filiformis* (Polychaeta), *Maldane glebifex* (Polychaeta), *Myriochele oculata* (Polychaeta), *Nucula tenuis* (Pelecypoda), and *Ophiura sarsi* (Ophiuroidea).

Numerical Analysis: *ln*-Transformed Density Data

A normal cluster analysis of *ln*-transformed density data produced eleven station groups at the 23.5% similarity level; Stations 31 (Group I) and 56 (Group G) did not group with any of the other stations (Fig. 2a; Table IIIa). Station Group A, a major group, was further subdivided at the 26% similarity level into A′ (stations within and adjacent to the Navarin Basin lease area) and A″ (stations adjacent to Cape Nome) (Figs. 2, 3; Table III). Station Group B, another large group, consisted of two station clusters, one within the Zhemchug Basin lease area and the other within the northern tip and to the east of the Navarin Basin lease area. Station Group C consisted of two stations within Kotzebue Sound and one station in the Zhemchug Basin lease area. Station Group D consisted of six stations northeast of the Navarin Basin lease area. Station Group E was composed of two stations in the Saint Matthew Basin lease area. Station Group F consisted of two stations north of Bering Strait and one station in the Zhemchug Basin lease area. Station Group G was just north of Bering Strait. Station Group H was composed of three stations between the Hope Basin lease area and the Seward Peninsula. Station Group I was located north of Nunivak Island. Station Group J consisted of three stations north of St. Lawrence Island (Chirikov Basin).

An inverse cluster analysis identified 42 species groups at the 23% similarity level (Fig. 4; Table IV). A two-way coincidence table (Feder and Matheke, 1979, 1980), as well as a reduced two-way table of average cell densities (Table V), were used to determine the species and species groups which characterized and distinguished each of the station groups. A summary of the major species groups follows (refer to Tables IV-V and Appendix B):

<u>Species Group 1</u> - The 14 species in this group were most important in Station 56, Station Group G. The two most important species at Station 56

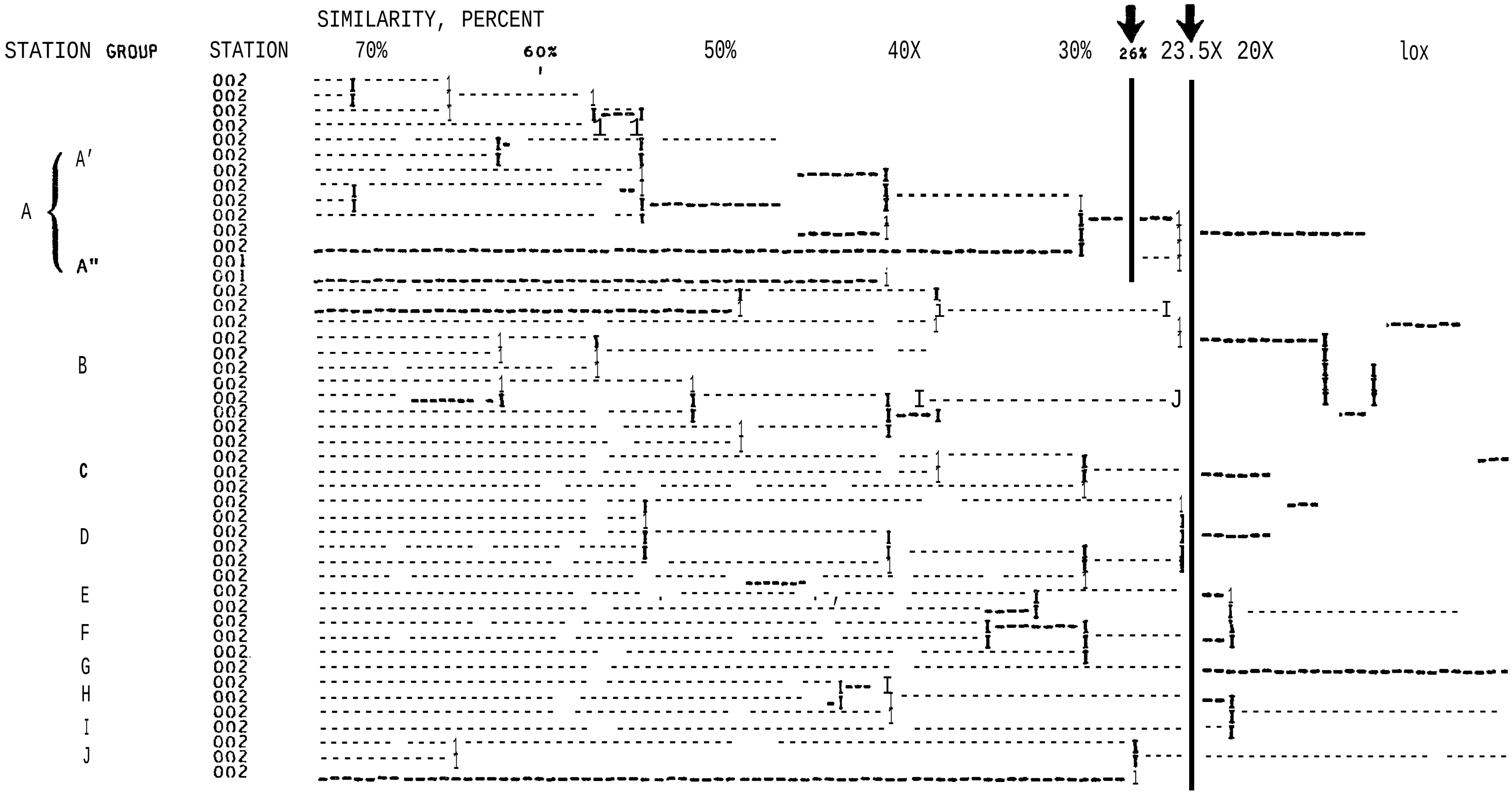

Figure 2a. Dendrogram produced by cluster analysis using h-transformed density data (no. of individuals/m^2) collected in the Bering and southeast Chukchi Seas.

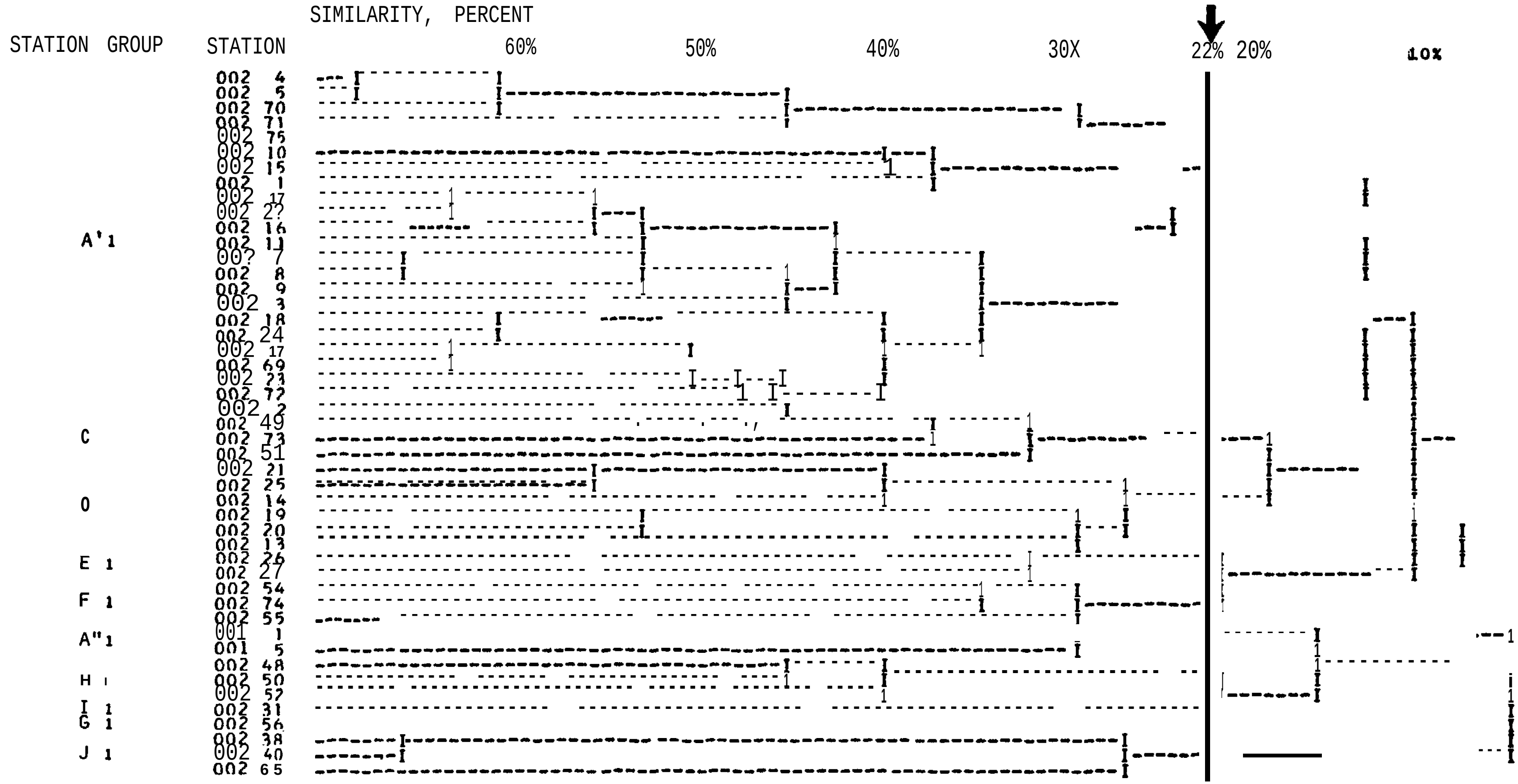

Figure 2b. Dendrogram produced by cluster analysis using untransformed density data (no. of individuals/m^2).

TABLE IIIa

STATION GROUPS FORMED BY CLUSTER ANALYSIS OF *ln*-TRANSFORMED AND UNTRANSFORMED DENSITY DATA (NUMBER OF INDIVIDUALS/M^2)

Station Group	Stations
	TRANSFORMED
A′	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13
A"	Nl, N5
B	16, 17, 18, 22, 23, 24, 69, 70, 71, 72, 75
C	49, 51, 73
D	14, 15, 19, 20, 21, 25
E	26, 27
F	54, 55, 74
G	56
H	48, 50 52
I	31
J	38, 40, 65
	UNTRANSFORMED
A'1	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 22, 23, 24, 69, 70, 71, 72, 75
A"1	Nl, N5
C1	49, 51, 73
D1	13, 14, 19, 20, 21, 25
El	26, 27
F1	54, 55, 74
G1	56
H1	48, 50, 52
11	31
J1	38, 40, 65

TABLE IIIb

COMPARISON OF STATION GROUPS FORMED BY CLUSTER ANALYSIS OF UNTRANSFORMED AND *ln*-TRANSFORMED DENSITY DATA

	ON ROUP	
	rm	
N1	A"1	A"
N5	A"1	A"
1	A'1	A'
2	A'1	A'
3	A'1	A'
4	A'1	A'
5	A'1	A'
7	A'1	A'
8	A'1	A'
9	A'1	A'
10	A'1	A'
11	A'1	A'
12	A'1	A'
15	A'1	D
16	A'1	B
17	A'1	B
18	A'1	B
22	A'1	B
23	A'1	B
24	A'1	B
69	A'1	B
70	A'1	B
71	A'1	B
72	A'1	B
75	A'1	B
49	C1	C
51	c1	c
73	c1	c
13	D1	A'
14	D1	D
19	D1	D
20	D1	D
21	D1	D
25	D1	D
26	E1	E
27	E1	E
54	F1	F
55	F1	F
74	F1	F
56	G1	G
48	H1	H
50	H1	H
52	H1	H
31	I1	I
38	J1	J
40	J1	J
65	J1	J

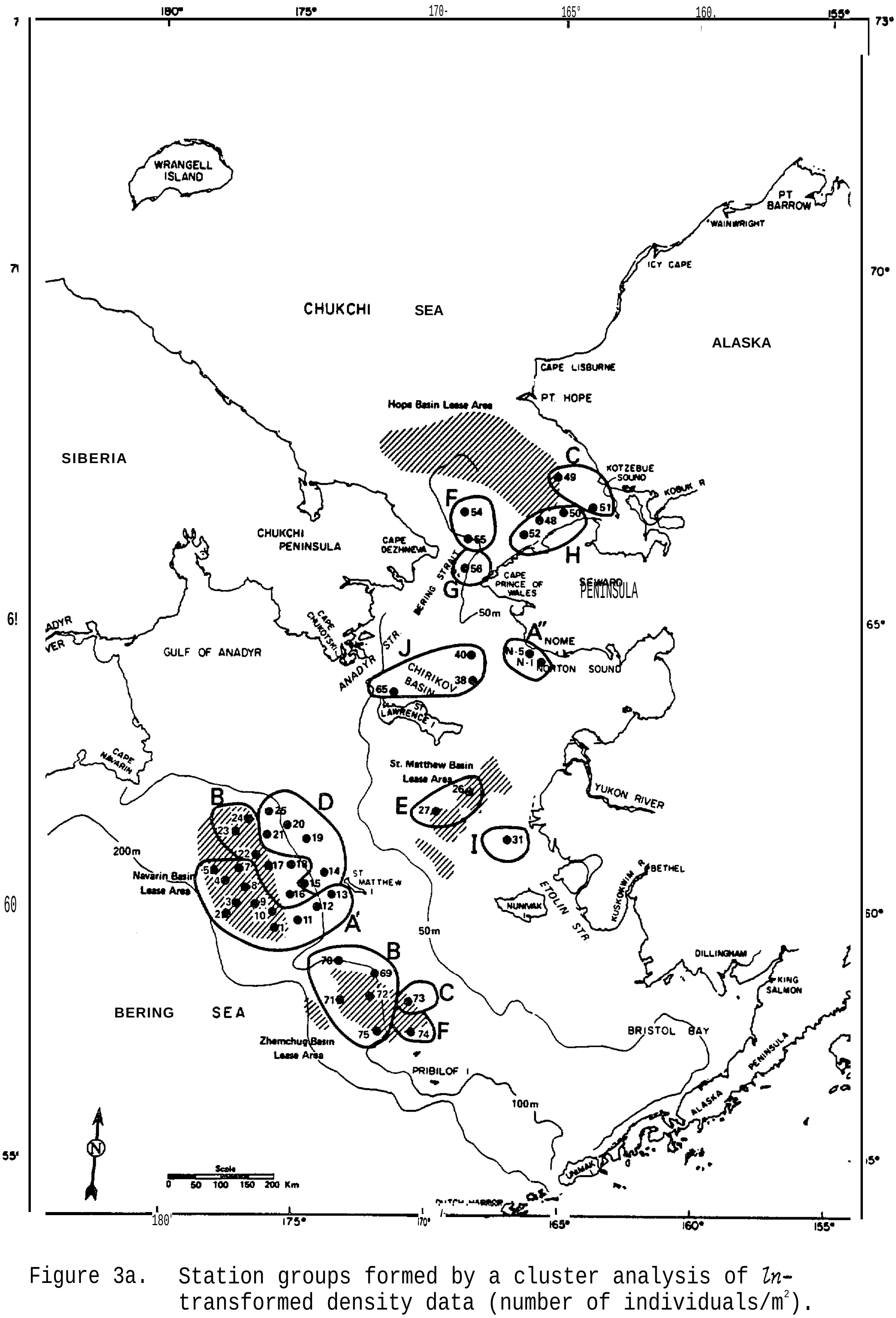

Figure 3a. Station groups formed by a cluster analysis of *ln*-transformed density data (number of individuals/m²).

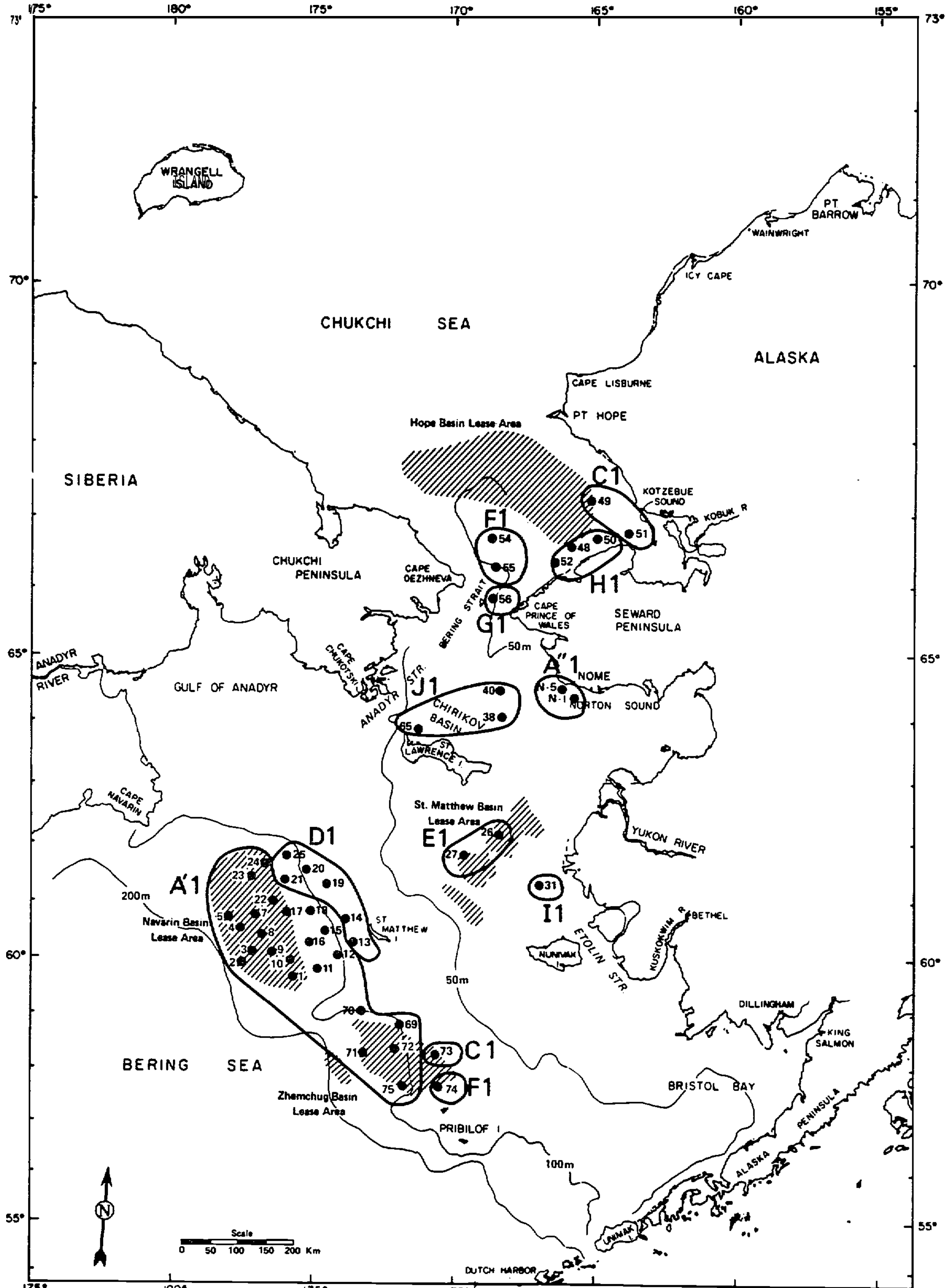

Figure 3b. Station groups formed by a cluster analysis of untransformed density data (number of individuals/m^2).

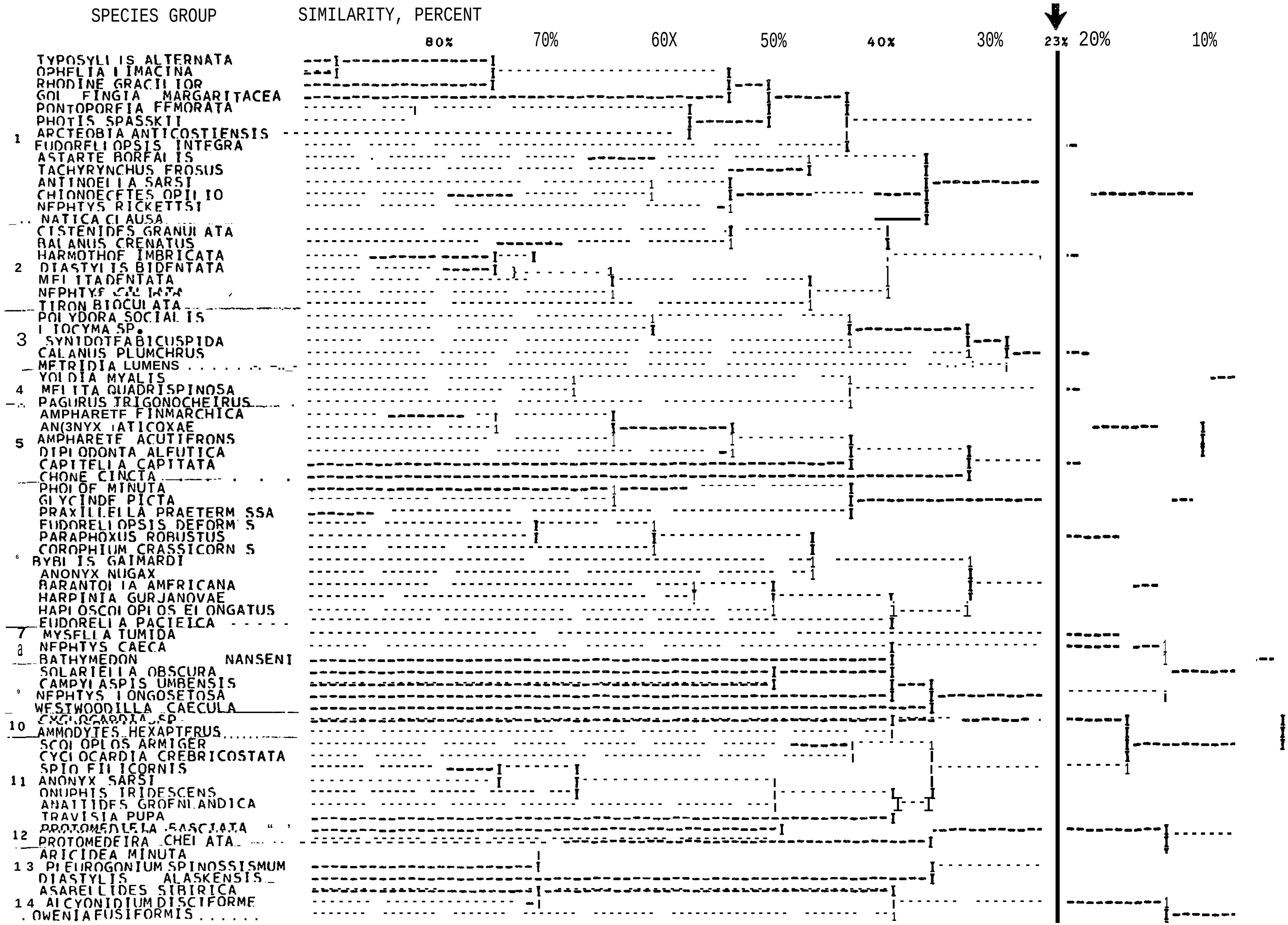

Figure 4. Species groups formed by an inverse cluster analysis in *ln*-transformed density data.

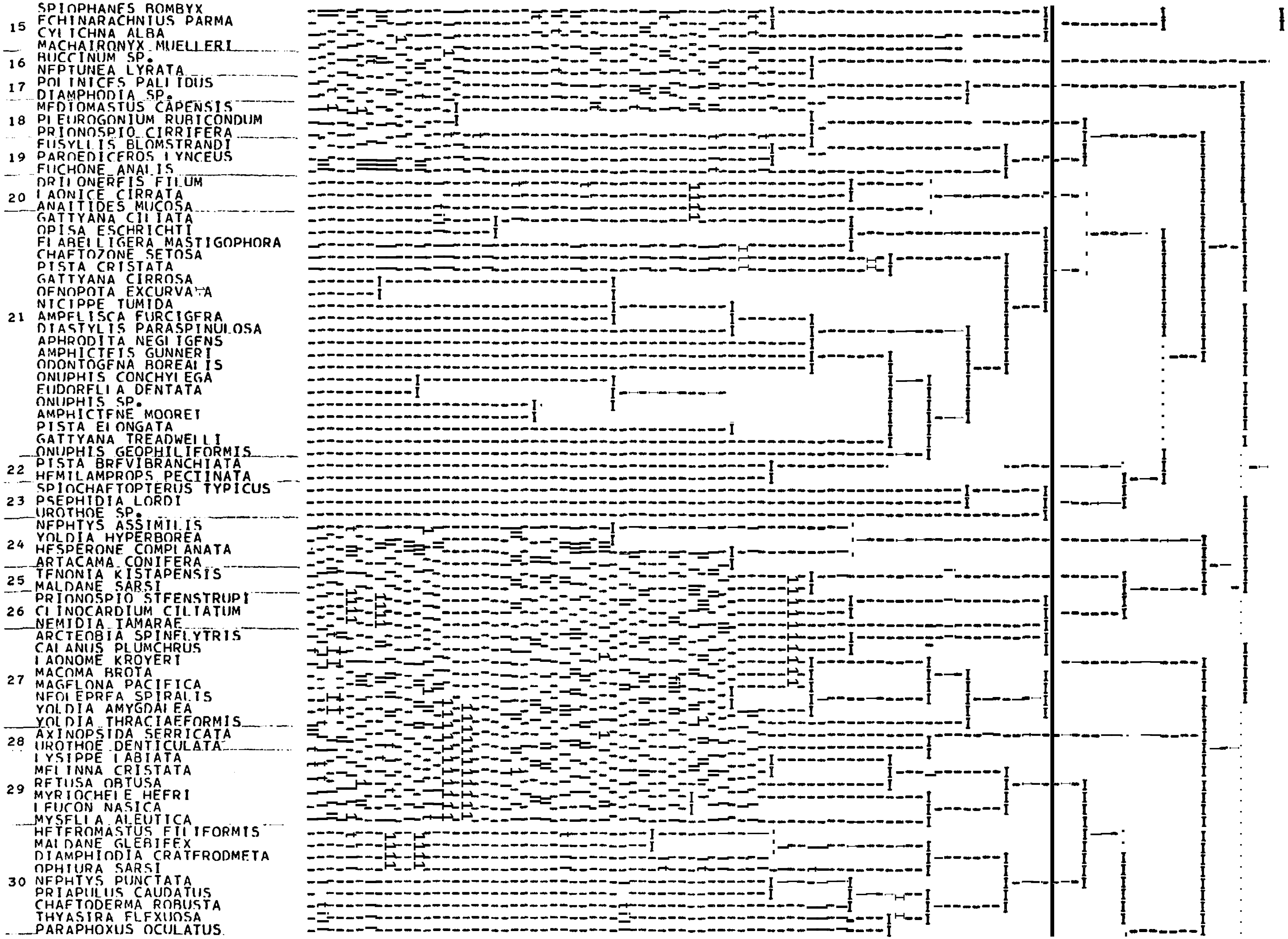
SPIOPHANES BOMBYX
15 ECHINARACHNIUS PARMA
CYLICHNA ALBA
MACHAIRONYX MUELLERI
16 BUCCINUM SP.
NEPTUNEA LYRATA
17 POLINICES PALLIDUS
DIAMPHODIA SP.
MEDIOMASTUS CAPENSIS
18 PLEUROGONIUM RUBICONDUM
PRIONOSPIO CIRRIFERA
EUSYLLIS BLOMSTRANDI
19 PAROEDICEROS LYNCEUS
EUCHONE ANALIS
DRILONEREIS FILUM
20 LAONICE CIRRATA
ANAITIDES MUCOSA
GATTYANA CILIATA
OPISA ESCHRICHTI
FLABELLIGERA MASTIGOPHORA
CHAETOZONE SETOSA
PISTA CRISTATA
GATTYANA CIRROSA
OENOPOTA EXCURVATA
NICIPPE TUMIDA
21 AMPELISCA FURCIGERA
DIASTYLIS PARASPINULOSA
APHRODITA NEGLIGENS
AMPHICTEIS GUNNERI
ODONTOGENA BOREALIS
ONUPHIS CONCHYLEGA
EUDORELLA DENTATA
ONUPHIS SP.
AMPHICTENE MOOREI
PISTA ELONGATA
GATTYANA TREADWELLI
ONUPHIS GEOPHILIFORMIS
22 PISTA BREVIBRANCHIATA
HEMILAMPROPS PECTINATA
SPIOCHAETOPTERUS TYPICUS
23 PSEPHIDIA LORDI
UROTHOE SP.
NEPHTYS ASSIMILIS
YOLDIA HYPERBOREA
24 HESPERONE COMPLANATA
ARTACAMA CONIFERA
TENONIA KISTAPENSIS
25 MALDANE SARSI
PRIONOSPIO STEENSTRUPI
26 CLINOCARDIUM CILIATUM
NEMIDIA TAMARAE
ARCTEOBIA SPINELYTRIS
CALANUS PLUMCHRUS
LAONOME KROYERI
MACOMA BROTA
27 MAGELONA PACIFICA
NEOLEPREA SPIRALIS
YOLDIA AMYGDALEA
YOLDIA THRACIAEFORMIS
AXINOPSIDA SERRICATA
28 UROTHOE DENTICULATA
LYSIPPE LABIATA
MELINNA CRISTATA
RETUSA OBTUSA
29 MYRIOCHELE HEERI
LEUCON NASICA
MYSELLA ALEUTICA
HETEROMASTUS FILIFORMIS
MALDANE GLEBIFEX
DIAMPHIODIA CRATERODMETA
OPHIURA SARSI
30 NEPHTYS PUNCTATA
PRIAPULUS CAUDATUS
CHAETODERMA ROBUSTA
THYASIRA FLEXUOSA
PARAPHOXUS OCULATUS

Figure 4.

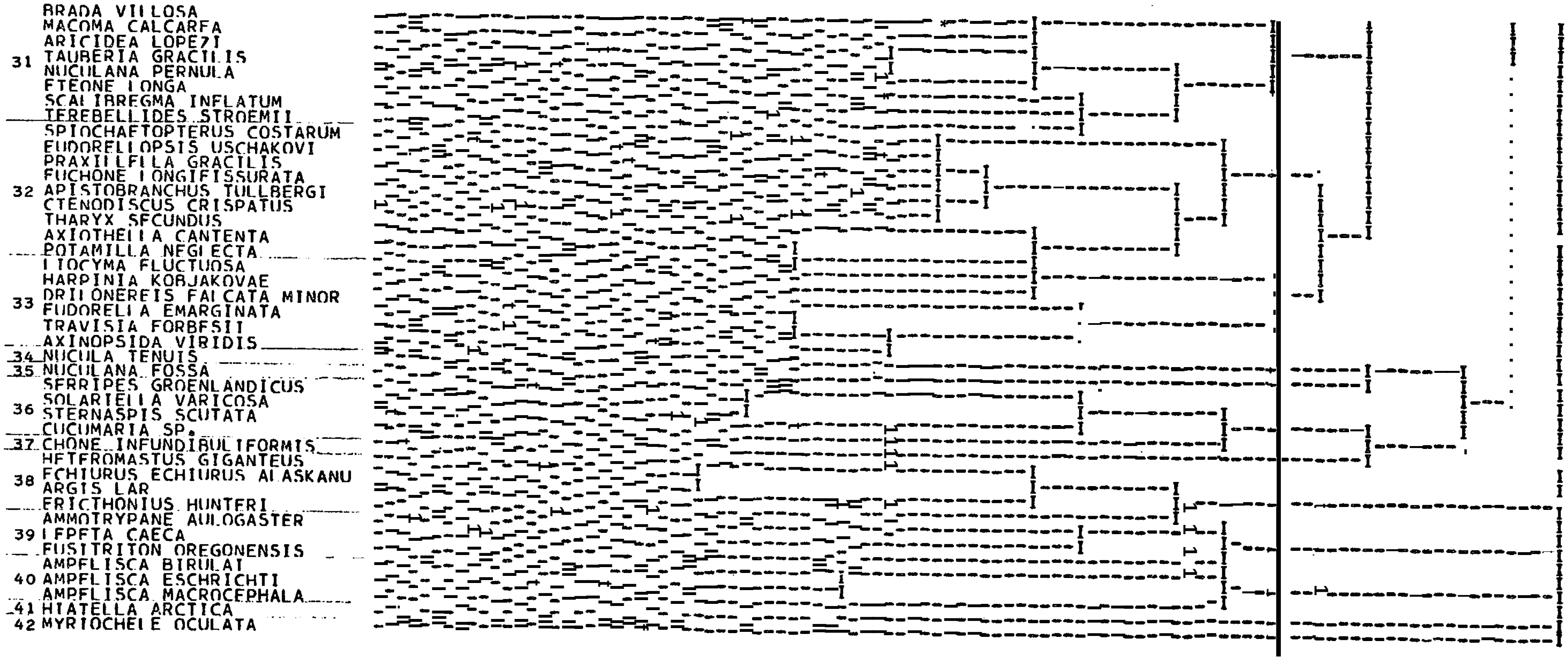

Figure 4. Continued

TABLE IV

SPECIES GROUPS FORMED BY INVERSE CLUSTER ANALYSIS BASED ON DENSITY
Feeding type and motility from Haflinger (1978); Fauchald and Jumars (1979); Feder and Matheke (1979, 1980); and Feder *et al.* (1980b).

Group Number	Species Name	Feeding Type[1]	Motility Type[2]
1	*Typosyllis alternata*	P	M
	Ophelia limacina	DF	M
	Rhodine gracilior	DF	SE
	Golfingia margaritacea	DF	SE
	Pontoporeia femorata	SF	SE/DM
	Photis spasskii	DF	M
	Arcteobea anticostiensis	P/s	M
	Eudorellopsis integra	DF/S	M
	Astarte borealis	SF	DM
	Tachyrhynchus erosus	S/P	M
	Antinoella sarsi	DF/P	M
	Chionoecetes opilio	s/P	M
	Nephtys rickettsi	DF/P	M
	Natica clausa	P	M
	Cistenides granulata	DF	M
	Balanus crenatus	SF	SE
	Harmothoe imbricata	s	M
	Diastylis bidentata	DF	M
	Melita dentata	DF	M
	Nephtys ciliata	DF/P	M
	Tiron bioculata	u	M
	Polydora socialis	DF	DM
	Liocyma sp.	SF	SE
	Synidotea bicuspida	s	M
	Calanus plumchrus	SF	M
	Metridia lucens	SF	M
	Yoldia myalis	DF	M
	Melita quadrispinosa	DF	M
	Pagurus trigonocheirus	s/P	M
	Ampharete finmarchica	DF	s
	Anonyx laticoxa	s	M
	Ampharete acutifrons	DF	SE
	Diplodonta aleutica	SF/DF	SE/DM
	Capitella capitata	DF	M
	Chone cincta	SF	DM
	Pholoe minutia	s/P	M
	Glycinde picta	DF/P	M
	Praxillella praetermissa	DF	SE
	Eudorellopsis deformis	DF	M
	Paraphoxus robustus	SF	M
	Corophium crassicornis	SF	SE
	Byblis gaimardi	SF	DM

TABLE IV

CONTINUEI)

Group Number	Species Name	Feeding Type[1]	Motility Type[2]
6	*Anonyx nugax*	S	M
	Barantolla americana	DF	M
	Harpinia gurjanovae	SF	M
	Haploscoloplos elongatus	DF	M
	Eudorella pacifica	DF	M
7	*Mysella tumida*	SF/DF	SE
8	*Nephtys caeca*	DF/P	M
	Bathymedon nanseni	DF/S	M
9	*Solariella obscura*	s/P	M
	Campylaspis umbensis	DF	M
	Nephtys longosetosa	DF/P	M
	Westwoodilla caecula	DF/ S	M
10	*Cyclocardia* sp.	SF	SE
	Ammodytes hexapterus	P/s	M
11	*Scoloplos armiger*	DF	M
	Cyclocardia crebricostata	SF	SE
	Spio filicornis	DF	DM
	Anonyx sarsi	s	M
	Onuphis iridescent	DF	SE/DM
	Anaitides groenlandica	P/DF	M
	Travisia pupa	DF	M
12	*Protomedeia fasciata*	DF	M
	Protomedeia chaelata	DF	M
13	*Aricidea* minutia	DF	M
	Pleurogonium spinosissmum	S/DF	M
	Diastylis alaskensis	DF	M
14	*Asabellides sibirica*	DF	SE
	Alcyonidium disciforme	SF	SE
	Owenia fusiformis	SF/DF	M
15	*Spiophanes bombyx*	DF	DM
	Echinarachnius parma	DF	M
	Cylichna alba	P	M
	Machaironyx muelleri	DF/ S	M
16	*Buccinum* sp.	P	M
	Neptunea lyrata	P	M
17	*Polinices pallidus*	P	M
	Diamphiodia sp.	DF	M
18	*Mediomastus capensis*	DF	M
	Pleurogonium rubicundum	S/DF	M
	Prionospio cirrifera	DF	DM
19	*Eusyllis blomstrandi*	P	M
	Paroediceros lynceus	s	M
	Euchone analis	SF	DM

TABLE IV

CONTINUED

Group Number	Species Name	Feeding Type[1]	Motility Type[2]
20	*Drilonereis filum*	DF	M
	Laonice cirrata	DF	DM
	Anaitides mucosa	P/DF	M
21	*Gattyana ciliata*	S	M
	Opisa eschrichti	u	u
	Flabelligera mastigophora	DF	M
	Chaetozone setosa	DF	DM
	Pista cristata	DF	SE
	Gattyana cirrosa	S	M
	Oenopota excurvata	P	M
	Nicippe tumida	SF	M
	Ampelisca furcigera	SF	SE/DM
	Diastylis paraspinulosa	DF	M
	Aphrodita negligens	DF	M
	Amphicteis gunner-i	DF	SE
	Odontogena borealis	SF/DF	SE
	Onuphis conchylega	DF	M
	Eudorella dentata	DF	M
	Onuphis sp.	DF	M/SE/DM
	Amphictene moorei	DF	M
	Pista elongata	DF	SE
	Gattyana treadwelli	S	M
	Onuphis geophiliformis	DF	SE/DM
22	*Pista brevibranchiata*	DF	S
	Hemilamprops pectinata	DF	M
23	*Spiochaetopterus typicus*	SF	SE
	Psephidia lordi	SF	SE/DM
	Urothoe Sp.	SF	M
24	*Nephtys assimilis*	DF/P	M
	Yoldia hyperborea	DF	M
	Hesperone complanata	S	M
	Artacama conifera	DF	DM
25	*Tenonia kitsapensis*	S/P	M
	Maldane sarsi	DF	SE
26	*Prionospio steenstrupi*	DF	DM
	Clinocardium ciliatum	SF	M
	Nemidia tamarae	S/P	M
27	*Arcteobea spinelytris*	S/P	M
	Calanus plumchrus	SF	M
	Laonome kroyeri	S/P	M
	Macoma brota	DF	SE
	Magelona pacifica	DF	M

TABLE IV

CONTINUED

Group Number	Species Name	Feeding Type[1]	Motility Type[2]
27	*Neoleprea spiralis*	DF	DM
	Yoldia amygdalea	DF	M
	Yoldia thraciaeformis	DF	M
28	*Axinopsida serricata*	SF/DF	SE
	Urothoe denticulata	SF	M
29	*Lysippe labiata*	DF	SE
	Melinna cristata	DF	SE
	Retusa obtusa	P	M
	Myriochele heeri	DF	SE
	Leucon nasica	DF	M
	Mysella aleutica	SF/DF	SE
30	*Heteromastus filiformis*	DF	M
	Maldane glebifex	DF	SE
	Diamphiodia craterodmeta	DF	M
	Ophiura sarsi	DF/P	M
	Nephtys punctata	DF/P	M
	Priapulus caudatus	P	M
	Chaetoderma robusta	DF/P	M
	Thyasira flexosa	SF/DF	SE
	Paraphoxus oculatus	SF	M
31	*Brada villosa*	DF	DM
	Macoma calcarea	DF	SE
	Aricidea lopezi	DF	M
	Tauberia gracilis	DF	M
	Nuculana pernula	DF	M
	Eteone longa	P	M
	Scalibregma inflatum	DF	M
	Terebellides stroemi	DF	SE
32	*Spiochaetopterus costarum*	SF/DF	SE
	Eudorellopsis uschakovi	DF	M
	Praxillella gracilis	DF	SE
	Euchone longifissurata	SF/DF	DM
	Apistobranchus tullbergi	DF	DM
	Ctenodiscus crispatus	DF	M
	Tharyx secundus	DF	DM
	Axiothella cantenata	DF	SE
	Potamilla neglects	SF	SE
33	*Liocyma fluctuosa*	SF	SE
	Harpinia kobjakovae	SF	M
	Drilonereis falcata minor	DF	M
	Eudorella emarginata	DF	M
	Travisia forbesii	DF	M
	Axinopsida viridis	SF/DF	SE
34	*Nucula tenuis*	DF	M

TABLE IV

CONTINUED

Group Number	Species Name	Feeding Type[1]	Motility Type[2]
35	*Nuculana* fossa	DF	M
36	*Serripes groenlandicus*	SF	SE
	Solarie lla varicosa	s/P	M
	Sternaspis scutata	DF	M
	Cucumaria sp.	DF	SE
37	*Chone infundibuliformis*	SF	DM
38	*Heteromastus giganteus*	DF	M
	Echiurus echiurus alaskanus	DF	DM
	Argis lar	s/P	M
	Ericthonius hunteri	SF	DM
39	*Ammotrypane aulogaster*	DF	M
	Lepeta caeca	SF	M
	Fusitriton oregonensis	P	M
40	*Ampelisca birulai*	SF	DM
	Ampelisca eschrichti	SF	DM
	Ampelisca macrocephala	SF	DM
41	*Hiatella arctica*	SF	SE
42	*Myriochele oculata*	DF	SE

[1]Feeding types: P = predator, S = scavenger, DF = detrital feeder, SF = suspension feeder, U = unknown

[2]Motility types: M = motile, DM = discretely motile, SE = sessile, U = unknown

TABLE V

STATION GROUP/SPECIES GROUP COINCIDENCE TABLE SHOWING AVERAGE CELL DENSITIES OF GROUPS FORNED BY A CLUSTER ANALYSIS OF TRANSFORMED DENSITY DATA

Taxon Groups	A'	A"	B	C	D	E	F	G	H	I	J
1	0* 7	2.0	0.3	0.3	0.2	0.4	3.6	5.5	2.9	0.5	4.8
2	0.1	6.8	0.1	0.2	0.0	0.0	1.8	33.8	1.2	0.0	0.9
3	0.1	0.2	0.1	0.0	0.1	0.0	1.9	0.0	0.0	0.0	0.0
4	0.0	5.2	0.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0	3.3
5	4.3	6.1	0.6	0.1	0.9	2.0	1.3	0.6	0.4	0.0	23.7
6	6.4	16.4	3.8	3.4	7.4	79.5	41.5	4.7	8.3	29.2	115.1
7	2.2	0.0	0.6	0.0	0.0	0.0	36.0	0.0	0.0	6.7	250.0
8	0.7	0.6	1.2	13.0	0.0	1.0	4.7	0.0	1.0	1.7	0.0
9	0.2	0.9	0.0	0.2	0.0	0.0	1.3	0.0	3.0	0.0	0.0
10	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.7	2.3
11	0.4	0.0	0.4	0.2	0.1	0.1	6.2	0.5	2.6	10.0	20.2
12	0.0	0.0	0.0	0.0	0.0	41.0	0.0	0.0	0.7	21.7	1.0
13	0.1	0.4	0.0	0.0	0.0	0.0	0.2	0.0	0.0	6.7	0.0
14	36.1	2.3	3.4	0.0	0.0	0.0	1.1	31.1	4.2	371.1	1.1
15	1.1	0.9	0.7	1.2	1.0	4.2	15.0	0.0	57.2	136.7	0.7
16	0.1	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.5	0.0	0.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.5	0.3	0.1	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
19	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.7	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
21	2.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
22	0.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.2	0.0	0.1	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0
25	0.8	0.0	0.3	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.3
26	0.6	0.0	0.2	0.7	1.3	0.3	0.7	0.0	0.0	1.1	0.0
27	1.0	0.9	1.7	0.6	0.1	0.8	0.1	0.0	0.2	0.4	0.0
28	70.8	0.0	52.6	4.7	1.0	6.5	0.0	0.0	0.7	0.0	1.7
29	11.1	1.0	12.0	4.8	1.4	0.8	0.3	0.0	0.8	2.8	0.0
30	48.7	12.6	53.3	5.3	7.3	7.3	11.8	6.3	6.6	3.3	6.8
31	6.4	8.9	2.4	0.6	5.2	13.8	3.5	2.1	1.2	0.8	1.3
32	5.1	6.9	3.7	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.1
33	7.2	0.2	4.1	2.2	0.8	1.0	0.0	0.6	0.1	0.0	2.2
34	5.3	6.2	10.6	122.0	28.7	499.0	2.7	0.0	81.3	83.3	18.7
35	0.5	0.0	0.9	75.3	0.0	24.0	0.0	0.0	5.3	0.0	0.0
36	3.2	8.1	0.8	35.5	0.2	1.8	3.2	0.8	6.0	0.0	0.8
37	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0
38	0.0	46.2	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.8
39	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
40	1.7	3.0	0.7	0.0	0.0	0.0	15.8	0.0	9.6	1.1	6740.0
41	0.0	0.0	0.2	0.0	0.0	0.0	0.0	820.0	0.0	0.0	0.0
42	20.5	213.2	12.6	20.7	0.3	0.0	2.7	0.0	1476.7	25,053.0	2.7

were the sipunculid *Golfingia margaritacea* and the polychaete *Ophelia limacina*, which occurred in densities of 33 and 20 individuals/m^2, respectively. This species group was also important in Station Groups F and J.

Species Group 2 - The species in this group were most important in Station Group G. The polychaete *Cistenides granulata* and the barnacle *Balanus crenatus* dominated species density.

Species Group 5 - The species in this group were most important in Station Groups A′, A″, and J. The polychaetes *Ampharete finnmarchica, A. acutifrons*, and *Chone cincta* dominated species density in this species group.

Species Group 6 - Species in Species Group 6 were most important in Station Groups A″, E, F, I, and J. Four species typically dominated in density: the amphipod *Harpinia gurjanovae*, the polychaetes *Haploscoloplos elongatus* and *Pholoe minuta* and the cumacean *Eudorella pacifica*.

Species Group 14 - This species group was most important in Station Group I. The polychaete *Asabellides sibirica* dominated in density (590 individuals/m^2) at Station Group I. This species group was also important at Station Groups A′ and G.

Species Group 15 - These species were most important in Station Groups H and I. The echinoid *Echinarachnius parma* and the polychaete *Spiophanes bombyx* dominated the density of this species group, specifically at Station Group H.

Species Group 21 - These species were most important in Station Group A′ , and specifically at Stations 3, 4, and 5. Two polychaetes, *Chaetozone setosa* and *Pista cristata*, and the bivalve *Odontogena borealis* were most important in density.

Species Group 24 - Species in this group were most important in Station Group D. The protobranch clam *Yoldia hyperborea* had its highest density (16 individuals/m^2) at Station 20 in this station group.

Species Group 28 - The two species in this group were most important in Station Groups A′ and B. The clam *Axinopsida serricata* dominated the species group, with 115 and 88 individuals/m^2 found at these two station groups, respectively.

Species Group 29 - These species were most important in Stations Groups A′ and B. The gastropod *Retusa obtusa* and the polychaete *Myriochele heeri* were the dominant species in this species group.

Species Group 30 - This species group was most important in Station Groups A′ and B. Important species, in terms of density, were the polychaete *Heteromastus filiformis* and the ophiuroid *Ophiura sarsi*.

Species Group 31 - The eight species in this group were most important in Station Groups A′ and E. Station 27, in Station Group E, contained all of the species in Species Group 31. One or more of the species were absent in all other stations in the other station groups. The polychaete *Brada villosa* appeared to be the most dominant species at these two station groups. This species group was also important in Station Groups A′ and D.

Species Group 32 - Species in this species group were most important in Station Groups A′, A″, and B. Station 16 in Station Group B contained all of the species in Species Group 32. All but two (*Eudorellopsis uschakovi* and *Ctenodiscus crispatus*) of the species in this group were polychaetes.

Species Group 33 - These species were most important in Station Groups A′ and B. Stations 4 and 5 of Station Group A′ contained high densities of this species group. The polychaete *Travisia forbesii* had a high density of 92 individuals/m^2 at Station 4.

Species Group 34 - The protobranch clam *Nucula tenuis*, the only member of this species group, was most important at Station Groups C, E, H, and I. The highest density occurred at Station 27 (Station Group E), with 994 individuals /m^2.

Species Group 35 - The protobranch clam *Nuculana* fossa, the only member of this species group, was most important at Station Groups C and E. Station 51 (Station Group C) contained a high density of 222 individuals/m^2.

Species Group 36 - These species were most important at Station Group C. Station 49 contained especially high densities of this species group. The sea cucumber *Cucumaria* sp. occurred in a density of 214 individuals/m^2 at this station.

Species Group 38 - These species were most important at Station Group A", specifically at Station N1. Two species dominated in density: the echiuroid worm *Echiurus echiurus alaskanus* and the amphipod *Ericthonius hunteri* occurred at Station N1 in densities of 165 and 168 individuals/m^2, respectively.

Species Group 40 - These species were important at Station Group J. Three amphipod species of the same genus (*Ampelisca*) occurred in this group. The amphipod *Ampelisca macrocephala* was the most common species present, with 14,408 individuals/m^2 found at Station 65.

Species Group 41 - The clam *Hiatella arctica*, the only member of this species group, was most important at Station Group G (Station 56), with a high density of 820 individuals/m^2 found here.

Species Group 42 - The polychaete *Myriochele oculata* was most important at Station Groups A", H, and I. The highest density occurred at Station 31 (Station Group 1), with 25,053 individuals/m^2 found there.

A summary of the major station groups follows (refer to Figs. 2a and 2b, Table V, and the dominance-diversity curves in Appendix B).

When Group A in the Navarin Basin lease area (delineated at the 23.5% similarity level: Fig. 2a, transformed density data) was located on a map, it was apparent that Stations N1 and N5 of this station group were located approximately 1000 km north of the other stations in Group A. Furthermore, examination of the species groups within Station Group A revealed that stations N1 and N5 were distinct, in terms of species densities, from the other Group A stations. Thus, subdivision of Group A into Station Groups A' and A" was made at the 26% similarity level. When untransformed data (information that increases the importance of dominant species to the similarity coefficients) were utilized in the cluster analysis, Stations N1 and N5 (Station Group A"1) were well-separated from the stations in the Navarin Basin group (Station Group A'1) (Fig. 2b; Tables IIIa, b).

Station Group A' - This station group contained 132 species and was composed primarily of species in Species Groups 14, 28, 29, 30, and 42; members of Species Groups 5, 6, 31, 32, 33, 34, and 36 were also common, but to a lesser extent. At least small numbers of individuals of species in most of the species groups were present in this station group. Species that were found in all 12 stations in Station Group A′ were *Haploscoloplos elongatus*, *Axinopsida serricata*, *Heteromastus filiformis*, *Nephtys punctata*, and *Priapulus caudatus*. The species dominant in density was *Heteromastus filiformis*, and the species dominant in biomass was *Ctenodiscus crispatus*.

Station Group A″ - This station group was characterized by species in Species Groups 6, 30, 38, and 42. Species Groups 2, 4, 5, 31, 32, 34, and 36 were also important, but to a lesser extent. Species dominating by numbers in this station group were *Myriochele oculata*, *Haploscoloplos elongatus*, *Ericthonius hunteri*, and *Diamphiodia craterodmeta*, in decreasing order of density. The dominant species, in terms of biomass, were *Argis lar* and *Echiurus echiurus alaskanus*.

Station Group B - The fauna in this station group was composed of species mainly in Species Groups 28, 29, 30, 34, and 42. Species Groups 6, 14, 32, and 33 were of lesser importance. Species in common at all stations in Station Group B were *Axinopsida serricata* and *Heteromastus filiformis*. The leading species, in terms of density, were *H. filiformis*, *Ophiura sarsi*, *Maldane glebifex*, *Axinopsida serricata*, *Diamphiodia craterodmeta*, and *Priapulus caudatus*. Five of these six species (all but *A. serricata*) were members of Species Group 30. The leading species, in terms of biomass, were *O. sarsi*, *M. glebifex*, and *Ctenodiscus crispatus*.

Station Group C - This group was characterized by species in Species Groups 8, 34, 35, 36, and 42. Species groups 6, 28, 29, and 30 were of lesser importance. The dominant species in this group, in terms of density, were *Nucula tenuis*, *Nuculana fossa*, *Cucumaria* sp., *Sternaspis scutata*, and *Serripes groenlandicus*. The latter three species, dominant in biomass, were members of Species Group 36.

Station Group D - This group was characterized by species in Species Group 34, with Species Groups 6, 30, and 31 of lesser importance. Species in common with all stations in Station Group D were *Barantolla americana*, *Nephtys punctata*, and *Macoma calcarea*. The species in this group dominant in density and biomass, were the polychaete *B. americana* and the clam respectively.

Station Group E - This group was characterized by Species Groups 6, 12, 31, 34, and 35. Species Groups 15, 28, and 30 were of lesser importance. The dominant species in this group, in terms of density and biomass, were the polychaete *Haploscoloplos elongatus* and the clam *Nucula tenuis*, respectively.

Station Group F - This group was characterized by species in Species Groups 6, 7, 11, 15, 30, and 40. Species Groups 1, 8, and 11 were of lesser importance. Species dominating in density at this station group were *Harpinia gurjanovae*, *Praxillella praetermissa*, *Glycinde picta*, *Haploscoloplos elongatus*, and *Barantolla americana*, all members of Species Group 6. *Echinarachnius parma* dominated in biomass.

Station Group G - This group was characterized by taxa in Species Groups 2, 14, and 41, with species groups 1, 6, 18, and 30 of lesser importance. Species dominating in density in this group were *Hiatella arctica*, *Asabellides sibirica*, *Balanus crenatus*, and *Cistenides granulata*, in decreasing order of density. The species dominating in biomass were *Hiatella arctica* and *Strongylocentrotus droebachiensis*.[1]

Station Group H - This group was characterized by Species Groups 15, 34, and 42, with Species Groups 6, 30, 36, and 40 of lesser importance. Taxa dominating in density were *Myriochele oculata*, *Echinarachnius parma*, and *Nucula tenuis*. The species dominating in biomass was *Macoma calcarea*.

Station Group I - This group was characterized by Species Groups 6, 11, 12, 14, 15, 34, and 42. Species Groups 7 and 13 were of lesser importance. The dominant species in this group (Station 31) were *Myriochele oculata*, *Asabellides sibirica*, *Alcyonidium disciforme*, and *Pholoe minuta*, in decreasing order of density. Foraminifera were also very important, occurring at a density of 3,753 individuals/m^2. The species dominating in biomass was *Alcyonidium disciforme*.

Station Group J - This group was characterized by Species Groups 1, 5, 6, 7, 11, 34, and 40. Species Groups 1 and 30 were of lesser importance. Species dominating in this group were *Ampelisca macrocephala*, *A. birulai*,

[1]Specimens originally listed in the data printouts as unidentified Echinoidea were determined as *Strongylocentrotus droebachiensis* after all data were analyzed.

A. eschrichti, and *Mysella tumida*, in decreasing order of density. *Ampelisca macrocephala* also dominated the biomass.

A principal coordinate analysis using the Czekanowski coefficient with transformed density data (Fig. 5) revealed station groupings similar to those produced by cluster analysis (Fig. 2a). The greatest amount of group separation was attributed to Axis 1 (25.2%; Table VI). The amount of separation attributed to Axes 2 and 3 was 16.2% and 10.8%, respectively. Groups distinctly separated in Figure 5a were A″, D, and G. Station groups that showed the least separation in Figure 5a were A′ and B. Stations 73 and 74, which clustered with Station Groups C and F, respectively (Fig. 2), but were spatially separated from these groups by approximately 1,000 km (Fig. 3a), also grouped with Station Groups C and F in the principal coordinate analysis (Fig. 5).

Numerical Analysis: Untransformed Density Data

A normal cluster analysis of untransformed abundance data produced ten station groups at the 22% similarity level (Fig. 2b; Table IIIa, b). One major group, identified as Station Group A'1, consisted primarily of stations deeper than 100 m within and adjacent to the Navarin Basin and Zhemchug Basin lease areas. This station group (A'1) originally consisted of two station groups (A' and B) that were identified by the log-transformed data analysis, indicating a general similarity between these two station groups. The dominant species linking these two groups were *Asinopsida serricata*, *Heteromastus filiformis*, and *Myriochele oculata*. The other large group, identified as Group Dl, consisted primarily of stations close to or shallower than 100 m, northeast of the Navarin Basin lease area. Group A"1 consisted of two stations adjacent to Cape Nome. The other station groups are identical to those delineated in the log-transformed cluster analysis (Figs. 2a and 3a).

Motility and Trophic Structure

The percent frequency of occurrences of motility and feeding classes in station groups formed by cluster analysis of transformed density data are presented in Table VII. The most frequent motility class in each station

PRINCIPAL COORDINATE ANALYSIS

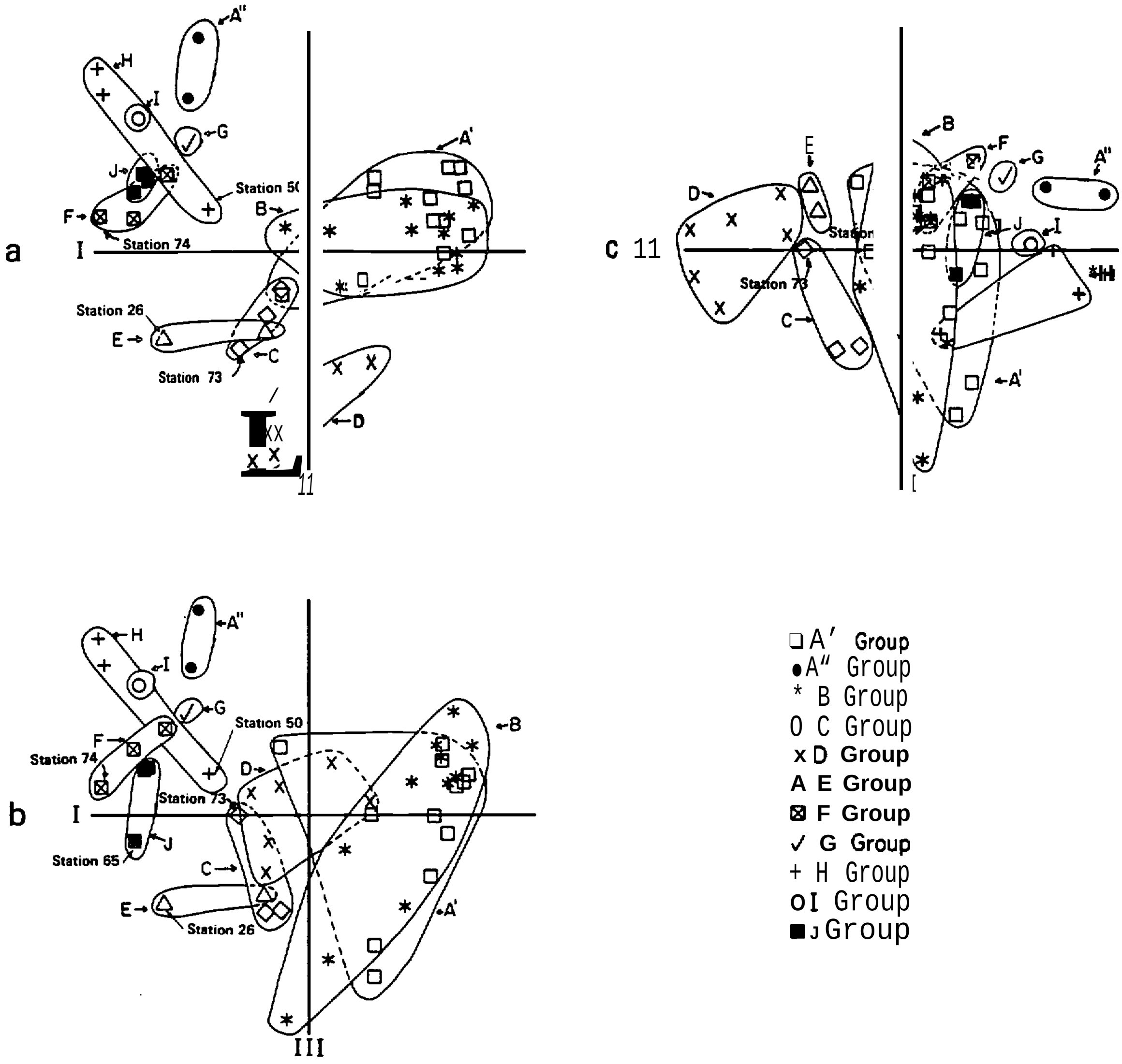

Figure 5. Plots of loadings on the first three coordinate axes extracted by principal coordinate analysis, using *ln*-transformed density data and the Czekanowski similarity coefficient.

group was of individuals that were motile. The percentage of motile individuals among station groups ranged from 55% (Group J) to 76% (Group C). Sessile and discretely motile organisms ranked second and third, respectively, in terms of percent frequency of occurrence. Deposit-feeding organisms dominated the feeding classes in all station groups, ranging from 51% (Group F) to 64% (Group D). Suspension feeders and predators were nearly equal at most station groups. Most station groups were composed of less than 12% scavengers.

Density, Biomass, and Diversity

Density, biomass, and diversity data arranged according to station groups delineated by cluster analysis of transformed density data are presented in Table VIII. Density values ranged from 148 individuals/m^2 at Station 21 (Station Group D) to 32,023 individuals/m^2 at Station 31 (Station Group I). The station groups with the lowest and highest mean density were Station Groups D and I, respectively (Table IX). Biomass values ranged from 14.2 g/m^2 at Station 71 (Station Group B) to 649.4 g/m^2 at Station 38

TABLE VI

AMOUNT OF BETWEEN-STATION-GROUP SEPARATION OF THE THREE DOMINANT AXES IN THE PRINCIPAL COORDINATE ANALYSIS OF *ln*-TRANSFORMED DENSITY DATA

Axis	Percent Separation of Station Groups	Cumulative percent
1	25.2	25.2
2	16.2	41.4
3	10.8	52.2

TABLE VII

DISTRIBUTION OF MOTILITY AND FEEDING CLASSES IN STATION GROUPS FORMED BY CLUSTER ANALYSIS OF *ln*-TRANSFORMED DENSITY DATA

N = number of species occurring in a station group, SE = sessile, DM = discretely motile, M = motile, DF = deposit feeder, SF = suspension feeder, P = predator, S = scavenger, U = unknown

Station Group	Motility Class %*				Feeding Class %*				
	M	DM	SE	U	DF	SF	P	S	U
A^{l} (N = 132)	60	15	24	1	57	20	13	9	1
A^{ll} (N = 63)	65	14	21	0	56	16	13	14	1
B (N = 101)	60	12	28	0	61	17	16	6	0
C (N = 49)	76	4	20	0	53	17	22	8	0
D (N = 48)	67	7	26	0	64	11	19	6	0
E (N = 44)	75	6	19	0	63	12	20	5	0
F (N = 81)	63	15	22	0	51	19	17	12	1
G (N = 33)	70	3	27	0	57	15	17	8	3
H (N = 65)	63	11	26	0	55	20	16	9	0
I (N = 38)	66	8	26	0	55	20	18	7	0
J (N = 72)	55	15	30	0	55	26	11	8	0

*Percentages based on the number of each species occurring in the station group.

TABLE VIII

DENSITY, BIOMASS, AND DIVERSITY OF INDIVIDUAL BENTHIC SAMPLING STATIONS

Stations are arranged according to the station groups delineated by a cluster analysis of transformed density data

Station Group	Station Number	Density (No/m^2)	Biomass (g/m^2)	No. of Taxe	Simpson Diversity	Shannon Diversity	Brillouin Diversity	Brillouin Evenness	Species Richness
A′	1	.400	118.3	38	0.05	3.27	2.94	0.90	7.26
	2	1666	239. 7	60	0.08	3.12	3.00	0.76	8.70
	3	3604	75.1	73	0.11	2.96	2.90	0.69	9.23
	4	2336	84.4	85	0.09	3.17	3.08	0.71	11.26
	5	2266	101.6	82	0.14	2.86	2.78	0.65	10.77
	7	2192	131.4	62	0.08	3.05	2.96	0.74	8.53
	8	2592	94.4	56	0.18	2.55	2.49	0.63	7.38
	9	1570	122.4	44	0.29	2.23	2.15	0.58	6.25
	10	868	27.2	40	0.06	3.18	3.03	0.86	6.30
	11	2186	144.4	62	0.08	3.20	3.10	0.77	8.58
	12	1596	173.2	50	0.08	3.05	2.97	0.78	6.90
	13	1086	21.8	39	0.07	3.04	2.87	0.83	6.41
A"	N1	2528	158.7	53	0.08	2.99	2.93	0.75	7.00
	N5	958	466.4	48	0.05	3.33	3.17	0.86	7.45
B	16	1954	90.7	54	0.10	2.95	2.88	0.74	7.27
	17	1950	167.3	41	0.17	2.41	2.34	0,65	5.75
	18	1618	46.3	53	0.08	3.08	2.95	0.77	7.87
	22	1702	215.9	36	0.16	2.51	2.42	0.70	5.23
	23	1826	130.3	45	0.08	2.94	2.84	0.77	6.52
	24	1348	92.4	39	0.06	3.02	2.91	0.82	5.88
	69	1784	122.6	45	0.13	2.73	2.67	0.72	6.08
	70	1718	155.8	48	0.17	2.52	2.45	0.65	6.65
	71	1018	14.2	29	0.26	2.00	1.93	0.59	4.30
	72	1006	325.9	32	0.19	2.33	2.23	0.67	4.95
	75	782	62.9	34	0.10	2.72	2.59	0.77	5.41
C	49	958	592.0	35	0.10	2.68	2.55	0.75	5.62
	51	796	68.4	26	0.24	2.00	1.92	0.61	3.98
	73	720	47.6	24	0.14	2.44	2.35	0.77	3.74
D	14	246	34.0	15	0.09	2.48	2.21	0.92	3.21
	15	890	156.8	32	0.07	2.96	2.79	0.85	5.43
	19	1152	157.0	39	0.09	2.85	2.75	0.78	5.78
	20	424	120.6	22	0.27	1.93	1.83	0.62	3.54
	21	148	20.8	11	0.30	1.61	1.44	0.66	2.23
	25	870	77.5	20	0.19	2.19	2.00	0.72	3.77
E	26	1352	32.5	26	0.40	1.53	1.48	0.46	3.62
	27	3036	266.4	45	0.19	2.35	2.31	0.62	5.58
F	54	3008	431..6	42	0.09	2.86	2.75	0.76	6.32
	55	9646	231.3	74	0.04	3.47	3.40	0.81	9.49
	74	1524	24.5	30	0.13	2.42	2.32	0.71	4.65
G	56	1933	634.6	43	0.30	2.17	2.12	0.57	5.73
H	48	4332	112.2	47	0.61	1.15	1,13	0.30	5.60
	50	1842	46.7	39	0.42	1.59	1.54	0.43	5.14
	52	2150	35.9	46	0.18	2.26	2.20	0.59	6.10
I	31	32023	145.0	36	0.68	0.90	0.89	0.25	3.67
J	38	15664	649.4	62	0.19	2.21	2.20	0.53	6.48
	40	9542	485.2	52	0.23	2.13	2.12	0.54	5.76
	65	21014	376.4	30	0.45	1.04	1.04	0.31	3.00

(Station Group J). The station group with the lowest and highest mean biomass were Station Groups H and G, respectively. The Shannon diversity ranged from 0.90 (Station 31:Station Group I) to 3.47 (Station 55:Station Group F) while the Brillouin diversity ranged from 0.89 at Station 31 to 3.40 at Station 55. Simpson diversity (a dominance index) ranged from 0.04 at Station 55 (74 taxa present) to 0.68 at Station 31 (36 taxa present). Brillouin evenness ranged from 0.25 at Station 31 (Station Group I) to 0.92 at Station 14 (Station Group D). Species richness ranged from 2.23 at Station 21 (Station Group D) to 11.26 at Station 4 (Station Group A′).

VII. DISCUSSION

Biologically Important Taxa (BIT)

One hundred and twenty eight (128) taxa were delineated as BIT, with 62 important in terms of biomass at one or more stations. Since some of these taxa are distributed throughout the study area or are common within specific station groups, they probably have great influence on trophic and

TABLE IX

MEAN DENSITY AND BIOMASS VALUES FOR ALL STATION GROUPS DETERMINED BY CLUSTER ANALYSIS OF *ln*-TRANSFORMED DENSITY DATA

Station Group	Density (No/m^2)	Biomass (g/m^2)
A′	1,864.	111.2
A"	1,743.	312.6
B	1,519.	129.5
C	825.	236.0
D	622.	94.4
E	2,194.	149.4
F	4,726.	229.1
G	1,933.	634.6
H	2,775.	64.9
I	32,023.	145.0
J	15,407.	503.7

other interactions in their particular localities. Many of these taxa should have value as monitoring organisms if any of the lease areas are developed into producing oil fields.

Numerical Analysis

The numerical analysis of transformed abundance data delineated 11 station groups on or near four potential petroleum lease areas (Navarin Basin, Zhemchug Basin, St. Matthew Basin, and Hope Basin) and within the Chirikov Basin (Figs. 2a and 3a).

Three station groups (Station Groups B, C, and F) contained stations which were spatially disjunct (i.e., well separated geographically) (Fig. 3a). Station Group B consisted of two station clusters, one in the Navarin Basin lease area and the other in the Zhemchug Basin lease area. Although the six density-dominating species (*Heteromastus filiformis*, *Ophiura sarsi*, *Maldane glebifex*, *Axinopsida serricata*, *Diamphiodia craterodmeta*, and *Priapulus caudatus*) in Station Group B occurred in both clusters, only *O. sarsi* and *A. serricata* dominated those stations in the Zhemchug Basin lease area, while the remaining four species dominated in the Navarin Basin lease area (data summary submitted to NODC). Separation of these two station clusters in Station Group B was not evident in the principal coordinate analysis.

Station Group C consisted of three stations, one of which (Station 73) was located approximately 1000 km south of the other two members of the group (Figs. 2a and 3a). All three stations were linked primarily by *Nucula tenuis* (Station Group 34) and, to a lesser extent, by *Sternapsis scutata* (Species Group 36). Station 73, located in deeper water than Stations 49 and 51, was characterized by (1) a larger number of *Nucula tenuis* and *Sternaspis scutata* than occurred at Stations 49 and 51, and (2) by the absence of *Nuculana* fossa (Species Group 35), *Cucumaria* sp., and *Serripes groenlandicus* (both in Species Group 36). This separation of Station 73 from the other two stations in Group C is also apparent in the principal coordinate analysis (Fig. 5). Station 49 was the only station of the station group that contained all five of the density-dominating species (N.

tenuis, N. fossa, Cucumaria sp. , *S. scutata*, and *S. groenlandicus*) of Station Group C. Station 51 contained high densities of *N. tenuis* and N. fossa.

Station Group F also consisted of three stations, one of which (Station 74) was located approximately 1000 km south of the other two members of the group (Figs. 2a and 3a). The three stations in the group were linked by *Pholoe minuta, Glycinda picta, Praxillella praetermissa, Harpinia gurjanovae, Haploscoloplos elongatus* (all in Species Group 6) and *Spiophanes bombyx* (Species Group 15). Stations 54 and 55, but not Station 74, were linked by *Westwoodilla caecula* (Species Group 9) and *Cyclocardia* sp. (Species Group 10). In addition, Station 74 was differentiated by the much lower density values (1524 individuals/m^2), one-third to one-sixth those of Stations 54 (3008 individuals/m^2) and 55 (9646 individuals/m^2), respectively. Furthermore, biomass estimates for Station 74 (24.5 g/m^2) were roughly six percent and ten percent of those at Stations 54 (431.6 g/m^2) and 55 (231.3 g/m^2), respectively. Among the six species (*Harpinia gurjanovae, Praxillella praetermissa, Glycinde picta, Haploscoloplos elongatus, Barantolla americana*, and *Paraphoxus oculatus*) that dominated in Group F, only two (*B. americana* and *P. oculatus*) did not occur at all three stations. When the principal coordinate analysis was examined, Station 74 was not obviously separated from the other two stations in Station Group F (Fig. 5), reaffirming the similarity of the stations in the group despite the considerable geographical separation of Station 74.

The Navarin Basin lease area consisted of three distinct station groups, A′, B, and D. Most of the stations in Groups A′ and B were located at depths between 100 m and 200 m. Similarities between the latter two groups exist in the importance of five dominant species groups (6, 28, 29, 30, 32) and in the dominance of three species: *Heteromastus filiformis, Axinopsida serricata*, and *Ophiura sarsi* (Figs. 1 and 5; Table V; Appendix B). The only station (Station 13) in Station Groups A′ and B with few individuals of the above three species occurred in the relatively shallow water adjacent to St. Matthew Island; Station 13 was the last station to join Station Group A′ in the cluster analysis of transformed density data (Fig. 2a), indicating its low affinity with Group A′. The principal coordinate analysis revealed the similarity of Groups A′ and B: little separation between these groups was apparent (Fig. 5). Reduced numbers of species (in either of the station groups) in Species Groups 5, 6, 7, 14, 19, 21, 23, 31, 33, 34, 36, and 42 distinguished Station Group B from Group A'.

Three (Stations 14, 19, and 20) of the six stations in Station Group D were located in water depths between 80 and 90 m. This station group had the lowest mean density (622 individuals/m^2) and second-lowest mean biomass (94 g/m^2) of all of the station groups (Table IX). Station Group Dwas well separated from all of the other groups in the principal coordinate analysis (Fig. 5).

Station Group E included two stations (Stations 26 and 27) in the St. Matthew Basin lease area at water depths of 35 and 46 m, respectively. These stations were dominated by the polychaete *Haploscoloplos elongatus*, with densities of 612 (at Station 26) and 418 (at Station 27) individuals/m^2. No other stations examined in the present survey contained such high densities of *H. elongatus*. Station 27 also contained the highest density, of all stations, of the protobranch clam *Nucula tenuis* (994 individuals/m^2). The highest concentration of *N. tenuis* elsewhere was at Station 50 in Station Group H, adjacent to Kotzebue Sound, with 238 individuals/m^2. Station 27 in Station Group E showed a close affinity with Station Groups C and D on plots of the first and second axes and of the first and third axes of the principal coordinate plot (Fig. 5a, b). Station 26 in Group E is consistently separated from Station 27 on these plots, presumably the result of the high density of *N. tenuis* at the latter station.

Station Group A″ consisted of two stations (N1 and N5, located close to Cape Nome) that were in only 22 m of water. These stations were dominated in density by the polychaetes *Myriochele oculata* (47 individuals/m^2) and *Haploscoloplos elongatus* (72 individuals/m^2) and in biomass by the shrimp *Argis lar* (17.6 g/m^2) and the echiuroid *Echiurus echiurus alaskanus* (9.2 g/m^2). Station Group A″ was well-separated in the principal coordinate analyses from all other station groups (Fig. 5), although it showed affinities to Station Groups G (geographically close) and I (another shallow-water station group dominated byM. *oculata*).

Station Group G, represented by a single station (Station 56) located in Bering Strait, was dominated by a suspension-feeding clam (*Hiatella* *arctica*), a deposit-feeding polychaete (*Asabellides sibirica*), and a suspension-feeding barnacle (*Balanus crenatus*), with densities of 820, 93, and 83 individuals/m^2, respectively. No other stations approximated the densities of these species. Biomass values at this station were dominated by three species, two of which were also important in density: *Hiatella arctica* (265.8 g/m^2), *Balanus crenatus* (22.8 g/m^2), and *Strongylocentrotus droebachiensis*[1] (221.8 g/m^2). In the principal coordinate analysis, Station 56 showed some affinity with the two Chukchi Sea stations of Group F (Stations 54 and 55) just north of the Bering Strait (Fig. 5). Both density and biomass at Station 56 were relatively high, with estimates of 1933 individuals/m^2 and 635 g/m^2, respectively. Stoker (1981) also reported a high biomass at stations in the region of the Bering Strait. He related these high values to: (1) high productivity in spring, (2) an influx of detrital carbon from the Yukon River (as well as Norton Sound; Feder, unpub. data), and (3) the current structure in the vicinity of the Strait, such that the velocity of the northward flow, with its contained detritus, is greatly increased (data presented in this Final Report appear to reflect this by the high abundance of the suspension-feeding clam *Hiatella* and the sea urchin *Strongylocentrotus*) and consequently transports much organic carbon to either side of the strait.

The stations in Group H, consisting of three stations northeast of the Bering Strait and along the Seward Peninsula, were dominated by the surface-deposit-feeding polychaete *Myriochele oculata* and the suspension-feeding sand dollar *Echinarachnius parma*; tunicates also dominated at two of the stations (Stations 48 and 52) of the group closest to the Bering Strait. The surface-deposit-feeding (and probably also suspension-feeding) clam *Macoma calcarea* dominated in biomass here. The mean density and biomass of the stations in this group ranged from 1842 to 4332 individuals/m^2 and 36 to 112 g/m^2, respectively. In the principal coordinate analysis, Stations 48 and 52 of Station Group H were well separated from all other groups in the plots of the first and second axes and of the first and third axes

[1]Listed in data sheets as Echinoida and identified after data were analyzed (see Results).

(Fig. 5a, b). Station 50, the one station of the group located adjacent to Kotzebue Sound and closest to Station Group C, is always separated from the other two stations of Group H and shows affinities with Group C. The high densities of the dominant species, both surface-deposit- and suspension-feeders, presumably reflect the periodic availability of detrital materials passing from the Bering Strait eastward along the Seward Peninsula (see Discussion in Stoker, 1981).

Station Group I is represented by a single station (Station 31) located just north of Etolin Strait (between the mainland and Nunivak Island). Station 31 was dominated by Foraminifera, the deposit-feeding polychaetes *Myriochele oculata* and *Asabellides sibirica*, and the suspension-feeding ectoproct (bryozoan) *Alcyonidium disciforme*. The latter species dominated in biomass. In the principal coordinate analysis, Group I is separated from all other groups. The high density of 32,023 individuals/m^2 at this station is the highest observed at any station sampled in this investigation, and is primarily the result of large numbers of the tube-dewelling polychaete *M. oculata*. The water in Etolin Strait probably contains terrestrial detritus derived from the Kuskokwim River in the summer; this material presumably settles out on the bottom adjacent to Station 31 when current velocities are reduced there. The highest Simpson Index (a dominance index that approaches 1.0 when few species occur at a station) was recorded at this station, with a value of 0.68; the lowest Shannon Diversity Index, 0.90, also occurred here. The species at Station 31 are dominated by organisms that appear to be adapted to an environment where the bottom is periodically enriched by the influx of allochthanous carbon from the Kuskokwim River. The extremely high foraminiferan density further suggests an enriched, but well oxygenated, bottom.

Station Group J, consisting of three stations north of St. Lawrence Island (the Chirikov Basin) , was distinguished by the dominance of amphipods in Species Groups 6 and 40. Within Station Group J, Station 65 (the station in the group closest to St. Lawrence Island) was the most dissimilar station in the group (Fig. 3a), due in part to the presence of over 14,000 *Ampelisca macrocephalus* /m^2 at that station. Also, at Station 65, the other two amphipod species of Species Group 40, *A. birulai* and *A. eschrichti*, were relatively unimportant. Conversely, Stations 38 and 40 had relatively high densities of all three of the amphipod species in Species Group 40. Station 65 joins the other two stations in Group J at a low similarity level (26%; Fig. 2a) in the *ln*-transformed cluster analysis. The area within and adjacent to Station Group J is a region where gray whales (*Eschrichtius robustus*) seasonally feed intensively on gammarid amphipods (Nerini *et al.*, 1980; personal communication), and where bearded seals (*Erignathus barbatus*) and walruses (*Odobenus rosmarus divergens*) also feed periodically on the bottom (Lowry and Frost, 1981). Although Station Group J shows strong affinities to Group F in the principal coordinate analysis (Fig. 5), these groups are not adjacent to each other geographically (Fig. 3a). However, the location of Station Group F north of the Chirikov Basin and the Bering Strait probably indicates settlement of larvae of species transported form the stations in Group J to the northern region. Group J is also relatively well separated geographically from all of the other station groups.

General Features of the Station Groups

An assessment of the biological data in this report indicates that most of the station groups, both within and adjacent to the basins considered, have features that separate them from all of the other groups. Characteristic species dominate in density and biomass in most of the groups, and can be used to describe these groups, thereby making it possible to plan viable monitoring programs for each of the petroleum lease areas. A description of some of the areas described in this report is also included in Stoker (1978), which complements and supplements some of the information presented here.

The station groups located primarily in the deeper waters of the Zhemchug and Navarin Basin lease areas (Station Groups A' and B) were composed mainly of deposit-feeding organisms characteristic of the muddy bottom present in these areas (see Feder *et al.*, 1980b). Two deposit-feeding species were common to this shelf area: the capitellid polychaete *Heteromastus filiformis* and the mud star *Ctenodiscus crispatus*.

The two stations (Stations 73 [Station Group C] and 74 [Station Group E]) within the Zhemchug Basin north of the Pribilof Islands are in waters shallower than are Station Groups A′ and B and are also characterized by deposit-feeding species. These species are more characteristic of mid-shelf areas (see Feder *et al.*, 1980b), however: at Station 73, the deposit-feeding clams *Nucula tenuis* and *Nuculana* fossa dominated, and, at Station 74, the deposit-feeding polychaetes *Praxillella praetermissa* and *Glycinde picta* dominated. The substratum in the vicinity of the latter station is characteristically higher in sand fractions than are other regions around the Pribilof Islands (Feder *et al.*, 1980b). A dominance, in terms of biomass, of two suspension-feeding species at Station 74 appears to reflect this difference in substrate, with the sand dollar *Echinarachnius parma* (probably also using resuspended particulate matter) and the clam *Serripes groenlandicus* present.

Station Group D, east of the Navarin Basin, is also dominated by deposit-feeding species. Again, however, the species differ somewhat from other nearby stations within the Basin. The deposit-feeding clams N. *tenuis* and *Macoma calcarea* and the deposit-feeding polychaete *Maldane glebifex* are the most common species present. The importance, in biomass, of the sand dollar *E. parma* suggests an increase in sand fractions of the substrate in the Group D area.

The stations within the St. Matthew Basin (Group E) suggest an enriched depositing environment. Three deposit-feeding species dominated in density: the polychaetes *Haploscoloplos elongatus* and *Barantolla americana* and the clam *N. tenuis*. The dominance in biomass of deposit-feeding clams (*N. tenuis*, *M. calcarea*, *N. fossa*, and *Yoldia amygdalea*) further indicates the presence of an organically rich bottom, presumably representing a region at the periphery of the very rich area encompassed by Station 31 (Station Group I). It is in the latter region that the extraordinary high densities of the deposit-feeding polychaete *Myriochele oculata* occurs.

The shallow-water stations (23-40 m) of the Chirikov Basin are dominated by tube-dwelling amphipods, *Ampelisca* spp. These amphipods are generally considered suspension feeders (probably feeding primarily on resuspended sediments available after storms) and typically occur where high levels of particulate material settle to the bottom. Presumably, zooplankters funneled through the Anadyr Strait and detrital particles from the Yukon River and Norton Sound contribute to this particulate material (see Stoker, 1981).

The stations off Cape Nome (Station Group A") also reflect an environment where particulate material is settling to the bottom. The polychaete *M. oculata* is very common here, and the deposit-feeding clam *M. calcarea* dominates in biomass. The suspended materials of Norton Sound (derived from the Yukon River and other rivers within the Sound) presumably contribute much of the food available to the benthic species of Station Group A".

Station Group G (Station 56), located in Bering Strait, reflects the high-velocity currents and hard substrate present here, by the increase in dominance of suspension-feeding species: the clam *Hiatella arctica* and the barnacle *Balanus crenatus*. An increase in benthic biomass is typically apparent in the Bering Strait (Stoker, 1978, 1981).

The species that dominate Station Group H, northeast of Bering Strait, indicate the deposition (as a result of loss of current velocity) of materials funneled through the Strait and into Kotzebue Sound. The polychaete *M. oculata* and the deposit-feeding clams *N. tenuis* and *M. calcarea* are important here. The presence of the sand dollar *E. parma* also suggests an increase in sand fraction in the sediment here.

The stations south of the Hope Basin lease area (Stations 54 and 55) were dominated by deposit-feeding species feeding on particulate material funneled through Bering Strait and deposited in a region where water currents have decreased in velocity. The deposit-feeding polychaetes *P. praetermissa*, *G. picta*, and *H. elongatus* were common here. The suspension-feeding sand dollar *E. parma* dominated in biomass, suggesting that particulate material is still an important component of the water column in this region.

The shallow, muddy stations of Kotzebue Sound, east of the Hope Basin lease area, were dominated by deposit-feeding species characteristic of such an environment. The clams *N. tenuis*, *N. fossa*, the sea cucumber *Cucumaria* sp. , and the polychaete *Sternaspis scutata* were common.

General Summary and Implications of Oil Development

In general, each of the station groups within or adjacent to the basin examined in this study had individual species and/or species groups that characterized and distinguished them from the other groups. In some cases, the similarities within groups occurred between stations that were widely separated geographically, e.g., the 1000 km separating stations of Station Groups C and F and the disjunct distribution of segments of Station Group B (Figs. 2a and 3a). Although the wide separation of stations within groups C and F implies ecological differences between these disjunct stations, in general, these station groups delineated by multivariate techniques appear to be distinctive enough to also be useful for monitoring purposes. Furthermore, knowledge of species composition within the station groups makes it possible to assess the ecological consequences of damage or loss of any of these species within the stations or station groups. Thus, the deposit-feeding species in the Zhemchug and Navarin Basins are actual or potential food resources for several bottom-feeding species (e.g., the Tanner crab *Chionoecetes opilio* and some species of bottomfishes), and loss of these food organisms could disrupt the trophic system involving these and other predatory species in the region of the lease areas (Feder and Jewett, 1981a; Jewett and Feder, 1981). The organically-enriched region of the St. Matthew Basin lease area sustains dense populations of numerous species of sessile, deposit-feeding organisms, many of which are of potential importance to bottom-feeding predators. No data are available on the epifaunal species composition or trophic interrelationship of species in the latter lease area. However, it is to be expected that such large concentrations of organisms as are found at Station 31 (Fig. 1; Table IX) must have ecological importance within the system, and alterations of the benthic biota would be expected if any of the species present were negatively affected by industrial activity. In addition, the high densities (25,000 individuals/m^2) of the tubes of the polychaete *Myriochele oculata* at Station 31 must stabilize the bottom sediments of the area to some extent. Loss of some or all of these sessile polychaetes could destabilize the bottom sediments, with subsequent alteration of the species composition, density, and/or biomass (e.g., see discussion in Rhoads, 1974). Similar destabilization of bottom sediments could also occur in the Chirikov Basin if severe damage was sustained by the tube-building ampeliscid amphipods (*Ampelisca* spp.) present in large numbers there, as well as the tube-dwelling polychaete *Myriochele oculata* within Station Group H (northeast of Bering Strait). In the case of the ampeliscids in the Chirikov Basin, gray whales depend on these crustaceans for food during the summer, and depletion of this resource would be critical for the whales at this time; they feed almost exclusively on their summering grounds (Frost and Lowry, 1981). Likewise, damage to the large bivalve mollusk populations present in the Chirikov Basin could negatively affect the bearded seals and walruses of the region (Stoker, 1978; Fay, 1981; Frost and Lowry, 1981; Lowry and Frost, 1981). The occasional importance of the northeastern Bering and southeastern Chukchi Seas to bottom-feeding fishes (Jewett and Feder, 1980; Feder and Jewett, 1981a) implies that the high standing stock of infauna (Stoker, 1978, 1981) is important to these organisms in those warm years when the fishes are able to migrate there to feed intensively. The continued presence of *Chionoecetes opilio*, a commercially-fished predator (in the southeastern Bering Sea) on infaunal organisms (Feder and Jewett, 1981a), in the latter regions also indicates the importance of sustaining healthy populations of infauna there.

VIII. CONCLUSIONS

Numerical analysis of van Veen grab samples collected in 1979 and 1980 in the eastern Bering and southeastern Chukchi Seas identified station groups (based on infaunal and slow-moving epifaunal species) on or near four potential petroleum lease areas — the Zhemchug Basin, Navarin Basin, St. Matthew Basin, and Hope Basin. A preliminary understanding of the Chirikov Basin, in conjunction with the data of Stoker (1978), also emerged from the present investigation. The present study, although based on collections made on one occasion at each station, makes it possible to develop a preliminary assessment of the infaunal composition in the vicinity of the above lease areas. As described in the introduction of the present report, organisms of the infaunal benthos are frequently chosen to monitor long-term pollution effects because they tend to remain in place, typically react to long-term environmental changes, and, by their presence, generally qualitatively reflect the nature of the substratum. Furthermore, the presence of epifaunal and finfish species of actual or potential commercial importance (crabs, shrimps, snails, bottomfishes), most of which feed on benthic organisms in the areas investigated, also emphasizes the necessity of understanding the benthic biota. Thus, changes in the availability of benthic food organisms (inclusive of many of the species addressed in this report) could indirectly affect these commercial species.

The data presented in this report, in conjunction with those of Haflinger (1978), Stoker (1978), Feder and Jewett (1978, 1980), and Feder *et al.* (1980b; in press), make it possible to understand the infaunal composition of each of the oil lease areas (each of which is separable biologically from the others) prior to initiation of industrial activity. Consequently, a benthic monitoring program can now be developed for each lease area, if required, with confidence that a reasonable data base is available to serve as the informational core of each program. However, it must be emphasized that most of the benthic biological data from the region considered in this report is distribution and abundance information only. Although limited life-history data are available for some bottom-living species (Feder and Jewett, 1978; Feder and Jewett, 1981a; Hood and Calder, 1981a, b; Feder *et al.*, in press), life-history information for the majority of these species is unavailable. Furthermore, a broad spectrum of physical and chemical environmental data, taken in conjunction with these benthic biological data, are virtually non-existent (but, see Haflinger, 1978; Stoker, 1978; relevant chapters in Hood and Calder, 1981a, b). Thus, although monitoring programs can be initiated, they can only be based on the available biological density and biomass data.

Generalizations, primarily based on multivariate analysis of *ln*-transformed density data, are presented below on the benthos in the vicinity of the petroleum lease areas investigated. A comparison of the summaries illustrates the uniqueness of most of the biological groups identified in the eastern Bering and southeastern Chukchi Seas. Each station group is considered briefly in terms of the major features that characterize it.

1. The infauna of the Zhemchug Basin lease area was segregated into three groups – Station Group B, Station 73, and Station 74 (Fig. 3a).
    a. Station Group B – the stations occurred at depths between 100 m and 200 m. Some stations in this station group also occur in the Navarin Basin lease area; these stations are considered when that group is presented. Most of the species in the group were deposit

feeders. The dominant species (in density) present were the polychaete *Heteromastus filiformis*, the brittle star *Ophiura sarsi*, the polychaete *Maldane glebifex*, the clam *Axinopsida serricata*, and the brittle star *Diamphiodia craterodmeta*, in decreasing order of importance. The leading species in biomass in this group were *O. sarsi*, *M. glebifex*, and the mud-consuming sea star *Ctenodiscus crispatus*, in decreasing order of importance.

b. Station 73 –located at 79.6 m, this station clustered with Station Group C, but is spatially separated by 1,000 km from the other stations in the group. Station Group C is considered below. The station was characterized in density by the deposit-feeding clam *Nucula tenuis* and the deposit-feeding polychaete *Sternaspis scutata*, in decreasing order of importance.

c* Station 74 – located at 72 m depth, just north of the Pribilof Islands. The station clustered with Station Group F, but was spatially separated by 1,000 km from the other stations in the group. Station Group F is considered separately below. The dominant species, by density, at this station were the amphipod *Harpinia gurjanovae* and the deposit-feeding polychaetes *Praxillella praetermissa* and *Glycinde picta*, in decreasing order of importance. Species dominant in biomass were *Nepthys caeca* (12.5 g/m^2), *Praxillella practermissa* (3.1 g/m^2), and unidentified Foraminifera (2.4 g/m^2).

2. The Navarin Basin lease area was composed of three relatively distinct station groups –Station Group A′, B, and D (Fig. 3a).

   a. Station Group A′ — most of the stations of this group occurred at depths between 100 m and 200 m. Station 12 of this group occurred at 103 m, and Station 13 was at 78 m; both of the latter stations were close to, and west of, St. Matthew Island. The dominant species present, in terms of density, was the deposit-feeding polychaete *Heteromastus filiformis*; the biomass dominant was the mud-consuming sea star *Ctenodiscus crispatus*. This group differed from Station Group B by differences in species groups (see Discussion and Table v).

b. Station Group B – although this station group is a disjunct one (i.e., separated by Station Group A'; Fig. 3a), its biological features are relatively similar throughout. See the description of this group under the Zhemchug Basin lease area above.

c. Station Group D — stations in this group occurred from 81 m to 103 m. This group had the lowest mean density (622 individuals/m^2) and the second lowest mean biomass (94 g/m^2) of all the station groups examined in this investigation. The dominant species, in terms of density and biomass, were the deposit-feeding polychaete *Barantolla americana* and the clam *Macoma calcarea*, respectively. Station 14, at 85 m and just northwest of St. Matthew Island, had a biomass of 34 g/m^2. Station 21, at 103 m, had the lowest biomass (21 g/m^2) of the entire station group.

3. The St. Matthew Basin lease area and vicinity consisted of two station groups – Station Groups E and I (Fig. 3a).

a. Station Group E – the two stations (Stations 26 and 27) in this group occurred at depths of 35 m and 46 m, respectively. The dominant species present, in terms of density and biomass, were the deposit-feeding polychaete *Haploscoloplos elongatus* and the deposit-feeding clam *Nucula tenuis*, respectively. No other station in any of the other station groups contained such high densities of *H. elongatus*.

b. Station Group H – the one station of this group, Station 31, occurred at 22 m, relatively close to the mainland and north of Etolin Strait. The dominant species, in density, was the polychaete *M. oculata*, with a density of 25,000 individuals/m^2. An ectoproct (bryozoan) *Alcyonidium disciforme*, dominated the biomass at this station. The high overall density at this station (32,023 individuals/m^2) was the highest value observed at any of the stations sampled in the investigation; this high density was primarily a reflection of the large numbers of the polychaete *M. oculata*. Large numbers of Foraminifera also characterized this station; the presence of such large numbers of these shelled protozoans was also unique to this station.

4. The Hope Basin lease area and vicinity consisted of three station groups – Station Groups C, F, and H (Fig. 3a).

   a. Station Group C – the two stations (Stations 49 and 51) in this group that is adjacent to the Hope Basin occurred at depths of 30 m and 24 m, respectively. The other station in the group, Station 73, was in the Zhemchug Basin lease area, and is discussed with the stations of that area. The species dominant in density (in decreasing order of importance) at Stations 49 and 51 were the deposit-feeding clams *Nucula tenuis* and *Nuculana* fossa and the sea cucumber *Cucumaria* sp., The species dominant in biomass were *Cucumaria* sp., the deposit-feeding polychaete *Sternaspis scutata* , and the large clam *Serripes groenlandicus*, in decreasing order of dominance.

   b. Station Group F – the two stations of this group are located south of the Hope Basin lease area and just north of Bering Strait; Stations 54 and 55 occurred at depths of 32 and 53 m, respectively. The other station in this group (Station 74) is in the Zhemchug Basin lease area and is discussed with the stations of that area. The dominant species, in decreasing order of density, were the amphipod *Harpinia gurjanovae* and the deposit-feeding polychaetes *Praxillella praetermissa* and *Glycinde picta*. The sand dollar *Echinarhachnius parma* dominated the biomass.

   c. Station Group H – The three stations of this group were northeast of Bering Strait, and occurred from depths of 13 m to 23 m. The dominant taxa (in decreasing order of density) were the polychaete *Myriochele oculata*, the sand dollar *E. parma*, and tunicates. The species dominating in biomass was the deposit-feeding clam *Macoma calcarea*.

5. Station groups from St. Lawrence Island through the Chirikov Basin to Bering Strait consisted of three station groups – Station Groups J, A", and G (Fig. 3a).

   a. Station Group J – the stations in this group are either adjacent to St. Lawrence Island or within the Chirikov Basin, and occurred at depths of 23-40 m. The dominant species (in decreasing order of density) were the tube-dwelling amphipods *Ampelisca macrocephala*, *A. birulai*, and A. *eschrichti*. *Ampelisca macrocephala* dominated in biomass. Station 65 of Group J was close to St. Lawrence Island (at 23 m), and differed from the other two stations of the group by having fewer *A. birulai* and *A. eschrichti*.

b. Station Group A" – the two stations of this group are adjacent to Cape Nome at a depth of 22 m. Species dominating in density were the polychaetes *M. oculata* and *Haploscoloplos elongatus* and the amphipod *Erichthonius hunteri*, in decreasing order of importance. The species dominant in biomass were the crangonid shrimp *Argis lar* and the deposit-feeding echiurid worm *Echiurus echiurus alaskanus*.

c* Station Group G – consists of a single station in Bering Strait at a depth of 52 m. Both the density and biomass at this station were relatively high, with values of 1,933 individuals/m^2 and 635 g/m^2, respectively. Species dominating in density were the boring clam *Hiatella arctica*, the sea urchin *Strongylocentrotus droebachiensis*, the deposit-feeding polychaete *Asabellides sibirica*, and the barnacle *Balanus crenatus*. This was the only station with high densities of *H. arctica* and *B. crenatus*. *Hiatella arctica* dominated the biomass.

Knowledge of species composition within the station groups delineated by this study makes it possible to make a preliminary assessment of the ecological consequences of damage to or loss of any of the food species within the stations or station groups. Many of the common, deposit-feeding infaunal species in the Zhemchug and Navarin Basin lease areas are actual or potential food resources for bottom-feeding species such as the Tanner crab (*Chionoecetes opilio*) and bottomfishes. Loss of any or all of the benthic food species as a result of industrial activity or petroleum contamination could seriously disrupt the trophic system involving these species. The dense populations of infaunal species in the vicinity of the St. Matthew Basin lease area consist of many species commonly taken as food by epibenthic predators elsewhere in the eastern Bering Sea, and damage to large segments of this food reserve could negatively affect as yet unknown biological interactions in the area. The dense masses of tubes of the polychaete *Myriochele oculata* in the area just north of Etolin Strait and Nunivak Island stabilize the bottom sediments of the area. Loss of, or damage to, a large segment of this polychaete population would destabilize the bottom sediments, consequently causing a new complement of species to be established. Obvious ecological changes would be expected in the latter area if such damage occurred. A similar change of the bottom structure would be expected in the Chirikov Basin if major mortality of, or damage to, the extensive ampeliscid amphipod populations present there occurred. In the latter situation, alteration of bottom structure with concomitant ecological changes are to be expected. However, a far more serious consequence of destruction of major portions of these amphipod beds would be manifested by the loss in food available to the large populations of gray whales (*Eschrictius robustus*) dependent on these crustaceans for a major component of their summer food. Damage to the bivalve populations in the Chirikov Basin via petroleum or other industrial development would affect an important seasonal food supply for bearded seals (*Erignathus barbatus*) and walruses (*Odobenus rosmarus*). The high benthic biomass located south and southeast of the Hope Basin lease area comprises a food reserve available to the resident Tanner crab and to transient populations of bottomfishes and marine mammals that periodically move into the region for summer feeding activity. The area is relatively shallow and could be readily contaminated by petroleum fractions. Damage to or loss of the high standing stocks of benthic food organisms in the Hope Basin lease area could be detrimental to the predatory species that frequent the region. It should be emphasized that both the Tanner crab and the transient bottomfish populations here are operating near the northern limits of their range, and alteration of any aspect of their environment could seriously affect their survival in the northeastern Bering and southeastern Chukchi Seas.

Availability of many readily-identifiable, biologically well-understood organisms is a preliminary to the development of monitoring programs. Sizeable biomasses of taxonomically well-known annelids, mollusks, crustaceans, and echinoderms were typical of most of the stations, and many of these taxa were sufficiently abundant to represent organisms potentially useful as monitoring tools. Some aspects of the feeding biology of these benthic organisms are known or can be surmised, based on a knowledge of the same or similar species elsewhere. However, other aspects of the biology of these organisms are poorly understood, although limited data are available for bivalve and gastropod growth as well as knowledge of reproduction and recruitment biology (see selected chapters in Hood and Calder, 1981a). Hopefully, future investigations in the study areas will clarify some of the more important aspects of the biology of the dominant benthic species; this information would increase the reliability of future monitoring programs for the eastern Bering and southeastern Chukchi Seas.

Initial assessment of all data for the study areas suggests that: (1) sufficient station group uniqueness exists to permit development of monitoring programs based on taxon composition within groups, using grab sampling and selected statistical techniques, and (2) adequate numbers of biologically relatively well-known, abundant, and/or large (in biomass) species are available to permit nomination of likely monitoring candidates for most of the Basins if oil-related activity is initiated.

IX. NEEDS FOR FURTHER STUDY

With respect to this study and to previous benthic studies in the Bering and Chukchi Seas, we feel that the following questions and comments need to be addressed in the future:

1. What is the seasonal variation in density and biomass of infauna in the areas examined?
2. With regard to the temporal variation referred to above, what are the life histories of the most important organisms (in terms of density, biomass, and/or act of promoting stability of the benthic environment) in each species group?
3. What are the most important species involved in trophic interactions with known and/or potential commercial fisheries species in the Bering and Chukchi Seas?
4. Are there specific stages in the life histories of the most important infaunal species that cause them to be very susceptible to effects of oil and/or industrial development?

5. Due to the extremely high species diversity (up to 85 taxa examined/ station and an average of 44 taxa/grab overall), abundance (up to 32,000 individuals/station and an average of 1,660 individuals identified/ station, yielding approximately 80,000 individuals identified overall), and biomass (173. g biomass/station), we were unable to analyze as many stations as we had originally planned, based on our best estimates of time available from earlier work in the southeastern Bering Sea and elsewhere (with attributes at most 60% of those discussed above). Hence, we analyzed all stations in the higher-priority (Navarin, Zhemchug, and Hope Basins) lease sale areas, but only analyzed selected stations in the lower-priority (St. Matthew and Chirikov basins) areas. Completion of analysis of samples in these latter areas would greatly improve our characterization of the infauna in these areas for future studies, thus allowing better monitoring of the infauna in these regions.

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APPENDIX A

LIST OF ALL TAXA IDENTIFIED FROM THE GRAB SAMPLES TAKEN APRIL 1979 AND MAY-JUNE 1980 IN THE EASTERN BERING AND CHUKCHI SEAS

Biologically important taxa (BIT) are shown by crosses (x) under the appropriate criteria

Criteria:

1. Taxon occur in 50 percent or more of stations
2. At least 10 percent of individuals at some stations
3. At least 10 percent of wet biomass at some stations
4. Abundant with respect to number of individuals at some stations
5. Abundant with respect to total biomass at some stations

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
SARCODINA RHIZOPODEA	X	X		X		24
PORIFERA						3
PORIFERA FRAGS						3
HYDROZOA						10
HYDROZOA COLONIES						6
SCYPHOZOA						1
ANTHOZOA			X	X		9
ALCYONACEA NEPHTHEIDAE						2
EUNEPHTHYA RUBIFORMIS				X		1
ACTINIARIA HALCAMPIDAE			X		X	2
TURBELLARIA						3
RHYNCHOCOELA	X		X			35
RHYNCHOCOELA FRAGS.						18
CEREBRATULUS SP.						13
NEMATODA	X			X		31
POLYCHAETA						4
POLYCHAETA FRAG.	X					42
POLYNOIDAE						14
POLYNOIDAE FRAGS.						3
NEMIDIA SP.						2
ANTINOELLA SARSI						5
ARCTEOBEA SP.						2
ARCTEOBIA ANTICOSTIENSIS						12
ARCTEOBIA SPINELYTRIS						7
ARCTONOE DP.						1
EUNOE SP.						1
EUNOE NODOSA						2
EUNOE OERSTEDI						2
GATTYANA SP.						4
GATTYANA CILIATA						3
GATTYANA CIRROSA						3
GATTYANA TREADWELLI						5
HARMOTHOE SP.						1
HARMOTHOE IMBRICATA						5
HARMOTHOE LUNULATA						2
POLYNOE CANADENSIS						1
POLYNOE GRACILIS						1
POLYEUNOA TUTA						1
HESPERONOE SP.						2
HESPERONE COMPLANATA						3
TENONIA KITSAPENSIS						0
TENONIA SP.						5
NEMIDIA TAMARAE						7
PSEUDOPOLYNOE SP.						2
PHOLOE SP.						2
PHLOE MINUTA						32
PHOLOE MINUTA FRAGS.						1
PHYLLODOCIDAE						3

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
PHYLLODOCIDAE FRAGS.						2
ANAITIDES SP.						9
ANAITIDES SP. FRAGMENT						1
ANAITIDES GROENLANDICA						10
ANAITIDES MUCOSA						7
ETEONE SP.						3
ETEONE SP. FRAGMENT						3
ETEONE PACIFICA						2
ETEONE LONGA	X					34
EULALIA SIGEFORMIS						2
HESIONIDAE						1
AMPHIDUROS SP.						1
SYLLIDAE				X		2
SYLLIDAE FRAGMENTS						1
AUTOLYTUS SP.						2
SYLLIS SP.						2
TYPOSYLLIS SP.						2
TYPOSYLLIS SP. FRAGS						1
TYPOSYLLIS ALTERNATA						3
TYPOSYLLIS FASCIATA						1
EUSGLLIS SP.						1
EUSYLLIS BLOMSTRANDI						5
EXOGONE SP						6
EXOGONE MOLESTA						1
NEREIS SP.						1
NEREIS PELAGICA						1
NEREIS PROCERA						1
NEREIS 70NATA						1
CERATOCEPHALE LOVENI						1
NEPHTYIDAE FRAGS						1
NEPHTYS SP.	X		X		X	30
NEPHTYS SP. FRAGS						6
NEPHTYS ASSIMILIS			X			1
NEPHTYS CILIATA						3
NEPHTYS CAECA			X		X	14
NEPHTYS PUNCTATA	X	X	X	X	X	38
NEPHTYS RICKETTSI			X		X	2
NEPHTYS LONGASETOSA						3
NEPHTYS PARADOXA						1
NEPHTYS CALIFORNIANSIIS						1
SPHAERODOROPSIS OCULATA						1
COMMENSODORUM SP.						1
GONIADIDAE FRAGMENT						0
GLYCINDE SP.						1
GLYCINDE PICTA						19
GLYCINDE ARMIGERA						1
ONUPHIDAE						2
ONUPHIDAE FRAGMENT						3

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
ONUPHIS SP.						2
ONUPHIS CONCHYLEGA						3
ONUPHIS GEOPHILIFORMIS						1
ONUPHIS IRIDESCENT						1
ONUPHIS PARVA						3
ONUPHIS PARVA						17
LUMBRINERIDAE				X		4
LUMBRINERIDAE FRAGS						1
LUMBRINERIS SP.	X	X	X	X	X	32
LUMBRINERIS SP. FRAGS.						4
LUMBRINEREIS BICIRRATA						1
LUMBRINEREIS ZONATA						2
DRILONEREIS FALCATA MINOR						12
DORVILLEIDAE						3
DORVILLEA SP.						1
SCHISTOMERINGOS CAECA						2
ORBINIIDAE						1
ORBINIDAE FRAGS						2
HAPLOSCOLOPLOS SP.						1
HAPLOSCOLOPLOS PANAMENSIS						1
HAPLOSCOLOPLOS ELONGATUS	X	X	X	X	X	44
SCOLOPLOS ARMIGER						7
PHYLO FELIX						1
PARAONIDAE						1
AEDICIRA ANTENNATA						1
ARICIDEA SP.						4
ARICIDEA SUECICA						1
ARICIDEA LOPEZI	X					26
ARICIDEA MINUTA						3
TAUBERIA GRACILIS						18
APISTOBRANCHUS SP.						2
APISTOBRANCHUS TULLBERGI						12
SPIONIDAE						15
SPIONIDAE FRAGS						1
LAONICE SP.						2
LAONICE CIRRATA						4
POLYDORA SP.						4
POLYDORA SOCIALIS						3
POLYDORA CILIATA						1
POLYDORA LIMICOLA						1
PRIONOSPIO SP.						10
PRIONOSPIO MALMGRENI						2
PRIONOSPIO CIRRIFERA						5
PRIONOSPIO STEENSTRUPI						9
SPIO SP.						2
SPIO FILICORNIS						3
SPIO CIRRIFERA						1
BOCCARDIA SP.						3

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
BOCCARDIA CALIFORNICA						1
SPIOPHANES BOMBYX						7
PYGOSPIO ELEGANS						1
SCOLFLEPIS SP.						1
MAGELONA SP.				X		8
MAGELONA SP. FRAGS.						3
MAGELONA PACIFICA						3
MAGELONA CERAE						2
SPIOCHAETOPTERUS SP.						7
SPIOCHAETOPTERUS TYPICUS						4
SPIOCHAETOPTERUS COSTARUM						4
CIRRATULIDAE	X	X		X		36
CIRRATULIDAE FRAGS						6
CIRRATULUS CIRRATUS						1
THARYX SP.				X		13
THARYX SECUNDUS						6
CHAETOZONE SETOSA						5
CIRROPHORUS BRANCHIATUS						1
FLABELLIGERIDAE						1
BRADA SP.						4
BRADA VILLOSA	X					24
BRADA INHABILIS						1
FLABELLIGERA AFFINIS						1
FLABELLIGERA MASTIGOPHORA					X	4
SCALIBREGMA INFLATUM						17
OPHELIIDAE						1
AMMOTRYPANE AULOGASTER						3
OPHELIA SP.						1
OPHELIA LIMACINA						4
TRAVESIA SP.						3
TRAVISIA FORBESII					X	9
TRAVISIA PUPA			X		X	2
OPHELINA GROENLANDICA						1
ANTIOBACTUM SP.						1
STERNASPIS SCUTATA			X	X	X	22
CAPITELLIDAE				X		3
CAPITELLIDAE FRAGS						6
CAPITELLA CAPITATA				X		21
HETEROMASTUS FILIFORMIS	X	X		X		39
HETEROMASTUS GIGANTEUS						2
NOTOMASTUS SP.						4
MEDIOMASTUS SP.						10
MEDIOMASTUS CAPENSIS						3
MEDIOMASTUS CALIFORNIENSIS						2
DECAMASTUS SP.						1
DECAMASTUS GRACILIS						1
BARANTOLLA SP.				X		1
BARANTOLLA AMERICANA	X	X		X		38

TAXON NAME	CRIT1	CRIT2	C R I T 3	CRIT4	CRIT5	STA OCC
MALDANIDAE	X		X	X	X	34
MALDANIDAE FRAGS.	X					35
ASYCHIS SP.						1
ASYCHIS SIMILIS						1
MALDANE SP.						8
MALDANE SARSI						7
MALDANE GLEBIFEX	X	X	X	X	X	30
NICOMACHE LUMBRICALIS						1
PETALOPROCTUS TENUIS BOREALIS						1
PETALOPROCTUS TENUIS						2
AXIOTHELLA SP.						1
AXIOTHELLA SP. FRAG						1
AXIOTHELLA CANTENTA						7
PRAXILLELLA SP.						6
PRAXILLELLA GRACILIS						13
PRAXILLELLA GRACILIS FRAGS.						2
PRAXILLELLA PRAETERMISSA				X		16
PRAXILLELLA AFFINIS						1
RHODINE SP.				X		8
RHODINE SP. FRAGS.						7
RHODINE GRACILIOR						5
EuCLYMENE DELINEATA						1
CLYMENURA SP.		X		X		9
CLYMENURA SP.FRAGS						3
CLYMENURA BOREALIS						1
CLYMENURA POLARIS						1
LUMBRICLYMENE SP.						8
LUMBRICLYMENE SP. FRAGS						3
OWENIIDAE						2
OWENIDAE FRAGS						1
OWENIA FUSIFORMIS		X		X	X	14
MYRIOCHELE SP.						1
MYRIOCHELE SP. FRAGS						1
MYRIOCHELE HEERI				X		12
MYRIOCHELE OCCULATA	X	X	X	X	X	27
PECTINARIIDAE						2
AMPHICTENE MOOREI						5
AMPHICTENE JAPONICA						2
CISTENIDES GRANULATA				X		12
CISTENIDES HYPERBOREA						1
PECTINARIA GRANULATA						1
AMPHARETIDAE						17
AMPHARETIDAE FRAGS.						8
AMAGE SP.						1
AMPHARETE SP.				X		9
AMPHARETE REDUCTA						2
AMPHARETE GOESI						1
AMPHARETE ACUTIFRONS						9

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
AMPHARETE FINNARCHICA				X		7
AMPHARETE LINDSTROMI						1
AMPHECTEIS SP.						6
AMPHICTEIS GUNNERI						6
AMPHICTEIS SCAPHOBRANCHIATA						1
LYSIPPE LABIATA						7
MELINNA CRISTATA			X	X	X	11
ASABELLIDES SP.						1
ASABELLIDES SIBIRICA				X		12
TEREBELLIDAE					X	13
TEREBELLIDAE FRAGS.						9
AMPHRITITE SP.						1
LEAENA ABRANCHIATA						1
NEOLEPREA SPIRALIS			X		X	2
NICOLEA ZOSTERICOLA						1
PISTA SP.			X		X	7
PISTASP. FRAG						1
PISTA CRISTATA						6
PISTA ELONGATA					X	3
PISTA BREVIBRANCHIATA						3
POLYCIRRUS SP.						1
POLYCIRRUS MEDUSA						2
ARTACAMA CONIFERI			X		X	5
ARTACAMA PROBOSCIDEA						1
LAPHANIS BOECKI						1
PROCLEA GRAFFII						1
STSCHAPOVELLA SP.						1
TEREBELLIDES STROEMII				X		18
TRICHOBRANCHUS GLACIALIS						2
SABELLIDAE			X	X	X	17
SABELLIDAE FRAGS.						3
CHONE SP.						7
CHONE INFUNDIBULIFORMIS			X		X	2
CHONE CINCTA				X		17
CHONE MAGNA						1
CHONE MOLLIS						1
EUCHONE SP.						2
EUCHONE ANALIS						3
EUCHONE PAPILLOSA						1
EUCHONE LONGIFISSURATA					X	8
MYXICOLA INFUNDIBULUM						1
POTAMILLA SP.						3
POTAMILLA NEGLECTA						8
POTAMILLA INTERMEDIA						1
POTAMILLA ABYSSICOLA						1
SABELLA SP.						2
FABRICIA CRENICOLIS						1
LAONOME SP.						1

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
LAONOME KROYERI						7
SERPULIDAE						2
SPIRORBIS SP.						3
APHRODITA CF. LONGIPALPA			X		X	1
APHRODITA NEGLIGENS			X		X	1
DISOMA SP.						1
DISOMA MULTISETOSUM						1
PECTONARIDAE FRAG						1 0
OLIGOCHAETA						5
MOLLUSCA						1
MOLLUSCA FRAG						2
CHAETODERMA ROBUSTA				X		21
POLYPLACOPHORA						1
ISCHNOCHITON ALBUS						1
PELECYPODA	X			X		32
PELECYPODA FRAGS.						3
ACILA CASTRENIS						1
NUCULA TENUIS	X	X	X	X	X	34
NUCULA BELLOTTI						1
NUCULANA SP.	X	X	X	X	X	27
NUCULANA PERNULA				X	X	13
NUCULANA FOSSA		X	X	X	X	7
TINDARIA SP.						2
YOLDIA SP.	X	X		X		32
YOLDIA AMYGDAIEA					X	7
YOLDIA HYPERBOREA			X		X	5
YOLDIA MYALIS						3
YOLDIA SCISSURATA						1
YOLDIA THRACIAEFORMIS			X		X	11
YOLDIELLA INTERMEDIA						1
CRENELLA DESSUCATA						1
CRENELLA LEANA						1
MEGACRENELLA COLUMBIANA						1
MUSCULUS SP.						1
MUSCULUS NIGER						1
MUSCULUS CORRUGATES						2
MUSCULUS JAPONICA						1
MUSCULUS LAEVIGATUS						1
MODIOLUS MODIOLUS						2
ASARTE SP.						3
ASTARTE BOREALIS					X	6
CYCLOCARDIA SP.						0
CYCLOCARDIA CREBRICOSTATA					X	13
THYASIRIDAE						2
AXINOPSIDA SP.						4
AXINOPSIDA SERRICATA	X	X		X		32
AXINOPSIDA VIRIDIS						16
THYASIRA FLEXUOSA						23

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TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
THYASIRA DISJUNCTA						1
DIPLODONTA SP.						1
DIPLODONTA ALEUTICA						3
MYSELLA SP.						18
MYSELLA TUMIDA						11
MYSELLA ALEUTICA						3
ODONTOGENA BOREALIS						7
OROBITELLA				X		4
CLINOCARDIUM SP.						2
CLINOCARDIUM CILIATUM						9
SERRIPES GROENLANDICUS			X	X	X	14
LIOCYMA FLUCTUOSA						13
LIOCYMA VIRIDIS						0
PSEPHIDIA LORDI						5
SPISULA POLYNYMA						1
TELLINIDAE						4
MACOMA SP.	X	X		X		28
MACOMA CALCAREA		X	X	X	X	16
MACOMA BROTA			X		X	4
MACOMA MOESTA MOESTA						1
MACONA CRASSULA						2
CRYPTOMYA CALIFORNICA						1
MYA ARENARIA						2
MYA PSEUDOARENARIA						1
HIATELLA ARCTICA		X	X	X	X	2
PENITELLA PENITA						1
LYONSIA SP.						1
LYONSIA ARENOSA						2
PERIPLOMA ALASKANA						1
ASTHFNOTHAERUS ADAMSI						2
THRACIA SP.						4
THRACIA DEVEXA						1
CARDIOMYA SP.						2
CARD1OMYA PECTENATA						1
CARDIOMYA BERINGENSIS						1
LEPTONIDAE						4
NEAEROMYA SP.						5
GASTROPODA	X					25
LEPETA CAECA			X			1
TROCHIDAE						5
MARGARITAS SP.			X			12
SOLARIELLA SP.						6
SOLARIELLA OBSCURA						4
SOLARIELLA VARICOSA						11
MOELLERIA COSTULATA						1
ALVINIA SP.						1
MICRANELLUM OREGONENSE						1
TACHYRYNCHUS EROSUS						7

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
BITTIUM MUNITUM			X		X	1
EPITONIUM GROENLANDICUM						1
CREPIDULA GRANDIS						1
TRICHOTROPIS KROYERI						2
NATICA SP.						2
NATICA CLAUSA						14
POLINICES SP.						7
NEVERITA NANUS						1
POLINICES PALLIDA						5
FUSITRITON OREGONENSIS						3
TROPHONOPSIS SP.						1
BUCCINIDAE						2
BUCCINUM PUCTRUM						1
COLUS SP.						1
NEPTUNEA SP.						1
NEPTUNEA LYRATA					X	3
NEPTUNEA COMMUNIS						1
ADMETE COUTHOUYI						1
SUAVODRILLIA KENNICOTTII						1
OENOPOTA SP.						17
OENOPOTA TURRICULA						1
OENOPOTA HARPA						1
OENOPOTA EXCURVATA						3
ODOSTOMIA SP.						6
ODOSTOMIA TENUISCULPTA						1
ODOSTOMIA SKIDEGATENSIS						1
ODOSTOMIA ARCTICA						1
RETUSA SP.						4
RETUSA OBTUSA	X			X		29
DIAPHANA MINUTA						1
PHILENE SP.						1
CYLICHNA ALBA	X					25
DORIDIDAE						1
AGLAJA DIOMEDEUM						1
OPISTOBRANCH						1
PYCNOGONIDA						1
NYMPHON SP.						1
NYMPHON BREVITARSE						1
ACHELIA SP.						1
CRUSTACEA						2
CRUSTACEA FRAGS.						6
POLYPHEMIDAE						1
PODOCOPA						2
COPEPODA						13
CALANOIDA						1
CALANOIDA FRAGS.						1
CALANUS SP.						1
CALANUS GLACIALIS						2

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
CALANUS PLUMCHRUS						4
CALANUS MARSHALLAE						2
AETIDEIDAE						2
METRIDIA LUCENS						4
BALANUS SP.		X	X	X	X	2
BALANUS SP. FRAGS						1
BALANUS CRENATUS				X		2
NEBALIA						2
MYSIS SP.						1
CUMACEA						13
CUMACEA F"RAG~-						4
LAMPROPIDAE						1
LAMPROPS SP.						4
HEMILAMPROPS SP.						0
HEMILAMPROPS PECTINATA						4
LEUCONIDAE FRAGS.						5
LEUCON SP.		X				12
LEUCON NASICA	X					24
LEUCON NASICA FRAGS.						1
LEUCON NASICOIDES						2
EUDORELLA SP.						6
EUDORELLA EMARGINATA						17
EUDORELLA PACIFICA						12
EUDORELLA ARCTICA						1
EUDORELLA DENTATA						4
EUDORELLOPSIS SP.						9
EUDORELLOPSIS INTEGRA						11
EUDORELLOPSIS DEFORMIS						8
EUDORELLOPSIS USCHAKOVI						11
DIASTYLIS SP.						8
DIASTYLIS ALASKENSIS						3
DIASTYLIS BIDENTATA				X		5
DIASTYLIS KOREANA						1
DIASTYLIS PARASPINULOSA						3
DIASTYLIS NUCELLA						1
BRACHYDIASTYLIS SP.						1
BRACHYDIASTYLIS RESIMA						1
PETALOSARIA DECLIVIS						1
CAMPYLASPIS SP.						4
CAMPYLASPIS UMBENSIS						0
CAMPYLASPIS AFFINIS						1
TANAIDACEA						13
ISOPODA						1
ARCTURUS SP.						1
SYNIDOTEA SP.						4
SYNIDOTEA BICUSPIDA						3
TECTICEPS ALASCENSIS						1
MUNNIDAE						1

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
MONNA SP.						2
PLEUROGONIUM RUBICONDUM						3
CRYPTONISCIDAE						1
GNATHIA						1
AMPHIPODA		X		X		22
AMPHIPODA FRAGS						22
ACONTHONOTOZOMATIDAE FRAG.						1
ODIUS SP.						1
ODIUS CARINATUS						1
ODIUS CASSIGERUS						2
AMPELISCIDAE FRAGS						3
AMPELISCA SP.						4
AMPELISCA MACROCEPHALA		X	X	X		18
AMPELISCIDAE BIRULAI		X		X		4
AMPELISCIDA ESCHRICHTI		X	X	X		10
AMPELISCA FURCIGERA						3
BYBLIS SP.						18
BYBLIS SP. FRAG						1
BYBLIS GAIMARDI						13
HAPLOOPS SP.						4
LEMBOS ARCTICUS						2
ARGISSA HAMATIPES						2
ATYIIDAE						1
UROTHOE SP.						0
COROPHIUM SP. FRAG						1
COROPHIUM CRASSICORNE						7
ERICTHONIUS SP.						3
ERICTHONIUS HUNTERI						4
ERICHTHONIUS FOLLI						1
GUERNEA SP.						1
GAMMARIDAE						3
GOMMARIDAE FRAGS.						2
CERADOCUS TORELLI						1
MAERA DANAE						2
MAERA LOVENI						1
MELITA SP.						1
MELITA SP. FRAGS						1
MELITA DENTATA						3
MELITA QUADRISPINOSA				X		3
EOHAUSTORIAS E(WS						1
PONTOPOREIA SP.						1
PONTOPOREIA FEMORATA						7
PRISCILLINA ARMATA		X		X		1
UROTHOE SP. FRAG						1
UROTHOE DENTICULATA		X		X		8
ISAEIDAE						8
ISAEIDAE FRAG.						1
PHOTIS SP.						8

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
PHOTIS SPASSKII						8
PHOTIS FISCHMANNI						2
PROTOMEDIA SP.		X		X		15
PROTOMEDIEIA SP.						3
PROTOMEDIEIA FASCIATA						3
PROTOMEDEIRA FASCIATOIDES						1
PROTOMEDEIRA CHAELATA				X		3
PODOCEROPSIS SP.				X		6
PODOCEROPSIS NITIDA						1
ISCHYROCERIDAE						3
ISCHYROCERUS SP.	X			X		26
ISCHYROCERUS ANGUIPES						1
ISCHYROCERUS BRUSILOVI						1
ISCHYROCERUS ENIGMATICUS						1
JASSA SP.						1
LILLJEBORGIA FISSICORNIS						1
LYSIANASSIDAE						6
LYSIANASSIDAE FRAGS						1
ANONYX SP.						20
ANONYX NUGAX						7
ANONYX AFFINIS						1
ANONYX MINIMUS						2
ANONYX MAGNUS						0
ANONYX AVINAE						1
ANONYX RUBUSTUS						2
BOEKISIMUS SP.						4
BOECKOSIMUS KRASSINI						2
BOECKOSIMUS SIBIRICUS						1
HIPPOMEDON						9
HIPPOMEDON ABYSSI						2
HIPPOMEDON PROPINQUUS						1
HIPPOMEDON KURILIOUS						1
HIPPOMEDON GRANULOSA						1
LIPIDEPECREUM KUSATICA						1
LEPIDEPECREUM COMATUM						1
OPISA ESCHRICHTI						3
ORCHOMENE SP.						13
ORCHOMENE PACIFICA						1
MELPHIDIPPIDAE						3
OEDICEROTIDAE	X					26
OEDICEROTIDAE FRAGS						3
ACEROIDES SP.						1
ACEROIDES LATIPES						2
ARRHIS LUTHKEI						1
BATHYMEDON SP.						4
BATHYMEDON NANSENI						5
MONOCULODES CARINATUS						1
MONOCULODES SP.						13

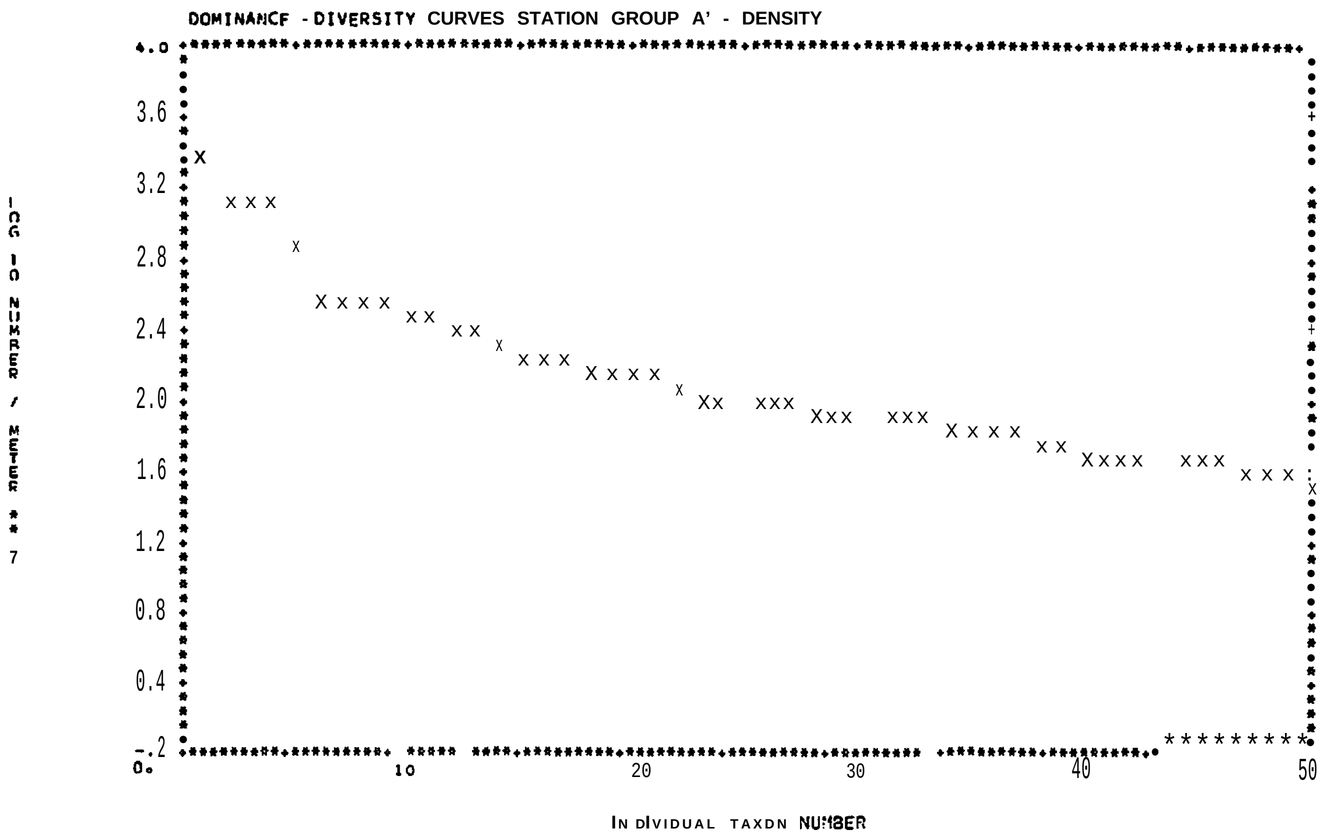
TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
MONOCULODES SP. FRAG						2
MONOCULODES DIAMESUS						2
MONOCULOPSIS LONGICORNIS						1
MACHAIRONYX MUELLERI						8
DYOPEDUS SP.						2
PAROEDICEROS INTERMEDIUS						1
PAROEDICEROS LYNCEUS						3
WESTWOODILLA CAECULA						6
PARDALISCIDAE						4
NICIPPE TUMIDA						3
PHOXOCEPHALIDAE						5
PHOXOCEPALIDAE FRAG						4
HARPINIA SP.				X		22
HARPINIA EMERYI						1
HARPINIA KOBJAKOVAE						16
HARPINIA QURJANOVAE						13
HARPINIA SHURINI						1
PARAPHOXUS SP.				X		10
PARAPHOXUS ROBUSTUS						3
PARAPHOXUS SP.						5
PARAPHOXUS OCULATUS				X		22
PLEUSTIDAE FRAG						9
PLEUSTES SP.						1
PLEUSYMPTES SP.						1
PODOCERIDAE						6
DULICHIA SP.						2
STENOTHOIDAE						9
SYNOPIIDAE						1
TIRON BI OCULATA						3
PARATHEMISTO PACIFICA						1
CAPRELLIDAE						11
EUPHAUSIACEA						1
DECAPODA FRAGS.						2
PANDALUS SP.						1
EUALUS SP.						1
ARGIS SP.						2
ARGIS LAR			X		X	2
PAGURUS SP.						4
PAGURUS TRIGONOCHEIRUS						4
LABIDOCHIRUS SPLENDESCENS						1
CHIONOECETES OPILIO			X		X	6
SIPUNCULIDA				X		13
GOLFINGIA SP.			X		X	7
GOLFINGIA MARGARITACEA			X			20
[illegible]						2
ECHIURUS						1
ECHIURUS ALASKANUS			X	X	X	1
PRIAPULIDA						1

TAXON NAME	CRIT1	CRIT2	CRIT3	CRIT4	CRIT5	STA OCC
PRIAPULUS CAUDATUS	X		X			31
PRIAPULUS SP.						0
ECTOPROCTA						12
ECTOPROCTA COLONIES			X		X	9
CHEILOSTOMATA						1
ALCYONIDIIDAE						1
ALCYONIDIUM SP.			X		X	1
ALCYONIDIUM DISCIFORME			X		X	3
ASTEROIDEA						7
ASTEROIDEA FRAGMENTS						1
CTENODISCUS CRISPATUS			X		X	14
ASTERIDAE						1
ECHINOIDEA			X		X	4
ECHINARACHNIUS PARMA		X	X		X	7
OPHIUROIDEA	X			X		26
OPHIURIDAE FRAGS.						5
DIAMPHIODIA CRATERODMETA	X	X		X		24
PANDELLIA CARCHARA						2
OPHIOPHOLIS ACULEATA						1
OPHIURIDAE						2
OPHIOPENIA SP.						1
OPHIURA SP.		X		X		5
OPHIURA SARSI	X	X	X	X	X	26
HOLOTHUROIDEA						3
CUCAMARIA SP.		X	X	X	X	2
SAGITTA ELEGANS						1
UROCHORDATA		X	X	X	X	9
MOLGULA GRIFFITHSII			X		X	1
ZOARCIDAE						1
AMMODYTES HEXAPTERUS			X			2
UNIDENTIFIED	X			X		29
UNIDENTIFIED ANI TISSUE FRAGS						1
UNIDENTIFIED FRAGS	X		X		X	27

TAXONS = 647

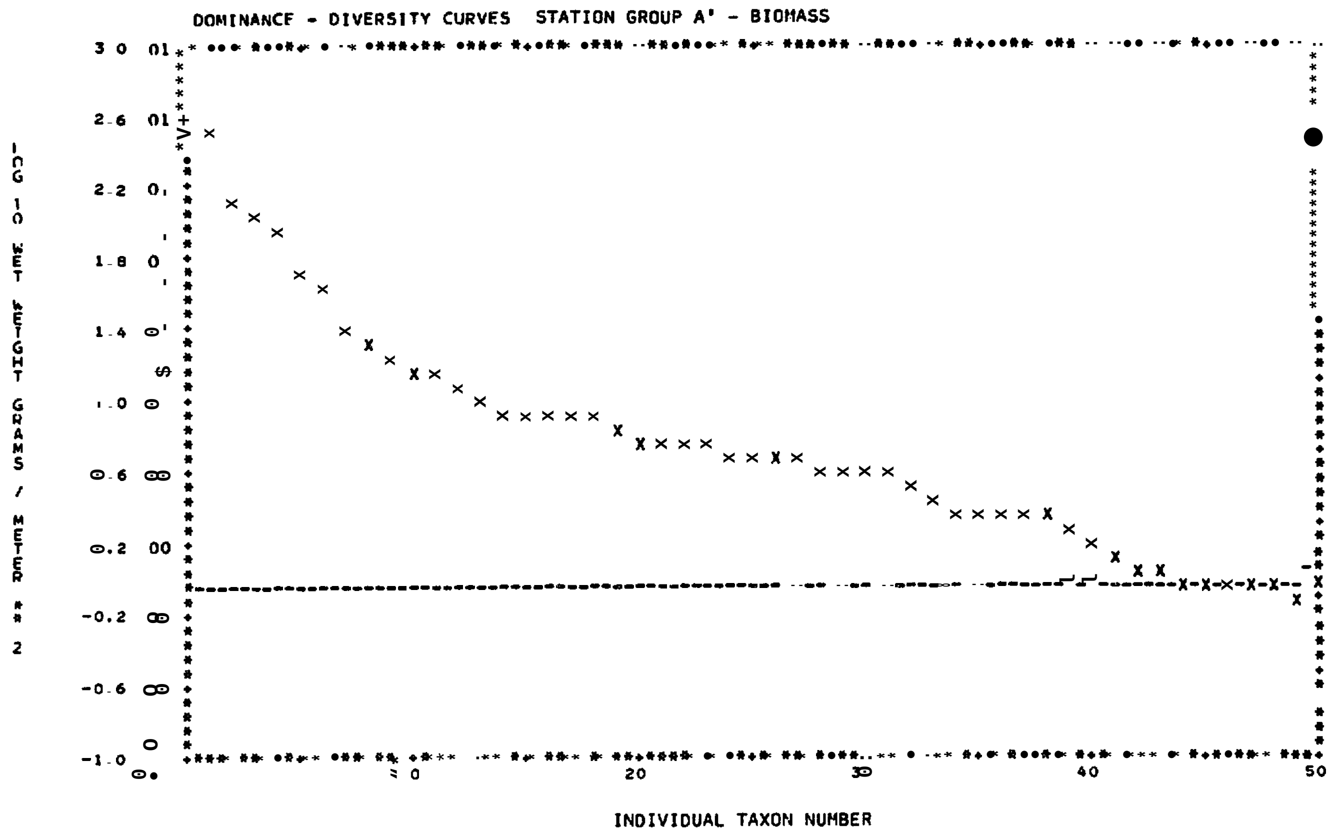
APPENDIX B

DOMINANCE-DIVERSITY CURVES OF DENSITY AND BIOMASS ESTIMATES FOR EACH STATION GROUP PRODUCED BY CLUSTER ANALYSIS OF *ln*-TRANSFORMED DENSITY DATA



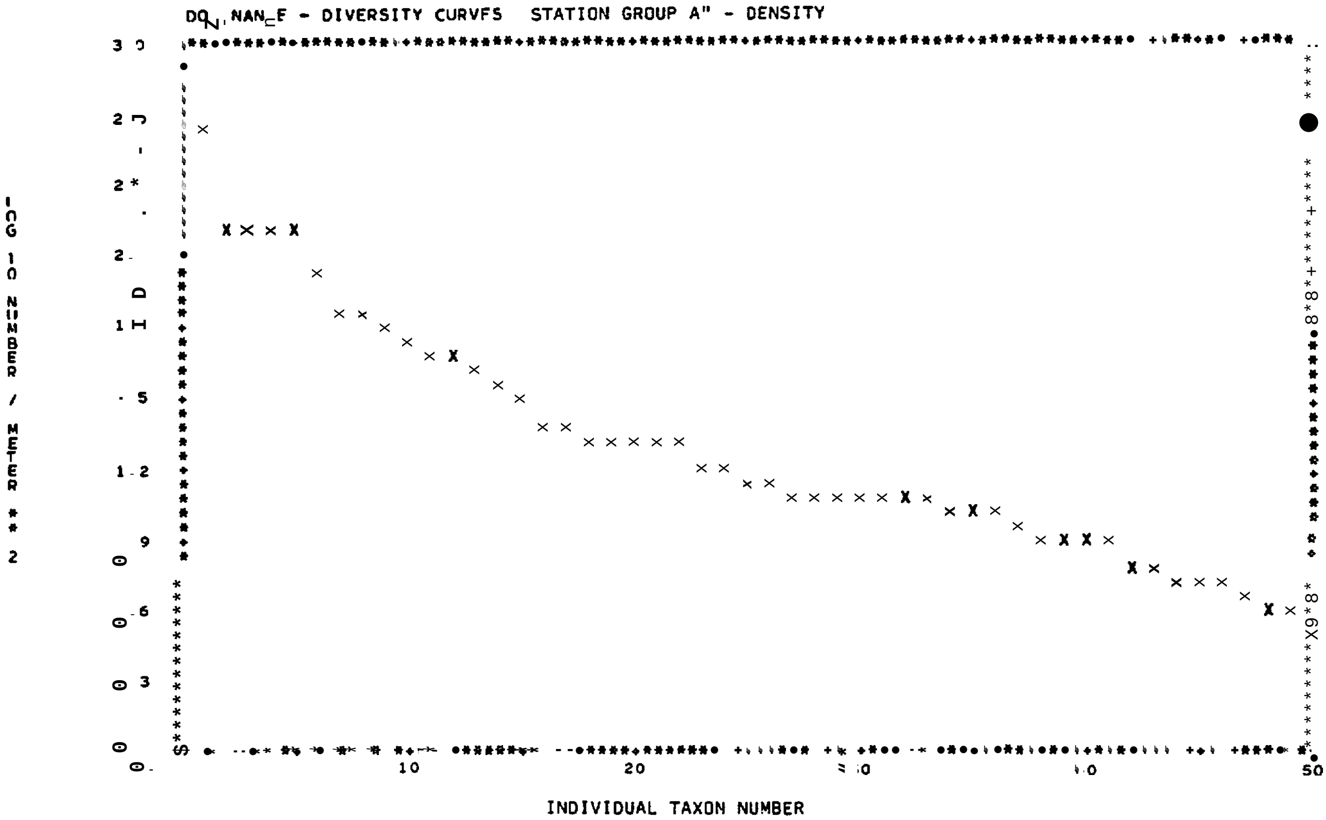
TAXDN ND.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	HETEROMASTUS FILIFORMIS	2278.000	3.358
2.	AXINOPSIDA SERRICATA	1376.000	3.139
3.	OWENIA FUSIFORMIS	1268.000	3.103
4.	OPHIURA SARSI	1210.000	3.083
5.	HAPLOSCCLOPLOS ELONGATUS	736.000	2.867
6.	RETUSA OBTUSA	394.000	2.595
7.	NEPHTYS PUNCTATA	386.000	2.587
8.	MALDANE GLEBIFEX	354.000	2.549
9.	CHAETODERMA ROBUSTA	342.000	2.534
10.	UROTHOE DENTICULATA	324.000	2.511
11.	MYRIOCHELE HEERI	290.000	2.462
12.	PRIAPULUS CAUDATUS	252.000	2.408
13.	MYRIOCHELE OCULATA	246.000	2.391
14.	ARICIDEA LOPEZI	196.000	2.292
15.	PARAPHOXUS OCULATUS	182.000	2.260
16.	CHONE CINCTA	176.000	2.246
17.	EUCHONE LONGIFISSURATA	164.000	2.215
18.	TRAVISIA FORBESII	154.000	2.188
19.	DIAMPHIODIA CRATERODMETA	150.000	2.176
20.	BARANTOLLA AMERICANA	138.000	2.140
21.	STERNASPIS SCUTATA	132.000	2.121
22.	CAPITELLA CAPITATA	126.000	2.100
23.	NUCULANA PERNULA	102*000	2.009
24.	ETEONE LONGA	100.000	2.000
25.	THYASIRA FLEXUOSA	100.000	2.000
26.	HARPINIA KOBJAKOVAF	100.000	2.000
27.	EUDORELLOPSIS USCHAKOVI	94.000	1.973
28.	BRADA VILLOSA	90.000	1.954
29.	CTENODISCUS CRISPATUS	86.000	1.934
30.	DRILONEREIS FALCATA MINOR	84.000	1.924
31.	LEUCON NASICA	82.000	1.914
32.	CHAETOZONE SETOSA	78.000	1.892
33.	ODONTOGENA BORFALIS	76.000	1.881
34.	APISTOBRANCHUS TULIBFRGI	74.000	1.869
35.	AXINOPSIDA VIRIDIS	72.000	1.857
36.	NUCULA TENUIS	64.000	1.806
37.	GOLFINGIA MARGARITACFA	64.000	1.806
38.	LIOCYMA FLUCTUOSA	54.000	1.732
39.	CYLICHNA ALBA	54.000	1.732
40.	SCALIBREGMA INFLATUM	52.000	1.716
41.	EUDORELLA EMARGINATA	52.000	1.716
42.	ONUPHIS GEOPHILIFORMIS	50.000	1.699
43.	PISTA CRISTATA	50.000	1.699
44.	AMPELISCA MACROCEPHALA	50.000	1.699
45.	THARYX SECUNDUS	46.000	1.663
46.	YOLDIA THRACIAEFORMIS	46.000	1.663
47.	PRAXILLELLA GRACILIS	42.000	1.623
48.	YOLDIA AMYGDALEA	40.000	1.602
49.	EUCHONE ANALIS	38.000	1.580
50.	TAUBERIA GRACILIS	36.000	1.556

Figure 1. Dominance-diversity curve (density) calculated from Station Group A'.



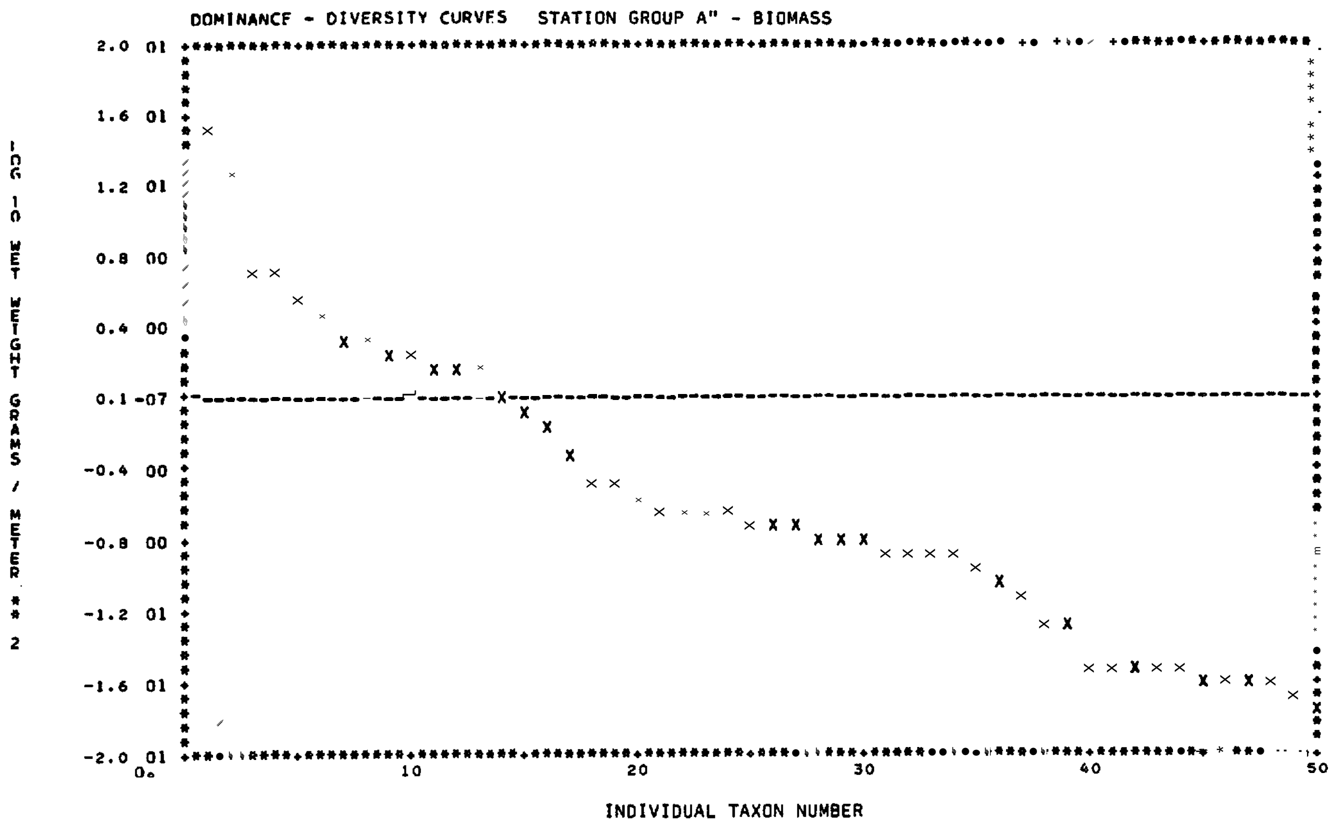
TAXON NO.	TAXON NAME	DATA VALUE	P.OT VALUE
1.	CTENODISCUS CRISPATUS	321.798	2.508
2.	OPHIURA SARSI	120.988	2.083
3.	NEPTUNEA LYRATA	112.980	2.053
4.	MALDANE GLEBIFEX	93.108	1.969
5.	YOLDIA THRACIAEFORMIS	50.020	1.699
6.	NEPHTYS PUNCTATA	40.300	1.605
7.	APHRODITA NEGLIGENS	25.116	1.400
8.	ARTACAMA CONIFERA	19.848	1.298
9.	AXIOTHELLA CANTENTA	16.902	1.228
10.	NEPHTYS CAECA	15.464	1.189
11.	PISTA BREVIBRANCHIATA	15.360	1.186
12.	OWENIA FUSIFORMIS	11.030	1.043
13.	EUCHONE LONGIFISSURATA	10.454	1.019
14.	CHONE CINCTA	8.832	0.946
15.	STERNASPIS SCUTATA	8.462	0.927
16.	PRAXILLELLA GRACILIS	8.318	0.920
17.	HAPLOSCOLOPLOS ELONGATUS	8.018	0.904
18.	CYCLOCARDIA CREBRICOSTATA	7.886	0.897
19.	DIAMPHIODIA CRATERODMETA	6.454	0.810
20.	CHAETODERMA ROBUSTA	6.088	0.784
21.	TRAVISIA FORBESII	5.774	0.761
22.	LAONICE CIRRATA	5.410	0.733
23.	FLABELLIGERA MASTIGOPHORA	5.310	0.725
24.	HETEROMASTUS FILIFORMIS	5.148	0.712
25.	PRIAPULUS CAUDATUS	5.138	0.711
26.	YOLDIA AMYGDALEA	4.450	0.648
27.	BRADA VILLOSA	4.370	0.640
28.	PISTA ELONGATA	4.110	0.614
29.	PISTA CRISTATA	3.974	0.599
30.	LIOCYMA FLUCTUOSA	3.920	0.593
31.	POLINICES PALLIDUS	3.700	0.568
32.	MACOMA CALCAREA	3.120	0.494
33.	LEPETA CAECA	2.574	0.411
34.	MYRIOCHELE HEERI	2.456	0.390
35.	TEREBELLIDES STROEMII	2.366	0.374
36.	SCALIBREGMA INFLATUM	2.290	0.360
37.	AXINOPSIDA SERRICATA	2.182	0.339
38.	NUCULANA PERNULA	2.090	0.320
39.	AMPHICTENE MOOREI	2.022	0.306
40.	MELINNA CRISTATA	1.452	0.162
41.	AMPHICTEIS GUNNERI	1.210	0.083
42.	SPIOCHAETOPTERUS COSTARUM	1.130	0.053
43.	SERRIPES GROENLANDICUS	1.114	0.047
44.	GOLFINGIA MARGARITACEA	0.964	-0.016
45.	APISTOBRANCHUS TULIBERGI	0.962	-0.017
46.	RETUSA OBTUSA	0.956	-0.020
47.	BARANTOLLA AMERICANA	0.934	-0.030
48.	YOLDIA HYPERBOREA	0.920	-0.036
49.	NEPHTYS CILIATA	0.812	-0.090
50.	NUCULA TENUIS	0.776	-0.110

Figure 2 Dominance-diversity curve (biomass) calculated from Station Group A'.



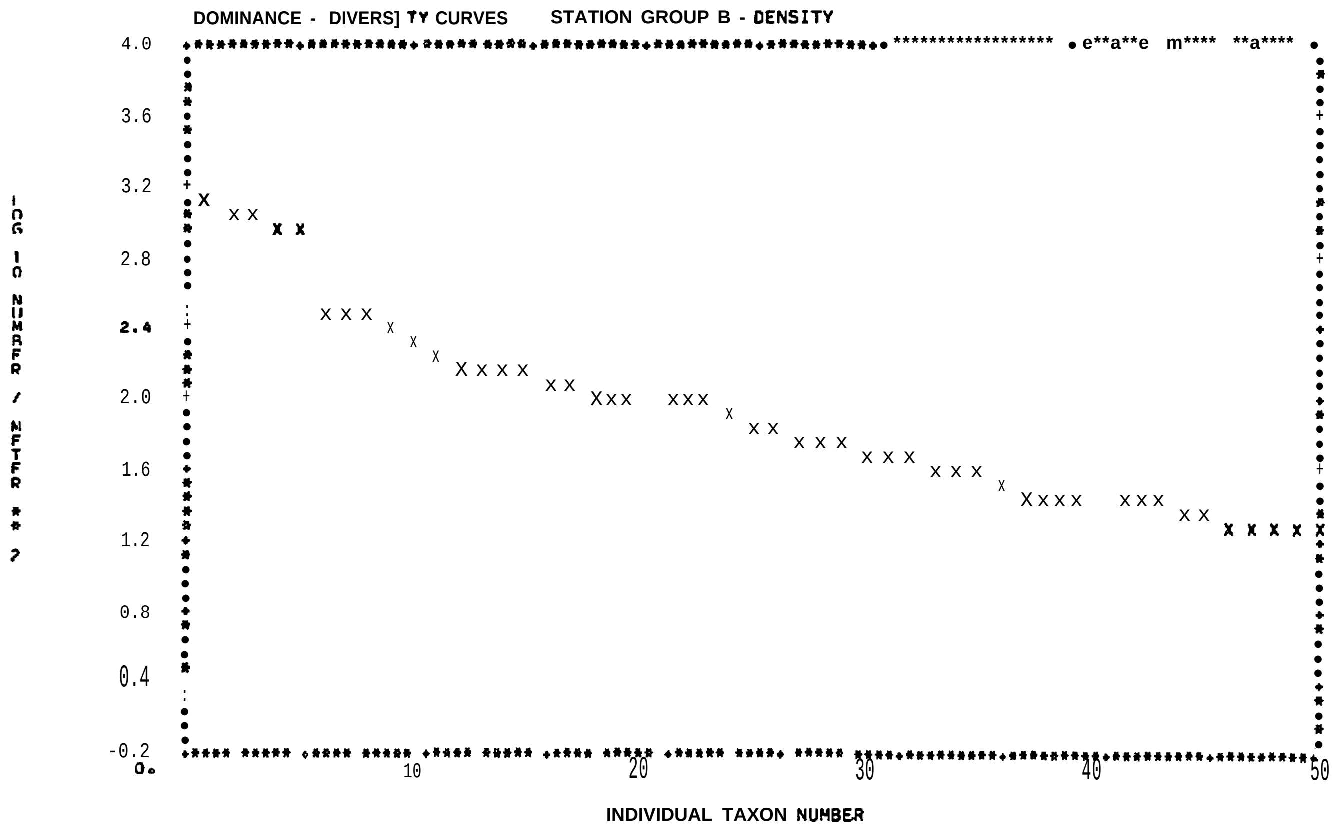
TAXON NO	TAXON NAME	DATA VALUE	PLOT VALUE
1.	MYRIOCHELE OCULATA	26.500	2.630
2.	HAPLOSCOLOPLOS ELONGATUS	74.500	2.242
3.	ERICTHONIUS HUNTERI	69.500	2.229
4.	DIAMPHIODIA CRATERODMETA	67.000	2.223
5.	ECHIURUS ECHIURUS ALASKANUS	05.000	2.217
6.	THARYX SECUNDUS	75.500	2.011
7.	TEREBELLIDES STROEMII	72.500	1.854
8.	HARPINIA GURJANOVAE	60.000	1.845
9.	STERNASPIS SCUTATA	52.500	1.796
10.	GLYCINDE PICTA	51.500	1.712
11.	AMPHARETE FINMARCHICA	41.000	1.708
12.	HETEROMASTUS FILIFORMIS	35.000	1.653
13.	BYBLIS GAIMARDI	34.000	1.643
14.	SCALIBREGMA INFLATUM	25.500	1.550
15.	HETEROMASTUS GIGANTEUS	20.000	1.477
16.	PHOLOE MINUTA	25.000	1.398
17.	CISTENIDES GRANULATA	22.000	1.398
18.	HARMOTHOE IMBRICATA	22.000	1.342
19.	DIASTYLIS BIDENTATA	20.000	1.342
20.	GOLFINGIA MARGARITACEA	10.500	1.312
21.	BALANUS CRENATUS	10.000	1.301
22.	MELITA QUADRISPINOSA	15.000	1.301
23.	ETEONE LONGA	15.000	1.176
24.	PHOTIS SPASSKII	14.000	1.176
25.	ASABELLIDES SIBIRICA	4.000	1.146
26.	POTAMILLA NEGLECTA	2.000	1.146
27.	BRADA VILLOSA	2.500	1.097
28.	NUCULA TENUIS	.500	1.097
29.	LEUCON NASICA	2.500	1.097
30.	PRIAPULUS CAUDATUS	2.500	1.097
31.	CHONE CINCTA	2.000	1.079
32.	AMPELISCA MACROCEPHALA	1.000	1.079
33.	BARANTOLLA AMERICANA	0.500	1.061
34.	PRAXILLELLA PRAETERMISSA	0.000	1.000
35.	RHODINE GRACILIOR	0.000	1.000
36.	LAONOME KROYERI	9.000	1.000
37.	YOLDIA MYALIS	8.500	0.978
38.	APISTOBRANCHUS TULLBERGI	7.000	0.903
39.	TAUBERIA GRACILIS	7.500	0.875
40.	EUDORELLA PACIFICA	7.500	0.875
41.	WESTWOODILLA CAECULA	.500	0.875
42.	AMPHARETE ACUTIFRONS	6.000	0.778
43.	AMPELISCA ESCHRICHTI	6.000	0.778
44.	CYLICHNA ALBA	5.0 0	0.699
45.	ARGIS LAR	5.000	0.699
46.	CHIONOECETES OPILIO	4.000	0.699
47.	PAROEDICEROS LYNCEUS	.500	0.653
48.	MAGELONA PACIFICA	4.000	0.602
49.	ANONYX LATICOXAE	4.000	0.602
50.	TIRON BIOCULATA	4.000	0.602

Figure 3. Dominance-diversity curve (density) calculated from Station Group A".



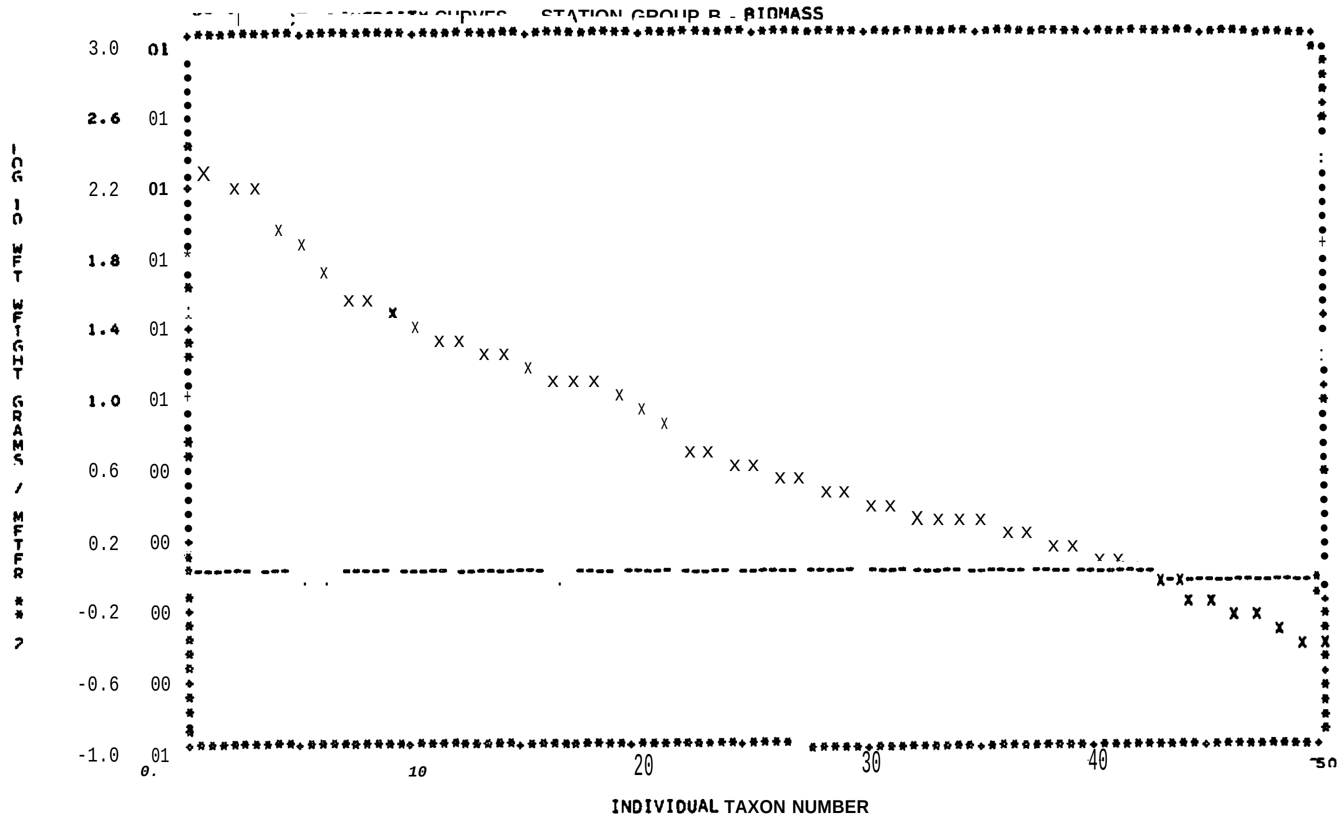
TAXON NO.	TAXON NAME	DATA VAL	PLOT VALUE
1.	ARGIS LAR	35.265	1.547
2.	ECHIURUS ECHIURUS ALASKANUS	18.493	1.267
3.	STERNASPIS SCUTATA	5.658	0.753
4.	DIAMPHIODIA CRATERODMETA	5.099	0.707
5.	SERRIPES GROENLANDICUS	3.588	0.555
6.	TEREBELLIDES STROEMII	2.863	0.457
7.	SCALIBREGMA INFLATUM	2.179	0.338
8.	HAPLOSCOLOPLOS ELONGATUS	1.935	0.287
9.	CISTENIDES GRANULATA	1.862	0.270
10.	YOLDIA MYALIS	1.812	0.258
11.	MYRIOCHELE OCULATA	1.367	0.136
12.	AMPHARETE FINMARCHICA	1.356	0.132
13.	GOLFINGIA MARGARITACEA	1.330	0.124
14.	POTAMILLA NEGLECTA	1.048	0.020
15.	BALANUS CRENATUS	0.852	-0.070
16.	BYBLIS GAIMARDI	0.713	-0.147
17.	ERICTHONIUS HUNTERI	0.510	-0.292
18.	RHODINE GRACILIOR	0.356	-0.449
19.	NUCULA TENUIS	0.323	-0.491
20.	CHONE CINCTA	0.300	-0.523
21.	THARYX SECUNDUS	0.230	-0.638
22.	LAONOME KROYERI	0.230	-0.638
23.	LIOCYMA FLUCTUOSA	0.220	-0.658
24.	CHIONOECETES OPILIO	0.215	-0.668
25.	GLYCINDE PICTA	0.201	-0.697
26.	HARMOTHOE IMBRICATA	0.187	-0.728
27.	AMPELISCA ESCHRICHTI	0.180	-0.745
28.	DIASTYLIS BIDENTATA	0.162	-0.790
29.	MELITA QUADRISPINOSA	0.160	-0.796
30.	PRAXILLELLA PRAETERMISSA	0.158	-0.801
31.	PRIAPULUS CAUDATUS	0.132	-0.879
32.	AMPHARETE ACUTIFRONS	0.128	-0.893
33.	BRADA VILLOSA	0.126	-0.900
34.	ASABELLIDES SIBIRICA	0.122	-0.914
35.	PHOLOE MINUTA	0.113	-0.947
36.	AMPELISCA MACROCEPHALA	0.100	-1.000
37.	BARANTOLLA AMERICANA	0.078	-1.108
38.	ANONYX LATICOXAE	0.056	-1.252
39.	HETEROMASTUS GIGANTEUS	0.055	-1.260
40.	HETEROMASTUS FILIFORMIS	0.031	-1.509
41.	LEUCON NASICA	0.031	-1.509
42.	ANTINOELLA SARSI	0.030	-1.523
43.	EUCHONE ANALIS	0.030	-1.523
44.	MALDANE GLEBIFEX	0.028	-1.553
45.	HARPINIA GURJANOVAE	0.026	-1.585
46.	ETEONE LONGA	0.024	-1.620
47.	CYLICHNA ALBA	0.023	-1.638
48.	EUDORELLA PACIFICA	0.023	-1.638
49.	MAGELONA PACIFICA	0.022	-1.658
50.	WESTWOODILLA CAECULA	0.018	-1.745

Figure 4. Dominance diversity curve (biomass) calculated from Station Group A".



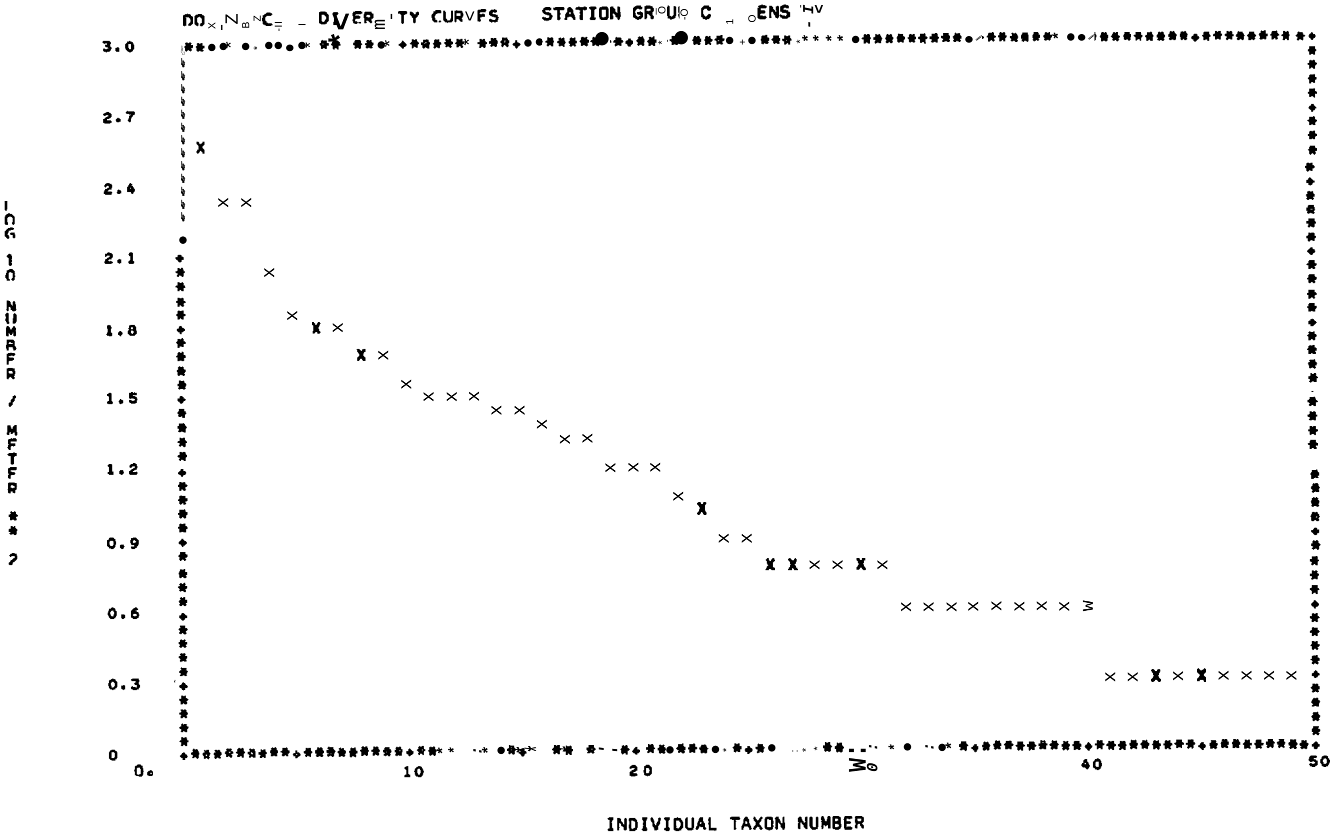
TAXON NO.	TAXON NAME	OATA VALUE	PLOT vALuE
1.	HETEROMASTUS FILIFORMIS	1284.000	3.109
2.	OPHIURA SARSI	1078.000	3.033
3.	MALDANE GLEBIFEX	1004.000	3.002
4.	AXINOPSIDA SERRICATA	966.000	2.985
S.	DIAMPHIODIA CRATERODMETA	926.000	2.967
6.	PRIAPULUS CAUDATUS	316.000	2.500
7.	RETUSA OBTUSA	292.000	2.465
8.	HAPLOSCOLOPLOS ELONGATUS	282.000	2.450
9.	PARAPHOXUS OCULATUS	244. 000	2.387
10.	UROTHOE DENTICULATA	192.000	2.283
11.	CHAETODERMA RORUSTA	178.000	2.25
12.	THYASIRA FLEXUOSA	152.000	2.18?
13.	BARANTOLLA AMERICANA	148.000	2.170
14.	MELINNA CRISTATA	144.000	2.158
1S.	MYRIOCHELE OCULATA	138.000	2.140
16.	PRAXILLELLA PRAETERMISSA	130.000	2.114
17.	NUCULA TENUIS	116.000	2.064
le.	LYSIPPE LABIATA	108.000	2.033
19.	APISTOBRANCHUS TULIBERGI	106.000	2.025
20.	LEUCON NASICA	106.000	2.025
21.	OWENIA FUSIFORMIS	104.000	2.017
22.	NEPHTYS PUNCTATA	98.000	1.991
23.	AXINOPSIDA VIRIDIS	92.000	1.964
24.	MYRIOCHELE HEERI	82.000	1.914
25.	TRAVISIA FORBESII	66.000	1.820
26.	CTENODISCUS CRISPATUS	64.000	1.806
27.	MYSELLA ALEUTICA	58.000	1.763
28.	BRADA VILLOSA	56.000	1.748
29.	EUCHONE LONGIFISSURATA	54.000	1,732
30.	ETEONE LONGA	50.000	1.699
31.	ARICIDEA LOPEZI	50.000	1.699
32.	NEOLEPREA SPIRALIS	50.000	1.699
33.	AXIOTHELLA CANTENTA	42.000	1.623
34.	PRAXILLELLA GRACILIS	42.000	1.623
3S.	EUDORELLA EMARGINATA	42.000	1.623
36.	PHOLOE MINuTA	32.000	1.505
37.	STERNASPIS SCUTATA	30.000	1.477
38.	CYCLOCARDIA CREBRICOSTATA	30. 000	1.477
39.	CYLICHNA ALBA	30.000	1.477
40.	HARPINIA KOBJAKOVAE	30.000	1.477
41.	TAUBERIA GRACILIS	28.000	1.447
42.	DRILONEREIS FALCATA MINOR	26.000	1.415
43.	GOLFINGIA MARGARITACEA	26.000	1.415
44.	NEPHTYS CAECA	24.000	1.380
45.	CHONE CINCTA	24.000	1.380
46.	MAGELONA PACIFICA	20.000	1.301
47.	THARYX SECUNDUS	20.000	1.301
48.	POTAMILLA NEGLECTA	20.000	1.301
49.	YOLDIA THRACIAEFORMIS	20.000	1.301
60.	AMPELISCA MACROCEPHALA	18.000	1.255

Figure 5. **Dominance-diversity** curve **(density)** calculated from Station Group B.



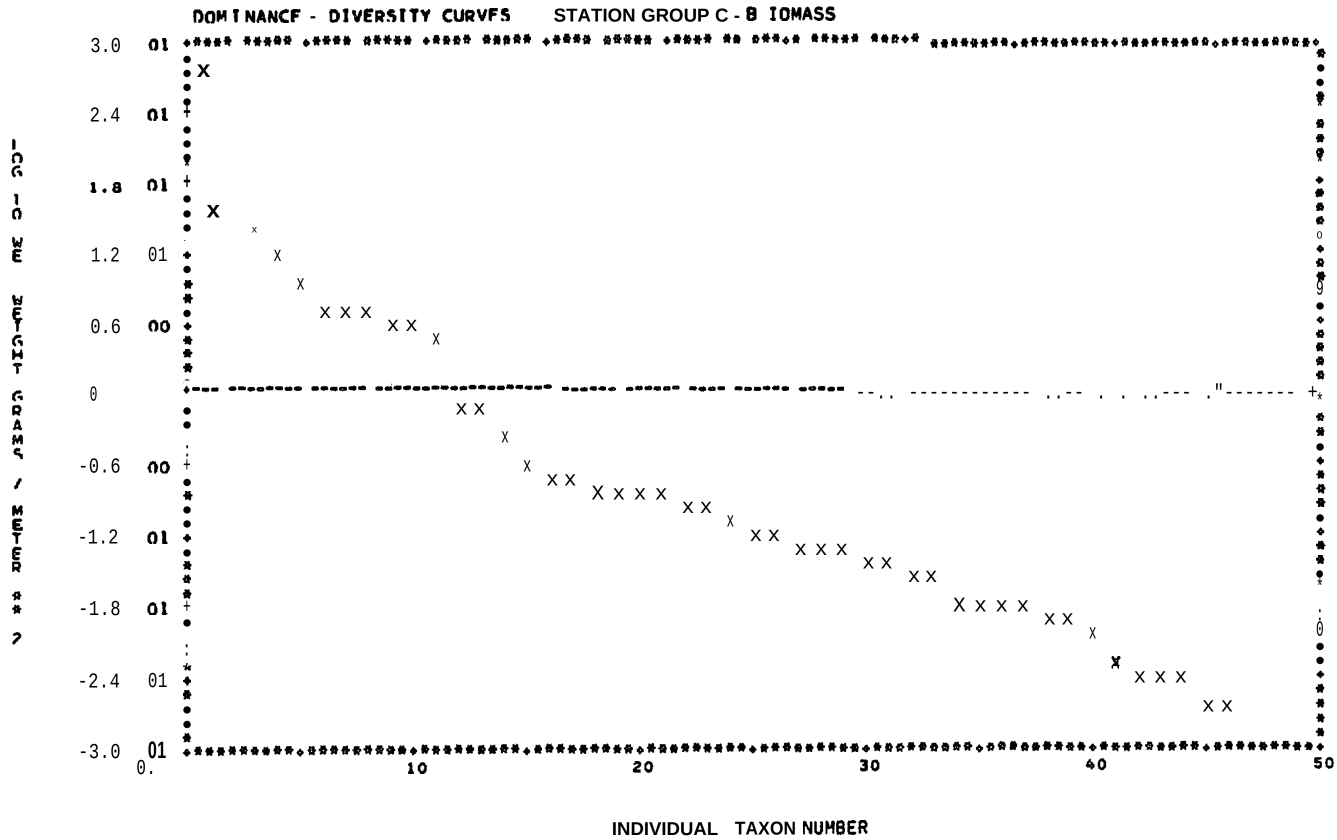
TAXON NO,	TAXON NAME	OATA VALUE	PLOT vALuE
1.	...IURA SARSI	174.928	2.243
2.	MALOANE GLEBIFEX	162.272	2.210
3.	CTENOOISCUS CRTSPATUS	161.760	2.209
4.	MACOMA BROTA	84.572	1.927
5.	NEPTUNEA LYRATA	75.826	1.880
6.	BUCCINUM SP.	48.724	1.688
7.	MACOMA CALCAREA	38.592	1.586
8.	DIAMPHIODIA CRATERODMETA	33.942	1.531
9.	NEPHTYS PUNCTATA	28.216	1.450
10.	NEOLEPREA SPIRALIS	23.088	1.363
11.	PRIAPULUS CAUDATUS	22.096	1.344
12.	GOLFINGIA MARGARITACEA	21.882	1.340
13.	YOLDIA THRACIAEFORMIS	17.656	1.247
14.	MELINNA CRISTATA	16.232	1.210
15.	PRAXILLELLA GRACILIS	14.092	1.149
16.	PISTA CRISTATA	12.526	1.098
17.	PAGURUS TRIGONOCHFIRUS	12.472	1.096
18.	YOLDIA AMYGDALEA	11.940	1.077
19.	AXIOTHELLA CANTENTA	10.220	1.009
20.	CYCLOCARDIA CREBRICOSTATA	8.050	0.906
21.	PRAXILLELLA PRAETERMISSA	7.082	0.850
22.	CHAETODERMA ROBUSTA	5.208	0.717
23.	YOLDIA HYPERBOREA	5.000	0.699
26.	HAPLOSCOLOPLOS FLONGATUS	3.990	0.601
25.	HETEROMASTUS FILIFORMIS	3.788	0.578
26.	MYRIOCHELE OCULATA	3.610	0.558
27.	CHONE CINCTA	3.452	0.538
28.	TRAVISIA FORBESII	2.868	0.458
29.	EUCHONE LONGIFISSURATA	2.700	0.431
30.	FLABELLIGERA MASTIGOPHORA	2.180	0.338
31.	NUCULA TENUIS	2.172	0.337
32.	AXINOPSIDA SERRICATA	1.902	0.279
33.	NEPHTYS CAECA	1.826	0.262
34.	THYASIRA FLEXUOSA	1.770	0.248
35.	PISTA ELONGATA	1.762	0.246
36.	LIOCYMA FLUCTUOSA	1.628	0.212
37.	BRADA VILLOSA	10450	0.161
38.	STERNASPIS SCUTATA	1.380	0.140
39.	LYSIPPE LABIATA	1.352	0.131
40.	POLINICES PALLIDUS	1.186	0.074
41.	AMPHICTEIS GUNNERI	1.152	0.061
42.	POTAMILLA NEGLECTA	0.940	-0.027
43.	BARANTOLLA AMERICANA	0.938	-0.028
44.	NUCULANA FOSSA	0.682	-0* 166
45.	TACHYRYNCHUS EROSUS	0.594	-0.226
46.	LEUCON NASICA	0.566	-0.247
47.	SPIOCHAETOPTERUS COSTARUM	0.500	-0.301
48.	RETUSA OBTUSA	0.446	-0.351
49.	LAONOME KROYERI	0.398	-0.400
50.	TEREBELLIDES STROEMII	0.392	-0.407

Figure 6. **Dominance-dive rsity curve (biomass)** calculated from **Station** Croup **B.**



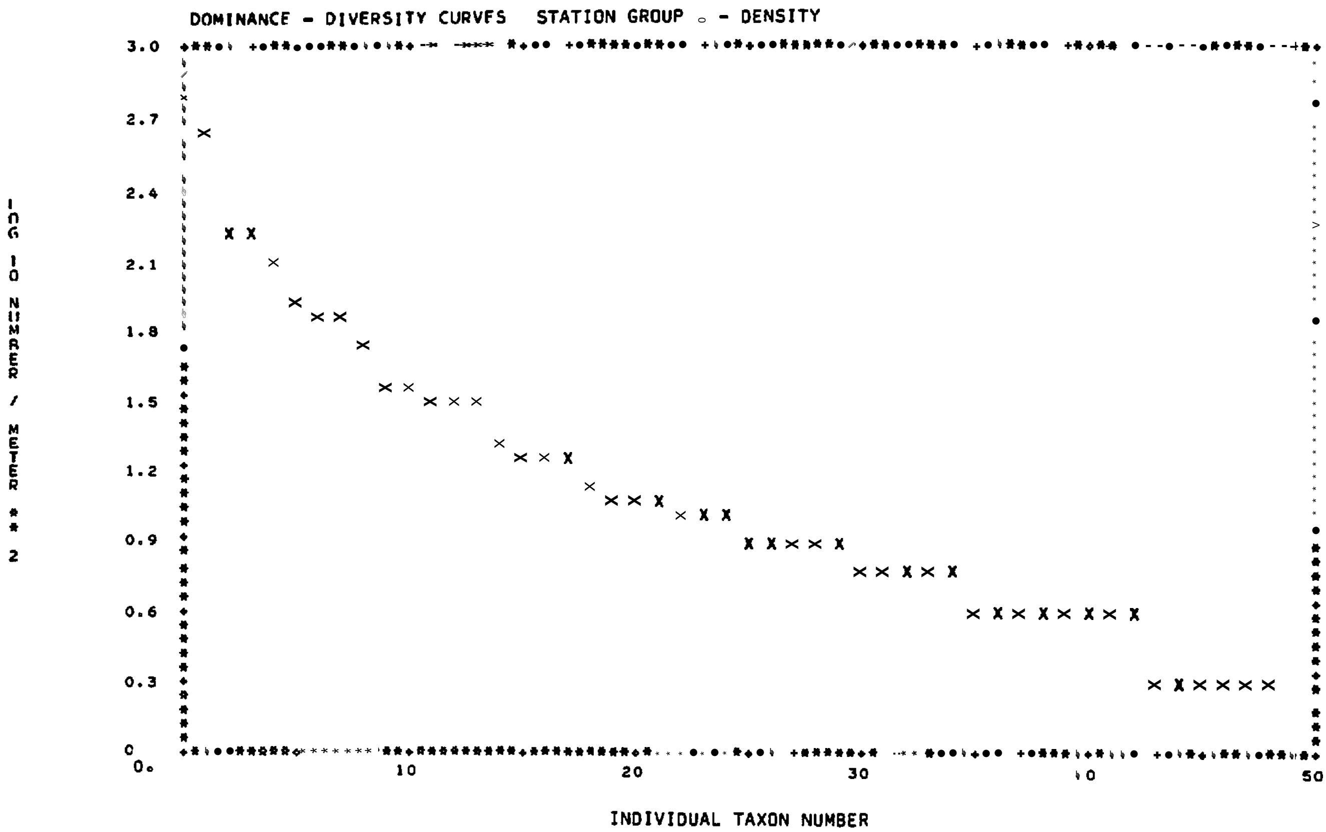
TAXON NO.	TAXON NAME	DAT . VALUE	PLOT VALUE
1.	NUCULA TENUIS	366.000	2.563
2.	NUCULANA FOSSA	224.000	2.354
3.	CUCUMARIA SP.	212.000	2.330
4.	STERNASPIS SCUTATA	118.000	2.049
5.	SERRIPES GROENLANDICUS	64.000	1.833
6.	RETUSA OBTUSA	62.000	1.806
7.	MYRIOCHELE OCULATA	68.000	1.792
8.	BARANTOLLA AMERICANA	48.000	1.681
9.	MALDANE GLEBIFEX	46.000	1.681
10.	NEPHTYS CAECA	32.000	1.556
11.	SOLARIELLA VARICOSA	30.000	1.505
12.	HAPLOSCOLOPLOS ELONGATUS	30.000	1.477
13.	DIAMPHIODIA CRATERODMETA	38.000	1.477
14.	NEPHTYS PUNCTATA	28.000	1.447
15.	AXINOPSIDA SERRICATA	24.000	1.447
16.	HARPINIA KOBJAKOVAE	22.000	1.380
17.	LEUCON NASICA	20.000	1.342
18.	HARPINIA GURJANOVAE	26.000	1.301
19.	HETEROMASTUS FILIFORMIS	16.000	1.204
20.	LIOCYMA FLUCTUOSA	1 .000	1.204
21.	BATHYMEDON NANSENI	16.000	1.204
22.	MACOMA CALCAREA	12.000	1.079
23.	OPHIURA SARSI	10.000	1.000
24.	THYASIRA FLEXUOSA	8.000	0.903
25.	CYLICHNA ALBA	8.000	0.903
26.	PHOLOE MINUTA	6.000	0.778
27.	GLYCINDE PICTA	6.000	0.778
28.	YOLDIA AMYGDALEA	6.000	0.778
29.	CLINOCARDIUM CILIATUM	6.000	0.778
30.	EUDORELLA PACIFICA	6.000	0.778
31.	EUDORELLOPSIS INTEGRA	6.000	0.778
32.	NEPHTYS CILIATA	4.000	0.602
33.	PRAXILLELLA PRAETERMISSA	4.000	0.602
34.	NEOLEPREA SPIRALIS	4.000	0.602
35.	LAONOME KROYERI	4.000	0.602
36.	CYCLOCARDIA CREBRICOSTATA	4.000	0.602
37.	ODONTOGENA BOREALIS	4.000	0.602
38.	PRIAPULUS CAUDATUS	4.000	0.602
39.	ECHINARACHNIUS PARMA	4.000	0.602
40.	DIAMPHODIA SP.	4.000	0.602
41.	ARCTEOBIA ANTICOSTIENSIS	2.000	0.301
42.	ETEONE LONGA	2.000	0.301
43.	CAPITELLA CAPITATA	2.000	0.301
44.	ASTARTE BOREALIS	2.000	0.301
45.	NATICA CLAUSA	2.000	0.301
46.	POLINICES PALLIDUS	2.000	0.301
47.	BYBLIS GAIMARDI	2.000	0.301
48.	MACHAIRONYX MUELLERI	2.000	0.301
49.	WESTWOODILLA CAECULA	2.000	0.301

Figure 7. Domin (density) calculated from Station Group C.



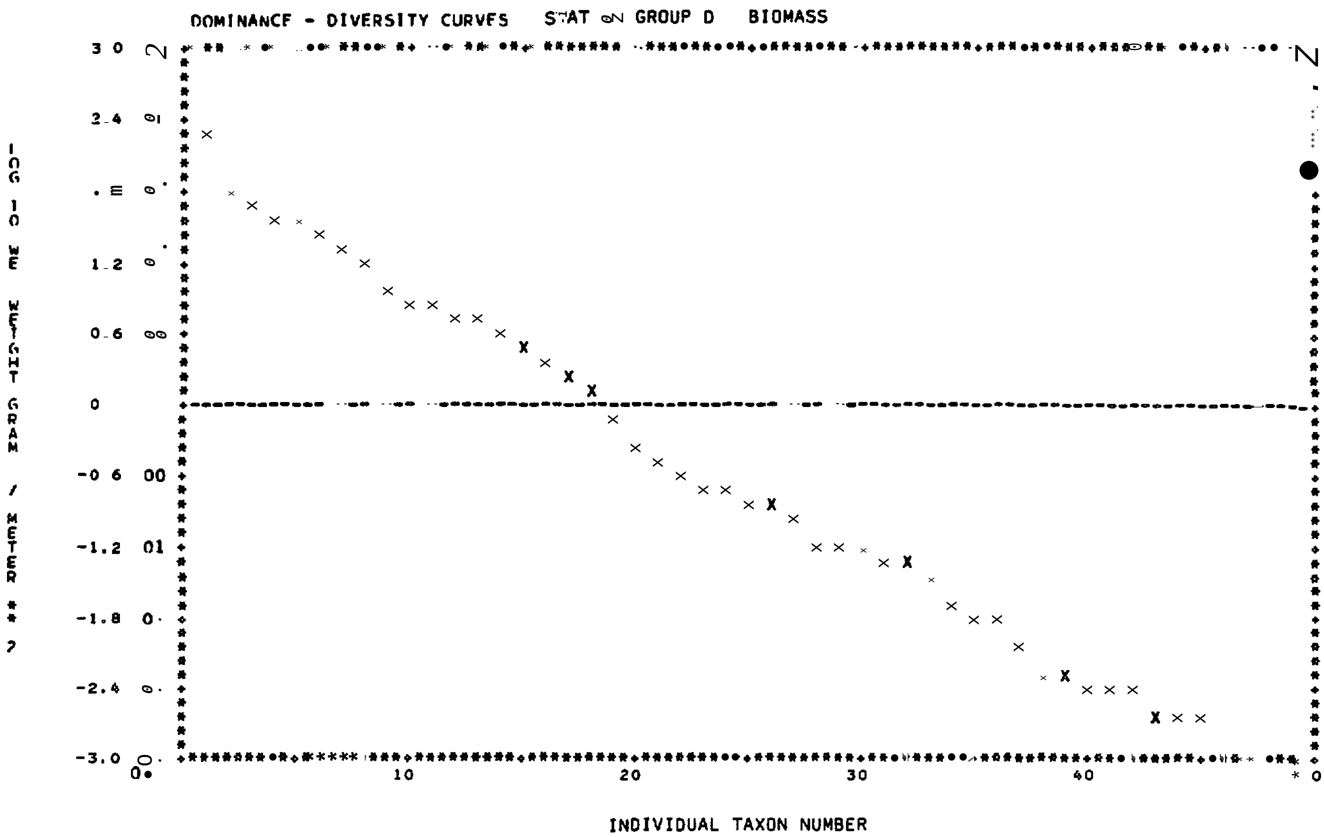
TAXON NO,	TAXON NAME	DATA VALUE	PLOT VALUE
1.	CUCUMARIA SP.	560.258	2.748
2.	NUCULANA FOSSA	34.898	1.543
3.	STERNASPIS SCUTATA	26.056	1.416
4.	MACOMA CALCAREA	14.574	1.164
5.	NUCULA TENUIS	9.254	0.966
6.	CLINOCARDIUM CILIATUM	5.854	0.767
7.	NEPHTYS PUNCTATA	5.032	0.702
a.	YOLDIA AMYGDALEA	4.826	0.684
9.	MALDANE GLEBIFEX	4.476	0.651
10.	NEPHTYS CAECA	3.686	0.567
11.	NEOLEPREA SPIRALIS	2..248	0.512
12.	PRAXILLELLA PRAETERMISSA	0.720	-0.143
13.	POLINICES PALLIDUS	0.674	-0.171
14.	DIAMPHIODIA CRATERODMETA	0.456	-0.341
15.	SOLARIELLA VARIICOSA	0.284	-0.547
16.	SERRIPES GROENLANDICUS	0.194	-0.712
17.	NEPHTYS CILIATA	0.172	-0.764
18.	LIOCYMA FLUCTUOSA	0.158	-0.801
19.	OPHIURA SARSI	0.150	-0.824
20.	LAONOME KROYERI	0.140	-0.854
21.	HAPLOSCOLOPIOS ELONGATUS	0.136	-0.866
22.	CYLICHNA ALBA	0.122	-0.914
23.	BARANTOLLA AMERICANA	0.102	-0.991
24.	LEUCON NASICA	0.078	-1.108
2s.	AXINOPSIDA SERRICATA	0.062	-1.2 8
26.	PRIAPULUS CAUDATUS	0.060	-1.2?2
27.	MYRIOCHELE OCULATA	0.054	-1.268
28.	RETUSA OBTUSA	0. 52	-1.284
29.	THYASIRA FLEXUOSA	0.850	-1.301
30.	HARPINIA GURJANOVAE	0.036	-1.444
31.	BATHYMEDON NANSENI	0.034	-1.469
32.	HETEROMASTUS FILIFORMIS	0.028	-1.553
33.	BYBLIS GAIMARDI	0.026	-1.585
34.	ECHINARACHNIUS PARMA	0.016	-1.796
3s .	DIAMPHODIA SP.	0.016	-1.796
36.	EUDORELLA PACIFICA	0.014	-1.854
37.	ODONTOGENA BOREALIS	0.014	-1.854
30.	HARPINIA KOBJAKOVAE	0.012	-1.921
39.	NATICA CLAUSA	0.012	-1.921
40.	ETEONE LONGA	0.008	-2.097
41.	PHOLOE MINUTA	0.006	-2.222
42.	GLYCINDE PICTA	0.004	-2.398
43.	CYCLOCARDIA CREBRICOSTATA	0.004	-2.398
44.	EUDORELLOPSIS INTEGRA	0.004	-2.398
4s.	ARCTEOBIA ANTICOSTIENSIS	0.002	-2.699
46.	MACHAIRONYX MUELLERI	0.002	-2.699

Figure 8. Dominance-diversity curve (biomass) calculated from Station Group C.



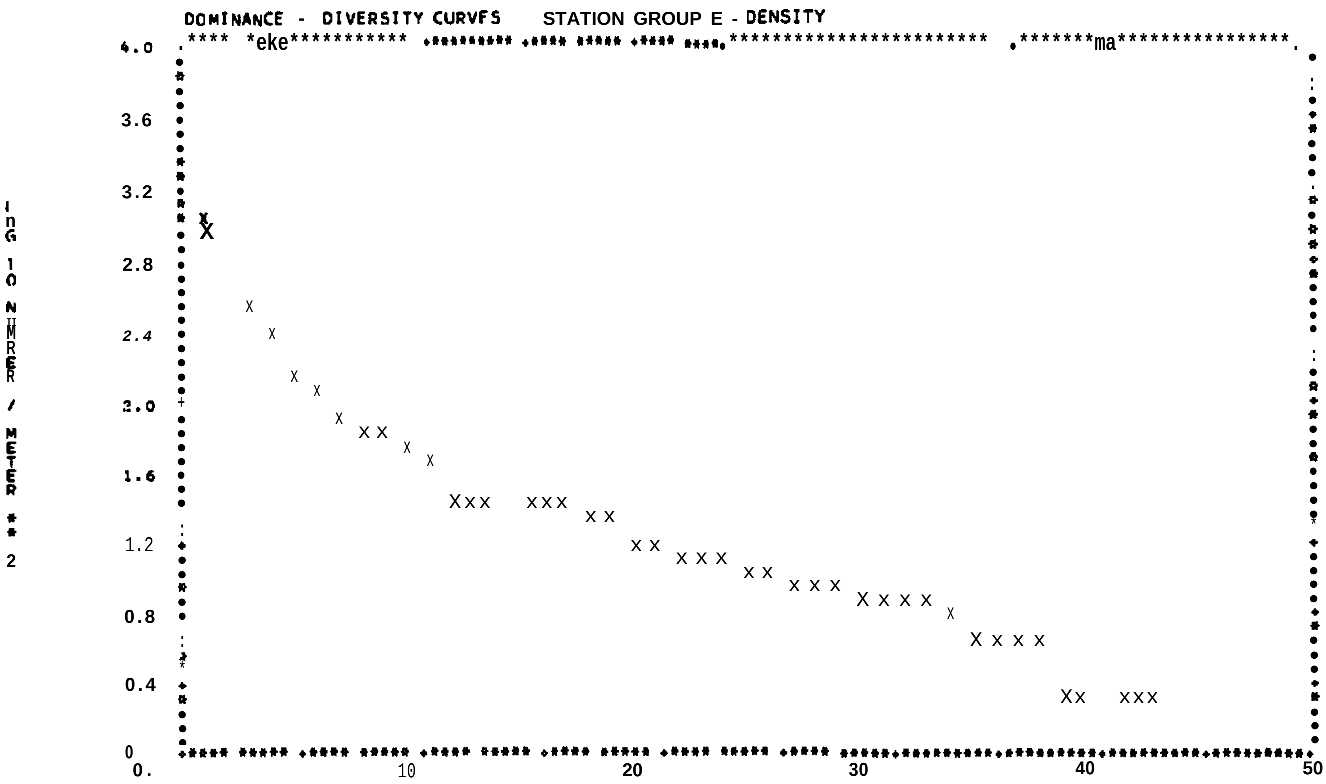
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	BARANTOLLA AMERICANA	464.000	2.667
2.	NUCULA TENUIS	172.000	2.236
3.	MALDANE GLEBIFEX	160.000	2.204
4.	MACOMA CALCAREA	130.000	2.114
5.	NEPHTYS PUNCTATA	80.000	1.903
6.	HETEROMASTUS FILIFORMIS	74.000	1.869
7.	PRIAPULUS CAUDATUS	68.000	1.833
8.	BRADA VILLOSA	58.000	1.763
9.	PRAXILLELLA PRAETERMISSA	36.000	1.556
10.	RETUSA OBTUSA	36.000	1.556
11.	CAPITELLA CAPITATA	32.000	1.505
12.	YOLDIA HYPERBOREA	32.000	1.505
13.	HAPLOSCOLOPLOS ELONGATUS	30.000	1.477
14.	ARICIDEA LOPEZI	22.000	1.342
15.	ETEONE LONGA	18.000	1.255
16.	NEPHTYS ASSIMILIS	18.000	1.255
17.	CYLICHNA ALBA	18.000	1.255
18.	EUDORELLOPSIS INTEGRA	14.000	1.146
19.	MELINNA CRISTATA	12.000	1.079
20.	AXINOPSIDA SERRICATA	12.000	1.079
21.	HARPINIA KOBJAKOVAF	12.000	1.079
22.	TEREBELLIDES STROEMII	10.000	1.000
23.	NUCULANA PERNULA	10.000	1.000
24.	EUDORELLA EMARGINATA	10.000	1.000
25.	NEMIDIA TAMARAE	8.000	0.903
26.	PRIONOSPIO STEENSTRUPI	8.000	0.903
27.	MALDANE SARSI	8.000	0.903
28.	ARTACAMA CONIFERA	8.000	0.903
29.	CLINOCARDIUM CILIATUM	8.000	0.903
30.	HESPERONE COMPLANATA	6.000	0.778
31.	TENONIA KISTAPENSIS	6.000	0.778
32.	AXINOPSIDA VIRIDIS	6.000	0.778
33.	ECHINARACHNIUS PARMA	6.000	0.778
34.	OPHIURA SARSI	6.000	0.778
35.	ANAITIDES GROENLANDICA	4.000	0.602
36.	SCALIBREGMA INFLATUM	4.000	0.602
37.	STERNASPIS SCUTATA	4.000	0.602
38.	CHAETODERMA ROBUSTA	4.000	0.602
39.	METRIDIA LUCENS	4.000	0.602
40.	LEUCON NASICA	4.000	0.602
41.	PONTOPOREIA FEMORATA	4.000	0.602
42.	DIAMPHIODIA CRATERODMETA	4.000	0.602
43.	ARCTEOBIA SPINELYTRIS	2.000	0.301
44.	PHOLOE MINUTA	2.000	0.301
45.	MYRIOCHELE OCULATA	2.000	0.301
46.	MACOMA BROTA	2.000	0.301
47.	EUDORELLOPSIS USCHAKOVI	2.000	0.301
48.	GOLFINGIA MARGARITACEA	2.000	0.301

Figure 9. Dominance-diversity curve (density) calculated from Station Group D.



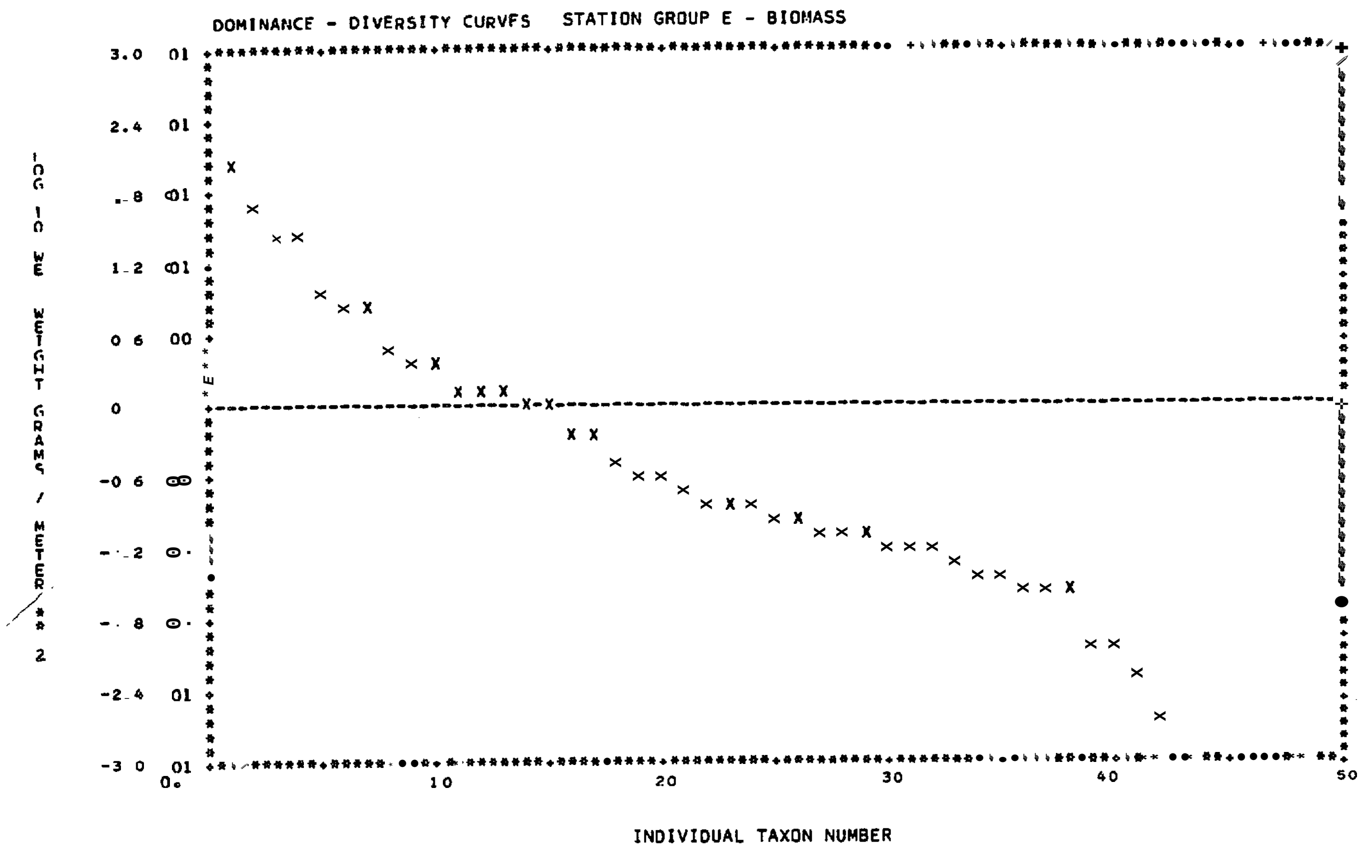
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	MACOMA CALCAREA	174.708	2.242
2.	NEPHTYS PUNCTATA	61.906	1.792
3.	ECHINARACHNIUS PARMA	52.046	1.716
4.	MALDANE GLEBIFEX	37.522	1.574
5.	YOLDIA HYPERBOREA	34.478	1.538
6.	ARTACAMA CONIFERA	27.376	1.437
7.	NUCULA TENUIS	18.956	1.278
8.	NEPHTYS ASSIMILIS	14.344	1.157
9.	PRAXILLELLA PRAETERMISSA	8.798	0.944
10.	OPHIURA SARSI	7.612	0.881
11.	NUCULANA PERNULA	6.174	0.791
12.	TEREBELLIDES STROEMII	5.906	0.771
13.	BARANTOLLA AMERICANA	5.556	0.745
14.	MELINNA CRISTATA	3.588	0.555
15.	PRIAPULUS CAUDATUS	3.016	0.479
16.	HAPLOSCOLOPLOS ELONGATUS	2.308	0.363
17.	MALDANE SARSI	1.862	0.270
18.	BRADA VILLOSA	1.200	0.079
19.	NEMIDIA TAMARAE	0.706	-0.151
20.	CAPITELLA CAPITATA	0.402	-0.396
21.	STERNASPIS SCUTATA	0.366	-0.437
22.	CHAETODERMA ROBUSTA	0.222	-0.654
23.	MACOMA BROTA	0.216	-0.666
24.	HETEROMASTUS FILIFORMIS	0.198	-0.703
25.	SCALIBREGMA INFLATUM	0.154	-0.812
26.	ETEONE LONGA	0.142	-0.848
27.	DIAMPHIODIA CRATERODMETA	0.096	-1.018
28.	CLINOCARDIUM CILIATUM	0.070	-1.155
29.	RETUSA OBTUSA	0.060	-1.222
30.	ANAITIDES GROENLANDICA	0.056	-1.252
31.	CYLICHNA ALBA	0.046	-1.337
32.	PONTOPOREIA FEMORATA	0.044	-1.357
33.	EUDORELLOPSIS INTEGRA	0.034	-1.469
34.	HESPERONE COMPLANATA	0.020	-1.699
35.	ARICIDEA LOPEZI	0.018	-1.745
36.	EUDORELLA EMARGINATA	0.018	-1.745
37.	AXINOPSIDA SERRICATA	0.010	-2.000
38.	AXINOPSIDA VIRIDIS	0.006	-2.222
39.	METRIDIA LUCENS	0.006	-2.222
40.	PRIONOSPIO STEENSTRUPI	0.004	-2.398
41.	HARPINIA KOBJAKOVAE	0.004	-2.398
42.	GOLFINGIA MARGARITACEA	0.004	-2.398
43.	TENONIA KISTAPENSIS	0.002	-2.699
44.	PHOLOE MINUTA	0.002	-2.699
45.	EUDORELLOPSIS USCHAKOVI	0.002	-2.699

Figure 10. Dominance-diversity curve (biomass) calculated from Station Group D.



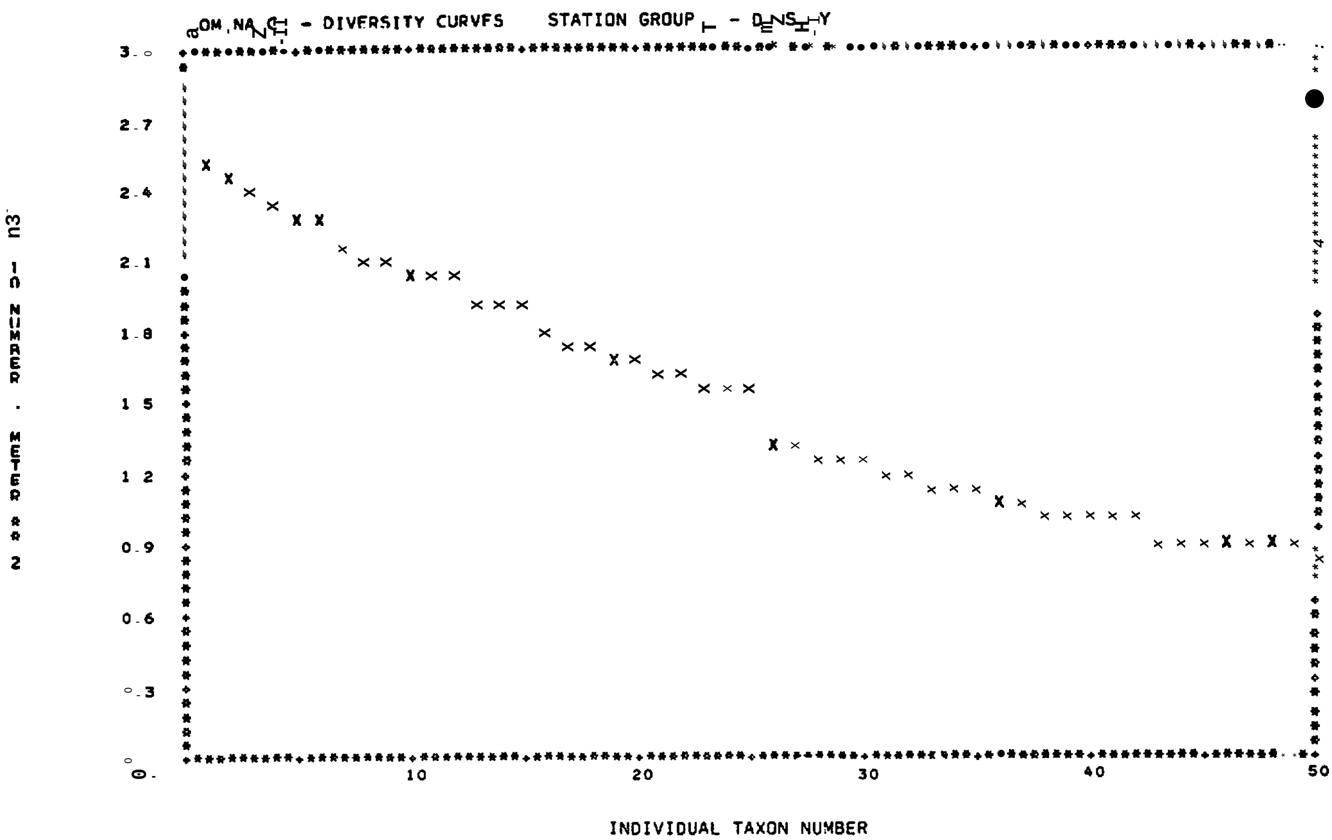
TAXON NO.	TAXON NAME	OATA VALUE	PLOT VALUE
1.	HAPLOSCOLOPL OS ELONGATUS	1030.000	3.013
2.	NUCULA TENU IS	998.000	2.999
3.	BARANTOLLA AMERICANA	380.000	2.580
4.	HARP I NIA GURJANOVAE	230.000	2.362
s.	PROTOMEDE IRA CHELATA	136.000	2.127
6.	EUDORELLA PACIF ICA	128.000	2.107
7.	BRADA VILLOSA	80.000	1.903
8.	GLYCINDE PICTA	70.000	1.845
9.	HETEROMASTUS FILIFORMIS	70.000	1.845
1o.	14 ACOMA CALCAREA	54.000	1.732
11.	NUCULANA FOSSA	48.000	1.681
12.	CYL ICHNA ALBA	30.000	1.477
13.	PROTOMEDIEIA FASCIATA	30.000	1.477
14.	AR ICIDEA LOPEZI	28.000	1.447
15.	PRAXILLELLA PRAETERMI SSA	26.000	1.415
16.	AX INOPSIDA SERRICATA	26.000	1.415
17.	THYASI RA FLEXUOSA	26.000	1.415
le.	CAP ITELLA CAPITATA	24.000	1.380
19.	BYBLIS GA IMARDI	22.000	1.342
20.	NEPHTYS PUNCTATA	16.000	1.204
21.	TAUBERIA GRACIL IS	16.000	1.204
22.	PHOLOE MINUTA	14.000	1.146
23.	ETEONE LONGA	14.000	1.146
24.	STERNASPI S SCUTATA	14.000	1.146
25.	NUCULANA PERNUL A	12.000	1.079
26.	YOLDIA AMYGDALEA	12.000	1.079
27.	SCAL IBREGMA I NFL ATUM	10.000	1.000
28.	Ax INOPS1OA VIRIDIS	10.000	1.000
29.	RETUSA OBTUSA	10.000	1.000
30.	ANTINOELLA SARSI	8.000	0.903
31.	EUDORELLOPSIS DEFORMIS	8.000	0.903
32.	PR IAPULUS CAUDATUS	8.000	0.903
33.	DIAMPHIODIA CRATERODMETA	8.000	0.903
34.	TEREBELL IDES STROEMI I	6.000	0.778
3s.	NEPHTYS CAECA	4.000	0.602
36.	MALDANE GLEB IFEX	4.000	0.602
37.	PONTOPOREIA FEMORATA	4.000	0.602
38.	MACHAIRONYX MUELLERI	4.000	0.602
39.	NEMIDIA TAMARAE	2.000	0.301
40.	AMAI TIIDES GROENLANDICA	2.000	0.301
41.	AX IOTHELLA CANTENTA	2.000	0.301
42.	HARPINIA KOBJAKOVAE	2.000	0.301
43.	ARGIS LAR	2.000	0.301

Figure 11. **Dominance-diversity** curve (density) calculated **from** Station Group **E.**



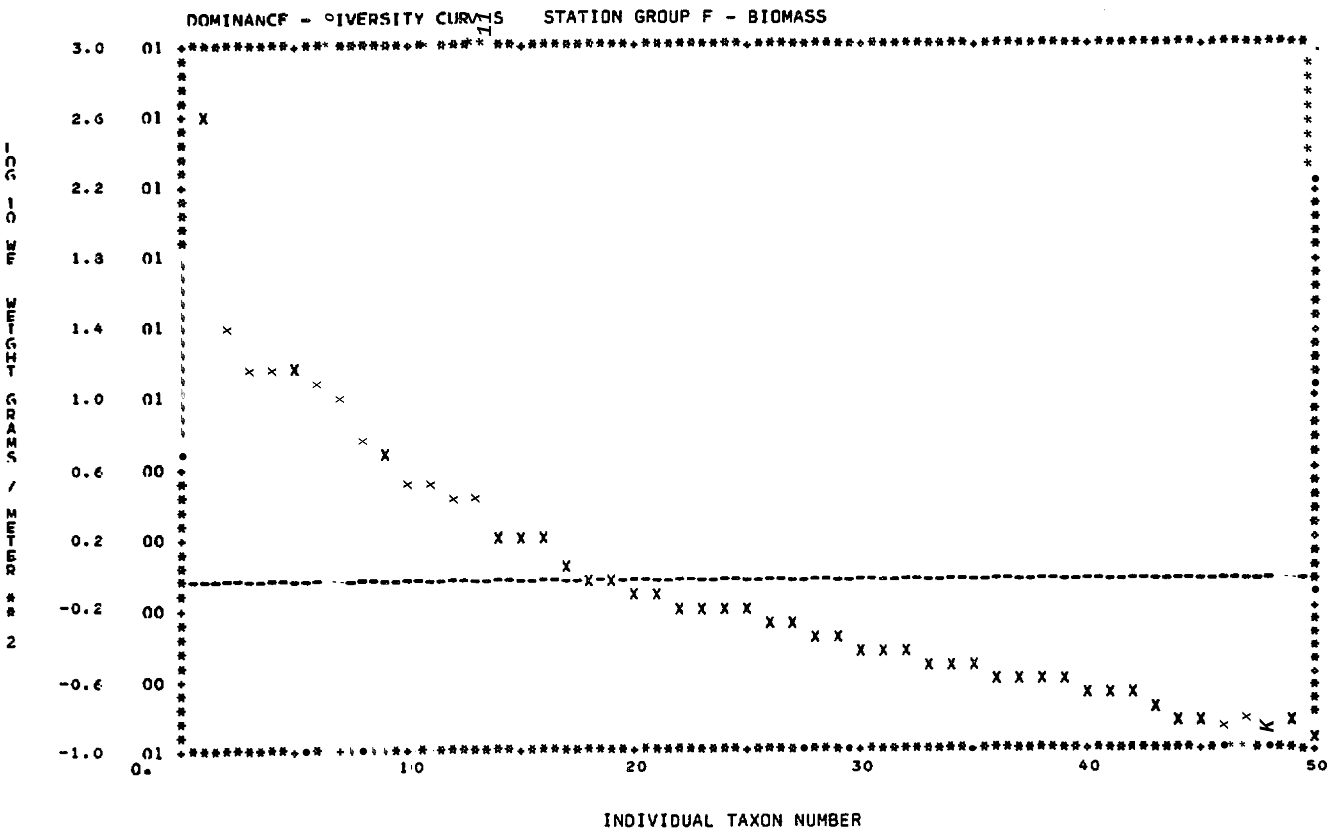
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	NUCULA TENUIS	106.102	2.026
2.	MACOMA CALCAREA	54.716	1.738
3.	NUCULANA FOSSA	27.424	1.438
4.	YOLDIA AMYGDALEA	26.242	1.419
5.	NUCULANA PERNULA	9.776	0.990
6.	HAPLOSCOLOPLOS ELONGATUS	7.584	0.880
7.	NEPHTYS PUNCTATA	7.462	0.873
8.	STERNASPIS SCUTATA	3.232	0.509
9.	PRAXILLELLA PRAETERMISSA	2.398	0.380
10.	TEREBELLIDES STROEMII	2.322	0.366
11.	NEPHTYS CAECA	1.482	0.171
12.	BRADA VILLOSA	1.348	0.130
13.	BARANTOLLA AMERICANA	1.248	0.096
14.	ARGIS LAR	1.126	0.052
15.	GLYCINDE PICTA	0.964	-0.016
16.	AXIOTHELLA CANTENTA	0.582	-0.235
17.	THYASIRA FLEXUOSA	0.568	-0.246
18.	CYLICHNA ALBA	0.336	-0.474
19.	MALDANE GLEBIFEX	0.274	-0.562
20.	BYBLIS GAIMARDI	0.252	-0.599
21.	HARPINIA GURJANOVAE	0.190	-0.721
22.	DIAMPHIODIA CRATERODMETA	0.154	-0.812
23.	EUDORELLA PACIFICA	0.128	-0.893
24.	PHOLOE MINUTA	0.126	-0.900
25.	HETEROMASTUS FILIFORMIS	0.100	-1.000
26.	PROTOMEDEIRA CHELATA	0.098	-1.009
27.	SCALIBREGMA INFLATUM	0.086	-1.066
28.	PRIAPULUS CAUDATUS	0.078	-1.108
29.	ARICIDEA LOPEZI	0.074	-1.131
30.	AXINOPSIDA SERRICATA	0.062	-1.208
31.	CAPITELLA CAPITATA	0.060	-1.222
32.	ANTINOELLA SARSI	0.056	-1.252
33.	PROTOMEDIEIA FASCIATA	0.054	-1.268
34.	TAUBERIA GRACILIS	0.034	-1.469
35.	AXINOPSIDA VIRIDIS	0.032	-1.495
36.	PONTOPOREIA FEMORATA	0.026	-1.585
37.	ETEONE LONGA	0.024	-1.620
38.	NEMIDIA TAMARAE	0.024	-1.620
39.	ANAITIDES GROENLANDICA	0.008	-2.097
40.	RETUSA OBTUSA	0.008	-2.097
41.	EUDORELLOPSIS DEFORMIS	0.006	-2.222
42.	HARPINIA KOBJAKOVAE	0.002	-2.699

Figure 12. Dominance-diversity curve (biomass) calculated from Station Group E.



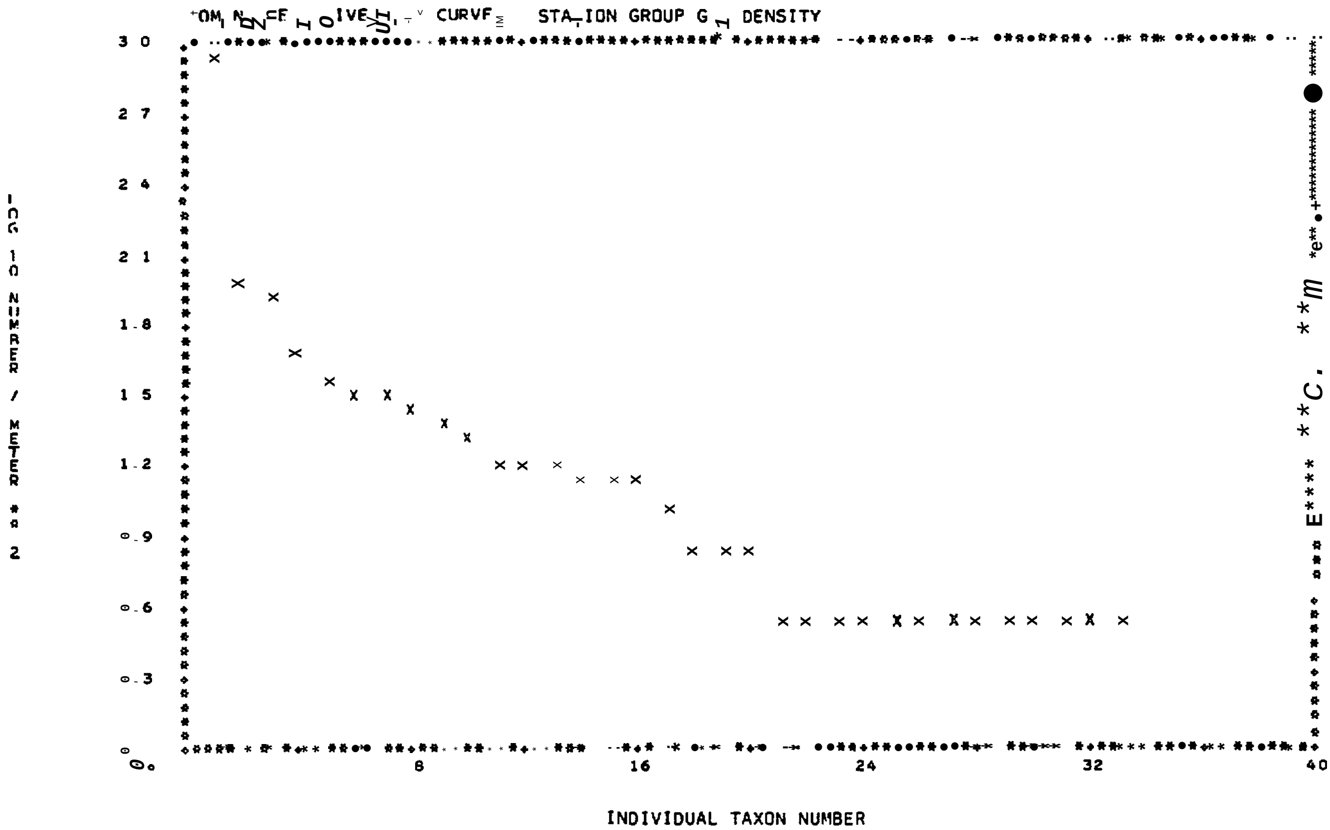
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	HARPINIA GURJANOVAE	316.000	2.500
2.	PRAXILLELLA PRAETERMISSA	284.000	2.453
3.	GLYCINDE PICTA	246.000	2.391
4.	HAPLOSCOLOPLOS ELONGATUS	214.000	2.330
5.	BARANTOLLA AMERICANA	180.000	2.255
6.	PARAPHOXUS OCULATUS	180.000	2.255
7.	AMPELISCA MACROCEPHALA	136.000	2.134
8.	ARCTEOBIA ANTICOSTIENSIS	128.000	2.107
9.	EUDORELLA PACIFICA	122.000	2.086
10.	PHOLOE MINUTA	116.000	2.064
11.	MYSELLA TUMIDA	108.000	2.033
12.	SPIOPHANES BOMBYX	106.000	2.025
13.	CYCLOCARDIA CREBRICOSTATA	86.000	1.934
14.	PHOTIS SPASSKII	80.000	1.903
15.	HETEROMASTUS FILIFORMIS	78.000	1.892
16.	ECHINARACHNIUS PARMA	62.000	1.792
17.	PONTOPOREIA FEMORATA	58.000	1.763
18.	TYPOSYLLIS ALTERNATA	56.000	1.748
19.	OPHELIA LIMACINA	50.000	1.699
20.	RHODINE GRACILIOR	46.000	1.663
21.	ETEONE LONGA	44.000	1.643
22.	GOLFINGIA MARGARITACEA	44.000	1.643
23.	SCOLOPLOS ARMIGER	36.000	1.556
24.	MALDANE GLEBIFEX	34.000	1.531
25.	EUDORELLOPSIS INTEGRA	34.000	1.531
26.	BRADA VILLOSA	20.000	1.301
27.	SERRIPES GROENLANDICUS	20.000	1.301
28.	ASTARTE BOREALIS	18.000	1.255
29.	BATHYMEDON NANSENI	18.000	1.255
30.	OPHIURA SARSI	18.000	1.255
31.	CISTENIDES GRANULATA	16.000	1.204
32.	SOLARIELLA VARICOSA	16.000	1.204
33.	NEPHTYS RICKETTSI	14.000	1.146
34.	SCALIBREGMA INFLATUM	14.000	1.146
35.	NATICA CLAUSA	14.000	1.146
36.	AMPHARETE ACUTIFRONS	12.000	1.079
37.	CHIONOECETES OPILIO	12.000	1.079
38.	NEPHTYS CAECA	10.000	1.000
39.	CAPITELLA CAPITATA	10.000	1.000
40.	TACHYRYNCHUS EROSUS	10.000	1.000
41.	CALANUS PLUMCHRUS	10.000	1.000
42.	WESTWOODILLA CAECULA	10.000	1.000
43.	ANTINOELLA SARSI	8.000	0.903
44.	MYRIOCHELE OCULATA	8.000	0.903
45.	ASABELLIDES SIBIRICA	8.000	0.903
46.	NUCULA TENUIS	8.000	0.903
47.	DIASTYLIS BIDENTATA	8.000	0.903
48.	MACHAIRONYX MUELLERI	8.000	0.903
49.	TIRON BIOCULATA	8.000	0.903
50.	GATTYANA TREADWELLI	6.000	0.778

Figure 13. Dominance-diversity curve (density) calculated from Station Group F.



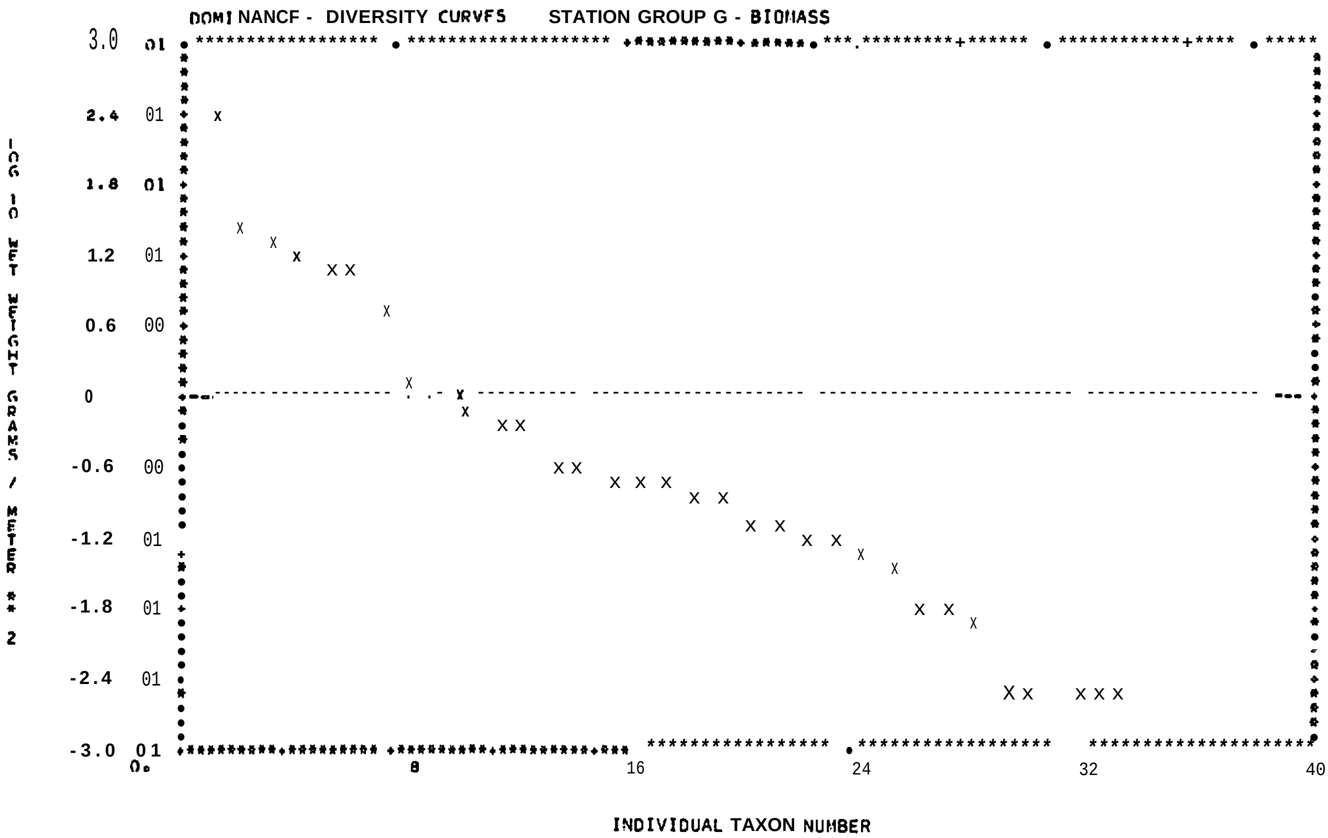
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
	ECHINARACHNIUS PARMA	368.830	2.567
1	NEPHTYS RICKETTSI	25.908	1.413
2	SERRIPES GROENLANDICUS	15.730	1.197
3	PRAXILLELLA PRAETERMISSA	15.728	1.197
4	CYCLOCARDIA CREBRICOSTATA	13.616	1.134
5	NEPHTYS CAECA	12.570	1.099
6	CUCUMARIA SP.	10.268	1.011
7	NATICA CLAUSA	5.494	0.740
8	RHODINE GRACILIOR	4.798	0.681
9	TACHYRYNCHUS EROSUS	3.560	0.551
10	AMPHARETE ACUTIFRONS	3.450	0.538
11	CISTENIDES GRANULATA	2.696	0.431
12	LIOCYMA SP.	2.630	0.420
13	SYNIDOTEA BICUSPIDA	1.720	0.236
14	ARCTEOBIA ANTICOSTIENSIS	1.676	0.224
15	SOLARIELLA VARICOSA	1.542	0.188
16	HAPLOSCOLOPLOS ELONGATUS	1.048	0.020
17	GLYCINDE PICTA	0.974	-0.011
18	PONTOPOREIA FEMORATA	0.842	-0.075
19	MYRIOCHELE OCULATA	0.808	-0.093
20	AMPELISCA MACROCEPHALA	0.768	-0.115
21	MELITA DENTATA	0.648	-0.188
22	BARANTOLLA AMERICANA	0.622	-0.206
23	MALDANE GLEBIFEX	0.596	-0.225
24	ASABELLIDES SIBIRICA	0.584	-0.234
25	MACOMA CALCAREA	0.540	-0.268
26	ANTINOELLA SARSI	0.530	-0.276
27	THYASIRA FLEXUOSA	0.442	-0.355
28	CHIONOECETES OPILIO	0.440	-0.357
29	ASTARTE BOREALIS	0.376	-0.425
30	PHOLOE MINUTA	0.362	-0.441
31	SCOLOPLOS ARMIGER	0.346	-0.461
32	OPHELIA LIMACINA	0.310	-0.509
33	BRADA VILLOSA	0.308	-0.511
34	MYSELLA TUMIDA	0.294	-0.532
35	AMPELISCA ESCHRICHTI	0.272	-0.565
36	ETEONE LONGA	0.268	-0.572
37	HARPINIA GURJANOVAE	0.262	-0.582
38	TYPOSYLLIS ALTERNATA	0.252	-0.599
39	PARAPHOXUS OCULATUS	0.224	-0.650
40	GOLFINGIA MARGARITACEA	0.208	-0.682
41	HARMOTHOE IMBRICATA	0.204	-0.690
42	PHOTIS SPASSKII	0.182	-0.740
43	SCALIBREGMA INFLATUM	0.154	-0.812
44	ANONYX NUGAX	0.148	-0.830
45	EUDORELLA PACIFICA	0.146	-0.836
46	SPIOPHANES BOMBYX	0.142	-0.848
47	HETEROMASTUS FILIFORMIS	0.136	-0.866
48	ANAITIDES GROENLANDICA	0.132	-0.879
49-50	TEREBELLIDES STROEMII	0.124	-0.907

Figure 14. Dominance-diversity curve (biomass) calculated from Station Group F.



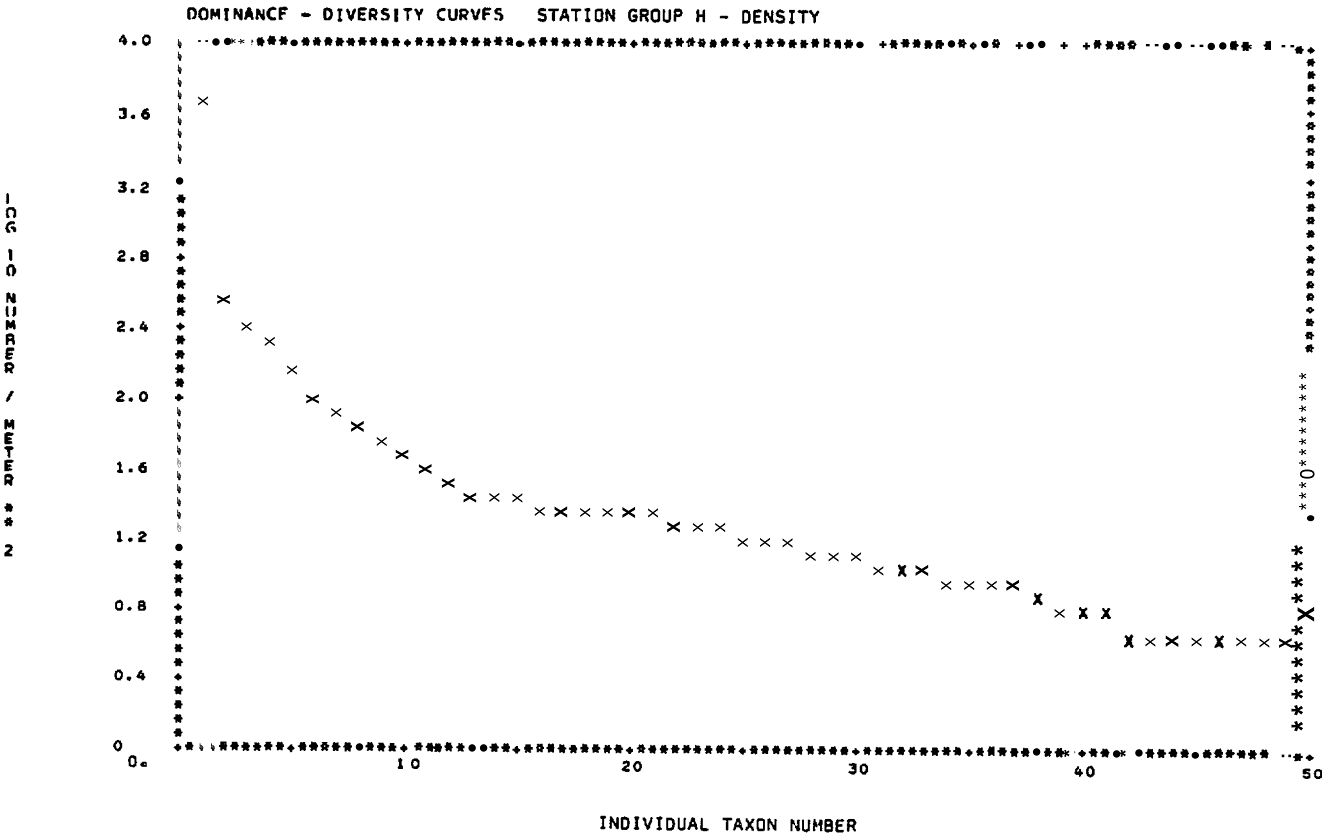
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	HIATELLA ARCTICA	819.999	2.914
2.	ASABELLIDES SIBIRICA	93.333	1.970
3.	BALANUS CRENATUS	83.333	1.921
4.	CISTENIDES GRANULATA	46.666	1.669
5.	OPHIURA SARSI	36.667	1.564
6.	NEPHTYS CILIATA	33.333	1.523
7.	GOLFINGIA MARGARITACEA	33.333	1.523
8.	DIASTYLIS BIDENTATA	26.667	1.426
9.	HARMOTHOE IMBRICATA	23.333	1.368
10.	OPHELIA LIMACINA	20.000	1.301
11.	TYPOSYLLIS ALTERNATA	16.667	1.222
12.	HAPLOSCOLOPLOS ELONGATUS	16.667	1.222
13.	MELITA DENTATA	16.666	1.222
14.	PHOLOE MINUTA	13.333	1.125
15.	GLYCINDE PICTA	13.333	1.125
16.	DIAMPHIODIA CRATERODMETA	13.333	1.125
17.	BARANTOLLA AMERICANA	10.000	1.000
18.	MACOMA CALCAREA	6.667	0.824
19.	PARAPHOXUS OCULATUS	6.667	0.824
20.	TIRON BIOCULATA	6.666	0.824
21.	ETEONE LONGA	3.333	0.523
22.	PRIONOSPIO CIRRIFERA	3.333	0.523
23.	SPIO FILICORNIS	3.333	0.523
24.	SCALIBREGMA INFLATUM	3.333	0.523
25.	MEDIOMASTUS CAPENSIS	3.333	0.523
26.	AMPHARETE ACUTIFRONS	3.333	0.523
27.	TEREBELLIDES STROEMII	3.333	0.523
28.	SERRIPES GROENLANDICUS	3.333	0.523
29.	LIOCYMA FLUCTUOSA	3.333	0.523
30.	NATICA CLAUSA	3.333	0.523
31.	EUDORELLA PACIFICA	3.333	0.523
32.	PLEUROGONIUM SPINOSSISMUM	3.333	0.523
33.	CHIONOECETES OPILIO	3.333	0.523

Figure 15 Dominance-diversity curve (density) calculated from Station Group G.



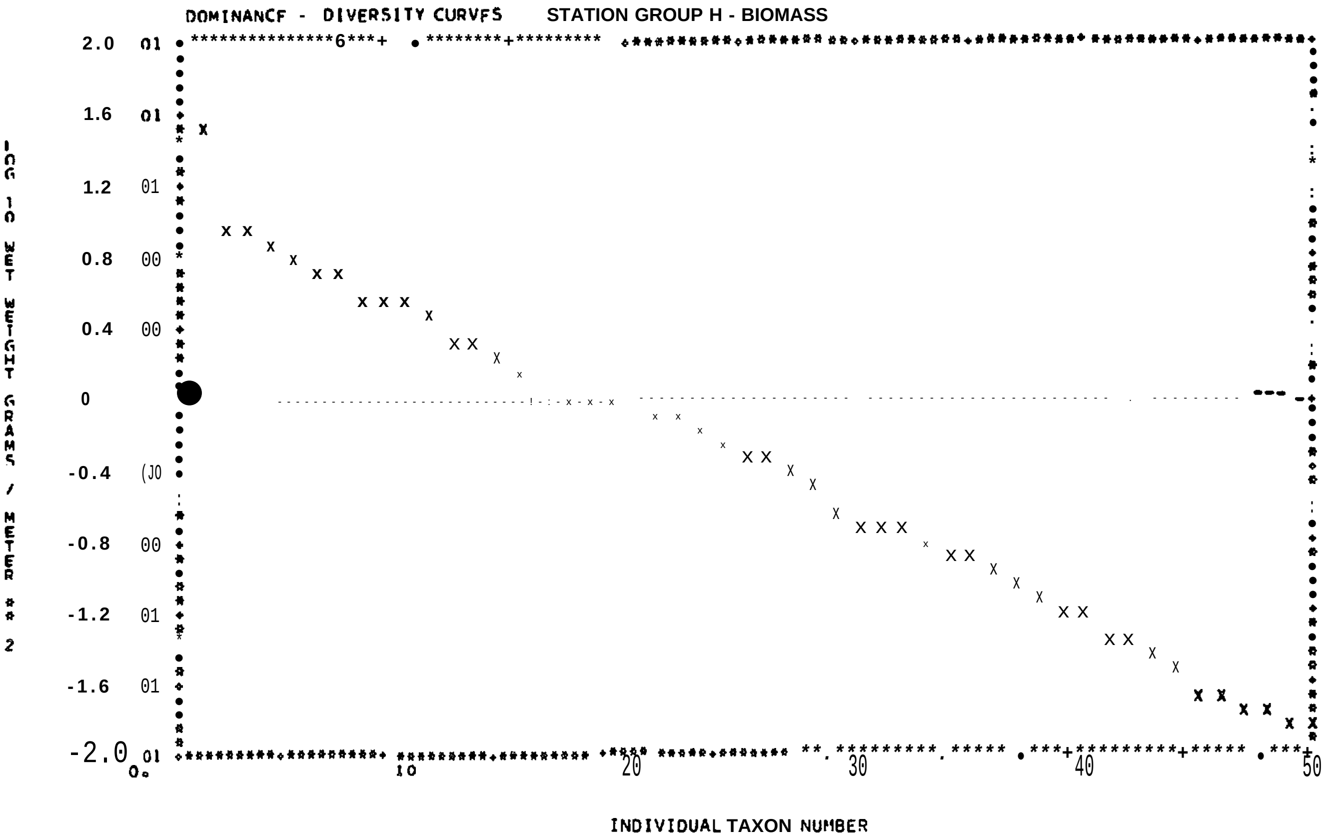
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	HIATELLA ARCTICA	265.853	2.425
2.	NATICA CLAUSA	31.013	1.492
3.	BALANUS CRENATUS	22.773	1.357
4.	NEPHTYS CILIATA	14.870	1.172
5.	CISTENIDES GRANULATA	12.810	1.108
4.	SERRIPES GROENLANDICUS	11.590	1.064
7.	ASABELLIDES SIBIRICA	4.930	0.693
8.	HARMOTHOE IMBRICATA	1.340	0.127
9.	MACOMA CALCAREA	1.053	0.022
10.	LIOCYMA FLUCTUOSA	0.763	-0.117
11.	OPHIURA SARSI	0.557	-0.254
12.	DIAMPHIODIA CRATERODMETA	0.527	-0.278
13.	GOLFINGIA MARGARITACEA	0.250	-0.602
14.	OPHELIA LIMACINA	0.233	-0.633
15.	SCALIBREGMA INFLATUM	0.217	-0.664
16.	MELITA DENTATA	0.216	-0.666
17.	DIASTYLIS BIDENTATA	0*203	-0.693
18.	CHIONOECETES OPILIO	0.150	-0.824
19.	TYPOSYLLIS ALTERNATA	0.147	-0.833
20.	HAPLOSCOLOPLOS ELONGATUS	0.080	-1.097
21.	BARANTOLLA AMERICANA	0.073	-1.132
22.	PHOLOE MINUTA	0.067	-1.174
23.	GLYCINDE PICTA	0.057	-1.244
24.	TEREBELLIDES STROEMII	0.050	-1.301
2s.	SPIO FILICORNIS	0.040	-1.398
26.	AMPHARETE ACUTIFRONS	0.017	-1.770
27.	TIRON BIOCULATA	0.017	-1.770
20.	PARAPHOXUS OCULATUS	0.013	-1.886
29.	ETEONE LONGA	0.003	-2.523
30.	PRIONOSPIO CIRRIFERA	0.003	-2.523
31.	MEDIOMASTUS CAPENSIS	0.003	-2.523
32.	EUDORELLA PACIFICA	0.003	-2.523
33.	PLEUROGONIUM SPINOSSISMUM	0.003	-2.523

Figure 16. Dominance-diversity curve (biomass) calculated from Station Croup c.



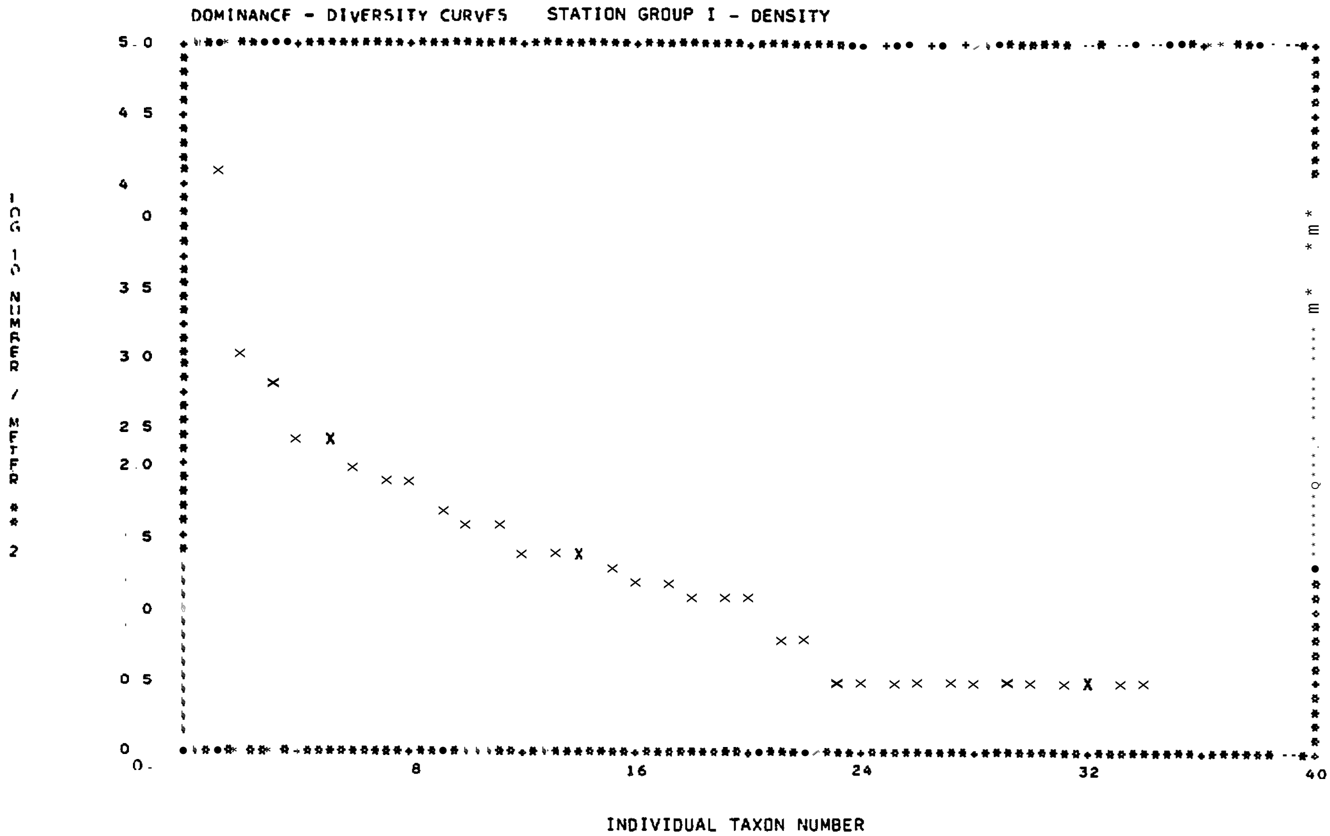
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	MYRIOCHELE OCULATA	4430.000	3.646
2.	ECHINARACHNIUS PARMA	388.000	2.589
3.	NUCULA TENUIS	244.000	2.387
4.	SPIOPHANES BOMBYX	206.000	2.314
5.	COROPHIUM CRASSICORNIS	150.000	2.17
6.	THYASIRA FLEXUOSA	94.000	2.976
7.	AMPELISCA MACROCEPHALA	82.000	1.913
8.	MACHAIRONYX MUELLERI	66.000	1.824
9.	GLYCINDE PICTA	60.000	1.770
10.	OPHIURA SARSI	48.000	1.688
11.	TACHYRYNCHUS EROSUS	42.000	1.621
12.	SERRIPES GROENLANDICUS	32.000	1.503
13.	PHOLOE MINUTA	28.000	1.405
14.	ALCYONIDIUM DISCIFORME	28.000	1.447
15.	CYLICHNA ALBA	26.000	1.447
16.	STERNASPIS SCUTATA	24.000	1.315
17.	CYCLOCARDIA CREBRICOSTATA	24.000	1.380
18.	NATICA CLAUSA	24.000	1.380
19.	HAPLOSCOLOPLOS ELONGATUS	22.000	1.380
20.	SCOLOPLOS ARMIGER	22.000	1.342
21.	CISTENIDES GRANULATA	22.000	1.342
22.	EUDORELLOPSIS INTEGRA	[illegible]0.000	1.342
23.	NUCULANA PERNULA	18.000	1.301
24.	ASTARTE BOREALIS	18.000	1.255
25.	NUCULANA FOSSA	16.000	1.2[illegible]5
26.	SOLARIELLA VARICOSA	16.000	1.204
27.	BYBLIS GAIMARDI	16.000	1.204
28.	NEPHTYS LONGOSETOSA	14.000	1.104
29.	CHONE INFUNDIBULIFORMIS	14.000	1.146
30.	RETUSA OBTUSA	14.000	1.146
31.	MALDANE GLEBIFEX	[illegible]2.000	1.146
32.	EUDORELLOPSIS DEFORMIS	[illegible]2.000	1.079
33.	WESTWOODILLA CAECULA	[illegible]2.000	1.079
34.	NEPHTYS PUNCTATA	[illegible]0.000	1.079
35.	HETEROMASTUS FILIFORMIS	[illegible]0.000	1.000
36.	ASABELLIDES SIBIRICA	[illegible]0.000	1.000
37.	PHOTIS SPASSKII	[illegible]0.000	1.000
38.	TRAVISIA PUPA	8.000	1.000
39.	ETEONE LONGA	6.000	0.903
40.	NEPHTYS CAECA	6.000	0.778
41.	CAMPYLASPIS UMBENSIS	6.000	0.778
42.	ARCTEOBIA ANTICOSTIENSIS	4.000	0.778
43.	HARMOTHOE IMBRICATA	4.000	0.602
44.	TAUBERIA GRACILIS	4.000	0.602
45.	CAPITELLA CAPITATA	4.000	0.602
46.	BARANTOLLA AMERICANA	4.000	0.602
47.	PRAXILLELLA PRAETERMISSA	4.000	0.602
48.	POTAMILLA NEGLECTA	4.000	0.602
49.	LAONOME KROYERI	4.000	0.602
50.	AXINOPSIDA SERRICATA	4.000	0.602

Figure 17. Dominance-diversity curve (density) calculated from Station Group H.



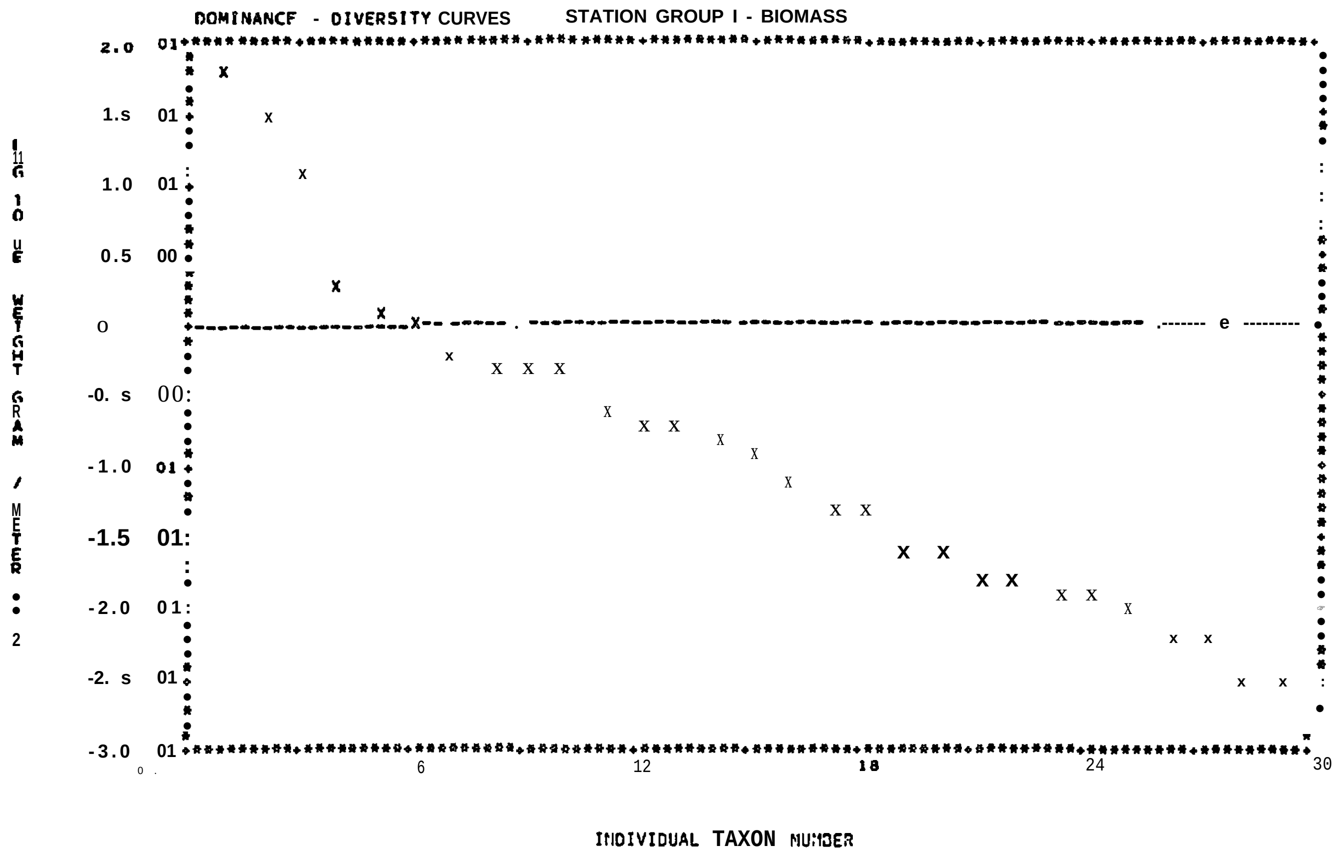
TAXON NO.	TAXON NAME	DATA vALuE	PLOT vALuE
1.	MACOMA CALCAREA	32.846	1.516
2.	TACHYRYNCHUS EROSUS	9.434	0.975
3.	MYRIOCHELE OCULATA	8.852	0.947
4.	CHONE INFUNDIBULIFORMIS	7.604	0.881
s.	CYCLOCARDIA CRFBRICOSTATA	6.114	0.786
6.	AMPELISCA MACROCEPHAIA	5.344	0.728
7.	AMMODYTES HEXAPTERUS	5.214	0.717
a.	ALCYONIDIUM DISCIFORME	3.624	0.559
9.	NUCULANA PERNULA	3.466	0.540
10.	ECHINARACHNIUS PARMA	3.458	0.539
11.	NUCULA TENUIS	2.776	0.443
12.	NEPHTYS CAECA	2.278	0.358
13.	MACOMA BROTA	2.070	0.316
14.	STERNASPIS SCUTATA	1.686	0.227
15.	BYBLIS GAIMARDI	1.390	0.143
16.	NEPHTYS PUNCTATA	1.200	0.079
17.	NEPHTYS LONGOSETOSA	1.156	0.063
18.	SPIOPHANES BOMBYX	1.054	0.023
19.	NUCULANA FOSSA	1.038	0.016
20.	LAONOME KROYERI	1.022	0.009
21.	ANAITIDES MUCOSA	0.898	-0.047
22.	THYASIRA FLEXUOSA	0.770	-0.114
23.	CISTENIDES GRANULATA	0.716	-0.145
24.	NATICA CLAUSA	0*554	-0.256
2s.	DIAMPHIODIA CRATERODMETA	0.476	-0.322
26.	SERRIPES GROENLANDICUS	0.452	-0.345
27.	ASTARTE BOREALIS	0.430	-0.367
28.	SOLARIELLA OBSCURA	0.358	-0.446
29.	MALDANE GLEBIFEX	0.210	-0.678
30.	PRAXILLELLA PRAETERMISSA	0.190	-0.721
31.	SOLARIELLA VARICOSA	0.182	-0.740
32.	TRAVISIA PUPA	0.174	-0.759
33.	COROPHIUM CRASSICORNIS	0.154	-0.812
34.	CYLICHNA ALBA	0.142	-0.848
3s.	GLYCINDE PICTA	0.132	-0.879
36.	HAPLOSCOLOPLOS ELONGATUS	0.118	-0.928
37.	AMPELISCA ESCHRICHTI	0.092	-1.036
38.	SCOLOPLOS ARMIGER	0*078	-1.108
39.	MACHAIRONYX MUELLERI	0.068	-1.167
40.	GOLFINGIA MARGARITACFA	0.062	-1.208
41.	PHOLOE MINUTA	0.040	-1.398
42.	HETEROMASTUS FILIFORMIS	0.040	-1.398
43.	OPHIURA SARSI	0.034	-1.469
44.	WESTWOODILIA CAECULA	0.032	-1.495
4s.	RHODINE GRACILIOR	0.020	-1.699
46.	RETUSA OBTUSA	0.020	-1.699
47.	ARCTEOBIA ANTICOSTIENSIS	0.016	-1.796
48.	ETEONE LONGA	0.016	-1.796
49.	HARMOTHOE IMBRICATA	0.014	-1.854
50.	PHOTIS SPASSKII	0.014	-1.854

Figure 18. Dominance-diversit y curve (biomass) calculated from Station Croup H.



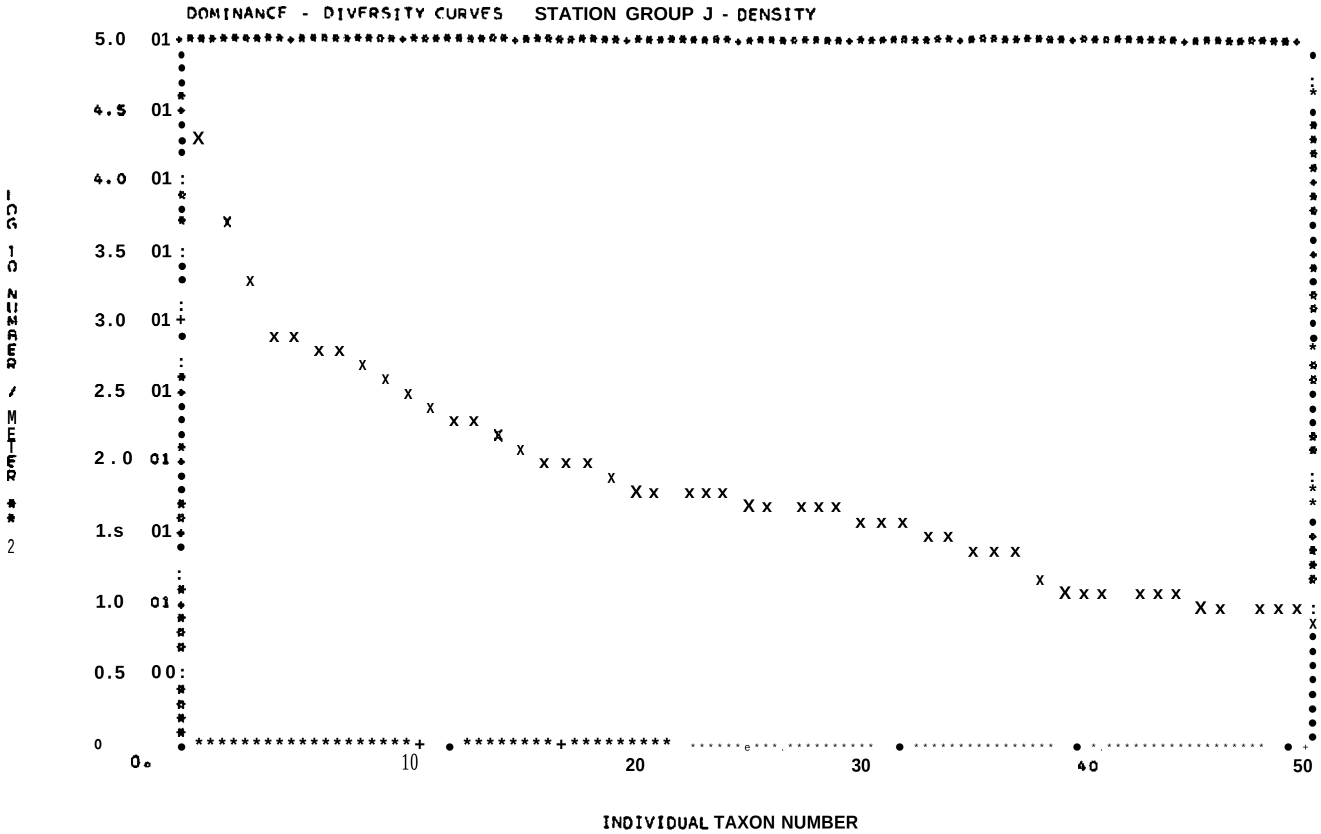
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	MYRIOCHELE OCULATA	********	4.055
2.	ASABELLIDES SIBIRICA	589.999	2.771
3.	ALCYONIDIUM DISCIFORME	376.666	2.576
4.	PHOLOE MINUTA	166.667	2.222
5.	OWENIA FUSIFORMIS	146.667	2.166
6.	SPIOPHANES BOMBYX	100.000	2.000
7.	NUCULA TENUIS	83.334	1.921
8.	GLYCINDE PICTA	83.333	1.921
9.	EUDORELLOPSIS DEFORMIS	53.334	1.727
10.	HAPLOSCOLOPLOS ELONGATUS	40.000	1.602
11.	SCOLOPLOS ARMIGER	40.000	1.602
12.	HETEROMASTUS FILIFORMIS	26.667	1.426
13.	CYLICHNA ALBA	23.333	1.368
14.	PROTOMEDEIA FASCIATA	23.333	1.368
15.	PROTOMEDEIRA CHELATA	20.000	1.301
16.	ANAITIDES GROENLANDICA	16.667	1.222
17.	RETUSA OBTUSA	16.666	1.222
18.	CYCLOCARDIA CREBRICOSTATA	13.334	1.125
19.	DIASTYLIS ALASKENSIS	13.334	1.125
20.	MACHAIRONYX MUELLERI	13.334	1.125
21.	MYSELLA TUMIDA	6.667	0.824
22.	COROPHIUM CRASSICORNIS	6.667	0.824
23.	ANTINOELLA SARSI	3.333	0.523
24.	ETEONE LONGA	3.333	0.523
25.	NEPHTYS CAECA	3.333	0.523
26.	NEPHTYS PUNCTATA	3.333	0.523
27.	ARICIDEA MINUTA	3.333	0.523
28.	PRIONOSPIO STEENSTRUPI	3.333	0.523
29.	TEREBELLIDES STROEMII	3.333	0.523
30.	LAONOME KROYERI	3.333	0.523
31.	CYCLOCARDIA SP.	3.333	0.523
32.	PLEUROGONIUM RUBICUNDUM	3.333	0.523
33.	AMPELISCA MACROCEPHALA	3.333	0.523
34.	CHIONOECETES OPILIO	3.333	0.523

Figure 19. Dominance-diversity curve (density) calculated from Station Group I.



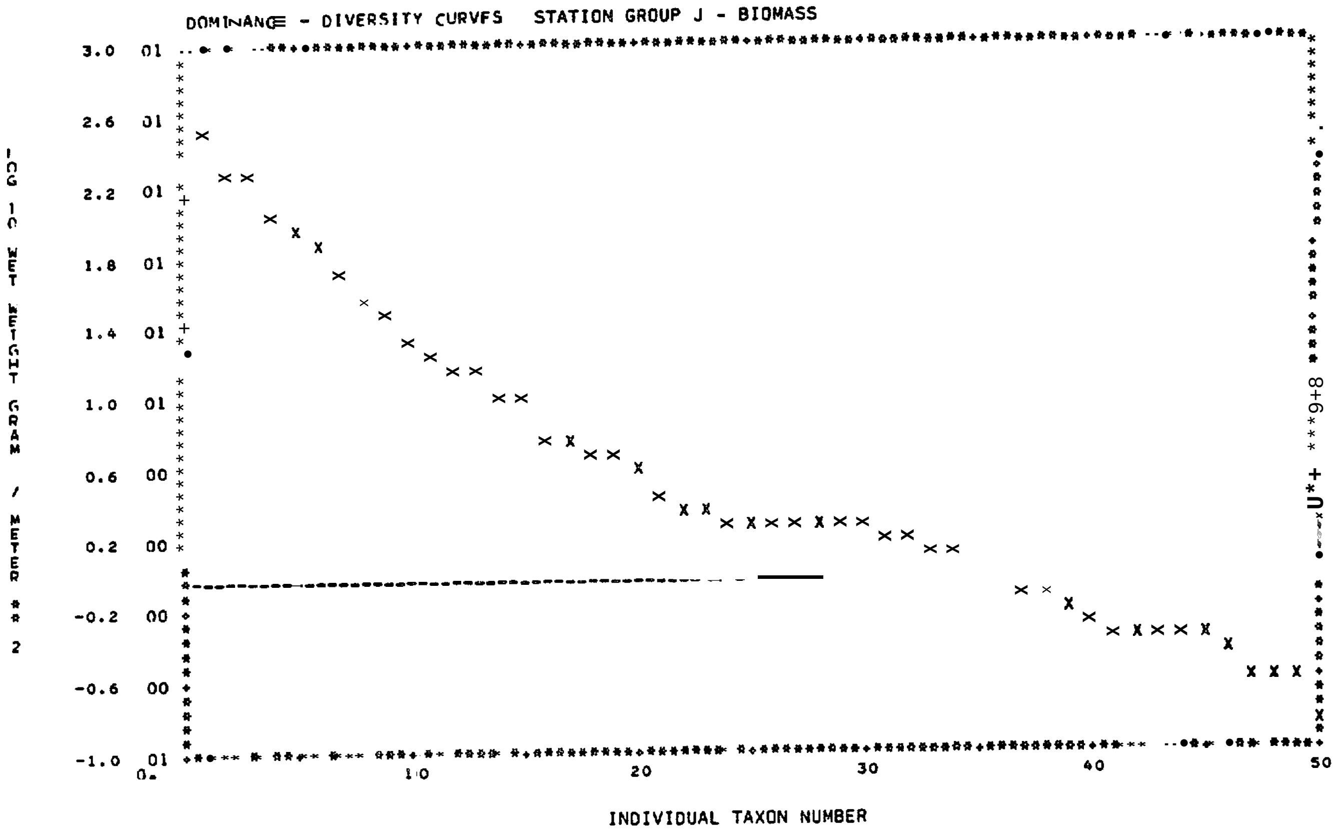
TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1.	ALCYONIDIUM DISCIFORME	69.287	1.841
2.	MYRIOCHELE OCULATA	32.030	1.506
3.	ASABELLIDES SIBIRICA	13.400	1.127
4.	ANAITIDES GROENLANDICA	1.917	0.283
5.	HAPLOSCOLOPLOS ELONGATUS	1.253	0.098
6.	ANTINOELLA SARSI	0.900	-0.046
7.	SCOLOPLOS ARMIGER	0.627	-0.203
8.	GLYCINDE PICTA	0.510	-0.292
9.	TEREBELLIDES STROEMII	0.487	-0.312
10.	CYLICHNA ALBA	0.463	-0.334
11.	PHOLOE MINUTA	0.257	-0.590
12.	SPIOPHANES BOMBYX	0.217	-0.664
13.	NUCULA TENUIS	0.203	-0.693
14.	OWENIA FUSIFORMIS	0.153	-0.815
15.	DIASTYLIS ALASKENSIS	0.127	-0.896
16.	PROTOMEDIEIA FASCIATA	0.073	-1.137
17.	CHIONOECETES OPILIO	0.05	-1.3 1
18.	NEPHTYS CAECA	0*04?	-1.3?8
19.	ETEONE LONGA	0.027	-1.569
20.	RETUSA OBTUSA	0.027	-1.569
21.	HETEROMASTUS FILIFORMIS	0.017	-1.770
22.	EUDORELLOPSIS DEFORMIS	0.017	-1.770
23.	CYCLOCARDIA SP.	0.013	-1.886
24.	MYSELLA TUMIDA	0.013	-1.886
25.	LAONOME KROYERI	0.010	-2.000
26.	AMPELISCA MACROCEPHALA	0.007	-2.155
27.	PROTOMEDEIRA CHFLATA	0.007	-2.155
26.	NEPHTYS PUNCTATA	0.003	-2.523
29.	PRIONOSPIO STEENSTRUPI	0.003	-2.523

Figure 20. Dominance-diversity curve (biomass) calculated for Station Croup 1.



TAXON NO.	TAXON NAME	OATA VALUE	PLOT vALuE
1.	AMPELISCA MACROCEPHALA	********	4.307
2.	AMPELISCA BIRULAI	5572. 000	3.746
3.	AMPELISCA ESCHRICHTI	2024.000	3.306
4.	MYSELLA TuMIDA	750.000	2.875
5.	PARAPHOXUS ROBUSTUS	742. 000	2.870
6.	BYBLIS GAIMARDI	644.000	2.809
7.	HARPINIA GURJANOVAE	640.000	2.806
8.	13 ARANTOLLA AMERICANA	528.000	2.723
9.	EUDORELLOPSIS DEFORMIS	416.000	2.619
10.	COROPHIUM CRASSICORNIS	298.000	2.474
11.	HAPLOSCOLOPLOS ELONGATUS	232.000	2.365
12.	ANONYX NUGAX	216.000	2.334
13.	EUDORELLA PACIFICA	186.000	2.270
14.	PRAXILLELLA PRAETERMISSA	150.000	2.176
15.	TRAVISIA PUPA	140.000	2.146
16.	HETEROMASTUS FILIFORMIS	108.000	2.033
17.	AMPHARETE FINMARCHICA	102.000	2.009
18.	AMPHARETE ACUTIFRONS	90.000	1.954
19.	ANONYX LATICOXAE	76.000	1.881
20.	SCOLOPLOS ARMIGER	68.000	1.833
21.	CYCLOCARDIA CREBRICOSTATA	64.000	1.806
22.	CHONE C1NCTA	62.000	1.792
23.	ANONYX SARSI	62.000	1.792
24.	CAPITELLA CAPITATA	60.000	1.778
25.	NUCULA TENUIS	56.000	1.748
26.	PONTOPOREIA FEMORATA	52.000	1.716
27.	THYASIRA FLEXUOSA	50.000	1.699
28.	PHOTIS SPASSKII	50.000	1.699
29.	GLYCINDE PICTA	48.000	1.681
30.	PHOLOE MINUTA	42.000	1.623
31.	SPIO FILICORNIS	40.000	1.602
32.	DIPLODONTA ALEUTICA	36.000	1.556
33.	GOLFINGIA MARGARITACEA	34.000	1*531
34.	AXINOPSIDA VIRIDIS	30.000	1.477
35.	ONUPHIS IRIDESCENS	26.000	1.415
36.	ANAITIDES GROENLANDICA	24.000	1.380
37.	NATICA CLAUSA	24.000	1.380
38.	PARAPHOXUS OCULATUS	16.000	1.204
39.	ETEONE LONGA	14.000	1.146
40.	CISTENIDES GRANULATA	14.000	1.146
41.	ASTARTE BOREALIS	14.000	1.146
42.	MELITA QUADRISPINOSA	14.000	1.146
43.	TEREBELLIDES STROEMII	12.000	1.079
44.	CH1ONOECETES OPIL1O	12.000	1.079
45.	ANTINOELLA SARSI	10.000	1.000
46.	YOLDIA MYALIS	10.000	1.000
47.	CYCLOCARDIA SP.	10.000	1.000
48.	AXINOPSIDA SERRICATA	10.000	1.000
49.	ERICTHONIUS HUNTERI	10.000	1.000
50.	NEPHTYS PUNCTATA	8.000	0.903

Figure 21. Dominance-diversity curve (density) calculated for Station Group J.



TAXON NO.	TAXON NAME	DATA VALUE	PLOT VALUE
1	AMPELISCA MACROCEPHALA	316.256	2.500
2	ASTARTE BOREALIS	192.842	2.285
3	SERRIPES GROENLANDICUS	176.764	2.247
4	AMPELISCA BIRULAI	101.650	2.007
5	CHIONOECETES OPILIO	92.256	1.965
6	AMPELISCA ESCHRICHTI	74.682	1.873
7	TRAVISIA PUPA	57.096	1.757
8	CYCLOCARDIA CREBRICOSTATA	36.394	1.561
9	BYBLIS GAIMARDI	29.354	1.468
10	AMMODYTES HEXAPTERUS	22.340	1.349
11	YOLDIA MYALIS	15.990	1.204
12	ANONYX NUGAX	15.360	1.186
13	PAGURUS TRIGONOCHEIRUS	13.226	1.121
14	ANAITIDES GROENLANDICA	10.258	1.011
15	NEPHTYS PUNCTATA	9.964	0.998
16	CISTENIDES GRANULATA	5.598	0.748
17	NATICA CLAUSA	5.278	0.722
18	HAPLOSCOLOPLOS ELONGATUS	4.948	0.694
19	PRAXILLELLA PRAETERMISSA	4.850	0.686
20	ANONYX LATICOXAE	3.656	0.563
21	ANONYX SARSI	2.928	0.467
22	NEPHTYS RICKETTSI	2.402	0.381
23	MYSELLA TUMIDA	2.126	0.328
24	NUCULA TENUIS	1.984	0.298
25	SCOLOPLOS ARMIGER	1.952	0.290
26	ONUPHIS IRIDESCENS	1.916	0.282
27	BARANTOLLA AMERICANA	1.806	0.257
28	AMPHARETE FINMARCHICA	1.776	0.249
29	PARAPHOXUS ROBUSTUS	1.766	0.247
30	LIOCYMA FLUCTUOSA	1.742	0.241
31	CHONE CINCTA	1.660	0.220
32	GOLFINGIA MARGARITACEA	1.542	0.188
33	TEREBELLIDES STROEMII	1.406	0.148
34	PONTOPOREIA FEMORATA	1.256	0.099
35	AMPHARETE ACUTIFRONS	1.082	0.034
36	HETEROMASTUS FILIFORMIS	0.956	-0.020
37	COROPHIUM CRASSICORNIS	0.798	-0.098
38	THYASIRA FLEXUOSA	0.792	-0.101
39	ANTINOELLA SARSI	0.650	-0.187
40	HARPINIA GURJANOVAE	0.558	-0.253
41	GLYCINDE PICTA	0.462	-0.335
42	OPHELIA LIMACINA	0.440	-0.357
43	PHOLOE MINUTA	0.422	-0.375
44	CYLICHNA ALBA	0.402	-0.396
45	EUDORELLOPSIS DEFORMIS	0.400	-0.398
46	MACOMA CALCAREA	0.350	-0.456
47	DIPLODONTA ALEUTICA	0.260	-0.585
48	PROTOMEDEIA FASCIATA	0.246	-0.609
49	EUDORELLA PACIFICA	0.238	-0.623
50	SPIO FILICORNIS	0.140	-0.854

Figure 22. Dominance-diversity curve (biomass) calculated for Station Group J.