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TRAWL SURVEY OF THE EPIFAUNAL INVERTEBRATES OF NORTON SOUND, SOUTHEASTERN CHUKCHI SEA, AND KOTZEBUE SOUND

Dr. H. M. Feder, Principal Investigator

with

Stephen C. Jewett

Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

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ERRATA

Feder, H. M. and S. C. Jewett. 1977. Trawl survey of the epifaunal invertebrates of Norton Sound, Southeastern Chukchi Sea, and Kotzebue Sound. Final Report to NOAA. R.U. No. 502. 148 p.

To meet the due date for this report, it was necessary to assemble, type and edit the report within a short time interval. This led to a number of errors. Corrections are listed below.

Page

72 Figure 22, correct caption is - Percent composition in number, volume, and frequency of occurrence of major food items from 16 Norton Sound starry flounders.

73 Figure 23, correct caption is - Food web for starry flounders, *Platichthys stellatus*, from Norton Sound, Port Clarence and Southeastern Chukchi Sea. The thickness of lines in the food web indicates the relative importance of prey items.

74 Figure 24, correct caption is - The relative importance of major food items of starry flounders from Norton Sound, Port Clarence, and the Southeastern Chukchi Sea. See Sect. V of the text for discussion of the Index of Relative Importance (IRI).

ACKNOWLEDGEMENTS

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

Very few studies have had the assessment of the sublittoral epifaunal invertebrates of the northern Bering Sea and/or the Chukchi as their goal (Ellson *et al.*, 1950 Sparks and Pereyra, 1966 Mueller and Feder, 1974). Further data on composition and basic biology of speices in these northern waters are essential before industrial activities take place there. It was the primary intent of this investigation to collect information on the composition, distribution, and biology of the epifaunal invertebrate components of Norton Sound, southeastern Chukchi Sea, and Kotzebue Sound.

The specific objectives of this study were:

1. A qualitative inventory of dominant benthic invertebrate epifaunal species within the study sites.
2. A description of spatial distribution patterns of selected benthic invertebrate epifaunal species in the designated study sites.
3. Preliminary observations of biological interrelationships between selected segments of the benthic biota in the designated study areas.

The trawl survey for the investigation of epifaunal invertebrates was effective, and excellent spatial coverage of the shelf of the northeastern Bering Sea and southeastern Chukchi Sea was obtained. One hundred" seventy-six stations were established; 106 stations in the Norton Sound area and 70 stations in the Chukchi Sea-Kotzebue area. Each station was occupied for 30 minutes with a 400-mesh Eastern otter trawl during September and October, 1976. Taxonomic analysis of the invertebrates collected in the Norton Sound area delineated 13 phyla and 187 species; Chukchi Sea - Kotzebue Sound invertebrates consisted of 11 phyla and 171

species. Echinoderms made up the bulk of the invertebrate biomass with 80.3% in the Norton Sound region and 59.9% in the Chukchi Sea-Kotzebue Sound region. Other important phyla were Arthropoda and Mollusca.

Feeding data were obtained on four species of sea stars (*Asterias amurensis, Leptasterias polaris acervata, Evasterias echinosoma, Lethasterias nanimensis*) and one species of flatfish (*Platichthys stellatus*). The sea stars were feeding on a variety of epifaunal and infaunal species with *E. echinosoma* and *L. nanimensis* primarily taking clams, specifically the Greenland cockle, *Serripes groenlandicus*. Differences in the food habits of the starry flounder, *P. stellatus*, between the study areas were apparent. Starry flounders from Norton Sound fed mainly on the clam, *Yoldia hyperborea* and the brittle star, *Diamphiodia craterodmeta;* starry flounders from the southeast Chukchi Sea mainly utilized the proboscis worm, *Echiurus echiurus alaskensis* and the prickleback fish, *Lumpenus fabricii*. Food data collected for *P. stellatus* have made it possible to develop a preliminary food web for the study areas.

The possible importance of sea stars, the invertebrate group dominating in biomass in the areas, is considered in this report. It is suggested that these organisms may contribute pulses of high energy organic material by way of gametes at spawning time, into overlying waters, and that they represent important components of secondary production in the study areas.

A large number of the species collected in the study area were either sessile or slow-moving forms. Furthermore, many important food organisms were deposit feeders or were species capable of using this feeding method part of the time. Many of these species would be affected by oil spills either because of their inability to leave the area or as a result of their dependence on sediments in the feeding process.

The importance of deposit-feeding clams in the diet of starry flounders and sea stars is demonstrated. A high probability exists that oil hydrocarbons will enter starry flounders, sea stars and other bivalve predators *via* deposit-feeding molluscs, suggesting that studies interrelating sediment, oil, deposit-feeding clams, and appropriate predator species should be initiated soon.

Initial assessment of the data suggests that a few unique, abundant, and/or large benthic species (snow crabs, king crabs, crangonid shrimps, sea stars, starry flounders) are characteristic of the areas investigated and that these species may represent organisms that could be useful for monitoring purposes. Two biological parameters that should be addressed in conjunction with petroleum-related activities are feeding and reproductive biology of important species. It is suggested that an intensive program designed to examine these parameters be initiated well in advance of industrial activity in the oil lease areas.

II. INTRODUCTION

General Nature and Scope of Study

The operations connected with oil exploration, production, and transportation in Norton Sound and the Chukchi Sea 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 a marine environment cannot be assessed, or even predicted, unless background data pertaining to the area are recorded 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

Figure 1. Benthic trawl stations occupied by NOAA Ship *Miller Freeman*, 2 September - 13 October, 1976.

interpretation of changes in species composition and abundance that might occur if the area becomes altered (see Nelson-Smith, 1973; Pearson, 1971, 1972; Rosenberg, 1973, for general discussions on benthic biological investigations in industrialized marine areas, and Lewis, 1970 for comments on the populations of marine species fluctuation or populations of marine species over a time span of a few to 30 or more years).

Benthic organisms (primarily the infauna, and sessile and slow-moving epifauna) are 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; and Rosenberg, 1973, for discussions on usage of benthic organisms for monitoring pollution).

Experience in pollution-prone areas of England (Smith, 1968), Scotland (Pearson, 1972), 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 any changes in species composition, diversity, abundance, and biomass. Such long-term data acquisition should make it possible to differentiate between normal ecosystem variation and pollutant-induced biological alteration. An intensive investigation of the benthos of Norton Sound and the Chukchi Sea is essential to an understanding of the trophic interactions involved there and the potential changes that may take place once oil-related activities are initiated.

The study reported here is a preliminary assessment of the benthic biology of selected invertebrate epifauna and the feeding biology of the starry flounder, *Platichthys stellatus*, of Norton Sound and the southeastern Chukchi Sea. This study is intended to extend northward the investigation of the Alaska continental shelf as part of the Outer Continental Shelf Environmental Program (OCSEAP). A quantitative assessment of the infauna of the study areas is still lacking. Specifically, this report considers the following: (1) the distribution and biomass of epifauna; (2) feeding observations on three species of sea stars and the starry flounder, *Platichthys stellatus*; *(3)* reproductive observations on five species of shrimps, eight species of crabs, and two species of sea stars; and (4) parasitological observations on two species of sea stars, and one species of hermit crab.

Relevance to Problems of Petroleum Development

The effects of oil pollution on subtidal benthic organisms have generally been neglected, although the results of a few studies, conducted after serious oil spills, have been published (see Boesch *et al.*, 1974 for review of these papers). Thus, lack of a broad data base elsewhere makes it difficult to predict the effects of oil-related activity on the subtidal benthos of the Norton Sound - Chukchi Sea - Kotzebue Sound. However, the expansion of research activities into these waters should ultimately enable *us* to identify certain species or areas that might bear closer scrutiny once industrial activity is initiated. It must be emphasized that a considerable time span is needed to comprehend fluctuations in density of marine benthic species, and it cannot be expected that a

short-term research program will result in predictive capabilities. Assessment of the environment must be conducted on a continuing basis.

Data indicating the effects of oil on most subtidal benthic invertebrates are fragmentary (Nelson-Smith, 1973), but echinoderms are "notoriously sensitive to any reduction in water quality" (Nelson-Smith, 1973). Echinoderms (ophiuroids and asteroids) are conspicuous members of the study areas (Feder *et al.*, 1977b), and could be affected by oil activities there. The sea star, *Asterias amurensis*, is the dominant epibenthic species of the shallow shelf of the Norton Sound - Chukchi Sea - Kotzebue Sound areas examined (Feder *et al.*, 1977b). Laboratory experiments have demonstrated the sensitivity of *Asterias rubens*, a species from the North Sea, to hydrocarbons when it is fed tissues contaminated with crude oil. The latter sea star, when fed *Mytilus edulis* containing low concentrations of crude oil, eventually died (Crapp, 1970). The sensitivity of *A. amurensis* to oil should also be examined experimentally. The snow crab, *Chionoecetes opilio*, is also commonly found in the study areas. Laboratory experiments with the closely related *Chionoecetes 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 C. *opilio* must be considered in future OCSEAP investigations in the Norton Sound - Chukchi Sea - Kotzebue Sound areas. Little other direct data based on laboratory experiments are available for subtidal benthic species (see Nelson-Smith, 1973). Thus, experimentation on toxic effects of oil on other common members of the subtidal benthos should be strongly encouraged for the near future in northern Alaska waters as well as for all OCSEAP areas of investigation. In addition, potential effects of the loss of sensitive species to the trophic structure of the shelf must be

examined. The latter problems can best be addressed once benthic food studies resulting from the Outer Continental Shelf program are available (e.g., see the following annual reports: Feder *et al.*, 1977a; Feder and Jewett, 1977; and Smith *et al.*, 1976).

A direct relationship between trophic structure (feeding type) and bottom stability has been demonstrated by Rhoads (see Rhoads, 1974 for review). He describes a diesel-fuel oil spill that resulted in oil becoming adsorbed on sediment particles which in turn caused *the* death of 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 substratum. Many common members of the infauna of the Norton Sound - Chukchi Sea are deposit feeders (Feder and Mueller, 1974; Feder *et al.*, 1977b; Feder and Jewett, unpub. observations); thus, oil-related mortality of these species could likewise result in a changed near-bottom sedimentary regime with alteration of species composition there. Furthermore, king and snow crabs and some bottom fishes use deposit feeders as food (Feder *et al.*, 1977a; Feder and Jewett, 1977).

III. CURRENT STATE OF KNOWLEDGE

Few studies. of benthic invertebrates have been made in the Norton Sound - Chukchi Sea - Kotzebue Sound areas. Sparks and Pereyra (1966) include a partial species list and general discussion of the benthos of the southeast Chukchi Sea. Feder and Mueller (1974) present data including species lists, population density, biomass, and feeding methods for invertebrates collected by otter trawl, van Veen grab, and dredge in Norton Sound near Nome. Ellson *et al.* (1950) present results of an exploratory fishing survey in the Nome area in 1949.

Most of the species collected in the current investigation were known; also similar species have been reported for other regions of the northeastern Bering Sea shelf by Soviet investigations (Neiman, 1960; Stoker, in prep.).

The starry flounder, *Platichthys stellatus*, occurs from southern California northward to the Gulf of Alaska, Bering Sea, extending into the Chukchi Sea and also off central Japan and Korea extending north to the Okhotsk Sea. Feeding information' for the starry flounder is available for this species from Monterey Bay, California (Orcutt, 1950) and from the San Juan Archipelago (Miller, 1967). Moiseev (1953) examined the food of coastal, small-mouthed, benthophagic flounders (a group to which *Platichthys stellatus* belongs) from the eastern coast of Russia.

IV. STUDY AREAS

The two regions examined included: (1) Norton Sound and the area north of St. Lawrence Island, and (2) the eastern Chukchi Sea south of Point Hope including Kotzebue Sound (Fig. 1). The Bering Strait arbitrarily divides the two areas. All stations were east of the U.S.-Russia Convention Line of 1867. The sampling area for the starry flounder food study reported here was divided into three general regions: the Norton Sound area, Port Clarence, and southeastern Chukchi Sea (Fig. 2).

V. SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

Data were collected in conjunction with trawling activities of the National Marine Fisheries Service on the NOAA Ship *Miller Freeman* from September 2-October 13, 1976. All collections were made with a 400-mesh

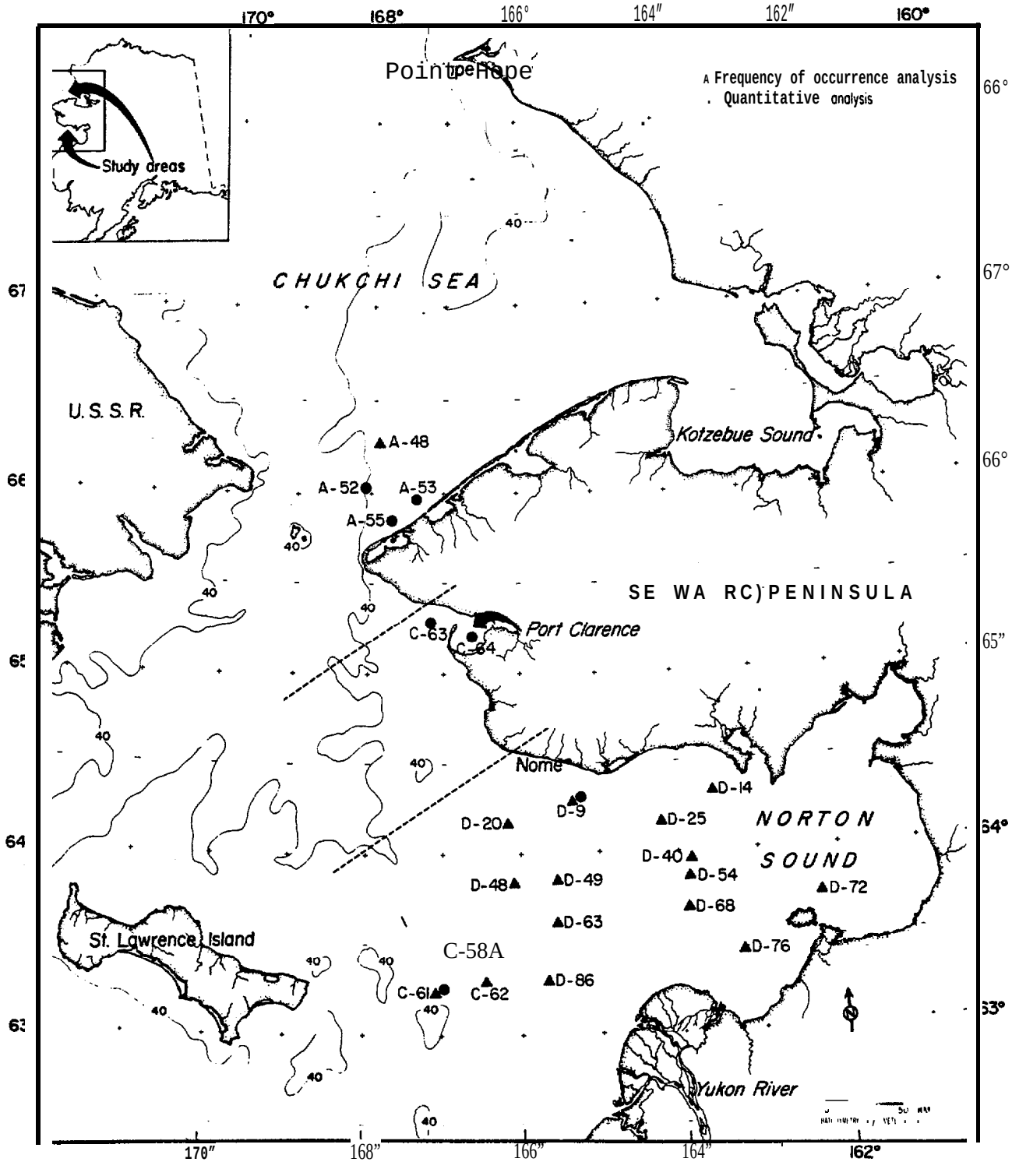

Figure 2. Sampling locations where starry flounder, *Platichthys stellatus*, digestive tracts were examined by frequency of occurrence and/or quantitative analysis. Dashed lines are arbitrarily placed to delineate the three sampling areas. See Sect. V of the text for methodology used in the starry flounder food studies.

eastern otter trawl with a 12.2 m horizontal opening; standard tows were 30 minutes.

Invertebrates, except for gastropod, were enumerated, weighed in the field, and given tentative identifications onboard ship by Institute of Marine Science personnel. The bulk of the gastropod data was collected by National Marine Fisheries Service personnel in accordance with contractual agreements. Aliquot samples and voucher specimens of all invertebrates (excluding gastropod) were preserved, and taken to the University of Alaska for positive identification. Taxonomic, distribution, abundance and biomass data were compiled in the laboratory at the University of Alaska at Fairbanks. Biomass per unit area (g/m^2) is calculated as follows: $\frac{W}{Tw\ (DxIOOO)}$; 'here '= 'eight 'grams)' Tw = width of trawl opening (meters), and (Dx1OOO) is distance fished (kilometers x 1000). The data bases for all calculations of biomass per m^2 are included with the station data submitted to the National Oceanographic Data Center (NODC).

When laboratory examination revealed more than a single species in a field identification, the counts and weights of the species in question were arbitrarily expanded from the laboratory species ratio to encompass the entire catch of the trawl.

Information on feeding, reproduction, parasites and general ecology of the invertebrates collected was recorded whenever time permitted. At a station where parasitism was evident, a sample of the host organism was examined to determine the degree of infection. In addition, feeding data on the starry flounder, *Platichthys stellatus*, was obtained.

Stations selected for starry flounder food studies were determined in the field, and were dependent upon the time available for proper pre-

servation of fish stomachs. Fish were immediately sorted, and either examined aboard ship or the digestive tracts removed and preserved in 10% buffered formalin for later examination in the laboratory in Fairbanks. The entire digestive tract, including the stomach and intestine, was examined. Each prey item was identified to the lowest taxon permitted by their state of preservation. The frequency of occurrence method of analysis, a semi-quantitative technique, was used for fish examined in the field (see Konstantinov, 1972; and Jewett, 1977, for application of this method). In the present report, since most fish were feeding, prey items are expressed as the number and percent of fish containing various food items relative to the total number of fish analyzed. Fish examined in the laboratory were analyzed using a quantitative method, i.e., frequency of occurrence in conjunction with a numerical and volumetric analysis of *gut* contents. Counts of all items and volumes of each taxon, measured by water displacement to the nearest 0.1 ml, were made. Fish examined in the field were sexed and measured (total length to the nearest 0.1 mm), and those examined in the laboratory were sexed, measured (total length), and weighed (total wet weight of fish to the nearest 0.1 g). The percent frequency of occurrence (F), the percent contribution by number (N), the percent by volume (V), and the index of relative importance (IRI) *were* calculated for each of the prey items for each station and each area. The latter index, IRI=F(N+V), was developed by Pinkas *et al.* (1971). A one way analysis of variance was used for all tests of significance on the index of relative importance (IRI).

VI. RESULTS

Distribution, Abundance and Biomass - Norton Sound Area

'The preliminary Norton Sound - Chukchi Sea - Kotzebue Sound benthic study permitted successful occupation of 106 stations in the Norton Sound area. A total of 347.98 km were fished, and the total epifaunal invertebrate biomass was 18,231.06 kg or 3.73 g/m^2. The occurrence of each species from the Norton Sound area is found in Appendix Table I.

Taxonomic analysis delineated 13 phyla, 26 classes, 89 families, 124 genera, and 187 species (Table 1). Mollusca, Arthropoda, and Echinodermata dominated in species representation with 74, 45, and 27 species respectively (Table II). These three phyla also dominated the invertebrate biomass, but in reverse order, i.e., Echinodermata (80.3% of the total biomass), Arthropoda (9.6%), and Mollusca (4.4%) (Table III).

The echinoderm families Asteridae, Gorgonocephalidae, and Strongylocentrotidae were the most abundant and important in biomass (Table IV; See App. Table 11 for percentage composition of all phyla by family). Four *sea* stars of the family Asteridae, *Asterias amurensis, Lethasterias nanimensis, Evasterias echinosoma* and *Leptasterias polaris acervata* made up 67.4% of the total invertebrate biomass (Table V; See App. Table 111 for percentage composition of all phyla by species). The basket star, *Gorgonocephalus caryi*, and the sea urchin, *Strongylocentrotus droebachiensis*, were also dominant by weight.

The sea star, *Asterias amurensis*, was distributed throughout most of Norton Sound. Stations north and northeast of St. Lawrence Island had few occurrences of this species (Fig, 3). High biomass stations were generally restricted to the inner-sound region. However, station D-20, located off

TABLE I

Species taken by trawl from the Norton Sound area onboard the NOAA Ship *Miller Freeman, 2* September-13 October, 1976

Phylum Porifera
- Class Demospongia
  - Family Axinellidae
    - *Phakellia* sp.
    - *Phakellia cribrosa* (Miklucho-Maclay)

Phylum Cnidaria
- Class Hydrozoa
  - Family Sertulariidae
    - "Unidentified species
- Class Scyphozoa
  - Unidentified species
- Class Anthozoa
  - Family Nephtheidae
    - *Eunephthya rubiformis* (Pallas)
  - Family Actinostolidae
    - *Stomphia coccinea (O.* F. Müeller)
  - Family Actinidae
    - Unidentified species

Phylum Rhynchocoela
- Unidentified species

Phylum Annelida
- Class Polychaeta
  - Family Polynoidae
    - *Arctonoe vittata* (Grube)
    - *Eunoe depressa* (Moore)
    - *Eunoe senta* (Moore)
  - Family Nereidae
    - *Nereis* sp.
  - Family Flabelligeridae
    - *Brada villosa* (Rathke)
  - Family Sternaspidae
    - *Stermaspis scutata* (Ranzani)
  - Family Pectinariidae
    - *Cistenides hyperborea* (Malmgren)
  - Family Terebellidae
    - *Terebella* sp.
  - Family Sabellidae
    - *Potamilla* sp.
    - *Jasminiera* sp.

TABLE I (Cent'd)

- Class Hirudinea
  - Family Piscicolidae
    - *Carcinobdella* sp.

Phylum Mollusca
- Class Polyplacophora
  - Family Acanthochitonidae
    - *Cryptochiton stelleri* (Middendorff)
  - Family Mopaliidae
    - *Amicula pallasii* (Middendorff)
    - *Amicula vestita* (Broderip and Sowerby)
- Class Pelecypoda
  - Family Nuculanidae
    - *Yoldia* sp.
    - *Yoldia hyperborea* (Loven)
    - *Yoldia myalis* (Couthouy)
  - Family Glycymeridae
    - *Glycymeris subobsoleta* (Carpenter)
  - Family Mytilidae
    - *Mytilus edulis* Linnaeus
    - *Musculus niger* Gray
    - *Musculus discors* (Linné)
  - Family Pectinidae
    - *Chlamys rubida* (Hinds)
  - Family Astartidae
    - *Astarte borealis* (Schumacher)
    - *Astarte montagui* (Dillwyn)
  - Family Carditidae
    - *Cyclocardia crebricostata* (Krause)
    - *Cyclocardia crassidens* (Broderip and Sowerby)
  - Family Kelliidae
    - *Pseudopythina* sp.
  - Family Cardiidae
    - *Clinocardium* sp.
    - *Clinocardium ciliatum* (Fabricius)
    - *Clinocardium nuttallii* (Conrad)
    - *Clinocardium californiense* Deshayes
    - *Serripes groenlandicus* (Bruquière)
  - Family Veneridae
    - *Liocyma fluctuosa* (Gould)
  - Family Mactridae
    - *Spisula polynyma* (Stimpson)

TABLE I (Control)

Family Tellinidae
Macoma sp.
Macoma calcarea (Gmelin)
Macoma brota Dall
Tellina lutea Wood

Family Myidae
Mya pseudoarenaria Schlesch

Family Hiatellidae
Hiatella arctica (Linné)
Panomya arctica (Lamarck)

Class Gastropod
Family Trochidae
Margaritas giganteus (Leche)
Solariella sp.
Solariella obscura (Couthouy)
Solariella varicosa (Mighels and Adams)

Family Turritellidae
Tachyrhynchus erosus (Couthouy)

Family Epitoniidae
Opalia sp.

Family Trichotropididae
Trichotropis bicarinata (Sowerby)
Trichotropis insignis Middendorff
Trichotropis kroyeri Philippi

Family Naticidae
Natica clausa Broderip and Sowerby
Polinices pallida (Broderip and Sowerby)

Family Velutinidae
Velutina sp.
Velutina plicatilis (Müller)

Family Muricidae
Boreotrophon clathratus (Linnaeus)

Family Buccinidae
Buccinum sp.
Buccinum angulosum Gray
Buccinum scalariforme Möller
Buccinum glaciale Linnaeus
Buccinum solenum Dan
Buccinum polare Gray
Buccinum fringillum Dall
Buccinum tenellum Dall

TABLE I (Cent'cl)

Family Neptuneidae
Ancistrolepsis sp.
Beringius crebricostatus Dan
Beringius beringii (Middendorff)
Beringius stimpsoni (Gould)
Colus spitzbergensis (Reeve)
Colus ombronius (Dan)
Colus hypolispus (Dan)
Liomesus ooides (Middendorff)
Neptunea ventricosa (Gmelin)
Neptunea borealis (Philippi)
Neptunea heros (Gray)
Plicifusus kroyeri (Möller)
Plicifusus verkruzeni Kobelt
Pyrulofusus deformis (Reeve)
Volutopsius Sp.
Volutopsius filosus Dall
Volutopsius fragilis Dan

Family Turridae
Oenopota harpa (Dan)
Obesitoma simplex (Middendorff)

Family Doridídae
Doris sp.

Family Dendronotidae
Dendronotus sp.

Class Cephalopoda
Family Octopodidae
octopus Sp.

Phylum Arthropoda
Class Pycnogonida
Unidentified species

Class Crustacea
Order Thoracica
Family Balanidae
Balanus sp.
Balanus balanus (Linné)
Balanus rostratus Pilsbry

Order Cumacea
Unidentified species

Order Isopoda
Family Idoteidae
Saduria entomon (Linnaeus)
Synidotea bicuspida (Owen)

Family Sphaeromatidae
Tecticeps sp.

TABLE I (Cent'd)

Order Amphipoda
- Family Ampeliscidae
  - Unidentified species
- Family Eusiridae
  - *Eusirus* sp.
  - *Rhachotropis* sp.
- Family Gammaridae
  - *Melita* sp.
  - *Melita dentata* Kröyer
- Family Ischyroceridae
  - *Jassa* sp.
- Family Lysianassidae
  - *Anonyx* sp.
  - *Anonyx nugax pacifica* Kröyer
  - *Anonyx ampulloides* Bate
  - *Socarnes* Sp.
- Family Podoceridae
  - *Dulichia spinosissima*
- Family Stegocephalidae
  - *Stegocephalus inflatus* Kröyer
- Family Hyperiidae
  - *Parathemisto japonica* Bovallius
- Family Caprellidae
  - Unidentified species

Order Decapoda
- Family Pandalidae
  - *Pandalus borealis* Kröyer
  - *Pandalus goniurus* Stimpson
  - *Pandalus hypsinotus* Brandt
- Family Hyppolytidae
  - *Lebbeus groenlandica* (Fabricius)
  - *Eualus* sp.
  - *Eualus fabricii* (Kröyer)
  - *Eualus gaimardii belcheri* (Bell)
  - *Eualus macilenta* (Kröyer)
- Family Crangonidae
  - *Crangon dalli* Rathbun
  - *Sclerocrangon boreas* (Phipps)
  - *Argis lar* (Owen)

TABLE I (Cent'd)

Family Paguridae
Pagurus ochotensis (Benedict)
Pagurus capillatus (Benedict)
Pagurus trigonocheirus (Stimpson)
Pagurus dalli (Benedict)
Labidochirus splendescens (Owen)

Family Lithodidae
Hapalogaster grebnitzkii Schalfeew
Paralithodes camtschatica (Tilesius)
Paralithodes platypus Brandt
Sculptolithodes derjugini Makarov

Family Majidae
Hyas coarctatus alutaceus Brandt
Chionoecetes opilio (Fabricius)

Family Atelecyclidae
Telmessus cheiragonus (Tilesius)

Phylum Sipunculida
Family Golfingiidae
Golfingia margaritacea (M. Sars)

Phylum Echiurida
Class Echiuridea
Family Echiuridae
Echiurus echiurus alaskensis Pallas

Phylum Priapulida
Family Priapulidae
Priapulus caudatus Lamarck

Phylum Ectoprocta
Class Cheilostomata
Family Flustridae
Flustra sp.

Family Bicellariellidae
Dendrobeania sp.

Class Cyclostomata
Family Diastoporidae
Diaperoecia sp.

Family Heteroporidae
Heteropora sp.

Class Ctenostomata
Family Alcyonidiidae
Alcyonidium sp.
Alcyonidium disciforme Smitt
Alcyonidium vermiculare Okada

TABLE I (Cent'd)

Family Flustrellidae
Flustrella gigantea Silen

Phylum Brachiopoda
Class Articulate
Family Dallinidae
Laqueus californianus Koch

Phylum Echinodermata
Class Asteroidea
Family Echinasteridae
Henricia sp.

Family Pterasteridae
Pteraster obscura (Perrier)

Family Solasteridae
Crossaster papposus (Linné)
Solaster sp.
Solaster damson< (Verrill)

Family Asteriidae
Asterias amurensis Lükten
Asterias rathbuni (Verrill)
Evasterias echinosoma Fisher
Evasterias troschellii (Stimpson)
Leptasterias sp.
Leptasterias alaskensis Fisher
Leptasterias polaris acervata Stimpson
Lethasterias sp.
Lethasterias nanimensis (Verrill)

Class Echinoidea
Family Echinarachniidae
Echinarachnius parma Lamarck

Family Strongylocentrotidae
Strongylocentrotus droebachiensis (O. F. Müller)

Class Ophiuroidea
Family Amphiuridae
Amphiodia sp.
Diamphiodia craterodmeta (Clark)

Family Gorgonocephalidae
Gorgonocephalus caryi (Lyman)

Family Ophiactidae
Ophiopholis aculeata (Linné)

Family Ophiuridae
Ophiura sarsi Lükten
Stegophiura sp.
Stegophiura nodosa Lükten

TABLE I (Cent'd)

Class Holothuroidea
Family Cucumariidae
Cucumaria sp.
Cucumaria calcigera (Stimpson)

Family Psolidae
Psolus japonicus Öestergren

Phylum Chordata
Subphylum Urochordata
Class Ascidiacea
Family Rhodosomatidae
Chelyosoma Sp.
Chelyosoma columbianum Huntsman
Chelyosoma orientale Redikorzev

Family Styelidae
Styela macrenteron Ritter
Pelonaia corrugata Forbes and Goods

Family Pyuridae
Boltenia ovifera (Linné)
Boltenia echinata Linné
Halocynthia sp.
Halocynthia aurantium (Pallas)

Class Thaliacea
Family Salpidae
Unidentified species

TABLE II

Number and percent of epifaunal invertebrate species by phylum and class from the Norton Sound area

Phylum	Class	No. of Species	% of Species
Porifera	Demospongia	2	1.08
Cnidaria	Hydrozoa	1	0.54
	Scyphozoa	1	0.54
	Anthozoa	3	1.61
	Totals	5	2.69
Rhynchocoela	Unidentified	1	0.54
Annelida	Polychaeta	10	5.38
	Hirudinea	1	0.54
	Totals	ii-	5.92
Mollusca	Polyplacophora	3	1.61
	Pelecypoda	27	14.52
	Gastropod	43	23.12
	Cephalopod	1	0.54
	Totals	74	39.79
Arthropods	Pycnogonida	1	0.54
	Crustacea	44	23.12
	Totals	45	23.66
Sipunculida		1	0.54
Echiurida	Echiuridea	1	0.54
Priapulida		1	0.54
Ectoprocta	Cheilostomata	2	1.08
	Cyclostomata	2	1.08
	Ctenostomata	5	2.69
	Totals	9	4.85
Brachiopoda	Articulata	1	0.54
Echinodermata	Asteroidea	14	7.53
	Echinoidea	2	1.08
	Ophiuroidea	8	4.30
	Holothuroidea	3	1.61
	Totals	27	14.52
Chordata	Ascidiacea	9	4.84
	Thaliacea	1	0.54
	Totals	10	5.38
	Grand Totals	186	100.00

TABLE III

Number, weight, and biomass (g/m^2) of the invertebrate phyla of the Norton Sound area (N.S.) and Chukchi Sea - Kotzebue Sound area (C.S.)

Phylum	Number of organisms		Weight (kg)		% Total wt.		g/m^2	
	N.S.	C.S.	N.S.	C.S.	N.S.	C.S.	N.S.	C.S.
Porifera	764	777	74.01	73.49	0.41	0.76	0.015	0.025
Cnidaria	24485	9488	782.56	426.55	4.29	4.44	0.160	0.146
Rhynchocoela	7	5	0.01	0.06	<.01	<.01	<.001	<.001
Annelida	1090	7282	4.72	14.53	0.03	0.15	0.001	0.005
Mollusca	8788	16489	794.86	1230.00	4.36	12.79	0.162	0.411
Arthropoda (Crustacea)	68510	66530	1756.44	1204.27	9.63	12.52	0.359	0.411
Sipunculida	3	*10*	0.04	0.24	cool	<.01	<.001	<.001
Echiuroidea	9	31	0.19	0.82	<.01	<.01	<.001	<.001
Ectoprocta	65	65	6.03	11.25	0.03	0.12	0.001	0.004
Priapulida	1		<.01		<.01	-	<.001	-
Brachiopoda	2		<.01		<.01	-	<.001	-
Echinodermata	93206	*60720*	14632.83	5763.55	80.26	59.93	2.994	1.967
Chordata (Ascidiacea)	7366	*41814*	179.35	892.45	0.98	9.28	0.036	0.304
TOTALS	204296	203211	8231.06	9617.21	100%	100%	3.73	3.28

TABLE IV

Number, weight, and biomass (g/m*) of major invertebrate families of the Norton Sound area (N.S.) and Chukchi Sea - Kotzebue Sound area (C.S.)

Phylum	Number of organisms		Weight (kg)		% Total wt.		g/m^2	
	N.S.	C.S.	N.S.	C.S.	N.S.	C.S.	N.S.	C.S."
Actiniidae	21498	7663	540.05	238.81	2.94	2.47	0.110	0.082
Neptuneidae	6495	12563	735.19	1176.40	4.00	12.18	0.150	0.405
Crangonidae	22568	15772	159.74	100.30	0.87	1.03	0.032	0.034
Paguridae	24420	21106	336.88	317.57	1.83	3.28	0.068	0.109
Lithodidae	1046	20	773.81	6.87	4.21	0.07	0.158	0.002
Maj idae	6264	25553	245.54	682.13	1.33	7.06	0.050	0.234
Atelecyclidae	1116	674	150.62	89.50	0.82	0.92	0.030	0.030
Asteridae	70866	28682	12669.50	4640.09	69.04	48.04	2.592	1.597
Strongylo-centrotidae	9572	8794	610.58	616.15	3.327	6.37	0.124	0.212
Gorgono-cephalidae	5218	1285	1281.55	331.81	6.98	4.43	0.262	0.114
Rhodosomatidae	146	15481	3.72	466.46	0.02	4.83	0.001	0.160
Styelidae	5541	5822	139.62	198.73	0.76	2.05	0.028	0.068
Pyuridae	1469	19018	33.01	219.69	0.18	2.27	0.006	0.075
TOTALS	176219	162433	17679.81	9084.51.	96.31	94.00	3.61	3.12

TABLE V

Percentage composition by weight and the feeding methods[1] of the leading invertebrate species collected in the Norton Sound area

Phylum	% wt. of all phyla	Leading Species	Feeding Method[2]	Avg. wt. per Individual	% wt. of phylum	% wt. of all phyla
Echinodermata	80.30	*Asterias amurensis*	P	178 g	68.29	54.46
		Gorgonocephalus caryi	SUS-P	246 g	8.76	6.98
		Lethasterias nanimensis	P	311 g	7.06	5.63
		Evasterias echinosoma	P	692 g	4.93	3.93
		Leptasterias polaris acervata	P	106 g	4.23	3.37
		Strongylocentrotus droebachiensis	H-S-P	64 g	4.17	3.33
		Totals			97.44	77.70
Arthropoda (Crustacea)	9.59	*Paralithodes camtschatica*	P-S	801 g	41.90	3.99
		Hyas coarctatus alutaceus	P-S ?	49 g	10.53	1.00
		Pagurus trigonocheirus	P-S ?	15 g	10.02	0.95
		Telmessus cheiragonus	P-S ?	135 g	8.62	0.82
		Pagurus capillatus	P-S ?	12 g	6.14	0.58
		Argis lar	S ?	7 g	5.66	0.54
		Totals			82.87	7.88
Mollusca	4.36	*Neptunea heros*	P-S	130 g	69.57	3.01
		Neptunea ventricosa	P-S	80 g	11.17	0.48
		Beringius beringi	P-S	90 g	6.00	0.26
		Serripes groenlandicus	Sus	38 g	5.43	0.24
Total	94.25	Totals			92.17	3.99

[1] Based on Hatanaka and Kosaka, 1958; Reese, 1966; Pearce and Thorson, 1967; Feder et al., 1977b; and pers. observation. Feeding methods for related species are included when no direct data are available for species included above.

[2] Feeding methods: P = predator; P-S = predator-scavenger; S = scavenger; Sus = suspension feeder; Sus-P = suspension feeder-predator; H-S-P = herbivore-scavenger-predator.

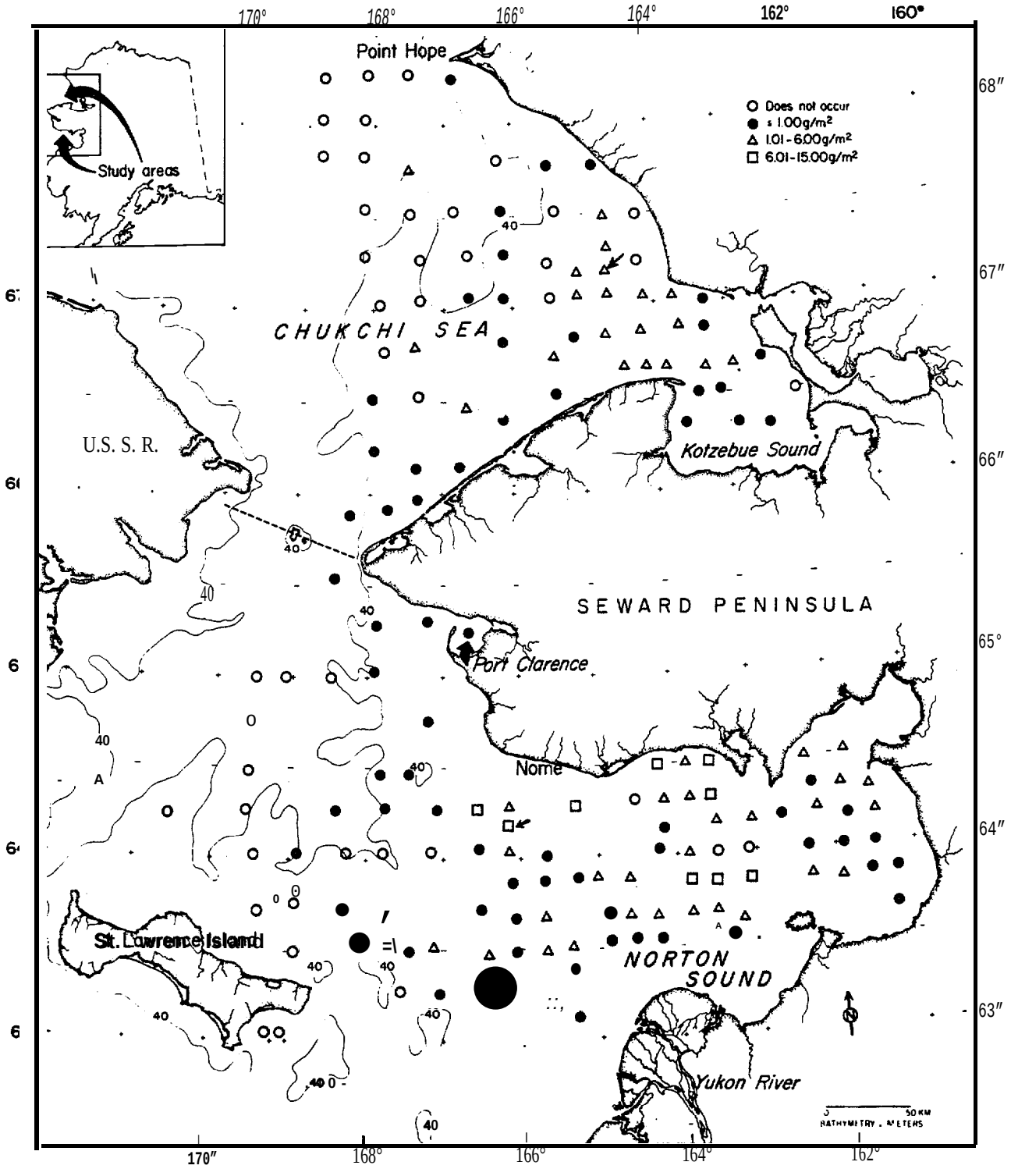

Figure 3. Distribution and biomass of the sea star, *Asterias amurensis*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 14.95 g/m^2 for Norton Sound area station D-20, and 5.98 g/m^2 for Chukchi Sea - Kotzebue Sound area station B-4.

Nome, had the highest biomass with 539.80 kg per standard tow or 14.95 g/m^2 (Fig. 3). Slightly less than 2500 specimens were taken at this station.

Lethasterias nanimensis occurred mainly in the northern half of Norton Sound (Fig. 4). This species was absent from stations north of St. Lawrence Island. Station D-7, also located off Nome, had the highest biomass with 85.58 kg per standard tow or 2.52 g/m^2 (Fig. 4).

Evasterias echinosoma, the largest sea star found on the survey (average wet weight of 692 g), and *L. nanimensis* were found at similar stations and attained similar biomasses at these stations (Fig. 5). Likewise, station D-7 also had the highest biomass of *E. echinosoma* with 136.20 kg per standard tow or 4.02 g/m^2 (Fig. 5).

Leptasterias polaris acervata had a different distributional pattern from the other sea stars. This species occurred mainly at those stations north and northeast of St. Lawrence Island (Fig. 6). However, station C-32, another station located off Nome, had the highest biomass with 322.03 kg per standard tow or 6.79 g/m^2 (Fig. 6).

The basket star, *Gorgonocephalus caryi*, was more restricted in its distribution, i.e., most stations of occurrence were in outer Norton Sound (Fig. 7). Station C-1, off Cape Prince of Wales near Bering Strait, had the highest biomass: 671.65 kg per standard tow or 14.88 g/m^2 (Fig. 7). Over 2000 basket stars were obtained at this station.

Another echinoderm, *Strongylocentrotus droebachiensis*, also contributed significantly to the overall biomass. High biomass stations were mainly in inner Norton Sound; however, station C-32 had the highest biomass: 224.42 kg per standard tow or 4.73 g/m^2 (Fig. 8).

Crabs dominated the arthopod biomass with 86.3% of the weight of the phylum, but they only comprised 8.25% of the total invertebrate biomass

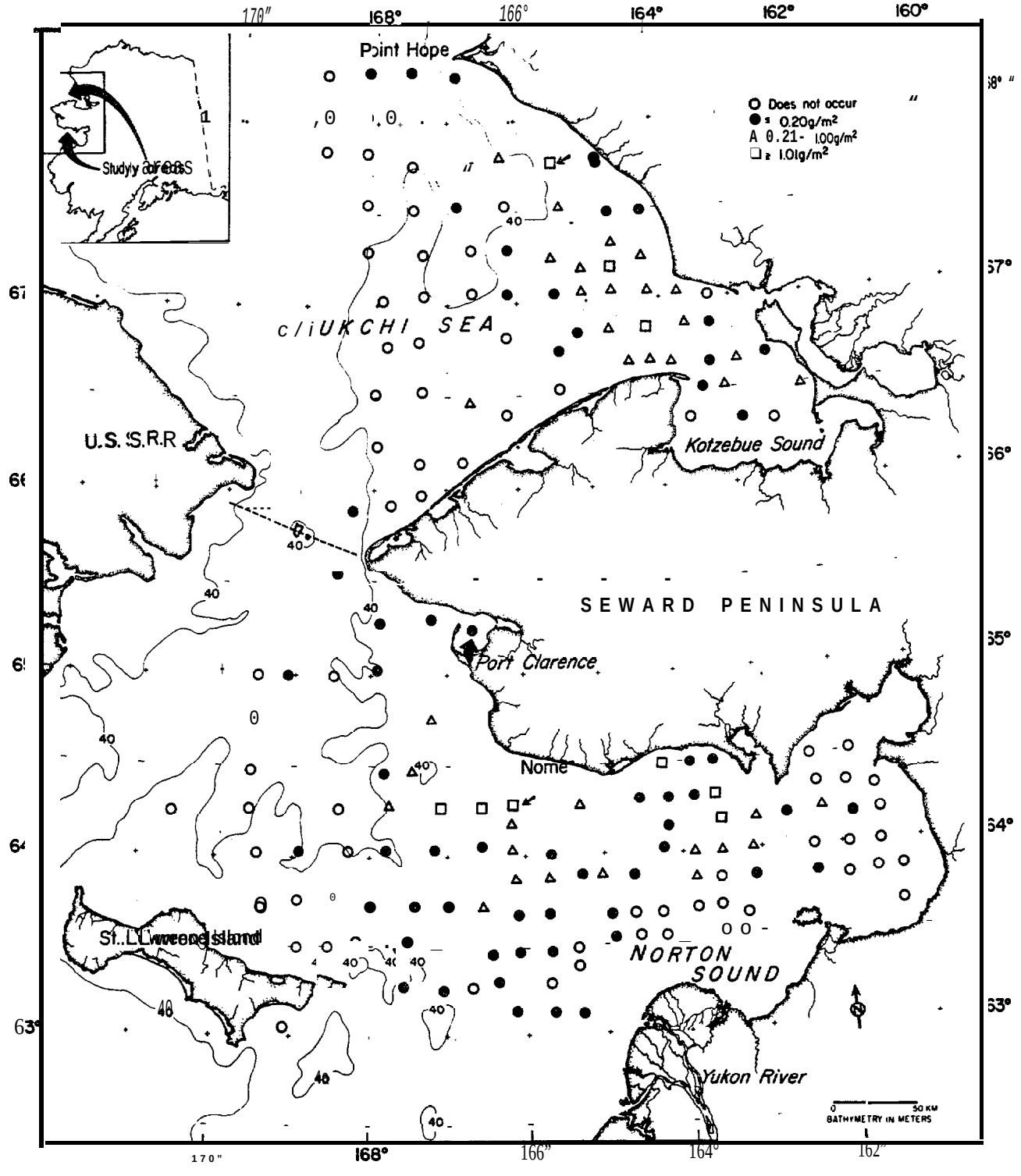

Figure 4. Distribution and biomass of the sea star, *Lethasterias nanimensis* from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 2.52 g/m^2 for Norton Sound area station D-7 and 2.45 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-14.

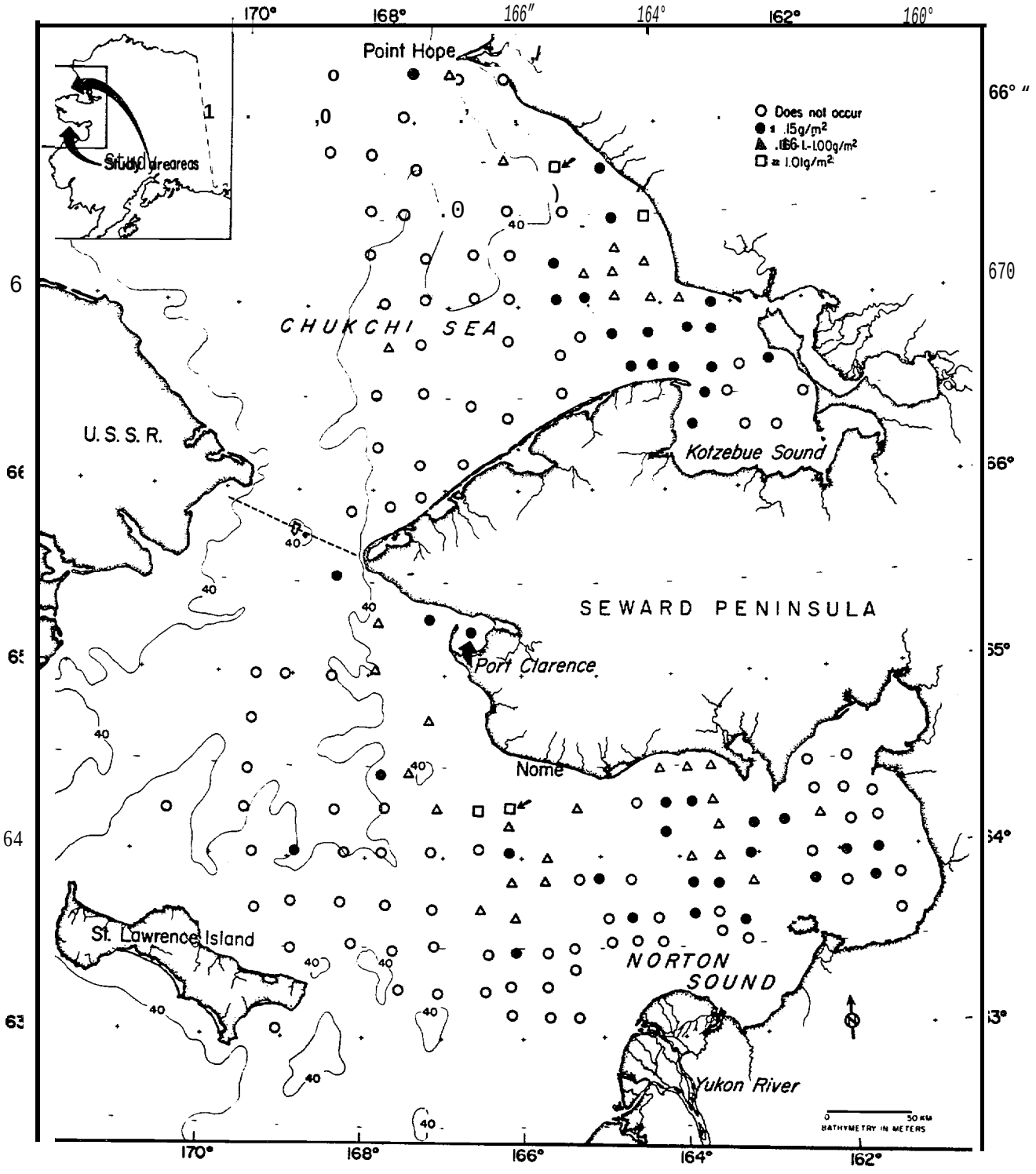

Figure 5. Distribution and biomass of the sea star, *Evasterias echinosoma* from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas Small arrows indicate highest biomass stations from the resDec-tive areas, i.e., 4.02 g/m^2 for Norton Sound area station 0-7 and 3.03 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-14.

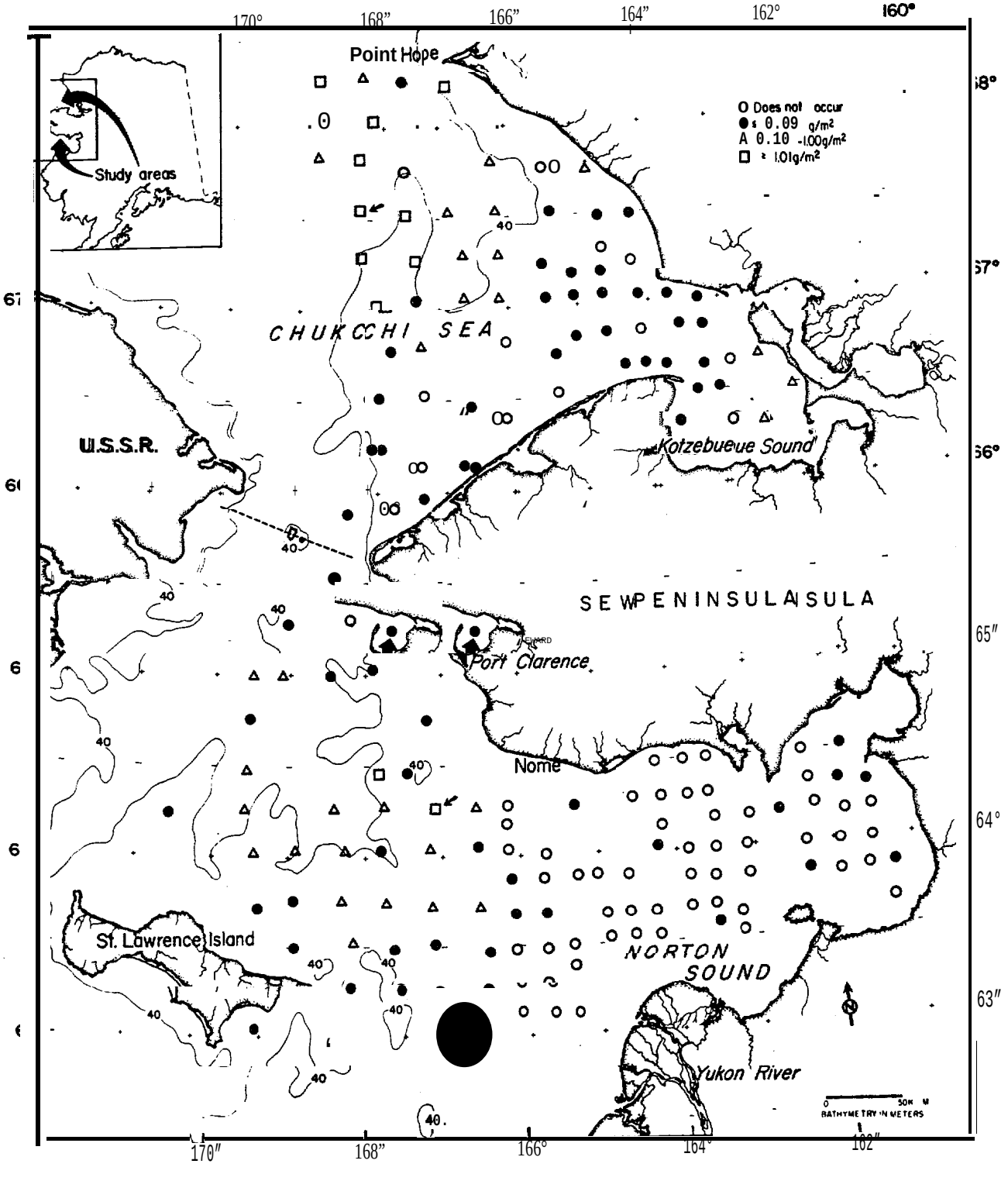

Figure 6. Distribution and biomass of the sea star, *Leptasterias polaris acervata*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 6.48 g/m^2 for Norton Sound station area C-32 and 7.48 g/m^2 for Chukchi Sea - Kotzebue Sound area station B-4.

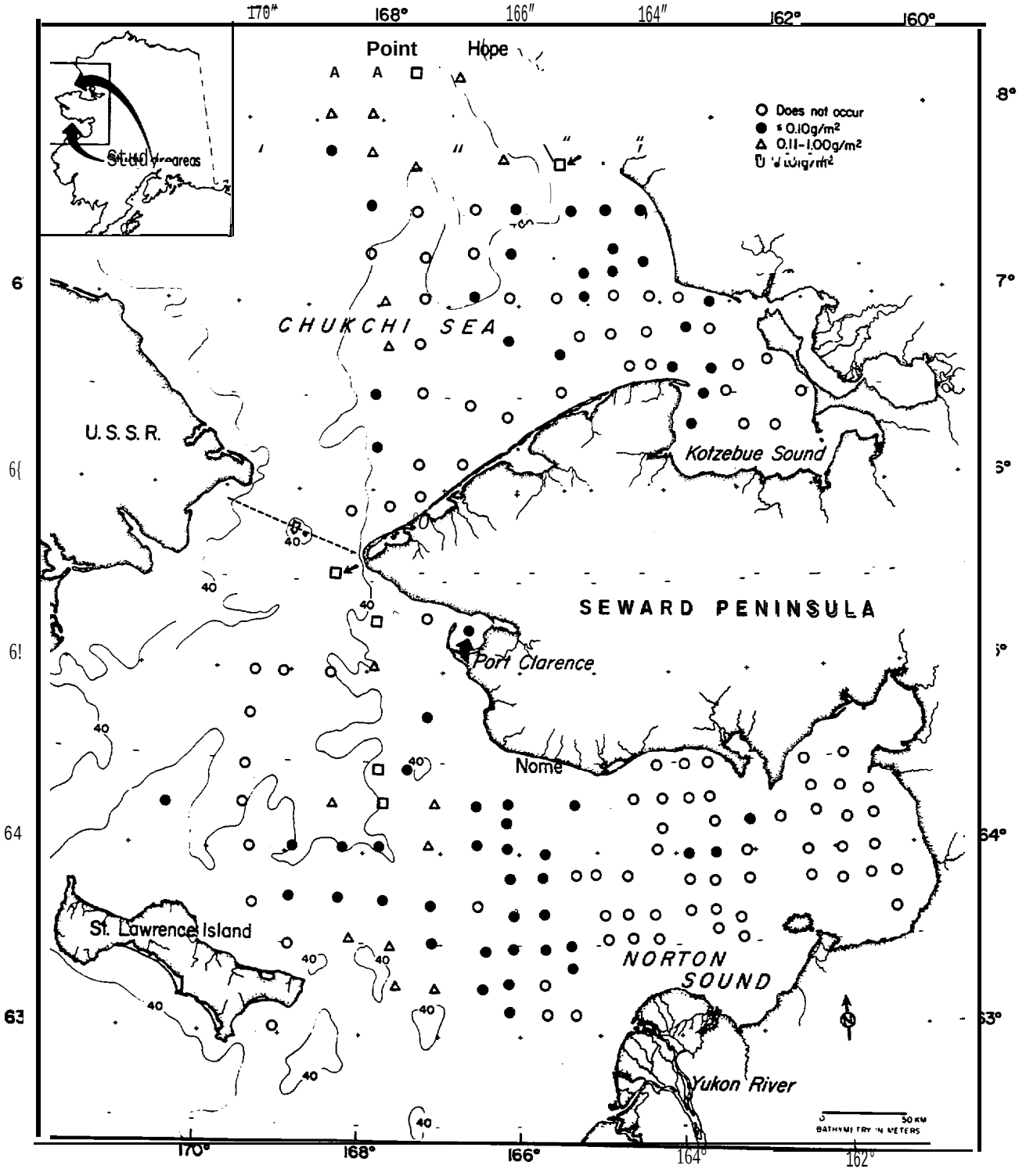

Figure 7. Distribution and biomass of the basket star, *Gorgonocephalus caryi*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 14.88 g/m^2 for Norton Sound area station C-1 and 2.59 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-14.

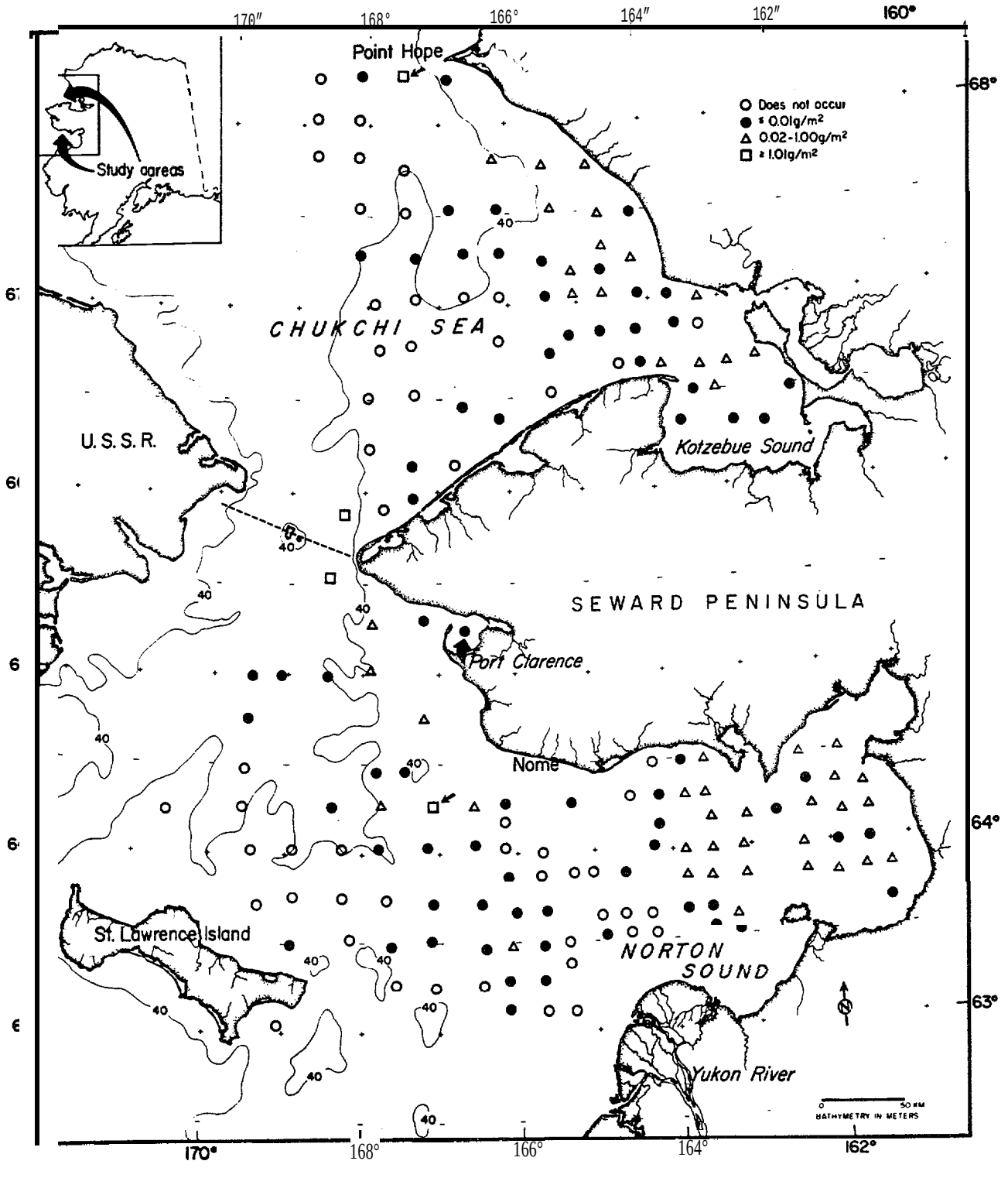

Figure 8. Distribution and biomass of the sea urchin, *Strongylocentro tus droebachiensis*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 4.73 g/m² for Norton Sound area station C-32 and 6.45 g/m² for Chukchi Sea - Kotzebue Sound area station A-2.

(see App. Table III for data base). The red king crab, *Paralithodes camtschatica*, occurred in less than half of the Norton Sound area stations. The distribution of this large crab (average weight of 801 g) was confined to the inner and mid portions of the Sound. The station with the highest biomass was D-9: 89.66 kg per standard tow or 2.14 g/m^2 (Fig. 9). However, only 34 king crabs were caught here.

Other crabs which also contributed considerably to the crustacean biomass were the spider crab, *Hyas coarctatus alutaceus*, the hermit crabs, *Pagurus trigonocheirus* and *P. capillatus*, and the crab of the family Atelecyclidae, *Telmessus cheiragonus*. The distribution and biomass of these species are shown in Figures 10-13 respectively.

The snow crab, *Chionoecetes opilio*, contributed little to the overall crustacean biomass (Fig. 14).

Shrimps contributed less than 10% of the arthropod biomass and less than 1% of the total invertebrate biomass (See App. Table III for data base). The crangonid, *Argis lar*, was the dominent shrimp and was widely distributed (Fig. 15).

The most common mollusc was the gastropod, *Neptunea heros*. This gastropod was widely dispersed throughout the Norton Sound area, and the station with the highest biomass was D-14 with 142.13 kg per standard tow or 1.10 g/m^2 (Fig. 16). Distribution and biomass maps for other common gastropod, *Beringius beringi* and *Neptunea ventricosa*, and the pelecypod, *Serripes groenlandicus*, are shown in Figures 17-19 respectively.

Distribution, Abundance and Biomass - Chukchi Sea - Kotzebue Sound area

The preliminary trawl survey of the Chukchi Sea - Kotzebue Sound area permitted the successful occupation of 70 stations. The total epifaunal

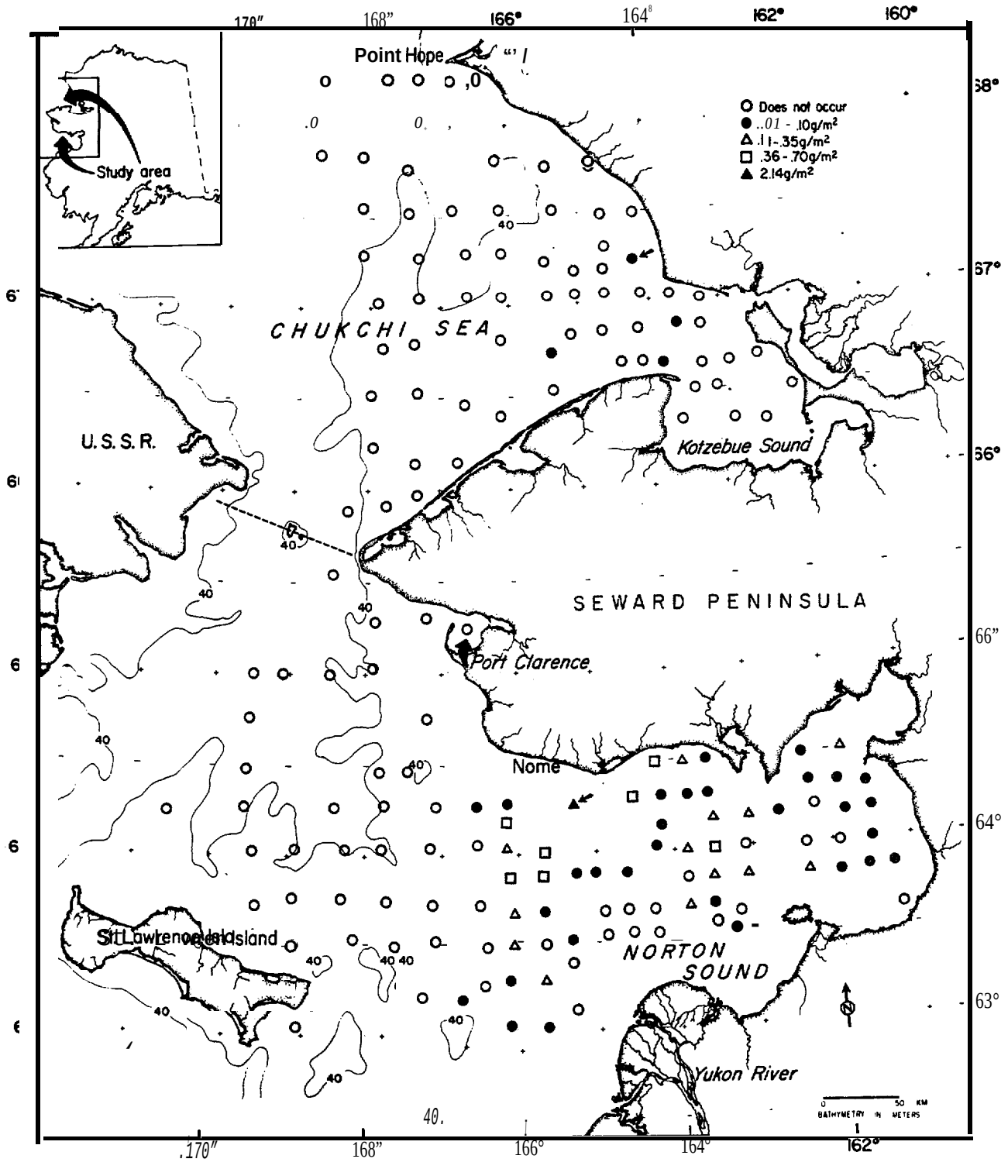

Figure 9. Distribution and biomass of the red king crab, *Paralithodes camtschatica*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 2.14 g/m^2 for Norton Sound area station D-9 and 0.03 g/m^2 for Chukchi Sea - Kotzebue Sound area station B-5.

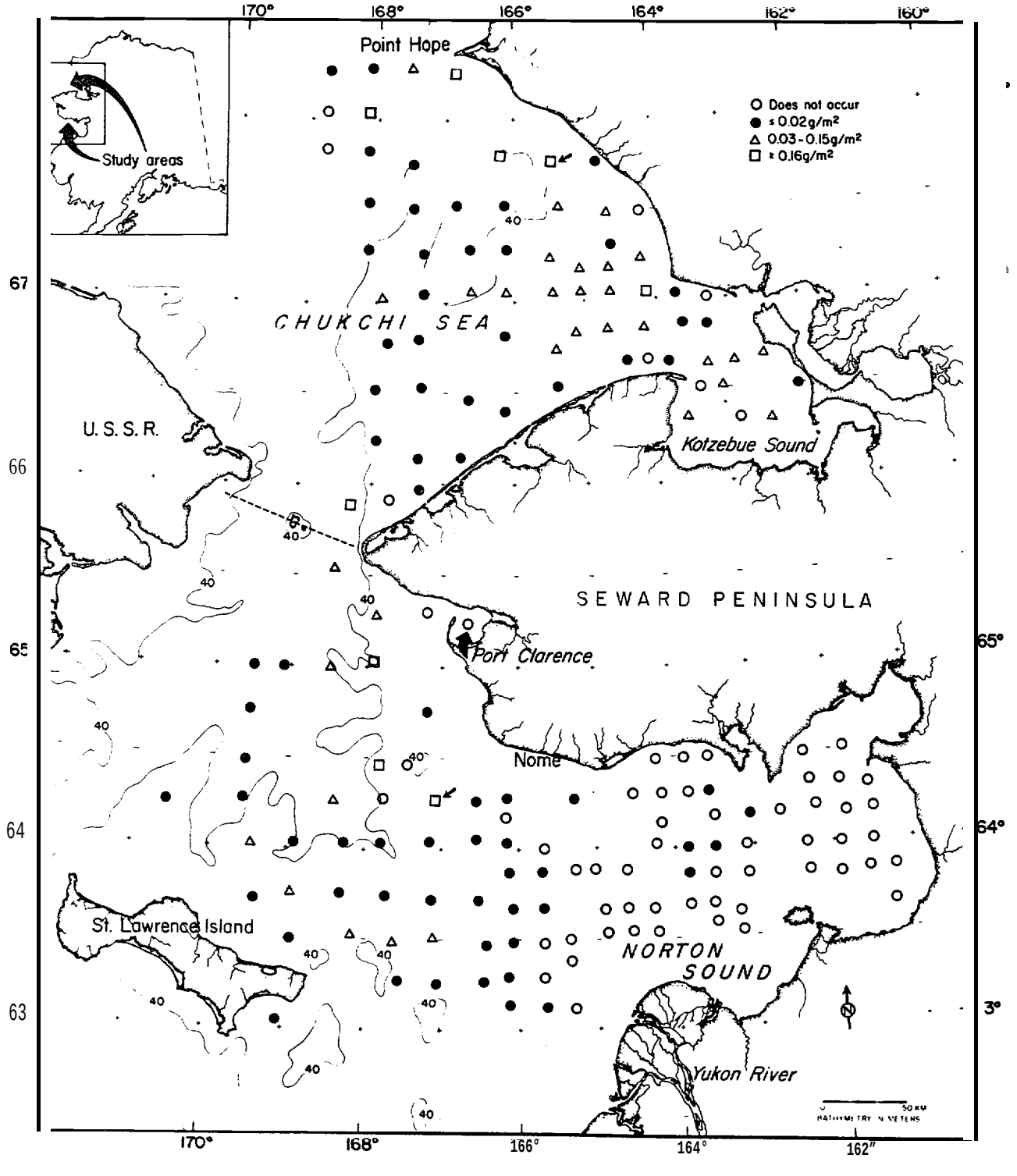

Figure 10. Distribution and biomass of the crab, *Hyas coarctatus alutaceus*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 2.57 g/m^2 for Norton Sound area station C-32 and 0.95 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-14.

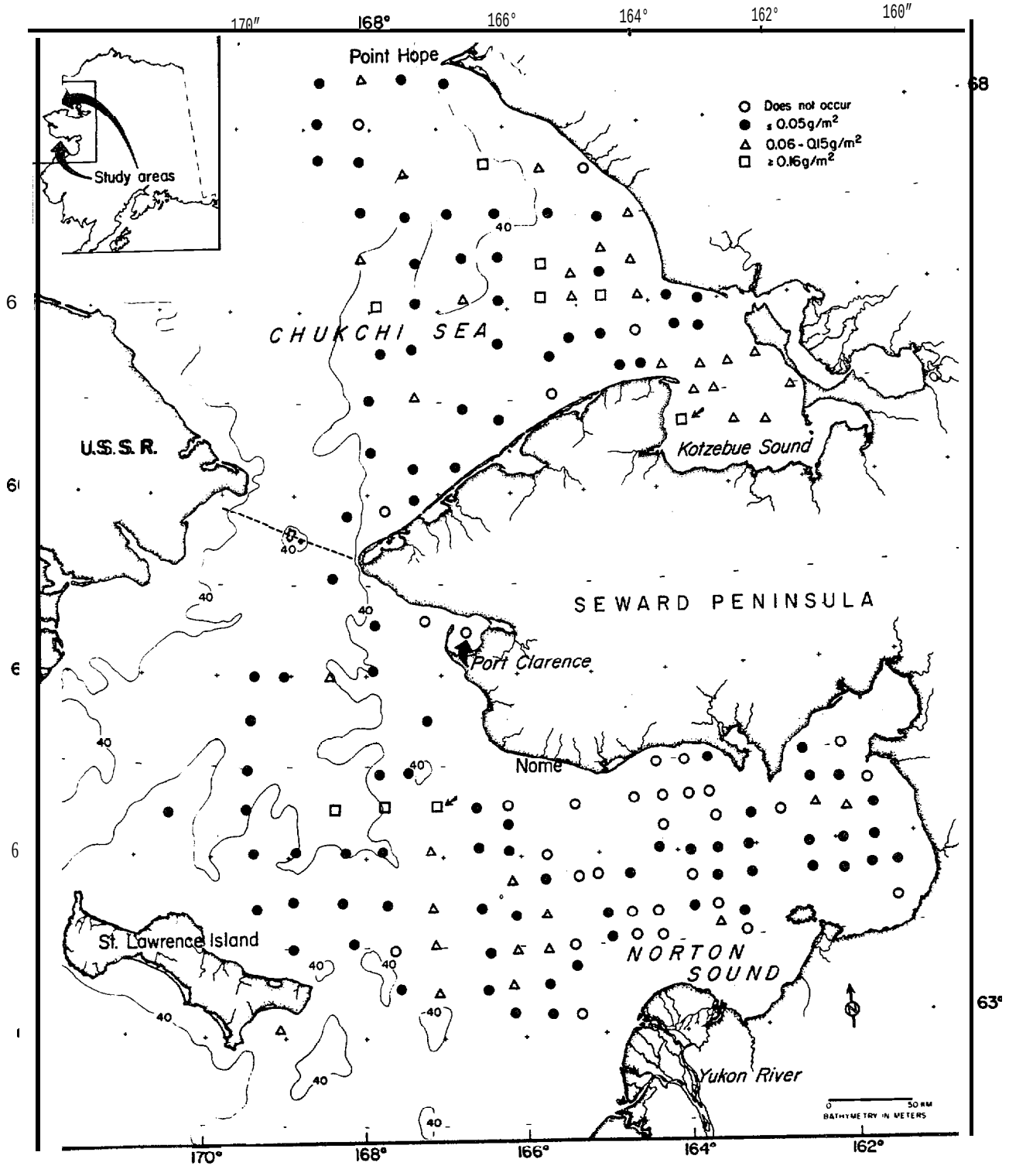

Figure 11. Distribution and biomass of the hermit crab, *Pagurus trigonocheirus*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 1.38 g/m^2 for Norton Sound area station C-32 and 0.64 g/m^2 for Chukchi Sea - Kotzebue Sound area station B-27.

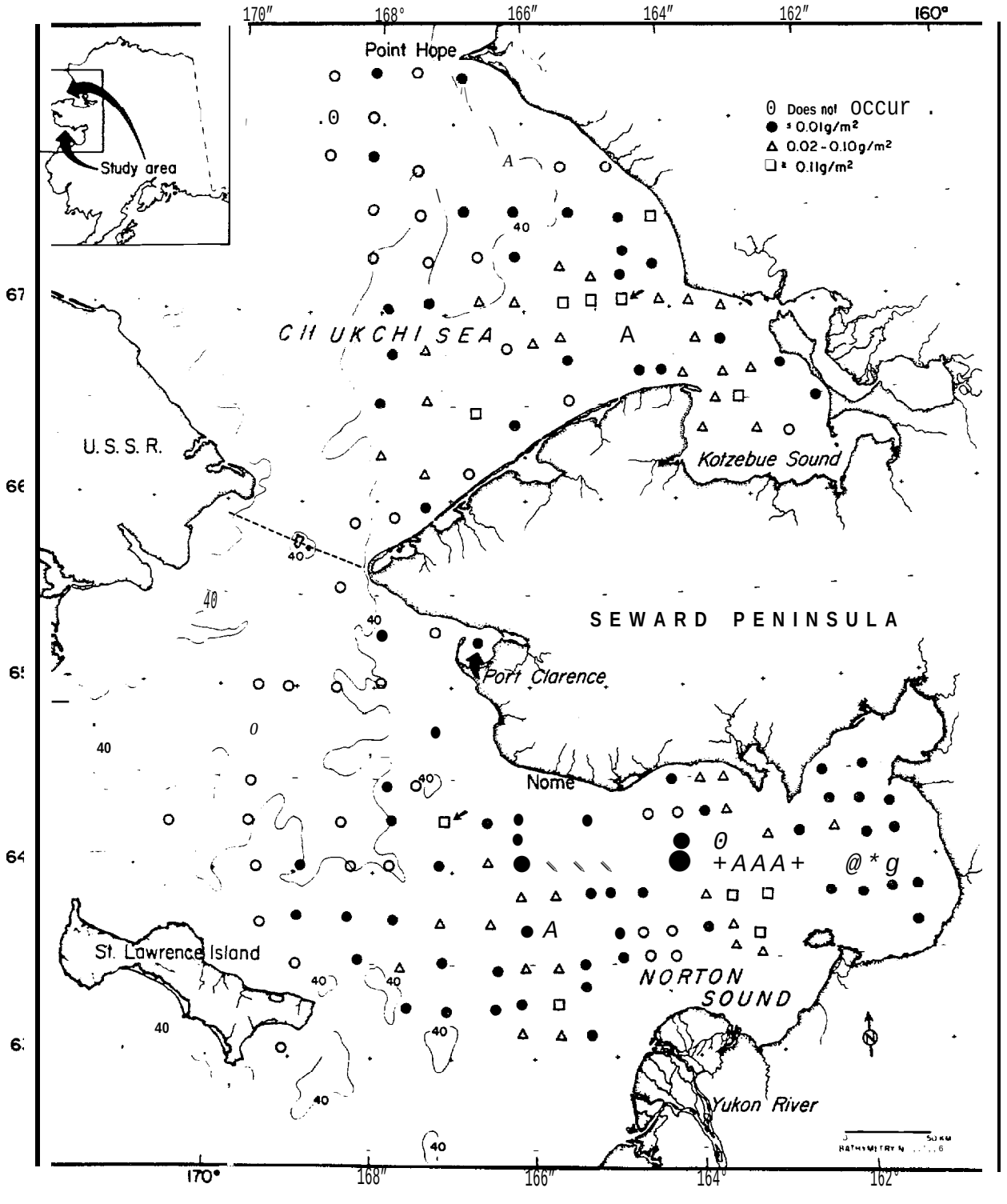

Figure 1.?. Distribution and biomass of the hermit crab, *Pagurus cavillatus* from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 0.41 g/m^2 for Norton Sound area station C-32 and 0.28 g/m^2 for Chukchi Sea - Kotzebue Sound area station B-7.

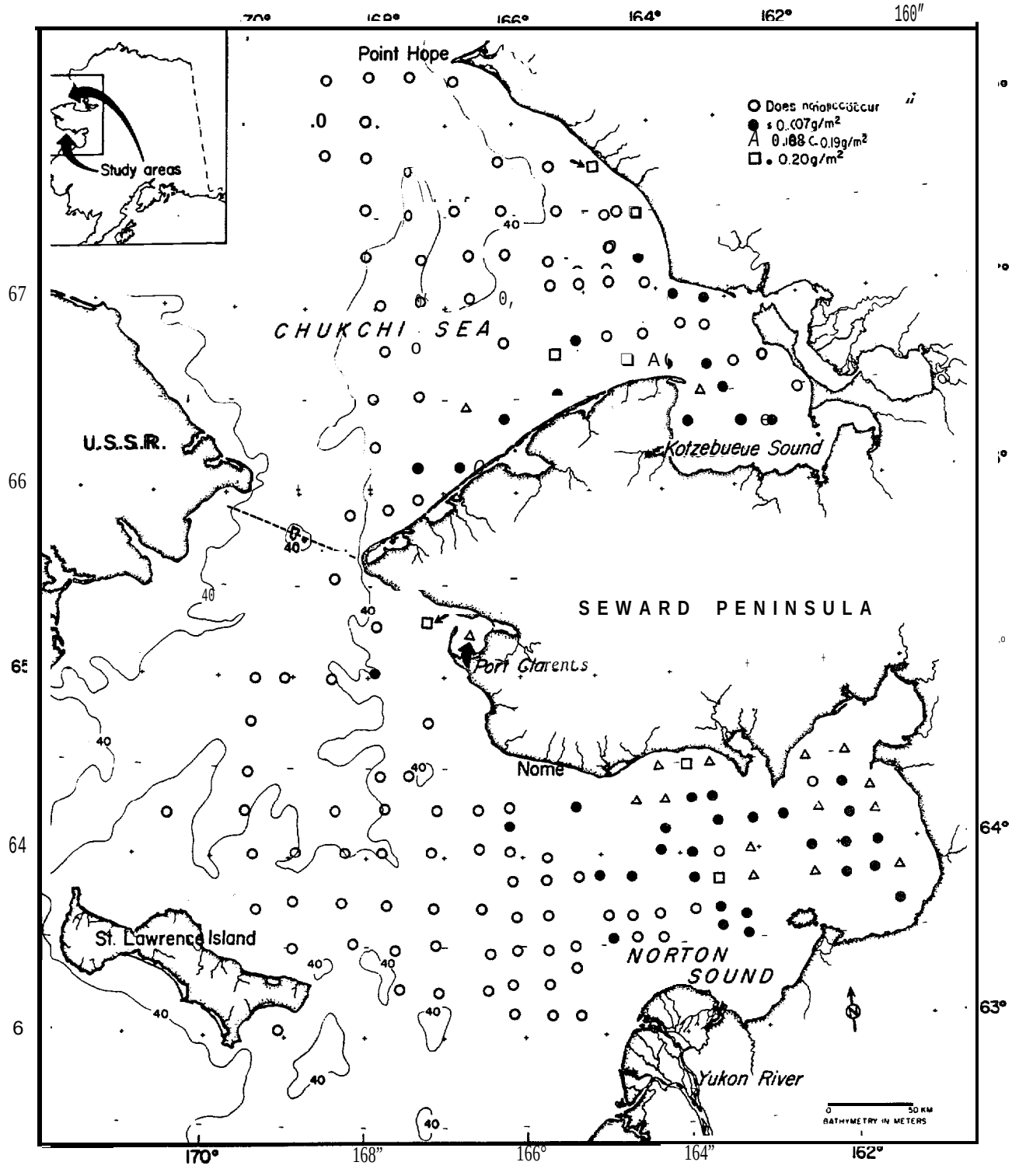

Figure 13. Distribution and biomass of the crab, *Telmessus cheiragonus*, from the Norton Sound. Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate-highest biomass stations from the respective areas, i.e., 0.39 g/m^2 for Norton Sound area station C-63 and 1.00 g/m^2 Chukchi Sea - Kotzebue Sound area station A-15.

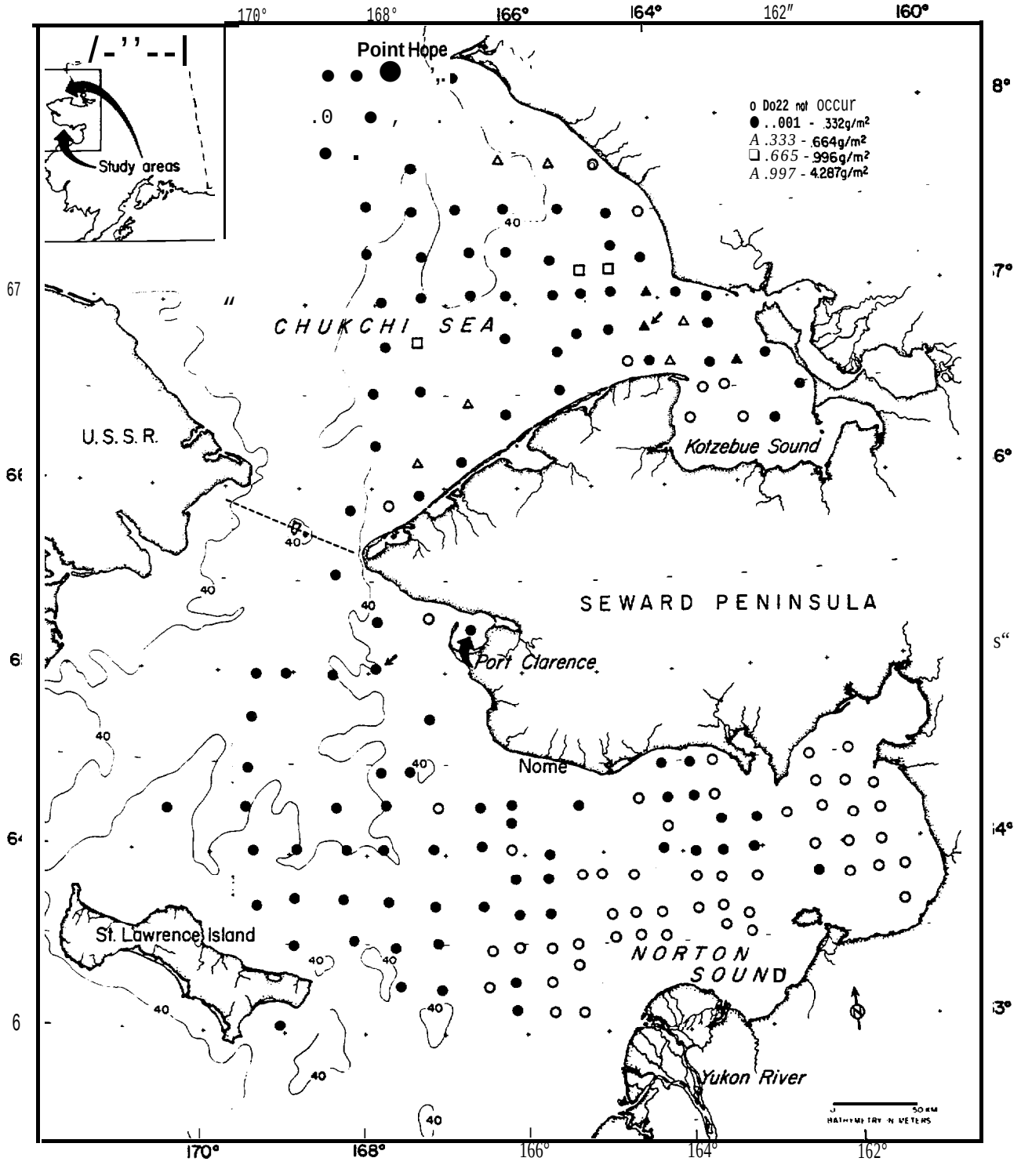

Figure 14. Distribution and biomass of the snow crab. *Chionoecetes opilio*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 0.23 g/m² for Norton Sound area station c-9 and 4.29 g/m² for Chukchi Sea - Kotzebue Sound area station B-13.

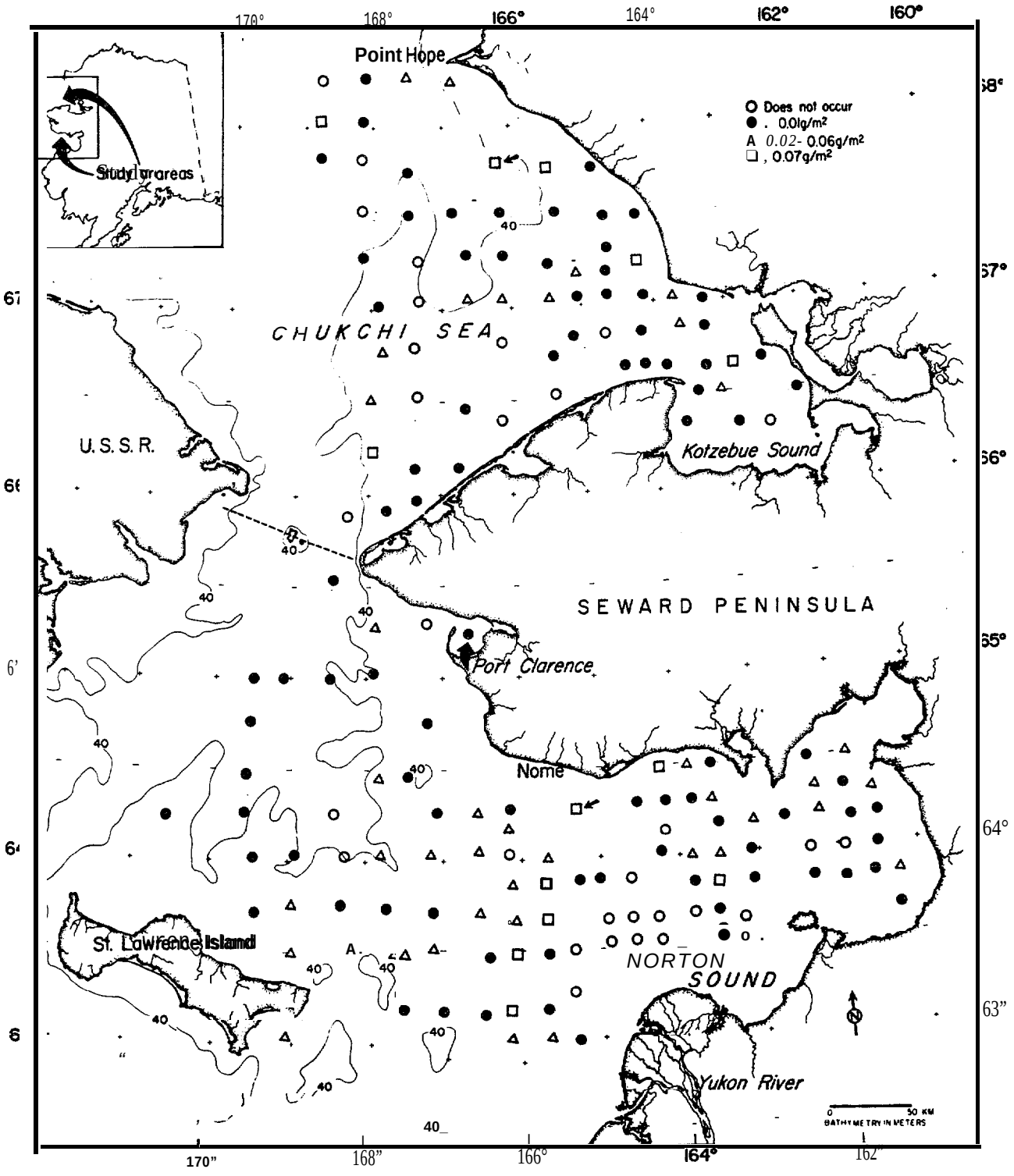

Figure 15. Distribution and biomass of the shrimp, *Argis lar*, from the Norton Sound, Chukchi Sea - Kotzebue Sound- study ''areas. Smal 1 arrows indicate highest biomass stations from the respective areas, i.e., 0.22 g/m^2 for Norton Sound area station D-9 and 0.29 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-13.

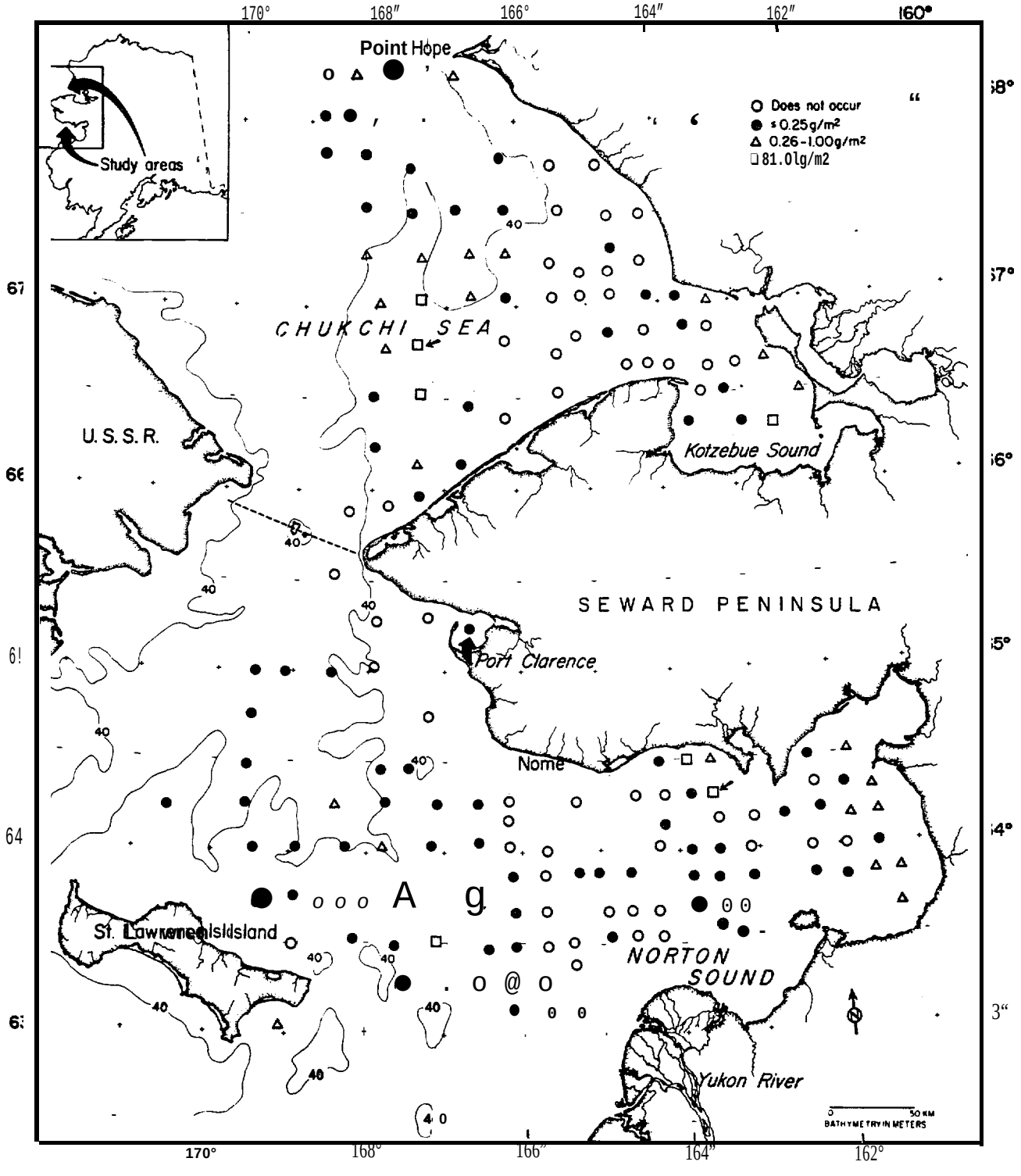

Figure 16. Distribution and biomass of the gastropod. *Neptunea heros*. from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 1.10 g/m² for Norton Sound area station D-14, and 11.40 g/m² for Chukchi Sea - Kotzebue Sound area station A-37.

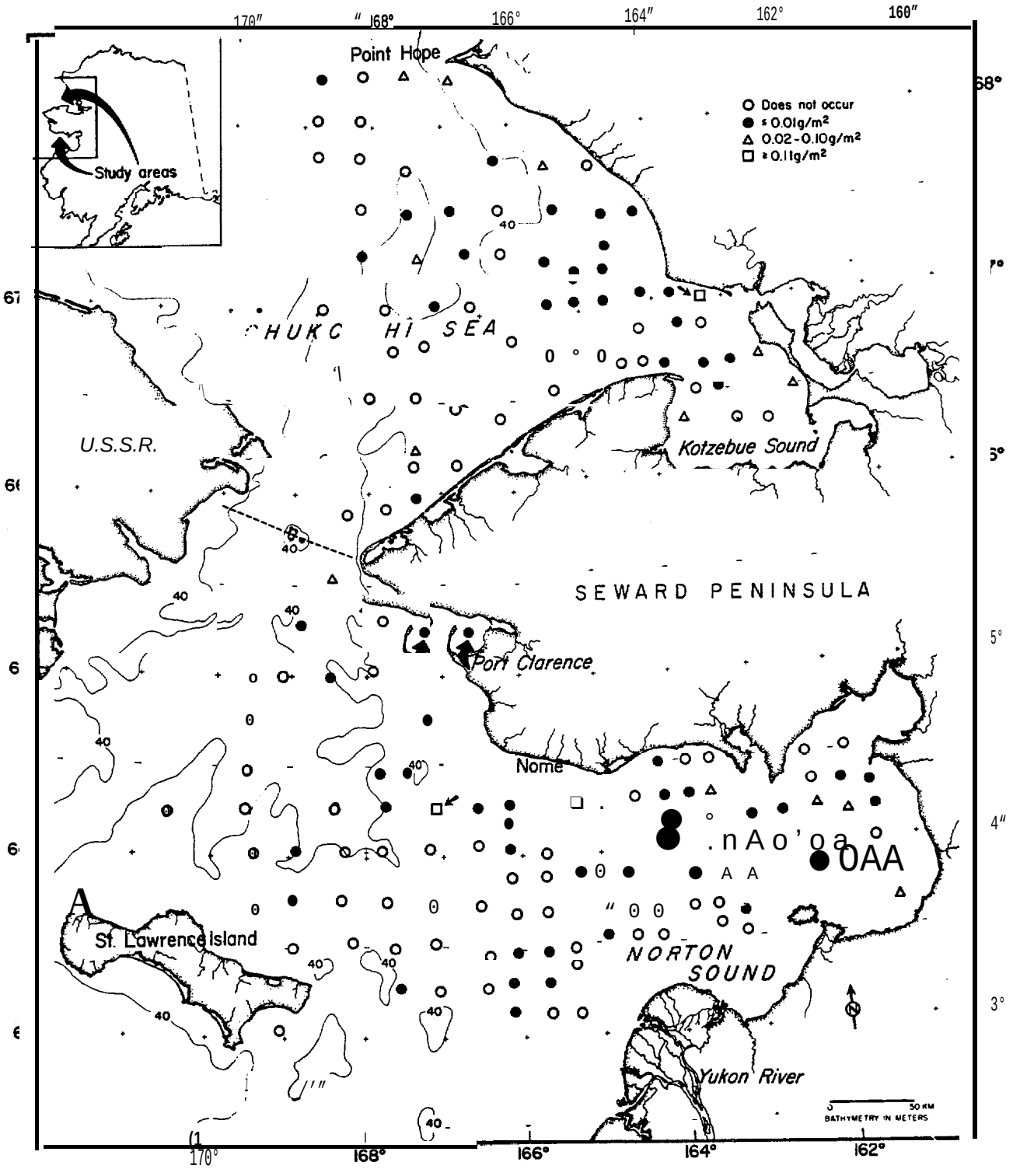

Figure 17. Dist ribut ion and biomass of the gastropod, *Beringius beringi*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas., i.e. 0.30 g/m² for Chukchi Sea, Norton Sound area station C-32 and 0.17 g/m² for Kotzebue Sound area station B-10.

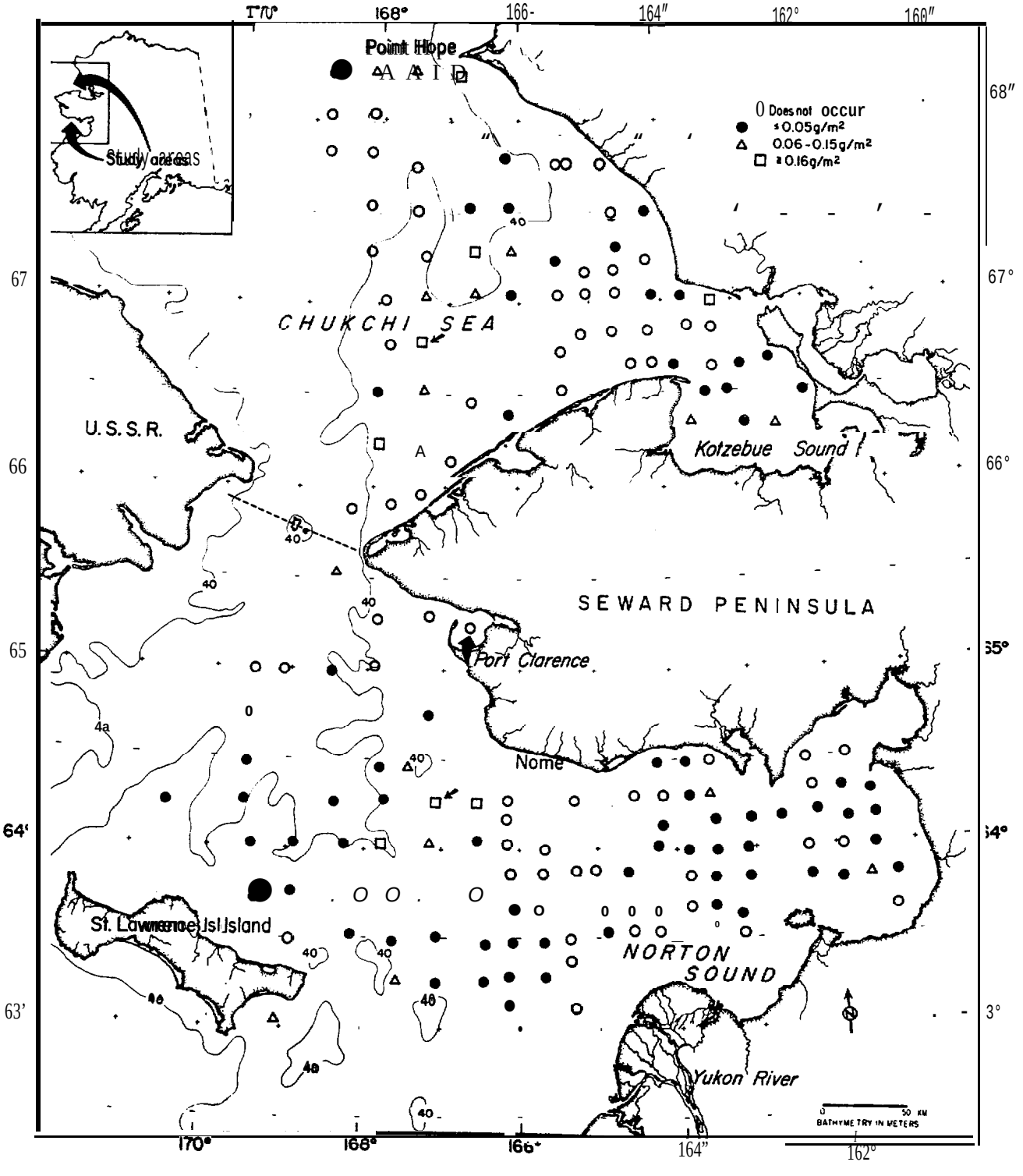

Figure 18. Distribution and biomass of the gastropod, *Neptunea ventricosa*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 0.28 g/m^2 for Norton Sound area station C-32 and 1.25 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-37.

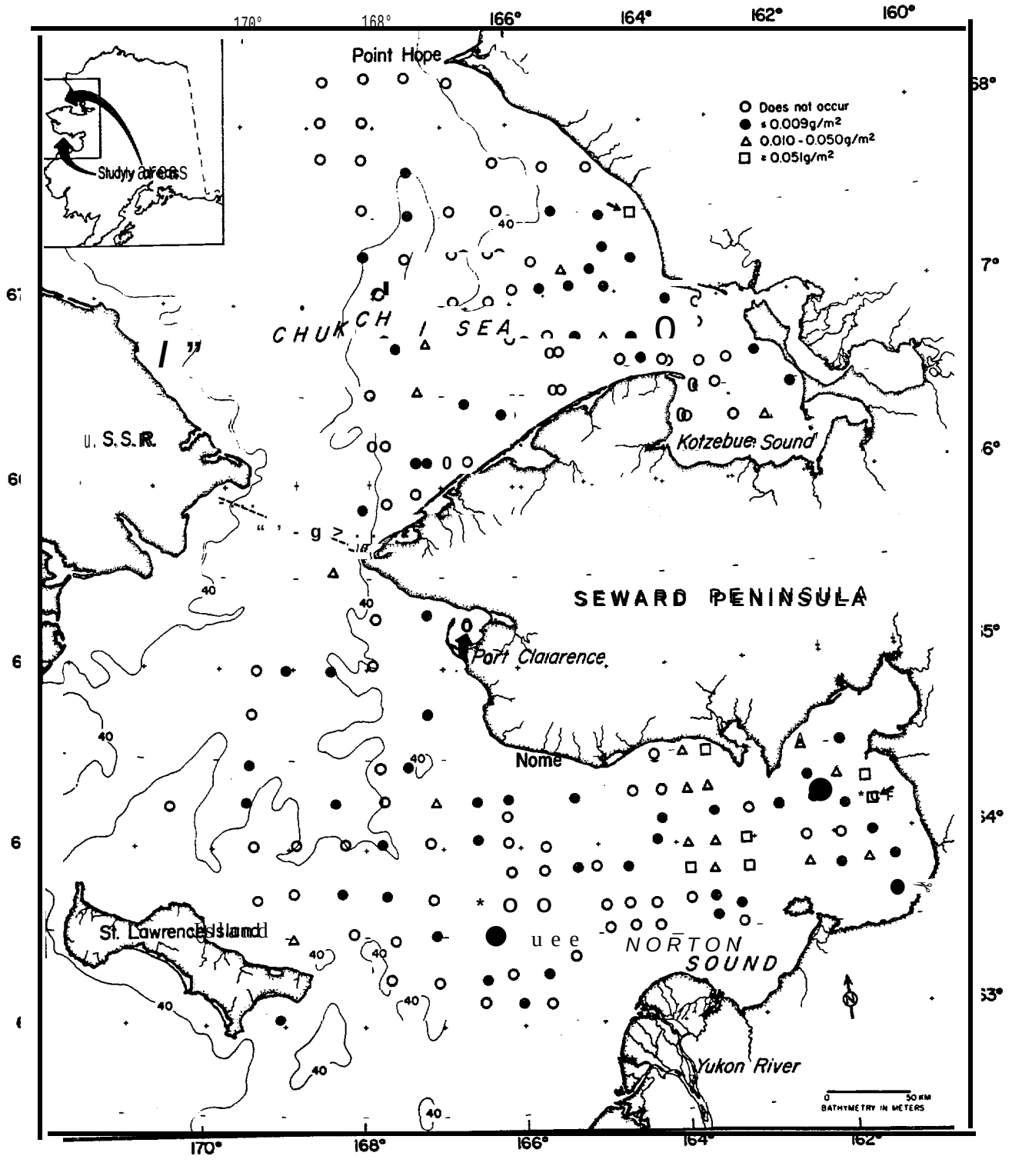

Figure 19. Distribution and biomass of the Greenland cockle, *Serripes groenlandicus*, from the Norton Sound, Chukchi Sea - Kotzebue Sound study areas. Small arrows indicate highest biomass stations from the respective areas, i.e., 0.20 g/m^2 for Norton Sound area station D-32 and 0.05 g/m^2 for Chukchi Sea - Kotzebue Sound area station A-22.

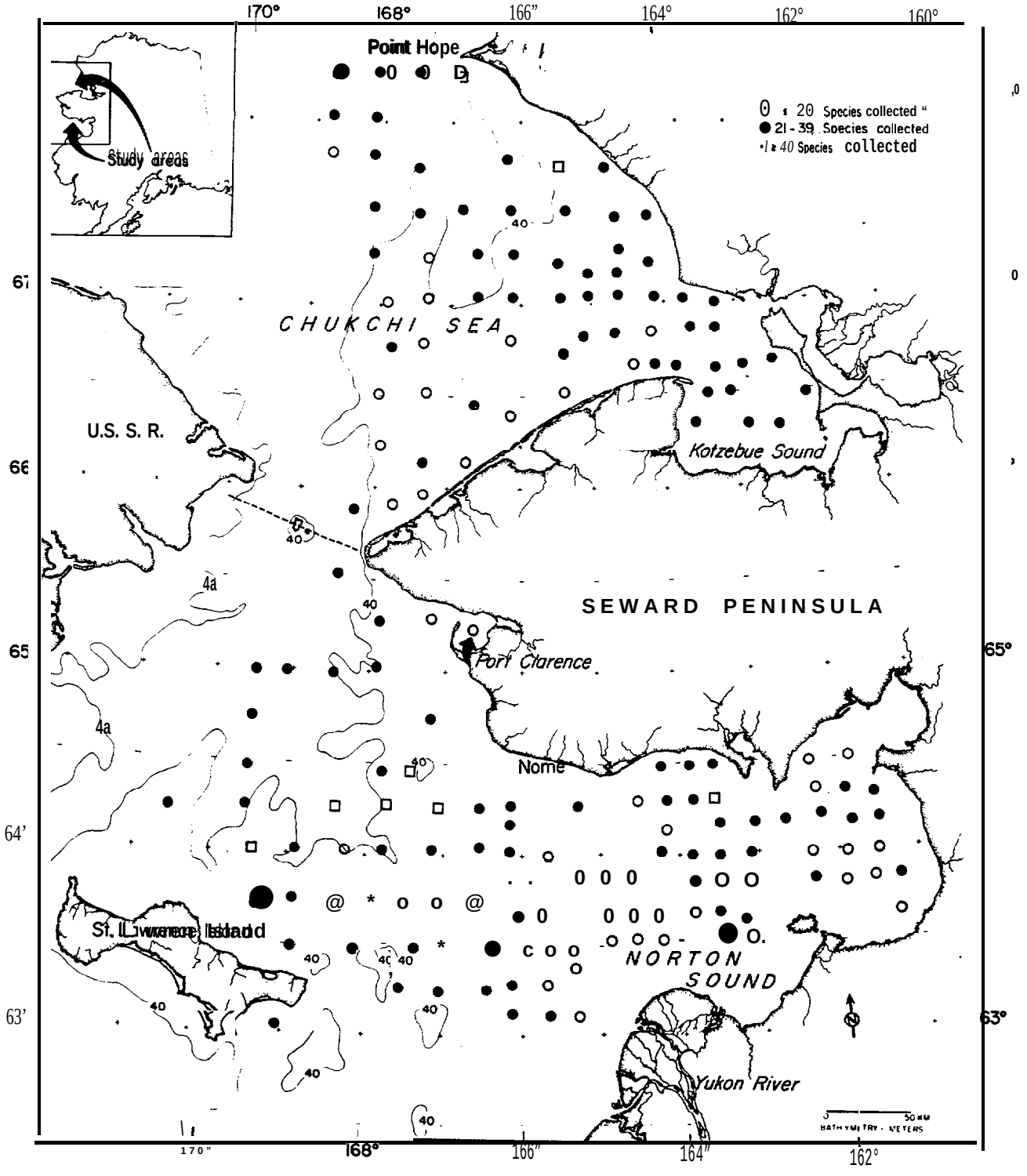

Figure 20. Species diversity by station location.

invertebrate biomass was 9617.24 kg or 3.31 g/m^2 in a total fishing distance of 224.07 km. Invertebrates from this area included 11 phyla and 171 species (Table VI). The occurrence of each species from the Chukchi Sea - Kotzebue Sound area is found in Appendix Table IV. Two phyla present in the Norton Sound area, Priapulida and Brachiopoda, were absent from the Chukchi Sea - Kotzebue Sound samples. Molluscs dominated in species representation with 70, and arthropod crustaceans and echinoderms followed with 36 and 24 species respectively (Table VII). Echinoderms made up the bulk of the invertebrate biomass with 59.9%; molluscs and arthropod crustaceans contributed 12.8% and 12.5% of the biomass, respectively (Table III).

The most common group present was the sea star family Asteridae (Phylum Echinodermata) (Table IV; See App. Table V for percentage composition of all phyla by family). The main species represented, in order of decreasing biomass, were *Asterias amurensis*, *Leptasterias polaris acervata*, *Lethasterias nanimensis* and *Evasterias echinosoma* (Table VIII; See App. Table VI for percentage composition of all phyla species). Other echinoderms of considerable importance were *Strongylocentrotus droebachiensis* and *Gorgonocephalus caryi*.

The most common species, *Asterias amurensis*, occurred mainly in Kotzebue Sound with station B-4 the station of highest biomass: 270.13 kg or 5.98 g/m^2 in a standard tow (Fig. 3)

Leptasterias polaris acervata occurred in most of the Chukchi Sea - Kotzebue Sound sampling area. High biomasses occurred in the western end of the station grid, especially at station A-16 where 202.48 kg or 7.47 g/m^2 were obtained in a standard tow (Fig. 6)

Lethasterias nanimensis and *Evasterias echinosoma* had similar distribution and biomass patterns. Most occurrences were in Kotzebue Sound and station A-14 had the highest biomass of both species, i.e. , 99.66 kg or

TABLE VI

Species taken by trawl from the Chukchi Sea - Kotzebue Sound area onboard the NOAA Ship *Miller Freeman*, 2 September-13 October, 1976

Phylum Porifera
- Class Demospongia
  - Family Microcionidae
    - *Microciona* sp.
    - *Microciona lambei* Burton
  - Family Axinellidae
    - *Phakellia* sp.
  - Family Halichondriidae
    - *Halichondria* sp.

Phylum Cnidaria
- Class Hydrozoa
  - Family Sertulariidae
    - *Abietinaria* sp.
- Class Scyphozoa
  - Unidentified species
- Class Anthozoa
  - Family Nephtheidae
    - *Eunephthya rubiformis* (Pallas)
  - Family Actinostolidae
    - *Stomphia* sp.
    - *Stomphia coccinea* (O. F. Müller)
  - Family Actiniidae
    - *Tealia crassicornis* (O. F. Müller)

Phylum Rhynchocoela
- Unidentified species

Phylum Annelida
- Class Polychaeta
  - Family Polynoidae
    - *Eunoe depressa* (Moore)
    - *Gattyana ciliata* Moore
  - Family Nereidae
    - *Nereis* sp.
  - Family Nephtyidae
    - *Nephtys* sp.
  - Family Flabelligeridae
    - *Brada inhabilis* (Rathke)
    - *Brada ochotensis* Annenkova

TABLE VI (Cent'd)

Family Sternaspidae
Sternaspis scutata (Ranzani)

Family Sabellariidae
Idanthyrsus armatus Kinberg

Family Pectinariidae
Cistenides hyperborea (Malmgren)

Family Ampharetidae
Amphitrite cirrata O. F. Müller

Family Sabellidae
Chone cincta Zachs
Potamilla sp.

Family Serpulidae
Unidentified species

Phylum Mollusca
Class Polyplacophora
Family Ischnochitionidae
Ischnochition albus (Linné)

Class Pelecypoda
Family Nuculidae
Nucula tenuis Montagu

Family Nuculanidae
Nuculana fossa Baird
Yoldia hyperborea (Loven)

Family Mytilidae
Mytilus edulis Linnaeus
Musculus niger (Gray)
Musculus discors (Linné)
Modiolus modiolus (Linnaeus)

Family Pectinidae
Chlamys rubida (Hinds)
Chlamys islandica (Müller)
Chlamys beringiana (Middendorff)

Family Astartidae
Astarte borealis (Schumacher)
Astarte montagui (Dillwyn)

Family. Carditidae
Cyclocardia S_p.
Cyclocardia ventricosa (Gould)
Cyclocardia crebricostata (Krause)
Cyclocardia crassidens (Broderip and Sowerby)

TABLE VI (Cent'd)

Family Cardiidae
Clinocardium ciliatum (Fabricius)
Clinocardium nuttallii (Conrad)
Clinocardium californiense Deshayes
Serripes groenlandicus (Bruguière)

Family Veneridae
Liocyma fluctosa (Gould)

Family Mactridae
Spisula polynyma (Stimpson)

Family Tellinidae
Macoma sp.
Macoma calcarea (Gmelin)
Macoma brota Dan

Family Myidae
Mya japonica Jay

Family Hiatellidae
Hiatella arctica (Linné)
Panomya arctica (Lamarck)

Class Gastropoda
Family Trochidae
Margaritas giganteus (Leche)
Solariella obscura (Couthouy)
Solariella varicosa (Mighels and Adams)

Family Turritellidae
Tachyrhynchus reticulates (Mighels and Adams)

Family Calytraeidae
Crepidula grandis (Middendorff)

Family Trichotropididae
Trichotropis bicarinata (Sowerby)

Family Naticidae
Natica clausa Broderip and Sowerby
Natica russa Gould
Polinices pallida Broderip and Sowerby

Family Velutinidae
Piliscus commondum (Middendorff)
Velutina sp.
Velutina plicatilis (Müller)
Velutina undata (Brown)

Family Muricidae
Boreotrophon clathrus (Linné)

TABLE VI (Cent'd)

Family Buccinidae
Buccinum angulosum Gray
Buccinum scalariforme Möller
Buccinum glaciale Linnaeus
Buccinum solenum Dan
Buccinum polare Gray
Buccinum tenellum Dall

Family Neptunidae
Ancistrolepis sp.
Ancistrolepis magna Dan
Beringius crebricostatus (Dan)
Beringius beringi Middendorff
Colus Sp.
Colus spitzbergensis (Reeve)
Colus hypolispus (Dan)
Mohnia corbis (Dan)
Neptunea lyrata (Gmelin)
Neptunea ventricosa (Gmelin)
Neptunea borealis (Philippi)
Neptunea ?-zeros (Gray)
Plicifusus brunneus (Dan)
Pyrulofusus deformis (Reeve)
Volutopsius Sp.
Volutopsius fragilis (Dan)

Family Cancellariidae
Admete couthouyi (Jay)

Family Doridídae
Unidentified species

Family Dendronotidae
Dendronotus sp.

Family Tritonidae
Tochina tetraquetra (Pallas)

Class Cephalopoda
Family Octopodidae
Unidentified species

Phylum Arthropoda
Class Crustacea
Order Thoracica
Family Balanidae
Balanus sp.
Balanus balanus (Linné)
Balanus rostratus Pilsbry

Order Mysidacea
Unidentified species

TABLE VI (Cent'd)

Order Cumacea
Unidentified species

Order Isopoda
Family Idoteidae
Saduria entomon (Linnaeus)

Order Amphipoda
Family Eusiridae
Rhachotropis sp.

Family Gammaridae
Melita sp.
Melita dentata Kröyer

Family Lysianassidae
Anonyx sp.

Family Stegocephalidae
Stegocephalopsis ampulla (Phipps)
Stegocephalus inflatus Kröyer

Order Decapoda
Family Pandalidae
Pandalus sp.
Pandalus goniurus Stimpson

Family Hippolytidae
Spirontocaris sp.
Spirontocaris murdochi Rathbun
Spirontocaris arcuata Rathbun
Lebbeus groenlandica (Fabricius)
Eualus gaimardii belcheri (Bell)
Heptacarpus sp.

Family Crangonidae
Crangon dalli Rathbun
Sclerocrangon boreas (Phipps)
Argis lar (Owen)
Argis crassa (Rathbun)

Family Paguridae
Pagurus capillatus (Benedict)
Pagurus trigonocheirus (Stimpson)
Pagurus rathbuni (Benedict)
Labidochirus splendescens (Owen)

Family Lithodidae
Hapalogaster grebnitzkii Schalfeew
Paralithodes camtschatica (Tilesius)
Paralithodes platypus Brandt
Paralithodes brevipes (Milne-Edwards and Lucas)

Family Majidae
Hyas sp.
Hyas coarctatus alutaceus Brandt
Chionoecetes opilio (Fabricius)

TABLE VI (Cent'd)

Family Atelecyclidae
Telmessus cheiragonus (Tilesius)

Phylum Sipunculida
Family Golfingiidae
Golfingia margaritacea (M. Sars)

Phylum Echiurida
Class Echiuroidea
Family Echiurdae
Echiurus echiurus alaskensis Pallas

Phylum Ectoprocta
Class Cheilostomata
Family Flustridae
Flustra sp.

Family Bicellariellidae
Dendrobeania sp.

Class Cyclostomata
Family Diastoporidae
Diaperoecia sp.

Family Heteroporidae
Heteropora sp.

Class Ctenostomata
Family Alcyonidiidae
Alcyonidium sp.
Alcyonidium disciforme Smitt
Alcyonidium vermiculare Okada

Phylum Echinodermata
Class Asteroidea
Family Echinasteridae
Henricia sp.
Henricia derjugini (Djakonov)

Family Pterasteridae
Pteraster obscura (Perrier)

Family Solasteridae
Crossaster papposus (Linné)
Solaster sp.
Solaster endeca (Linné)

Family Asteridae
Asterias sp.
Asterias amurensis Lütken
Asterias rathbuni (Verrill)
Evasterias echinosoma Fisher
Leptasterias sp.
Leptasterias polar-is acervata Stimpson
Lethasterias sp.
Lethasterias nanimensis (Verrill)

TABLE VI (Cent'd)

Class Echinoidea
Family Echinarachniidae
Echinarachnius parma Lamarck

Family Strongylocentrotidae
Strongylocentrotus droebachiensis (O. F. Müller)

Class Ophiuroidea
Family Amphiuridae
Diamphiodia craterodmeta

Family Gorgonocephalidae
Gorgonocephalus caryi (Lyman)

Family Ophiactidae
Ophiopholis aculeata (Linné)

Family Ophiuridae
Ophiura sarsi Lütken
Stegophiura nodosa Lütken

Class Holothuroidea
Family Cucumariidae
Cucumaria sp_a
Cucumaria calcigera (Stimpson)

Family Psolidae
Psolus japonicus Oestergren

Phylum Chordata
Subphylum Urochordata
Class Ascidiacea
Family Rhodosomatidae
Chelyosoma sp.
Chelyosoma orientale Redikorzev

Family Styelidae
Styela macrenteron Ritter
Pelonaia corrugata Forbes and Goods

Family Pyuridae
Boltenia ovifera (Linné)
Boltenia echinata Linné
Halocynthia aurantium (Pallas)

Class Thaliacea
Family Salpidea
Unidentified species

TABLE VII

Number and percent of epifaunal invertebrate species by phylum and class from the Chukchi Sea

Phylum	Class	No. of Species	% of Species
Porifera	Demospongia	4	2.34
Cnidaria	Hydrozoa	1	0.58
	Scyphozoa	1	0.58
	Anthozoa	4	2.34
	Totals	6	3.50
Rhynchocoela	Unidentified	1	0.58
Annelida	Polychaeta	13	7.60
Mollusca	Polyplacophora	1	0.58
	Pelecypoda	28	16.37
	Gastropod	40	23.39
	Cephalopod	1	0.58
	Totals	70	40.92
Arthropods	Crustacea	36	21.05
Sipunculida		1	0.58
Echiurida	Echiuroidea	1	0.58
Ectoprocta	Cheilostomata	2	1.17
	Cyclostomata	2	1.17
	Ctenostomata	3	1.75
	Totals	7	4.09
Echinodermata	Asteroidea	14	8.19
	Echinoidea	2	1.17
	Ophiuroidea	5	2.92
	Holothuroidea	3	1.75
	Totals	24	14.03
Chordata	Ascidiacea	7	4.09
	Thaliacea	1	0.58
	Totals	8	4.67
	Grand Totals	171	100.00

TABLE VIII

Percentage composition by weight and the feeding methods[1] of the leading invertebrate species collected in the Chukchi Sea - Kotzebue Sound area

Phylum	% wt. of all phyla	Leading Species	Feeding[2] Method	Avg. wt. per Individual	% wt. of phylum	% wt. of all phyla
Echinodermata	59.93	*Asterias amurensis*	P	202 g	35.54	21*21
		Leptasterias polaris acervata	P	*96* g	20.90	*12.47*
		Strongylocentrotus droebachiensis	H-S-P	70 g	10.69	6.38
		Lethasterias nanimensis	P	*299* g	*9.67*	*5.77*
		Evasterias echinosoma	P	*656* g	*6.39*	3.81
		Gorgonocephalus caryi	Sus-P	258 g	5.76	3.44
		Totals			88.95	53.08
Mollusca	12.79	*Neptunea heros*	P-S	101 g	*79.98*	*10.19*
		Neptunea ventricosa	P-S	71 g	10.80	1.38
		Beringius beringi	*P-S*	*85* g	*2.35*	*0.30*
		Totals			93.13	11.87
Arthropoda (Crustacea)	12.52	*Chionoecetes opilio*	P-S	27 g	43.76	5.46
		Pagurus trigonocheirus	P-S ?	17 g	15.77	1.97
		Hyas coarctatus alutaceus	P-S ?	25 g	12.87	1.61
		Telmessus cheiragonus	P-S ?	133 g	*7.43*	*0.93*
		Pagurus capillatus	P-S ?	12 g	7.24	0.90
		Argis lar	*S ?*	7 g	*4.34*	*0.54*
Total	*85.24*	Totals			*91.41*	*11.41*

[1]Based on Hatanaka and Kosaka, 1958; Reese, 1966; Pearce and Thorson, 1967; Feder *et al.*, 1977b; and pers. observation. Feeding methods for related species are included when no direct data are available for species included above.

[2]Feeding methods: P = predator; P-S = predator-scavenger; S = scavenger;
Sus = suspension feeder; Sus-P = suspension feeder-predator;
H-S-P = herbivore-scavenger-predator.

2.45 g/m² for *L. nanimensis* and 122.91 kg or 3.03 g/m² for *E. echinosoma* (Figs. 4 and 5).

The sea urchin, *Strongylocentrotus droebachiensis*, was also found primarily in Kotzebue Sound. However, the highest biomass was recorded in one of the northern-most stations, A-2. In a standard tow, 261.96 kg or 6.45 g/m² was obtained at this location (Fig. 8).

The only other echinoderm that contributed significantly to the overall invertebrate biomass was the basket star, *Gorgonocephalus caryi*. The stations of high biomass of this species occurred in the northern region, specifically, station A-14 where 105.20 kg or 2.59 g/m² were obtained in a single tow (Fig. 7).

Of the 70 species of molluscs collected, the gastropod *Neptunea heros* dominated. This species represented 80.0% of the mollusc biomass, but only 10.2% of the total invertebrate biomass (Table VIII). *Neptunea heros* occurred at the eastern and western stations of the Chukchi Sea - Kotzebue Sound grid. The highest biomass occurred *at* station A-37 with 360.08 kg or 11.40 g/m² in a standard tow (Fig. 16).

The distribution and biomass of *Beringius beringi* and *Neptunea ventricosa*, two other leading gastropod, are shown in Figures 17 and 18, respectively.

The King crab, *Paralithodes camtschatica*, the most important arthropod in the Norton Sound area, was only found at four stations in the Chukchi Sea - Kotzebue Sound area (Fig. 9). The snow crab, *Chionoecetes opilio*, replaced *P. camtschatica* in the latter area, occurring in 96% of the stations (App. Table IV) and contributing 43.8% of the crustacean weight or 5.5% of the invertebrate weight (Table VIII). Station B-13 had the highest biomass of this crab with 106.69 kg or 4.29 g/m² in a standard tow (Fig. 14). The

crabs *Pagurus trigonocheirus*, *Pagurus capillatus*, *Hyas coarctatus alutaceus*, and *Telmessus cheiragonus*, and the shrimp *Argis lar* were also important crustaceans in this area as well as in the Norton Sound area. The distribution and biomass of these crustacean species are found in Figures 10-13 and 15.

Diversity

The number of species for each station was tabulated, and three general categories of species diversity were arbitrarily established: High (≥40 species), intermediate (21-39 species), and low (≤20 species) (Table IX: Fig. 20). Most of the low diversity stations in the Norton Sound area were located in the eastern portion of Norton Sound and the stations off the Yukon River. Most of the high diversity stations were located between Nome and St. Lawrence Island. Intermediate diversities were recorded at all of the other stations (Fig. 20).

Only two high diversity stations, stations A-3 and A-14, were noted in the Chukchi Sea - Kotzebue Sound area (Fig. 20). Low diversity stations were located mainly northeast of the Bering Strait.

Feeding Observations

Sea stars

A preponderance of invertebrates collected were predators and/or scavengers, and the leading species (listed in Tables V and VIII) that were in these categories made up nearly 90% of the total invertebrate biomass. Only two feeding *Asterias amurensis* were taken; one was eating the sea urchin, *Strongylocentrotus droebachiensis*, and the other was eating the sand dollar,

TABLE IX

Trawl stations from the Norton Sound, Chukchi Sea - Kotzebue Sound areas, and number of species obtained at each station

Norton Sound area stations

Station	No. of Species	Station	No. of Species	Station	No. of Species
C-1	35	C-61	33	D-46	16
C-5	26	C-62	30	D-48	23
C-6	17	C-63	11	?)-49	23
C-7	20	C-64	16	D-50	16
C-8	35	C-65	42	D-51	15
C-9	31	D-2	24	D-52	25
C-12	21	D-3	26	D-54	22
C-16	33	D-4	22	D-55	27
C-19	22	D-5	16	D-56	36
C-22	37	D-6	16	D-58	26
C-23	50	D - 7	23	D-59	20
C-26	36	D-9	35	D-60	19
C-28	24	?)-11	16	D-61	24
C-30	41	D-12	22	D-62	24
C-31	40	D-13	29	D-63	25
C-32	43	D-14	43	D-65	11
C-33	32	D-17	16	D-66	6
C-38	41	D-18	21	D-67	7
C-39	33	D-19	21	D-68	19
C-40	19	D-20	23	D-69	25
C-41	28	D-25	18	D-70	28
C-42	34	D-27	29	D-75	14
C-43	29	D-28	34	D-76	26
C-47	25	D-29	32	D-77	22
C-48	25	D-30	30	D-78	9
C-49	24	D-31	26	D-79	17
C-50	37	D-32	30	D-80	5
C-51	27	D-34	28	D-81	7
C-52	30	D-35	17	D-83	21
C-54	22	D-39	26	D-84	16
C-55	23	D-40	32	D-85	8
C-56	26	D-41	34	D-86	19
C-57	27	D-42	35	D-87	24
C-58	30	9-44	7	D-88	10
C-60	30	D-45	15	D-89	21
				D-90	22

TABLE IX (Cent'd)

Chukchi Sea - Kotzebue Sound area station

Station	No. of Species	Station	No. of Species	Station	No. of Species
A-1	32	A-32	27	B-4	24
A-2	39	A-33	35	B-5	30
A-3	54	A-34	29	B-6	33
A-5	21	A-36	24	B-7	29
A-10	35	A-37	17	B-8	26
A-n	21	A-39	12	B-9	31
A-13	31	A-40	28	B-10	33
A-14	41	A-42	18	B-11	22
A-15	28	A-43	15	B-12	23
A-16	29	A-44	33	B-13	20
A-17	23	A-45	15	B-14	25
A-18	34	A-46	9	B-15	23
A-19	26	A-48	18	B-17	18
A-20	37	A-49	25	B-18	25
A-21	35	A-50	16	B-19	29
A-22	29	.4-53	22	B-20	31
A-24	27	A-54	33	B-21	34
A-25	16	A-55	6	B-22	33
A-26	26	A-56	24	B-23	25
A-27	24	A-57	21	B-24	38
A-28	28	A-58	17	B-26	27
A-30	17	B-1	29	B-27	29
A-31	12	B-3	22	B-28	24
				B-29	2 3

Echinarachnius parma. More extensive feeding observations were made on the other common sea-star species: *Leptasterias polaris acervata*, *Evasterias echinosoma*, and *Lethasterias nanimensis* (Table X). In the Norton Sound area, 30 *L. polaris acervata* were observed feeding at 18 stations. The species most frequently consumed were *Echinarachnius parma* and *Balanus* spp. At least 30 *L. polaris acervata* in the Chukchi Sea - Kotzebue Sound area were found feeding at 17 stations. Main prey items were two ascidians, (*Chelyosoma orientale* and *Boltenia echinata*), a gastropod (*Natica clausa*), a polychaete (*Cistenides* sp.), and a clam (*Macoma calcarea*). In both study areas, *Evasterias echinosoma* and *Lethasterias nanimensis* were feeding primarily on clams, specifically, the Greenland cockle, *Serripes groenlandicus*.

Starry flounder (*Platichthys stellatus*)

Combined study areas - During the sampling period, 307 starry flounder digestive tracts were examined from 22 stations (Fig. 2; Table XI). Stomach contents included representatives of 10 phyla, 1"2 classes, 39 families, 42 genera, and 48 species (Table XII). The number of fish examined in Norton Sound, Port Clarence, and southeastern Chukchi Sea was 142, 134, and 31 individuals, respectively (Table XI). One hundred thirty-one (131) fish were examined using the frequency of occurrence of prey method. Most fish in the Chukchi Sea and all fish in Port Clarence were examined using a quantitative method of analysis (See Methods; Table XI). The mean length and weight of the 176 fish examined quantitatively were 341 ± 54 mm and 614 ± 405 g respectively. The frequency of occurrence method delineated 21 different food organisms (Table XIII); an additional 28 food organisms were

TABLE X

Food of the sea stars *Leptasterias polaris acervata*, *Evasterias echinosoma* and *Lethasterias nanimensis* as determined in the present study

Prey	*Leptasterias polaris acervata*		*Evasterias echinosoma*		*Lethasterias nanimensis*	
	Chukchi Sea	Norton Sound	Chukchi Sea	Norton Sound	Chukchi Sea	Norton Sound
Polychaeta		2:2				
Cistenides sp.	4:7[1]					
Nuculana fossa	1:1					
Musculus niger			1:1			
Astarte borealis	1:1		3:3			
Cyclocardia ventricosa	1:1					
Cyclocardia crebricostata	1:1	2:2				
Clinocardium ciliatum			1:1			1:1
Clinocardium californiense					1:1	
Serripes groenlandicus		2:2	3:12	3:3	3:5	2:6
Macoma sp.		1:1				
Macoma calcarea	2:4					
Mya truncata			1:1			
Margarites sp.				1:1		
Natica sp.	1:1					
Natica clausa	2:9					1:1
Boreotrophon clathratus	1:2					
Buccinium sp.	1:1					
Gastropod fragments		2:2				
Balanus spp.		3:6				
Amphipoda		1:1				
Eualus sp.		1:1				
Hyas coarctatus alutaceus		1:1				
Ectoprocta		1:1				
Echinarachnius parma		2:11		1:1		1:2
Chelyosoma orientale	1:many[2]					
Boltenia echinata	1: many[2]					
TOTALS	17:30+	18:30	9:18	5:5	4:6	5:10

[1]Number of stations where predators were feeding on prey:Number of predators feeding on prey

[2]Many observations noted; no tally available.

TABLE XI

A summarization of station data for the three sampling areas. The number of starry flounders examined, the number and percent of fish feeding, and the method of analysis used for examining these fish in the study areas.

Sampling area	Station	Depth m	Latitude	Longitide	Method of Analysis: Freq. of Occur. Number Examined	Freq. of Occur. Number Feeding	Quantitative Number Examined	Quantitative Number Feeding	% Feeding
Norton Sound	D-09	23.0	64°18′	165°21′	17	15	10	9	89
	D-20	24.0	64°11′	166°09′	12	12			100
	D-49	22.7	63°51′	166°04′	10	9			90
	D-48	29.0	63°51′	165°40′	6	6			100
	D-63	26.3	63°40′	165°46′	10	9			90
	D-76	27.3	63°29′	166°01′	4	0			0
	D-86	25.4	63″19′	165°45′	4	4			100
	D-54	20.0	63°51′	163°52′	8	7			88
	D-68	16.3	63°40′	163°53′	9	9			100
	D-72	19.0	63°46′	162°15′	4	4			100
	D-25	22.0	64°10′	164°14′	4	4			100
	C-58	27.0	63°28′	166°28′	3	2			67
	C-62	26.0	63°15′	166°29′	2	1	-		50
	D-14	22.0	64°20′	163°33′	9	8			89
	D-40	20.0	63°58′	163°50′	18	16			89
	C-61	26.0	63°14′	167°05′	6	6	6	6	100
TOTALS	16				126	112	16	15	89
Port Clarence	C-63	14.5	65°18′	167°11′			6	6	100
	C-64	15.0	65°16′	166°36′			128	121	95
TOTALS	2						134	127	95
Chukchi Sea	A-48	35.0	66°15′	167°59′	5	4			80
	A-52	38.2	66″02′	168°02′			10	10	100
	A-55	16.3	65°50′	167°46′			12	9	75
	A-53	20.0	65°59′	167°22′			4	3	75
TOTALS	4				5	4	26	22	84
GRAND TOTALS	22				131	116	176	164	91

TABLE XII

A list of food items from the stomachs of 280 feeding *Platichthys stellatus* collected in Norton Sound, Port Clarence, and southeastern Chukchi Sea, 2 September - 13 October, 1976

Phylum Cnidaria
  Class Hydrozoa
    Unidentified species

Phylum Rhynchocoela
    Unidentified species

Phylum Annelida
  Class Polychaete
    Family Nephtyidae
      Nephtys sp.
      Nephtys rickettsi
    Family Goniadidae
      Glycinde armigera
    Family Lumbrineridae
      Lumbrineris sp.
    Family Sternaspidae
      Sternaspis scutata
    Family Arenicolidae
      Arenicola glacialis
    Family Pectinaridae
      Cistenides hyperborea
    Family Ampharetidae
      Lysippe labiata
    Family Polynoidae
      Unidentified species

Phylum Mollusca
  Class Pelecypoda
    Family Nuculanidae
      Yoldia sp.
      Yoldia hyperborea
      Yoldia seminuda
    Family Mytilidae
      Musculus niger
      Musculus corrugates
    Family Carditidae
      Cyclocardia ventricosa
    Family Cardiidae
      Clinocardium ciliatum
      Serripes groenlandicus
    Family Myidae
      Mya sp.
    Family Lyonsiidae
      Lyonsia norvegica

TABLE XII (Cent'd)

- Class Gastropoda
  - Family Naticidae
    - *Polinices pallida*
  - Family Cancellaridae
    - *Admete* sp.
  - Family Scaphandridae
    - *Cylichna occulta*
  - Family Turridae
    - *Oenopota* sp.

- Phylum Arthropoda
  - Class Crustacea
    - Order Thoracia
      - Family Balanidae
    - Order Cumacea
      - Family Leuconidae
        - *Leucon* sp.
      - Family Diastylidae
        - *Diastylis* sp.
        - *Diastylis sulcata*
    - Order Isopoda
      - Family Idoteidae
        - *Saduria entomon*
        - *Synidotea nodulosa*
    - Order Amphipoda
      - Family Gammaridae
      - Family Haustoriidae
        - *Pontoporeia femorata*
    - Order Decapoda
      - Family Hippolytidae
        - Unidentified species
      - Family Crangonidae
        - *Crangon* sp.
        - *Crangon dalli*
        - *Argis lar*
      - Family Paguridae
        - *Labidochirus splendescens*
      - Family Majidae
        - *Chionoecetes opilio*

- Phylum Priapulida
  - *Priapulus caudatus*

- Phylum Echiuroidea
  - Class Echiurida
    - Family Echiuridae
      - *Echiurus echiurus alaskensis*

TABLE XII (Cent'd)

Phylum Echinodermata
  Class Echinoidea
    Family Echinarachniidae
      Echinarachnius parma
  Class Ophiuroidea
    Family Ophiuridae
      Stegophiura nodosa
    Family Amphiuridae
      Diamphiodia craterodmeta

Phylum Urochordata
  Class Ascidiacea
    Family Styelidae
      Pelonaia corrugata

Phylum Chordata - Superclass Pisces
  Class Osteichthyes
   Order Gadiformes
    Family Gadidae
      Eleginus gracilis
   Order Scorpaeniformes
    Family Cottidae
      Myoxocephalus Sp.
   Order Perciformes
    Family Stichaeidae
      Lumpenus fabricii

TABLE XIII

Frequency and percent frequency of occurrence of food items in stomachs of 126 *Platichthys stellatus* collected in 16 Norton Sound Stations 2 September - 13 October, 1976

Food Items	Number	Percent
Coelenterata		
Hydrozoa	1	0.7
Annelida		
Polychaeta	3	2.3
Polynoidae	1	0.7
Pectinariidae		
Cistenides hyperborea	1	0.7
Mollusca		
Pelecypoda		
Nuculanidae		
Yoldia hyperborea	46	35.9
Mytilidae		
Musculus niger	18	14.0
Cardiidae		
Serripes groenlandicus	29	22.6
Myidae		
Mya sp.	1	0.7
Gastropod		
Turridae		
Oenopota Sp.	1	0.7
Arthropoda		
Crustacea		
Balanidae	1	0.7
Idoteidae		
Saduria entomon	1	0.7
Synidotea nebulosa	1	0.7
Crangonidae		
Argis lar	1	0.7
Paguridae		
Labidochirus splendescens	1	0.7
Echiurida		
Echiurdea		
Echiuridae		
Echiurus echiurus alaskensis	6	4.6
Priapulida		
Priapulus caudatus	6	4.6

TABLE X111 (Cent'd)

Food Items	Number	Percent
Echinodermata		
Echinoidea		
Echinarchniidae		
Echinarachnius parma	6	4-.6
Ophiuroidea		
Ophiuridae		
Stegophiura nodosa	7	5.4
Amphiuridae		
Diamphiodia craterodmeta	33	25.7
Chordata		
Osteichthyes		
Stichaeidae		
Lumpenus fabricii	3	2.3
Unidentified fish	7	5.4
Empty Stomachs	14	10.9

determined in the laboratory from quantitative samples (Table XIV). Leading species identified by the frequency of occurrence method were a protobranch clam (*Yoldia hyperborea*), a brittle star (*Diamphiodia craterodmeta*) and the Greenland cockle (*Serripes groenlandicus*). In order of decreasing relative importance, the major prey items from the quantitative samples were *Diamphiodia craterodmeta*, *Yoldia hyperborea*, a tube-dwelling polychaete (*Cistenides hyperborea*), a sand dollar (*Echinarachnius parma*), a proboscis worm (*Echiurus echiurus alaskensis*), and a priapulid worm (*Priapulus caudatus*) (see Table XIV; Fig. 21; App. Table VII). A food web for Norton Sound - Port Clarence - Chukchi Sea starry flounders is presented in Figure 22, and is based on unpublished notes and data contained in Appendix Table VII.

Feeding differences (based on the index of relative importance: IRI) between sexes were examined in fish analyzed by the quantitative method. The number of males and females examined was 106 and 70, respectively; the number of empty stomachs was 7 and 5, respectively. No significant differences (α=0.05) in feeding between sexes was apparent (see App. Tables VIII and IX).

Feeding differences (based on IRI) between each of the three sampling areas were found to be significantly different (α=0.05) (Fig. 23). The heterogeneity of major food organisms between sampling areas is shown in Figures 23-26.

Among the 106 males and 70 females examined, 58.5% and 74.3% respectively were found to be sinistrial (eyes on the left side). For the total 176 fish, 64.7% were sinistral.

Norton Sound - The most frequently consumed organisms in 126 Norton Sound starry flounders, in order of decreasing percent frequency of oc-

TABLE XIV

Frequency of occurrence, number, volume and index of relative importance of food items frnm starry flounders of Norton Sound, Port Clarence, and the southeastern Chukchi Sea, 2 September-13 October, 1976. Food items with corresponding percentage represent the level at which identifications were made. SE = number of stomach examined.

	NORTON SOUND SE=16				PORT CLARENCE SE=134				CHUKCHI SEA SE=26			
	Percent			Index of relative importance	Percent			Index of relative importance	Percent			Index of relative importance
Food Items	Frequency F	Number N	Volume V	F(N+V)	Frequency F	Number N	Volume V	F(N+V)	Frequency F	Number N	Volume V	F(N+V)
Rhynchocoela	6.25	0.10	1.58	10.50	--	--	--	--	--	--	--	--
Annelida												
Polychaeta	6.25	0.10	0.06	1.00	11.19	0.66	0.73	15.33	--	--	--	--
Nephtys sp.	--	--	--	--	0.75	0.01	0.08	0.06	--	--	--	--
Nephtys rickettsi	--	--	--	--	0.75	0.01	0.02	0.02	--	--	--	--
Glycinde armigera	--	--	--	--	0.75	0.01	0.02	0.02	--	--	--	--
Lumbrineris sp.	--	--	--	--	0.75	0.01	0.03	0.03	--	--	--	--
Sternaspis scutata	--	--	--	--	26.87	1.19	1.00	58.84	--	--	--	--
Arenicola glacialis	--	--	--	--	--	--	--	--	3.85	0.94	4.47	20.82
Cistenides hyperborea	6.25	0.10	0.03	0.81	20.90	4.50	2.96	55.91	--	--	--	--
Lysippe labiata	--	--	--	--	0.75	0.08	0.01	0.06	--	--	--	--
Mollusca												
Pelecypoda	--	--	--	--	2.99	0.05	0.06	0.32	--	--	--	--
Yoldia sp.	--	--	--	--	0.75	0.04	0.25	0.21	--	--	--	--
Yoldia hyperborea	37.50	1.86	4.51	239.25	81.34	10.92	41.54	267.09	--	--	--	--
Yoldia seminuda	--	--	--	--	0.75	0.05	0.58	0.47	--	--	--	--
Musculus niger	--	--	--	--	7.46	0.14	0.57	5.29	--	--	--	--
Musculus Corrugates	--	--	--	--	0.75	0.01	0.01	0.01	--	--	--	--
Cyclocardia ventricosa	6.25	0.10	0.03	0.81	--	--	--	--	--	--	--	--
Clinocardium ciliatum	--	--	--	--	2.99	0.07	0.08	0.44	--	--	--	--
Serripes groenlandicus	12.50	0.20	0.19	4.87	8.96	0.14	0.58	6.45	--	--	--	--
Mya sp.	--	--	--	--	8.96	0.14	0.40	4.83	--	--	--	--
Lyonsia norvegica	--	--	--	--	2.24	0.04	0.06	0.20	--	--	--	--
Gastropod												
Naticidae	--	--	--	--	0.75	0.01	0.04	0.03	--	--	--	--
Polinices pallida	--	--	--	--	0.75	0.01	0.01	0.01	--	--	--	--
Admete sp.	--	--	--	--	1.49	0.62	0.02	0.05	--	--	--	--
Cylichna occults	--	--	--	--	0.75	0.01	0.01	0.01	--	--	--	--
Arthropods												
Crustacea	--	--	--	--	0.75	0.01	0.01	0.01	--	--	--	--
Cumacea												
Leucon sp.	--	--	--	--	0.75	0.02	0.01	0.02	--	--	--	--
Diastylis sp.	--	--	--	--	6.72	0.32	0.09	2,75	--	--	--	--
Diastylis sulcata	--	--	--	--	0.75	0.06	0.01	0.05	--	--	--	--
Isopoda												
Synidotea nodulosa	12.50	0.88	0.35	15.37	26.87	0.73	0.41	30.63	--	--	--	--
Amphipoda	12.50	0.20	0.06	3.25	5.97	0.24	0.12	2.14	--	--	--	--
Gammaridae	--	--	--	--	0.75	0.01	0.01	0.01	--	--	--	--
Pontoporeia femorata	--	--	--	--	1.49	0.04	0.02	0.03	--	--	--	--

TABLE XIV (Continued)

Food Items	NORTON SOUND SE=16 Frequency F	Percent Number N	Volume V	Index of relative importance F (N+V)	PORT CLARENCE SE=134 Frequency F	Percent Number N	Volume V	Index of relative importance F(N+V)	CHUKCHI SEA SE=26 Frequency F	Percent Number N	Volume V	Index of relative importance F (N+V)
Decapoda												
Hippolytidae	--	--	--	--	--	--	--	--	**19.23**	**5.66**	**3.73**	**180.56**
Crangon **sp.**	--	--	--	--	**1.49**	0.02	0.02	0.05	--	--	--	--
Crangon dalli	6.25	0.10	0.32	2.62	--	--	--	--	--	--	--	--
Argis lar	--	--	--	--	0.75	0.01	0.04	0.03	--	--	--	--
Chionoecetes opilio	**6.25**	**14.30**	**1.58**	**99.25**	0.75	0.35	2.24	1.94	--	--	--	--
Echiuroidea												
Echiurida												
Echiurus echiurus alaskensis	--	--	--	--	--	--	—	--	**46.15**	**28.30**	50.88	**3654.15**
Priapulida												
Priapulus caudatus	**6.25**	0.29	**0.44**	4.56	**20.90**	0.35	2.81	**66.04**	--	--	--	--
Echinodermata												
Echinoidea												
Echinarachnius parma	**31.25**	24.19	75.47	3114.37	0.75	0.06	0.04	0.07	--	--	--	--
Ophiuroidea												
Diamphiodia craterodmeta	**43.75**	57.49	**15.35**	**3186.75**	52.24	79.54	38.16	**6148.64**	--	--	--	--
Stegophiura nodosa	--	--	--	--	0.75	0.02	0.02	0.03	3.85	27.36	7.83	**135.48**
Unidentified Ophiuroids	**6.25**	0.10	0.03	**0.81**	--	--	--	--	--	--	--	--
Urochordata												
Ascidiacea	--	--	--	--	--	--	--	--	**11.54**	7.55	**0.11**	88.39
Pelonaia corrugata	--	--	--	--	0.75	0.05	0.05	0.07	--	--	--	--
Chordata-Pisces	--	--	--	--	--	--	--	--	3.85	9.43	9.32	72.18
Osteichthyes												
Eleginus gracilis	--	--	--	--	0.75	0.01	6.23	4.68	3.85	0.94	0.37	5.04
Myoxocephalus **ap.**	--	--	--	--	0.75	0.01	0.71	0.54	--	--	--	--
Lumpenus fabricii	--	--	--	--	--	--	--	--	38.46	19.81	23,29	1657.62

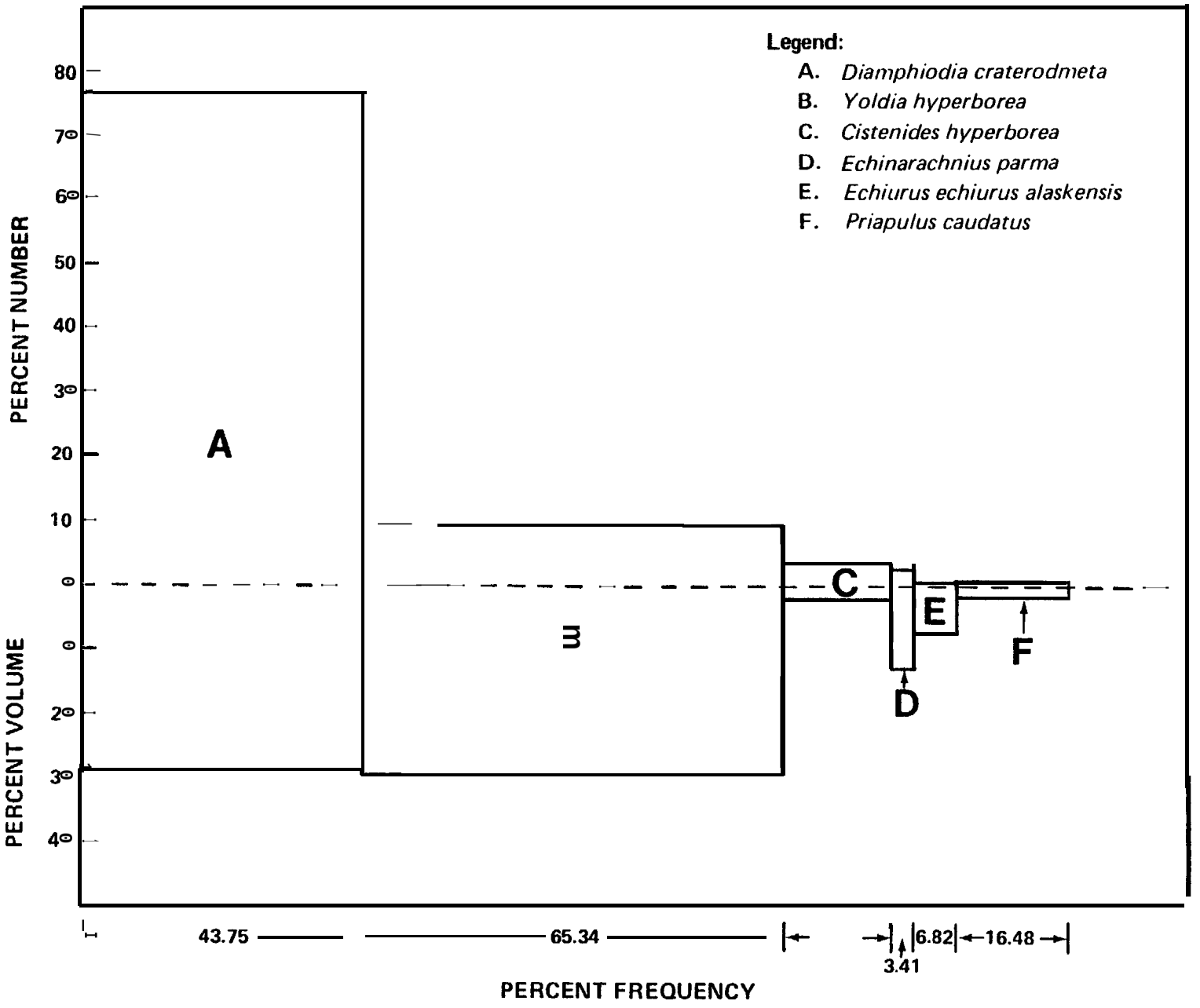

Figure 21. Percent composition by number, volume, and frequency of occurrence of major food items from 176 starry flounders, *Platichthys stellatus*, from Norton Sound, Port Clarence and the Southeastern Chukchi Sea.

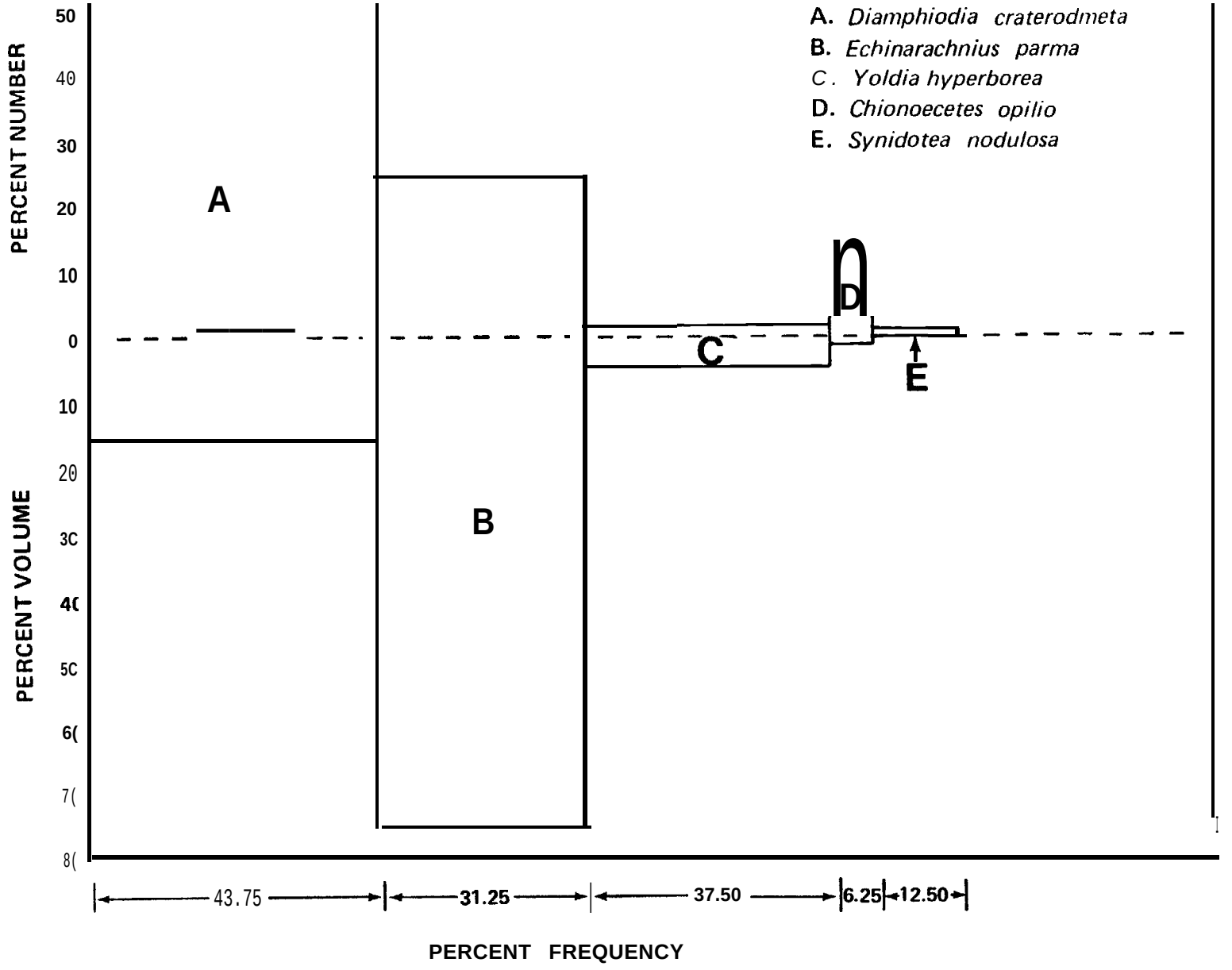

Figure 22. Food web for starry flounders, *Platichthys stellatus*, from Norton Sound, port Clarence and Southeastern Chukchi Sea. The thickness of lines in the food web indicates the relative importance of prey items.

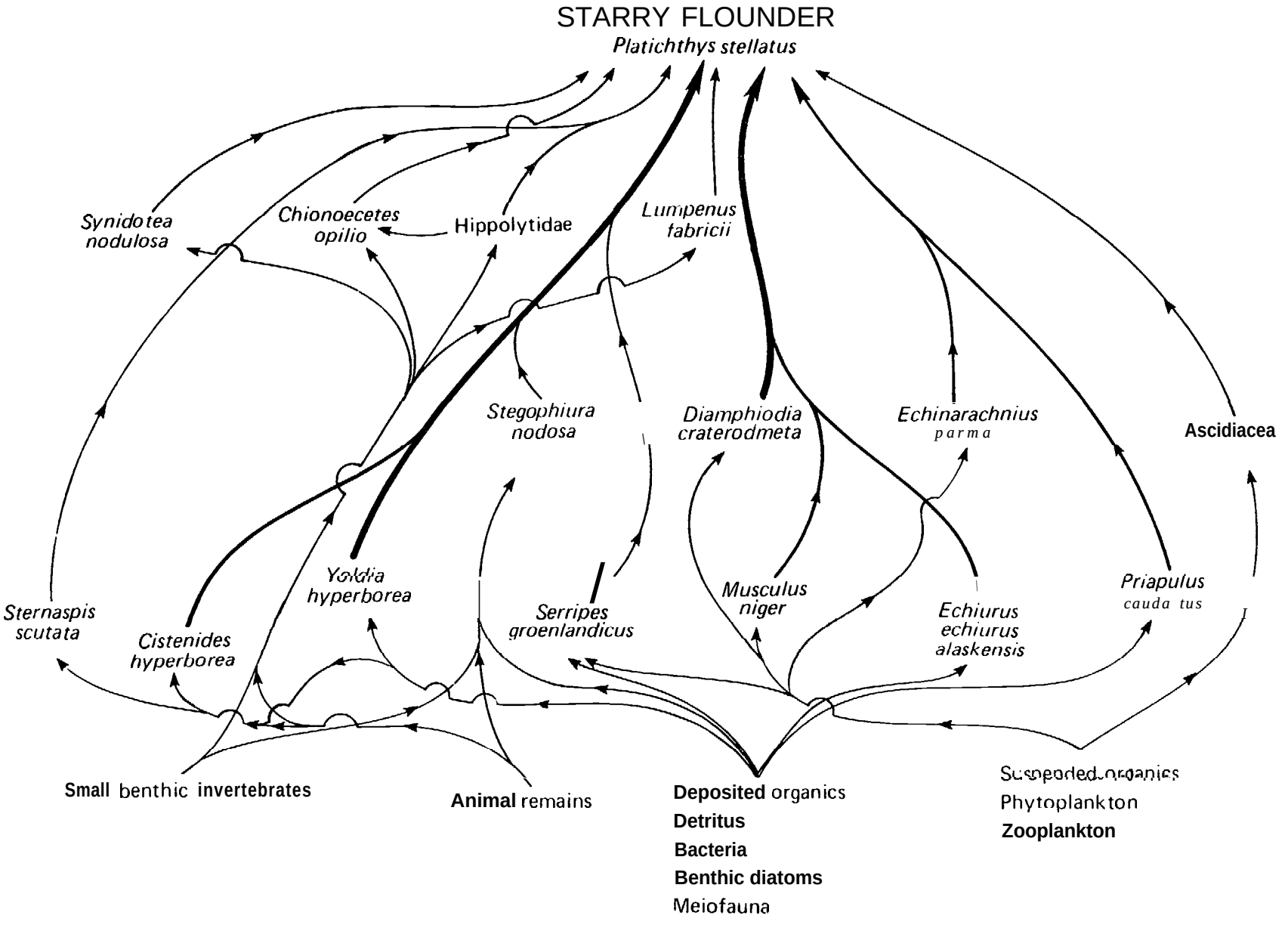

Figure 23. The relative importance of major food items of starry flounders from Norton Sound, Port Clarence, and the Southeastern Chukchi Sea. See Sect. V of the text for discussion of the Index of Relative Importance (IRS).

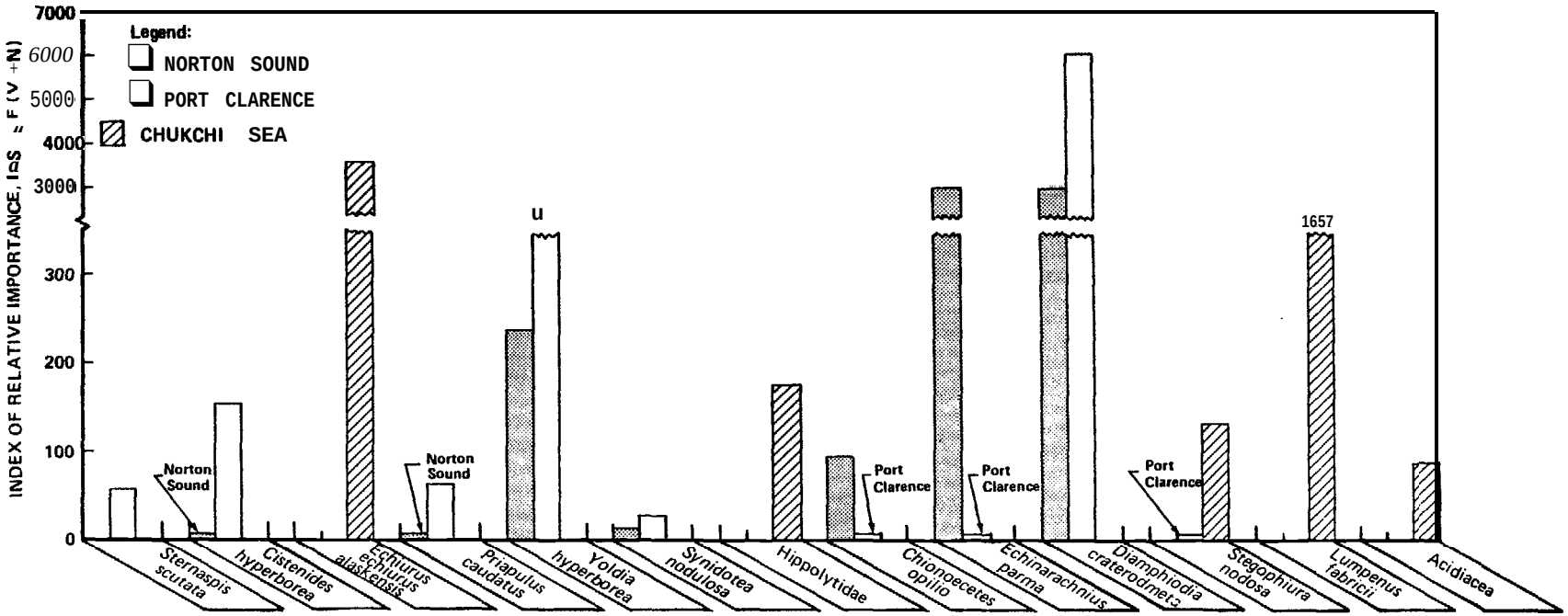

Figure 24. Percent composition by number, volume, and frequency of occurrence of major food organisms from 16 Norton Sound starry flounders.

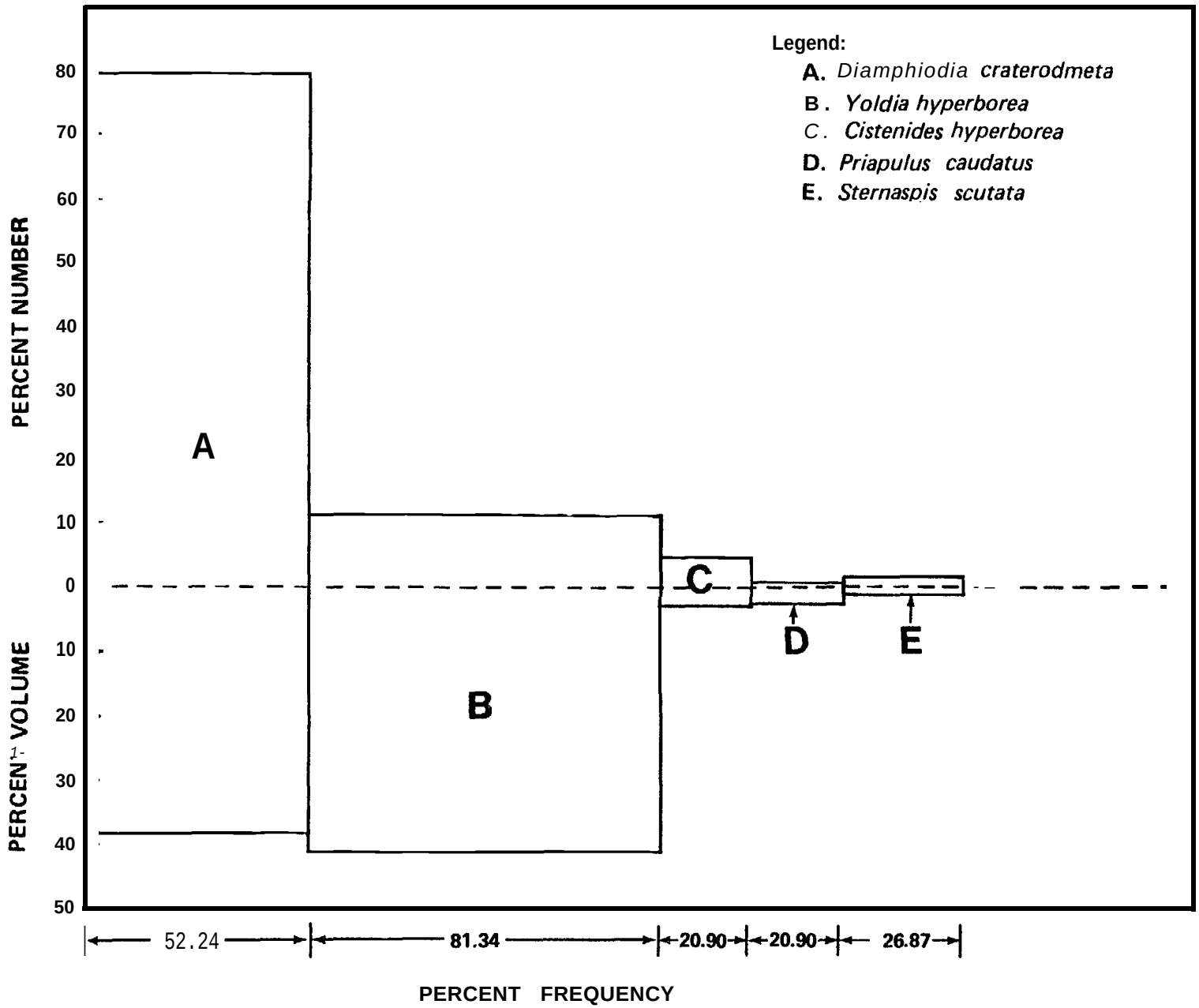

Figure 25. Percent composition by number, volume, and frequency of occurrence of major food items from 134 Port Clarence starry flounders.

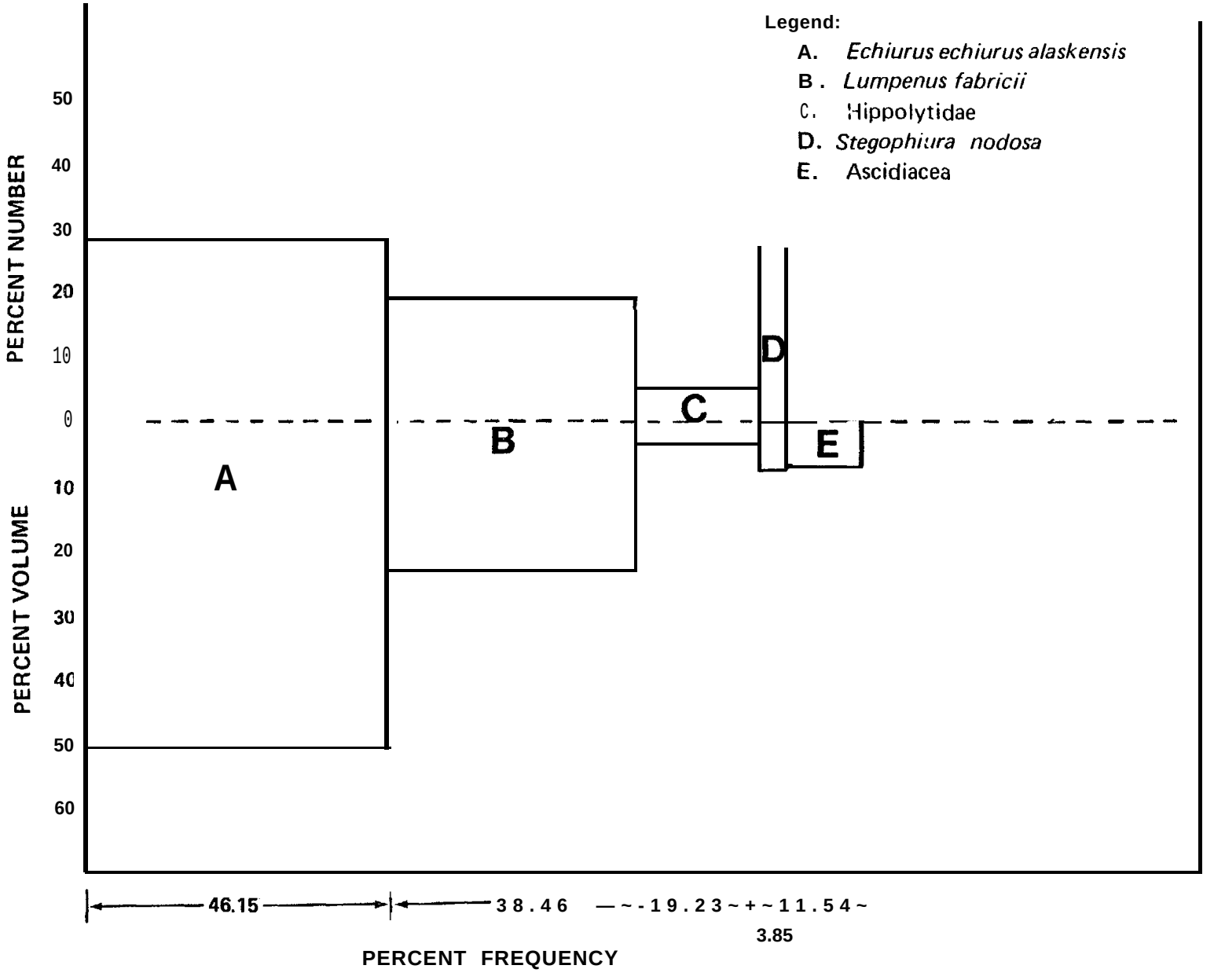

Figure 26. Percent composition by number. volume, and frequency of occurrence of major food items from 26 southeastern Chukchi Sea starry flounders.

currence, were the protobranch clam, *Yoldia hyperborea* (35.9%), the brittle star, *Diamphiodia craterodmeta (25.7%),* the Greenland cockle, *Serripes groenlandicus* (22.6%], and the mussel, *Musculus niger (14.0%)* (Table XIII).

Fourteen different organisms were identified from 16 starry flounders examined by the quantitative method of analysis (Table XIV; App. Table X). In decreasing order of relative importance, the major prey items were *Diamphiodia craterodmeta, Echinarachnius parma, Yoldia hyperborea,* the snow crab, (*Chionoecetes opilio*), and an isopod (*Synidotea nodulosa*) (Table XIV; Fig. 24).

Port Clarence - Stomach contents of 134 starry flounders were examined from this area by the quantitative method. Forty (40) food items were identified, with annelids and molluscs leading in species representation (Table XIV: App. Table XI). The major food items, in decreasing order of relative importance, were *Diamphiodia craterodmeta, Yoldia hyperborea, Cistenides hyperborea, Priapulus caudatus*, and an errant polychaete (*Sternaspis scutata*) (Table XIV; Fig. 25).

Whole organisms were typically consumed, but the caudal appendage of the burrowing worm, *Priapulus caudatus*, was occasionally the only portion of this animal taken.

Southeastern Chukchi Sea - A small sample of 26 starry flounder was examined by the quantitative method from the southeastern portion of the Chukchi Sea. Major food organisms, in terms of decreasing relative importance, were *Echiurus echiurus alaskensis*, the prickleback

fish (*Lumpenus fabricii*), shrimps of the family Hippolytidae, a brittle star (*Stegophiura nodosa*), and unidentified tunicates of the class Ascidiacea (Table XIV; App. Table XII; Fig. 26).

Typically, only the anterior portion of the worm-like *Echiurus* was consumed. *Echiurus* burrows in the sediment-with its proboscis at the surface, and the entire worm is rarely fully exposed (Meglitsch, 1972).

The prickleback fish, *Lumpenus fabricii*, ranged from 85-160 mm in length, and was always swallowed whole. As many as 18 of these fish were found in a single stomach.

The five starry flounders examined by the frequency of occurrence method showed the same organisms to be important.

Reproductive Observations

Reproductive observations were made on five species of shrimps, eight species of crabs, and two species of sea stars (Table XV). Most reproductive data were obtained from the Norton Sound area.

Most of the shrimp data are for the shrimp, *Argislar.* More than 12,000 individuals of this species were examined from 62 stations of the Norton Sound area, and nearly 5,000 were examined from 24 Chukchi Sea - Kotzebue Sound stations. In Norton Sound, 17% had blue and green ovaries visible through the cephalothorax and 24% were carrying aqua or green eggs attached to their pleopods. In the Chukchi Sea - Kotzebue Sound area, 23% were carrying aqua eggs.

A summarization of the reproductive observations of *Pandalus goniurus, Argis lar, Crangon dalli, Sclerocrangon boreas, Eualus gaimardii belcheri, Pagurus trigonocheirus, P. capillatus, P. ochotensis, Labidochirus splendescens,*

TABLE XV

Reproductive observations on selected epifaunal invertebrates by area

Norton Sound Area	Chukchi Sea - Kotzebue Sound Area
Argis lar	
No. stations examined - 62	No. stations examined - 24
No. shrimps examined - 12,136	No. shrimps examined - 4,786
% with blue ovary - 3%	% with aqua eggs - 23%
% with green ovary - 14%	
% with green eggs - 5%	
% with aqua eggs - 19%	
% with internal eggs - 17%	
% with external eggs - 24%	
Crangon dalli	
No. stations examined - 13	No observations
No. shrimps examined - 4,630	
% with pale green eggs - <.01%	
% with white eggs - 9%	
% with eggs - 9%	
Pandalus goniurus	
No. stations examined - 12	No observations
No. shrimps examined - 2,490	
% with green eggs - 1%	
% with aqua eggs - 17%	
% with eggs - 18%	
Sclerocrangon boreas	
No. stations examined - 12	No. stations examined - 2
No. shrimps examined - 539	No. shrimps examined - 2,845
% with tan and green eggs - 6%	Many with green eggs - no % available
% with aqua eggs - 31%	
% with eyed-aqua eggs - 8%	
% with eggs - 45%	
Eualus gaimardii be lcheri	
No. stations examined - 4	No observations
No. shrimps examined - 156	
% with green eggs - 22%	

TABLE XV (Cent'd)

Norton Sound Area	Chukchi Sea - Kotzebue Sound Area
Pagurus trigonocheirus	
No. stations examined - 35	No. stations examined - 3
No. crabs examined - 3,853	No. crabs examined - 429
% with dark purple eggs - 8%	% with dark purple eggs - 6%
Labidochirus splendescens	
No. stations examined - 26	No. stations examined - 3
No. crabs examined - 2,426	No. crabs examined - 112
% with dark purple eggs - 18%	% with purple-black eggs -33%
% with purple-gray eggs - 1%	% with eggs - 33%
% with eggs - 19%	
Pagurus capillatus	
No. stations examined - 9	No. stations examined - 2
No. crabs examined - 1,416	No. crabs examined - 303
% with purple-black eggs - 8%	% with purple eggs - 3%
% with eggs - 8%	
Pagurus ochotensis	
No. stations examined - 9	No observations
No. crabs examined - 412	
% with purple-black eggs - 33%	
% with brown eggs - 1%	
% with eggs - 34%	
Paralithodes camtschatica	
No. stations examined - 9	No observations
No. female crabs examined-412	
% with purple eggs - 15%	
% with brown eggs - 6%	
% with eggs - 21%	
Hyas coarctatus alutaceus	
No. stations examined - 20	No. stations examined - 14
No. female crabs examined-739	No. female crabs examined-707
% with orange eggs - 17%	% with orange eggs - 24%
% with eyed eggs - 1%	% with purple eggs - 1%
% with eggs - 18%	% with dark brown eggs - 1%
	% with eggs - 26%

TABLE XV (Cent'd)

Norton Sound Area		Chukchi Sea - Kotzebue Sound Area	
Chionoecetes opilio			
No. stations examined -	6	No. stations examined -	6
No. female crabs examined -	432	No.. female crabs examined -	1,908
% with orange eggs -	4%	% with orange eggs -	5%
Telmessus cheiragonus			
No. stations examined -	9	*No.* stations examined -	21
No. female crabs examined -	403	No. female crabs examined -	not determined
% with orange ovaries -	29%	None with eggs; all large females	
Z with orange eggs -	2%	with orange ovaries.	
Leptasterias polaris acervata			
No. stations examined -	2	*No.* stations examined -	6
No. sea stars examined -	87	No. sea stars examined -	6,318
% brooding young -	2%	% brooding young -	<.1%
Leptasterias sp.			
No. stations examined -	16	*No.* stations examined -	5
No. sea stars examined -	1,784	No. sea stars examined -	322
% with orange eggs in oral region -	2%	% with orange eggs in oral region -	1%
% with brooding young -	3%	% with brooding young -	1%

Paralithodes camtschatica, *Hyas coarctatus alutaceus*, *Chionoecetes opilio*, *Telmessus cheiragonus*, *Leptasterias polaris acervata*, and *Leptasterias* sp. *is* found in Table XV.

Twenty-nine percent of the female horse *crab, Telmessus cheiragonus*, examined in Norton Sound stations contained-orange ovaries; 2% were bearing eggs. None of the *T. cheiragonus in the* Chukchi Sea - Kotzebue Sound stations were bearing eggs, but all of the large females examined contained orange ovaries.

Parasitological Observations

Microscopic examination of nodules on the aboral surface of two sea stars, *Leptasterias polaris acervata* and *Leptasterias* sp. from randomly selected stations revealed the presence of unidentified parasitic gastropod.[1] As many as 25 nodules up to 2.5 cm in diameter were observed on some specimens. Parasitized *L. polaris acervata was* observed in seven scattered stations in the Norton Sound area and 11 localized stations in the Chukchi Sea - Kotzebue Sound area; the percentage of parasitized individuals in the respective stations was 15% and 10% (Table XVI, Fig. 1).

Stations with parasitized *Leptasterias* sp. were localized in the Norton Sound area. The percentage of infection at these stations was 13% (Table XVI) . Samples from only four stations in the Chukchi Sea area contained parasitized *Leptasterias* sp.

Other parasitic observations included: rhizocephalids (parasitic barnacles) attached to the abdomen of hermit crabs, specifically *Pagurus capillatus*; parasitic isopods found under the cephalothorax of shrimps, primarily *Argis lar.*

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[1] Taxonomic work and further aspects of the biology of this parasitic gastropod will be included in B. MeCain, R. U. 332.

TABLE XVI

Occurrence of parasitic gastropod on two sea stars in the Norton Sound and Chukchi Sea - Kotzebue Sound sampling areas, 2 September-13 October, 1976

P indicates parasitism observed but not enumerated.

Leptasterias polaris acervata

Norton Sound

Station	No. Examined	Parasitized No.	Parasitized %
C-61	8	3	38
C-55	52	11	21
C-48	30	1	3
C-51	31	3	10
C-64	4	1	25
C-39	13	1	8
D-62	4	1	25
Totals	142	21	15

Chukchi Sea

A-19	153	23	15
A-17	287	13	5
A-27	132	36	27
A-56	416	7	2
A-26	112	24	21
A-32	110	21	19
A-31	P	P	P
A-25	P	P	P
B-6	P	P	P
A-16	P	P	P
A-30	P	P	P
Totals	1,210	124	10

Leptasterias sp.

Norton Sound

Station	No. Examined	Parasitized No.	Parasitized %
C-60	26	8	31
C-56	47	1	2
C-51	48	11	23
C-50	30	6	20
C-52	43	17	40
C-33	1,348	202	15
C-32	601	30	5
C-61	8	1	13
D-87	12	1	8
D-39	24	6	25
Totals	2,187	283	13

Chukchi Sea

A-2	11	3	27
A-1	5	3	60
B-20	22	5	23
B-7	P	P	P
Totals	38	11	29

VII. DISCUSSION

General Observations

Most invertebrate species collected in this investigation were reported in other benthic studies of the northeastern Bering Sea shelf and southeastern Chukchi Sea (Ellson *et al.*, 1950; Neiman, 1963; Sparks and Pereyra, 1966; Feder and Mueller, 1974; and Stoker, in prep.). The majority of the species identified are of boreal Pacific origin. The near absence of higher arctic species is not surprising in view of the strong northerly currents that prevail during the summer months on the eastern side of the Bering Sea, Bering Strait, and the Chukchi Sea (Stoker, in prep.). Likewise, Pruter and Alverson (1962) found few high arctic species of flatfishes in the southeastern Chukchi Sea.

Benthic trawl studies in the northeast Gulf of Alaska and the southeast Bering Sea showed that arthropod crustaceans dominated the invertebrate biomass, with 71.4% and 61.7% in the respective regions (Jewett and Feder, 1976; Feder *et al.*, 1977a). The total echinoderm biomass from each of these areas was 19.0% and 17.5%, respectively. Trawl surveys in the coastal waters of Norton Sound, near Nome, and the southeastern Chukchi Sea showed that echinoderms (especially asteroids) dominated the invertebrate biomass (Feder and Mueller, 1974; Sparks and Pereyra, 2966). The echinoderm biomass in the present study was 80.3% in the Norton Sound area and 59.9% in the Chukchi Sea - Kotzebue Sound area. This change in dominance from crustaceans to echinoderms in the northern waters examined may be attributable to an increased availability of food for the echinoderms. This availability of food may, in turn, reflect

the absence of large populations of competing crabs and demersal fishes in these northern regions (Neiman, 1963), many of which use similar food items elsewhere (Feder and Jewett, 1977; Feder *et al.*, 1977a).

Since sea stars made up 69 and 48% of the total epifaunal invertebrate biomass in the Norton Sound and the Chukchi *Sea* - Kotzebue Sound areas, respectively, their importance cannot be overlooked. Sea stars are not typically utilized at higher trophic levels (Feder et *al.*, 1974; Feder, unpubl. data from the Gulf of Alaska and Bering Sea), and are known to be long lived (Hyman, 1955). Thus, it would appear that these animals represent relatively immobile carbon reservoirs. However, a considerable portion of sea-star carbon is, in fact, returned to the sea annually as gamete production (Feder and Paul, unpubl.). For example, Hatanaka and Kosaka (1958) calculated that 20-30% of the weight of *Asteria amurensis* in Tokyo Bay is gonadal material which is ultimately extruded during spawning (also see Feder, 1956 and 1970 for comments on the reproductive biology of the sea star *Pisaster ochraceus*). Sea stars generally exhibit distinct annual reproductive cycles, and those species that shed their gametes into the surrounding water tend to liberate their sex products over short periods of time (Feder, 1956, Boolootian, 1966). Such pulses of high energy reproductive material during the spawning of large populations of sea stars probably represent important components of secondary production in the study areas.

The epifaunal standing stock reported in the present study is similar to standing stock estimates presented in OCSEAP benthic trawl studies elsewhere, i.e., see Jewett and Feder, 1976; Feder *et al.*, 1977a; and Feder and Jewett, 1977. The total biomass of epifaunal invertebrates in the northeast Gulf of Alaska and two bays around Kodiak Island was 2.6 g/m^2 (Jewett and Feder, 1976) and 4.7 g/m^2 (Feder and Jewett, 1977) respectively. The

epifaunal biomass in the present study deviated little from past studies, i.e., 3.7 g/m^2 in the Norton Sound area and 3.3 g/m^2 in the Chukchi Sea - Kotzebue Sound area.

Russian benthic investigations (Neiman, 1963), provide biomass estimates based on grab samples for infauna and small epifauna from the southeast Bering Sea with the lowest value reported as 55 g/m^2. Use of a commercial trawl results in the loss of infaunal and small epifaunal organisms that are an important part of the benthic biomass. Therefore, the total benthic biomass value is probably best expressed by combining both grab and trawl values. Combined infaunal and epifaunal surveys should be part of all future investigations designed by OCSEAP.

Highest biomass stations for *nine* of the 17 dominant species (Tables V, VIII; Figs. 3-5, 9-12, 17, 19) are located in northern Norton Sound, primarily off Nome, extending northwest to the Bering Strait. The highest biomass stations for the remaining eight dominant species were scattered throughout the Chukchi Sea - Kotzebue Sound area (Tables V, VIII; Figs. 6-8, 13-16, 18). Most of these organisms rely on detritus either directly or indirectly. The main current flow in the St. Lawrence Island into Norton Sound before flowing toward the Bering Strait (Ellson *et al.*, 1950). Due to the shallow depth, these currents likely extend from the surface to the bottom. Substantial sediment input from the Yukon and Kuskokwim Rivers are carried by these currents and the finer fractions settle out as the velocity decreases (McRoy and Goering, 1976). Near its source, this sediment input (consisting largely of coarser and heavier fractions), may smother many species, and may markedly deter settlement of benthic larvae (Stoker, in prep.). This effect, as well as the low chlorinity and salinity

from these rivers (Ellson, *et al.*, *1950),* probably account for the many low diversity stations off the Yukon River.

Feeding Observations

Sea Stars

The sea stars, *Leptasterias polaris acervata, Evasterias echinosoma,* and *Lethasterias nanimensis* are food generalists, and their diet is probably determined largely by the relative abundance of prey species available to them. These three sea-star species exhibit extraoral feeding and typically remain arched over their prey when taken from the bottom. Although certain species have been identified as more frequently consumed prey items than other species, spatial and seasonal variations as well as preference and availability of prey have not been examined. Therefore, caution must be exercised in interpreting the present feeding data.

Starry Flounders

Major food groups consumed by *Platichthys stellatus* from the northern limits of its range do not differ from those taken by the fish in other geographic localities (Orcutt, 1950; Miller, 1967). The main organisms preyed upon by starry flounders in the present study were the brittle star, *Diamphiodia craterodmeta,* and the protobranch clam, *Yoldia hyperborea.* Although brittle stars are reported from *P. stellatus* stomach contents in other areas, they were never consistently important food items there (Orcutt, 1950; Moiseev, 1953; and Miller, 1967). Orcutt (1950) occasionally found the entire digestive tract of starry flounders filled with the brittle star *Ophiura lütkeni* (disc diameter 12-25 mm), and Miller (1967) observed the brittle star, *Amphiodia* sp. among gut Contents, The gut contents of starry

flounders from Port Clarence and Norton Sound, the two areas where the largest samples were obtained, were dominated by *Diamphiodia craterodmeta*. Nearly *600* of these tiny brittle stars (disc diameter 1.5-7 mm) were found in a single gut in Port Clarence; typically 20-200 brittle stars were observed per digestive tract.

Small clams, particularly thin-shelled species, are reported to be a main food group of adult starry flounders elsewhere (Villadolid, 1927; Orcutt, 1950; Moiseev, 1953; Miller, 1967; Jewett and Feder, 1976). The digestive tracts of starry flounders in the present study were often completely filled with the thin-shelled clam *Yoldia hyperborea*. Other bivalves, such as *Serripes groenlandicus* and *Musculus niger*, were also important food items for starry flounders in Norton Sound (Table XIV). These molluscs were usually swallowed whole. The selectivity for *Diamphiodia craterodmeta* and Y. *hyperborea* is probably due to their high abundance in the sampling areas and their vulnerability at the sediment surface (Feder, unpub. data).

The proboscis of *Echiurus echiurus alaskensis* and the caudal appendages of *Priapulus caudatus* lie close to the surface during feeding and defecating activities, and, therefore, are readily accessible to active bottom feeding fishes, such as *P. stellatus*. *Priapulus* has previously been reported as food for starry flounders (Miller, 1967; Land, 1970).

The prickleback, *Lumpenus fabricii*, was an important food of starry flounders in the Chukchi Sea. However, fishes are not commonly consumed by *P. stellatus*. Starry flounders from the San Juan Archipelago did not contain fishes (Miller, 1967) although, small fishes such as *Sardinops*,

Citharichthys, *Cymatogaster* and *Lycodopsis* have been listed as uncommon food for this species (Villadolid, 1927; Orcutt, 1950; Clemens and Wilby, 1961).

The shortcomings of the Index of Relative Importance (IRI) are noted by Pinkas *et al*. (1971). They point out that frequency of occurrence tabulations are sensitive to sampling error, numerous small organisms overshadow the importance of a few large ones, and differential digestion rates distort volumetric measurements. In our data, *Chionoecetes opilio* appears as one of the major food organisms for Norton Sound starry flounders. However, only one stomach contained this crab which amounted to less than 5 ml in volume. The reason for the high index is explained by the large number of small individuals present, 146 megalopa larvae. A similar situation is noted for *Stegophiura nodosa* in the Chukchi Sea. In the latter case, only one stomach contained the prey, but the percent by number and volume was high enough to yield a high index. Both of the previous illustrations came from small samples; Norton Sound - 16 stomachs and the Chukchi Sea - 26 stomachs, respectively. For the best interpretation of the importance of food organisms, larger samples should be available e.g., Norton Sound - 134 stomachs available for analysis. Although the IRI may fall short of the theoretical ideal, it does allow one to handle the importance of various foods when frequency of occurrence, numerical, and volumetric data is available.

Food items of major importance in the diet of starry flounders tend to differ in each of the study areas. These food differences probably reflect differential prey selectivity and/or differences in prey density and/or availability of the prey in each area. Although *Diamphiodia craterodmeta* and *Yoldia hyperborea*, were food organisms of major importance to

starry flounders of Norton Sound and Port Clarence, they were completely absent from the diet of the Chukchi Sea starry flounders. The availability of prey organisms to starry flounders and the comprehension of their biological interactions with *P. stellatus* can only be fully understood when accomplished in conjunction with quantitative sampling via grabs and/or dredges as well as further trawl sampling. Grab and dredge activities were not part of the present study.

Platichthys stellatus belongs to a group of flatfishes normally having eyes on the right side (dextral), but, reversed individuals having eyes on the left side (sinistral) are very common in this species. There is a regional trend in the degree of sinistral starry flounders (see Orcutt, 1950, for a review of the geographic variations in the starry flounder). In general, the proportion of sinistral specimens increases northward along the east Pacific and dextral specimens are nearly absent from Japan waters. The percent of sinistral fish in the present study (64.7%) coincide with the findings of Townsend (1937) i.e., 67.1% of starry flounder from Alaska were sinistral.

Starry flounders may not be perennial inhabitants of the Chukchi Sea. Pruter and Alverson (1962) found only one starry flounder while conducting a demersal trawl investigation in the southeastern Chukchi Sea during August, 1959. In discussing variations in the biomass of food benthos in the Bering Sea, Neiman (1963) suggests that yearly fluctuations in water temperature, rather than availability of food, may be the determining factor responsible for the northern distribution of flatfishes. In the study of Pruter and Alverson (1962) the average bottom water temperature was 4.9°C. However, in the present study where the average bottom water temperature was 6.3°C, nearly 100 starry flounders were

caught in the southeastern Chukchi Sea. It seems unlikely that small temperature differences alone are sufficient to cause movement of *P. stellatus* into the Chukchi Sea during fall months. Perhaps other physical factors such as water currents and 0_2 content act synergistically in northward movement of starry flounders.

Reproductive Observations

Little is known about the reproductive biology of invertebrate species for the Norton Sound - Chukchi Sea - Kotzebue Sound areas. Knowledge of the reproductive condition of species may be useful in view of probable increased petroleum mineral and fishing exploration in northern waters. It may be useful in the sense that reproductive data might suggest that probing certain areas during critical reproductive periods should be avoided, i.e. mating, spawning, and/or egg bearing and egg-hatching periods. Examination of the percentage of different egg colors in invertebrates should give some initial insights to the developmental sequence.

The color of king crab (*Paralithodes camtschatica*) eggs elsewhere progresses from dark purple when deposited, to light purple, to light tan in the eyed-egg condition (personal observation). The egg color of the snow crab (*Chionoecetes bairdi*) elsewhere transform from bright orange when deposited, to eyed-light-tan eggs just prior to hatching (personal observation). Presumably, similar color changes of eggs from *P. camtschatica* and C. *opilio* occur in the study area.

The sequence of egg maturation for most of the other species listed in Table XV is not known.

VIII . CONCLUSIONS

Trawling operations in the Norton Sound resulted in the collection of 13 phyla and 187 species; 11 phyla and 171 species were collected in the Chukchi *Sea* - Kotzebue Sound area. Mollusca, Crustacea, and Echinodermata are the most heavily represented phyla with 74, 45, and 27 species respectively in the Norton Sound Area and 70, 36, and 24 species respectively in the Chukchi Sea - Kotzebue Sound area. Echinoderms, primarily sea stars, made up the major portion of the invertebrate biomass with 80.3% from the Norton Sound area and 59.9% from the Chukchi Sea - Kotzebue Sound area. Arthropod crustaceans and molluscs also contributed considerably to the overall biomass from both areas.

Since sea stars make up the bulk of the epifaunal invertebrate biomass in the study areas, their biological importance cannot be overlooked. It is suggested that these sea stars do not represent relatively immobile carbon reservoirs as has been often suggested, but, instead, that they contribute pulses of high energy organic material, as gametes, into adjacent waters, during their spawning periods. It is possible that the gametes shed by large populations of sea stars in the study areas represent important components generally overlooked in calculations of secondary productivity.

There is now a satisfactory knowledge, on a station basis (for the months sampled), of the distribution, abundance and biomass of the major epifaunal invertebrates in the study areas. Additional seasonal data are essential. It is only when such continuing information is available that a reasonable biological assessment of the effect of an oil spill on these areas can be made.

The sea stars, *Leptasterias polaris acervata*, *Evasterias echinosoma*, and *Lethasterias nanimensis* are food generalists, and their diet is probably determined largely by the relative abundance of prey species available to them. The latter two species fed mainly upon clams, specifically the Greenland cockle *Serripes groenlandicus*. Due to lack of dredge or grab data on the abundance of infauna in the area, it is not known whether this variability in consumption of food items are due to preference or availability of these items.

Analysis of stomach contents of the starry flounder *Platichthys stellatus* show many differences in the feeding habits between Norton Sound, Port Clarence and the southeastern Chukchi Sea. Starry flounders from Norton Sound mainly use the deposit-feeding clam, *Yoldia hyperborea*, and the small brittle star, *Diamphiodia craterodmeta*, as food, while starry flounders from southeastern Chukchi Sea mainly consume the proboscis worm, *Echiurus echiurus alaskensis*, and the prickleback fish, *Lumpenus fabricii*.

Availability of many readily identifiable, biologically well understood organisms is a preliminary to the development of monitoring programs. Sizeable biomasses of taxonomically well-known echinoderms, crustaceans, and molluscs were typical of most of our stations, and many species of these phyla were sufficiently abundant to represent organisms potentially useful as monitoring tools. The present investigation has clarified several aspects of the biology of some of these organisms, and should aid in the development of future monitoring programs for the Norton Sound - Chukchi Sea - Kotzebue Sound areas.

IX. NEEDS FOR FURTHER STUDY

1. Although the trawling activities were satisfactory for determination of the distribution, abundance, and biomass of epifauna, a substantial component of both areas, the infauna, was not sampled. Since infaunal species represent important food items, it is essential that dredging and grab sampling be accomplished in the near future.

2. Additional studies are needed during other seasons and years to describe seasonal and year-to-year variations in the distribution, relative abundance and biomass, and reproductive biology of the epifauna.

3. Seasonal predator-prey relationships should be examined in conjunction with simultaneous infaunal sampling.

4. It is essential that large samples of the dominant clam prey species be obtained to initiate recruitment, age, growth, and mortality studies. These data will then be comparable to similar data being collected for clams of Cook Inlet and the Bering Sea (Feder *et al.*, 1977a). Any future modeling efforts concerned with carbon or energy flow in the Norton Sound - Chukchi Sea area will need this type of information.

5. No systematically collected physical, chemical, and geological data are currently available. These, data should be obtained in the future in conjunction with all biological sampling efforts.

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APPENDIX TABLE I

Occurrence of each species in the Norton Sound area
September-October 1976

A total of 106 stations were occupied. Taxonomic names represent the lowest level of identification

Taxonomic Name	Relative Occurrence	% of all Occurrences	% of all Sta.[2]
Porifera	17	0.583	16.038
Phakellia sp.	7	0.240	6.604
Phakellia cribrosa	1	0.034	0.943
Cnidaria	5	0.172	4.717
Hydrozoa	22	0.755	20.755
Sertulariidae	3	0.103	2.830
Scyphozoa	31	1.064	29.245
Anthozoa	20	0.686	18.869
Eunephthya rubiformis	69	2.368	65.094
Stomphia sp.	10	0.343	9.994
Stomphia coccinea	18	0.618	16.981
Actiniidae	51	1.750	48.113
Rhynchocoela	3	0.103	2.830
Polychaeta	8	0.275	7.547
Polynoidae	48	1.647	45.283
Arctonoe vittata	1	0.034	0.943
Eunoe depressa	4	0.137	3.774
Eunoe senta	2	0.069	1.887
Nereidae	2	0.069	1.887
Nereis sp.	2	0.069	1.887
Brada villosa	1	0.034	0.943
Sternaspis scutata	1	0.034	0.943
Cistenides hyperborea	2	0.069	1.887
Terebella sp.	2	0.069	1.887
Sabellidae	8	0.275	7.547
Potamilla sp.	1	0.034	0.943
Jasminiera sp.	2	0.069	1.887
Carcinobdella sp.	4	0.137	3.774
Cryptochiton stelleri	1	0.034	0.943
Amicula pallasii	1	0.034	0.943
Amicula vestita	6	0.206	5.660
Yoldia sp.	1	0.034	0.943
Yoldia hyperborea	4	0.137	3.774
Yoldia myalis	5	0.1.72	4.717
Glycymeris subobsoleta	2	0.069	1.887
Mytilus edulis	10	0.343	9.434
Musculus niger	1	0.034	0.943
Musculus discors	22	0.755	20.755
Chlamys rubida	1	0.034	0.943
Astarte borealis	9	0.309	8.491
Astarte montagui	2	0.069	1.887

APPENDIX TABLE I (Cent'd)

Taxonomic Name	Cumulative Occurrence	% of all Occurrences	% of all Sta.
Cyclocardia crebricostata	4	0.137	3.774
Cyclocardia crassidens	1	0.034	0.943
Pseudopythina sp.	1	0.034	0.943
Clinocardium sp.	1	0.034	0.943
Clinocardium ciliatum	13	0.446	12.264
Clinocardium nuttallii	1	0.034	0.943
Clinocardium californiense	10	0.343	9.434
Serripes groenlandicus	68	2.334	64.151
Liocyma fluctuosa	2	0.069	1.887
Spisula polynyma	2	0.069	1.887
Macoma sp.	2	0.069	1.887
Macoma calcarea	6	0.206	5.660
Macoma brota	10	0.343	9.434
Tellina lutes alternidentata	1	0.034	0.943
Mya pseudoarenaria	2	0.069	1.887
Hiatella arctica	28	0.961	26.415
Panomya arctica	1	0.034	0.943
Gastropod	11	0.377	10.377
Margaritas giganteus	1	0.034	0.943
Solariella sp.	1	0.034	0.943
Solariella obscura	1	0.034	0.943
Solariella varicosa	2	0.069	1.887
Tachyrhynchus erosus	1	0.034	0.943
Opalia sp.	1	0.034	0.943
Trichotropis bicarinata	6	0.206	.5.660
Trichotropis insignis	2	0.069	1.887
Trichotropis kroyeri	1	0.034	0.943
Na-tics clausa	3	0.103	2.830
Polinices pallida	2	0.069	1.887
Velutina sp.	3	0.103	2.830
Velutina plicatilis	5	0.172	4.717
Boreotrophon clathratus	3	0.103	2.830
Buccinum sp.	1	0.034	0.943
Buccinum angulosum	12	0.412	11.321
Buccinum scalariforme	3	0.013	2.830
Buccinum glaciale	4	0.137	3.774
Buccinum solenum	1	0.034	0.943
Buccinum polare	5	0.172	4.717
Buccinum fringillum	1	0.034	0.943
Buccinum tenellum	2	0.069	1.887
Ancistrolepis sp.	1	0.034	0.943
Beringius crebricostatus	1	0.034	0.943
Beringius beringi	52	1.784	49.057
Beringius stimpsoni	6	0.206	5.660
Colus spitzbergensis	7	0.240	6.604

APPENDIX TABLE I (Cent'd)

Taxonomic Name	Cumulative Occurrence	% of all Occurrences	% of all Sta.
Colus ambronius	1	0.034	0.943
Colus hypolispus	4	0.137	3.774
Liomesus ooides	1	0.034	0.943
Neptunea ventricosa	66	2.265	62.264
Neptunea communis borealis	13	0.755	12.264
fle~-tunes *heros*	77	2.642	72.642
Plicifusus kroyeri	3	0.103	2.830
Plicifusus verkruzeni	1	0.034	0.943
Pyrulofusus deformis	23	0.789	21.698
Volutopsius sp.	1	0.034	0.943
Volutopsius filosus	1	0.034	0.943
Volutopsius fragilis	10	0.343	9.434
Oenopota harpa	1	0.034	0.943
Obesitoma simplex	1	0.034	0.943
Doridídae	2	0.069	1.887
Doris sp.	1	0.032	0.943
Dendronotus sp.	3	0.103	2.830
octopus sp.	2	0.069	1.887
Pycnogonida	2	0.069	1.887
Balanus sp.	8	0.275	7.547
Balanus balanus	44	1.510	41.509
Balanus rostratus	1	0.034	0.943
Cumacea	2	0.069	1.887
Isopoda	2	0.069	1.887
Idoteidae	2	0.069	1.887
Saduria entomon	17	0.583	16.038
Synidotea bicuspida	13	0.446	12.264
Tecticeps sp.	3	0.103	2.830
Amphipoda	4	0.137	3.774
Ampeliscidae	2	0.069	1.887
Eusirus sp.	10	0.343	9.434
Rhachotropis sp.	3	0.103	2.830
Gammaridae	2	0.069	1.887
Melita sp.	10	0.343	9.434
Melita den-tutu	2	0.069	1.887
Jassa sp.	1	0.034	0.943
Lysianassidae	1	0.034	0.943
Anonyx sp.	11	0.377	10.337
Anonyx nugax pacifica	3	0.103	2.830
Anonyx ampulloides	1	0.034	0.943
Socarnes sp.	1	0.034	0.943
Podoceridae	1	0.034	0.943
Dulichia spinosissima	1	0.034	0.943
Stegocephalus inflatus	3	0.103	2.830
Parathemisto japonica	4	0.137	3.774
Caprellidae	1	0.034	0.943
Pandalus borealis	1	0.034	0.943

APPENDIX TABLE I (Cent'd)

Taxonomic Name	Cumulative Occurrence	% of all Occurrences	% of all Sta.
Pandalus goniurus	49	1.682	46.226
Pandalus hypsinotus	14	0.480	13.208
Lebbeus groenlandica	20	0.686	18.868
Eualus sp.	1	0.034	0.943
Eualus fabricii	3	0.103	2.830
Eualus gaimardii belcheri	18	0.618	16.981
Eualus macilenta	1	0.034	0.943
Crangon dalli	50	1.716	47.170
Sclerocrangon boreas	36	1.235	33.962
Argis lar	104	3.569	98.113
Pagurus ochotensis	36	1.235	33.962
Pagurus capillatus	94	3.226	88.679
Pagurus trigonocheirus	87	2.986	82.075
Labidochirus splendescens	79	2 .711	74.528
Lithodidae	1	0.034	0.943
Hapalogaster grebnitzkii	12	0.412	11.321
Paralithodes camtschatica	58	1.990	54.717
Paralithodes platypus	15	0.515	14.151
Sculptolithodes derjugini	1	0.034	0.943
Hyas lyratus	2	0.069	1.887
Hyas coarctatus alutaceus	59	2.025	55.660
Chionoecetes opilio	61	2.093	57.547
Telmessus cheiragonus	55	1.887	51.887
Golfingia margaritacea	3	0.103	2.830
Echiurus echiurus alaskensis	7	0.240	6.604
Priapulus caudatus	1	0.034	0.943
Ectoprocta	41	1.407	38.679
Flustridae	1	0.034	0.943
Flustra sp.	13	0.446	12.264
Dendrobeania sp.	1	0.034	0.943
Diaperoecia sp.	11	0.377	10.377
Heteropora sp.	2	0.069	1.887
Alcyonidium sp.	6	0.206	5.660
Alcyonidium disciforme	5	0.172	4.717
Alcyonidium vermiculare	6	0.206	5.660
Flustrella gigantea	3	O*103	2.830
Dallinidae	1	0.034	0.943
Laqueus californianus	1	0.034	0.943
Henricia sp.	29	0.995	27.358
Pteraster obscurus	10	0.343	9.434
Crossaster papposus	25	0.858	23.585
Solaster sp.	2	0.069	1.887
Solaster dawsoni	1	0.034	0.943
Asterias amurensis	103	3.535	97.170
Evasterias echinosoma	58	1.990	54.717
Evasterias troschelii	1	0.034	0.943

APPENDIX TABLE I (Cent'd)

Taxonomic Name	Cumulative Occurrence,	% of all Occurrences	% of all Sta.
Leptasterias sp.	72	2.471	67.925
Leptasterias polaris acervata	54	1.853	50.943
Lethasterias sp.	2	0.069	1.887
Lethasterias nanimensis	77	2.642	72.642
Echinoidea	1	0.034	0.943
Echinarachnius parma	19	0.652	17.925
Strongylocentrotus droebachiensis	83	2.848	78.302
Amphiodia sp.	1	0.034	0.943
Amphipholis sp.	18	0.618	16.981
Diamphiodia craterodmeta	4	0.137	3.774
Gorgonocephalus caryi	51	1.750	48.113
Ophiopholis aculeata	2	0.069	1.887
Ophiura sarsi	8	0.275	7.547
Stegophiura sp.	2	0.069	1.887
Stegophiura nodosa	30	1.030	28.302
Cucumaria sp.	4	0.137	3.774
Cucumaria calcigera	1	0.034	0.943
Psolus japonicus	5	0.172	4.717
Chordata:ascidiacea	73	2.505	68.868
Chelyosoma sp.	8	0.275	7.547
Chelyosoma columbianum	2	0.069	1.887
Chelyosoma orientale	2	0.069	1.887
Styelidae	9	0.309	8.491
Styela macrenteron	66	2.265	62.264
Pelonaia corrugata	8	0.275	7.547
Boltenia ovifera	26	0.892	24.528
Boltenia echinata	8	0.275	7.547
Halocynthia sp.	1	0.034	0.943
Halocynthia aurantium	11	0.377	10.377
Salpidae	1	0.034	0.943
	2914	100%	

[1] $\frac{\text{Cumulative occurrence}}{\text{Total cumulative occurrence}}$

[2] $\frac{\text{Cumulative occurrence}}{\text{Total No. of stations occupied}}$

APPENDIX TABLE 11

Percentage composition of all phyla by family from all stations in the Norton Sound area
September-October 1976

Taxonomic Name	Count	% Count	Wt. (gm)	% wt.	gm/m^2 all Sta.
Porifera					
(Unident. family)	754	0.3688	72577.00	0.3995	0.01485
Axinellidae	10	0.0049	1429.00	0.0079	0.00029
Cnidaria					
(Unident. family)	51	0.0249	6592.00	0.0363	0.00135
Hydrozoa					
(Unident. family)	64	0.0313	3624.00	0.0199	0.00074
Sertulariidae	3	0.0015	80.00	0.0004	0.00002
Scyphozoa					
(Unident. family)	287	0.1404	139532.00	0.7680	0.02856
Anthozoa					
(Unident. family)	268	0.1311	39452.00	0.2172	0.00807
Nephtheidae	1520	0.7434	27641.00	0.1521	0.00566
Actinostolidae	793	0.3879	25594.00	0.1409	0.00524
Actiniidae	21499	10.5151	540052.27	2.9726	0.11053
Rhynchocoela					
(Unident. family)	7	0.0034	12.00	0.0001	0.00000
Polychaeta					
(Unident. family)	10	0.0049	13*00	0.0001	0.00000
Polynoidae	921	0.4505	4181.00	0.0230	0.00086
Nereidae	4	0.0020	4.00	0.0000	0.00000
Flabelligeridae	1	0.0005	5.00	0.0000	0.00000
Sternaspidae	1	0.0005	1.00	0.0000	0.00000
Pectinariidae	4	0.0020	5.00	0.0000	0.00000
Terebellidae	3	0.0015	11.00	0.0001	0.00000
Sabellidae	142	0.0695	502.00	0.0028	0.00010
Piscicolidae	4	0.0020	4.00	0.0000	0.00000
Acanthochitonidae	2	0.0010	120.00	0.0007	0.00002
Mopaliidae	25	0.0120	425.73	0.0023	0.00009
Nuculanidae	22	0.0108	32.00	0.0002	0.00001
Glycymerididae	3	0.015	2.00	0.0000	0.00000
Mytilidae	474	0.2318	4064.00	0.0224	0.00083
Pectinidae	5	0.0024	524.00	0.0029	0.00011
Astartidae	86	0.0418	1287.73	0.0071	0.00026
Carditidae	20	0.0097	76.09	0.0004	0.00002
Kelliidae	1	0.0005	2.00	0.0000	0.00000
Cardiidae	1210	0.5919	45607.45	0.2510	0.00933
Veneridae	30	0.0147	41.00	0.0002	0.00001
Mactridae	3	0.0015	355.00	0.0020	0.00007
Tellinidae	28	0.0137	514.00	0.0028	0.00011
Myidae	2	0.0010	130.00	0.0007	0.00003
Hiatellidae	125	0.0611	181.00	0.0010	0.00004
Gastropod					
(Unident. family)	27	0.0130	783.45	0.0043	0.00016

APPENDIX TABLE 11 (Cent'd)

Taxonomic Name	Count	% Count	Wt. (gm)	% wt.	gm/m² all Sta.
Trochidae	6	0.0029	225.00	0.0012	0.00005
Turritellidae	8	0.0039	45.00	0.0002	0.00001
Epitoniidae	1	0.0005	20.00	0.0001	0.00000
Trichotropididae	34	0.0165	562.27	0.0031	0.00012
Naticidae	10	0.0049	181.00	0.0010	0.00004
Velutinidae	9	0.0044	67.00	0.0004	0.00001
Muricidae	12	0.0059	192.27	0.0011	0.00004
Buccinidae	113	0.0553	2530.00	0.0139	0.00052
Neptuneidae	6495	3.1766	735193.18	4.0467	0.15047
Turridae	2	0.0010	90.00	0.0005	0.00002
Doridiidae	3	0.0015	13.00	0.0001	0.00000
Dendronotidae	26	0.0128	1053.64	0.0058	0.00022
Octopodidae	8	0.0037	545.45	0.0030	0.00011
Arthropoda: Pycnogonida (Unident. family)	2	0.0010	2.00	0.0000	0.00000
Balanidae	1171	0.5727	36474.00	0.2008	0.00746
Cumacea (Unident. family)	2	0.0010	2.00	0.0000	0.00000
Isopoda (Unident. family)	3	0.0015	2.00	0.0000	0.00000
Idoteidae	3538	1.7304	31325.00	0.1724	0.00641
Sphaeromatidae	121	0.0592	22.00	0.0001	0.00000
Amphipoda (Unident. family)	20	0.0098	5.00	0.0000	0.00000
Ampeliscidae	8	0.0039	4.00	0.0000	0.00000
Eusiridae	53	0.0259	62.00	0.0003	0.00001
Gammaridae	54	0.0264	48.00	0.0003	0.00001
Ischyroceridae	1	0.0005	1.00	0.0000	0.00000
Lysianassidae	183	0.0895	120.00	0.0007	0.00002
Podoceridae	3	0.0015	2.00	0.0000	0.00000
Stegocephalidae	10	0.0049	58.00	0.0003	0.00001
Hyperiidae	27	0.0132	27.00	0.0001	0.00001
Caprellidae	1	0.0005	1.00	0.0000	0.00000
Pandalidae	7102	3.4736	9883.00	0.0544	0.00202
Hippolytidae	728	0.3559	1893.45	0.0104	0.00039
Crangonidae	22568	11.0382	159742.27	0.8793	0.03269
Paguridae	24420	11.9439	336885.36	1.8543	0.06895
Lithodidae	1046	0.5116	773817.00	4.2593	0.15837
Majidae	6265	3.0641	245544.55	1.3515	0.05025
Atelecyclidae	1184	0.5791	159802.00	0.8796	0.03271
Sipunculida	3	0.0015	37.00	0.0002	0.00001
Echiuridae	9	0.0044	192.00	0.0011	0.00004
Priapulida	1	0.0005	1.00	0.0000	0.00000
Flustridae	15	0.0073	545.00	0.0030	0.00011
Alcyonidiidae	18	0.0088	S85.00	0.0049	0.00018

APPENDIX TABLE II (Cent'd)

Taxonomic Name	Count	% Count	Wt.(gm)	% Wt.	gm/m^2 all Sta.
Dallinidae	1	0.0005	1.00	0.0000	0.00000
Echinasteridae	106	0.0516	*1293.73*	0.0071	*0.00026*
Pterasteridae	34	0.0166	*3062.00*	0.0169	*0.00063*
Solasteridae	241	0.1177	*6804.82*	0.0375	*0.00139*
Asteridae	70866	34.6608	*12669499.91*	69.7366	*2.59297*
Echinarachniidae	2040	0.9978	*2188.00*	0.0120	*0'.00045*
Strongylocentrotidae	9572	4.6818	*610588.46*	3.3609	*0.12496*
Amphiuridae	2745	1.3426	*1117.00*	0.0061	*0.00023*
Gorgonocephalidae	5218	2.5522	*1281550.00*	7.0540	*0.26229*
Ophiactidae	74	0.0360	*172.73*	0.0010	*0.00004*
Ophiuridae	982	0.4803	*1409 .00*	0.0078	*0.00029*
Cucumariidae	18	0.0088	*51.00*	0.0003	*0.00001*
Rhodosomatidae	146	0.0714	*3723.00*	0.0205	*0.00076*
Styelidae	5541	2.7101	*139622.00*	0.7685	*0.02858*
Pyuridae	1469	0.7185	*33013.00*	0.1817	*0.00676*

APPENDIX TABLE III

Percentage Composition of all Phyla by Species from all Stations in the Norton Sound area, September-October 1976
Taxonomic names represent the lowest level of identification.

Taxonomic Name	Count	% Count	Weight (g)	% Total	g/m² for* occurrence astations	g/m² for all stations	% Phylum count	% Phylum Weight
Porifera	754	0.4	72577.00	0.40	0.1086	0.01485	98.69	98.07
Phakellia sp.	9	0.0	1427.00	0.01	0.0051	0.00029	1.18	1.93
Phakellia cribrosa	1	0.0	2.00	0.00	0.0001	0.00000	0.13	0.00
Cnidaria	51	0.0	6592.00	0.04	0.0328	0.00135	0.21	0.84
Hydrozoa	64	0.0	3624.00	0.02	0.0041	0,00074	0.26	0.46
Sertulariidae	3	0.0	80.00	0.00	0.0007	0.00002	0.01	0.01
Scyphozoa	287	0.1	1.39532.00	0.77	0.1162	0.02856	1.17	17.83
Anthozoa	268	0.1	39452.00	0.22	0.0488	0.00807	1.09	5.04
Eunephthya rubiformis	1520	0.7	27641.00	0.15	0.0099	0.00566	6.21	3.53
Stomphia sp.	43	0.0	1514.00	0.01	0.0040	0.00031	0.18	0.19
Stomphia coccinea	750	0.4	24080.00	0.13	0.0310	0.00493	3.06	3.08
Actiniidae	21499	10.5	540052.27	2.97	0.2614	0.11053	87.80	69.01
Rhynchocoela	7	0.0	12.00	0.00	0.0001	0.00000	100.00	100.00
Polychaeta	10	0.0	13.00	0.00	0.0000	0.00000	0.92	0.28
Polynoidae	907	0.4	4152.00	0.02	0.0022	0,00085	83.21	87.85
Arctonoe vittata	1	0.0	1.00	0.00	0.0000	0.00000	0.09	0.02
Eunoe depressa	10	0.0	17.00	0.00	0.0001	().00000	0.92	0.36
Eunoe senta	3	0.0	11.00	0.00	0.0001	0.00000	0.28	0.23
Nereidae	2	0.0	2.00	0.00	0.0000	0.00000	0.18	0.04
Nereis sp.	2	0.0	2.00	0.00	0.0000	0.00000	0.18	0.04
Brada villosa	1	0.0	5.00	0.00	0.0001	0.00000	0.09	0.11
Sternaspis scutata	1	0.0	1.00	0.00	0.0000	0.00000	0.09	0.02
Cistenides hyperborea	4	0.0	5.00	0.00	0.0001	0.00000	0.37	0.11
Terebella sp.	3	0.0	11.00	0.00	0.0001	0.00000	0.28	0.23
Sabellidae	48	0.0	319.00	0.00	0.0010	0.00007	4.40	6.75
Potamilla sp.	91	0.0	181.00	0.00	0.0040	0.00004	8.35	3.83
Jasmineira sp.	3	0.0	2.00	0.00	0.0000	0.00000	0.28	0.04
Carcinobdella sp.	4	0.0	4.00	0.00	0.0000	0.00000	0.37	0.0s
Cryptochiton stelleri	2	0.0	120.00	0.00	0.0031	0.00002	0.02	0.02
Amicula pallasii	4	0.0	59.09	0.00	0.0012	0.00001	0.05	0.01
Amicula vestita	20	0.0	366.64	0.00	0.0014	0.00008	0.23	0.05

APPENDIX TABLE III (Continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Yoldia sp.	1	0.0	2.00	0.00	0.0001	0.00000	0.01	0.00
Yoldia hyperborea	13	0.0	13.00	0.00	0.0001	0.00000	0.15	0.00
Yoldia myalis	8	0.0	17.00	0.00	0.0001	0.00000	0.09	0.00
Glycymeris subobsoleta	3	0.0	2.00	0.00	0.0000	0.00000	0.03	0.00
Mytilus edulis	56	0.0	1757.00	0.01	0.0043	*0.00036*	0.64	0.22
Musculus niger	1	0.0	25.00	0.00	0.0007	0.00001	0.01	0.00
Musculus discors	417	0.2	2282.00	0.01	0.0026	0.00047	4.75	0.29
Chlamys rubida	5	0.0	524.00	0.00	0.0116	0.00011	0.06	0.07
Astarte borealis	79	0.0	1120.00	0.01	0.0030	0.00023	0.90	0.1$
Astarte montagui	6	0.0	167.73	0.00	0.0020	0.00003	0.07	0.02
Cyclocardia crebricostata	15	0.0	53.36	0.00	0.0003	0.00001	0.17	0.01
Cyclocardia crassidens	4	0.0	22.73	0.00	0.0005	0,00000	0.05	0.00
Pseudopythina sp.	1	0.0	2.00	0.00	0.0000	0.00000	0.01	0.00
Clinocardium sp.	3	0.0	70.00	0.00	0.0016	0.00001	0.03	0.01
Clinocardium ciliatum	48	0.0	979.00	0.01	0.0018	0.00020	0.55	0.12
Clinocardium nuttallii	1	0.0	15.00	0.00	0.0004	0.00000	0.01	0.00
Clinocardium cali_forniense	*38*	0.0	1397.00	0.01.	0.0034	0.00029	0.$3	0.S8
Serripes groenlandicus	1120	0.5	43146.45	*0.24*	0.0156	0.00883	12.75	5.43
Liocyma fluctuosa	30	0.0	41.00	0.00	0.0005	0.00001	0.34	0.01
Spisula polynyma	3	0.0	355.00	0.00	0.0046	0.00007	0.03	0.04
Macoma sp.	2	0.0	26.00	0.00	0.0003	0.00001	0.02	0.00
Macoma calcarea	9	0.0	134.00	0.00	0.0006	0.00003	0.10	0.02
Macoma brota	15	0.0	352.00	0.00	0,.0009	0.00007	0.17	0.04
Tellina lutea alternidentata	2	'3.0	2.00	0.00	0.0000	0.00000	0.02	0.00.
Mya pseudoarenaria	2	0.0	130.00	0.00	0.0017	0.00003	0.02	0.02
Hiatella arctica	123	0.1	180.00	0.00	0.0002	0.00004	1.40	0.02
Panomya arctica	2	0.0	1.00	0.00	0.0000	0.00000	0.02	0.00
Gastropoda	26	0.0	783.45	0.00	0.0017	0.00016	0.30	0.10
Margarites giganteus	1	0.0	45.00	0.00	0.0012	0. 00001	0.01	0.01
Solariella sp.	1	0.0	45.00	0.00	0.0012	0.00001	0.01	0.01
Solariella obscura	2	0.0	45.00	0.00	0.001.2	0.00001	0.02	0.01
Solariella varicosa	2	0.0	90 .00	0.00	0.0012	0.00002	0.02	0.01
Tachyrhynchus erosus	8	0.0	.0.00	0.00	0.001.2	0.00001	0.09	0.01
Oenalia sp.	1	0.0	20.00	0.00	0.0006	0.00000	0.01	0.0C

APPENDIX TABLE III (Continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Trichotropis bicarinata	31	0.0	427.27	0.00	0.0018	0.00009	0.35	0.05
Trichotropis insignis	2	0.0	90.00	0.00	0.0(315	0,00002	0.02	0.01
Tricho tropis kroyeri	1	0.0	45.00	0.00	0.0010	0.00001	0.01	0.01
Na tics clausa	3	0.0	91.00	0.00	0.0008	0.00002	0.03	0.01
Polinices pallida	7	0.0	90.00	0.OO	0.0011	0.00002	0.08	0.01
Velutina sp.	3	0.0	12.00	0.00	0.0001	0.00000	0.03	0.00
Velutina plicatilis	6	0.0	55.00	0.00	0.0003	0.00001	0.07	0.01
Boreotrophon clathrus	12	0.0	192.27	0.00	0.0015	0.00004	0.14	0.02
Buccinum sp.	7	0.0	499.00	0.00	0.0111	0.00010	0.0s	0.06
Buccinum angulosum	38	0.0	812.00	0.00	0.001.7	0.00017	0.43	0.10
Buccinum scalariforme	16	0.0	271..00	0.00	0.0022	0.00006	0.18	0.03
Buccinum glaciale	5	0.0	180.00	0.00	0.0012	0.00004	0.06	0.02
Buccinum solenum	2	0.0	45.00	0.00	0.0010	0.00001	0.02	0.01
Buccinum polare	15	0.0	452.00	0.00	0.0025	0.00009	0.17	0.06
Buccinum fringillum	1	0.0	45.00	0.00	0.0010	0.00001	0.01	0.01
Buccinum tenellum	29	0.0	226.00	0.00	0.0029	0.00005	0.33	0.03
Ancistrolepis sp.	123	0.1	639'>.45	0.04	0.1348	0.00131	1.40	0.s0
Beringi as crebricostatus	16	0.0	1407.00	0.01	0.0415	0.00029	0.18	0.18
Beringius beringi	527	0.3	47687.91	0.26	0.0222	0.00976	6.00	6.00
Beringius stimpsoni	26	0.0	1740.27	0.01	0.0071	0.00036	*0.29*	0.22
Colus spitzbergensis	16	0.0	417.27	0.00	0.0014	0.00009	*0.19*	0.05
Co lus cabronius	2	0.0	102.27	0.00	0.0022	0.00002	*0.03*	0.01
Co lus hyperlispus	8	0.0	237.27	0.00	0.0013	0.00005	*0.09*	0.03
Liomesus ooides	1	0.0	45.00	0.00	0.0015	0.00001	0.01	0.01
Neptunea ven tricosa	1999	0.5	88768.09	0.49	0.0337	0.01817	*12.51*	11.17
Neptunea communis borealis	87	0.0	1625.00	0.01	0.0019	0.001333	0.99	0.20
Neptunea heros	4264	2.1	553003.27	3.04	0.1790	0.11318	48.53	69.57
Plicifusus kroyeri	47	0.0	1017.27	0.01	0.0076	0.00021	0.54	0.13
Plicifusus verkruzeni	2	0.0	102.27	0,00	0.0022	0.00002	0.03	0.01
Pyrulofusus deformis	204	0.1	28882.82	0.16	0.0297	0.00591	2.32	3.63
Volutopsius sp.	2	0.0	1.36.00	0.00	0.0035	0.00003	0.02	0.02
Volutopsius filosus	1	0.0	45.00	0.00	0.0010	0.00001	0.01	0.01
Volutopsius fragilis	68	0.0	3581.00	0.02	0.0090	0.00073	0.77	0.45

APPENDIX TABLE III (Continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total	g/m² for* occurrence Wt. stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Oenopota harpa	1	0.0	45.00	0.00	0.0012	0.00001.	0.01	0.01
Obesitoma simplex	1	0.0	45.00	0.00	0.0010	0.00001	0.01	0.01
Doridid**ae**	2	0.0	3.00	0.00	0.0000	0.00000	0.02	0.00
Doris sp.	1	0.0	1.0.00	0.00	0.0003	0.00000	0.01	0.00
Dendronotus sp.	26	0.0	1053.64	0.01	0.0078	0.00022	0.30	0.13
Octopus sp.	7	0,0	545.45	(3.00	0.0059	0.00011.	0.09	0.07
Arthropoda: Pycnogonida	2	0*0	2.00	0.00	0.0000	0.00000	100.00	100.00
Balanus sp.	172	0.1	3057.00	0.02	0.0097	0.00063	0.25	0.17
Balanus balanus	979	0.5	33397.00	0.18	0.0185	0.00684	1.43	1.90
Balanus rostratus	20	0.0	20.00	0.00	0.0006	0.00000	0.03	0. 00
Cumacea	2	0.0	2.00	0.00	0.0000	0.00000′	0.00	0.00
Isopoda	3	0.0	2.00	0.00	0.0000	0.00000	0.00	0.00
Idoteidae	21	0.0	3.00	0.00	0.0000	0.00000	0.03	0.00
Saduria entomon	3480	1.7	31300.00	0.17	0.0495	0.00641	5.0s	1.79
Synidotea bicuspida	37	0.0	22.00	0.00	0.0000	0. 00(?00	0.05	0.00
Tecticeps sp.	121	0.1	22.00	0.00	0.0002	0.00000	0.18	0.00
Amphipoda	20	0.0	5.00	0.00	0.0000	0.00000	0.03	0.00
Ampeliscidae	8	0.0	4.00	0.00	0.0001	0.00000	0.01	0. 00
Eusirus sp.	50	(). 0	58.00	0.00	0.0001	0.00001	0.07	0.00
Rhachotropis sp.	3	0.0	4.00	0.00	0.0000	0.00000	0.00	0.00
Gammaridae	6	0.0	1.3.00	0.00	0.0002	0.00(-)00	0.01	0.00
Melita sp.	45	0.0	33.00	0.00	0.0001	0.00001	0.07	0.00
Melita dentata	3	0.0	2.00	0.00	0.0000	0.00000	0.00	0.00
Jassa sp.	1	(). 0	1.00	0.00	0.0000	0,00000	0.00	0.00
Lysianassidae	3	0.0	1..00	0.00	0.0000	0.00000	0.00	0.00
Anonyx sp.	83	0.0	50.00	0.00	0.0001	0.00001	0.12	0.00
Anonyx nugax pacifica	46	(3.0	37.00	0.00	0".0003	0.00001.	0,07	0.00
Anonyx ampulloides	50	0.0	30.00	0.00	0.0006	0.00001	0.07	0.00
Scearmea sp.	1	0.0	2.00	0.00	0.0001	0.00000	0.00	0.00
Podoceridae	2	0.0	1.00	0.00	0.0000	0.00000	0.00	0. 00
Dulichia spinosissima	1	0.0	1..00	0.00	0.0000	$3.00(100	0.00	0. 00
Stegocephalus inflatus	10	0.0	58.00	0.00	0.0005	0.00001	0.01	0. 00
Parathemisto japonica	27	0.0	27.00	0.00	0.0002	0.00001	0.0;	0. 00
Caprellidae	1	0.0	1.00	0.00	0.0000	0. 00(300	0.00	0.00
Pandalus borealis	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.00

APPENDIX TABLE III (Continued)

Taxonomic Name	Count	% count	Weight (g)	% Total Wt.	g/m² for* Occurrence stations	g/m² for all stations	% Phylum count	% Phylum Weight
Pandalus goniurus	6888	3.4	7918.00	0.04	0.0040	0.00162	10.05	0.45
Pandalus hypisonotus	213	0.1	1964.00	0.01	0.0035	0.00040	0.31	0.11
Lebbeus groenlandica	277	0.1	1416.45	0.01	0.0018	0.00029	0.40	0.08
Eualus sp.	1	0.0	1.00	0.00	0.0000	0.00000	0.(-)0	0.00
Eualus fabricii	7	0.0	9.00	0.00	0.0001	0.00000	0.01	0.00
Eualus gaimardii belcheri	442	0.2	466.00	0.00	0.0007	0.00010	0.65	0.03
Eualus macilenta	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.00
Crangon dalli	5927	2.9	16082.00	0.09	0.0083	0.00329	8.65	0.92
Sclerocrangon boreas	3361	1.6	.44695.82	0.25	0.0303	0.00915	4.91	2.54
Argis lar	13280	6.5	98964.45	0.54	0.0236	0.02025	19.38	5.63
Pagurus ochotensis	641	0.3	20331.00	0.11	0.0150	0.00416	0.94	1.16
Pagurus capillatus	8800	4,3	107270.45	0.59	0.0284	0.02195	12.84	6.11
Pagurus trigonocheirus	11629	5.7	175122.91	0.96	0.0507	0.03584	16.97	9.97
Labidochirus splendescens	3350	1.6	34161.00	0.19	0.0109	0.00699	4.89	1.94
Lithodidae	2	0.0	726.00	0,00	0.0248	0.00015	0.00	0.04
Hapalogaster grebnitzkii	28	0.0	209.00	0.00	0.0004	0.00004	0.04	0.01
Paralithodes camtschatica	914	0.4	732070.00	4.03	0.3129	0.14981	1.33	41.68
Paralithodes platypus	103	0.1	41537.00	0.23	0.0646	0.00850	0.15	2.36
Sculptolithodes derjugini	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.00
Hyas lyratus	14	0.0	3904.00	0.02	0.0455	0.00080	0.02	0.22
Hyas coarctatus alutaceus	3791	1.9	184060.55	1.01	0.0793	0.03767	5.53	10.48
Chionoecetes opilio	2460	1.2	57580.00	0.32	0.0240	0.01178	3.59	3.28
Telmessus cheiragonus	1184	0.6	159802.00	0.88	0.0702	0.03271.	1.73	9.10
Golfingia margaritacea	3	0.0	37.00	0.00	0.0003	0.00001	100.00	100.00
Echiurus echiurus alaskensis	9	0.0	192.00	0.00	0.0007	0.00004	100.00	100.0(3
Priapulus caudatus	1	0.0	1.00	0.00	0.0000	0.00000	100.00	100.00
Ectoprocta	43	0.0	5334.00	0.03	0.0033	0.00109	39.71	46.93
Flustridae	1	0.0	20.00	0.00	0.0007	0.00000	0.92	0.1s
Flustra sp.	15	0.0	545.00	0.00	0.0010	0.0001 I	11.85	4.79
Dendrobeania sp.	1	0.0	20. 00	0.00	0.0005	0.00000	0.92	0.18
Diaperoecia sp.	25	0.0	3588.36	0.02	0.0081	0.00073	23.34	31.57
Heteropora sp.	2	0.0	292.00	0.00	0.0039	0.00006	1.85	2.57
Alcyonidium sp.	6	0.0	819.00	0.00	0.0035	0.00017	5.54	7.21
Alcyonidium disciforme	5	0.0	47.00	0.00	0.0002	0.00001	4.62	0.41

APPENDIX TABLE III (Continued)

Taxonomic Name	Count	% count	Weight	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Alcyonidium vermiculare	7	0.0	19.00	0.00	0.0001	0.00000	6.47	0.17
Flustrella gigantea	3	0.0	682.00	0.00	0.0054	0.00014	2.77	6.00
Dallinidae	1	0.0	1.00	0.00	0.0000	0.00000	50.00	50.00
Laqueus californianus	1	0.0	1.00	0.00	0.0000	0.00000	50.00	50.00
Henricia sp.	105	0.1	1293.73	0.01	0.0011	0.00026	0.11	0.01
Pteraster obscurus	34	0.0	3062.00	0.02	0.0074	0.00063	0.04	0.02
Crossaster papposus	238	0.1	6149.82	0.03	0.0058	0.00126	0.25	0.04
Solaster sp.	2	0.0	390.00	0.00	0.0044	0.00008	0.00	0.00
Solaster dawsoni	1	0.0	265.00	0.00	0.0059	0.00005	0.00	0.00
Asterias amurensis	56898	27.8	10216723.27	56.24	2.4628	2.09098	*61.04*	69.82
Evasterias echinosoma	1043	0.5	721412.91	3.97	0.3069	0.14765	1.12	4.93
Evasterias troschelii	2	0.0	205.00	0.00	0.0050	0,00004	0.00	0.00
Leptasterias sp.	3645	1.8	57899.45	0.32	0.0200	0.01.185	3.91	0.40
Leptasterias polaris acervata	5862	2.9	61841.8.55	3.40	0.2784	0.12657	6.29	4.23
Lepthasterias sp.	94	0.0	22246.00	0.12	0.2734	0.00455	0.10	0.15
Lethasterias nanimensis	3323	1..6	1032594.73	5.68	0.3292	0.21133	3.56	7.06
Echinoidea	3	0.0	50.00	0.00	0.0012	0.00001	0.00	0.00
Echinarachnius parma	2040	1.0	2188.00	0.01	0.0029	0.00045	2.19	0.01
Strongylocentrotus droebachiensis	9572	4.7	610588.46	3.36	0.1823	0.12496	10.27	4.17
Amphiodia sp.	20	0.0	1.00	0.00	0.0000	0.00000	0.02	0.00
Amphipholis sp.	2472	1.2	864.00	0.00	0.0011	0.0001.8	2.65	0.01
Diamphiodia craterodmeta	253	0.1	252.00	0.00	0.0015	0.00005	0.27	0.00
Gorgonocephalus caryi	5218	2.6	1.281550.82	7.05	0.6182	0.26229	5. 60	8.76
Ophiopholis aculeata	74	0.0	172.73	0.00	().0023	0.01)004	0.08	0.00
Ophiura carci.	788	0.4	1285.00	0.01	"0. 0(341	0.00026	0.85	0.01
Stegophiura sp.	2	0.0	2.00	0.00	0.0000	0,00000	0.00	0.00
Stegophiura nodosa	192	0.1	122.00	0.00	0.0001	0.00002	0.21	0.00
Cucumaria sp.	11	0.0	41.00	0,00	0.0(302	0,00001	0.01	0.00
Cucumaria calcigera	7	0.0	10.00	0.00	0.0002	0.(10000	0.01	0.00
Psolus japonicus	1308	0.6	55042.82	0.30	0.2463	"().01127	1.40	0.38

APPENDIX TABLE III (Continued)

Taxonomic Name	count	z count	Weight (g)	%	g/m² for* occurrence stations	g/m² for all stations Total	% Phylum Count	% Phylum Weight
Chordata: Ascidiacea	115	0.1	122814.00	0.68	0.0428	0.02514	1.54	40.(.$
Chelyosoma Sp.	20	0.0	2938.00	0.02	0,0096	0.00060	0.27	0.97
Chelysoma columbianum	4	0.0	265.00	0.00	0.0036	0.00005	0.05	0.09
Chelyosoma orientale	122	0.1	520.00	0.00	0.0072	0.00011	1.63	0.17
Styelidae	208	0.1	2990.00	0.02	0.0076	0,00061	*2.78*	0.99
Styela macrenteron	*5525*	*2.7*	*139564.00*	*0.77*	*0.0534*	0.02856	73.85	46.19
Pelonaia corrugata	*16*	*0.0*	*58.00*	0.00	0.0002	0.00001	0.21	0.02
Boltenia ovifera	237	0.1	19986.00	0.11	0.0188	0.00409	*3.17*	6.61
Boltenia echinata	*1168*	*0.6*	*2391.00*	0.01	*0.0074*	*0.00049*	15.61	0.79
Halocynthia sp.	1	0.0	350.00	0.00	0.0078	0.00007	0.01	0.11
Halocynthia aurantium	63	0.0	10286.00	0.06	0.0234	0.00?11	0.84	3.40
Salpidae	2	0,0	2.00	0.00	0.0001	0.00000	0.03	0.00

*Biomass listed here is only for those stations where the respective taxa occurs; not all stations.

APPENDIX TABLE IV

Occurrence of Each Species in the Chukchi Sea - Kotzebue Sound area, September-October, 1976

A total of 70 stations were occupied. Taxonomic names represent the lowest level of identification.

Taxonomic Name-	Cumulative Occurrence	% of all Occurrences	% of all Sta.[2]
Porifera	3	0.157	4.286
Microciona sp.	1	0.052	1.429
Microciona lambei	1	0.052	1.429
Phakellia sp.	3	0.157	4.286
Halichondria sp.	2	0.105	2.857
Hydrozoa	2	0.105	2.857
Abietinaria sp.	1	0.052	1.429
Scyphozoa	26	1.363	37.143
Eunephthya rubiformis	24	1.258	34.286
Stomphia sp.	7	0.367	10.000
Stomphia coccinea	14	0.734	20.000
Actiniidae	32	1.677	45.714
Tealia crassicornis	1	0.052	1.429
Rhynchocoela	3	0.157	4.286
Polychaeta	1	0.052	1.429
Polynoidae	48	2.516	68.571
Eunoe depressa	3	0.157	4.286
Gattyana ciliata	1	0.052	1.429
Nereis sp.	1	0.052	1.429
Nephtys Sp.	3	0.157	4.286
Brada inhabilis	1	0.052	1.429
Brada ochotensis	1	0.052	1.429
Sternaspis scutata	2	0.105	2.857
Idanthyrsus armatus	1	0.052	1.429
Cistenides hyperborea	1	0.052	1.429
Ampharetidae	1	0.052	1.429
Amphitrite cirrata	1	0.052	1.429
Chone cincta	1	0.052	1.429
Potamilla sp.	2	0.105	2.857
Serpulidae	1	0.052	1.429
Ischnochiton albus	1	0.052	1.429
Nucula tenuis	4	0.210	5.714
Nuculana fossa	6	0.314	11.429
Yoldia hyperborea	1	0.052	1.429
Mytilus edulis	1	0.052	1.429
Musculus niger	3	0.157	4.286
Musculus discors	8	0.419	11.429
Modiolus modiolus	1	0.052	1.429
Chlamys rubida	1	0.052	1.429
Chlamys islandica	2	0.105	2.857
Chlamys beringiana	1	0.052	1.429
Astarte borealis	12	0.629	17.143
Astarte montagui	2	0.105	2.857
Cyclocardia sp.	1	0.052	1.429

APPENDIX TABLE IV (continued)

Taxonomic Name	Cumulative Occurrence	% of all Occurrences	% of all Sta.
Cyclocardia ventricosa	2	0.105	2.857
Cyclodardia crebricostata	1	0.052	1.429
Cyclocardia crassidens	3	0.157	4.286
Clinocardium ciliatum	23	1.205	32.857
Clinocardium nuttallii	1	0.052	1.429
Clinocardium californiense	5	0.262	"7.143
Serripes groenlandicus	29	1.520	41.429
Liocyma fluctuosa	2	0.105	2.857
Spisula polynyma	2	0.105	2.857
Macoma sp.	3	0.157	4.286
Macoma calcarea	5	0.262	7.143
Macoma brota	4	0.210	5.714
Mya japonica	1	0.052	1.429
Hiatella arctica	20	1.048	28.571
Panomya arctica	1	0.052	1.429
Gastropod	10	0.524	14.286
Margarites giganteus	1	0.052	1.429
Solariella obscura	1	0.052	1.429
Solariella varicosa	1	0.052	1.429
Tachyrynchus reticulatus	1	0.052	1.429
Crepidula grandis	3	0.157	4.286
Trichotropis bicarinata	2	0.105	2.857
Natica clausa	11	0.577	15.714
Natica russa	1	0.052	1.429
Polinices pallida	8	0.419	11.429
Piliscus commodum	1	0.052	1.429
Velutina sp.	1	0.052	1.429
Velutina plicatilis	7	0.367	10.000
Velutina undata	1	0.052	1.429
Boreotrophon clathratus	2	0* 105	2.857
Buccinum angulosum	10	0.524	14.286
Buccinum scalariforme	16	0.839	22.857
Buccinum glaciale	1	0.052	1.429
Buccinum solenum	4	0.210	5.714
Buccinum polare	11	0.577	15.714
Buccinum tenellum	6	0.314	8.571
Ancistrolepis sp.	3	0.157	4.286
Ancistrolepis magna	1	0.052	1.429
Beringius crebricostatus	1	0.052	1.429
Beringius beringi	36	1.887	51.429
Colus sp.	1	0.052	1.429
Colus spitzbergensis	4	0.210	5 .714
Colus hypolispus	7	0.367	10.000
Mohnia corbis	1	0.052	1.429
Neptunea lyrata	2	0.105	2.857
Neptunea ventricosa	36	1.887	51.429
Neptunea communis borealis	19	0.996	27.143

APPENDIX TABLE IV (continued)

Taxonomic Name	Cumulative Occurrence	% of all Occurrence	% of all Sta.
Neptunea heros	44	2.306	62.857
Plicifusus brunneus	1	0.052	1.429
Pyrulofusus deformis	7	0.367	10.000
Volutopsius sp.	3	0.157	4.286
Volutopsius fragilis	14	0.734	20.000
Admete couthouyi	1	0.052	1.429
Doridídae	2	0.105	2.857
Dendronotus sp.	8	0.419	11.429
Tochuina tetraquetra	4	0.210	5.714
octopus sp.	5	0.262	7.143
Balanus sp.	6	0.314	8.571
Balanus balanus	7	0.367	10.000
Balanus rostratus	3	0.157	4.286
Mysidae	1	0.052	1.429
Cumacea	1	0.052	1.429
Isopoda	2	0.105	2.857
Saduria entomon	1	0.052	1.429
Amphipoda	3	0.157	4.286
Eusiridae	1	0.052	1.429
Rhachotropis sp.	2	0.105	2.857
Melita sp.	1	0.052	1.429
Melita dentata	3	0.157	4.286
Anonyx sp.	10	0.524	14.286
Stegocephalopsis ampulla	1	0.052	1.429
Stegocephalus inflatus	8	0.419	11.429
Pandalus sp.	1	0.052	1.429
Pandalus goniurus	17	0.891	24.286
Spirontocaris sp.	1	0.052	1.429
Spirontocaris murdochi	1	0.052	1.429
Spirontocaris arcuata	7	0.367	10.000
Lebbeus groenlandica	11	0.577	15.714
Eualus gaimardii belcheri	11	0.577	15.714
Heptacarpus sp.	1	0.052	1.429
Crangon dalli	8	0.419	11.429
Sclerocrangon boreas	22	1.153	31.429
Argis lar	64	3.354	91.429
Argis crassa	2	0.105	2.857
Pagurus capillatus	55	2.883	78.571
Pagurus trigonocheirus	69	3.616	98.571
Pagurus rathbuni	12	0.629	17.143
Labidochirus splendescens	56	2.935	80.000
Hapalogaster grebnitzkii	1	0.052	1.429
Paralithodes camtschatica	5	0.262	7.143
Paralithodes platypus	2	0.105	2.857
Paralithodes brevipes	1	0.052	1.429
Hyas sp.	1	0.052	1.429
Hyas coarctatus alutaceus	66	3.459	94.286

APPENDIX TABLE IV (continued)

Taxonomic Name	Cumulative Occurrence	% of all Occurrence	% of all Sta.
Chionoecetes opilio	67	3.512	95.714
Telmessus cheiragonus	21	1.101	30.000
Golfingia margaritacea	6	0.314	8.571
Echiurus echiurus alaskensis	11	0.577	15.714
Ectoprocta	8	0.419	11.429
Flustridae	3	0,157	4.286
Flustra sp.	17	0.891	24.286
Dendrobeania sp.	2	0.105	2.857
Diaperoecia sp.	10	0.524	14.286
Heteropora sp.	1	0.052	1.429
Alcyonidium sp.	4	0.210	5.714
Alcyonidium disciforme	1	0.052	1.429
Alcyonidium vermiculare	13	0.681	18.571
Henricia sp.	16	0.839	22.857
Henricia derjugini	1	0.052	1.429
Pteraster obscurus	33	1.730	47.143
Crossaster papposus	37	1.939	52.857
Solaster sp.	1	0.052	1.429
Solaster endeca	1	0.052	1.429
Asterias sp.	2	0.105	2.857
Asterias amurensis	51	2.673	72.857
Asterias rathbuni	4	0.210	5.714
Evasterias echinosoma	34	1.782	47.571
Leptasterias sp.	44	2.306	62.857
Leptasterias polaris acervata	60	3.145	85.714
Lethasterias sp.	1	0.052	1.429
Lethasterias nanimensis	44	2.306	62.857
Echinoidea	1	0.052	1.429
Echinarachnius parma	2	0.105	2.857
Strongylocentrotus droebachiensis	50	2.621	71.429
Amphipholis sp.	1	0.052	1.429
Gorgonocephalus caryi	38	1,992	54.286
Ophiopholis aculeata	2	0.105	2.857
Ophiura sarsi	39	2.044	55.714
Stegophiura nodosa	8	0.419	11.429
Cucumaria sp.	6	0.314	8.571
Cucumaria calcigera	1	0,052	1.429
Psolus japonica	7	0.367	10.000
Chordata: Ascidiacea	36	1.887	51.429
Chelyosoma sp.	15	0.786	21.429
Chelyosoma orientale	4	0.210	5.714
Styelidae	9	0.472	12.857

APPENDIX TABLE IV (continued)

Taxonomic Name	Cumulative Occurrence	% of all Occurrence	% of all Sta.
Styela macrenteron	36	1.887	51.429
Pelonaia corrugata	2	0.105	2.857
Boltenia ovifera	31	1.625	44.286
Boltenia echinata	20	1.048	28.571
Halocynthia aurantium	6	0.314	8.571
Salpidae	3	0.157	4.286
	1908	100%	--

[1] $\frac{\text{Cumulative occurrence}}{\text{Total cumulative occurrence}}$

[2] $\frac{\text{Cumulative occurrence}}{\text{Total No. of stations occupied}}$

APPENDIX TABLE V

Percentage Composition of all Phyla by Family from all Stations in the Chukchi Sea - Kotzebue Sound area, September-October 1976

Taxonomic Name	Total No. of individuals (Count)	% Count	Wt. (gm)	% wt.	gm/m^2 all Sta.
Porifera					
(Unident. family)	758	0.3731	71894.56	0.7523	0.02455
Microcionidae	3	0.0017	248.90	0.0026	0.00008
Axinellidae	9	0.0044	933.00	0.0098	0.00032
Halichondriidae	6	0.0030	415.00	0.0043	0.00014
Hydrozoa					
(Unident. family)	3	0.0015	93.00	0.0010	0.00003
Sertulariidae	1	0.0005	200.00	0.0021	0.00007
Scyphozoa					
(Unident. family)	167	0.0821	138996.00	1.4544	0.04746
Nephtheidae	926	0.4555	14479.27	0.1515	0.00494
Actinostolidae	727	0.3578	33971.95	0.3555	0.01160
Actiniidae	7664	3.7698	238819.00	2.4989	0.08154
Rhychocoela					
(Unident. family)	5	0.0025	61.00	0.0006	0.00002
Polychaeta					
(Unident. family)	1	0.0005	5.00	0.0001	0.00000
Polynoidae	501	0.2464	1258.89	0.0132	0.00043
Nereidae	3	0.0015	12.00	0.0001	0.00000
Nephtyidae	39	0.0192	241.25	0.0025	0.00008
Flabelligeridae	2	0.0010	20.00	0.0002	0.00001
Sternaspidae	206	0.1015	156.25	0.0016	0.00005
Sabellariidae	12	0.0059	10.00	0.0001	0.00000
Pectinariidae	1	0.0005	1.00	0.0000	0.00000
Ampharetidae	10	0.0049	18.00	0.0002	0.00001
Terebellidae	1	0.0005	2.00	0.0000	0.00000
Sabellidae	6406	3.1512	12811.00	0.1340	0.00437
Serpulidae	100	0.0492	1.00	0.0000	0.00000
Ischnochitonidae	4	0.0020	2.00	0.0000	0.00000
Nuculidae	1414	0.6956	1607.00	0.0168	0.00055
Nuculanidae	23	0.0111	25.50	0.0003	0.00001
Mytilidae	24	0.0118	191.94	0.0020	0.00007
Pectinidae	88	0.0433	6058.00	0.0634	0.00207
Astartidae	415	0.2041	6151.67	0.0644	0.00210
Carditidae	12	0.0061	85.44	0.0009	0.00003
Cardiidae	286	0.1404	8831.25	0.0924	0.00302
Veneridae	2	0.0010	2.00	0.0000	0.00000
Mactridae	2	0.0010	100.00	0.0010	0.00003
Tellinidae	58	0.0285	1763.25	0.0184	0.00060
Myidae	1	0.0005	45.00	0.0005	0.00002
Hiatellidae	115	0.0566	185.00	0.0019	0.00006
Gastropod					
(Unident. family)	95	0.0468	6595.59	0.0690	0.00225

APPENDIX TABLE V (continued)

Taxonomic Name	Total No. of individuals (Count)	% Count	Wt. (gm)	% wt.	gm/m^2 all Sta.
Trochidae	3	0.0015	91.00	0.0010	0.00003
Turritellidae	1	0.0005	45.00	0.0005	0.00002
Calyptraeidae	6	0.0030	57.00	0.0006	0.00002
Trichotropididae	92	0.0455	276.88	0.0029	0.00009
Naticidae	365	0'1795	3966.25	0.0415	0.00135
Velutinidae	18	0.0088	41.94	0.0004	0.00001
Muricidae	2	0.0010	90.00	0.0009	0.00003
Buccinidae	858	0.4222	14842.50	0.1553	0.00507
Neptuneidae	12564	6.1802	1176408.32	12.3094	0.40164
Cancellariidae	2	0.0010	1.00	0.0000	0.00000
Doridídae	2	0.0010	11.00	0.0001	0.00000
Dendronotidae	17	0.0084	445.00	0.0047	0.00015
Tritoniidae	5	0.0025	1170.00	0.0122	0.00040
Octopodidae	16	0.0078	913.20	0.0096	0.00031
Balanidae	1084	0.5332	2058.00	0.0215	0.00070
Mysidae	1	0.0005	1.00	0.0000	0.00000
Cumacea	1	0.0005	1.00	0.0000	0.00000
Isopoda (Unident. family)	2	0.0010	2.00	0.0000	0.00000
Idoteidae	2	0.0010	5.00	0.0001	0.00000
Amphipoda	229	0.1126	456.00	0.0048	0.00016
Eusiridae	12	0.0059	7.00	0.0001	0.00000
Gammaridae	5	0.0025	4.00	0.0000	0.00000
Lysianassidae	146	0.0718	372.44	0.0036	0.00012
Stegocephalidae	499	0.2455	2202.00	0.0230	0.00075
Pandalidae	1089	0.5357	1095.00	0.0115	0.00037
Hippolytidae	334	0.1643	1691.51	0.0177	0.00058
Crangonidae	15772	7.7585	100308.16	1.0496	0.03425
Paguridae	21107	10.3826	317578.95	3.3230	0.10843
Lithodidade	20	0.0098	6873.00	0.0719	0.00235
Maj idae	25554	12.5701	682138.71	7.1376	0.23289
Atelecyclidae	674	0.3317	89507.00	0.9366	0.03056
Sipunculida (Unident. family)	10	0.0049	240.00	0.0025	0.00008
Echiuridae	31	0.0154	818.50	0.0086	0.00028
Flustridae	17	0.0084	763.00	0.0080	0.00026
Alcyonidiidae	28	0.0140	9169.44	0.0959	0.00313
Echinasteridae	911	0.4480	8106.95	0.0848	0.00277
Pterasteridae	230	0.1131	13964.00	0.1461	0.00477
Solasteridae	480	0.2362	20807.61	0.2177	0.00710
Asteridae	28683	14.1094	4640093.92	48.5517	1.58420
Echinarachniidae	3	0.0015	30.00	0.0003	0.00001
Strongylocentrotidae	8795	4.3263	616152.68	6.4471	0.21036
Amphiuridae	5	0.0025	1.00	0.0000	0.00000
Gorgonocephalidae	1285	0.6323	331809.12	3.4719	0.11329

APPENDIX TABLE V (continued)

Taxonomic Name	Total No. of individuals (Count)	% Count	Wt. (gm)	% wt.	gm/m² all Sta.
Ophiactidae	45	0.0221	70.00	0.0007	0.00002
Ophiuridae	20047	9.8613	80374.75	0.8410	0.02744
Cucumariidae	63	0.0310	808.63	0.0085	0.00028
Rhodosomatidae	15481	7.6154	466460.46	4.8808	0.15926
Styelidae	5822	2.8641	198733.12	2.0794	0.06785
Pyuridae	19018	9.3552	219690.51	2.2987	0.07501

APPENDIX TABLE VI

Percentage Composition of all Phyla by Species from all Stations in the Chukchi Sea - Kotzebue Sound area, September-October, 1976.

Taxonomic names represent the lowest level of identification.

Taxonomic Name	Count	.% Count	Weight g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum count	% Phylum Weight
Porifera	758	0.4	**71894.56**	0.75	**0.6119**	*0.02455*	97.63	97.83
Microciona **sp.**	2	0.0	**243.90**	0.00	**0.0060**	*0.00008*	0.31	0.33
Microciona lambei	1	0.0	**5.00**	0.00	**0.0001**	0.00000	0.13	0.01
Phakellia S_p.	9	0.0	**933.00**	0.01	**0.0086**	**0.00032**	1.16	**1.27**
Halichondria **sp.**	6	0.0	**415.00**	0.00	**0.0051**	0.00014	0.77	0.56
Hydrozoa	3	0.0	**93.00**	0.00	**0.0011**	0.00003	0.03	**0.02**
Abietinaria **sp.**	**1**	(3.0	**200.00**	0.00	**0.0047**	0.00007	**0.01**	**0.05**
Scyphozoa	**167**	0.1	**138996.00**	**1.45**	**0.1329**	0.04746	1.76	**32.59**
Eunephthya rubiformis	926	0.5	**14479.27**	**0.15**	**0.0166**	0.00494	9.76	*3,39*
Stomphia **sp.**	501	0.2	**23253.00**	**0.24**	**0.0757**	0.00794	5.28″	**5.45**
Stomphia coccinea	226	0.1	**10718.95**	**0.11**	**0.0206**	0.00366	2.39	**2.51**
Actiniidae	7662	*3.8*	**238729.00**	**2.50**	**0.1864**	0.08151	80.76	55.97
Tealia crassicornis	1	0.0	**90.00**	**0.00**	**0.0028**	0.00003	0.01	**0.02**
Rhynchocoela	5	0.0	**61.00**	**0.00**	**0.0007**	0.00002	100.00	**100.00**
Polychaeta	1	**0.0**	**5.00**	**0.00**	**0.0002**	0.00000	0.01	**0.03**
Polynoidae	354	0.2	**797.89**	**0.01**	**0.0004**	0.00027	**4.86**	**5.49**
Eunoe depressa	**142**	**0.1**	**396.00**	**0.00**	**0.0039**	0.00(314	**1.95**	2.7?
Gattyana ciliata	5	0.0	**65.00**	**0.00**	**0.0016**	0.0000?	0.07	0.45
Nereis **sp.**	3	0.0	**12.00**	**0.00**	**0.0003**	0.00000	0.04	0.0s
Nephtys **sp.**	39	0.0	**241.25**	**0.00**	**0.0019**	0.0000s	**.0.54**	1.66
Brada inhabilis	**1**	**0.0**	**8.00**	**0.00**	**0.0002**	0.00000	**0.01**	0.06
Brada ochotensis	1	**0.0**	**12.00**	**0.00**	**0.0004**	0.000(1(3	**0.0**ᵖ	**0.08**
Ctenaspis scutata	206	**0.1**	**156.25**	**0.00**	**0.0020**	0.00005	2.83	1.07
Idanthyrsus armatus	12	0.0	**10.00**	**0.00**	**0.0002**	0.00000	*0.16*	**0.07**
Cictenides hyperborea	**1**	0.0	**1.00**	**0.00**	**0.0000**	0.00000	**0.01**	**0.01**
Ampharetidae	10	0.0	**18.00**	**0.00**	**0.0004**	**0.00001**	**0.14**	**0.12**
Amphitrite cirrata	1	0.0	**2.00**	**0.00**	**0.0001**	0.00000	**0.01**	**0.01**
Chone cincta	1	0.0	**1.00**	**0.00**	**0.0000**	0.00000	**0.01**	**0.01**
Potamilla **sp.**	*6405*	*3.2*	**12810.00**	**().13**	**0.1669**	0.004″37	**87.96**	**88.12**
Serpulidae	100	0.0	**1.00**	**0.00**	**0.0000**	0.00000	1.37	**0.01**
Ischnochiton albus	4	0.0	**2.00**	**0.00**	**0.0000**	0.0(')000	0.0'2	**0.00**
M.cuts *tenuis*	1414	0.7	**1607.00**	**0.02**	**0.0113**	0.00055	8.5S	**0.13**

APPENDIX TABLE VI (continued)

Taxonomic Name	count	% Count	Weight (g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Nuculana fossa	21	0.0	23.50	0.00	0.0001	0.00001	0.13	0.00
Yoldia hyperborea	1	0.0	2.00	0.00	0.0001	0.00000	0.01	0.00
Mytilus edulis	1	0.0	15.00	0.00	0.0003	0.00001	0.01	0.00
Musculus niger	3	0.0	95.00	0.00	0.0008	0.00003	0.02	0.01
Musculus discors	19	0.0	76.94	0.00	0.0002	0.00003	0.11	0.01
Modiolus modiolus	1	0.0	5.00	0.00	0.0002	0.1)0000	0.01	0.00
Chlamys rubida	20	0.0	400.00	0.00	0.0098	0.00014	0.12	0.03
Chlamys islandica	65	0.0	5498.00	0.06	0.0658	0.00188	0.39	0.45
Chlamys beringiana	3	0.0	16(3.00	0.00	0.0039	0.00005	0.02	0.01
Astarte borealis	412	0.2	6148.67	0.06	0.0128	0.00210	2.50	0.50
Astarte montagui	3	0.0	3.00	0.00	0.0000	0.00000	0.02	0.00
Cyclocardia sp.	2	0.0	10.00	0.00	0.0002	0.00000	0.01	0.00
Cyclocardia ventricosa	3	0.0	14.00	0.00	0.0002	0,00000	0.02	0.00
Cyclocardia crebricostata	2	0.0	4.00	0.00	0.0001	0.00000	0.01	0.00
Cyclocardia crassidens	5	0.0	57.44	0.00	0.0005	0.00002	0.03	0.00
Clinocardium ciliatum	78	0.0	1590.00	0.02	0.0017	0,00054	0.47	0.13
Clinocardium nuttallii	1	0.0	25,00	0.00	0.0005	0.00001	0.01	0.00
Clinocardium californiense	27	0.0	613.00	(). 01	0.0035	0.00021	().16	0.05
Serripes groenlandicus	179	0.1	6603.25	0.07	0.0059	0.00225	1.09	0.54
Liocyma fluctuosa	2	0.0	2.00	0.430	0.0000	0.00000	0.01	0.00
Spisula polynyma	2	0.0	100.00	0.00	0.0011	0.00003	0.01	0.01
Macoma sp.	22	0.0	913.00	0.01	0.0084	0.00031	0.13	0.07
Macoma calcarea	17	0.0	346.25	0.00	0.0019	().(10012	0.10	0.03
Macoma brota	19	0.0	504.00	0.01	0.0033	0.00017	0.12	0.04
Mya japonica	1	0.0	45.00	0.00	0.0011	0. 0002	0.01	0.00
Hiatella arctica	114	0.1	1 60 .00	0.00	0.0002	0. 00005	0.69	0.01
Panomya arctica	1	0.0	25.00	0.00	0.0007	0.')0001	0.01	0.00
Gastropoda	95	0.0	6595.59	0.07	0.0159	0.00225	0.58	0.5A
Margarites giganteus	1	0.0	45.00	0.00	0.0017	0.00002	0.01	0,00
Solariella obscura	1	0.0	1.00,	0.00	0.0000	0.00000	0.01	0.00
Solariella varicosa	1	0.0	45.00	0.00	0.0017	0.00002	0.01	0.00
Tachyrnchus reticulatis	1	0.0	45.00	0.00	0.0011	0.00002	0.01	0.00
Crepidula grandis	6	0.0	57.00	0.00	0.0004	0.00002	0.04	0.,00
Trichotropis bicarinata	92	0.0	276.88	0.00	0.0034	0.00009	0.56	0.02
Natica clausa	223	0.1	231.3.00	0.02	0.0058	0.00079	1.35	0.19

APPENDIX TABLE VI (continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Natica russa	12	0.0	*93.75*	(3.00	*0.0026*	0.00003	*0.08*	0.01
Polinices pallida	129	0.1	*1559.50*	0.02	*0.0055*	0.00053	*0.79*	0.13
Pilisecs commodum	2	0.0	2.00	0.00	0.0001	0.00000	*0.01*	0.00
Velutina sp.	2	0.0	2.50	0.00	0.0001	0.00000	0.02	(). 00
Velutina plicatilis	11	0.0	35.44	0.00	0.0001	0.00001	*0.07*	0.00
Velutina undata	2	0.0	2.00	0.00	0.0000	0.00000	0.01	().00
Boreotrophon clathratus	2	0.0	90.00	0.00	0.0011	0.00003	0.01	0.01
Buccinum angulosum	219	0.1	4717.00	0.05	0.0121	0.00161	1.33	0.38
Buccinum scalariforme	241	0.1	3944.00	0.04	0.0063	0.00135	1.46	0.32
Buccinum glaciale	90	0.0	1180.00	0.01	0.0290	0.00040	0.55	0.10
Buccinum solenum	30	0.0	1088.00	0.01	0.0080	0.00037	0.18	0.09
Buccinum polare	197	0.1	2900.00	0.03	0.0077	0.00099	1.19	0.24
Buccinum tenellum	'81	0.0	1013.50	0.01	0.0043	0.00035	0.49	0.08
Ancistrolepis sp.	6	0.0	453.00	0.00	0.0040	0.00015	0.04	0.04
Ancistrolepis magna	3	0.0	90.00	0.00	0 .0028	0.0003	0.02	0.01
Beringius crebricostatus	2	0.0	45.00	0.00	0.0012	0.00002	0.01	0.00
Beringius beringi	340	0.2	28897.(37	0.30	0.0200	0.00987	2.06	2.35
Colus sp.	1	0.0	45.00	0.00	0.0012	0.00002	0.01	0.00
Colus spitzbergensis	10	0.0	271.00	0.00	0.0016	0.00009	0.06	0.02
Colus hypolispus	42	0.0	551.25	0.01	0.0021	0.00019	0.26	0.04
Mohnia corbis	11	0.0	953.00	0.01	0.0192	0.00033	0.07	0.08
Neptunea lyrata	4	0.0	317.00	0.00	0.0038	0.00011	0.02	0.03
Neptunea ventricosa	1857	0.9	132807.25	1.39	0.0938	0.04534	1'1.26	10.80
Neptunea communis borealis	197	0.1	3352.00	0.04	0.0045	0.00114	1.19	0.27
Neptunea berm	9671	4.2	983728.50	10.29	0.5815	0.33586	58.65	79.08
Plicifusus brunneus	1	0.0	45.00	0.00	0.0011	0.00002	0.01	0.00
Pyrulofusus deformis	157	0.1	9334.00	0.10	0.0351	0.00319	0.95	0.76
Volutopsius Sp.	75	0.0	5035.00	0.05	0.0391	0.00172	0.45	0.41
Volutopsius fragilis	185	0.1	10484.25	0.11	0.0187	0.00358	1.12	0.85
Admete couthouyi	2	0.0	1.00	0.00	0.0000	0.00000	0.01	0.00
Doridídae	2	0.0	11.00	0.00	0.0001	0.00000	0.01	0.00
Dendronotus sp.	17	0.0	445.00	0.00	0.0014	0.00015	0.10	0.04
Tochuina tetraquetra	5	0.0	1170.00	0.01	0.0076	0.00040	0.03	0.10
Octopus Sp.	16	0.0	913.20	0.02	0.0051	0.00031	0.10	0.07

APPENDIX TABLE VI (continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Balanus sp.	932	0.5	296.00	0.00	0.0012	0.00009	1.40	0.02
Balanus balanus	116	0.1	716.00	0.01	0.0023	0.00024	0.17	0.06
Balanus rostratus	36	0.0	1073.00	0.01	0.0086	0.00037	0.05	0.09
Mysidae	1	0.0	1.00	0.00	0.0000	0,00000	0.00	0.00
Cumacea	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.00
Isopoda	2	0.0	2.00	0.00	0.0000	0.00000	0.00	0.00
Sadaria entomon	2	0.0	5.00	0.00	0.0001	0.00000	0.00	0.00
Amphipoda	229	0.1.	456,00	0.00	0.0040	0.00016	0.34	0.04
Eusiridae	9	0.0	5.00	0.00	0.0001	0.00000	0.01	0.00
Rhachotropis sp.	3	0.0	2.00	0.00	0.0000	0.00000	0.00	0.00
Melita sp.	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.00
Melita dentata	4	0.0	3.00	0.00	0.0000	0.00000	0.01	0.00
Anonyx Sp.	146	0.1	342.44	0.00	0.0009	0.00012	0.22	0.03
Stegocephalopsis ampulla	2	0.0	10.00	0.00	0.0003	0.00000	0.00	0.00
Stegocephalus inflatus	497	0.2	2192.00	0.02	0. 0080	0.00075	0.75	0.1s
Pandalus sp.	5	0.0	1.00	0.00	0.0000	0.00000	0.01	0.00
Pandalus goniurus	1084	0.5	1094.00	0.01	0.0017	0.00037	1.63	0.09
Spirontocaris sp.	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.1"[]
Spirontocaris murdochi	1	0.0	15.00	0.00	0.0006	0.00001	0.(10	0.00
Spirontocaris arcuata	26	0.0	53.00	0.00	0.0002	0.00002	0.04	0.00
Lebbeus groenlandica	226	0.l	1535.51	0.02	0.0037	0.0005?	0.34	0.13
Eualus gaimardii belcheri	69	0.0	80.00	0.00	0.0002	0.00003	0.10	0.01
Heptacarpus sp.	11	0.0	7.00	0.00	0.0002	0.00000	0.02	0.00
Crangon dalli	25	0.0	74.00	0.00	0.0002	0.00003	0.04	0.01
Sclerocrangon boreas	7438	3.7	47779.21	0.50	0.0553	().01()"31	11.18	3.97
Argis lar	8286	4.1	52314.95	0.55	0.0211	0.01786	12.45	4.34
Argis crassa	23	0.0	140.00	0.00	0.0019	0.00005	0.03	0.01
Pagurus capillatus	7124	3.5	87235.75	0.91	0.0407	0.02978	10.71	7.24
Pagurus trigonocheirus	10851	5.3	189951.85	1.99	0.0702	0.06'{s5	16.31	*15.77*
Pagurus rathbuni	691	0.3	8313.00	0.09	0.0187	0.00?84	1.04	0.69
Labidochirus splendescens	2440	1.2	32073.35	0.34	0.0146	0.01095	3.67	2.66
Hapalogaster grebnitzkii	3	0.0	20.00	0.00	0.0004	0.00001	0.00	0.00
Paralithodes camtschatica	5	0.0	2497.00	0.03	0.0137	0.00085	0.01	0.21

APPENDIX TABLE VI (continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total Wt.	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weigh t
Par lithodes platypus	11	0.0	431.3.00	0.05	0.0477	0.00147	0.02	0.36
Par lithodes brevipes	1	0'0	43.00	0.00	0.0009	0.00001	0.00	0.00
Hya sp.	15	0.0	180.00	0.00	0.0042	0.00006	0.02	0.01
Hyas coarctatus alutaceus	6105	3.0	155029.85	1.62	0.0600	0.05293	9". 18	12.87
Chionoecetes opilio	19433	9.6	526928.86	5.51	0.2020	0.17990	29.21	43.76
Telmessus cheiragonius	614	0.3	89507.00	0.94	0.1071	0.03056	1.01	7.43
Golfingia margaritacea	10	0.0	240.00	0.00	0.0010	0.00008	100.00	100.00
Echiurus echiurus alaskensis	31	0.0	81.8.50	0.01	0.0020	0.00028	100.00	100.00
Ectoprocta	9	0.0	259.88	0.00	0.0008	0.00009	12.61	2.26
Flustridae	3	0.0	207.00	0.00	0.0019	0.00007	4.01	1.80
Flustra sp.	17	0.0	763.00	0.01	0.0012	0.00026	22.70	6.63
Dendrobeania sp.	2	O*O	14.00	0.00	0.0002	0.00000	2.67	0.12
Diaperoecia sp.	11	0.0	1020.00	0.01	0.0026	0.00035	14.69	8.86
Heteropora sp.	4	0.0	80.00	0.00	0.0020	0,00003	5.34	0.69
Alcyonidium sp.	5	0.0	9127.00	0.10	0.0570	0.00312	6.6S	79.27
Alcyonidium disciforme	1	0.0	2.00	0,00	0.0001	0.00000	1.34	0.02
Alcyonidium vermiculare	22	0.0	40.44	0.00	0.0001	0.00001	29.97	0.35
Heteroicia sp.	898	0.4	7289.88	0.08	0.0128	0.00249	1.48	0.13
Heteroicia derjugini	12	0.0	817.07	0.01	0.0201	0.00028	0.02	0.01
Pteraster obscurus	230	0.1	13964.00	0.15	0.0108	0.00477	0.38	0.24
Crossaster papposus	467	0.2	13625.76	0.14	0.0090	0.00465	0.77	0.24
Solaster sp.	7	0.0	5365.85	0.06	0.1321	0.00183	0.01	0.09
Solaster endeca	6	0.0	1816.00	0.02	0.0383	0.00062	0.01	0.03
Asterias sp.	941	0.5	207024.00	2.17	2.6187	0.07068	1.55	3.59
Asterias amurensis	10150	5.0	2048652.40	21.44	0.9980	0.69944	16.72	35. 54
Asterias rathbuni	1789	0.9	234037.00	2.45	1.5470	0.07990	2.95	4.06
Evasterias echinosoma	561	0.3	368018.20	3.85	0.2743	0.12565	0.92	6.39
Leptasterias sp.	725	0.4	8763.79	0.09	0.0050	0.00299	1.19	0.15
Leptasterias polaris acervata	12613	6.2	1204691.00	12.61	0.5163	0.41130	20.77	20.90
Lethasterias sp.	37	0.0	11350.00	0.1.2	0.3143	0.00388	0.06	0.20
Lethasterias nanimensis	1866	0.9	557557.54	5.83	0.3189	0.19036	3.07	9.67
Echinoidea	2	010	150.00	0,00	0.0037	0.00005	0.00	0.00

APPENDIX TABLE VI (continued)

Taxonomic Name	Count	% Count	Weight (g)	% Total Wt	g/m² for* occurrence stations	g/m² for all stations	% Phylum Count	% Phylum Weight
Echinarachnius parma	3	0.0	3.00	0.00	0.0006	0.00001	0.00	0.00
Strongylocentrotus droebachiensis	8795	4.3	616152.68	6.45	0.3114	0.21036	14.48	10.69
Amphipholis sp.	5	0.0	1.00	0.00	0.0000	0.00000	0.01	0.00
Gorgonocephalus caryi	1285	0.6	331809.12	3.47	0.2343	0.11329	2.12	5.76
Ophiopholis aculeata	45	0.0	70.00	0.00	0.0008	0.00002	0.07	0.00
Ophiura sarsi	19956	9.8	80328.75	0.84	0.0526	0.02743	32.87	1.39
Stegophiura nodosa	91	0.0	46.00	0.00	0.0001	0.00002	0.15	0.00
Cucumaria Sp.	61	0.0	778.63	0.01	0.0034	0.00027	0.10	0.01
Cucumaria calcigera	2	0.0	30.00	0.00	0.0008	0.00001	0.00	0.00
Psolus japonica	171	0.1	51185.12	0.54	0.1785	0.01748	0.28	0.89
Chordata: Ascidiacea	67	0.0	40694.00	0.43	0.0282	0.01389	0.16	4.36
Chelyosoma sp.	7509	3.7	439444.12	4.60	0.7178	0.15003	17.93	47.09
Chelyosoma orientale	7972	3.9	27016.34	0.28	0.1760	0.00922	19.04	2.90
Styelidae	107	0.1	4803.00	0.05	0.0125	0.00164	0.26	0.51
Styela macrenteron	5820	2.9	198727.12	2.08	0.1384	0.06785	13.90	21.30
Polonaia corrugata	2	0.0	6.00	0.00	0.0001	0.00000	0.00	0.00
Boltenia ovifera	481	0.2	28429.17	0.30	0.0237	0.00971	1.15	3.05
Boltenia echinata	17391	8.6	35412.34	0.37	0.0465	0.01209	41.53	3.79
Halocynthia aurantium	1146	0.6	155849.00	1.63	0.6835	0.05321	2.74	16.70
Salpidae	1385	0.7	2770.00	0.03	0.0273	0.00095	3.31	0.30

*Biomass listed here is only for those stations where the. respective taxa occurred; not all stations.

APPENDIX TABLE VII

Summary of Prey Items of *Platichthys stellatus*[1] by Frequency of Occurrence, Number, Volume, and Relative Importance from Norton Sound, Port Clarence, and Southeastern Chukchi Sea

Samples taken from September 4 through October 4, 1976 at stations c-61, D-9, C-63, C-64, A-52, and A-53.

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. of Taxon	Freq. of Taxon	% by NO. of Taxon	No. of Taxon	% by Vol. Of Taxon	vol. of Taxon (ml)	Importance of Taxon
Rhynchocoela	410.0	1222.0	75.0	0.57	1	0.01	1	0.28	5.0	0.16
Polychaeta	333.8	562.0	54.7	9.09	16	0.59	57	0.49	8.7	9.82
Nephtys sp.	390.0	806.0	100.0	0.57	1	0.01	1	0.06	1.0	0.04
Nephtys rickettsi	290.0	339.0	0.0	0.57	1	0.01	1	0.01	0.2	0.01
Glycinde armigera	360.0	750.0	25.0	0.57	1	0.01	1	0.01	0.2	0.01
Lumbrineris sp.	360.0	750.0	25,0	0.57	1	0.01	1	0.02	0.4	0.02
Sternaspis scutata	323.1	483.6	53.5	20.45	36	1.05	101	0.67	12.0	35.25
Arenicola glacialis	440.0	1320.0	25.0	0.57	1	0.01	1	0.67	12.0	0.39
Pectinariidae	320.0	415.0	50.0	1..14	2	0.95	91	0.39	7.0	1.52
Cistenides hyper.bores	324.3	483.7	50 .9	15.34	27	3.03	291	1.61	28.8	71.23
Lysippe labiata	280.0	252.0	0.0	0.57	1	0.07	7	0.01	0.1	0.04
Pelecypoda	322.5	533.0	43.8	2,27	4	0.04	4	0.04	0.7	0.18
Yoldia Sp.	340.0	550.0	25.0	0.57	1	0.03	3	0.17	3.0	0.11
Yoldia hyperborea	324.6	490.9	51.7	65.34	115	9.83	943	28.76	514.7	2521.62
Yoldia seminuda	290.0	324.0	50.0	0.57	1	0.04	4	0.39	7.0	0.25
Musculus niger	355.0	680.0	57.5	5.68	1.0	0.13	12	0.39	6.9	2.90
Musculus corrugatus	310.0	354.0	25.0	0.57	1	0.01	1	0.01	0.1	0.01
Cyclocardia ventricosa	530.0	2500.0	1.00.0	0.57	1	0.01	1	0.01	0.1	0.01
Clinocardium ciliatum	317.5	461.3	68.8	2.27	4	0.06	.6	0.06	1.0	0.27
Serripes groenlandicus	324.9	503.1	50.0	7.95	14	0.15	14	0.42	7.6	4.54
Mya sp.	322.1	448.5	50.0	6.82	12	0.13	12	0.27	4.8	2.68

APPENDIX TABLE VII

Continued

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. % of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by vol. of Taxon	Vol. of Taxon (ml)	Importance of Taxon
Lyonsia norvegica	316.7	455.3	58,3	1.70	3	0.03	3	0.03	0.6	0.11
Naticidae	360.0	750.0	50.0	0.57	1	0.01	1	0.03	0.5	0.02
Polinices pallida	310.0	379.0	25.0	0.57	1	0.01	1	0.01	0.1	0.01
Admete sp.	325.0	472.5	62.5	1.14	2	0.02	2	0.01	0.2	0.04
Cylichna occulta	290.0	237.0	75.0	0.57	1	0.01	1	0.01	0.1	0.01
Crustacea	310.0	377.0	25.0	0.57	1	0.01	1	0.01	0.1	0.01
Leucon sp.	310.0	375.0	25.0	0.57	1	0.02	2	0.01	0.1	0.02
Diastylis sp.	296.1	338.8	41.7	5.11	9	0.28	27	13.06	1.1	1.75
Diastylis sulcata	350.0	565.0	50.0	0.57	1	0.05	5	0.01	0.1	0.03
Synidotea nodulosa	330.5	554.4	61.8	21.59	38	0.74	71	0.34	6.0	23.22
Amphipoda	352.9	653.5	52.5	5.68	10	0.23	22	0.09	1.6	1.81
Gammaridae	310.0	375.0	25.0	0.57	1	0.01	1	0.01	0.1	0.01
Pontoporeia femorata	310.0	386.5	75,0	1.14	2	0,03	3	0.01	0.2	0.05
Hippolytidae	436.0	1299.0	75.0	2.84	5	0.06	6	0.56	10.0	1.77
Crangon sp.	265.0	308.5	25.0	1.14	2	0.02	2	0.01	0.2	0.04
Crangon dalli	360.0	666.0	0.0	0.57	1	0.01	1	0.06	1.0	0.04
Argis lar	400.0	1022.0	25.0	0.57	1	0.01	1	0.03	0.5	0.02
Chionoecetes opilio	389.5	797.0	50,0	1.14	2	1.83	176	1.79	31.0	4.12
Echiurus echiurus alaskensis	420.0	1.245.8	60.4	6.82	12	0.31	30	7.63	136.5	54.14
Priapulus caudatus	317.5	437.8	49.1	16.48	29	0.34	33	1.97	35.2	38.08
Echinarachnius parma	432.2	1501.0	75.0	3.41	6	2.63	252	13.3s	239.5	54.58
Ophiuroidea	530.0	2500.0	100.0	0.57	1	0.01	1	0.01	0.1	0.01

APPENDIX TABLE VII

Continued

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. % of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by vol. of Taxon	vol. of Taxon (ml)	Importance of Taxon
Diaphiodia craterodmeta	329.1	526.5	52.3	43.75	77	76.31	7320	28.40	508.3	4581.35
Stegophiura nodosa	400.0	1035.0	50.0	1..14	2	0.32	31	1.18	21.2	1.71
Urochordata	440.0	1345.7	41.7	1.7(-4	3	0.08	8	().()2	0.3	0.17
Pelonaia corrugata	360.0	750.0	25.0	0.57	1	0.04	4	0.03	0.6	0.04
Teleostei	400.0	1000.0	125.0	0.57	1	0.10	10	1.40	25.0	0.84
Eleginus gracilis	430.0	1098.5	62,5	1.14	2	0.02	2	4.25	76.0	4.85
Myoxocephalus sp.	400.0	1.022.0	25.0	0.57	1	0.01	1	0.48	8.6	0.28
Lumpenus fabricii	369.0	802.5	60.0	5,68	10	0.22	21	3.49	62.5	21.09
TOTAL							9592		1789.6	

[1]Predator Data: Mean length - 340.7 mm
Std. deviation - 54.2 mm
Median length - 330.0 mm

Mean weight - 613.8 g
Std. deviation -405.0 g
Median weight - 460.0 g

Mean fullness - 47.0%
Std. deviation - 31.8%
Number examined - 176
(includes 12 empty)

Sinistral individuals - 64.77%
Dextral individuals - 35.23%

APPENDIX TABLE VIII

Summary of Prey Items of Male *Platichthys stellatus* by Frequency of Occurrence, Number, Volume and Relative Importance from Norton Sound, Port Clarence, and Southeastern Chukchi Sea

Samples taken from September 4 through October 4, 1976 at stations C-61, D-9, c-63, C-64, A-52, A-55, and A-53.

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. % of Taxon	Freq. of Taxon	Z by No. of Taxon	No. of Taxon	% by Vol. of Taxon	Vol. of Taxon (ml)	Importance of Taxon
Polychaeta	315.0	*430.5*	54.2	11.32	12	1.17	53	0.85	6.3	22.84
Nephtys rickettsi	290.0	*339.0*	0.0	0.94	1	0.02	1	0.03	0.2	0.05
Stenaspis scutata	311.8	*410.6*	52.1	22.64	24	1.63	74	1.28	9,5	65.92
Pectinariidae	320.0	*415.0*	50.0	1.89	2	2.01	91	0.94	7.0	5.57
Asterides hyperborea	308.8	*389.4*	51.6	15.09	16	4.57	207	3.42	25.4	120.55
Lysippe labiata	280.0	*252.0*	0.0	0.94	1	0.15	7	0.01	0.1	0.16
Pelecypoda	300.0	351.3	25.0	2.83	3	0.07	3	0.04	0.3	0.30
Yoldia Sp.	340.0	*550.0*	25.0	0.94	1	0.07	3	0.40	3.0	0.44
Yoldia hyperborea	315.4	*427,2*	47.9	80.19	85	9.71	440	51.69	384.2	4923.70
Yoldia seminuda	290.0	*324.0*	50.0	0.94	1	0.09	4	0.07	7.0	0.67
Musculus niger	345.0	632.5	54.2	5.66	6	0.13	6	0.30	2.2	2.43
Clinocardium ciliatum	296.7	346.7	58.3	2.83	3	0,11	5	0.12	0.9	0.66
Serripes groenlandicus	311.3	*394.6*	45.0	9.43	10	0.22	10	0.90	6.7	10.59
Mya sp.	322.9	*466.3*	53.6	6.60	7	0.15	7	0.28	2.1	2.89
Lyonsia norvegica	285.0	*326.0*	75.0	1.89	2	0,04	2	0.03	0.2	0.13
Admete sp.	325.0	*472.5*	62.5	1.89	2	0.04	2	0.03	0.2	0.13
Cylichna occulta	290.0	*237.0*	75.0	0.94	1	0.02	1	(1.(-)1	0.1	0.03
Crustacea	310.0	*377.0*	25.0	0.94	1	(').02	1	0,01	0.1	0.03
Leucon sp.	310,0	*375.0*	25.0	0,94	1	0.04	2	0.01	0.1	0.05
Diastylis sp.	290.0	*311.1*	40.6	7.55	8	0.55	25	0.13	1.0	5.18
Diastylis sulcata	350.0	*565.0*	50.0	0.94	1	0,11	5	0.01	0.1	0.12

APPENDIX TABLE VIII

Continued

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. % of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by Vol. of Taxon	vol., of Taxon (ml)	Importance of Taxon
Synidotea nodulosa	310.8	404.4	54.0	23.58	25	0.91	41	0.47	3.5	32.45
Amphipoda	343.3	584.3	62.5	5.66	6	0.31	14	0.15	1.:	2.59
Gammaridae	310.0	375.0	25.0	0.94	1	0.02	1	0.01	0.1	0,03
Pontoporeia femorata	*310.0*	386.5	75.0	1.89	2	0.07	3	0.03	0.2	0.18
Crangon sp.	265.0	308.5	25.0	1.89	2	0.04	2	0.03	0.2	0.13
Echiurus echiurus alaskensis	*250.0*	200.0	75.0	0.94	1	0.02	1	1.10	8.2	1.06
Priapulus caudatus	315.6	420.6	48.6	16.98	18	0.42	19	3.18	23.6	61.04
Diarphiodia craterodmeta	314.7	432.9	47.6	50.00	53	77.17	3496	31.31	232.7	5424.04
Lumpenus fabricii	*303.3*	375.0	41.7	2.83	3	0.09	4	2.29	17.0	6.72
TOTAL							4530		743.3	

[1]Predator Data: Mean length - 313.7 mm; Std. deviation - 31.8 mm; Median length - 310.0 mm. Mean weight - 419.1 g; Std. deviation - 149.0 g; Median weight - 390.0 g. Mean fullness - 42.7%; Std. deviation - 27.0%; Number examined - 106 (includes 7 empty). Sinistral individuals - 58.49%; Dextral - 41.51%

APPENDIX TABLE IX

Summary of Prey Items of Female *Platichthys stellatus*[1] by Frequency of occurrence, Number, Volume and Relative Importance from Norton Sound, Port Clarence, and Southeastern Chukchi Sea

Samples taken from September 4 through October 4, 1976 at stations c-61, D-9, C-63, C-64, A-52, A-55, and A-53.

Taxon-Prey items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by Vol. of Taxon	Vol. of Taxon (ml)	Importance of Taxon
Rhynchocoela	410.0	1222.0	75.0	1.43	1	0.02	1	0.48	5.0	0.71
Polychaeta	390.0	956.5	56.3	5.71	4	0.08	4	0.23	2.4	1.76
Nephtys sp.	390.0	806.0	100.0	1.43	1	0.02	1	0.10	1,0	0.16
Glycinde armigera	360.0	750.0	25.0	1.43	1	0,02	1	0.02	0.2	0.06
Lumbrineris sp.	360.0	750.0	25.0	1.43	1	0.02	1,	0.04	0.4	0.08
Stemaspis scutata	3.45.8	629.4	56.3	17.14	12	0.53	27	0.24	2.5	13.24
Arenicola glacialis	440.0	1320.0	25.0	1.43	1	0.02	1	1.15	12.0	1.67
Cistenides hyperborea	346.8	620.7	50.0	15.71	11	1.66	84	0.32	3.4	31.1s
Pelecypoda	390.0	]078.0	100.0	1.43	1	0.02	1	0.04	0.4	0.08
Yoldia hyperborea	350.7	671.5	62.5	42 .86	30	9.94	503	12.47	110.5	960..'.0
Musculus niger	370.0	751.3	62.5	5.71	4	0,12	6	0.45	4.7	3.24
Musculus corrugates	310.0	354.0	25.0	1.43	1	0.02	1	0.01	0.1	0.04
Cyclocardia ventricosa	530.0	2500.0	100.0	1.43	1	0.02	1	0.01	0.1	0.04
Clinocardium ciliatum	380.0	805.0	100.0	1.43	1	0.02	1	0.01	0.1	0.04
Serripes groenlandicus	358.8	774.3	62.5	5.71	4	0.08	4	0.09	0.9	0.94
Mya Sp.	321.0	423.6	45.0	7.14	5	0.10	5	0.26	2.7	2.55
Lyonsia norvegica	380.0	714.0	25.0	1.43	1	0.02	1	0.04	0.4	0.08
Naticidae	360.0	750.0	50.0	1.43	1	0.02	1	0.05	0.5	0.10
Polinices pallida	310.0	379.0	25.0	1.43	1	0.02	1	0.01	0.1	0.04
Diastylis sp.	345.0	560.0	50.0	1.43	1	0.04	2	0.01	0.1	0.07
Cnidotea nodulosa	368.5	842.8	76.9	1s.57	13	0.59	30	0. 24	2.5	15. 44

APPENDIX TABLE 'IX

Continued

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by Vol. Of Taxon	Vol. of Taxon (ml)	Importance of Taxon
Amphipoda	367.3	757.3	37.5	5.71	4	0.16	8	0.05	0.5	1.18
Hippolytidae	436.0	1299.0	75.0	7.14	5	0.12	6	11.96	10.0	7.67
Crangon dalli	360.0	666.0	0.0	1.43	1	0.02	1	0.10	1.0	0.16
Argis lar	400.0	1022.0	25.0	1.43	1	0.02	1	0.05	0.5	0.10
Chionoecetes opilio	389.5	797.0	50.0	2.86	2	3.48	176	3.06	32.0	18.67
Echiurus echiurus alaskensis	435.5	1340.9	59.1	15.71	11	0.57	29	12.26	128.3	201.70
Priapulus caudatus	320.6	466.0	50.0	15.71	11	0.28	14	1,11	11,6	21,77
Echinarachnius parma	432.2	1501.0	75.0	8.57	6	4.98	252	22.89	239.5	238.87
Ophiuroidea	530.0	2500.0	100.0	1.43	1	0.02	1	0.01	0.1	0.04
Liamphiodia craterodmeta	360.9	733.2	62.5	34.29	24	75.54	3824	26. 34	275.6	3493.16
Stegophiura nodosa	400.0	1035.0	50.0	2.86	2	0.61	31	2.03	21.2	7.54
Urochordata	440.0	1345.7	41.7	4.29	3	0.16	8	*().03*	0.3	0.80
Pelonaia corrugata	360.0	750.0	25.0	1.43	1	0.08	4	0.06	0.6	0.19
Teleostei	400. o	1000.0	125.0	1.43	1	0.20	10	*2.39*	25.0	3.70
Eleginus gracilis	430.0	1098.5	62.5	2.86	2	0.04	2	*7.26*	76,0	20.87
Myoxocephalus sp.	400.0	1022.0	25.0	1.43	1	0.02	1	0.82	8.6	1.20
Lumpenus fabricii	397.1	985.7	67.9	10.00	7	0,34	17	*4.35*	45.5	46.84
TOTAL							5062		1046.3	

[1]Predator Data: Mean length - 381.7 mm; Std. deviation - 55.4 mm; Median length - 380.0 mm. Mean weight - 908.7 g; Std. deviation - 484.2 g; Median weight - 805.0 g. Mean fullness - 53.6%; Std. deviation - 36.9%; Number examined - 70 (includes 5 empty). Sinistral individuals - 74.29%; Dextral individuals - 25.71%

APPENDIX TABLE X

Summary of Prey Items of *Platichthys stellatus*[1] by Frequency of Occurrence, Number, Volume and Relative Importance from Norton Sound

Samples taken from September 30 through October 4, 1976 at stations C-61 and D-9.

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	Z Freq. of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by vol. of Taxon	Vol. of Taxon (ml)	Importance of Taxon
Rhynchocoela	410.0	1222.0	75.0	6.25	1	0.10	1	1.58	5,0	10.48
Polychaeta	410.0	1222.0	75.0	6.25	1	0.10	1	0.06	0.2	1.01
Cistenides hyperborea	410.0	1222.0	75.0	6.25	1	0.10	1	0.03	0.1	0.81
Yoldia hyperborea	340.8	622.7	45.8	37.50	6	1.86	19	4.52	14.3	239.11
Cyclocardia ventricosa	530.0	2500.0	100.0	6.25	1	0.10	1	0.03	0.1	0.81
Serripes groenlandicus	371.5	876.5	50.0	12.50	2	0.20	2	0.19	0.6	4.82
Synidotea nodulosa	470.0	1861.0	87.5	12.50	2	0.88	9	0. 35	1.1	15.36
Amphipoda	394.5	864.5	25.0	12.50	2	0.20	2	0.06	0.2	3.24
Crangon dalli	360.0	666.0	0.0	6.25	1	0.1.0	1	0.32	1.0	2.59
Chionoecetes opilio	409.0	1059.0	0.0	6.25	1	14.30	146	1.58	5.0	99.24
Priapulus caudatus	257.0	228.0	25.0	6.25	1	0.29	3	0.44	1.4	4.60
Echinarachnius parma	446.6	1651..2	85.0	31.25	5	24.19	247	75.47	239.0	3113.30
Ophiuroidea	530.0	2500.0	100.0	6.25	1	0.10	1	0.03	0.1	0.81
Diaphiodia craterodmeta	350.0	661.7	39.3	43.75	7	57.49	587	15.35	48.6	3186.6s
TOTAL							1021		316.7	

[1]Predator Data: Mean length - 380.6 mm; Std. deviation - 68.5 mm; Median length - 360.0 mm; Mean weight - 967.4 g; Std. deviation - 693.6 g; Median weight - 649.0 g; Mean fullness - 45.3%; Std. deviation - 34.5%; Number examined - 16 (includes 1 empty); Sinistral individuals - 93.75%; Dextral individuals - 6.25%

APPENDIX TABLE XI

Summary of Prey Items of *Platichthys stellatus* by Frequency of Occurrence, Number, Volume and Relative Importance from Port Clarence

Samples taken from September 4 through September 17, 1976 at stations C-63 and C-64.

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by Vol. of Taxon	vol. of Taxon (ml)	Importance of Taxon
Polychaeta	328.7	518.0	53.3	11.19	15	0.66	56	0.71	8,5	15.30
Nephtys sp.	390.0	806.0	100.0	0.75	1	0.01	1	0.08	1.0	0.07
Nephtys rickettsi	290.0	339.0	0.0	0.75	1	0.01	1	0.02	0.2	0.02
Glycinde armigera	360.0	750.0	25.0	0.75	1	0.01	1	0.02	0.2	0.02
Lumbrinereis sp.	360.0	750.0	25.0	0.75	1	0.01	1	0.03	0.4	0.03
Sternaspis scutata	323.1	483.6	53.5	26.87	36	1.19	101	1.00	12.0	58.82
Cistenides hyperborea	321.0	455.3	50.0	20.90	28	4.50	381	2.96	35.7	155.99
Lysippe labiata	280.0	252.0	0.0	0.75	1	0.08	7	0.01	0.1	0.07
Pelecypoda	322.5	533.0	43.8	2.99	4	0.05	4	0.06	0.7	0.31
Yoldia sp.	340.0	550.0	25.0	0.75	1	0.04	3	0.25	3.0	0.21
Yoldia hyperborea	323.7	483.7	52.1	81.34	109	10.92	924	41.54	500 .4	4266.97
Yoldia seminuda	290.0	324.0	50.0	0.75	1	0.05	4	0.58	7.0	0.47
Musculus niger	355.0	680.0	57.5	7.46	10	0.14	12	0.57	6.9	5.33
Musculus corrugatus	310.0	354.0	25.0	0.75	1	0.01	1	0.01	0.1	0.02
Clinocardium ciliatum	317.5	461.3	68.8	2.99	4	0.07	6	0.08	1.0	0.46
Serripes groenlandicus	317.1	440.8	50.0	8.96	12	0.14	12	0.58	7.0	6.47
Mya sp.	322.1	448.5	50.0	8.96	12	0.14	12	0.40	4.8	4.84
Liocyma norvegica	31.6.7	445.3	58.3	2.24	3	0.04	3	0.05	0.6	0.19
Naticidae	360.0	750.0	50.0	0.75	1	0.01	1	0.04	0.5	0.04
Polinices pallida	310.0	379.0	25.0	0.75	1	0.01	1	0.01	0.1	0.02

APPENDIX TABLE XI

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TnxOn-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. of Taxon	Freq. of Taxon	Z by No. of Taxon	No. of Taxon	% by Vol. of Taxon	Vol. of Taxon (ml)	Impor tance of Taxon
Admete sp.	325.0	472.5	62,5	1.49	2	0.02	2	0.0?	0.2	0.06
Cylichna occulta	290.0	237.0	75.0	0.75	1	0.01	1	0.01	0.1	0.02
Crustacea	310.0	377.0	25.0	0.75	1	0.01	1	0.01	0.1	0.02
Leucon sp.	310.0	375.0	25.0	0.75	1	0.02	2	0.01	0.1	0.02
Diastylis sp.	296.1	338.8	41.7	6.72	9	0.32	27	0.09	1.1	2.76
Diastylis sulcata	350.0	565.0	50.0	0.75	1	0.06	5	0.01	0.1	0.05
Cnidotea nodulosa	*322.8*	481.8	60.4	26.87	36	0.73	62	0.41	4.9	30.61
Amphipoda	342.5	600.8	59.4	5.97	8	0.24	20	0.12	1.4	2.10
Gammaridae	310.0	375.0	25.0	0.75	1	0.01	1	0.01	0.1	0.02
Pontoporeia femorata	*310.0*	386.5	75.0	1.49	2	0.04	3	0.02	0.'2	0.08
Crangon Sp.	265.0	308.5	25.0	1.49	2	0.02	2	0.02	0.2	0.06
Argis sp.	400.0	1022.0	25.0	(). 75	1	0.01	1	0.04	0.5	0.04
Chioneocetes opilio	*370.0*	.535.0	100.0	0.75	1	0.35	30	2.24	27.0	1.94
Priapulus caudatus	*319.6*	445.3	50.0	20.90	28	0,35	30	2.81	33.8	66.04
Echinarachnius parma	360.0	750.0	25.0	0.75	1	0.06	5	0.04	0.5	0.08
Amphiodia craterodmeta	*327.0*	513.0	53.6	52.24	70	79.54	6733	38.16	459,7	61<8.58
Stegophiura nodosa	*360.0*	750.0	25.0	0.75	1	0.02	2	0.02	0.2	0.03
Pelonaia corrugata	*360.0*	750.0	25.0	0.75	1	0.05	4	0.05	0.6	0.07
Eleginus gracilis	*460.0*	1172.0	125.0	0.75	1	0.01	1	6.23	75.0	4.66
Myoxocephalus sp.	*400.0*	1022.0	25.0	0.75	1	0.01	1	0.71	8.6	0.54
TOTAL							8465		1204.6	

Predator Data:
Mean length - 325.1 mm
Std. deviation - 39.1 mm
Median length - 320.0 mm
Mean weight - 490.5 g
Std. deviation - 220.2 g
Median weight - 415.0 g
Mean Fullness - 47.2%
STD deviation - 29.4X
Number examined - 134
(includes 7 empty)
Sinistral individuals - 58.21%
Dextral individuals - 41.79%

APPENDIX TABLE XII

Summary of Prey Items of *Platichthys stellatus*[1] by Frequency of Occurrence, Number, Volume and Relative Importance from Southeastern Chukchi Sea

Samples taken from September 5, 1976 at stations A-52, A-55, and A-53.

Taxon-Prey Items	Avg Length of Pred., mm	Avg Weight of Pred., g	Avg Full of Pred	% Freq. of Taxon	Freq. of Taxon	% by No. of Taxon	No. of Taxon	% by Vol. of Taxon	vol. of Taxon *(ml)*	Importance of Taxon
Arenicola glacialis	440.0	1320.0	25.0	3.85	1	0.94	1	4.47	12.0	20.83
Hippolytidae	436.0	1299.0	75.0	19.23	5	5.66	6	3.73	10.0	180.53
Echiurus echiurus alaskensis	420.0	1245.8	60.4	46.15	12	28.30	30	50.88	136.5	3654.36
Stegophiura nodosa	440.0	1320,0	75.0	3.85	1	27.36	29	7.83	21.0	135.33
Urochordata	440.0	1345.7	41.7	11.54	3	7.55	8	0.11	0.3	88.37
Teleostei	400. 0	1000.0	125.0	3.85	1	9,43	10	9.32	25.0	72.12
Eleginus gracilis	400.0	1025.0	0.0	3.85	1	0.94	1	0.37	1.0	5.06
Lumpenus fabricii	369.0	802.5	60.0	38.46	10	19.81	21	23.29	62.5	1657.93
TOTAL							106		268.3	

[1] Predator Data:
Mean length - "396. 9 mm
Std. deviation - 60.9 mm
Median length - 400.0 mm
Mean weight - 1031.8 g
Std. deviation - 484.2 g
Median weight - 1025.0 g
Mean fullness - 47.1%
Std. deviation - 40.6%
Number examined - 26
(includes 4 empty)
Sinistral individuals - 80.77%
Dextral individuals - 19.23%