Stomach Contents of Crabs and Bottomfish from Alice Arm, Hastings Arm, Observatory Inlet and Nass River, B.C., October, 1983

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p. 13, line 18 - Yoldia thraciaeformis should be Yoldia martyria

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ABSTRACT

Byers, S.C., B.J. Reid and M.A. Farrell. 1984. Stomach contents of crabs and bottomfish from Alice Arm, Hastings Arm, Observatory Inlet and Nass River, B.C., October 1983. Can. MS. Rep. Fish. Aquat. Sci. 1771: ix + 65 p.

Stomach contents of Golden king crabs, Lithodes aequispina (Benedict), Tanner crabs, Chionoecetes bairdi (Rathbun) and eight species of cod-like fishes and flounders from the vicinity of Alice Arm, B.C. were examined quantitatively. Ophiuroidea was the dominant prey taxon of the Golden king crab in terms of percentage wet weight and frequency of occurrence. Tanner crabs fed predominantly on Annelida (polychaeta), Arthropoda (mainly shrimp) and Mollusca (mainly the bivalve Transennella tantilla). The stomachs of both the Golden king crab and the Tanner crab from Alice Arm and Hastings Arm were substantially less full than the stomach of Tanner crab from Observatory Inlet. Arthropoda (hyperbenthic shrimp) was the dominant prey group of the cod-like fishes. The five species of flounders fed predominantly on infauna (polychaetes and bivalves), and epifauna (hermit crabs and brittle stars). The quantity of food consumed by flounders from Alice Arm and Hastings Arm was less than that consumed by the flounders from Nass River and Observatory Inlet. The index of fullness for cod-like fishes was generally greater than that for flounders reflecting the differences in feeding behaviour and habitat of preferred prey items (hyperbenthic versus benthic). The effect of the Amax mine tailings discharge on benthic invertebrate density is discussed in terms of potential prey availability to crabs and flounders in Alice Arm.

RÉSUMÉ

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Les contenus stomacaux de crabes royaux dorés, Lithodes aequispina (Benedict), de crabes de Tanner, Chionoecetes bairdi (Rathbun), et de huit espèces apparentées à la morue ou de plies de la région du bras d'Alice (C.-B.) ont été examinés. Les ophiuroidés représentaient la principale proie des crabes royaux dorés. Les crabes de Tanner se nourrissaient surtout d'annélidés (polychètes), d'arthropodes (surtout des crevettes) et de mollusques (surtout le bivalve Transennella tantilla). Les estomacs des crabes de ces deux espèces des bras Alice et Hastings étaient, de façon appréciable, moins bien remplis que ceux des crabes de Tanner de l'inlet Observatory. Les arthropodes (crevettes hyperbenthiques) étaient la proie dominante des poissons apparentés à la morue. Les cinq espèces de plies se nourissaient surtout d'organismes de l'endofaune (polychètes et bivalves) et de l'épifaune (bernard-l'hermite et ophiuroidés). La quantité de nourriture consommée par les plies des bras Alice et Hastings était moins importante que celle consommée par les plies de la rivière Nass et de l'inlet Observatory. L'indice de plénitude des poissons apparentés à la morue était généralement plus élevé que celui des plies, ce qui reflète les differences entre les comportements d'alimentation et les habitats de la proie préférée (hyperbenthique ou benthique). On traite des effets du rejets des résidus de la mine Amax sur la densité des invertébrés benthiques dans le contexte de la disponibilité des proies pour les crabes et les plies du bras Alice.

INTRODUCTION

The Amax Kitsault molybdenum mine is located at the head of Alice Arm in northern British Columbia. The mine discharged mill tailings into Alice Arm from April of 1981 until November of 1982 when it shut down for an indefinite period. A number of studies have been conducted by both the Federal Department of Fisheries and Oceans and the Environmental Protection Service, Environment Canada, to monitor pre- and post-discharge effects of the tailings deposition on the Alice Arm ecosystem. These programs included benthic community analysis, epibenthic submersible observations, zooplankton composition and distribution, transmissometry and water chemistry, trace metal concentrations in tissues and sediment, and sedimentation rates.

The objectives of this study were to identify the prey items found in the stomachs of crabs and bottomfish collected from Alice Arm, Hastings Arm, Observatory Inlet and Nass River, B.C. The findings have been discussed with reference to results from previous epibenthic and infaunal studies conducted in the area in an attempt to elucidate the relationship between the prey items consumed and the benthic composition in these areas. The gut contents of the crab and bottomfish examined have also been compared to the prey items identified in these species from other locations in the Pacific Northwest. Consideration was given to possible effects of the mine tailings deposition on prey availability to the species examined.

MATERIALS AND METHODS

GENERAL

The study area (Figure 1) included Alice Arm, Hastings Arm, Observatory Inlet and the Nass River Estuary.

Two species of crab and eight species of bottomfish were collected for stomach content analyses. The species examined included Lithodes aequispina - Golden king crab, Chionoecetes bairdi - Tanner crab, Gadus macrocephalus - Pacific cod, Theragra chalcogramma - Walleye pollock, Sebastes aleutianus - Rougheye rockfish, Atheresthes stomias - Turbot, Glyptocephalus zachirus - Rex sole, Hippoglossoides elassodon - Flathead sole, Microstomus pacificus - Dover sole, and Parophrys vetulus - English sole (Table 1).

FIELD SAMPLING

Figures 2 and 3 present otter trawl and king crab pot locations in the four study areas. Trawl coordinates and depths are presented in Appendix A-1, while king crab pot depths are presented in Appendix E-1.

Samples were collected during two cruises which were conducted from October 7-11, 1983 and October 27 to November 1, 1983. Crab and fishes were collected by otter trawl during the first cruise, while additional crab samples were collected in commercial king crab pots during the second. The trawling gear consisted of two otter doors attached to a net with a 5.8 m throat and a 3.8 cm mesh body. Trawls were conducted with a 3:1 scope over an average distance of 1 km and at a speed of 2.5 knots. All the Golden king crabs obtained by trawl were kept for stomach analyses; however, only a portion of the Tanner crabs were retained. All fish specimens obtained by trawl from Alice Arm and Hastings Arm were retained for gut analyses however the fish from Observatory Inlet and Nass River were subsampled and do not represent the total trawl catch.

Commercial king crab pots (dimensions 1.8 x 1.8 x 0.9 m) were deployed in Alice Arm and Hastings Arm during the second cruise. The Golden king crabs collected by pots were initially used to supplement the small numbers obtained from the trawls; however, a sample bias became apparent during examination of stomach contents of these crabs. The pots were baited with frozen herring in perforated plastic containers which attracted large numbers of amphipods. Consequently, stomach contents of the trapped crabs were predominated by the cosmopolitan and epipelagic amphipod, Koroga megalops (Family Lysianassidae). This species was not identified in the gut contents of any of the crabs caught by trawl. There are obviously several factors (biased food supply, restricted movement, overcrowding, digestion period, soak time) which could have affected the feeding response of these caged crabs. The incidental presence of other food groups (eg. echinoderms (ophuiroids and echinoids), plants, fish, egg cases, and molluscs) noted in these organisms was probably a result of ingestion prior to caging, and may be more representative of typical feeding behaviour. However, as a result of the apparent bias in stomach content data from these caged crabs the data for trapped crabs have been presented but are not discussed (Appendix E-1 and E-2).

One Pacific cod (G. macrocephalus) was also obtained in a King crab pot (Alice Arm Set 042) during the second cruise and was retained for stomach analyses. Jewett (1978) found no significant difference in prey items in Pacific cod collected in pots versus trawls, thus the stomach content data from this fish were included in the discussion.

Crab and fish were identified in the field; lengths, weights and sex (crabs only) were recorded for each specimen. Stomachs were immediately excised and placed in glass jars with 10% buffered formalin. The posterior portion of the esophagus was removed with the crab stomachs. For some fish samples, intestines were also removed with the stomachs and examined separately for prey items.

LABORATORY ANALYSIS

In the laboratory, crab and fish stomach samples were separated on the basis of species and collection location. Data from the two sampling cruises were considered collected during one sampling period since less than one month elapsed between cruises. As the feeding habits of both species of crabs examined may vary with size (maturity) and sex, differences in stomach contents between different size classes and among sexes were noted where possible.

All stomach contents were examined by stereomicroscope and confirmed by examination under a compound microscope. Prey items were identified to the lowest possible taxonomic level and enumerated. Presence was recorded where individuals could not be recognized due to the advanced state of digestion (eg. echinoderms, amphipods, some polychaetes and plant matter).

Prey items of each taxon were blotted dry (using a 63 micron mesh to collect the content[s]) and weighed to the nearest 0.0001 g. Prey item weights of each species from each location were then combined and calculations were performed on combined totals. The percentage wet weight and frequency of occurrence of each food item was determined according to the methods employed by Jewett and Feder (1982; Ibid, 1983).

Individuals which had food in their stomach or were empty were included in the data analysis. Most items found in the stomachs, including skeletal and digested material (indeterminate animal matter), were considered food. Endoparasites and nematodes, found exclusively in the fish specimens, were not considered prey items and therefore were not included in the analysis of data.

DATA ANALYSIS

Until recently, the majority of prey food data on crabs (Paralithodes camtschatica and Chionoecetes bairdi) and to a certain extent, fish, were analyzed using the frequency-of-occurrence method. As pointed out by Hyslop (1980) and Jewett and Feder (1983) this method accurately assesses feeding trends but fails to provide an interpretation of the relative importance of an individual food item. MacDonald and Green (1983) demonstrated that little information is gained when applying compound indices to a data set compared with any single measure. Several methods of analyses, however, were chosen in this study for the sake of comparison with the recent literature: wet weight provided a quantitative measure of prey item bulk; frequency-of-occurrence, a measure of precision; actual counts of identified prey taxa, a general measure of consumption; and, an index of fullness to relate total prey weight to variation in size of the predator. The index of fullness was calculated by dividing the total wet weight of the prey items in a stomach by the total wet weight of the predator, in parts per 10,000 (0/000) (Tarverdieva, 1976; Bernard, 1979).

Gravimetric measurements such as wet weight should be viewed with caution. Mills et al. (1982) demonstrated that preservation (formalin or alcohol) can have dramatic effects on the wet weights of marine invertebrates. He showed that in 10% buffered formalin changes in bivalve weights were statistically significant over a 5 month study period while weight changes in other groups did not significantly increase or decrease. On the other hand, animals preserved in 70% isopropanol showed statistically significant weight differences in four of the five groups examined. With this in mind, all taxa from the present study were maintained in 10% buffered formalin prior to obtaining wet weight measurements, and then transferred to 50% isopropanol.

The weights obtained for mollusc prey consisted of approximately 50% shell material and 50% soft parts, while the sedentariate polychaete Myriochele oculata consisted of approximately 80% tube material.

RESULTS

A list of prey items found in all stomachs and intestines of the crab and fish species examined is presented in Appendix B. Prey items or prey taxa included only identifiable food items. In contrast, food groups or prey groups were defined to include any matter ingested by the predator including indeterminate material. Indeterminate animal matter was present in all specimens examined and accounted for 100% of the wet weight in one fish. For this reason indeterminate matter was incorporated in wet weight, frequency of occurrence and index of fullness determinations. The dominant food groups found in each species have been presented in order of decreasing wet weight. Unless otherwise stated, indeterminate animal matter should be assumed to contribute the remainder of the total prey wet weight for any given species.

Sediments were also noted in some of the stomachs examined. Sand grains were found in one Tanner crab and fine silt in one Turbot. In both cases, the sediment could not be quantitatively dissociated from indeterminate animal matter and was therefore included in this category.

CRABS

Lithodes aequispina - Golden (or brown) king crab.

Stomach contents of five specimens of Golden king crab from Alice Arm and Hastings Arm were examined. The five major food groups noted in order of decreasing weight included; Echinodermata, indeterminate animal matter, plant matter, Mollusca, and Pisces. The echinoderms dominated in terms of percentage wet weight (56.8%) and frequency of occurrence, (100%) (Table 2).

The two Golden king crabs sampled from Alice Arm contained only four of the referenced food groups, the exception being Mollusca (Appendix C-1). Echinodermata (Ophiuroidea) was the dominant food group and contributed 80.9% of the total prey wet weight. Other relevant prey groups included Pisces (fish bones) and plant matter.

The three Golden king crab collected from Hastings Arm, in contrast, had all five food groups represented. Echinodermata (Ophiuroidea) contributed 32.5% of the total prey wet weight and as previously mentioned occurred in 100% of the stomachs examined. Plant matter, Mollusca and Pisces (fish vertebrae) were the other important contributors. The bivalve Lyonsia sp. was the only identifiable mollusc.

The trawl data for the Golden king crabs are summarized in Appendix A-2. The carapace lengths (CL) of the Alice Arm crabs were 139 and 143 mm, respectively. All crabs collected in Alice Arm were male. The maximum number of prey items identified in any crab from Alice Arm was two. The mean wet weight of food found in the stomachs of crabs from this area was 2.10 g (n = 2).

The CL of crabs sampled in Hastings Arm ranged from 98-136 mm. Of the three individuals examined two were males and one female. In contrast to crabs from Alice Arm, the maximum number of prey items identified from a single crab (97 mm male) was five. The mean wet weight of food found in the Hastings Arm individuals was 0.14 g (n = 3).

One of the Golden king crabs collected from Hastings Arm was found to be parasitized by the rhizocephalan barnacle Briarosaccus callosus (Jewett et al., 1983). The total food wet weight, frequency of occurrence for specific prey items and index of fullness for this individual did not differ markedly from unparasitized crabs from the same location.

Chionoecetes bairdi - Tanner crab, Snow crab, Queen crab.

The trawl data for Tanner crab are presented in Appendix A-3.

Stomach contents of five male Tanner crab from Alice Arm and three from Observatory Inlet were examined. Two crabs, one from each area, did not contain food. These individuals, however, were included in the calculations for percentage frequency of occurrence.

The four major food groups identified in Tanner crab included; Arthropoda, indeterminate animal matter, Annelida and Mollusca (Table 2). The arthropods predominated by weight (42.5%); however, the three distinguishable food groups (arthropods, annelids and molluscs) had a similar frequency of occurrence (37.5%).

The five Alice Arm crab stomachs examined contained predominantly the Annelida-Family Nephtyidae (42.3% wet weight and 40% occurrence) (Appendix C-2). The most common species in the Mollusc group were the bivalves _Transennella_ _tantilla_ and _Poromya_ sp. The arthropod contribution was comprised predominantely of indeterminate amphipods.

In contrast to the Alice Arm specimens, the three Observatory Inlet crabs had a much larger representation of arthropods (84.7% wet weight and 66.7% occurrence). Shrimp of the Family Crangonidae were the most dominant taxon. The dominant prey taxon of the Annelida group was the polychaete _Myriochele oculata_. _Transennella_ _tantilla_ was the dominant mollusc found in Observatory Inlet Tanner crab.

The carapace width (CW) for the Alice Arm Tanner crabs ranged from 103-140 mm. A maximum of three prey items were identified from a single crab and the mean wet weight of food found in Alice Arm Tanner crabs was 0.06 g (n = 5). The Observatory Inlet crabs on the other hand had a CW range of 75-118 mm and contained a maximum of four prey items. The mean food wet weight in these crabs was 0.46 g (n = 3).

FISH

Table 3 summarizes the dominant prey groups in the stomachs of eight species of fish obtained from the four sample areas. Appendix A-4 provides a summary of fish lengths and weights. Appendices D-1 to D-5 detail the species composition of the dominant prey groups. For purposes of discussion, the fish have been arbitrarily divided into two groups: cod-like fishes and flatfishes.

COD-LIKE FISHES

Gadus macrocephalus - Pacific or Gray cod.

Two Pacific cod were examined for stomach contents: one from Alice Arm and one from Observatory Inlet. The four prey groups identified in order of decreasing weight were: Arthropoda, indeterminate animal matter, Pisces and Mollusca.

The dominant prey item in the Alice Arm cod was the caridean shrimp Pandalopsis dispar, which accounted for 90.8% of the total prey wet weight. Pisces (fish otolith) was also an important part of the diet.

Three major identifiable prey groups were present in the cod from Observatory Inlet; however, the dominant arthropod in this specimen consisted of shrimps of the Families Crangonidae and Pandalidae (39.2% by weight). The subgroup Bivalvia (shell fragments) contributed a small portion of the total prey wet weight.

Two prey items were identified in the Alice Arm cod compared to five items in the Observatory Inlet cod. The total wet weight of prey items in each fish was 17.09 g and 2.19 g, respectively.

Theragra chalcogramma - Walleye pollock or bigeye.

Five individual pollock were examined for prey items: one from Alice Arm and four from Observatory Inlet. Five prey groups were represented in order of decreasing weight: indeterminate animal matter, Arthropoda, Mollusca, plant matter and Cnidaria. The dominant prey group was Arthropoda which contributed 44.4% of the total prey wet weight and had a 100% frequency occurrence.

The dominant prey items identified in the Alice Arm pollock were caridean shrimp and amphipods which collectively contributed 12.1% of the total wet weight. These two taxa plus the indeterminate matter had a combined wet weight of 0.82 g.

Arthropoda was also the dominant prey group in the four pollock from Observatory Inlet (76.6% of the total prey wet weight with 100% frequency occurrence). The major arthropod prey taxon in Observatory Inlet pollock were the shrimps Pandalus borealis, Crangon communis, Pasiphaea pacifica, calanoid copepods and hyperiid amphipods. Minor contributions were also made by Mollusca and to a lesser degree, Hydrozoa. The maximum number of prey taxa identified in any one pollock from Observatory Inlet was five. The mean wet weight of food was 1.63 g (n = 4).

In addition, two intestines were examined from Observatory Inlet pollock. All prey items identified in the intestines were present in the stomachs. The intestines were also noted to be highly infested with endoparasites.

Sebastes aleutianus - Rougheye rockfish.

Four individual rockfish were collected from the Nass River station. The dominant prey group in this species was Arthropoda which occurred in 50% of all stomachs examined and contributed 69.7% of the total prey wet weight. Crangon communis was the major taxon identified in this group. The remaining arthropod contributions were made by amphipods.

Of the four stomachs examined, one was empty, while two were invaginated. The maximum number of prey taxa identified in any rockfish stomach was two and the overall mean wet weight of the prey items was 0.32 g (n = 4).

FLATFISHES

***Atheresthes stomias* - Turbot or Arrowtooth flounder.**

The one turbot examined was collected in Alice Arm and contained only indeterminate animal matter which had a wet weight of 0.25 g.

***Glyptocephalus zachirus* - Rex sole.**

Two specimens of Rex sole were obtained from Nass River. The four food groups identified in the stomachs of Rex sole included: indeterminate animal matter, Annelida, Echinodermata and Arthropoda. The dominant taxon in both fish was Annelida, specifically the polychaetes *Goniada annulata* and *Myriochele oculata* which collectively contributed 33.6% of the prey wet weight. Echinoderms (Holothuroidea) and Crustaceans (Cumacea and Amphipoda) were also important dietary consitituents.

A maximum of seven prey items were identified from a single individual and the mean wet weight of prey items was 0.21 g (n = 2).

The intestines of the Rex sole were also examined and two prey items not present in the stomach were identified: the polychaete *Lumbrineris luti* and the amphipod Family Ampeliscidae.

Hippoglossoides elassodon - Flathead sole.

Five Flathead sole were examined in this study: four from Observatory Inlet and one from Nass River. The one specimen from Nass River contained exclusively indeterminate animal matter weighing 0.20 g.

The five major prey groups which were identified in the stomachs of Flathead sole from Observatory Inlet included: (in order of decreasing weight) indeterminate animal matter, Arthropoda, Annelida, plant matter and Cnidaria. Arthropoda (the hermit crab Pagurus sp.) accounted for 94.5% of the total prey wet weight and had a frequency occurrence of 25%. The group Annelida was represented by the polychaeta taxa Capitellidae, Myriochele oculata and Lumbrineridae. A maximum of seven prey taxa were identified in a single stomach and the mean wet weight for all stomach items was 0.46 g (n = 4).

Examination of the intestines of these five specimens revealed a somewhat different composition (Appendix D-5). The single Nass River Flathead sole intestines contained 81.8% (by weight) Echinodermata (Ophiuroidea). The intestines of the Observatory Inlet fish on the other hand were dominated by Mollusca (78.7%). The snail Lunatia pallida and the clams Yoldia thraciaeformis and Clinocardium ciliatum represented the Mollusca group. The Arthropoda (hermit crab Pagurus spp., shrimp Pandalus borealis and crab - Family Majidae) accounted for 6.2% of the total prey wet weight. Foraminiferida and Annelida were minor contributors.

One prey taxon with a wet weight of 22.0 g was present in the intestine of the Nass River sole while five prey taxa were identified in the intestine of one Observatory Inlet sole. The mean prey wet weight in the four Observatory Inlet sole intestines examined was 3.0 g.

Microstomus pacificus - Dover sole.

The two Dover sole examined were collected from Hastings Arm and the Nass River Estuary. The five prey groups identified in this species in order of decreasing weight were indeterminate animal matter, Annelida, Echinodermata, Arthropoda and Mollusca.

The dominant taxon of the Hastings Arm fish was Annelida (Family Sabellidae) which contributed 27.3% of the total prey wet weight.

In contrast, Ophiuroidea was the dominant taxon in the Nass River specimen. Annelida (species Myriochele oculata) were also present. The amphipod Paraphoxus oculatus accounted for a very small percentage of the total prey wet weight in Dover sole taken from the Nass River.

One prey taxon having a wet weight of 0.10 g was identified in the stomach of the Hastings Arm sole while five prey taxa (wet weight 0.62 g) were reported in the Nass River sole.

Parophrys vetulus - English or lemon sole.

All four specimens of English sole were collected from Observatory Inlet. Seven food groups predominated. Annelida was the dominant taxon and accounted for 43.1% of the wet weight and occurred in 75.5% of the stomachs examined. The Annelida were represented by Lumbrineris zonata, Myriochele oculata, Sternaspis scutata, Cirrophorus branchiatus and several other sedentariate polychaete families. Plant matter and nemerteans also contributed significantly to the diet of English sole from Observatory Inlet. The remaining prey groups which included Cnidaria, Arthropoda and Mollusca contributed to a lesser extent.

A maximum of fifteen prey taxa were identified in one English sole stomach. The mean wet weight of all prey items in the four stomachs examined was 0.33 g.

The intestines of the English soles also contained a large number of identifiable prey items (Appendix D-5). Annelida was once again the dominant prey group and made up 21.2% of the wet weight in 75.0% of the fish intestines. Twenty polychaete taxa were identified in the intestines of English sole compared to twelve taxa found in the stomachs. Eight of these taxa were found both in intestines and stomachs. Plant matter accounted for 5.8% of the weight. The Mollusca were represented by Aplacophora, the gastropod Cylichna alba, and the bivalve Transennella tantilla. Arthropoda, Hydroida and Pisces were present in minimal quantities.

The mean wet weight of all prey items in the four intestines examined was 1.20 g.

DISCUSSION

CRABS: OVERVIEW

Until recently there was little published information on the biology and distribution of the Golden king crab, Lithodes aequispina (Benedict) in the Northeast Pacific. Published studies on the life history of the crab are primarily the result of research conducted in Japanese and Russian waters (McBride et al., 1982). The geographic distribution of this species was summarized by Butler and Hart (1962) who identified a range extension from Japan, around the Pacific Rim and into southern British Columbia waters. Further distributional data are presented by McBride *et al*. (1982) who recently summarized the available information on the distribution and abundance of this species in the Bering Sea and Aleutian Islands. Studies in Alice Arm, B.C. have also provided some additional information on the biology and population dynamics of the Golden king crab in B.C. waters (O'Connell, 1977; Littlepage, 1978; Jewett *et al*., 1983).

A close relative, the Red king crab, *Paralithodes camtschatica* (Tilesius), has been extensively studied because of its significance as the most important commercial shellfish in Alaska. During the 1980-1981 season, the fishery at Kodiak Island yielded 9.3 x 10^3 metric tons of Red king crab (Jewett and Feder, 1982). Another crab which has received much attention due to its fishery value in the Gulf of Alaska and Southeastern Bering Sea is the Tanner crab, *Chionoecetes bairdi* (Rathbun). The 1981 Kodiak Tanner crab fishery yielded 5.3 x 10^3 metric tons of this species (Jewett and Feder, 1983).

The Golden king crab has a similar distribution to the Red king crab but is only lightly fished in the eastern North Pacific (McBride *et al*., 1982). There are several reasons for this. The Golden king crab is generally found in deeper waters, the females mature at larger sizes and produce fewer (though large-sized) eggs, and both sexes are parasitized by the rhizocephalan barnacle *Briarosaccus callosus* (Boschma) which can result in sterility (McBride *et al*., 1982; McMullen and Yoshihara, 1970).

Golden and Red king crabs and Tanner crabs have been described from Alice Arm and its associated inlets (O'Connell, 1977; Ibid, 1981; Littlepage, 1978; Demill, 1983; Jewett *et al*., 1983). In this study only the Golden king crab and Tanner crab were collected for observations on their diet.

For both crab species examined in the present study, the majority of prey items which dominated by percentage wet weight also dominated in terms of percentage frequency of occurrence.

Lithodes aequispina - Golden (or brown) king crab.

Information on the diet of Golden king crabs has not been previously recorded in the scientific literature. Jewett and Feder (1982) have reported that one main food group predominates in the diet of the Red king crab though this tends to vary with location. Echinodermata, specifically Ophiuroidea, was the dominant prey item in the stomachs of the Golden king crabs taken in trawls in our study from both Alice Arm and Hastings Arm (Figure 4). This finding is in agreement with that of Tarverdiera (1976) who found echinoderms to be the dominant prey of Red king crabs collected in the southeastern part of the Bering Sea.

The prey diversity differed in Golden king crabs collected in Alice Arm compared to Hastings Arm. The maximum number of taxa identified from one crab in Alice Arm was two while five taxa were reported in a single Hastings Arm crab stomach. In contrast Jewett and Feder (1982) identified 25 taxa from a single Red king crab collected near Kodiak Island, Alaska.

The Golden king crabs in Alice Arm, however, had proportionately fuller stomachs than those from Hastings Arm (Figure 5). The crabs from trawl A1-III near the Kitsault mine outfall and A2-IV (mid Alice Arm) contained the same amount of food and both contained more food than the crabs from Hastings Arm (11 versus 2 $^{o}/_{ooo}$, respectively). None of the crabs observed, however, were more than one quarter full. In comparison Jewett and Feder (1982) reported a maximum stomach fullness in a single Red king crab of 78%. The consumption of food by the Red king crabs was also found to be greater in the spring and summer and was significantly different in crabs from different areas, depths, size groups and molt-classes. Consequently, a larger sample size than that obtained in this study, and sampling on a seasonal basis, would undoubtedly provide more quantitative information on feeding habits of the crabs resident in Alice Arm and Hastings Arm.

Ophiuroids, the dominant prey item of the Golden crabs examined in this study are common epifauna in both Alice Arm and Hastings Arm (Kathman <u>et al</u>., 1983). Benthic grab stations located near the outfall and in proximity with our trawl station A1-III had a mean number of 5 ophiuroids per m^2. Two benthic grab stations which were near trawl stations A2-I and A2-IV yielded 970 and 100 ophiuroids per m^2, respectively in 1982. In Hastings Arm, benthic grab stations near trawl station H2 supported a mean of 15 ophiuroids per m^2.

According to McBride <u>et al</u>. (1982) the main spawning period for Golden king crabs in the North Pacific is from July to October. Crabs from this study were collected in October. The reproductive condition of King crabs is easily detected by the presence of egg clutches or matted pleopodal setae in female crabs. Egg hatching in King crabs typically precedes mating and spawning (Jewett et al, 1983). Only one of the five Golden king crab captured in trawls in the present study was a female, which was reproductively sterilized by the parasite <u>Briarosaccus callosus</u>. However, many of the female Golden king crab collected during the second cruise were holding egg clutches or had matted pleopodal setae (N. Sloan pers. comm.).

Ecdysis (molting) is associated with reproduction and growth in mature King crabs (Sakuda, 1961; Donaldson <u>et al</u>., 1981). Jewett and Feder (1982) postulated that the diet of crabs which have recently molted consists of prey items which will replace the calcium carbonate lost during ecdysis (eg. echinoderms such as ophiuroids, and molluscs such as barnacles and clams). The diet of the Golden king crabs collected during this study consisted predominantly of echinoderms. The diet as well as the reproductive condition of the female crabs suggest that the Golden crabs in both Alice Arm and Hastings Arm were spawning at the time of collection. This reproductive condition may have dictated a selection or preference for the prey items ingested. It should be noted, however, that the stomach of the single parasitized (hence sterile) female crab examined from Hastings Arm did not differ from the unparasitized crabs from the same location in total wet weight, frequency of taxa occurrence or percent fullness.

Chionoecetes bairdi - Tanner crab.

The prey items in the stomachs of Tanner crabs from Alice Arm differed from those of Tanner crabs from Observatory Inlet (Figure 4). The dominant food in Alice Arm crabs was Annelida (errantiate Family Nephtyidae). Mollusca proved to be of some importance in their diet with the most significant contributor being the clam Transennella tantilla. Tanner crab stomachs from Observatory Inlet were dominated by the taxon Arthropoda (mainly crangonid shrimps). Minimal contributions to the diet were made by the sedentariate polychaete Myriochele oculuta and the clam Transennella tantilla.

Paul et al. (1979) found clams, hermit crabs and barnacles to be the dominant food organisms (by frequency of occurrence) in Tanner crabs from Cook Inlet in Alaska, while Tanner crabs examined from near Kodiak Island, Alaska were dominated by the prey groups arthropods, fish and molluscs (Jewett and Feder, 1983). As was the case in the present study, the crustaceans that dominated the arthropod prey group of the Kodiak Island Tanner crabs were mainly pandalid and crangonid shrimps.

The most obvious difference in Tanner crabs between the two study areas was in the fullness of the stomach (Figure 5). Crabs from Observatory Inlet had a high index of fullness while those from Alice Arm were much less full. Alice Arm Tanner crabs collected near the tailings discharge were essentially empty. This condition is probably as much a function of crab size (CW>110 mm) as sampling location (Tarverdiera, 1976).

A difference was observed in the number of prey taxa and in the fullness of the stomachs in different size classes of Tanner crabs. The immature males (<105 mm) from both Alice Arm and Observatory Inlet contained three and four prey taxa respectively compared to a maximum of one taxon in the more mature crabs (>105 mm). The fullest of the immature male Tanner crabs were from Observatory Inlet. Studies done near Kodiak Island, Alaska showed that smaller C. bairdi (<100 mm CW) were found to contain significantly more food than did the large crabs (Jewett and Feder, 1983). Tarverdieva (1976) concluded that adult Tanner crab (>110 mm CW) feed mainly on polychaetes while the young feed predominantely on mollusks with the intensity of feeding being highest for the young and decreasing with an increase in crab size. Paul et al. (1979), however, found no difference in the frequency of occurrence of prey in Tanner crabs of different size (matures > 110 mm, immatures < 110 mm) or sex from Cook Inlet, Alaska.

As stated earlier, Tanner crabs examined in this study consumed both infauna and epifauna. The dominant infaunal organism (errantiate polychaete Family Nephtyidae) has been previously reported in Alice Arm (Littlepage, 1978; Kathman et al., 1983). Members of this family are free-living, motile burrowers, common in soft substrates and may be extremely abundant (Fauchald and Jumars, 1979). The bivalve Transennella tantilla found in the guts of Alice Arm crabs was one of the most abundant bivalves recorded in Alice Arm in 1982 (Kathman et al.). This bivalve was also a part of the diet of the Tanner crabs in Observatory Inlet. The dominant epifauna consumed by the Tanner crabs from Observatory Inlet belonged to the shrimp Family Crangonidae. Crangonidae have been recorded from this site by Demill (1983).

FISH: OVERVIEW

The fish species examined in this study have been reported in previous studies of the area (Littlepage, 1978; O'Connell, 1981; Goyette and Christie, 1982; Demill, 1983). Little information is available on their feeding habits in B.C. waters except for those species of distinct commercial value. Recent work conducted in Hecate Strait and the vicinity of Queen Charlotte Sound provide information and observations on stomach contents and feeding behaviour of groundfish (Westrheim and Harling, 1983; Hay et al, IN PREP). Additional information on feeding habits and diets of some of these species is included from studies on the continental shelf off Oregon and near Kodiak Island in Alaska (Hagerman, 1952; Kravitz et al., 1977; Kreuz et al., 1982; Pearcey and Hancock, 1978; and Jewett, 1978).

As was the case for crabs, the majority of prey items which dominated by wet weight also dominated in terms of frequency of occurrence for all fish species examined.

COD-LIKE FISHES

Gadus macrocephalus - Pacific (or gray) cod.

The dominant prey group of the Pacific cod from both Alice Arm and Observatory Inlet was Arthropoda (Figure 4). Caridean shrimps of the Families Crangonidae and Pandalidae were the most common crustaceans. The Observatory Inlet cod contained more taxa than did the Alice Arm cod: five and two taxa respectively; however, in terms of the index of fullness the Observatory Inlet cod was considerably less full (Figure 6). A single caridean shrimp, Pandalopsis dispar, was the dominant taxon of the Alice Arm cod while crangonid shrimp were the most dominant taxon found in cod from Observatory Inlet. Fish (unidentifiable) were also important in the diet of cod taken from both areas.

The main food items of Pacific cod collected in Hecate Strait between September, 1982 and February, 1983 consisted of sandlance (22.8% body weight), herring (14.5%), and shrimp (9.3%) (Hay et al., IN PREP). The major proportion of the shrimp weight in Hecate Strait cod stomachs was contributed by the Families Crangonidae and Pandalidae. Pacific cod collected in Queen Charlotte Sound and near Vancouver Island were also found to feed on sandlance (52-83% incidence of evaluated samples), and herring (39-43%) (Westrheim and Harling (1983)). "Shrimp", including copepods, euphausids, munids, and pandalids, were considered a secondary species and accounted for 11-19% prey incidence. In addition to the pelagic species mentioned the diet of the Pacific cod may also include a variety of infauna and epifauna such as worms, crabs, and molluscs (Hart, 1973).

Jewett (1978) analyzed stomachs of Pacific cod taken in conjunction with crab-assessment studies near Kodiak Island, Alaska. The summer diet of Pacific cod from this area was fishes (sandlance, pollock and flatfishes), crabs (Tanner crab juveniles), shrimps (crangonid and pandalid) and amphipods.

Theragra chalcogramma - Walleye pollock.

Arthropoda dominated the diet of the pollock collected from both Alice Arm and Observatory Inlet. The species composition in the stomach of the pollock caught near the tailings outfall consisted predominantly of caridean shrimp and amphipods. The major portion of diet of the pollock caught in Observatory Inlet consisted of the shrimps Pandalus borealis, Crangon communis and Pasiphaea pacifica.

The pollock taken from Observatory Inlet contained a greater number of taxa (per stomach) than did the individual from upper Alice Arm: five and two taxa, respectively. The fish from the two areas also differed considerably in terms of fullness. Pollock stomachs from Observatory Inlet were noted to be eight times fuller than those from Alice Arm.

Major prey items identified in Walleye pollock collected in Hecate Strait between September, 1982 and February, 1983 were crustaceans (unspecified) comprising 62.7% of the body weight, euphausids (15.3%), herring (5.7%) and shrimp (3.4%) (Hay et al., IN PREP), with the Families Crangonidae and Pandalidae comprising the major portion of the shrimp weight. The principal items for Walleye pollock in B.C. waters according to Hart (1973) are shrimps, sandlance, and herring while Alaskan pollock have been found to feed predominantly on young pink, chum, and coho salmon.

Sebastes aleutianus - Rougheye rockfish.

Arthropoda dominated prey groups by weight but not frequency of occurrence in the rockfish collected in the Nass River estuary. This is due in part to one stomach being empty and two partially inverted. The Caridean shrimp, Crangon communis was the major prey item identified while Amphipods accounted for a minor portion of the Arthropoda weight. The stomach index of fullness was low. There are no published data on the feeding of this rockfish in B.C. waters.

FLATFISHES

Atheresthes stomias - Turbot or Arrowtooth flounder.

No information on feeding was obtained from the turbot collected in Alice Arm as its stomach was essentially empty.

Turbot are known, however, to be almost exclusively piscivores (J. Westrheirm, pers. comm.). Prey items identified from Hecate Strait turbot in 1982-1983 indicated the following food items: herring, (43.0% of body weight), rockfish (15.7%), flounder (6.7%) and shrimp (3.4%) (Hay *et al.*, IN PREP). The major contribution to the shrimp weight in Hecate Strait turbot was from pandalids and crangonids.

Glyptocephalus zachirus - Rex sole.

While little is know about the life history of Rex sole (Hart, 1973), the available information on their feeding behaviour suggests that these species have a relatively restricted diet, and that dietary composition changes with age. Pearcey and Hancock (1978) found in studies on the continental shelf off central Oregon that small (<150 mm) Rex sole feed mainly on amphipods and other crustaceans. Large Rex sole (150-450 mm), on the other hand were found to feed chiefly on polychaetes.

In this study, annelids were the dominant prey group identified in the stomachs of the Rex sole collected near Nass River. The species composition consisted chiefly of the Polychaeta Goniada annulata and Myriochele oculata. Sea cucumbers or holothurians, were also of considerable importance by weight. Seven taxa were identified but the index of fullness was low compared to that reported in the Rougheye rockfish from the same trawl.

Hippoglossoides elassodon - Flathead sole.

The Flathead sole collected from Nass River was essentially empty. Arthropoda (predominantely the hermit crab Pagurus sp.) was the dominant prey group in the sole from Observatory Inlet. Polychaeta (Capitellidae, Lumbrineridae and the Owenid, Myriochele oculata) also contributed to the diet of this species of sole. The number of taxa (7) in the Flathead stomachs was similar to that found in the Rex sole but stomach fullness was slightly less.

A different species composition was encountered in the Flathead sole intestines. Ophiuroids were the dominant prey group identified in the intestines of the Nass River Flathead while molluscs were dominant in the sole from Observatory Inlet. The snail Lunatia pallida and clams Yoldia martyria and Clinocardium ciliatum were the most common molluscan species identified. The shrimp Pandalus borealis and crab (Family Majidae) were also dietary constituents.

The combination of food in the stomachs and intestines of Flathead sole examined in this study are comparable to the food items reported in Flathead sole from Puget Sound which included clams, worms and crustaceans (Hart, 1973).

Microstomus pacificus - Dover sole

According to Hart (1973) Dover sole frequent soft bottom habitats and as such their feeding is concentrated on burrowing infaunal forms. Sipunculids, polychaetes, echinoids, ophiuroids and gastropods have been found in the guts of Dover sole; however, infaunal bivalves and scaphapods are typically more common (Hagerman, 1952). Yoldia, a deep water infaunal bivalve has also been identifed as a preferred food item (S. Westrheim, pers. comm.). An intensive study of the feeding habits of Dover, Rex and Slender sole off the Oregon coast conducted by Pearcey and Hancock (1978) concluded that Dover sole have a very catholic diet. The dietary composition appeared to vary among stations of different depths and sediment types indicating opportunistic feeding. Pelecypods, ophiuroids, seapens and anemones were noted to dominate the diet at shallow to intermediate depths (74-102 m) in sand or silty sand bottoms, while annelids comprised over 90% of the diet of fish from deeper stations (>150 m) with clay-silt or silty clay bottoms.

The dominant taxon of two Dover sole stomachs examined in this study was Annelida. The species consumed differed between areas (station depths >150 m) but both taxa were sedentariate polychaetes (Sabellidae and Myriochele oculata). Ophuiroids, found in other flatfish species from this trawl site also contributed to the diet of the Dover sole.

There was also a notable difference in the number of taxa and the index of fullness between the Hastings Arm and the Nass River sole. The Nass River sole contained four taxa compared to one taxon in Hastings Arm sole and had a greater reported index of fullness (15 $^{o}/_{ooo}$ versus 5 $^{o}/_{ooo}$, respectively).

Parophrys vetulus - English or lemon sole.

The typical feeding habitat of this small-mouthed sole is shallow sandy bottoms where they feed predominantly on benthic meiofauna such as clams, clam siphons and other bivalves, worms, small crabs and brittle stars (Hart, 1973; Kreuz et al., 1982). Polychaetes and amphipods are the most common organisms eaten by large English sole (Kravitz et al., 1977).

The prey group Annelida (Polychaeta) dominated the diet of English sole examined in this study. The sole taken from Observatory Inlet (station depth 77-82 m) contained more species of polychaetes than any other fish examined during this study. The English sole also had the greatest representation of prey taxa (15) of any other fish examined. The intestines accounted for yet another nine polychaete taxa, and three molluscan taxa including aplacophorans. Plants were also noted to be common in the diet of English sole. The index of fullness in the Observatory Inlet English sole was comparable to that of the Flathead sole taken from the same area. Both of these fish however were relatively empty compared to the walleye pollock caught in the same trawl. This is directly related to the size of prey items consumed by each species (shrimp versus worms).

GENERAL DISCUSSION

Sixty-four prey taxa were identified from the crabs and fish examined in this study (Appendix B). Of these taxa, sixteen were found only in the intestines of fish. Forty-six taxa of infauna and epifauna identified as prey items in these specimens have been reported from the area in previous studies (Littlepage, 1978; O'Connell, 1981; Demill, 1983; Kathman et al., 1983). Previous records were attained by benthic grab, otter trawls and submersible observations.

The term "hyperbenthos" describes the assemblage of planktonic and epibenthic organisms found near the bottom but which access the water column by diel migrations (Sibert et al., 1977). In the present study the hyperbenthos are defined as those organisms which spend more time in the water column compared to the epifauna which live strictly on the bottom and make infrequent excursions into the water column.

The prey items of the crabs have already been described as common fauna. The Golden king crab investigated in this study fed predominantly on epifauna such as ophiuroids (brittle stars) and infauna such as molluscs. The Tanner crabs fed predominantly on hyperbenthos such as shrimp and infauna such as bivalves and polychaetes.

In the present study the cod-like fishes (Pacific cod, Walleye pollock and Rougheye rockfish) fed primarily on hyperbenthic shrimp and occasionally epifaunal amphipods. Flatfish on the other hand ingested primarily infauna such as polychaetes and molluscs and epifauna such as brittle stars and hermit crabs but less frequently, hyperbenthic shrimp.

The cod-like fishes all had fuller stomachs than the flatfish, an indication of relative size of hyperbenthos compared to the size of infauna consumed. The pollock, being bathypelagic at 200 m (Hart, 1973) appears to have a relatively restricted diet and is primarily dependent on hyperbenthos for its food supply. According to Butler (1980) the species of shrimp consumed by these pollock support this argument. Pandalus borealis migrate vertically in the water column and are known to be eaten by cod and turbot; Crangon communis, ranked as the most common local shrimp, has been caught in bottom and midwater trawls while Pasiphaea pacifica is epipelagic and is commonly taken in midwater trawls. Two other food items ingested by the pollock, calanoid copepods and hyperiid amphipods, are also pelagic. Consequently, the preferred prey items of pollock would not provide an indication of benthic invertebrate abundance. Pacific cod and the Rougheye rockfish are more restricted in habitat and do not or are not able to move vertically in the water column to the same extent as the pollock. The diet of these fish is dominated by hyperbenthos and epibenthos. On the other hand flounders, by virtue of their adaptation to benthic habitats, are the most dependent on epifauna and infauna for their food supply. Accordingly, the standing stocks of benthic invertebrates may dictate the degree to which these species will utilize particular areas.

This hypothesis is supported by Pearcy and Hancock (1978) who reported a strong positive correlation between standing stocks of predator (Dover sole) and prey (polychaetes), which suggested that Dover sole select habitats where their principal preferred food was most abundant regardless of depth and bottom type.

Physical or chemical perturbations which drastically reduce or eliminate benthic standing stocks will affect flatfish distribution. A correlation between water quality, infaunal abundance and flatfish distribution was reported by Levings (1980) who concluded that distribution of English sole in Howe Sound was restricted due to dissolved oxygen depletion in Howe Sound basin which effectively eliminated infaunal food sources.

Reductions in infaunal density and diversity in Alice Arm have also been reported by Kathman et al. (1983). The reported decrease in invertebrate abundance (and hence flatfish prey availability) between 1977 (O'Connell and Byers, 1978) and 1982 correlates well with patterns of Amax mine tailings deposition, and sedimentation data. The reduction in flatfish food sources also appears to correlate well with flatfish catch data. In October of 1983 no flatfish were recovered from three trawls at station A1 near the tailings outfall, while four trawls at station A2 (mid-Alice Arm) produced only one flounder, a Turbot. In contrast one trawl at station A3 in Observatory Inlet which is highly productive (DeMill, 1983) and removed from the area of active tailings flow yielded 28 flounder (D. Goyette, pers. comm.). Submersible observations conducted in 1976 and again in 1982 also appear to confirm a decline in flatfish abundance in areas of Alice Arm subject to tailings disposal. In 1976 flatfish were reported as abundant in the head of Alice Arm, whereas no flatfish were reported from the same area in 1982 (Sullivan and Brothers, 1979; DeMill, 1983).

These findings are not surprising in that Burling et al. (1983) concluded that the high rates of tailings deposition from the Amax mine would bury most sedentary infaunal organisms. In addition, the unstable bottom and high turbidity currents resulting from the tailings discharge would restrict movements of larger, more mobile epifauna in the areas of active tailings flow. Burial of preferred benthic prey organisms (infauna) and increased turbidity during periods of mine operation would appear to have restricted flatfish utilization of Alice Arm.

As with flatfish, the utilization of Alice Arm by Golden king and Tanner crabs may also be restricted due to burial of food (epifauna and infauna) by tailings. A comprehensive population study of crabs in Alice Arm was not conducted during mine operation, however, submersible observations in July 1982 revealed that Golden king crab were utilizing areas of fresh tailings deposition (Demill, 1983). Bernard (1979) concluded that a marked seasonality of diet occurs in the Dungeness crab

Cancer magister from Hecate Strait which conforms to the recruitment patterns of the benthic fauna. Jewett and Feder (1982; Ibid, 1983) found that the diet of Tanner crabs and Red king crabs was area specific and thus opportunistic. The opportunistic feeding behaviour of the crabs suggest they would utilize areas of active tailings deposits by feeding on hyperbenthos, epifauna or infauna which can adapt to continuous tailings deposition.

Jewett *et al*. (1983) described the crab population in Alice Arm in November, 1982 shortly after mine shut down. Recent crab surveys conducted in October 1983 and March 1984 have also delineated crab utilization of Alice Arm during mine shut down (N. Sloan, pers. comm.). A similar study should be conducted during mine operation to assess the impacts of active tailings discharge on crab utilization and feeding habits in Alice Arm. Similarly, the effect of a long-term perturbation of this nature on flatfish distribution patterns in the area has not been investigated. In order to adequately assess the impacts of tailings discharges on flatfish populations of Alice Arm, studies designed to examine seasonal flatfish migratory patterns, recruitment and feeding habits, during periods of non-operation (benthic recolonization period) would be required.

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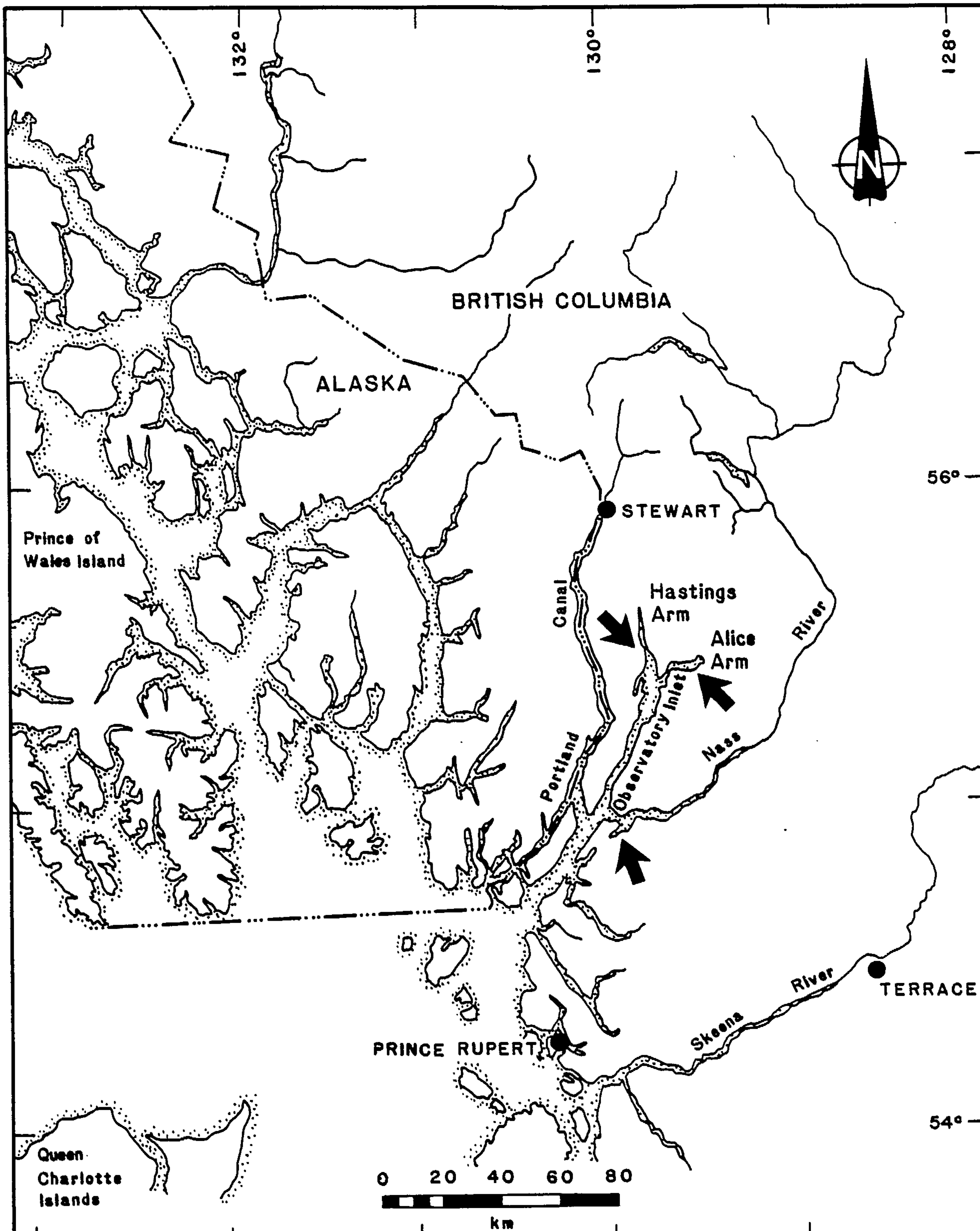

FIGURE 1. Study areas in northern British Columbia.

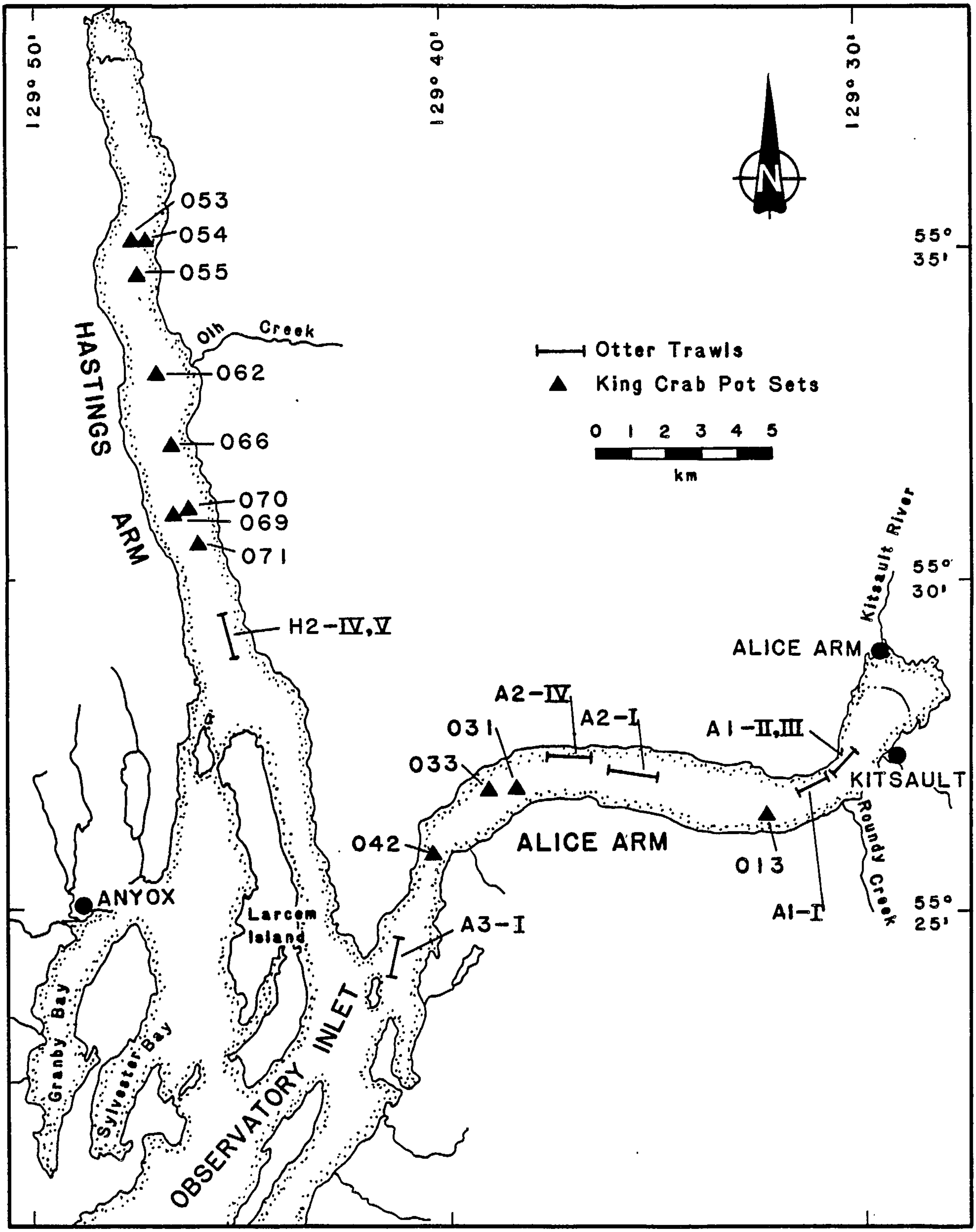

FIGURE 2. Otter trawl and king crab pot stations in Alice Arm, Hastings Arm and Observatory Inlet.

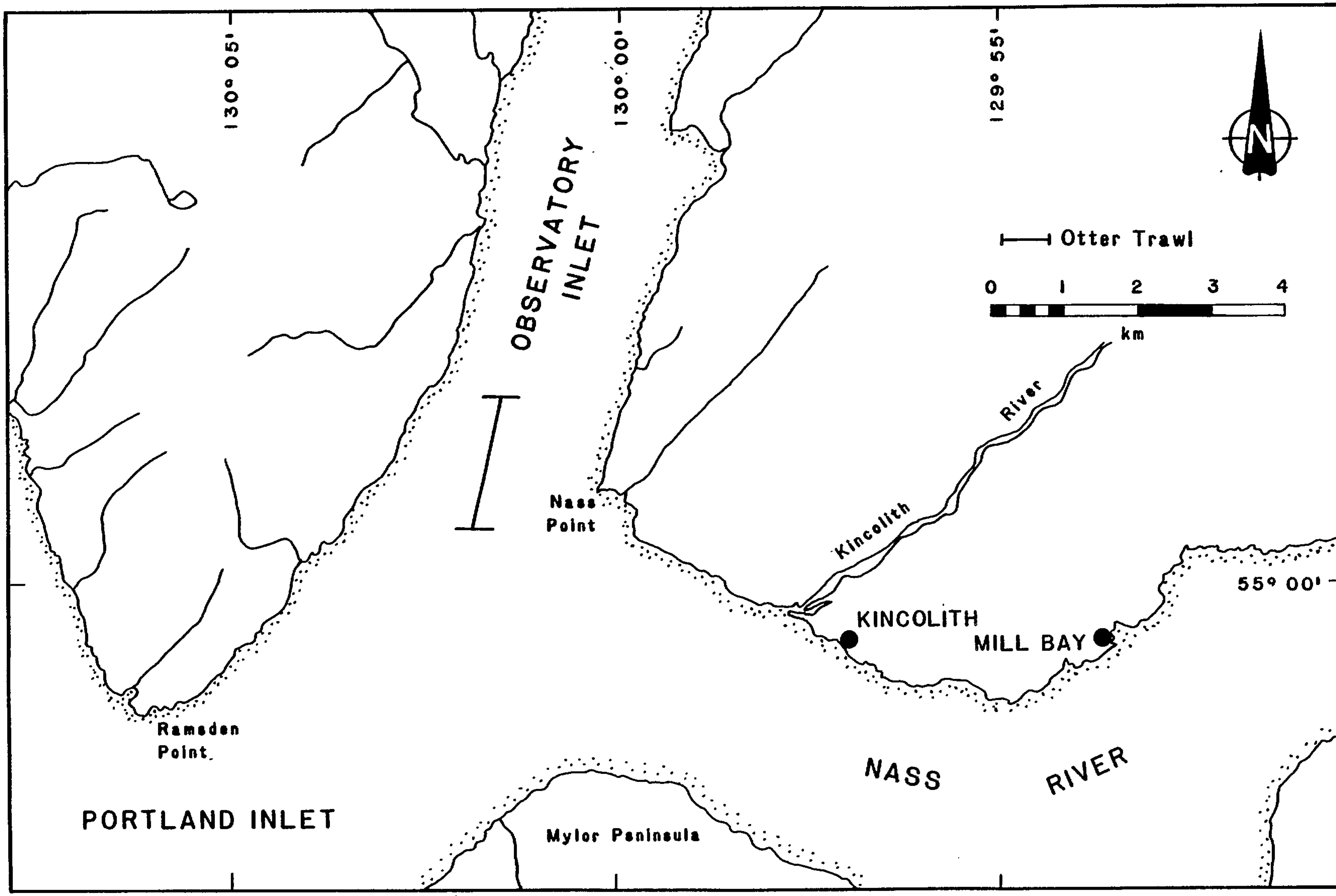

FIGURE 3, Otter trawl station near Nass River.

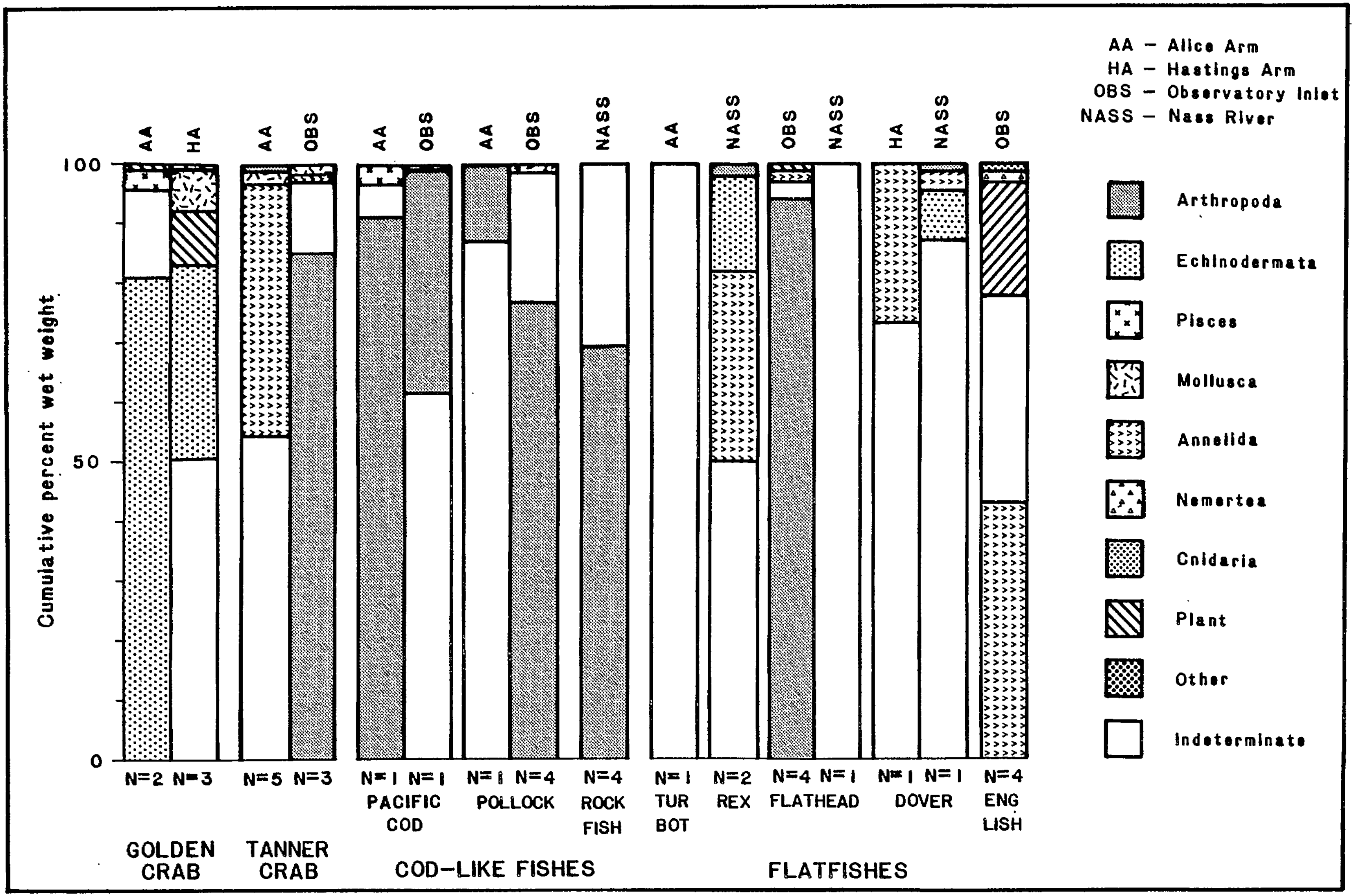

FIGURE 4. Dominant food groups in stomachs of crabs and fish from the four sample areas.

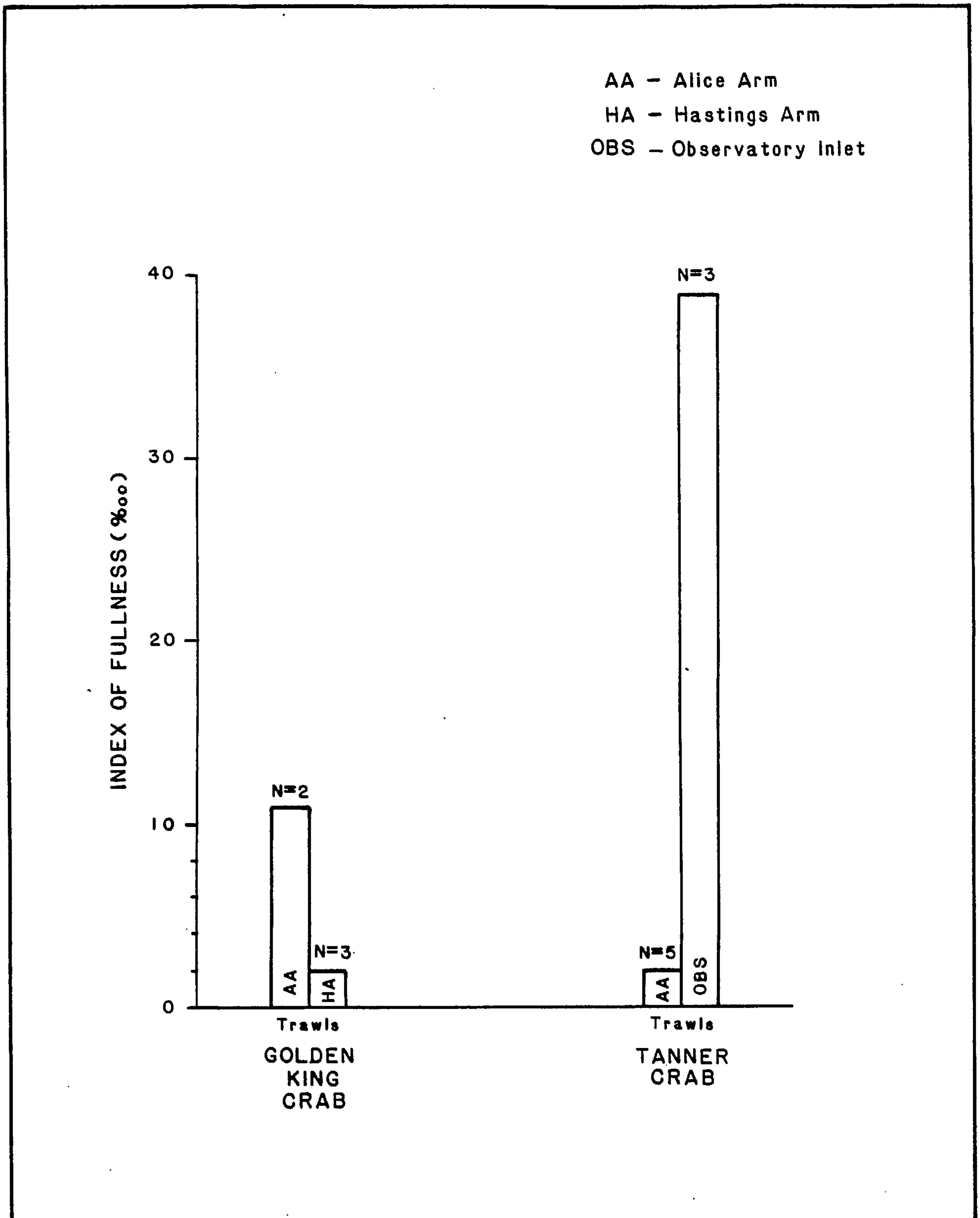

FIGURE 5. Index of fullness of crab stomach contents by area.

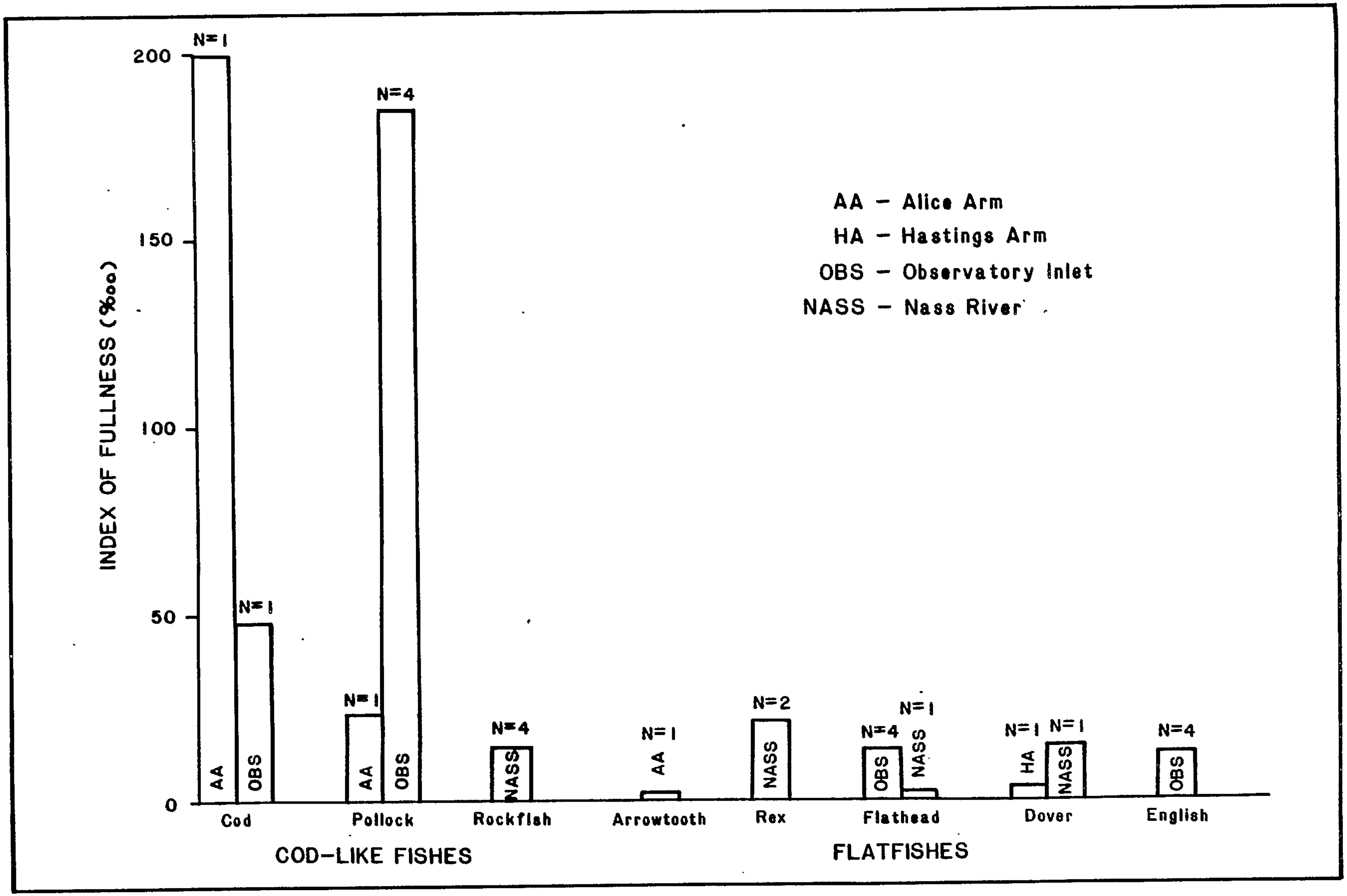

FIGURE 6. Index of fullness of fish stomach contents by area.

TABLE 1. Common and scientific names of crabs and fish collected, sampling locations and numbers of stomachs examined.

COMMON NAME	SCIENTIFIC NAME	LOCATION	STOMACHS EXAMINED
CRABS			
Golden king crab	Lithodes aequispina Benedict	Alice Arm Hastings Arm	2 3
Tanner crab	Chionoecetes bairdi Rathbun	Alice Arm Observatory Inlet	5 3
COD-LIKE FISHES (Codfish and scorpionfish)			
Pacific cod	Gadus macrocephalus Tilesius	Alice Arm Observatory Inlet	1 1
Walleye pollock	Theragra chalcogramma (Pallas)	Alice Arm Observatory Inlet	1 4
Rougheye rockfish	Sebastes aleutianus (Jordan and Evermann)	Nass River	4
FLATFISHES (Righteye flounders)			
Turbot	Atheresthes stomias (Jordan and Gilbert)	Alice Arm	1
Rex sole	Glyptocephalus zachirus Lockington	Nass River	2
Flathead sole	Hippoglossoides elassodon Jordan and Gilbert	Observatory Inlet Nass River	4 1
Dover sole	Microstomus pacificus (Lockington)	Hastings Arm Nass River	1 1
English sole	Parophrys vetulus Girard	Observatory Inlet	4

TABLE 2. Dominant food groups in the stomachs of _Lithodes aequispina_ and _Chionoecetes bairdi_ from trawls in the vicinity of Alice Arm, 1983.

Dominant Food Groups	_Lithodes aequispina_ Percentage wet weight of food	_Lithodes aequispina_ Percentage frequency occurrence	_Chionoecetes bairdi_ Percentage wet weight of food	_Chionoecetes bairdi_ Percentage frequency occurrence
Annelida	-	-	21.3	37.5
Mollusca	4.1	50.0	1.4	37.5
Arthropoda			42.5	37.5
Echinodermata	56.8	100.0	-	-
Pisces	2.1	41.5	-	-
Indeterminate animal matter	32.6	83.5	34.8	50
Plant matter	4.4	41.5		
Individuals examined	5		8	
% containing food	100.0		75.0*	
Sample areas	Alice Arm, Hastings Arm		Alice Arm, Observatory Inlet	

* Empty stomachs were included in the calculation of frequency occurrence.

TABLE 3. Dominant food groups in the stomachs of eight species of fish obtained by trawl from the four sample areas.

	COD-LIKE FISHES						FLATFISHES									
	Pacific cod *G.macrocephalus*		Walleye pollock *T. chalcogramma*		Rougheye *S. aleutianus*		Turbot *A. stomias*		Rex sole *G. zachirus*		Flathead sole *H. elassodon*		Dover sole *M. pacificus*		English sole *P. vetulus*	
Dominant	% wet wt	% freq occur	% wet wt	% freq occur	% wet wt	% freq occur	% wet wt	% freq occur	% wet wt	% freq occur	% wet wt	% freq occur	% wet wt	% freq occur	% wet wt	% freq occur
Protozoa																
Cnidaria	NEG*			12.5							0.1	12.5			0.2	25.0
Rhynchocoela															1.3	25.0
Annelida									33.6	100.0	0.8	12.5	15.0	100.0	43.1	75.0
Mollusca	NEG	50.0	0.1	12.5									NEG	50.0	NEG	25.0
Arthropoda	65.0	100.0	44.4	100.0	69.6	50.0			2.2	50.0	47.3	12.5	0.2	50.0	0.1	50.0
Echinodermata									14.6	50.0			4.8	50.0		
Pisces	1.9	100.0														
Indeterminate animal matter	33.0	100.0	55.5	100.0	30.4	75.0	100.0	100.0	49.6	100.0	51.4	100.0	80.0	100.0	34.9	75.0
Plant matter			0.1	12.5							0.4	12.5			20.3	75.0
Individuals examined	2		5		4		1		2		5		2		4	
% containing food	100.0		100.0		75.0***		100.0		100.0		100.0		100.0		100.0	
Sample areas	Alice Arm** Observatory Inlet		Alice Arm Observatory Inlet		Nass River		Alice Arm		Nass River		Observatory Inlet Nass River		Hastings Arm Nass River		Observatory Inlet	

* NEG = Negligible
** Alice Arm Pacific cod collected in pot
*** Empty stomachs included in frequency occurrence caluculation

APPENDIX A-1

Otter trawl coordinates and depths in Alice Arm, Hastings Arm, Observatory Inlet and Nass River, October, 1983.

TRAWL	DATE	LOCATION (ON BOTTOM)	LOCATION (START UP)	DEPTH (m)
ALICE ARM				
A1-I	7 Oct	55°27.82'N 129°30.57'W	55°27.99'N 129°30.00'W	223-172
A1-II	8 Oct	55°27.13'N 129°29.87'W	55°27.28'N 129°29.70'W	165
A1-III	8 Oct	55°27.10'N 129°29.97'W	55°27.95'N 129°29.60'W	157-102
A2-I	8 Oct	Not Recorded	52°26.81'N 129°34.35'W	373-358
A2-IV	11 Oct	55°27.00'N 129°35.41'W	55°26.87'N 129°33.90'W	395-356
AA-42*	29 Oct	-	-	256
HASTINGS ARM				
H2-IV	10 Oct	55°31.70'N 129°46.80'W	Not recorded	300-265
H2-V	10 Oct	55°31.00'N 129°46.50'W	55°32.00'N 129°47.00'W	302-293
OBSERVATORY INLET				
A3-I	11 Oct	55°24.70'N 129°40.78'W	55°24.20'N 129°40.80'W	77-82
NASS RIVER				
	10 Oct	55°00.40'N 130°01.85'W	55°01.42'N 130°01.42'W	192-188

*King crab pot set

APPENDIX A-2

Summary of trawl data collected on Golden king crabs in Alice Arm and Hastings Arm, October, 1983.

LOCATION	DATE	NO.	CARAPACE LENGTH (CL) (mm)	CARAPACE WIDTH (CW) (mm)	WHOLE WET WEIGHT (g)	WITH PARASITE	SEX MALE	SEX FEM
ALICE ARM								
A1-III	8 Oct	1	139	145	1,693	-	1	0
A2-IV	11 Oct	5	143	150	2,045	-	1	0
HASTINGS ARM								
H2-IV	10 Oct	2	136	142	1,525	-	1	0
H2-V	10 Oct	3	114	116	549	1	0	1
H2-V	10 Oct	4	98	97	637	-	1	0

APPENDIX A-3

Summary of trawl data collected on Tanner crabs from Alice Arm and Observatory Inlet, October, 1983.

LOCATION	DATE	NO.	CARAPACE LENGTH (CL) (mm)	CARAPACE WIDTH (CW) (mm)	WHOLE WET WEIGHT (g)	WITH PARASITE	SEX MALE
ALICE ARM							
A1-I	7 Oct	1	105	120	452	-	1
A1-I	7 Oct	2	108	120	523	-	1
A1-II	8 Oct	3	99	103	390	-	1
A2-I	8 Oct	4	100	105	331	-	1
A2-I	8 Oct	5	130	140	1,071	-	1
OBSERVATORY INLET							
A3-I	11 Oct	6	-	118	507	-	1
A3-I	11 Oct	7	-	77	140	-	1
A3-I	11 Oct	8	-	75	110	-	1

APPENDIX A-4

Summary of trawl data collected on the eight species of fish from the vicinity of Alice Arm, October, 1983.

SPECIES	DATE	NO.	LOCATION	WHOLE WET WEIGHT (g)	LENGTH (mm)
COD-LIKE FISHES (Codfish and scorpionfish)					
Pacific cod	11 Oct	1	A3-I	459	350
	29 Oct	2	AA 42*	852**	650
Walleye pollock	7 Oct	1	A1-I	352	310
	11 Oct	2	A3-I	87	280
	11 Oct	3	A3-I	83	220
	11 Oct	4	A3-I	87	220
	11 Oct	5	A3-I	113	235
Rougheye rockfish	11 Oct	1	Nass River	509	325
	11 Oct	2	Nass River	64	165
	11 Oct	3	Nass River	60	170
	11 Oct	4	Nass River	NR	NR
FLATFISHES (Righteye flounders)					
Turbot	11 Oct	1	A2-IV	1,278	497
Rex sole	11 Oct	1	Nass River	103	270
	11 Oct	2	Nass River	101	250
Flathead sole	11 Oct	1	A3-I	375	350
	11 Oct	2	A3-I	230	290
	11 Oct	3	A3-I	232	320
	11 Oct	4	A3-I	316	330
	11 Oct	5	Nass River	872	470
Dover sole	10 Oct	1	H2-IV	293	320
	11 Oct	2	Nass River	453	215
English sole	11 Oct	1	A3-I	313	325
	11 Oct	2	A3-I	198	283
	11 Oct	3	A3-I	317	325
	11 Oct	4	A3-I	270	315

* Cod collected in King crab pot.
** Whole wet weight not recorded. This represents an estimate.

APPENDIX B

Taxonomic list of prey items found in all stomachs and intestines of crabs and fishes examined. (Previous records of the prey items from the study area are indicated by author. Items present only in the intestine are shown (+).)

FOOD ITEMS	INTESTINE ONLY	RECORDS
PROTOZOA		
SARCODINA		
Foraminiferida: forams		X
METAZOA		
CNIDARIA		
Hydroida: hydroids		K
RHYNCHOCOELA		
Nemertea: ribbon-worms		?(K)
ANNELIDA		
Errantiate Polychaeta: free-moving marine worms		
Phyllodocidae	+	?(K)
Nephtyidae		?(K,D)
Glyceridae	+	X
Goniadidae		
Goniada annulata Moore		K,L
Lumbrineridae		?(K)
Lumbrineris luti Berkeley and Berkeley		K
Lumbrineris bicirrata (Treadwell)		X
Paraninoe simpla (Moore)		K,L
Sedentariate Polychaeta: tube-dwelling marine worms		
Orbiniidae		
Leitoscoloplos pugettensis (Pettibone)		K
Scoloplos sp.		X
Paraonidae		
Aricidea quadrilobata Webster and Benedict		X
Cirrophorus branchiatus Ehlers		K,L
Levinsenia gracilis (Tauber)	+	K,L
Cossuridae		
Cossura sp.	+	?(K)
Sternaspidae		
Sternaspis scutata (Renier)		K
Capitellidae		?(K)
Decamastus gracilis Hartman		L
Heteromastus sp.	+	K
Maldanidae	+	?(K)

APPENDIX B

FOOD ITEMS	INTESTINES ONLY	RECORDS
Oweniidae		
Myriochele oculata Zachs		K,L
Amphictenidae		
Pectinaria sp.	+	K
Ampharetidae	+	?(L)
Trichobranchidae		
Terebellides stroemi Sars	+	K,L
Trichobranchus glacialis Malmgren		X
Sabellidae		?(K)
Indeterminate polychaetes		-
MOLLUSCA		
Aplacophora: wormlike burrowers	+	K,L
Gastropoda: snails		
Prosobranchia		
Naticidae		
Lunatia pallida (Broderip and Sowerby)		X
Cylichnidae		
Cylichna alba (Brown)	+	L
Bivalvia: clams		
Palaeotaxodonta		
Nuculanidae		
Yoldia martyria Dall	+	K
Heterodonta		
Cardiidae		
Clinocardium ciliatum (Fabricius)	+	O
Veneridae		
Transennella tantilla (Gould)		K
Anomalodesmata		
Lyonsiidae		
Lyonoid		
Poromyidae		X
Poromya sp.		X
Indeterminate bivalves		-
ARTHROPODA		
Crustacea		
Copepoda: small crustaceans		
Calanoida		X
Malacostraca: large crustaceans		
Eucarida		
Decapoda		O,D

APPENDIX B

FOOD ITEMS	INTESTINES ONLY	RECORDS
Natantia: swimming crustaceans		O,D
Caridea: shrimp		O,D
Pasiphaeidae		
Pasiphaea pacifica Rathbun		D
Crangonidae		?(L,O,D)
Crangon communis Rathbun		O,D
Pandalidae		?(L,O,D)
Pandalopsis dispar Rathbun		O,D
Pandalus borealis Kryer		O,D
Reptantia: crawling crustaceans		?(L,O,D)
Anomura: crablike forms		
Paguridae: hermit crabs		
Pagurus spp.		
Brachyura: true crabs		
Majidae	+	D
Peracarida: shrimplike crustaceans		
Cumacea		
Campylaspis rufa	+	X
Diastylis sp.		X
Eudorella pacifica Hart	+	?(K)
Amphipoda		
Ampeliscidae		X
Eusiridae		?(K)
Gammaridae		?(K)
Hyperiidae		?(K)
Lysianassidae		
Koroga megalops Holmes		K
Phoxocephalidae		
Paraphoxus oculatus Sars		K
Indeterminate amphipods		-
ECHINODERMATA		
Ophiuroidea: brittle stars		?(K)
Holothuroidea: sea cucumbers		?(K,L)
PISCES: fish		
PLANT MATTER		
TOTAL PREY TAXA:	16	64
TOTAL PREVIOUS RECORDS		46

?: Taxa present but of a higher or lower taxonomic level than those recorded in this study.
X: Taxa not observed from previous records.
K: Kathman et al, 1983
L: Littlepage, 1978
O: O'Connell, 1981
D: Demill, 1983

APPENDIX C-1*

Stomach contents of five *Lithodes aequispina* (Golden king crabs) collected by trawl from Alice Arm and Hastings Arm, October, 1983.

FOOD ITEMS	ALICE ARM Trawl % wet wt	freq occur	HASTINGS ARM Trawl % wet wt	freq occur
PROTOZOA (total)				
Foraminiferida				
CNIDARIA (total)				
Hydroida				
ANNELIDA (total)				
Nephtyidae				
Lumbrineridae				
Myriochele oculata				
Indeterminate polychaete				
MOLLUSCA (total)			8.2	100.0
Gastropoda (total)			2.8	66.7
Lunatia pallida				
Indeterminate gastropods			2.8	66.7
Bivalvia (total)			5.4	33.3
Poromya sp.				
Transennella tantilla				
Lyonsia sp.			5.0	33.3
Indeterminate bivalves			0.4	33.3
ARTHROPODA (total)				
Natantia				
Crangonidae				
Reptantia				
Indeterminate reptants				
Indeterminate amphipods				
ECHINODERMATA (Total)	80.9	100.0	32.8	100.0
Ophiuroidea	80.9	100.0	32.8	100.0
PISCES	4.0	50.0	0.1	33.3
INDETERMINATE ANIMAL MATTER	14.9	100.0	50.4	66.7
PLANT MATTER	0.2	50.0	8.6	33.3
% containing food	100.0		100.0	
Index of fullness (0/000)	11		2	
Individuals examined	2		3	
Max prey taxa per individual	2		5	
(Mean) wet weight of food (g)	2.10		0.14	

* Abbreviations used throughout Appendices C, D and E: % wet wt = percentage wet weight; freq. occur. = percentage frequency occurrence; NEG = negligible wet weight.

APPENDIX C-2

Stomach contents of eight Chionoecetes bairdi (Tanner crabs) from Alice Arm and Observatory Inlet, October 1983.

FOOD ITEMS	ALICE ARM % wet wt	ALICE ARM freq occur	OBSERVATORY INLET % wet wt	OBSERVATORY INLET freq occur
PROTOZOA (total)			NEG	33.3
Foraminiferida			NEG	33.3
CNIDARIA (total)				
Hydroida				
ANNELIDA (total)	42.3	40.0	0.3	33.3
Nephtyidae	41.8	20.0		
Lumbrineridae				
Myriochele oculata			0.2	33.3
Indeterminate polychaete	0.5	20.0	0.1	33.3
MOLLUSCA (total)	2.5	20.0	0.2	66.7
Gastropoda (total)				
Lunatia pallida				
Indeterminate gastropods				
Bivalvia (total)	2.5	20.0	0.2	66.7
Poromya sp.	0.4	20.0		
Transennella tantilla	2.1	20.0	0.2	33.3
Lyonsia sp.				
Indeterminate bivalves			NEG	66.7
ARTHROPODA (total)	0.4	20.0	84.7	66.7
Natantia			30.9	33.3
Crangonidae			53.8	33.3
Reptantia				
Indeterminate reptants				
Indeterminate amphipods	0.4	20.0		
ECHINODERMATA (total)				
Ophiuroidea				
PISCES				
INDETERMINATE ANIMAL MATTER	54.9	40.0	14.8	66.7
PLANT MATTER				
% containing food	80.0*		66.7*	
Index of fullness (0/000)	2		39	
Individuals examined	5		3	
Max prey taxa per individual	3		4	
(Mean) wet weight of food (g)	0.06		0.46	

* Empty stomachs were included in the calculation of percentage frequency occurrence.

APPENDIX D-1

Stomach contents of *Gadus macrocephalus* (Pacific cod) and *Theragra chalcogramma* (Walleye pollock) from Alice Arm and Observatory Inlet, 1983.

FOOD ITEMS	*G. macrocephalus* ALICE ARM % wet wt	*G. macrocephalus* ALICE ARM freq occur	*G. macrocephalus* OBSERVATORY I. % wet wt	*G. macrocephalus* OBSERVATORY I. freq occur	*T. chalcogramma* ALICE ARM % wet wt	*T. chalcogramma* ALICE ARM freq occur	*T. chalcogramma* OBSERVATORY I. % wet wt	*T. chalcogramma* OBSERVATORY I. freq occur
PROTOZOA (total)								
Foraminiferida								
CNIDARIA (total)							NEG	25.0
Hydroida							NEG	25.0
RHYNCHOCOELA (total)								
Nemertea								
ANNELIDA (total)								
Errantiate polychaete								
Phyllodocidae								
Nephtyidae								
Glyceridae								
Goniada annulata								
Lumbrineris luti								
Lumbrineris bicirrata								
Paraninoe simpla								
Lumbrineridae								
Sedentariate polychaete								
Leitoscoloplos pugettensis								
Scoloplos sp.								
Aricidea quadrilobata								
Cirrophorus branchiatus								
Levinsenia gracilis								
Cossura sp.								
Sternaspis scutata								
Decamastus gracilis								
Heteromastus sp.								
Capitellidae								
Maldanidae								
Myriochele oculata								
Pectinaria sp.								
Ampharetidae								
Terebellides stroemi								
Trichobranchus glacialis								
Sabellidae								
Indeterminate polychaetes								
MOLLUSCA (total)			0.1	100.0	0.1	25.0		
Aplacophora								
Gastropoda (total)								
Lunatia pallida								

APPENDIX D-1 (Continued)

FOOD ITEMS	*G. macrocephalus* ALICE ARM % wet wt	*G. macrocephalus* ALICE ARM freq occur	*G. macrocephalus* OBSERVATORY I. % wet wt	*G. macrocephalus* OBSERVATORY I. freq occur	*T. chalcogramma* ALICE ARM % wet wt	*T. chalcogramma* ALICE ARM freq occur	*T. chalcogramma* OBSERVATORY I. % wet wt	*T. chalcogramma* OBSERVATORY I. freq occur
Cylichna alba								
Bivalvia (total)								
Yoldia martyria								
Clinocardium ciliatum								
Transennella tantilla					0.1	25.0		
Indeterminate bivalves			0.1	100.0				
ARTHROPODA (total)	90.8	100.0	39.2	100.0	12.1	100.0	76.6	100.0
Copepoda							0.7	50.0
Decapoda							1.4	25.0
Natantia			12.5	100.0			0.6	25.0
Caridea			1.1	100.0	11.79	100.0		
Pasiphaea pacifica							6.0	25.0
Crangonidae			15.8	100.0				
Crangon communis							22.0	25.0
Pandalidae			10.0	100.0				
Pandalopsis dispar	90.8	100.0						
Pandalus borealis							44.9	25.0
Reptantia								
Pagurus spp.								
Majidae								
Campylaspis rufa								
Diastylis sp.								
Eudorella pacifica								
Ampeliscidae								
Eusiridae								
Gammaridae								
Hyperiidae							0.5	25.0
Paraphoxus oculatus								
Indeterminate amphipods					0.3	100.0	0.5	75.0
ECHINODERMATA (total)								
Ophiuroidea								
Holothuroidea								
PISCES (fish otolith)	3.9	100.0						
INDETERMINATE ANIMAL MATTER	5.3	100.0	60.7	100.0	87.9	100.0	23.1	100.0
PLANT MATTER							0.26	25.0
% containing food	100.0		100.0		100.0		100.0	
Index of fullness (0/000)	200		48		23		184	
Individuals examined	1		1		1		4	
Max prey taxa per individual	2		5		2		5	
(Mean) wet weight of food (g)	17.09		2.19		0.82		1.63	

APPENDIX D-2

Stomach contents of Sebastes aleutianus (Rougheye rockfish) and Atheresthes stomias (Turbot) from Alice Arm and Nass River, 1983.

	S. aleutianus NASS RIVER		A. stomias ALICE ARM	
FOOD ITEMS	% wet wt	freq occur	% wet wt	freq occur
PROTOZOA (total)				
Foraminiferida				
CNIDARIA (total)				
Hydroida				
RHYNCHOCOELA (total)				
Nemertea				
ANNELIDA (total)				
Errantiate polychaete				
Phyllodocidae				
Nephtyidae				
Glyceridae				
Goniada annulata				
Lumbrineris luti				
Lumbrineris bicirrata				
Paraninoe simpla				
Lumbrineridae				
Sedentariate polychaete				
Leitoscoloplos pugettensis				
Scoloplos sp.				
Aricidea quadrilobata				
Cirrophorus branchiatus				
Levinsenia gracilis				
Cossura sp.				
Sternaspis scutata				
Decamastus gracilis				
Heteromastus sp.				
Capitellidae				
Maldanidae				
Myriochele oculata				
Pectinaria sp.				
Ampharetidae				
Terebellides stroemi				
Trichobranchus glacialis				
Sabellidae				
Indeterminant polychaetes				
MOLLUSCA (total)				
Aplacophora				
Gastropoda (total)				
Lunatia pallida				

APPENDIX D-2 (Continued)

FOOD ITEMS	*S. aleutianus* NASS RIVER % wet wt	freq occur	*A. stomias* ALICE ARM % wet wt	freq occur
Cylichna alba				
Bivalvia (total)				
Yoldia martyria				
Clinocardium ciliatum				
Transennella tantilla				
Indeterminant bivalves				
ARTHROPODA (total)	69.6	50.0		
Copepoda				
Decapoda				
Natantia	3.0	25.0		
Caridea				
Pasiphaea pacifica				
Crangonidae				
Crangon communis	65.9	25.0		
Pandalidae				
Pandalopsis dispar				
Pandalus borealis				
Reptantia				
Pagurus spp.				
Majidae				
Campylaspis rufa				
Diastylis sp.				
Eudorella pacifica				
Ampeliscidae				
Eusiridae				
Gammaridae				
Hyperiidae				
Paraphoxus oculatus				
Indeterminate amphipods	0.7	50.0		
ECHINODERMATA (total)				
Ophiuroidea				
Holothuroidea				
PISCES				
INDETERMINATE ANIMAL MATTER	30.4	75.0	100.0	100.0
PLANT MATTER				
% containing food	75.0*		100.0	
Index of fullness (0/000)	14		2	
Individuals examined	4		1	
Max prey taxa per individual	2		0	
(Mean) wet weight of food (g)	0.32		0.25	

* Empty stomachs were included in the calculation of percentage frequency occurrence.

APPENDIX D-3

Stomach contents of *Glyptocephalus zachirus* (Rex sole) and *Hippoglossoides elassodon* (Flathead sole) from Observatory Inlet and Nass River, 1983.

	G. zachirus		*H. elassodon*			
	NASS RIVER		OBSERVATORY I.		NASS RIVER	
FOOD ITEMS	% wet wt	freq occur	% wet wt	freq occur	% wet wt	freq occur
PROTOZOA (total)						
Foraminiferida						
CNIDARIA (total)			0.2	25.0		
Hydroida			0.2	25.0		
RHYNCHOCOELA (total)						
Nemertea						
ANNELIDA (total)	33.6	100.0	1.8	25.0		
Errantiate polychaete						
Phyllodocidae						
Nephtyidae						
Glyceridae						
Goniada annulata	18.3	50.0				
Lumbrineris luti						
Lumbrineris bicirrata						
Paraninoe simpla						
Lumbrineridae			0.1	25.0		
Sedentariate polychaete						
Leitoscoloplos pugettensis						
Scoloplos sp.						
Aricidea quadrilobata						
Cirrophorus branchiatus			NEG	25.0		
Levinsenia gracilis						
Cossura sp.						
Sternaspis scutata						
Decamastus gracilis						
Heteromastus sp.						
Capitellidae			0.1	25.0		
Maldanidae						
Myriochele oculata	4.2	100.0	0.1	25.0		
Pectinaria sp.						
Ampharetidae						
Terebellides stroemi						
Trichobranchus glacialis						
Sabellidae						
Indeterminate polychaetes	11.1	50.0	1.5	25.0		
MOLLUSCA (total)						
Aplacophora						
Gastropoda (total)						
Lunatia pallida						

APPENDIX D-3 (Continued)

FOOD ITEMS	G. zachirus NASS RIVER % wet wt	G. zachirus NASS RIVER freq occur	H. elassodon OBSERVATORY I. % wet wt	H. elassodon OBSERVATORY I. freq occur	H. elassodon NASS RIVER % wet wt	H. elassodon NASS RIVER freq occur
Cylichna alba						
Bivalvia (total)						
Yoldia martyria						
Clinocardium ciliatum						
Transennella tantilla						
Indeterminate bivalves						
ARTHROPODA (total)	2.2	50.0	94.5	25.0		
Copepoda						
Decapoda			NEG	25.0		
Natantia						
Caridea						
Pasiphaea pacifica						
Crangonidae						
Crangon communis						
Pandalidae						
Pandalopsis dispar						
Pandalus borealis						
Reptantia						
Pagurus spp.			94.5	25.0		
Majidae						
Campylaspis rufa	0.7	50.0				
Diastylis sp.						
Eudorella pacifica						
Ampeliscidae						
Eusiridae						
Gammaridae	0.8	50.0				
Hyperiidae						
Paraphoxus oculatus	0.7	50.0				
ECHINODERMATA (total)	14.6	50.0				
Ophiuroidea						
Holothuroidea	14.6	50.0				
PISCES						
INDETERMINATE ANIMAL MATTER	49.6	100.0	2.8	100.0	100.0	100.0
PLANT MATTER			0.8	25.0		

	G. zachirus NASS RIVER	H. elassodon OBSERVATORY I.	H. elassodon NASS RIVER
% containing food	100.0	100.0	100.0
Index of fullness (0/000)	21	13	2
Individuals examined	2	4	1
Max prey taxa per individual	7	7	0
(Mean) wet weight of food (g)	0.21	0.46	0.20

APPENDIX D-4

Stomach contents of Microstomus pacificus (Dover sole) and Parophrys vetulus (English sole) from Hastings Arm, Nass River and Observatory Inlet, 1983.

	M. pacificus				P. vetulus	
	HASTINGS ARM		NASS RIVER		OBSERVATORY INLET	
FOOD ITEMS	% wet wt	freq occur	% wet wt	freq occur	% wet wt food	freq occur
PROTOZOA (total)						
Foraminiferida						
CNIDARIA (total)					0.2	25.0
Hydroida					0.2	25.0
RHYNCHOCOELA (total)					1.3	25.0
Nemertea					1.3	25.0
ANNELIDA (total)	27.3	100.0	2.7	100.0	43.2	75.0
Errantiate polychaete						
Phyllodocidae						
Nephtyidae						
Glyceridae						
Goniada annulata						
Lumbrineris luti					1.6	50.0
Lumbrineris bicirrata					22.4	25.0
Paraninoe simpla					0.1	25.0
Lumbrineridae					0.8	25.0
Sedentariate polychaete						
Leitoscoloplos pugettensis					0.4	25.0
Scoloplos sp.					NEG	25.0
Aricidea quadrilobata					0.1	25.0
Cirrophorus branchiatus					1.0	75.0
Levinsenia gracilis						
Cossura sp.						
Sternaspis scutata					2.4	25.0
Decamastus gracilis					0.7	25.0
Heteromastus sp.						
Capitellidae						
Maldanidae						
Myriochele oculata			2.5	100.0	12.2	50.0
Pectinaria sp.						
Ampharetidae						
Terebellides stroemi						
Trichobranchus glacialis					1.0	25.0
Sabellidae	27.3	100.0				
Indeterminate polychaetes			0.2	100.0	0.5	25.0
MOLLUSCA (total)			NEG	100.0	NEG	25.0
Aplacophora						
Gastropoda (total)						
Lunatia pallida						
Cylichna alba						

APPENDIX D-4 (Continued).

FOOD ITEMS	*M. pacificus* HASTINGS ARM % wet wt	freq occur	NASS RIVER % wet wt	freq occur	*P. vetulus* OBSERVATORY INLET % wet wt food	freq occur
Bivalvia (total)						
Yoldia martyria						
Clinocardium ciliatum						
Transennella tantilla						
Indeterminate bivalves			NEG	100.0	NEG	25.0
ARTHROPODA (total)			0.4	100.0	0.2	50.0
Copepoda					0.1	25.0
Decapoda						
Natantia						
Caridea						
Pasiphaea pacifica						
Crangonidae						
Crangon communis						
Pandalidae						
Pandalopsis dispar						
Pandalus borealis						
Reptantia						
Pagurus spp.						
Majidae						
Campylaspis rufa						
Diastylis sp.						
Eudorella pacifica						
Ampeliscidae						
Eusiridae					0.1	25.0
Gammaridae						
Hyperiidae						
Paraphoxus oculatus			0.4	100.0		
ECHINODERMATA (total)			9.5	100.0		
Ophiuroidea			9.5	100.0		
Holothuroidea						
PISCES						
INDETERMINATE ANIMAL MATTER	72.7	100.0	87.3	100.0	34.9	75.0
PLANT MATTER					20.3	75.0
% containing food	100.0		100.0		100.0	
Index of fullness (0/000)	3		14		12	
Individuals examined	1		1		4	
Max prey taxa per individual	1		5		15	
(Mean) wet weight of food (g)	0.10		0.62		0.33	

APPENDIX D-5

Intestine contents of *Hippoglossoides elassodon* (Flathead sole) and *Parophrys vetulus* (English sole) from Observatory Inlet and Nass River, 1983.

FOOD ITEMS	*H. elassodon* OBSERV. INLET % wet wt	*H. elassodon* OBSERV. INLET freq occur	*H. elassodon* NASS RIVER % wet wt	*H. elassodon* NASS RIVER freq occur	*P. vetulus* OBSERVATORY INLET % wet wt food	*P. vetulus* OBSERVATORY INLET freq occur
PROTOZOA (total)	0.1	50.0				
Foraminiferida	0.1	50.0				
CNIDARIA (total)					NEG	50.0
Hydroida					NEG	50.0
RHYNCHOCOELA (total)						
Nemertea						
ANNELIDA (total)	NEG	50.0			21.2	75.0
Errantiate polychaete						
Phyllodocidae					NEG	25.0
Nephtyidae					0.2	25.0
Glyceridae					NEG	25.0
Goniada annulata						
Lumbrineris luti					NEG	25.0
Lumbrineris bicirrata					0.4	25.0
Paraninoe simpla						
Lumbrineridae						
Sedentariate polychaete						
Leitoscoloplos pugettensis					0.4	75.0
Scoloplos sp.						
Aricidea quadrilobata						
Cirrophorus branchiatus					0.1	75.0
Levinsenia gracilis					NEG	25.0
Cossura sp.					NEG	25.0
Sternaspis scutata					3.6	75.0
Decamastus gracilis					0.1	50.0
Heteromastus sp.					NEG	25.0
Capitellidae					0.2	50.0
Maldanidae					0.2	25.0
Myriochele oculata	NEG	50.0			9.0	75.0
Pectinaria sp.					0.1	25.0
Ampharetidae					0.6	25.0
Terebellides stroemi					0.4	50.0
Trichobranchus glacialis					0.9	50.0
Sabellidae					NEG	25.0
Indeterminate polychaetes					5.0	75.0
MOLLUSCA (total)	78.7	50.0			1.0	75.0
Aplacophora					0.4	75.0
Gastropoda (total)	34.7	25.0				
Lunatia pallida	34.7	25.0				
Cylichna alba					0.3	25.0

APPENDIX D-5 (Continued)

FOOD ITEMS	H. elassodon OBSERV. INLET % wet wt	freq occur	H. elassodon NASS RIVER % wet wt	freq occur	P. vetulus OBSERVATORY INLET % wet wt	freq occur
Bivalvia (total)	44.0	25.0				
Yoldia martyria	32.3	25.0				
Clinocardium ciliatum	11.7	25.0				
Transennella tantilla					NEG	25.0
Indeterminate bivalves					0.3	75.0
ARTHROPODA (total)	6.1	75.0			0.2	50.0
Copepoda						
Decapoda						
Natantia	0.4	25.0				
Caridea						
Pasiphaea pacifica						
Crangonidae						
Crangon communis						
Pandalidae						
Pandalopsis dispar						
Pandalus borealis	2.5	25.0				
Reptantia						
Pagurus spp.	2.9	25.0				
Majidae	0.2	25.0				
Campylaspis rufa					NEG	25.0
Diastylis sp.						
Eudorella pacifica						
Ampeliscidae						
Eusiridae						
Gammaridae						
Hyperiidae						
Paraphoxus oculatus					NEG	25.0
Indeterminate amphipods					0.2	25.0
ECHINODERMATA (total)			81.8	100.0		
Ophiuroidea			81.8	100.0		
Holothuroidea						
PISCES	NEG	100.0			NEG	50.0
INDETERMINATE ANIMAL MATTER	15.1	100.0	18.2	100.0	71.8	100.0
PLANT MATTER					5.8	75.0
% containing food	100.0		100.0		100.0	
Individuals examined	4		1		4	
Max prey taxa per individual	5		1		20	
(Mean) wet weight of food (g)	3.0		22.0		1.20	

APPENDIX E-1

Summary of data collected on Golden king crabs taken in pots from Alice Arm and Hastings Arm, November, 1983.

LOCATION	DATE	NO.	CARAPACE LENGTH (CL) (mm)	CARAPACE WIDTH (CW) (mm)	WHOLE WET WEIGHT (g)	WITH PARASITE	SEX MALE	SEX FEMALE	FEMALE WITH EGGS	FEMALE WITH MS*	POT DEPTH (m)	POT SOAK TIME (h)
POTS												
AA 013	28 Oct	6	141	147	1,450	–	0	1		1	329	23.3
AA 013	28 Oct	7	139	145	1,650	–	1	0			329	23.3
AA 013	28 Oct	8	141	147	1,850	–	1	0			329	23.3
AA 013	28 Oct	9	134	139	1,200	–	0	1			329	23.3
AA 013	28 Oct	10	131	135	1,300	–	0	1		1	329	23.3
AA 013	28 Oct	11	126	130	1,200	–	1	0			329	23.3
AA 031	29 Oct	12	131	135	1,350	–	0	1		1	388	42.8
AA 031	29 Oct	13	150	158	2,550	–	1	0			388	42.8
AA 031	29 Oct	14	144	150	2,050	–	1	0			388	42.8
AA 033	29 Oct	15	140	145	1,500	–	0	1		1	388	43.3
AA 033	29 Oct	16	135	140	1,400	–	0	1		1	388	43.3
AA 033	29 Oct	17	142	148	1,400	–	0	1		1	388	43.3
TOTAL INDIVIDUALS		14					7	7	6			
PERCENTAGES						0	50	50	85.7			
MEAN CARAPACE LENGTH			138.3				140.3	136.3				
HA 053	31 Oct	18	137	142	1,350	–	0	1	1		238	23.9
HA 054	31 Oct	19	161	170	3,150	–	1	0			245	24.0
HA 055	31 Oct	20	173	184	2,800	–	1	0			360	24.7
HA 062	31 Oct	21	152	160	2,200	–	1	0			274	25.6
HA 066	31 Oct	22	121	124	1,050	–	0	1	1		305	26.3
HA 066	31 Oct	23	120	124	1,050	–	0	1	1		305	26.3
HA 069	01 Nov	24	107	104	750	1	0	1			313	41.9
HA 069	01 Nov	25	120	123	950	1	1	0			313	41.9
HA 070	01 Nov	26	147	137	1,750	1	1	0			302	42.2
HA 070	01 Nov	27	140	134	1,450	1	0	1			302	42.2
HA 070	01 Nov	28	113	110	800	1	0	1			302	42.2
HA 071	01 Nov	29	123	123	1,150	1	1	0			256	42.3
TOTAL INDIVIDUALS		15				7	8	7	3			
PERCENTAGES						46.7	53.3	46.7	50.0			
MEAN CARAPACE LENGTH			130.8				138.8	121.7				

*WITH MS = crabs with matted pleopodal setae

APPENDIX E-2

Stomach contents of twenty-four Lithodes aequispina (Golden king crabs) collected by pot from Alice Arm and Hastings Arm, November, 1983.

FOOD ITEMS	ALICE ARM pot Set % wet wt	ALICE ARM pot Set freq occur	HASTINGS ARM Pot Set % wet wt	HASTINGS ARM Pot Set freq occur
PROTOZOA (total)				
Foraminiferida				
CNIDARIA (total)	0.3	8.3		
Hydroida	0.3	8.3		
ANNELIDA (total)	NEG	8.3		
Nephtyidae				
Lumbrineridae	NEG	8.3		
Myriochele oculata				
Indeterminate polychaete				
MOLLUSCA (total)	0.3	33.3		
Gastropoda (total)	0.3	25.0		
Lunatia pallida	0.3	25.0		
Indeterminate gastropods	NEG			
Bivalvia (total)	NEG	8.3		
Nucula sp.				
Transennella tantilla				
Pandora sp.				
Indeterminate bivalves	NEG	8.3		
ARTHROPODA (total)	94.7	83.3	63.6	91.6
Natantia				
Crangonidae				
Reptantia	1.3	16.6		
Indeterminate reptants				
Calliopiidae	0.1	8.3	0.1	16.6
Koroga megalops	1.5	41.7	3.6	33.3
Indeterminate amphipods	92.0	75.0	59.9	75.0
ECHINODERMATA (total)	2.1	41.7	7.9	41.7
Ophiuroidea	2.1	41.7	7.7	33.0
Echinoidea				
EGG CASE	0.2	8.3	0.2	16.6
PISCES	0.6	33.3		
INDETERMINATE ANIMAL MATTER	1.1	33.3	27.0	58.3
PLANT MATTER	0.7	58.3	1.2	66.7
% containing food	100.0		100.0	
Index of fullness (0/000)	11		8	
Individuals examined	12		12	

DUE DATE

94/7/11			
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