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THE DISTRIBUTION, ABUNDANCE AND DIVERSITY OF THE EPIFAUNAL BENTHIC ORGANISMS IN TWO (ALITAK AND UGAK) BAYS OF KODIAK ISLAND ALASKA

Dr. H. M. Feder, Principal Investigator

with :

Max Hoberg

Stephen C. Jewett

Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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

Little is known about the biology of the non-commercially important invertebrate components of the shallow, nearshore benthos of bays of Kodiak Island, and yet these components may be the ones most significantly affected by the impact of oil resulting from offshore petroleum operations. Some baseline data on species composition is essential before industrial activities take place in waters adjacent to Kodiak Island. It is the intent of this investigation to collect information on the composition, distribution, and biology of the epifaunal invertebrate components of two bays of Kodiak Island.

The specific objectives of this study are:

1. A qualitative inventory of dominant benthic invertebrate epifaunal species within two study sites (Alitak and Ugak bays).
2. A description of spatial distribution patterns of selected benthic invertebrate epifaunal species in the designated study sites.
3. Observations of biological interrelationships between segments of the benthic biota in the designated study areas.

Fifty-three permanent stations have been established in the two bays - 28 stations in Alitak Bay and 25 stations in Ugak Bay. These stations have been occupied with a 400-mesh Eastern otter trawl on three separate cruises in June, July and August of 1976. Taxonomic analysis of the epifauna collected has delineated 10 phyla, 20 classes, 54 families, 68 genera and 89 species. The Arthropoda (Crustacea) dominated species composition and biomass. Porifera, Cnidaria, and Mollusca, were also important, but accounted for only 1.1% of the biomass collected.

Differences in sex composition and stage of maturity of king and snow crab between and within the two bays were noted. King crab occurred mainly at the outer stations of Alitak Bay and consisted mostly of egg-bearing females and juveniles. The crab were well dispersed throughout Ugak Bay, and mainly consisted of juveniles. Snow crab in Alitak Bay were primarily juveniles; snow crab in Ugak Bay were primarily adult males. Life history data for these crabs for the summer months is now available.

Food data for king and snow crabs for the two bays is available, and this data in conjunction with similar data from Cook Inlet and the Bering Sea should contribute to a fuller understanding of the trophic role of these crustaceans in their respective ecosystems. Additional food data for three species of demersal flatfishes, as well as an assessment of the literature, have made it possible to develop a preliminary food web for Alitak and Ugak bays and inshore waters around Kodiak Island. Comprehension of basic food interrelationships is essential for assessment of the potential impact of oil on the crab-dominated benthic systems of the near-shore waters of Kodiak.

The importance of deposit-feeding clams in the diet of crabs in the two Kodiak bays has been demonstrated by feeding studies there. It is suggested that an understanding of the relationship between oil, sediment, deposit-feeding clams, and crabs be developed in a further attempt. to understand the possible impact of "oil on the two commercially important species of crab in the Kodiak area.

Initial assessment of data suggests that a few unique, abundant, and/or large inv.ertebrate species (king crab, snow crab, several species of clams) are available in the bays under investigation and that these species may represent organisms that could be useful for monitoring purposes.

It is suggested that a complete understanding of the benthic systems in both bays can only be obtained when the infauna is assessed in conjunction with the epifauna. Infaunal species are important food items for king and snow crabs. A program designed to examine the infauna should be initiated in the near future.

II. INTRODUCTION

General Nature and Scope of Study

The operations connected with oil exploration, production, and transportation in the Gulf of Alaska present a wide spectrum of potential dangers to the marine environment (see Olson and Burgess, 1967, for general discussion of marine pollution problems). Adverse affects 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 interpretations 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). Populations of marine species fluctuate over a time span of a few to 30 years (Lewis, 1970).

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). The presence of large numbers of benthic epifaunal species of actual or potential commercial importance (crabs, shrimps, scallops, snails, fin fishes) in the shelf ecosystem of Kodiak Island further dictates the necessity of understanding benthic communities since many commercial species feed on infaunal and small epifaunal residents of the benthos (see Zenkevitch, 1963, and this report for a discussion of the interaction of commercial species and the benthos). Thus, drastic changes in density of the food benthos would affect the health and numbers of these fisheries organisms.

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 the Kodiak shelf as well as its bays, 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. An ongoing benthic biological program in the Gulf of Alaska has emphasized the development of a qualitative and quantitative inventory of prominent species of the benthic infauna and epifauna there (Feder *et al.*, 1976). In addition, a developing investigation concerned with the biology of selected benthic species from the northeast Gulf of Alaska and lower Cook Inlet will further our understanding of the overall Gulf of Alaska benthic system (Feder *et al.*, 1977). Initiation of a program designed to examine the subtidal benthos of the Kodiak shelf will expand the coverage of the Gulf of Alaska benthic system, and specifically an assessment of the fauna of shallow bays of Kodiak will extend the investigation into little-studied shallow-water benthic systems. The study reported here then, is a preliminary assessment of two shallow bays of Kodiak Island, and is intended to precede a greater overall investigation of the Kodiak Island shelf.

The objectives of this investigation are:

1. A qualitative inventory of dominant benthic invertebrate epifaunal species within two study sites (Alitak and Ugak bays).
2. A description of spatial distribution patterns of selected benthic invertebrate epifaunal species in the designated study sites.
3. Observations of biological interrelationships between segments of the benthic biota in the designated study areas.

Relevance to Problems of Petroleum Development

The effects of oil pollution on subtidal benthic organisms have been seriously neglected, although a few studies, conducted after serious oil spills, have been published (see Boesch *et al.*, 1974 for review of these papers). Thus, lack of a broad data base elsewhere makes it difficult at present to predict the effects of oil-related activity on the subtidal benthos of the Kodiak continental shelf and the two Kodiak bays investigated. However, the expansion of research activities into Kodiak 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 understand fluctuations in density of marine benthic species, and it cannot be expected that a short-term research program will result in total 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). The tanner or snow crab (*Chionoecetes bairdi*) is a conspicuous member of the shallow shelf of Kodiak Island and its bays, and supports a commercial fishery of considerable importance there. Laboratory experiments with this species have shown that postmolt individuals lose most of their legs after exposure "to Prudhoe Bay crude oil; obviously this aspect of the biology of the snow crab must be considered in the continuing assessment of this benthic species in the Gulf of Alaska (Karinen and Rice, 1974). Little other direct data based on laboratory experiments is available for subtidal benthic species (see Nelson-Smith, 1973). Experimentation on toxic effects of oil on other common members of the subtidal benthos should be strongly encouraged for the near future in Kodiak waters as well as for the overall OCS area of investigation. In addition, potential effects of the loss of sensitive species to the trophic structure of the shelf must be examined. The latter problem can be addressed once benthic food studies are made available as a result of OCS studies (e.g., the following annual reports: Feder *et al.*, 1977, and Smith *et al.*, 1977).

A direct relationship between trophic structure (feeding type) and bottom stability has been demonstrated by Rhoads (see Rhoads, 1974 for review). They describe a diesel-fuel oil spill that resulted in oil becoming adsorbed on sediment particles which in turn caused 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 Gulf of Alaska are deposit feeders; thus, oil-related mortality of these species could result in a changed near-bottom sedimentary regime with alteration of species composition there. In addition, the commercially important king crab and snow crab and some bottom fishes use deposit feeders as food (Feder *et al.*, 1977 and present report); thus, oil hydrocarbons might indirectly affect fisheries for these species around Kodiak Island.

As suggested previously, on completion of initial baseline studies in pollution-prone areas, selected stations should be examined on a long-term basis. Cluster analysis methods (see further discussion under Methods; also see Feder *et al.*, 1976, 1977, for a detailed discussion on methodology) might provide good techniques for the selection of stations for continuous monitoring of the Kodiak Shelf and its bays. In addition, these techniques could provide insights into normal ecosystem variation (Clifford and Stephenson, 1975; Williams and Stephenson, 1973; Stephenson *et al.*, 1974).

III. CURRENT STATE OF KNOWLEDGE

Little is known about the biology of the invertebrate benthos of the Gulf of Alaska, although a compilation of some relevant data on the Gulf of Alaska is available (Rosenberg, 1972). The exploratory fishing drag program of the National Marine Fisheries Service (undated) is the most extensive investigation of the benthic epifauna of the Kodiak shelf.[1] Caution must be exercised in interpreting data from these trawl studies. Results from these surveys, directed toward different groups and/or species, are not typically comparable due to the alteration of gear and sampling effort from one cruise to another. Some unpublished information on the epifauna in the vicinity of Kodiak Island is available (i.e., Alaska Department of Fish and Game King Crab Indexing Surveys).[2] The International Pacific Halibut Commission surveys parts of the Kodiak shelf annually but only records commercially important crabs (see Intl. Pac. Halibut Comm., 1961). A compilation of some relevant data on renewable resources of the Kodiak shelf is available (AEIDC, 1975).

Iv. STUDY AREA

A large number of stations were occupied in two Kodiak Island bays in conjunction with the Alaska Department of Fish and Game. Alitak Bay and Ugak Bay, located on the south and east side of the Island respectively, were the sites of benthic trawling activities during the summer of 1976 (Figs. 1 and 2).

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[1] Unpublished data. Reports available from the National Marine Fisheries Service Laboratory, Kodiak, Alaska.

[2] Unpublished data. Inquiries may be directed to Alaska Department of Fish and Game, Box 686, Kodiak, Alaska 99615.

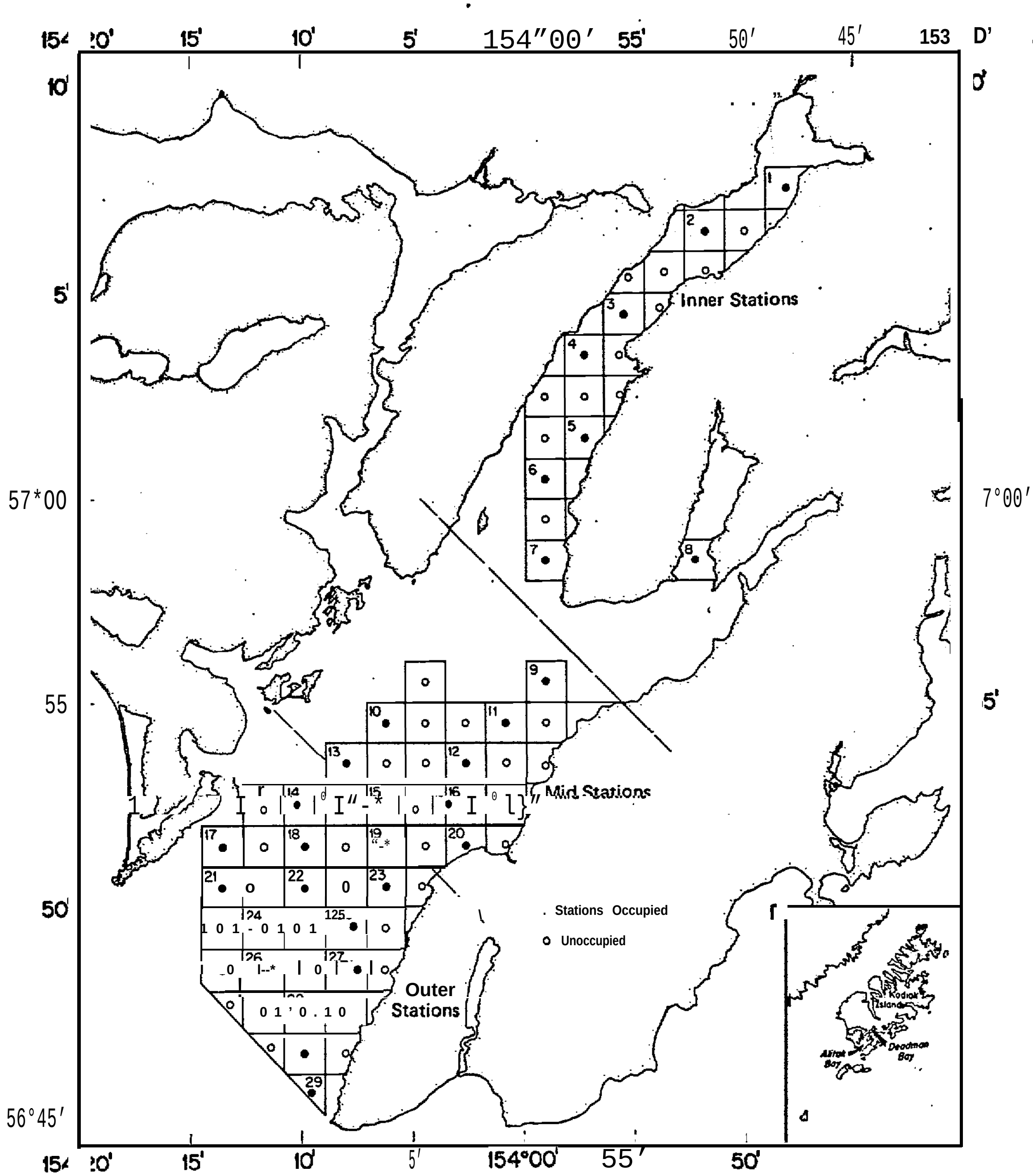

Figure 1. Trawl station grid and stations occupied in Alitak Bay, Kodiak Island, Alaska. June, July, and August, 1976. The oblique lines drawn across the bay divides it into three sections referred to in the text.

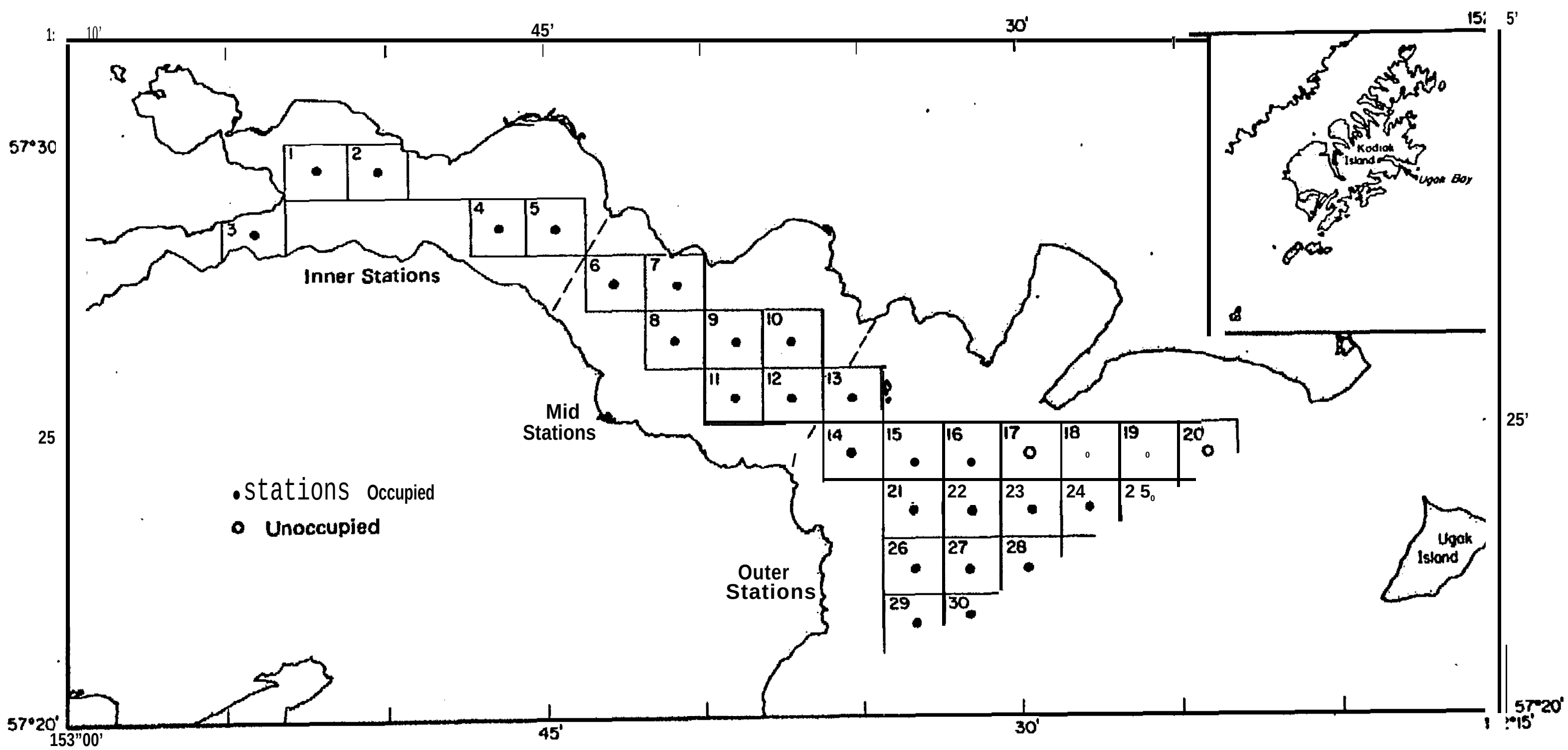

Figure 2. Trawl station grid in Ugak Bay, Kodiak Island, Alaska. June, July, and August, 1976. The oblique, dashed lines drawn across the bay divide it into three sections referred to in the text.

V. SOURCES, METHODS AND RATIONALE OF DATA COLLECTION

Benthic epifauna was collected onboard the M/V *Big Valley* in 1976 during June 17-22, July 18-28 and August 19-29. Thirty-minute tows were made at predetermined stations (Figs. 1 and 2) using a commercial size 400-mesh Eastern otter trawl with a 12.2 m horizontal opening.

The number of stations occupied in each bay by cruise are as follows:

Cruise Date	Alitak Bay	Ugak Bay	Total Stations
June 17-22	28	25	53
July 18-28	28	25	53
August 19-29	22	25	47
TOTAL	78	75	153

Bay stations were arbitrarily divided into three sections; inner stations, mid-bay stations, and outer stations.

Invertebrates were sorted on shipboard, given tentative identifications, counted, and weighed. Aliquot samples of individual species were preserved and labeled for final identification at the Institute of Marine Science, University of Alaska. Laboratory examination occasionally revealed more than one species in a sample that had been identified in the field (e.g., field identifications of *Eualus macilenta* were later found to also contain *E. gaimardii belcheri*). 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. .

After final identification, all invertebrates were assigned code numbers to facilitate data analysis by computer (Mueller, 1975). Representative and voucher samples of invertebrates are stored at the Institute of Marine Science, University of Alaska, Fairbanks, Alaska.

The major limitations of the survey were those imposed by the selectivity of the otter trawl used and the seasonal movements of certain species taken. In addition, rocky-bottom areas could not be sampled since otter trawls of the type used can only be fished on relatively smooth bottoms. Due to the location of stored commercial crab gear in Alitak Bay, six stations (9 through 13) had to be eliminated during the August sampling period.

Food data was collected by examination of stomachs either on shipboard or in the laboratory of two species of crab (snow crab, *Chionoecetes bairdi* and king crab, *Paralithodes camtschatica*) and three species of flatfishes (*Limanda aspera, Hippoglossoides elassodon* and *Lepidopsetta bilineata*). Only male snow crab between 75 and 180 mm carapace width were examined; only male king crab between 90 and 200 mm carapace width were examined. Food organisms are expressed in frequency of occurrence, i.e., the percent of stomachs containing various food items from the total number of stomachs analyzed. Empty stomachs were included in making calculations of frequency of occurrence.

King crab and snow crab were separated by weight, sex, and state of maturity. Male king crab were considered sexually mature if their wet weight was at least 2.2 kg. Male snow crab were considered mature if their wet weight was at least 0.45 kg. Weight criteria established for maturity of both crab species are approximations (J. Hilsinger and S. Jewett, unpublished). Female crab were classified as immature (pre-reproductive) or mature (reproductive or post-reproductive) based on the enlarged abdomen, modified pleopods, and egg clutch of the adults.

Data tables consist primarily of data pooled from all cruises from both bays. These data are used as the bases for biological generalizations about the Kodiak bays studied. Selected biological aspects of each bay are treated separately in the text. Separate tables and discussions for each bay will be available in the Final Report, and will contain additional information from a fourth cruise in March 1977.

Data referred to in the text is generally from field notebooks and is not available to NODC at the the" of this Annual Report. Complete station data will be available to NODC at the time of the final report.

VI. RESULTS

Distribution and Abundance

Taxonomic analysis of epifaunal invertebrates from 153 stations delineated 10 phyla, 20 classes, 54 families, 68 genera and 89 species (Table I; Appendix I). Arthropoda (Crustacea) and Mollusca dominated species representation with 36 and 28 species respectively (Table I, Appendix 1). Arthropod crustaceans accounted for 97.3% of the total invertebrate biomass (Table II; Appendix II) and 96% of the total weight was made up of the families Pandalidae, Lithodidae, and Majidae (Table III; Appendix I). The leading species in each of these families respectively was the pink shrimp, *Pandalus borealis*; the king crab, *Paralithodes camtschatica*; and the snow (tanner) crab, *Chionoecetes bairdi* (Table IV; Appendix I). Although 28 species of molluscs were present, they only accounted for 0.1% of the total invertebrate biomass (Table II; Appendix I).

The average catch of *Pandalus borealis* for all stations was 9.9 kg per tow. Abundant catches of pink shrimp were obtained from Alitak Bay stations 11 through 16 (Fig. 1) and Ugak Bay stations 10 through 14, 22 and 23 (Fig. 2). The greatest single catch of pink shrimp was obtained in July at Alitak Bay station 23; 426.0 kg.

TABLE I

A LIST OF SPECIES TAKEN BY TRAWL FROM ALITAK AND UGAK BAYS, KODIAK ISLAND, ALASKA IN JUNE, JULY AND AUGUST, 1976

Phylum Porifera
- Unidentified species

Phylum Cnidaria
- Class Hydrozoa
  - Unidentified. species
- Class Scyphozoa
  - Unidentified species
- Class Anthozoa
  - Subclass Alcyonaria
    - Family Pennatulidae
      - *Ptilosarcus gurneyi* (Gray)
    - Family Actinostolidae
      - *Stomphia coccinea* (O. F. Müller)
    - Family Actiniidae
      - Unidentified species

Phylum Annelida
- Class Polychaeta
  - Family Polynoidae
    - Unidentified species
  - Family Nereidae
    - *Nereis* sp.
  - Family Serpulidae
    - *Crucigera irregularis* Bush
- Class Hirudinae
  - Family Acanthochitonidae
    - *Notostomobdella* sp.

Phylum Mollusca
- Class Pelecypoda
  - Family Nuculanidae
    - *Nuculana* fossa Baird
    - *Yoldia hyperborea* Lovén in Torell
    - *Yoldia thraciaeformis* Storer
  - Family Mytilidae
    - *Mytilus edulis* Linnaeus
    - *Musculus discors* (Gray)
    - *Modiolus modiolus* (Linnaeus)
  - Family Pectinidae
    - *Pecten caurinus* Gould
    - *Chlamys rubida* Hinds
  - Family Anomiidae
    - *Pododesmus macrochisma* Deshayes
  - Family Astartidae
    - *Astarte rollandi* Bernardi
    - *Astarte esquimalti* Baird
  - Family Cardiidae
    - *Clinocardium ciliaatum* (Fabricius)
    - *Clinocardium nuttallii* Conrad
    - *Serripes groenlandicus* (Bruguiére)

TABLE I

CONTINUED

Family Veneridae
- *Saxidomus gigantea* (Deshayes)
- *Protothaca staminea* (Conrad)

Family Tellininidae
- *Macoma calcarea* (Gmelin)
- *Macoma moesta* (Deshayes)

Family Hiatellidae
- *Hiatella arctica* (Linnaeus)

Family Teredinidae
- *Bankia setacea* Tryon

Class Gastropoda

Family Calyptraeidae
- *Crepidula nummaria* Gould

Family Velutinidae
- *Velutina* sp.

Family Cymatiidae
- *Fusitriton oregonensis* (Redfield)

Family Thaididae
- *Nucella lamellosa* (Gmelin)

Family Neptunidae
- *Neptunea lyrata* (Gmelin)

Family Dorididae
- Unidentified species

Class Cephalopod

Family Gonatidae
- *Gonatus* sp.

Family Octopodidae
- *Octopus* sp.

Phylum Arthropoda

Class Crustacea

Family Balanidae
- *Balanus balanus* Pilsbury
- *Balanus hesperius* Pilsbury
- *Balanus rostratus* Pilsbury

Class Isopoda
- Unidentified species

Class Amphipoda
- Unidentified species

Class Decapoda

Family Pandalidae
- *Pandalus* sp.
- *Pandalus borealis* Kröyer
- *Pandalus goniurus* Stimpson
- *Pandalus hypsinotus* Brandt
- *Pandalopsis dispar* Rathbun

Family Hippolytidae
- *Eualus biunguis* Rathbun
- *Eualus gaimardii belcheri* (Bell)
- *Eualus macilenta* (Kröyer)

TABLE I

CONTINUED

- Family Crangonidae
  - *Crangon dalli* Rathbun
  - *Crangon communis* Rathbun
  - *Sclerocrangon boreas* (Phipps)
  - *Argis lar* (Owen)
  - *Argis dentata* (Rathbun)
  - *Argis crassa* Rathbun
- Family Paguridae
  - *Pagarus* sp.
  - *Pagurus ochotensis* Brandt
  - *Pagurus aleuticus* (Benedict)
  - *Pagurus capillatus* (Benedict)
  - *Pagurus kennerlyi* (Stimpson)
  - *Pagurus beringanus* (Benedict)
  - *Elassochirus tenuimanus* (Dana)
  - *Labidochirus splendescens* (Owen)
- Family Lithodidae
  - *Paralithodes camtschatica* (Tilesius)
- Family Majidae
  - *Oregonia gracilis* Dana
  - *Hyas lyratus* Dana
  - *Chionoecetes bairdi* Rathbun
  - *Pugettia gracilis* (Dana)
- Family Cancridae
  - Cancer sp.
  - *Cancer magister* Dana
  - Cancer *oregonensis* (Dana)
- Family Atelecyclidae
  - *Telmessus cheiragonus* (Tilesius)
- Family Pinnotheridae
  - *Pinnixa occidentalis* Rathbun

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

Phylum Ectoprocta
- Unidentified species

Phylum Brachiopoda
- Class Articulate
  - Family Cancellothridae
    - *Terebratulina unguicula* Carpenter
  - Family Dallinidae
    - *Terebratalia* transversal (Sowerby)

Phylum Echinodermata
- Class Asteroidea
  - Family Echinasteridae
    - *Henricia* sp.
  - Family Solasteridae
    - *Solaster stimpsoni* Verrill

TABLE I

CONTINUED

Family Asteridae
Stylasterias forreri (de Loriol)
Evasterias echinosoma (Stimpson)
Evasterias troschelii (Stimpson)
Pycnopodia helianthoides (Brandt)
Family Strongylocentrotidae
Strongylocentrotus droebachiensis (O. F. Miller)
Class Ophiuroidae
Family Gorgoncephalidae
Gorgonocephalus caryi (Lyman)
Class Holothuroidea
Family Molpadiidae
Molpadia sp.
Family Cucumariidae
Cucumaria sp.
Phylum Chordata
Class Ascidiacea
Family Styelidae
Pelonaia corrugata Forbes Goods

TABLE 11

NUMBERS, WEIGHT, AND DENSITY OF MAJOR EPIFAUNAL INVERTEBRATE PHYLA OF ALITAK AND UGAK BAYS; 1976
(Trawl survey pooled data from cruises in June, July, and August)

Phylum	Number of Organisms	Weight(kg)	Percent of Total Weight	Mean Grams per Square Meter
Porifera	1650	102.03	0.7	0.18
Cnidaria	241	45.67	0.3	0.08
Mollusca	570	19.30	0.1	0.03
Arthropoda (Crustacea only)	319120	12619.44	97.3	22.36
Echinodermata	297	157.70	1.2	0.28
TOTAL	321878	12944.14	99.6	22.93

TABLE III

NUMBERS, WEIGHT, AND DENSITY OF MAJOR EPIFAUNAL INVERTEBRATE FAMILIES OF ALITAK AND UGAK BAYS, 1976
(.Trawl survey, pooled data from cruises in June, July, and August)

Family	Number of Organisms	Weight(kg)	Percent of Total Weight	Mean Grams per Square Meter
Actiniidae	195	41.41	0.3	0.07
Pandalidae	281899	2372.66	18.3	4.20
Hippolytidae	12827	89.77	0.7	0.15
Crangonidae	7733	53390.66	0.4	0.09
Lithodidae	4420	3668.80	28.3	6.50
Maj idae	11397	6403.41	49.4	11.34
Asteridae	232	150.02	1.1	0.26
TOTAL	318703	66116.73	98.5	22.61

TABLE IV

NUMBERS, WEIGHT, AND DENSITY OF THE MAJOR EPIFAUNAL SPECIES OF ARTHROPODA (CRUSTACEA) FROM ALITAK AND UGAK BAYS, 1976

(Trawl survey, pooled data from cruises of June, July, and August)

Species	Number of Organisms	Weight(kg)	Percent of Total Weight	Percent of Phylum Weight	Mean Grams per Square Meter
Pandalus borealis	79312	1528.02	11.8	12.11	2.70
Pandalus goniurus	38671	311.90	2.4	2,47	0.55
Pandalus hypsinotus	61470	493.38	1.1	3.91	0.87
Pandalopsis dispar	2446	39*35	0.3	0.31	0.06
Eualus gaimardii belcheri	10292	71.99	0.5	0.57	0.12
Argis dentata	3676	25.83	0.2	0.20	0.04
Paralithodes camtschatica	4420	3668.80	28.3	29.07	6.50
Chionoecetes bairdi	11287	6399.84	49.4	50.71	11.33
TOTAL	211574	12539.11	94.0	99.35	22.17

The average catch of *Paralithodes camtschatica* for all stations was 23.97 kg. Alitak Bay stations 21 through 29 and Ugak Bay stations 1 and 3 had the highest catches. The single largest catch was obtained at Alitak Bay station 28 during July.

Chionoecetes bairdi was normally dominant at all stations. The average catch was 41.8 kg. Large. catches were obtained in Alitak Bay stations 2 through 5 and Ugak Bay stations 9, 10, 13 and 22. The largest catch was recorded at Alitak Bay station 3.

Differences in sex composition and stage of maturity of king crab and snow crab were evident between and within bays (Table V). During the three sampling periods in Alitak Bay, king crab were found mainly in the outermost stations (stations 14, 17, 18, 19, and 21 through 29) (Table V; Fig. 1). These outer stations were mainly composed of adult egg-bearing females and juveniles. The sex ratio of king crabs in the outer Alitak stations for the present study as well as from. other studies (Gray and Powell, 1966; Kingsbury and James, 1971) is presented in Table VI. The sex ratio for king crab obtained in Ugak Bay for the present study is presented in Table VII.

King crab were well dispersed throughout Ugak Bay in all months. The composition was mainly juveniles (Table V).

The trend for the catch of snow crab in Alitak Bay declined from June to August. Adult males were the main component of the population during all sampling periods (Table V).

Snow crab were most abundant in the outer Ugak Bay stations (stations 13 through 30) (Fig. 2). The composition was mainly adult males (Table V). . . .

TABLE V

SEX-MATURITY COMPOSITION OF KING CRAB AND SNOW CRAB IN ALITAK AND UGAK BAYS, JUNE, JULY, AND AUGUST, 1976

Alitak Bay Stations	Composition	June King crab No.	June King crab %	June Snow crab No.	June Snow crab %	July King crab No.	July King crab %	July Snow crab No.	July Snow crab %	August King crab No.	August King crab %	August Snow crab No.	August Snow crab %
1-7 (inner)	Adult males	0	0	1148	98	0	0	653	97	3	30	417	95
	Adult females w/eggs	0	0	8	1	0	0	16	2	7	70	11	3
	Juvenile males	0	0	0	0	0	0	0	0	0	0	2	<1
	Juvenile females	0	0	8	1	0	0	6	1	0	0	9	2
	Total	0	0	1164	100	0	0	675	100	10	100	439	100
9-13, 15, 16, 20 (mid-bay)	Adult males	0	0	603	88	41	67	895	92	6	15	84	92
	Adult females w/eggs	1	100	55	8	4	6	53	6	16	39	4	4
	Juvenile males	0	0	0	0	13	21	14	1	14	34	2	2
	Juvenile females	0	0	27	4	4	6	8	1	5	12	2	2
	Total	1	100	685	100	62	100	970	100	41	100	92	100
14, 17, 18, 19, 21-29 (outer)	Adult males	25	7	1037	76	28	4	583	61	21	8	178	67
	Adult females w/eggs	165	50	319	23	244	35	271	28	100	37	69	26
	Juvenile males	87	26	8	1	236	34	12	1	92	34	9	3
	Juvenile females	56	17	4	<1	186	27	93	10	56	21	11	4
	Total	333	100	1368	100	694	100	959	100	269	100	267	100
Ugak Bay Stations													
1-5 (inner)	Adult males	8	7	180	87	23	2	214	42	20	5	190	77
	Adult females w/eggs	1	1	16	8	2	<1	59	12	5	1	19	8
	Juvenile males	43	38	0	0	397	43	196	38	193	50	18	7
	Juvenile females	61	54	11	5	511	55	42	8	169	44	21	8
	Total	113	100	207	100	933	100	511	100	387	100	248	100
6-12 (mid-bay)	Adult males	7	29	567	90	23	6	212	56	2	1	213	81
	Adult females w/eggs	3	13	31	5	9	2	33	9	1	1	8	3
	Juvenile males	12	50	0	0	189	50	109	29	76	45	25	10
	Juvenile females	2	8	35	5	159	42	25	6	88	53	16	6
	Total	24	100	633	100	380	100	379	100	167	100	262	100

" TABLE V

CONTINUED

Ugak Bay Stations	Composition	June King crab No.	June King crab %	June Snow crab No.	June Snow crab %	July King crab No.	July King crab Z	July Snow crab No.	July Snow crab %	August King crab No.	August King crab %	August Snow crab No.	August Snow crab %
13-30 (outer)	Adult males	21	29	591	83	21	8	728	62	2	<1	339	76
	Adult females w/eggs	7	10	38	5	36	13	61	5	9	1	23	5
	Juvenile males	29	40	0	0	149	53	189	16	379	57	59	14
	Juvenile females	15	21	79	12	73	26	200	17	282	42	24	5
	Total	72	100	708	100	279	100	1178	100	672	100	445	100

Stations 9-13 in Alitak Bay were not sampled during August due to the presence of stored crab gear.

TABLE VI

SEX RATIOS OF KING CRAB IN OUTER ALITAK BAY[1]

Date	Mature Crabs			Immature Crabs		
	Male	Female	Ratio[2]	Male	Female	Ratio[2]
April 1970[3]	390	1419	3.63	60	76	1.26
May 1962[4]	366	584	1.59	28	21	0.75
June 1970[3]	198	359	1.81	103	66	0.64
June 1976	25	165	6.60	87	56	0.64
July 1976	28	244	8.71	236	186	0.78
August 1976	21	100	4.76	92	56	0.60

[1]Additional data not reported here is found in Kingsbury *et al.*, 1974.

[2]Females per male.

[3]Kingsbury and James, 1971.

[4]Gray and Powell, 1966.

TABLE VII

SEX RATIOS OF KING CRAB IN UGAK BAY JUNE, JULY, AND AUGUST 1976

Date	Mature Crabs			Immature Crabs		
	Male	Female	Ratio[1]	Male	Female	Ratio[1]
June	36	11	0.30	84	78	0.92
July	67	47	0.70	735	743	1.01
August	24	15	0.60	648	539	0.83

[1]Females per male

Feeding Data

Food contents were examined from 67 snow crab (*Chionoecetes bairdi*), 17 king crab (*Paralithodes camtschatica*), 17 yellowfin sole (*Limanda aspera*), 5 flathead sole (*Hippoglossoides elassodon*) and 4 rocksole (*Lepidopsetta bilineata*) (Table VIII).

The two commercial crabs, *P. camtschatica* and *C. bairdi*, were feeding on different items with little overlap. *Paralithodes camtschatica* concentrated on *Nuculana fossa*, miscellaneous clam species, *Margaritas* sp., and miscellaneous fishes. *Chionoecetes bairdi* fed primarily on polychaetes, Nuculanidae, miscellaneous clam species (consumed about equally by both crabs), caridean shrimps, and plant matter. Sediment was found in 44.8% of snow crab stomachs. Although the latter item had the highest frequency of occurrence in snow crab stomachs, it is not clear if sediment actually represents a food source for *Chionoecetes bairdi* or is incidentally taken in the feeding process.

Among the fishes examined for stomach contents, *Limanda aspera* used fishes, *C. bairdi*, and clams, including the deposit-feeding *Macoma* as major food items; *Hippoglossoides elassodon* concentrated on euphausids and caridean shrimps; *Lepidopsetta bilineata* fed primarily on polychaetes and *Nuculana fossa*.

The Kodiak Island food web (Fig. 3) is based on data presented in this report, information from McDonald and Peterson (1976) and Feder *et al.* (1977) which presents some Pacific cod data from Kodiak. The food web (Fig. 3) is presented so that carbon flow is generally from bottom to top and always in the direction of the arrows. Data was insufficient to clearly identify major food pathways. Polychaetes, gastropod (snails), pelecypods (clams), amphipods, anomurans (hermit crabs), brachyurans (true

TABLE VIII

PERCENT FREQUENCY OF OCCURRENCE OF FOOD ITEMS (LISTED ACCORDING TO LOWEST LEVEL OF TAXONOMIC IDENTIFICATION) FOUND IN STOMACHS OF INVERTEBRATES AND FISHES FROM ALITAK AND UGAK BAYS, KODIAK ISLAND, 1976

Food Item	Percent frequency of occurrence of food items found in stomachs of:				
	Paralithodes camtschatica N=17	*Chionoecetes bairdi* N=67	*Limanda aspera* N=17	*Hippoglossoides elassodon* N=5	*Lepidopsetta bilineata* N=4
Polychaeta	-[1]	11.9			75.0
Nuculanidae		9.0			
Nuculana fossa	47.1				50.0
Yoldia sp.					25.0
Pelecypoda	29.4	29.9	17.7		25.0
Axinopsida sp.					25.0
Macoma sp.			11.8		25.0
Tellina sp.		1.5			
Spisula polynyma	5.9		5.9		
Siliqua alta			5.9		
Mytilus edulis		1.5			
Gastropoda	5.9				-
Margarites sp.	11.8				
Fusitriton oregonensis	5.9				
Crustacea		3.0			
Euphausiacea				60.0	
Caridea		16.4		14.2	25.0
Crangonidae		1.5			

TABLE VIII

CONTINUED

Food Item	Percent frequency of occurrence of food items found in stomachs of:				
	Paralithodes camtschatica N=17	*Chionoecetes bairdi* N=67	*Limanda aspera* N=17	*Hippoglossoides elassodon* N=5	*Lepidopsetta bilineata* N=4
Brachyura	-	9.0	-	-	-
Majidae	5.9	-	-	-	-
Chionoecetes bairdi	-	-	11.8	-	25.0
Atelecyclidae	5.9	-	-	-	-
Echiurus echiurus	-	1.5	-	-	-
Teleostei	17.7	3.0	17.7	-	25.0
Osmeridae	-	-	5.9	-	-
Mallotus villosus	-	-	5.9	-	-
Unidentified plants	5.9	31.3	-	-	-
Sediment	-	44.8	-	-	-
Empty stomachs	23.5	22.4	47.1	-	-

[1] All dashes indicate food item not present

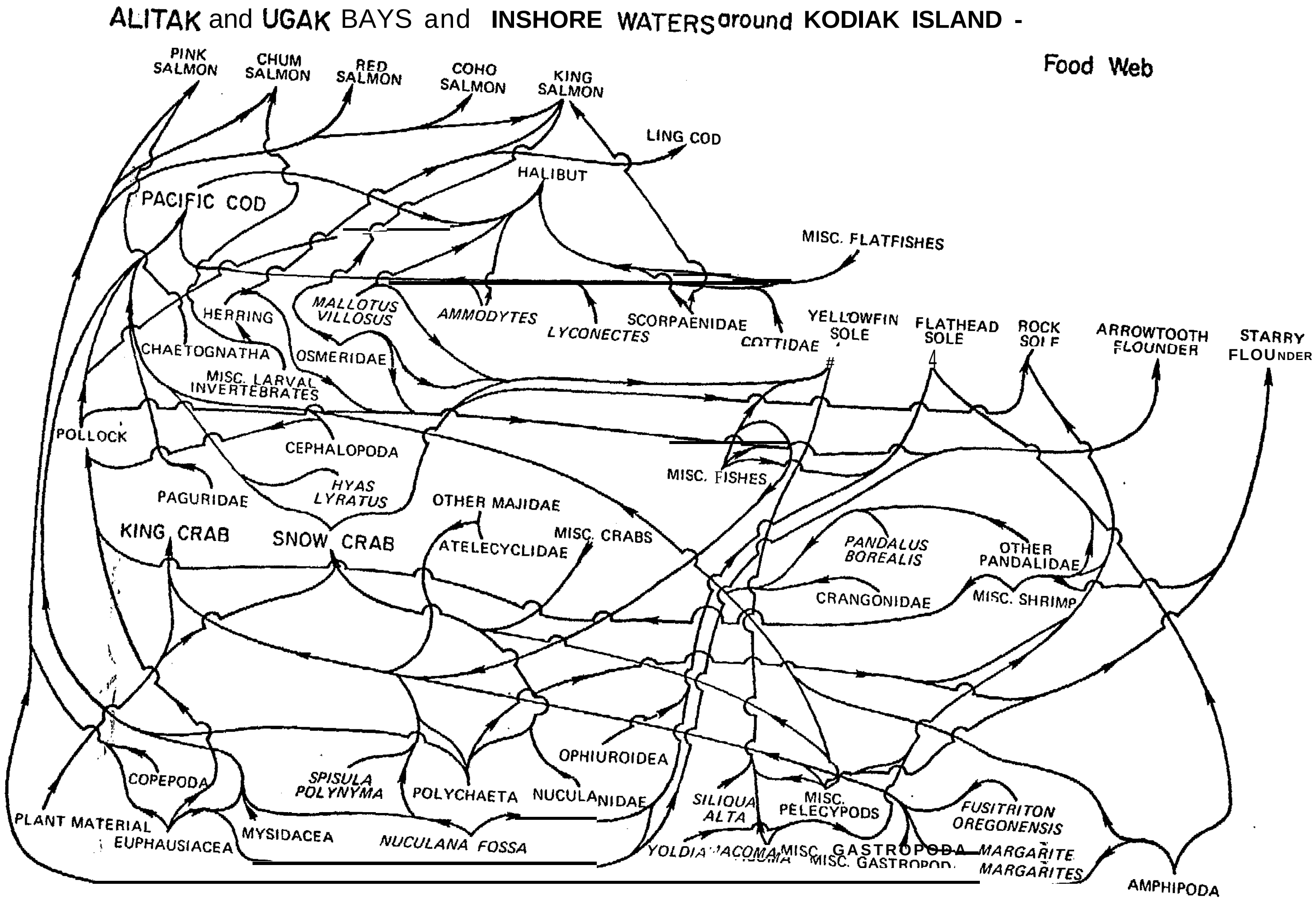

Figure 3. A food web based on the epibenthic species taken from Alitak and Ugak Bays and inshore waters around Kodiak Island, Alaska.

crabs), and carideans (shrimps) are the major invertebrate food items in the web. Shrimps and crabs are important food items for most fishes as well as some of the crabs. Small fishes such as herring, capelin and sandlance are important as food for the larger predatory fishes such as Pacific cod, king salmon and halibut (see Feder *et al.*, 1977 for additional Gulf of Alaska food data).

Feeding relationships for snow crab, king crab, and Pacific cod (data from Feder *et al.*, 1977 and S. Jewett, unpublished data for Kodiak) are shown in more detail in Figures 4, 5, and 6, respectively. The snow and king crabs (two of the most important commercial organisms on the Kodiak shelf) feed heavily on animals relying in whole or in part on deposited organics, detritus, bacteria, benthic diatoms, and meiofauna (Figs. 5 and 6, Table IX). Pacific cod feeds primarily on animals that are feeding on small benthic invertebrates or scavenging on animal remains (Fig. 6; Table IX). The invertebrates in the two bays relied on a variety of feeding methods (Table IX) while the fishes tended to be predators.

Number, weight and frequency of occurrence calculations used in this report are based on Appendix Tables 1-4.

VII. DISCUSSION

Station Coverage

The trawl program discussed in this report represents the first intensive coverage of epifaunal invertebrates of Alitak and Ugak Bays. Preliminary plans called for 28 stations to be occupied monthly in Alitak Bay and 25 stations in Ugak Bay for June, July, and August 1976. August sampling in Alitak Bay was hampered when stored crab gear prevented sampling

Food Web - KODIAK ISLAND

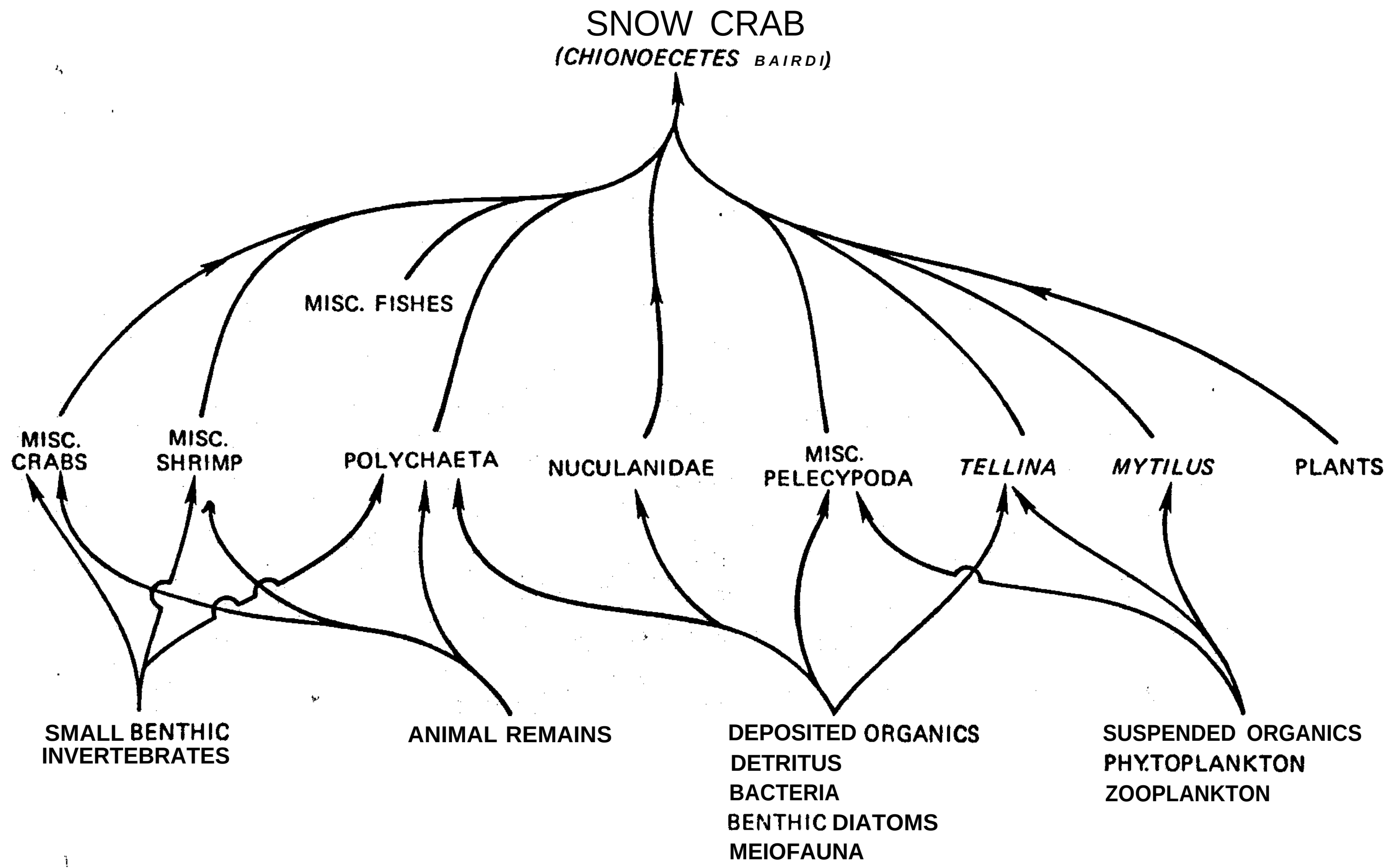

Figure 4. Food web showing carbon flow to snow crab (*Chionoecetes bairdi*) in **Alitak** and Ugak Bays and inshore waters around Kodiak Island, Alaska,

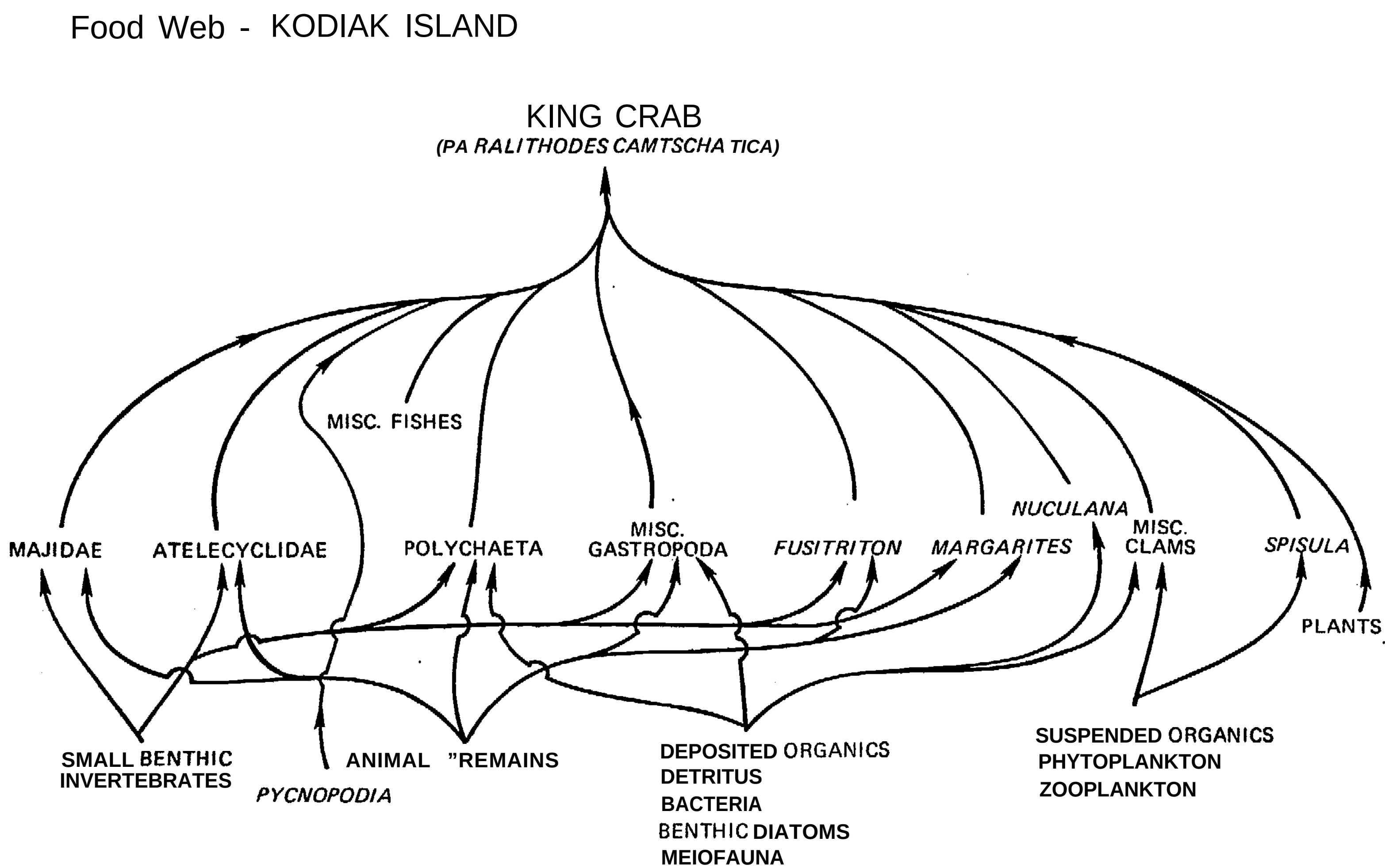

Figure 5. Food web showing carbon flow to king crab (*Paralithodes camtschatica*) in Alitak and Ugak Bays and inshore waters around Kodiak Island, Alaska.

Food Web -, KODIAK ISLAND

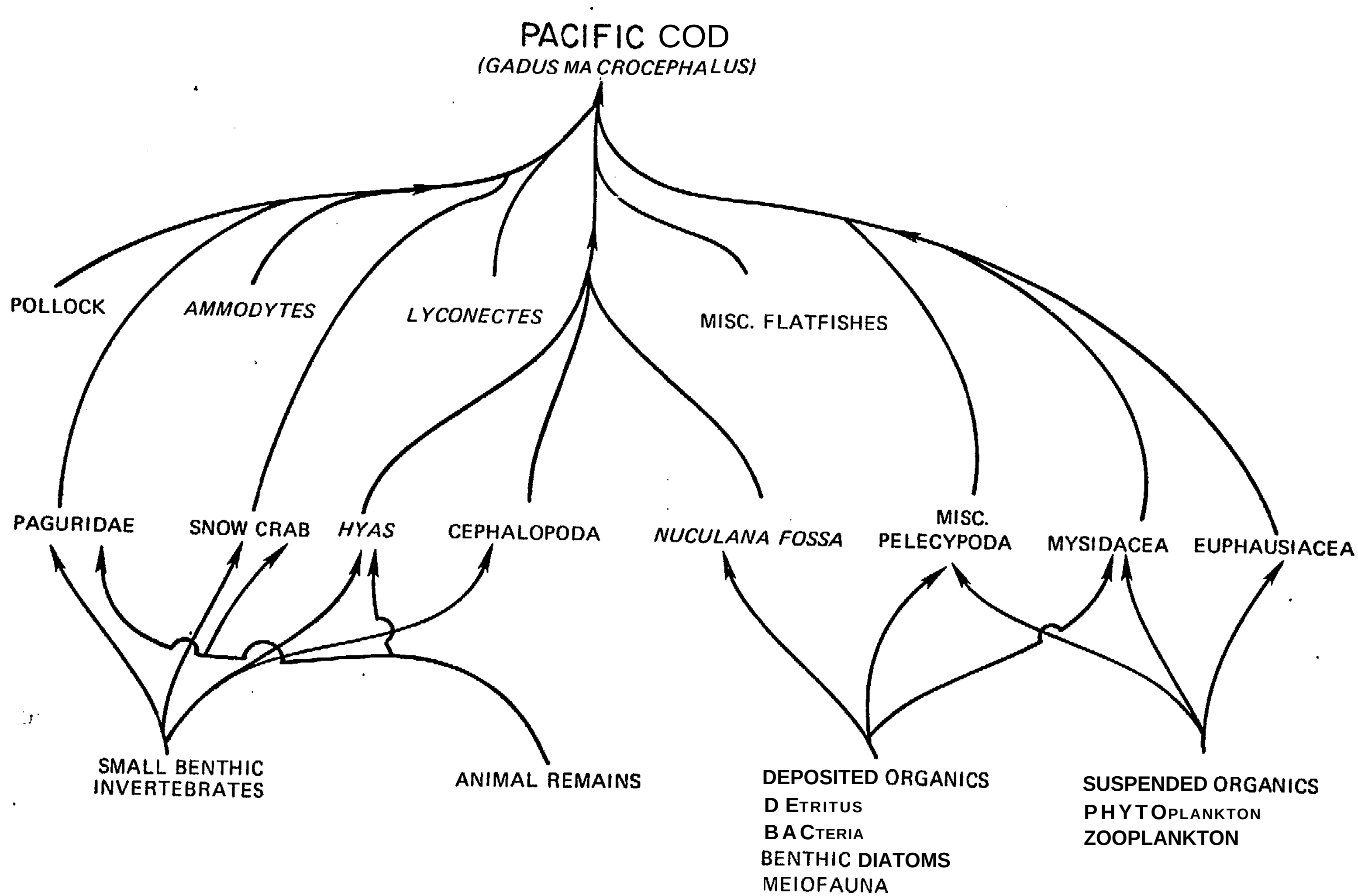

Figure 6. Food web showing carbon flow to Pacific cod (*Gadus macrocephalus*) from inshore waters around Kodiak Island, Alaska. (Also see Feder et *al.*, 1977 for comments on cod food habits in the Gulf of Alaska).

TABLE IX

FEEDING METHODS[1] OF ORGANISMS INCLUDED IN THE KODIAK ISLAND (ALITAK AND UGAK BAYS AND OTHER INSHORE WATERS) FOOD WEB

Phylum abbreviations: A=Annelida; M=Mollusca; Art=Arthropoda; Ecd=Echinodermata
Ctn=Chaetognatha; Cho=Chordata; X=dominant feeding method; O=other feeding method

Organism	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Polychaeta	A	X	X	X	X	
Gastropoda	M	X		X	X	
Margaritas	M					X
Fusitriton oregonensis	M			X	X	
Nuculana fossa	M	X				
Yoldia sp.	M	X				
Spisula polynyma	M		X			
Axinopsida Sp.	M					X
Siliqua alta	M					X
Macoma sp.	M	X	O			
Cephalopoda	M			X	X	
Mysidacea	Art		X	X	X	
Amphipoda	Art	X		X	X	
Euphausiacea	Art		X			
Pandalidae	Art			X	X	-
Pandalus borealis	Art			X	X	
Crangonidae	Art			X	X	
Paguridae	Art			X	X	
Paralithodes camtschatica	Art			X	X	
Majidae	Art			X	X	

TABLE IX

CONTINUED

Organism	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Hyas lyratus	Art			X	X	
Chionoecetes bairdi	Art			X	X	
Atelecyclidae	Art					X
Ophiuroidea	Ecd	X	X	X	X	
Chaetognatha	Ctn				X	
Clupea harengus pallasi (herring)	Cho				X	
Oncorhynchus gorbuscha (pink salmon)	Cho				X	
O. *keta* (chum salmon)	Cho				X	
O. kisutch (coho salmon)	Cho				X	
o. *nerka* (red salmon)	Cho				X	
o. *tshawytscha* (King salmon)	Cho				X	
Osmeridae	Cho				X	
Mallotus villosus (capelin)	Cho				X	
Theragra chalcogramma (pollock)	Cho				X	
Gadus *macrocephalus* (Pacific cod)	Cho			X	X	
Lyconectes sp.	Cho				X	

TABLE IX

CONTINUED

Organism	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Ammodytes sp. (sand lance)	Cho				X	
Scorpaenidae	Cho				X	
Ophiodon sp. (lingcod)	Cho				X	
Cottidae	Cho				X	
Atheresthes stomias (arrowtooth flounder)	Cho				X	
Hippoglossoides elassodon (flathead sole)	Cho				X	
Hippoglossus stenolepis (Pacific halibut)	Cho				X	
Lepidopsetta bilineata (rock sole)	Cho				X	
Limanda aspera (yellowfin sole)	Cho				X	
Platichthys stellatus (starry flounder)	Cho				X	

[1] Based on Barnes, 1968; Feder, unpublished data; Hart, 1973; Newell, 1970; Pearce and Thorson, 1967; and Rasmussen, 1973.

of five stations. During the three sampling periods, 78 stations were occupied in Alitak Bay covering a total of 1.76 km^2. Station coverage in Ugak Bay was 1.69 km^2. The average distance fished at each station was 1.85 km.

Species Composition and Diversity

Examination of the species composition of both bays revealed crustaceans and molluscs to be the major epifaunal invertebrates present. In general, epifaunal diversity was similar to that reported in Feder *et al.* (1976) for the northeast Gulf of Alaska. Major differences between the northeast Gulf of Alaska and the Kodiak bay fauna were the low numbers of species of annelids and echinoderms found in the bays. Coverage of the northeast Gulf of Alaska revealed 30 species of annelids and 36 species of echinoderms; however, these phyla in Alitak and Ugak Bays only comprised 4 and 10 species respectively. *Pagurus* was the most diverse genus present with six species collected.

Alitak Bay has a past history as a king crab mating ground (Kingsbury and James, 1971), and has been a major producer of commercial-sized crab in the Kodiak Island area since 1953 (Gray and Powell, 1966). Outer Alitak Bay was also the site of king crab distribution, abundance, and composition studies (Gray and Powell, 1966; Kingsbury *et al.*, 1974) conducted by the Alaska Department of Fish and Game during the summer months of 1962 and 1970.

King crab live most of their lives on the deeper part of the continental shelf, coming into the shallows once a year to mate. Except during the mating season (mid-March to June), the sexes remain apart in deep water (Iverson, 1966). However, changing physical conditions from year to year may alter the periodicity of migration and breeding. The documented-life history of the king crab reported elsewhere is reflected in the observations made for this crab in the two Kodiak bays discussed in this report. Examination of sex composition and stage of maturity of king crab from the past and present studies in outer Alitak Bay indicate a low ratio of adult females to adult males during the mating season (Tables V and VI). After mating has presumably occurred and sexes separate the ratio increases (Tables V and VI). The absence of adult males from the bays in the latter part of the present study reflects their departure following spawning. Segregation between sexes in juveniles is not apparent (Tables V and VI; Powell and Nickerson, 1965).

Catches of king crab and snow crab in Ugak Bay during the present study reflect a similar sex-maturity composition to that found during A.D.F. & G. crab indexing studies in this bay, i.e., a predominance of juvenile king crab of both sexes and adult male snow crab. Although Ugak Bay does not typically yield commercial-size king crab, the outer bay is often fished for snow crab (A.D.F. & G., Kodiak, Alaska snow crab catch statistics).

Food Habits

The main species examined for stomach contents (*Chionoecetes bairdi* and *Paralithodes camtschatica*) in the present study were the most abundant and widely dispersed organisms present. Important food items consumed by Alitak Bay and Ugak Bay snow crab differed from food items used by [illegible] this crab in Cook Inlet. Feder *et al.* (1977) examined 715 snow crab in Cook Inlet, and found the main items in order of decreasing percent frequency of occurrence in stomachs were *Macoma* spp. (clams), *Pagurus* spp. (hermit crabs), *Balanus* spp. (barnacles), and sediment. The only similar stomach item in the present study was sediment. The role of sediment in crab feeding is not known. However, regardless of whether or not sediment is taken incidentally or selectively, Yasuda (1967) found benthic diatoms to be abundant in *Chionoecetes opilio elongatus* in the Bering Sea. Yasuda (1967) postulated that diatoms were taken indirectly with food and sediment. Inferences from the present study, as well as other snow crab food data (Feder et *al.*, 1977; Yasuda, 1967; Feder, unpublished data) concerning prey species, suggest that the foods used by snow crab are area specific.

Food items among king crab appear to be similar at different geographic locations. McLaughlin and Hebard (1961) found molluscs to be the most frequently consumed food group (69.0%) in Bering Sea king crab (with pelecypods more frequent than gastropod). Echinoderms ranked second, appearing in 42.2% of the crabs. Bering Sea king crab examined by Feder (Feder *et al.*, 1977) also showed pelecypod molluscs to be the dominant food, specifically *Clinocardium* sp. and *Nuculana* sp. *Nuculana*, a deposit feeder, is the most frequently occurring food used by king crab in Alitak and Ugak Bays. Gastropod were food items of secondary importance in the present study. Although echinoderms were absent from the 17 king crab examined, sand dollars (Echinoidea) are occasionally consumed by king crab occupying the outer continental shelf between Alitak and Ugak Bays (Guy C. Powell, A. D. F. and G., personal communication).

The two commercially important animals of great abundance near Kodiak Island (king crab and-snow crab) feed on a wide variety of organisms. The king crab, with its large claws, is taking snails, clams, and fishes, while the snow crab with its long, thin, curved claws is better able to remove plant material, polychaetes, shrimps, and small clams from the bottom. Post larval stages of king crab were not preyed upon by any of the fishes examined. However, the soft-shelled stage of king crab is probably preyed on since soft-shell snow crab are known prey of *Octopus* and sea stars (John Hilsinger, unpublished data).

The use of deposit-feeding animals as food, as well as the consistent uptake of sediments, by king and snow crabs in the Kodiak area may be critical in the event of oil contamination of sediments on crab feeding grounds.

VIII. CONCLUSIONS

Fifty-three permanent stations have been established in two bays of Kodiak Island - Alitak (28 stations) and Ugak (25 stations) bays. These stations have been occupied in conjunction with Alaska Department of Fish and Game personnel.

There is now a satisfactory knowledge, on a station basis (for the months sampled), of the distribution and abundance of epifaunal invertebrates (89 species identified to date) of the two study bays. Ten phyla are represented in the collection. The important groups, in terms of species, in descending order of importance are the Arthropoda (Crustacean), Mollusca, Echinodermata and Annelida. The latter three groups only accounted for 1.3% of the biomass collected, while the Arthropoda accounted for 97.3% of the biomass.

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 bays can be made. An additional cruise carried out in March 1977 should furnish vitally needed mid-year data.

Differences in sex composition and stage of maturity of king and snow crab between and within the two bays were evident. Throughout the sampling period in Alitak Bay, king crab occurred mainly at the outer stations and consisted primarily of egg-bearing females and juveniles of both sexes. King crab were well dispersed throughout Ugak Bay during this period, and consisted mainly of juveniles. Snow crab in Alitak Bay were primarily juvenile while mainly adult males inhabited Ugak Bay. Life history data for these crabs for the summer months are now available.

Preliminary feeding data for the most common epifaunal species of the two bays is presented in this report. Of special importance is the food data compiled for the two commercially important crabs of the Kodiak area - snow and king crabs. These data in conjunction with similar data compiled for these two species in Cook Inlet and the Bering Sea (Feder *et al.*, 1977) should contribute to an understanding of the trophic role of the crabs in their respective ecosystems and the impact of oil on crab dominated systems such as those found in Alitak and Ugak Bays.

The importance of deposit-feeding clams in the diet of crabs is demonstrated for the two bays; this situation is also true for crabs observed elsewhere. A high probability exists that oil hydrocarbons will enter crabs *via* these deposit-feeding molluscs, suggesting that studies inter-relating sediment, oil, deposit-feeding clams, and crabs should be initiated soon.

Sampling crabs and fishes using trawls and stomach analysis has made it possible to-understand a major component (the epifauna) of two Kodiak bays. However, a full comprehension of the benthic system there will only be achieved when these studies are expanded to include an assessment of infauna as well. Data available to date suggest that adequate numbers of unique, abundant, and/or large species are available to permit nomination of likely monitoring candidates. Presumably a monitoring program would be based primarily on recruitment, growth, reproduction, and food habits of the chosen species.

IX. NEEDS FOR FURTHER STUDY

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

2. The present study has produced a data base describing the abundance, density, and distribution of epibenthic invertebrates as well as notes on reproductive biology of commercially important crabs during June, July, and August 1976. Additional studies are needed during other seasons and years to describe seasonal and year-to-year variations in the distribution and relative abundance 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.*, 1977). Any future modeling efforts concerned with carbon or energy flow in the Kodiak area will need this type of information.

5. No physical and chemical data are currently available. This information should be obtained in the future in conjunction with all biological sampling efforts.

PREFERENCES

Arctic Environmental Information and Data Center. 1975. Kadyak - a background for living. Univ. Alaska, AEIDC Publ. No. B-75, Sea Grant Publ. No. 75-9. 326 pp.

Barnes, R. D. 1968. *Invertebrate Zoology.* W. B. Sanders Company, Philadelphia. 743 pp.

Boesch, D. F., C. H. Hershner and J. H. Milgram. 1974. *Oil Spills and the Marine Environment.* Ballinger Publishing Co., Cambridge, Mass. 114 pp.

Clifford, H. T. and W. Stephenson. 1975. An *Introduction to Numerical Classification.* Academic Press. pp. 229.

Feder, H. M., G. Mueller, G. Matheke and S. Jewett. 1976. The distribution, abundance, diversity, and productivity of benthic organisms in the Gulf of Alaska. Ann. Rep. to NOAA R.U. #281, Inst. Mar. Sci., Univ. Alaska, Fairbanks. 174 pp.

Feder, H. M., K. Haflinger, J. Hilsinger, M. Hoberg, S. Jewett, G. Matheke and G. Mueller. 1977. The distribution, abundance, diversity, and productivity of benthic organisms in the Gulf of Alaska and the Bering Sea. Ann. Rep. to NOAA R.U. #281, Inst. Mar. Sci., Univ. Alaska, Fairbanks (in press).

Gray, G. W. and G. C. Powell. 1966. Sex ratios and distribution of spawning king crabs in Alitak Bay, Kodiak Island, Alaska (Decapoda Anomura, Lithodidae). Crustacean 10(3):303-309.

Hart, J. L. 1973. Pacific fishes of Canada. Fish. Res. Bd. Can. Bull. 180. 740 pp.

International Pacific Halibut Commission. 1964. Catch records of a trawl survey conducted by the Intl. Pac. Halibut Comm. between Unimak Pass and Cape Spencer, Alaska from May 1961 to April 1963. Intl. Pac. Halibut Comm. Dec. No. 36. 524 pp.

Iversen, E. F. 1966. The King-sized crab. *Sea Frontiers* 12(4):228-237.

Karinen, J. F. and S. D. Rice. 1974. Effects of Prudhoe Bay crude oil on molting tanner crabs, *Chionoecetes bairdi. Marine Fisheries Review* 36(7):31-37.

Kingsbury, A. P. and K. E. James. 1971. Abundance and composition of King crabs in thee Alitak and Kaguyak Bay areas during April and June, 1970. Alaska Dept. Fish Game Inf. Leafl. No. 152. 42 pp.

Kingsbury, A. P., N. P. Johnson and R. J. Kaiser. 1974. King crab study. Completion report for period July 1, 1962 to June 30, 1972. Proj. No. 5-22-R, Comm. Fish. Res. Dev. Act. prepared for NOAA, Natl. Mar. Fish. Serv. by Alaska Dept. Fish Game. 93 pp.

Lewis, J. R. 1970. Problems and approaches to base-line studies in coastal communities. FAO Tech. Conf. on Mar. Pollution and its Effect on Living Resources and Fishing. FIR:MP 70/E-22. pp. 7.

McDonald, K. B. and K. K. Petersen. 1976. Kodiak Island: Physical environment, biota, and potential problems related to oil exploration. A scientific report based primarily on OCSEAP-sponsored research. Science Applications, Inc., Boulder, Colorado. 146 pp.

McLaughlin, P. A. and J. F. Hebard. 1961. Stomach contents of the Bering Sea King crab. *Intl. North Pac. Fish. Comm. Bull.* 5:5-8.

Mueller, G. 1975. A preliminary taxon list and code for ADP processing. Sea Grant Proj. A/77-02. 159 pp.

Nelson-Smith, A. 1973. *Oil Pollution and Marine Ecology.* Paul Elek (Scientific Books) Ltd., London. 260 pp.

Newell, R. G. 1970. *Biology of Intertidal Animals.* Logos Press Limited, London. 444 pp.

Olson, T. A. and F. J. Burgess, eds. 1967. *Pollution and Marine Ecology.* Interscience, New York. 364 pp.

Pearce, J. B. and G. Thorson. 1967. The feeding and reproductive biology of the red whelk, *Neptunea antigua* (L.) Gastropoda, Prosobranchia). *Ophelia* 4 (2): 277-314.

Pearson, T. H. 1971. The benthic ecology of Loch Linnhe and Loch Eil, a sea loch system on the west coast of Scotland. 111. The effect on the benthic fauna of the introduction of pulp mill effluent. *J. Exp. Mar. Biol. Ecol.*6:211-233.

Pearson, T. H. 1972. The effect of industrial effluent from pulp and paper mills on the marine benthic environment. *Proc. Roy. Sot. Lend. B.* 130:469-485.

Pearson, T. H. 1975. The benthic ecology of Loch Linnhe and Loch Eil, a sea loch system on the west coast of Scotland. IV. Changes in the benthic fauna attributable to organic enrichment. *J. Exp. Mar. Biol. Ecol.* 20:1-41.

Powell, G. C. and R. B. Nickerson. 1965. Aggregations among juvenile king crabs (*Paralithodes camtschatica,* Tilesius) Kodiak, Alaska. *Animal Behaviour* 13:2-3.

Rasmussen, E. 1973. Systematic and ecology of the Iselfjord marine fauna. *Ophelia* 11 (l-2): 1-495.

Rhoads, D. C. 1974. Organism-sediment relations on the muddy sea floor. *Oceanogr. Mar. Biol. Ann. Rev.* 12:263-300.

Rosenberg, D. H. 1972. A review of the oceanography and renewable resources of the northern Gulf of Alaska. Report R72-23, Inst. Mar. Sci., Univ. Alaska, Fairbanks. Sea Grant Report 73-3, 690 pp.

Rosenberg, R. 1973. Succession in benthic macrofauna in a Swedish fjord subsequent to the closure of a sulphite pulp mill. *Oilos* 24:244-258.

Smith, J. E., ed. 1968. *Torrey* Canyon *Pollution* and *6l Marine Life*. Cambridge Univ. Press, Cambridge. 196 pp.

Smith, R., A. Paulson, J. and J. Rose. 1977. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. Ann. Rep. to NOAA R.U. #284, Inst. Mar. Sci., Univ. Alaska, Fairbanks (in press).

Stephenson, W., W. T. Williams and S. Cook. 1974. The macrobenthos of soft bottoms in Moreton Bay (south of Peel Island). *Mere. Queensl. Mus.* 17:73-124.

Straughn, D. 1971. Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970. Allan Hancock Foundation, Univ. of Southern California, Los Angeles. 425 pp.

Williams, W. T. and W. Stephenson. 1973. The analysis of three-dimensional data (sites x species x time) in marine ecology. *J. Exp. Mar. Biol. Ecol.* 11:207-227.

Yasuda, T. 1967. Feeding habits of the zuwaigani, *Chionoecetes opilio elongatus*, in Wakasa Bay. I. Specific composition of the stomach contents. *Bull. Jap. Soc. Sci. Fish* 33(4):315-319. (Transl. from Jap. Fish. Res. Bd. Can. Transl. Ser. No. 1111.)

Zenkevitch, La A. 1963. *Biology of the Seas of the USSR* George Allen and Unwin., Ltd., London. 955 pp.

X. SUMMARY OF 4TH QUARTER OPERATIONS

Ship or Laboratory Activities

1. During 3-18 March 1977 the M/V *Big Valley* conducted benthic trawling in Ugak and Alitak Bay.

2. Scientific party:

Stephen Jewett, Research Assistant, collected data on distribution and abundance, trophic relationships and reproductive activity.

3. Methods - field sampling:

Benthic trawling was conducted with a 400-mesh Eastern otter trawl. Stations selected from a sampling grid typically were sampled for 20 minutes or 1.85 kilometers.

4. Sample localities:

See text figures 1 and 2

5* Data collected:

Twenty-three stations were occupied in Ugak Bay and 21 stations were occupied in Alitak Bay.

6. Distribution and abundance data, cluster analysis, predator-prey relationships and reproductive notes will be included in the Final Report. Data will be examined within and between Ugak and Alitak Bay.

XI. APPENDIX

FREQUENCY OF OCCURRENCE OF EPIFAUNAL INVERTEBRATES AS WELL AS PERCENT COMPOSITION BY PHYLA, 'FAMILY AND SPECIES

OCCURENCES OF EACH SPECIES

SPECIES CODE	TAXANOMIC NAME	OCCURS	% OF ALL OCCUR	% OF ALL STATIONS	DISTKM
3200000000	PORIFERA	41.	3.116	26.974	70.27
3301000000	HYDROZOA	6.	0.456	3.947	10.17
3302000000	SCYPHOZOA	2*	0.152	1.316	3.70
3303480101	PTILOSARCUS GURNEYI	8.	0.608	5.263	12.94
3303540101	STOMPHIA COCCINEA	1.	0.076	0.658	1.85
3303550000	ACTINIIDAE	24.	1.824	15.789	38.36
4801000000	POLYCHAETA	4.	0.304	2.632	5.54
4801010000	POLYNOIDAE	3.	0.228	1.974	3.69
4801230400	NEREIS SP.	3.	0.228	19974	3.69
4801700201	CRUCIGERA IRREGULARIS	3*	0.228	1.974	3.69
4803000000	HIRUDINEA	1*	0.076	0.658	1*85
4803010100	NOTOSTOMOBDELLA SP.	8.	0.608	5.263	12.94
4904030203	NUCULANA FOSSA	14.	1.064	9.211	20.32
4904030502	YOLDIA HYPERBOREA	4.	0.304	2.632	6.47
4904030507	YOLDIA THRACIAEFORMIS	1*	0.076	0.658	1085
4904070101	MYTILUS EDULIS	2.	0.152	1.316	3*70
4904070402	MUSCULUS DISCORS	3.	0.228	1.974	3.69
4904070601	MODIOLUS MODIOLUS	1*	0.076	0.658	1085
4904080102	CHLAMYS RUBIDA	5*	.0.380	3.289	6*OO
4904080401	PECTIN CAURINUS	4.	0.304	2.632	5*54
4904100101	PODODESMUS MACROCHISMA	1.	0.076	0.658	0.92
4904110106	ASTARTE ROLLANDI	1.	0.076	0.658	0.92
4904110108	ASTARTE ESQUIMALTI	1.	0.076	0.658	0.92
4904200101	CLINOCARDIUM CILIATUM	11.	0.836	7.237	17.56
4904200102	CLINOCARDIUM NUTTALLII	1.	0.076	0.658	1.85
4904200201	SERRIPES GROENLANDICUS	7.	0.532	4.605	11.09
4904210201	SAXIDOMUS GIGANTEA	1*	0.076	0,658	0.92
4904210701	PROTOTHACA STAMINEA	1.	0.076	0.658	1.85
4904240101	MACOMA CALCAREA	8.	0.608	5.263	14*8O
4904240107	"'At_JtIA MOESTA	3.	0.228	1.974	4.62
4904290201	HIATELLA ARCTICA	9.	0.684	5.921	14.79
4904310101	BANKIA SETACEA	2.	0.152	10316.	3.70
4905230201	CREPIDULA NUMMARIA	3*	0.228	1*974	3.69
4905270200	VELUTINA SP.	1.	0.076	0.658	0.92
4905290101	FUSITRITION OREGONENSIS	12.	0.912	7.895	19.41
4905310102	NUCELLA LAMELLOSA	29	0.152	10316	2.77
4905330801	NEPTUNEA LYRATA	7.	0.532	4.605	12.0.2
4905570000	DORIDIDAE	1.	0.076	0.658	1085
4907050200	GONATUS SP.	2.	0.152	1.316	3.70
4907120200	OCTOPUS SP.	2*	0.152	1.316	3.70
5318020102	BALANUS BALANUS	10.	0.760	6.579	15*71
5318020108	BALANUS HESPERIUS	3.	0.228	1.974	3.69
5318020110	BALANUS ROSTRATUS	1.	0.076	0.658	0.92
5330000000	ISOPODA	1.	0.076	0.658	1.85
5331000000	AMPHIPODA	1.	0.076	0.658	0.92
5333040101	PANDALUS BOREALIS	113.	8.587	74,342	198.35
5333040102	PANDALUS GONIURUS	45*	3.419	29.605	78.60
5333040106	PANDALUS HYPSINOTUS	114*	8.663	75.000	197.85
5333040204	PANDALOPSIS DISPAR	24.	1.824	15.789	41.61
5333050402	EUALUS BIUNGUIS	53.	4.027	34.868	91.08
5333050406	EUALUS GAIMARDII BELCHERI	20.	1.520	13.158	37.00
5333050412	EUALUS MACILENTA	14.	1.064	9.211	25.90
5333060107	CRANGON DALLI	35,	2.660	23.026	57.78

OCCURENCES OF EACH SPECIES

SPECIES CODE	TAXANOMIC NAME	OCCURS	% OF ALL OCCUR	% OF ALL STATIONS	DIST KM
5333060111	CRANGON COMMUNIS	44.	3.343	28.947	76.75
5333060201	SCLEROCRANGON BOREAS	2*	0.152	1.316	1.84
5333060301	ARGIS LAR	23.	1.748	15.132	42.55
5333060302	ARGIS DENTATA	65.	4.939	42.763	112.81
5333060305	ARGIS CRASSA	3.	0.228	1.974	2.76
5333110200	PAGURUS SP.	1.	0.076	0.658	0.92
53331102o2	PAGURUS OCHOTENSIS	320	2.432	21.053	50.83
5333110203	PAGURUS ALEUTICUS	43*	3.267	28.289	70.25
5333110205	PAGURUS CAPILLATUS	18.	1036I3	11.842	28.65
53331102I?7	PAGURUS KENNERLYI	3.	0.228	1.974	3.69
5333110209	PAGURUS BERINGANUS	3*	0.228	1.974	4062
5333110301	ELASSOCHIRUS TENUIMANUS	3.	0.228	1.974	4.16
5333110401	LABIDOCHIRUS SPLENDESCENS	3.	0.228	1.974	3*69
5333120701	PARALITHODES CAMTSCHATICA	122*	9.271	80.263	202089
5333170101	OREGONIA GRACILIS	19*	1.444	12.500	32.36
5333170201	HYAS LYRATUS	8.	0.608	5.263	12001
5333170302	CHI('J?1OCCFTES BAIRDI	150.	11.398	98.684	253.76
53331705(33	EPIALTUS GRACILIS	10*	0.760	60579	15.71
5333180100	CANCER SP.	1.	0.076	0.658	1.85
5333180104	CANCER MAGISTER	9.	0.684	5.921	15.72
5333180106	CANCER OREGONENSIS	10.	0.760	6.579	14.78
53331901(?1	TELMESSUS CHEIRAGONUS	4*	0.304	2.632	6.47
53332103W3	PINNIXA OCCIDENTALIS	1*	0.076	0.658	1.85
6001020101	ECHIURUS ECHIURUS	1.	0.076	0.658	1,85
640000009'0	ECTOPROCTA	2*	0.152	1.316	2.77
670203010'1	TEREBRATULINA UNGUICULA	1.	0.076	0.658	0.92
6702050401	TEREBRATALIA TRANSVERSA	2.	0.152	1.316	1.84
6801080100	HENRICIA SP.	2.	0.152	1.316	2.77
6301110304	SOLASTER STIMPSONI	2*	0.152	1.316	3.70
6801120301	EVASTERIAS ECHINOSOMA	18.	1.368	11oS42	30051
690112030"2	EVASTERIAS TROSCHELII	10.	0.760	6.579	15*71
6801121101	STYLASTERIAS FORRERI	2.	0.152	1.316	2.77
6801121201	PYCNOPODIA HELIANTHOIDES	3.	0.228	1.974	4.62
6802040201	STRONGYLOCENTROTUS DROEBACHIENSIS	19.	1.444	12.500	32.36
6803040201	GORGONOCEPHALUS CARYI	1.	0.076	0.658	0.92
6804050100	MOLPADIA SP.	1.	0.076	00658	1.85
6904100100	CUCUMARIA SP.	4*	0.304	2.632	7.40
7200000000	CHORDATA:ASCIDIACEA	22.	10672	14.474	36*05
7203020501	PELONAIA CORRUGATA	1.	0.076	OO658	1.85

TOTAL DISTANCE FISHED = 256.53 KM

APPENDIX TABLE II

NUMBERS, WEIGHT, AND DENSITY OF EPIFAUNAL INVERTEBRATE PHYLA IN ALITAK AND UGAK BAYS, KODIAK ISLAND, JUNE, JULY, ANJI AUGUST, 1976

PERCENTAGE COMPOSITION BY WEIGHT - ALL PHYLA

TAXON CODE		COUNT	% COUNT	WEIGHT	% WEIGHT	GM/M SQ ALL STA	%-BIOMASS.
32	PORIFERA	1650.34	0.5109	102028o55	0.7874	0,18078	0.79
33	CNIDARIA	240.97	0.0746	45673*81	0.3525	0.08093	O*35
48	ANNELIDA	1014*83	0.3142	1082045	0,0084	0.00192	0. 01
49	MOLLUSCA	570.40	0. 1766	19304.36	0.1490	0.03421	0.15
53	ARTHROPODA:CRUSTACEA	319120.64	98.7922	12619440-75	9793945	22.36038	97.39
60	ECHIUROIDEA	1.67	0.0005	25.00	0.0002	0.00004	0.00
65	ECTOPROCTA	3000	0.(3009	227.00	0.0018	0.00040	0.00
67	BRACHIOPODA	5*OQ	0.0015	33.00	0.0003	0.00006	0.00
68	ECHINODERMATA	297.10	0.0920	157709.22	1.2172	0.27944	1*22
72	CHORDATA:ASCIDIACEA	118.12	0.0366	11507090	.0-0888	0.02039	0.09

48

APPENDIX TABLE 111

NUMBERS, WEIGHT, AND DENSITY OF EPIFAUNAL INVERTEBRATE FAMILIES IN ALITAK AND UGAK BAYS, KODIAK ISLAND, JUNE, JULY, AND AUGUST, 1976

COMPOSITION OF ALL PHYLA BY FAMILY

TAXON CODE		COUNT	% COUNT	WEIGHT	% WEIGHT	GM/M SQ ALL STA	% BIOMASS
320000	PORIFERA	1650.34	0.5109	102028.55	0.7874	0.18078	0.79
330100	HYDROZOA	8.67	0.0027	2154.33	0.0166	0.00382	0.02
330200	SCYPHOZOA	2.00	0.0006	145.00	0.0011	0.00026	0.00
330348	PENNATULACEA PENNATULIDAE	30.33	0.0094	597.00	0.0046	0.00106	0.00
330354	ACTINOSTOLIDAE	4.00	0.0012	1360.00	0.0105	0.00241	0.01
333355	ACTINIIDAE	195.97	0.0607	41417.48	0.3197	0.07339	0.32
480100	POLYCHAETA	813.57	0.2519	821.57	0.0063	0.00146	0.01
480101	POLYNOIDAE	5.33	0.0017	6.67	0.0001	0.00001	0.00
480123	NEREIDAE	12.50	0.0039	24.50	0.0002	0.00004	0.00
480170	SERPULIDAE	172.43	0.0534	206.71	0.0016	0.00037	0.00
480300	HIRUDINEA	1.67	0.0005	1.67	0.0000	0.00000	0.00
480301	ACANTHOCHITONIDAE	9.33	0.0029	21.33	0.0002	0.00004	0.00
490403	NUCULANIDAE	83.33	0.0258	122.83	0.0009	0.00022	0.00
490407	MYTILIDAE	53.00	0.0164	759.00	0.0059	0.00134	0.01
490408	PECTINIDAE	16.61	0.0051	2978.11	0.0230	0.00528	0.02
490410	ANOMIIDAE	4.00	0.0012	80.00	0.0006	0.00014	0.00
490411	ASTARTIDAE	4.00	0.0012	8.00	0.0001	0.00001	0.00
490420	CARDIIDAE	49.00	0.0152	1550.00	0.0120	0.00275	0.01
490421	VENERIDAE	3.00	0.0009	128.00	0.0010	0.00023	0.00
490424	TELLINIDAE	23.10	0.0071	880.62	0.0068	0.00156	0.01
490429	HIATELLIDAE	96.61	0.0299	56.61	0.0004	0.00010	0.00
490431	TEREDINIDAE	104.00	0.0322	14.00	0.0001	0.00002	0.00
490523	CALYPTRAEIDAE	5.43	0.0017	4.43	0.0000	0.00001	0.00
490527	VELUTINIDAE	1.00	0.0003	1.00	0.0000	0.00000	0.00
490529	CYMATIIDAE	106.33	0.0329	11413.67	0.0881	0.02022	0.09
490531	THAIDIDAE	4.22	0.0013	43.33	0.0003	0.00008	0.00
490533	NEPTUNEIDAE	11.00	0.0034	610.00	0.0047	0.00108	0.00
490557	DORIDIDAE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

APPENDIX TABLE III

CONTINUED

TAXON CODE		COUNT	% COUNT	WEIGHT	% WEIGHT	GM/M SQ ALL STA	% BIOMASS
490705	GONATIDAE	2.00	000006	70.00	0.0005	0.00012	0.00
490712	OCTOPODIDAE	2.33	0.0007	583.33	0-0045.	0000103	0.00
531802	BALANIDAE	290.33	0.0899	3887.67	0.0300	0.00689	0.03
533000	ISOPODA	1000	0.0003	1.00	0 . 0 0 0 0	0.00000	0.00
533100	AMPHIPODA	2.00	0.0006	I*OO	0.0000	0.00000	0.00
533304	PANDALIDAE	281899.36	87.2694	2372664.38	18.3118	4.20412	18.31
533305	HIPPOLYTIDAE	12827.39	3.9711	89775.28	0.6929	0.15907	0.69
533306	CRANGONIDAE	7733.40	2.3941	53390.66	0.4121	0.09460	0.41
533311	PAGURIDAE	486.44	0.1506	12108047	0.0935	0.02145	0.09
533312	LITHODIDAE	4420.62	1.3685	3668800.53	2803151	6.50075	28.32
533317	MAJIDAE	11397.49	3.5284	6403419.25	49-4204	11.34622	49.42
533318	CANCRIDAE	53.18	0.0165	13803.52	001065	0.02446	O*11
533319	ATELECYCLIDAE	6.93	0.0021	1586.43	0.0122	0.00261	0.01
533321	PINNOTHERIDAE	•2.50	0.0008	2.50	0.0000	0S00000	0.00
600102	ECHIURIDAE	1067	0.0005	25.00	0.0002	0.00004	0.00
660000	ECTOPROCTA	3.00	0.0009	227.00	0.0018	0.00040	O*00
670203	CANCELLOTHYRIDIDAE	1.00	0.0003	1.00	0.0000	0900000	0.00
670205	DALLINIDAE	4.00	0.0012	32.00	0.0002	0.00006	0.00
680108	ECHINASTERIDAE	3.00	0.0009	180.00	"000014	0.00032	0*00
68.?111	SOL45TCRIOAE	4.17	0.0013	275.00	0.0021	0.00049	0.00
680112	ASTERIIDAE	232.68	0.0720	150020095	191576	0.26582	1.16
680204	STRONGYLOCENTROTIDAE	48.41	0.0150	777.27	0.0060	0.00138	0.01
680304	GORGONOCEPHALIDAE	1.33	0.0004	80.00	0.0006	0900014.	0.00
680405	MOLPADIIDAE	1.00	0.0003	20.00	0.0002	0.00004	0.00
680410	CUCUMARIIDAE	6.50	0.00,20	6356.00	0.0491	0.01126	0.05
720000	CHORDATA:ASCIDIACEA	117.12	0.0363	11499.90	0.0888	0.02038	0,09
720302	STYELIDAE	1.00	0.0003	8.00	0.0001	0.00001	0.00

APPENDIX TABLE IV

NUMBERS, WEIGHT, AND DENSITY OF EPIFAUNAL INVERTEBRATE SPECIES IN ALITAK AND UGAK BAYS, KODIAK ISLAND, JUNE, JULY, AND AUGUST, 1976

Composition of all phyla by species

TAXON CODE	TAXONOMIC NAME	COUNT	% COUNT	WEIGHT	% WEIGHT	GM M SQ OCC STA	GM M SQ ALL STA	BIOM %	PHYL C	% PHYL W
?200000000	PORIFERA	1650.3	0.5	102028.55	0.79	0.6600	0.18078	0.79	100.00	100.00
3301000000	HYDROZOA	8.7	0*0	2154.33	0.02	0.0963	0000382	0.02	3.60	4,72
3302000000	SCYPHOZOA	2*O	0.0	145.00	0.00	0.0178	0.00026	0.00	0.83	0.32
?303490101	PTILOSARCUS GURNEYI	3003	0*0	597.00	0*00	0.0210	0.00106	0.00	12.59	1031
3303540101	STOMPHIA COCCINEA	4.0	0.0	1360.00	0.01	0.3342	0.00241	0.01	1.66	20913
3303550000	ACTINIIDAE	196.0	0.1	41417.48	0,32	0.4908	0.07339	Q*3Z	81.33	90.68
4?01000000	POLYCHAETA	813.6	0.3	821.57	0001	0.0674	0.00146	O*O1	80.17	75.90
4901010000	POLYNOIDAE	5*3	0.0	6.67	0*00	0.0000	0.00001	0.00	0.53	0.62
4?01230400	NEREIS SP.	1205	0.0	24.50	0.00	0.0030	0.00004	0.00	1.23	2.26
4?01700201	CRUCIGERA IRREGULARIS	172.4	0*1	206.71	0*00	0.0255	0.00037	0.00	16.99	19*IO
4303000000	HIRUDINEA	1.7	0.0	1.67	0*00	090004	0.00000	0.00	0.16	0.15
4403010100	NOTOSTOMOBDELLA SP.	9.3	0.0	21.33	0.00	0.0007	0.00004	0.00	-0.92-	"-1.97
4?04030203	NUCULANA FOSSA	71.7	0.0	44.17	0.00	0.0010	0.00008	0.00	12.56	0.23
4?04030502	YOLDIA HYPERBOREA	10.7	0.0	28.67	0.00	0.0020	0.00005	0.00	1.87	0.15
4?04030507	YOLDIA THRACIAEFORMIS	1.0	0.0	50.00	0.00	0.0123	0.00009	'0.00"	0.18	0.26
4GO4O7O101	MYTILUS EDULIS	19*O	0.0	80.00	0*00	0.0098	0.00014	0.00	3.33	0941
4304070402	MUSCULUS DISCORS	30.0	0.0	668.00	0.01	0.0823	0.00118	0.01	5.26	3.46
4?04070601	MODIOLUS MODIOLUS	4.0	0.0	11.00	0.00	0.0027	0.00002	0.00	0.70	0.06
4?04080102	CHLAMYS RUBIDA	8.8	0.0	194.44	0.00	0.0147	0.00034	0.00	1.54	1.01
4934080401	PECTEN CAURINUS	7.8	0.0	2783.67	0.02	0.2284	0.00493	0.02	1.37	14.42
4?04100101	PODODESMUS MACROCHISMA	4.0	0.0	80.00	0.00	0.0395	0.00014	0.00	0.70	0.41
4?04110106	ASTARTE ROLLANDI	2.0	0.0	4.00	0*00	0.0020	0.00001	0.00	0.35	0.02-
4?04110108	ASTARTE ESQUIMALTI	2.0	0*0	4.00	0.00	0.0020	0.00001	0.00	0.35	0.02
4994200101	CLINOCARDIUM CILIATUM	34.3	0.0	351.67	0.00"	0.0091	0-00062	0000	6.02	1.82'
4>04200102	CLINOCARDIUM NUTTALLII	1.7	0.0	366.67	0.00	0.0901	0.00065	0.00	0.29	1.90
4904200201	SERRIPES GROENLANDICUS	13*O	0*0	831.67	0*01	0.0341	0.00147	0.01	2*28	4.31

APPENDIX TABLE IV

CONTINUED

ALL PHYLA BY SPECIES, CONTINUED.

TAXON CODE	TAXONOMIC NAME	COUNT	% COUNT	WEIGHT	% WEIGHT	GM M SQ Occ STA	GM MSQ ALL STA	BIOM %	PHYL C %	PHYL U
4904210201	SAXIDOMUS GIGANTEA	290	0.0	118.00	0.00	0.0583	0.00021	0.00	0.35	0.61
4904210701	PROTOTHACA STAMINEA	1.0	0.0	10.00	0.00	0.0025	0.00002	0.00	O*I8	O*O5
4904240101	MACOMA CALCAREA	17.1	0.0	698.95	0.01	0.0215	0-00124	O*O1	3-00	3.62
4904240107	MACOMA MOESTA	6.0	0.0	181.67	0*00	0.0179	0.00032	0 8 0 0	1.05	0.94
4904290201	HIATELLA ARCTICA	9606	0.0	56.61	0.00	0.0017	0.00010	0.00	16.94	0.29
6X?4310101	BANKIA SETACEA	104*O	0.0	14.00	0.00	0.0017	0.00002	0.00	18.23	0.07
4905230201	CREPIDULA NUMMARIA	5*4	0*0	4.43	0.00	0.0005	0.00001	0000	O*95	0.02
4905270200	VELUTINA SP.	1.0	0.0	1.00	0.00	0.0005	0.00000	0.00	0018	0.01
4305290101	FUSITRITION OREGONENSIS	106.3	0*0	11413.67	0.09	'Os2673	0.02022	0.09	18.64	59.12
J.cM5310102	NUCELLA LAMELLOSA	4.2	0.0	43.33	0*00	0.0071	0.00008	0.00	O*Y4	0922
4905330801	NEPTUNEA LYRATA	11.0	0.0,	610.00	0*00	0.0231	0*00108	0*00	1*93	3.16
4905570050	DORIDIDAE	1.4	0.0	1.43	0*00	0.0004	0.00000	0*00"	O*25	0.01
4907050200	GONATUS SP.	2.0	0.0	70.00	0.00	0s0086.	0.00012	--0.00	0035	0.36
4907120200	OCTOPUS SP.	2.3	0.0	583.33	0*00	0.0717	0.00103	0.00	0.41	3.02
5318020102	BALANUS BALANUS	213.3	0.1	2176.67	0.02	0.0630	0.00386	0.02	O*O7	0.02
5319020138	BALANUS HESPERIUS	24.0	0.0	111.00	0.00	0.0137	0.00020	0.00	0.0.1	0.00
5318020110	BALANUS ROSTRATUS	5300	0*0	1600.00	0.01	0,7905	0.00284	0.01	0.02	0.01
5330000000	ISOPODA	1*0	0.0	1*00	0.00	0.0002	0900000	0.00	0.00	0.00
5331000000	AMPHIPODA	2.0	0.0	1.00	0*00	0.0005	0.00000	0.00"	0.00	0.00
5333040101	PANDALUS BOREALIS	79312.4	55.5	1528021.17	11.79	3.5017	2.70750	11.79	56.19	12.11
5333040102	PANDALUS GONIURUS	38671.0	12.0	311903.00	2.41	1.8037	0.55266	2.41	12.12	2.47
5333040106	PANDALUS HYPSINOTUS	61470.0	19.0	493387.20	3*81	1.1335	0.87423	3.81	19.26	3.91
5333040204	PANDALOPSIS DISPAR	2446.0	0.8	39353.00	0.30	0.4299	0.06973	0.30	0877	0.31
'333050402	EUALUS BIUNGUIS	1979.4	0.6	13861.28	0.11	0.0692	0.02456	0011	0.62	O i I
5333050406	EUALUS GAIMARDII BELCHERI	1029200	3.2	71990.00	0.56	0.8844	0.12756	0.56	3.23	0.57
5333050412	EUALUS MACILENTA	556.0	0.2	3924.00	O*O3	0.0689	0.00695	0.03	0.17	0.03
5333060107	CRANGON DALLI	869.6	0.3	5655.61	0.04	0.0445	0.01002	0.04	0.27	0.04

APPENDIX TABLE IV

CONTINUED

ALL PHYLA BY SPECIES. CONTINUED.

TAXON-CODE	TAXONOMIC NAME	COUNT	% COUNT	WEIGHT	% WEIGHT	G M M SQ OCC STA	GM M SQ ALL STA	BIOM %	PHYL C %	PHYL W
5333060111	CRANGON COMMUNIS	1455.7	0.5	10179.G7	0.08	0.0603	0.01804	0.08	0.46	0.08
5333060201	SCLEROCRANGON BOREAS	87.0	O*O	289.00	0.00	0.0714	0.00051	0*00	0.03	0.00
5333060301	ARGIS LAR	1638.0	0.5	11410.00	0.09	0.1219	0.02022	0.09	0.51	0.09
5333060302	ARGIS DENTATA	3676.1	1*1	25833.57	0.20	0.1041	0.04577	0.20	1.15	0.20
5333060305	ARGIS CRASSA	7.0	0.0	23.00	0.00	0.0038	0.00004	0.00	0.00	0.00
5333110200	PAGURUS SP.	2.0	0.0	2.00	0.00	0.0010	0.00000	0.00	0.00	0.00
5333110202	PAGURUS OCHOTENSIS	254.7	0.1	6205.82	0.05	0.0555	0.01100	0.05	0.08	0.05
5333110203	PAGURUS ALEUTICUS	154.4	0.0	5044.39	0.04	0.0326	0000894	0.04	0.05	0.04
5333110205	PAGURUS CAPILLATUS	41.2	O*O	544.68	0.00	0.0086	0.00097	0.00	O*O1	0.00
5333110207	PAGURUS KENNERLYI	21.4	O*O	218.57	0.00	0.0269	0.00039.	0.00.	-0.01	0.00
5333110209	PAGURUS BERINGANUS	5.7	0.0	50.00	0.00	0.0049	0.00009	0.00	0.00	0.00
5333110301	ELASSOCHIRUS TENUIMANUS	4*O	0.0	20.00	0.00	0.0022	0.00004	0.00	0.00	0.00
5333110401	LABIDOCHIRUS SPLENDESCENS	3*O	0.0	23.00	0.00	0.0028	0*00004	0.00	0.00	0.00
5333120701	PARALITHODES CAMTSCHATICA	4420.6	1.4	3668800,53	28.32	8.2194	6.50075	28.32	1.39	29.07
5333170101	OREGONIA GRACILIS	47.7	O*O	613.57	O*OO	0.0086	0.00109	0*00	0*01	0.00
5333170201	HYAS LYRATUS	45.9	0.0	2882.29	0.02	0.1091.	0.00511	0.02	().01	0.02
5333170302	CHIONOECETES BAIRDI	11287.4	3.5	6397840.69	49.39	11.4637	11033987	49039	3.54	50.71
5333170503	EPIALTUS GRACILIS	16.4	0.0	82.71	0.00	0.0024	0000015	0.00	0.01	0.00
5333180100	CANCER SP.	2.5	0.0	2.50	0.00	0.0006	0.00000	0.00	0.00	0.00
5333180104	CANCER MAGISTER	15.8	0.0	13667.02	0.11	0.3952	0.02422	0*11	0.00	0.11
'333190106	CANCER OREGONENSIS	34.8	0.0	134.00	0.00	0.0041	0.00024	0.00	0.01	0.00
5333190101	TELMESSUS CHEIRAGONUS	6.9	0.0	1506.43	0.01	0.1115	0.00281	0.01	0.00	0.01
'333210303	PINNIXA OCCIDENTALIS	2.5	0.0	2.50	0.00	0.0006	0.00000	0.00	0.00	0.00
5901020101	ECHIURUS ECHIURUS	1.7	0.9	25.00	0.00	0.0061	0.00004	0.00	100.00	100.00
6600000000	ECTOPROCTA	3.0	0.0	227.00	0.00	0,0312	0*00040	0*00	100*00	100,00
6702030101	TEREBRATULINA UNGUICULA	1.0	0.0	1.00	0.00	0.0005	0.00000	0.00	20.00	3*O3

APPENDIX TABLE IV

CONTINUED

ALL PHYLA BY SPECIES. CONTINUED.

TAXON CODE	TAXONOMIC NAME	COUNT	% COUNT	WEIGHT	% WEIGHT	GM MSQ OCC STA	GM M 50 ALL STA	BIOM %	PHYL C %	PHYL W
6702050401	TEREBRATALIA TRANSVERSA	4.0	000	32.00	0.00	0.0079	0.00006	0.00	80.00	96.97
6801080100	HENRICIA SP.	3*O	0.0	180*00	0.00	0.0295	0.00032	0.00	1.01	0.11
6801110304	SOLASTER STIMPSONI	4.2	0*0	275.00	0.00	0.0338	0.00049	0.00	1.40	O*17
6301120301	EVASTERIAS ECHINOSOMA	91.4	0*0	17571.27	0014	0.2618	0.03113	0.14	30.77	11.14
6801120302	EVASTERIAS TROSCHELII	61.7	0*0	18598.57	0.14	005381	0-03295	0.14	20.77	11.79
6801121101	STYLASTERIAS FORRERI	3.0	0.0	1270.00	0.01	0.2084	0000225	0.01	1.01	0.81
6801121201	PYCNOPODIA HELIANTHOIDES	76.6	0.0	112581011	0.87	1.0765	0.19948	0.87	25.77	71.39
6802040201	STRONGYLOCENTROTUS DROEBACHIENSIS	48.4	0.0	777.27	0*01	0.0109	0.00138	0,01	16.30	0.49
6803040201	GORGONOCEPHALUS CARYI	1.3	0.0	80.00	0.00	0.0395	0.00014	0900	0.45	O*O5
6804050100	MOLPADIA SP.	1*O	0*0	20900	0.00	0.0049	0900004"	0.00	"0.3.%	0.01
6604100100	CUCUMARIA SP.	6.5	0.0	6356*OO	0.05	093904	0.01126	0.05	2.19	4.03
7200000000	CHORDATA:ASCIDIACEA	117.I	0.0	11499.90	0.09	0.1450	0.02038	0.09	99.15	99.93
7703020501	PELONAIA CORRUGATA	1.0	0.0	8*00	0.00	0.0020	0.00001 "	0*00	0.85	0*07

OCS COORDINATION OFFICE

University of Alaska

ENVIRONMENTAL DATA SUBMISSION SCHEDULE

DATE: March 31, 1977

CONTRACT NUMBER: 03-5-022-56 T/OilUMBER: 29

PRINCIPAL INVESTIGATOR: Dr. H. M. Feder

Submission dates are estimated only and will be updated, if necessary, each quarter. Data batches refer to data as identified in the data management plan.

Cruise/Field Operation	Collection Dates		Estimated Submission Dates[1]			
	From	To	Batch 1	2	3	4
Big Valley 001	6/17/76	6/23/76	5/30/77			
Big Valley 002	7/18/76	7/28/76	5/30/77			
Big Valley 003	8/19/76	8/29/76	5/30/77			
Big Valley 004	3/3/77	3/18/77	6/30/77			

NOTE : [1] Data Management Plan submitted August 16, 1976, we await formal approval by Contracting Officer.