ENVIRONMENTAL PROTECTION SERVICE
ENVIRONMENT CANADA
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ENVIRONMENTAL STUDIES IN ALICE ARM AND HASTINGS ARM, BRITISH COLUMBIA

PART III: INITIAL PRODUCTION PERIOD - AMAX/KITSAULT MINE - SEDIMENT AND TISSUE TRACE METALS, MAY-JUNE AND OCTOBER 1981

REGIONAL PROGRAM REPORT 82 - 14

by

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ABSTRACT

A series of studies has been undertaken in Alice Arm by the Environmental Protection Service from 1976 to the present. Studies involve sediment and tissue sampling for trace metals, transmissometer measurements and water column chemistry on the suspended particulate and bottom trawls and submersible observations for bottom conditions, turbidity and species distribution. Relative to the Amax/Kitsault mine, studies have been divided into baseline and initial production period and are being presented in a five part report series. The present report, Part III, contains data on sediment and tissue trace metals collected after start-up of the Amax/Kitsault mine in April 1981. Additional sampling was carried out in May-June and October 1981 to further define the horizontal and vertical trace metal distribution in the marine sediments and to observe any early changes in tissue metal levels in selected species during the initial production period. Comparisons have been drawn with baseline data collected prior to mine start-up.

Sediment core profiles taken in October 1981 confirm the general increase in sediment trace metal content observed in 1978 from previous mining activity in Alice Arm and the copper smelter at Anyox. Surface sediment concentrations in upper Alice Arm, around the Kitsault mine outfall, are rapidly returning to levels observed in the underlying deposits from the previous B.C. Molybdenum mine. Despite the general mineralization in the surrounding river basins levels of most trace metals in the natural sediments do not appear to differ significantly from normal background levels.

Short term duration tests were conducted on a sample of Kitsault mine tailings to determine metal leachability. Results demonstrated no leaching of metals under normal conditions in seawater, however, preliminary indications of a potential for leaching in a mild acid medium were observed. Similar pH ranges occur in animal digestive system.

Although the potential for bioaccumulation of metals upon exposure to the Kitsault mine tailings is unknown, most tissue metal levels in Alice Arm had not changed significantly during the period of the study. Tests however, were conducted within a relatively short period after mine start-up. An exception was the bivalve Yoldia thraciaeformis in which the whole body tissues showed a pronounced increase in copper lead, zinc and cadmium. In some cases tissue concentrations exceeded maximum levels found in surrounding sediment strongly suggesting bioaccumulation rather than sample contamination.

RÊSUMÊ

Depuis 1976, le Service de la protection de l'environnement a procédé à une série d'études sur le bras Alice. ces études ont consisté en la détection de métaux à l'état de traces dan des échantillons de sédiments et de tissue, en mesures à l'aide du transmissiomètre, en l'étude des propriétés chimiques des particules en suspension dans la colonne d'eau, en prélèvements à l'aide du chalut de fond, en l'observation, à l'aide d'un submersible, de la vie dans les profondeurs, de la turbidité et de la répartition des espèces. Afin de mieu analyser les effets de la mine Amax/Kitsault sur l'environnement, on a étalé ces études sur deux périodes, une période de référence et une période correspondant à la production initiale. On a en outre divisé le rapport en cinqu partie séparées. Le présent rapport intitulé partie III contient les données portant sur les métaux à l'état de traces relevés dans les sédiments at les tissus dans le bras Alice après la mise en exploitation de la mine Amax/Kitsault en avril 1981. En mai-juin et octobre 1981 on a prélevé une autre série d'échantillons, afin de mieux déterminer la répartition horizontale et verticale des métaux à l'état de traces dans les désiments marins et de détecter toute modification initiale dans la concentration en métaux à l'état de tracas relevée durant la période initiale de production dans les tissus d'espèces sélectionnées. On a ainsi pu comparer les résultats avec les données de base recueillies avant la mise en exploitation de la mine.

Les profils fournis par l'étude des carottes de sédiments prélevées en octobre 1981 confirment l,augmentation générale du degré de concentration des métaux à l'état de traces observé en 1978 et résultant de l'exploitation de la mine dans le bras Alice et de la fonderie de cuivre d'Anyox. La concentration des métaux dans les sédiments de surface prélevés dans la partie supérieure du bras Alice, autour de l'exutoire de la mine Kitsault, se rapproche rapidment des niveaux observés dans les dépôts plus prfonds remontant à l'époque de l'exploitation de la mine B.C. Molybdenum. En dépit de la minéralisation généralisée des bassins hydrographiques environnants, les niveaux de concentration de la plupart

des métaux à l'état de traces relevés dans les sédiments naturels ne semblent pas être sensiblement plus élevés due les niveaux relevés dans des condition normales.

On a procédé à des tests de courte durée sur un échantillon de résidus provenant de la mine Kitsault afin de déterminer le taux de lixiviation des métaux. Les résultats ont montré que ce taux était nul dans l'eau de mer, dans les conditions normales, mais certaines indications laissent prévoir une possible lixiviation dans un milieu modérément acide. On relève un intervalle de pH similaire dans l'appareil digestif des animaux. Bien que l'on ne sache pas s'il y a bioaccumulation des métaux sous l'effet des résidus de la mine Kitsault, la plupart des degrés de concentration des métaux relevés dans les tissus prélevés dans le bras Alice n'on pas montré de changement notable durant la durée de l'étude. Il faut noter, cependant, que les tests auxquels on a procédé aprés la mise en exploitation de la mine n'ont duré qu'un temps relativement bref. La seule exception a été le mollusque bivalve Yoldia thraciaeformis dont tous les tissus ont montré une nette augmentation du degré de concentration du cuivre, du plomb, du zinc et du cadmium. Dans certains cas, le degré de concentration a dépassé les niveaux maximum relevés dans les sédiments environnants, ce qui permet de conclure à une bioaccumulation plutôt qu'à une contamination de l'échantillon.

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SUMMARY

1. Core samples taken from upper Alice Arm near the Kitsault mine showed two main peaks in copper (Cu), lead (Pb), zinc (Zn) cadmium (Cd) and molybdenum (Mo) concentrations. The upper peak occurred between 0 and 30 cm representing fresh deposits from the Kitsault mine. The lower peak between 30 and 40 cm represents tailings deposits from the previous B.C. Molybdenum mine which had been covered by natural sediment deposits since closure in 1972.

2. Below approximately 40-50 cm sediment concentrations approached natural background levels. The relatively low concentrations in the top 10-12 cm and lower portion of core sample taken off the Kitsault River estuary indicated no significant natural trace metal input from the head of Alice Arm.

3. Natural sediment concentrations do not appear to be appreciably affected by mineralization in the area. Natural background concentrations for Cu, Pb, Zn, Cd, arsenic (As) and Mo were 40-55 mg/kg, 11-25 mg/kg, 90-150 mg/kg, less than 0.6 mg/kg, 12-31 mg/kg and less than 2.5 mg/kg, respectively.

4. Maximum concentrations found in a surface grabs taken near centre channel off the Kitsault mine (Station M-9) for Cu, Pb, Zn, Cd, As and Mo by comparison were 90.4 mg/kg, 217 mg/kg, 683 mg/kg, 19.6 mg/kg, 33.0 mg/kg and 209 mg/kg, respectively.

5. Seven months after start-up of the Kitsault mine, tissue trace metal concentration in most species sampled had not changed significantly from data collected prior to start-up. One exception was the bivalve, *Yoldia thraciaeformis* from Alice Arm which did exhibit a pronounced increase over previous levels for Cu, Pb, Zn and Cd. In some cases tissue concentrations were well above those observed in the surrounding surface sediment strongly suggesting metal bioaccumulation.

1. INTRODUCTION

Amax of Canada Ltd., which owns and operates the Kitsault mine began commissioning the mill in April 1981. Previously the site had been operated by B.C. Molybdenum from 1967 to 1972. In preparation for the re-opening of the Kitsault mine the Environmental Protection Service (EPS) had carried out a series of studies to obtain baseline information prior to start up and to assess the effects from the previous B.C. Molybdenum operation and a nearby abandoned copper smelter at Anyox. These studies were undertaken 1) between 1976 and 1980; 2) immediately following start-up, in April 1981, and 3) continued periodically throughout the initial production period to assess compliance with federal regulations established for the Kitsault mine (Alice Arm Tailings Deposit Regulations, AATDR) and to monitor trace metal levels in the marine biota. Studies included analysis of tissue and sediment for trace metals, water column measurements for turbidity and suspended particulate characteristics, bottom trawls for species relative abundance and submersible observations, with the Pisces IV, for bottom and conditions, turbidity and species distribution.

Because of the distinct nature of various segments of the study and the volume of information available, data are being presented in five separate parts, divided into the baseline period or that prior to start up of the Kitsault mine and the initial production period. Monitoring programs are continuing and additional reports will be prepared as data becomes available. The report series has been structured as follows:

<u>ENVIRONMENTAL STUDIES IN ALICE ARM AND HASTINGS ARM, BRITISH COLUMBIA</u>

Part I - <u>Baseline Studies, Amax/Kitsault Mine - Sediment and Tissue Trace Metals from Two Abandoned Mine Sites - B.C. Molybdenum and Anyox</u>. This report contains all sediment and tissue trace metal data collected in Alice Arm, prior to start-up of the Kitsault mine. Samples were also obtained from several control sites along the outer B.C. coast, and data from the copper smelter site at Anyox in Hastings Arm.

Part II - Baseline Studies, Amax/Kitsault Mine - Transmissometry and Water Chemistry
This report contains transmissometer measurements (turbidity), along with results of total suspended particulate analysis for organic, inorganic and trace metal concentrations of the natural suspended particulate in May and October 1980. Previously reported transmissometer data from June 1977 (Sullivan and Brothers, 1979) are also provided.

Part III - Initial Production Period, Amax/Kitsault Mine - Sediment and Tissue Trace Metals - 1981. This report contains sediment and tissue trace metal data from samples collected in May-June and October 1981, after start-up of the Amax/Kitsault mine.

Part IV - Initial Production Period, Amax/Kitsault Mine - Transmissometry and Water Chemistry - 1981 and 1982. This report contains transmissometer measurements, along with results of total suspended particulate analysis for organic, inorganic and trace metal concentrations in samples collected from Alice Arm in 1981 and 1982.

Part V - Baseline and Initial Production Period, Amax/Kitsault - Submersible Observations and Otter Trawls - 1980-1982. This report contains data on species abundance and distribution from 1980-1981 otter trawl surveys; along with observations of species distribution, bottom conditions and the tailings turbidity field taken from the submersible Pisces IV in July 1982. Reference is also made to submersible observations and otter trawl results, previously reported by Sullivan and Brothers (1979).

The present report (Part III) contains all sediment and tissue trace metal data collected during the initial production period, specifically in May-June and October 1981. Although certain comparisons with the baseline data collected prior to start-up have been made, the reader is advised to refer to Part I (Goyette and Christie, 1982) for specific details.

1.1 Study Area (taken from Part I)

The study area is located on the northern British Columbia coast approximately 144 km (90 miles) north of the city of Prince Rupert, B.C. (Figure 1). Alice Arm, site of the new Kitsault mine, is a glacially fed inlet about 18.5 km (10 nautical miles) in length and 1.4 km (0.8 nautical miles) in width, which along with Hastings Arm, forms a terminal branch of Observatory Inlet. Alice Arm is separated from Observatory Inlet by a complex of shallow sills near the entrance. The inner sill depth is approximately 42 metres (Figure 2). The maximum depth within Alice Arm is about 380 metres (1200 ft). Two main rivers, the Kitsualt, the more dominant and glacial river, and the Illiance, flow into the head of Alice Arm (Figure 2). Two smaller creeks, Roundy Creek and Lime Creek, enter Alice Arm near the Kitsault townsite. The latter drains the mine operating area (Figure 2). Littlepage (1978) estimates the total annual discharge into Alice Arm to be $1.6 \times 10^9 m^3$ (1.3 million acre-feet).

Hastings Arm is slightly longer (22.2 km or 12 nautical miles) and shallower (max. 307 m) than Alice Arm and within certain limits, can serve as a control inlet. Anyox, site of the abandoned copper smelter, is situated at the mouth of Hastings Arm in Granby Bay, near the junction with Alice Arm (Figure 1).

1.2 Previous Mining Operations

Over the years, the area around Alice Arm has been the site of numerous mining ventures. Littlepage (1978), reports that between 1911 and 1972 nine regional mines produced some 388,000 tons of copper, lead, molybdenum, gold and silver. The most recent mining venture has been the B.C. Molybdenum mine (1967 to 1972). The production rate averaged

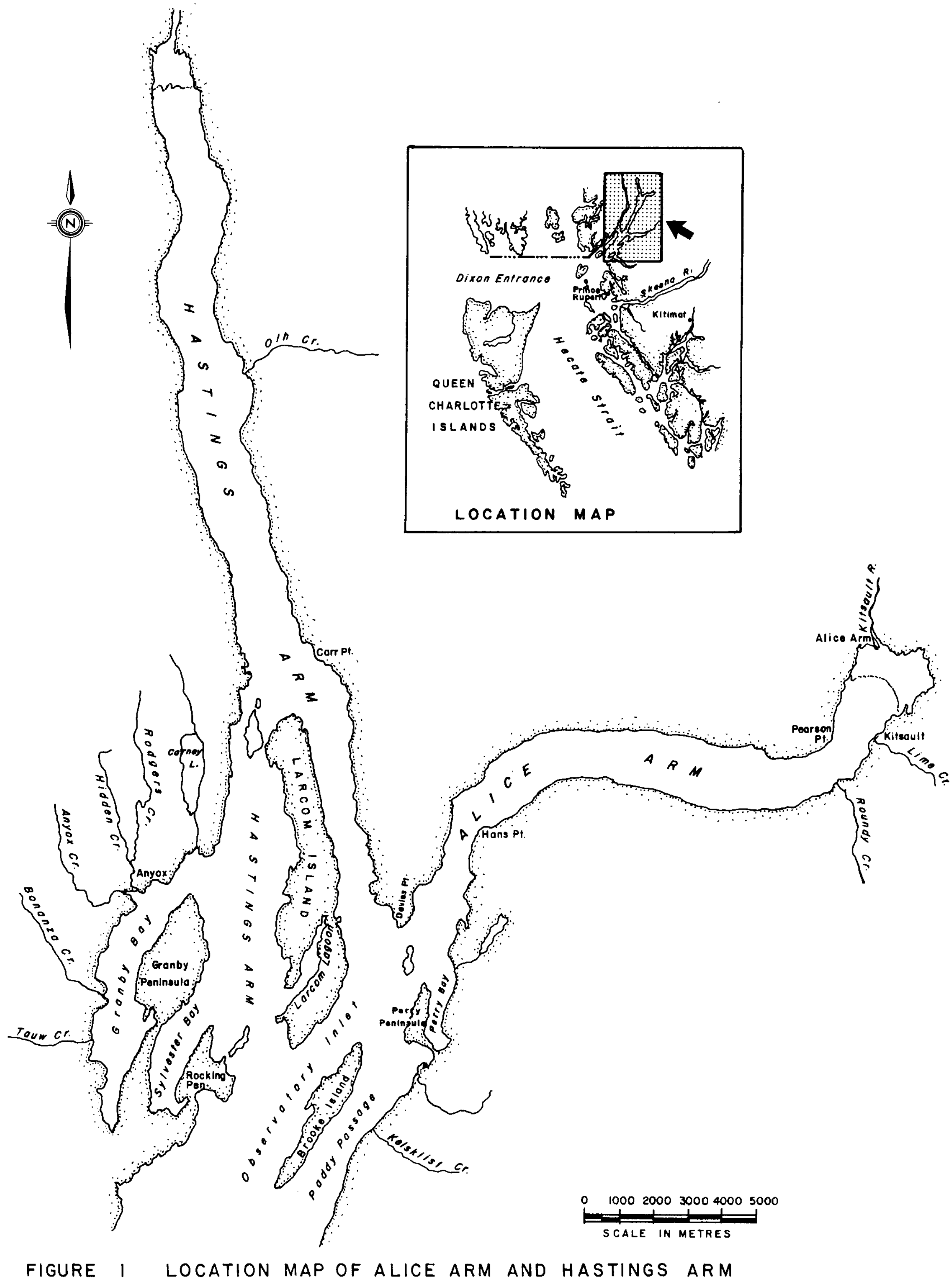

FIGURE 1 LOCATION MAP OF ALICE ARM AND HASTINGS ARM

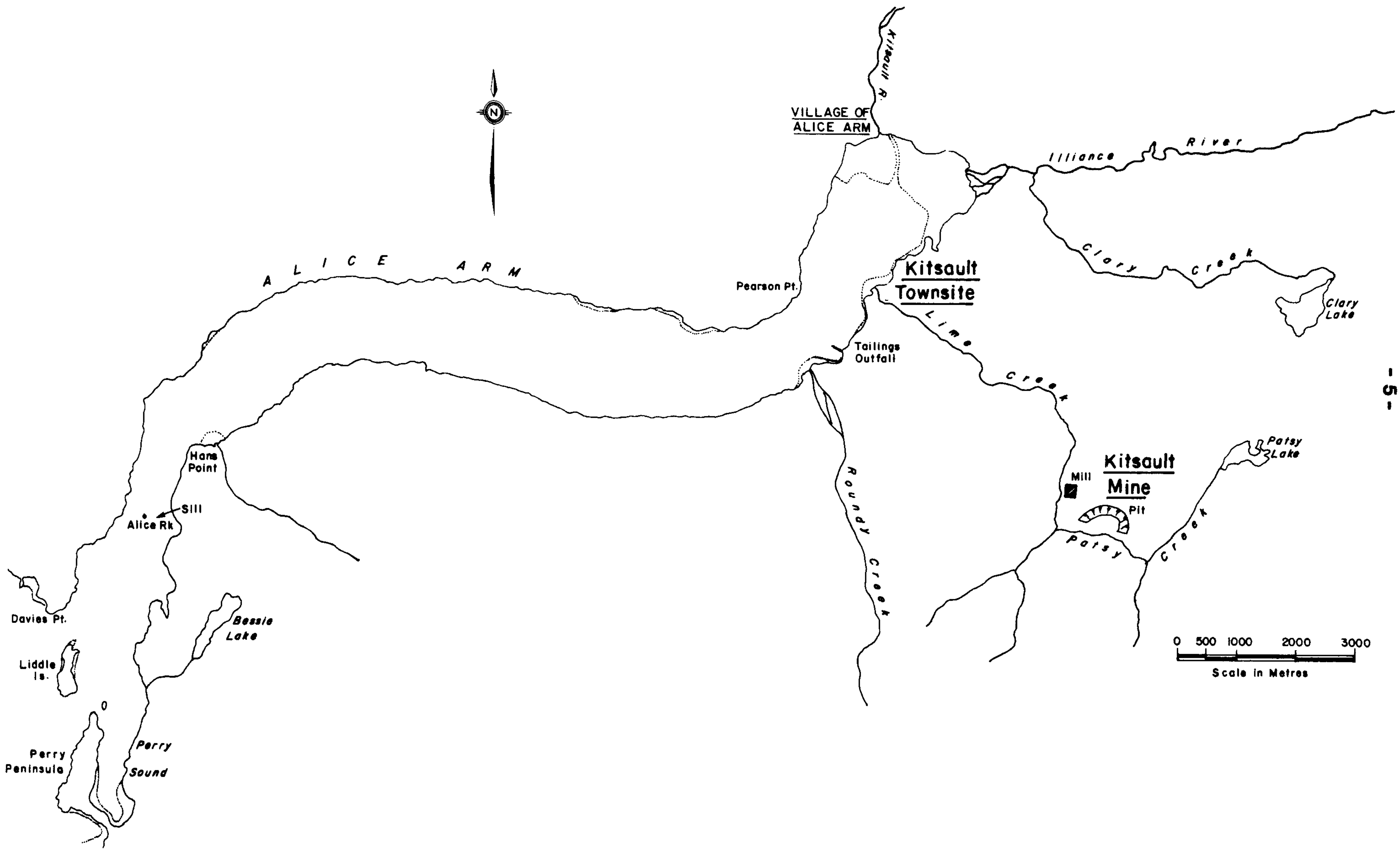

FIGURE 2 LOCATION MAP — ALICE ARM AND KITSAULT MINE DRAINAGE AREA

about 6,000 tons of ore per day, the bulk of which was discarded as tailings. Tailings from the mill, which was located some 5 kilometres inland, were discharged directly into Lime Creek (Figure 2) which flows into Alice Arm. Assuming a continuous operation of 330 days per year, this would represent a total of about 12 million tons discharged into Alice Arm during the six year life of the mine.

Anyox operated between 1914 and 1936 by Granby Consolidated Mining and Smelting Company. Martin (1933) reports that between 1924 and 1930, the daily tonnage through the concentrator ranged from 1,000 to 5,000 tons. The slag from the smelter was deposited on the shoreline of Granby Bay, portions of which still extend below low water. The slag pile occupies about 51 acres and represents several million tons. The tailings appear to have been impounded inland in a small tailings pond located behind the smelter adjacent to Hidden Creek.

Unlike B.C. Molybdenum (B.C. Res. Council, 1975), the ore body at Anyox appears to be readily susceptible to chemical and bacteriological oxidation. The British Columbia Research Council (1973) conducted studies to determine the feasibility of copper recovery through in situ leaching. Low pH (2.2 - 2.6), and relatively high iron (134 - 4770 mg/l), copper (2.6 - 294 mg/l), and zinc (2.9 - 73 mg/l) levels were found in Hidden Creek which drains the mine area and flows into Granby Bay (Figure 1). This factor is important when interpreting trace metal concentrations in tissue samples from the Anyox area.

Several smaller mines, notably the Torbrit, Dolly Varden and Esperanza mines, operated in the Alice Arm area between 1911 and 1959 (Littlepage, 1978). Apart from construction of the Kitsault mine and a brief helicopter logging operation, there has been no major industrial activity in the area since 1972 when B.C. Molybdenum ceased operation.

1.3 Kitsault Mine (Amax of Canada Ltd.)

The B.C. Molybdenum property was acquired by Amax of Canada Ltd. (formerly Climax Molybdenum Corporation) and production was resumed in April 1981. The designed production rate has been increased to about 12,000 tons of ore per day, twice that of the previous operation. It has been estimated that approximately 100 million tons will be processed over the 26 year life of the mine. The majority of the tonnage will be discharged directly into Alice Arm as tailings. However, steps are being taken to reduce cadmiun, lead and zinc which may lower the volume slightly.

In contrast to the previous operation, tailings from the Kitsualt mine are being piped to the foreshore of Alice Arm, where they are mixed with seawater and discharged near shore at a depth of 50 metres. The submerged outfall is located between Lime Creek and Roundy Creek (Figure 2), generally referred to as Rocky Point.

The tailings effluent from the Kitsault mine comes under special Federal regulations (AATDR) which were promulgated in April, 1979. These regulations set certain conditions on the effluent characteristics, behavior and deposition of the tailings once discharged into Alice Arm. (Appendix 13).

2. MATERIALS AND METHODS

In 1981 a sampling grid system for sediment and water was devised for Alice Arm (Figure 3). This was to permit greater coverage of the arm and better communication with the ship's bridge on sampling locations through alpha-numeric coordinates. However, separate figures for sediment sampling stations are also given in the report for ease in reference to specific sampling locations. Otter trawl stations are similar to those used in 1977 to 1980. All surveys in 1981 were carried out aboard the survey vessel CSS Vector.

2.1 Sediment Cores

During the October 1981 survey core samples were taken along the central axis of Alice Arm, the approaches to Anyox and two stations in Hastings Arm (Figure 4-A and 4-B). Coordinates and depths are given in Appendix 1. Cores were collected using a Benthos corer equipped with a 60 kg weight, plastic core tube and catcher. The corer was allowed to free fall at approximately 10-15 metres from the bottom by releasing the ship's winch. Cores were extracted from the core tube by inserting a wooden plunger from the top end. Subsamples were taken at intervals of 0-2, 4-6, 10-12, 14-16, 20-22 centimetres and 10 cm thereafter to a maximum of 1.3 metres. Surface grabs were also taken at selected stations using a stainless steel Smith-MacIntyre grab. The top few centimetres from the centre of the grab were retained for analysis. Samples were frozen on board in whirlpac bags. Samples were later analyzed, unsieved, at the West Vancouver Laboratory of the Department of Environment and Fisheries and Oceans using an Inductively-Coupled Argon Plasma Optical Emmission Spectrometer (ICAP) as described by Swingle and Davidson (1979). Fine definition for lead and cadmium analysis was determined using the Jarrell Ash 850AAS with a FLA 100 graphite tube furnace. Standard Reference Materials BCSS-1 and MESS-1 for marine sediment and NBS-1645 for River Sediment were analysed in the same manner (Appendix 2).

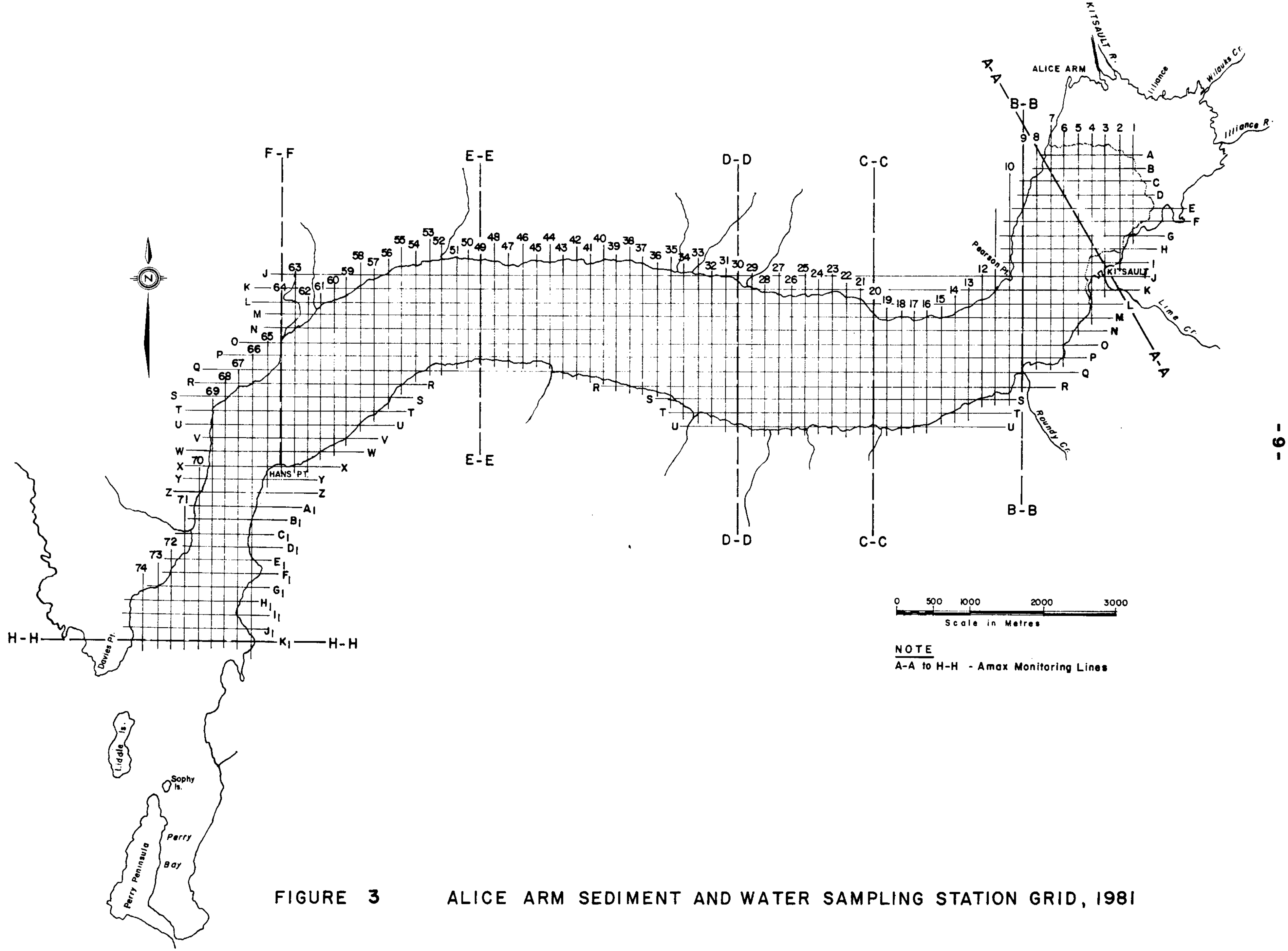

FIGURE 3 ALICE ARM SEDIMENT AND WATER SAMPLING STATION GRID, 1981

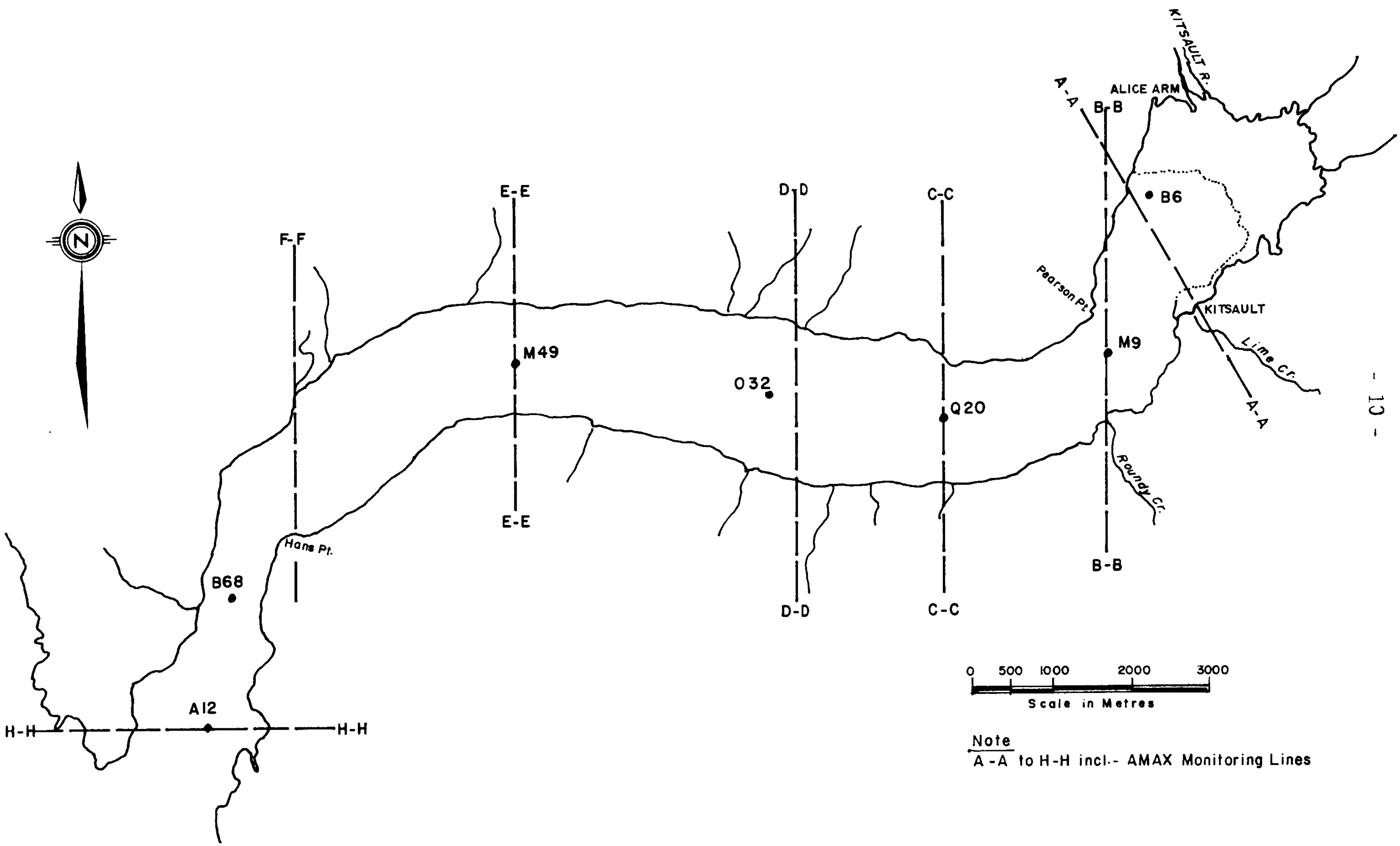

FIGURE 4A SEDIMENT CORE STATIONS - ALICE ARM - October 1981

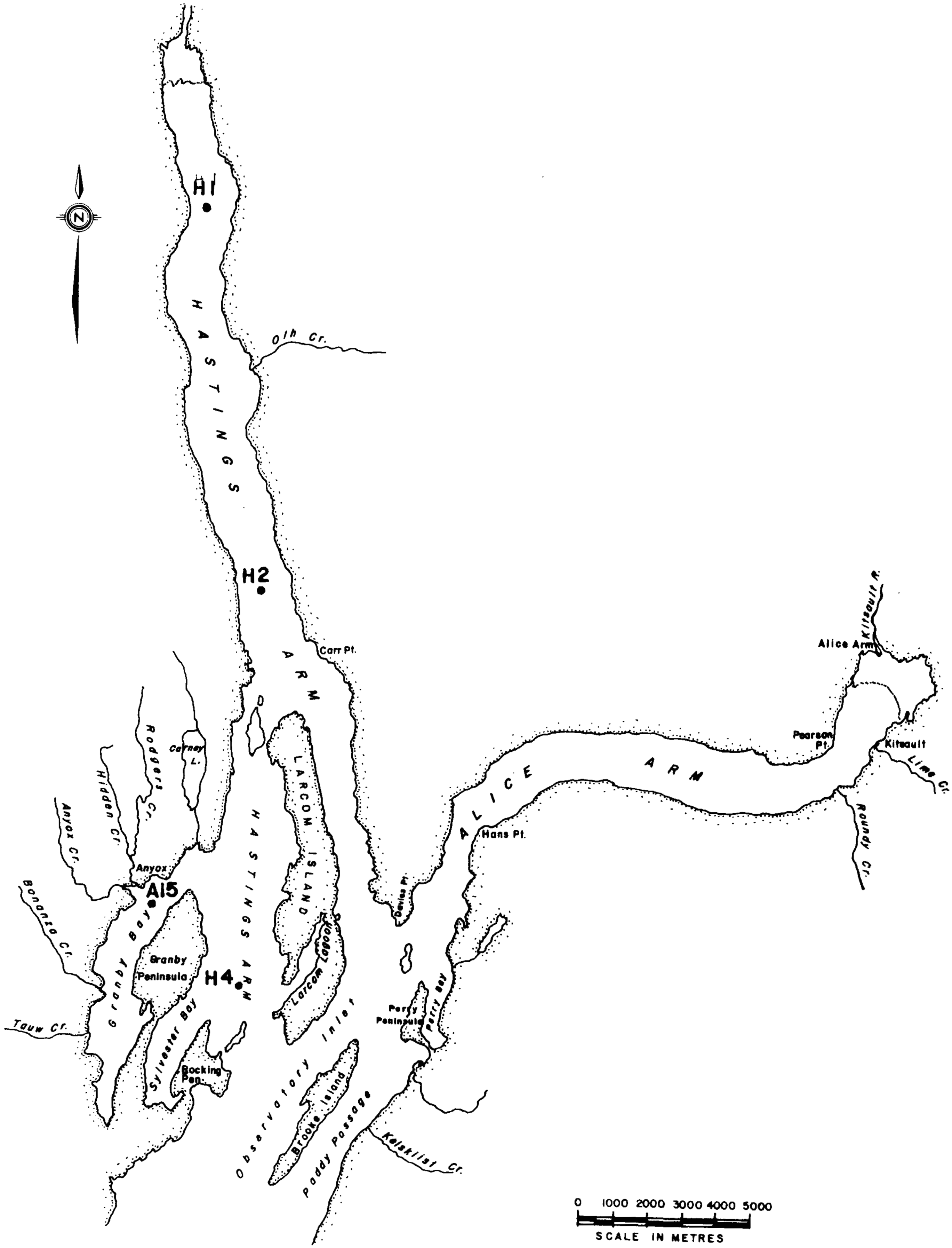

FIGURE 4B SEDIMENT CORE STATIONS - HASTINGS ARM - Oct. 1981

In August 1981, Dobrocky Seatech Ltd. provided 53 dried and sieved sediment samples collected from Alice Arm during their regular monitoring program to EPS for interlaboratory comparison of trace metal analysis. Results of comparative analysis are given in Appendix 3. For arsenic determinations by EPS, sediment samples were treated with an aqua regia acid leach following by automated hydride generation with ICAP detection of the hydride.

2.2 Tissue Samples

2.2.1 Trawl Samples

Tissue samples were collected using a small otter trawl which consisted of a 3.8 cm mesh net with a 5.8 metre throat. Station locations for the May-June and October 1981 surveys are shown in Figure 5. Station coordinates and depths are given in Appendix 4. Station A-1 near the head of Alice Arm had to be moved approximately 1.0 km seaward of its 1977-1980 location due to groundlines and current meter array placed off Pearson Point by Amax. This was not expected to effect comparison with tissue data from previous surveys. Trawls were towed along center channel with a 3:1 scope for a distance of 0.8 km, generally, near the head, middle and entrance of both Alice Arm and Hastings Arm. In June 1981 an additional trawl was conducted in Sylvester Bay (H-5, figure 5) and Somerville Island [54°42.48'N 130°16.19'W to 54°42.26'N 130°17.74'W(50 m)], which is located at the entrance to Portland Inlet. These two sites were not sampled in the 1976-1980 surveys.

Species collected for analysis were generally, pandalid shrimp (*Pandalus borealis*, *P. hypsinotus* and *Pandalopsis dispar*); crangon Shrimp (*Crangon communis*); Brown and Alaska King crab (*Lithodes aequispina*, *Paralithodes camtschiatica*), Tanner crab (*Chionoecetes bairdi*), bivalve (*Yoldia thraciaeformis*), Walleye pollock (*Theragra chalcogramma*) and all species of flatfish present in the catch.

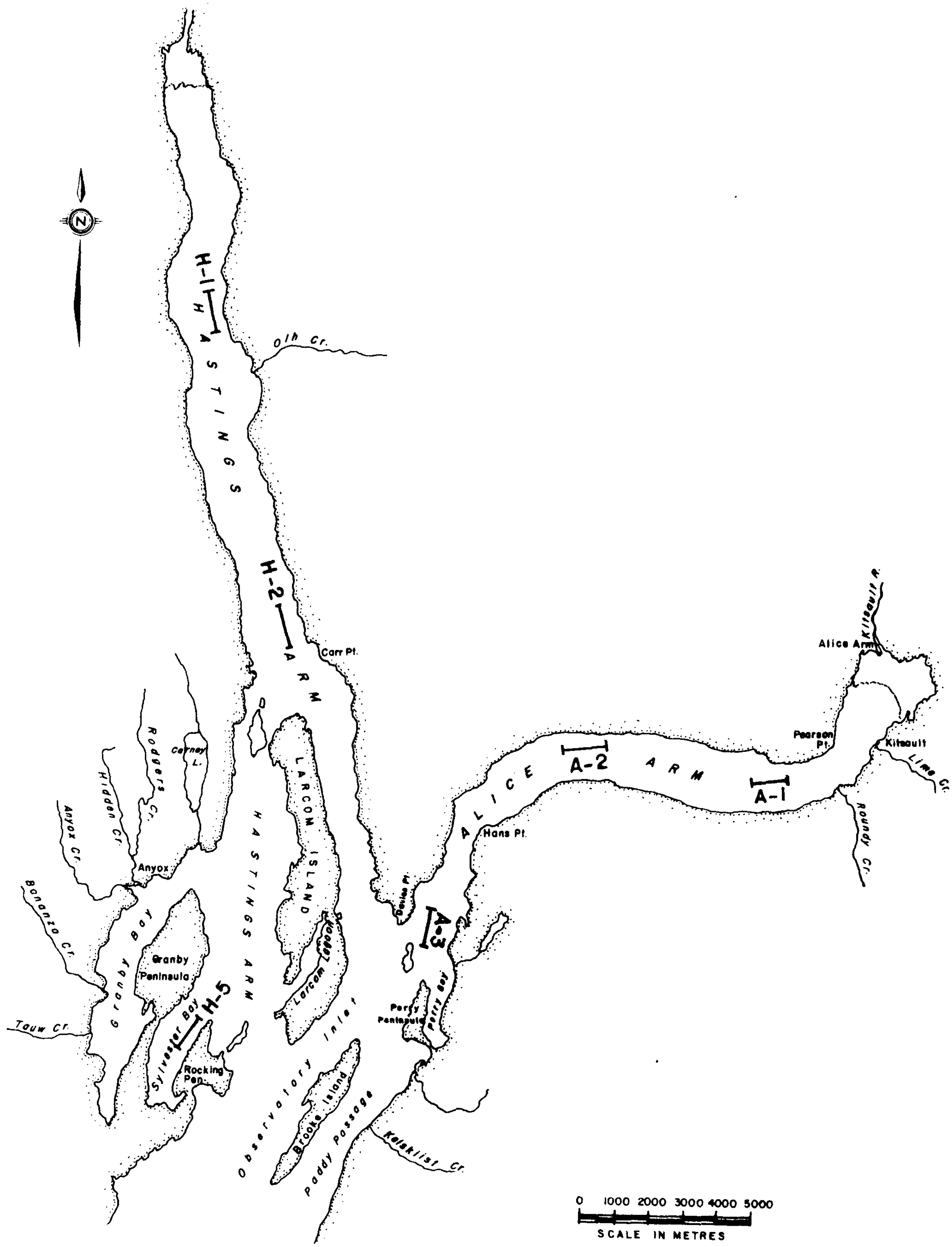

FIGURE 5 OTTER TRAWL STATIONS - ALICE ARM AND HASTINGS ARM - May-June, 1981 and October 1981

Pandalid shrimp were beheaded and tail section frozen in whirlpac bags; crangon shrimp were frozen whole, and for crab, only the legs and claws were retained. Yoldia spp. were frozen whole, in the shell, following purging for 24 hours in seawater taken from outside Alice Arm to remove trace metal bearing sediment and food from the stomach. On occasion, other invertebrate species, eg. Macoma, Colus, Molpadia, were collected. Fish tissue consisted of muscle filets with skin removed. Samples were frozen individually in whirlpac bags.

2.2.2 Intertidal Samples A limited number of mussel (Mytilus edulis) samples were collected during the May-June 1981 survey. Sampling stations are shown in Figure 6a, coordinates in Appendix 5. Sample sites occupied during baseline studies from 1977 to 1980 are shown in Figure 6b. Mussels were frozen whole in the shell following purging for 24 hours in seawater taken from outside Alice Arm. Additional samples were taken in October 1981 but lost due to freezer malfunction at the West Vancouver laboratory.

2.2.3 Analytical Procedures

Prior to 1981, most of the shrimp and bivalve samples were analysed in composites of 10 to 20 individuals. In 1981 attempts were made to analyze the individuals separately. Occasionally, eg. Yoldia sp., insufficient tissue required using more than one animal. The numbers used in the composite samples were kept to a minimum, generally 2 or 3 individuals.

Tissue trace metal analyses were carried out at the West Vancouver Laboratory according to procedures outlined by Swingle and Davidson (1979) which were basically as follows: tissue samples were thawed, blended, freeze-dried and oxidized in a low temperature asher. The ash containing the metallic salts was then dissolved in warm

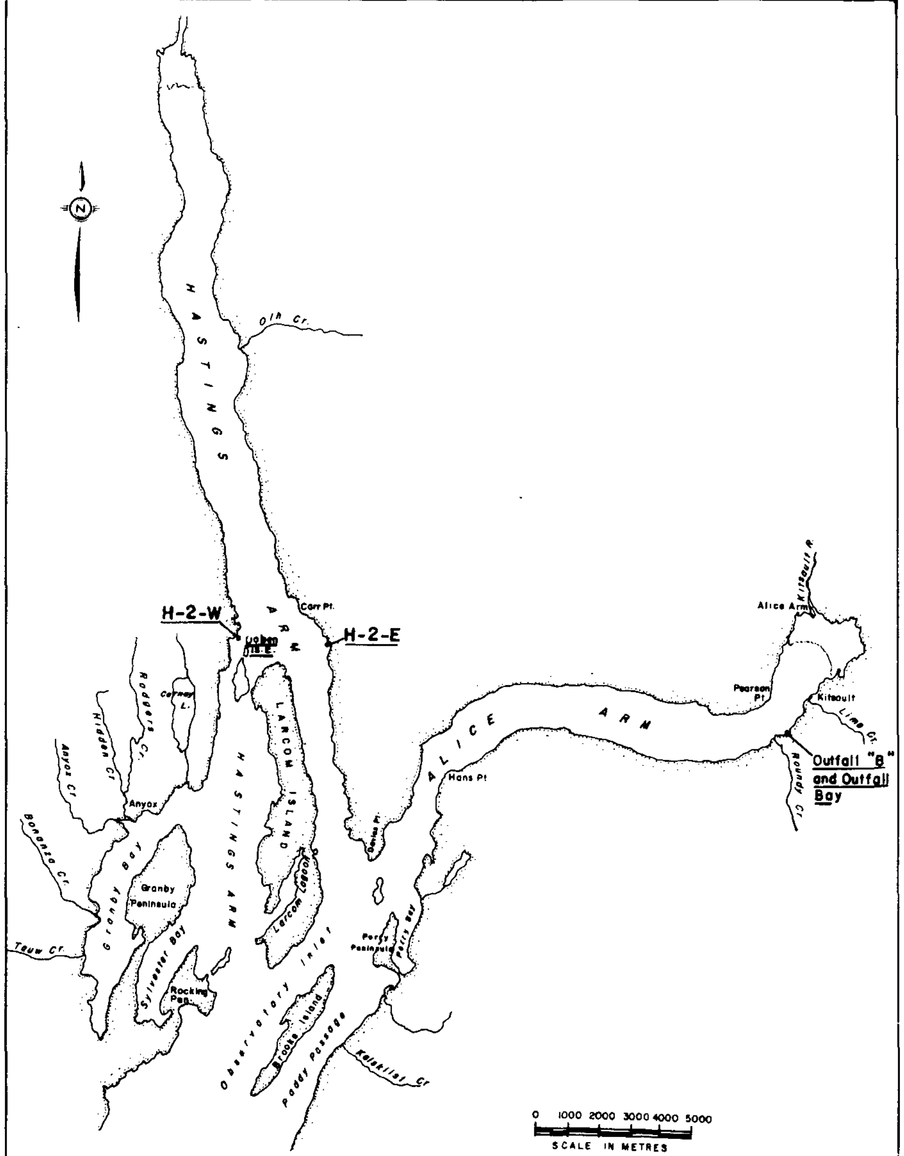

FIGURE 6a INTERTIDAL SAMPLING STATIONS - ALICE ARM AND HASTINGS ARM - May-June, 1981

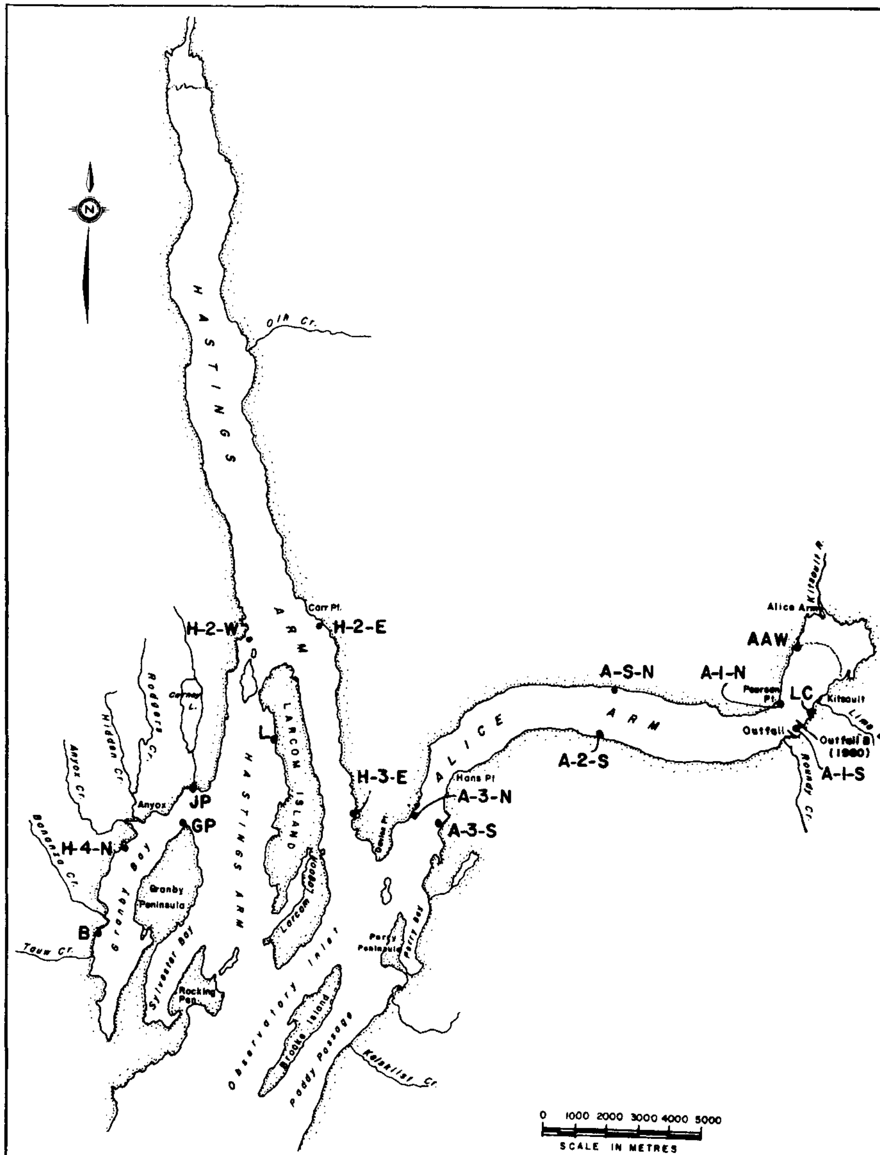

FIGURE 6b INTERTIDAL SAMPLING STATIONS - ALICE ARM AND HASTINGS ARM - 1977-1980

concentrated nitric acid. Samples were analyzed on the ICAP. Standard Reference Material (SRM) 1577 (bovine liver) from the National Bureau of Standards (NBS) was prepared and analyzed in the same manner. In some cases the detection limits for lead and cadmium in the baseline studies (1976-1980) were considered inadequate. In 1981, all tissue samples from Alice Arm that were below the ICAP detection limit for lead and cadmium were analyzed by the Jarrell Ash 850 AAS with a FLA 100 graphite tube furnace to lower the detection limit.

The West Vancouver Laboratory routinely conducts quality control checks through daily batch control using calibration standards, analytical blanks, duplicate analysis of test samples and analysis of standard reference materials along with each batch. Longer term quality control is conducted through "blind audit" samples to check analyst performance and participation in interlaboratory studies with Fisheries and Oceans Freshwater Institute, Environment Canada's Centre for Inland Waters, US Geological Survey, International Atomic Energy Agency and others. Typical results obtained by the West Vancouver Laboratory for Tissue Standard Reference Materials are shown in Appendix 6-A.

In August 1981 composites for interlaboratory comparison from tissues of *Mytilus edulis*, *Chinocarduim nuttalli*, *Lyopsetta exilis* and *Pandalus borealis* were also received from Dobrocky Seatech Ltd. Additional Sub-samples had been sent by Amax to an independent commercial laboratory. The mean of three samples from each species for As, Cd, Cu, Mo, Pb and Zn obtained by the three laboratories is given in Appendix 6-B. Values have been taken from Amax (1981).

3. Results and Discussion

3.1 Sediment Cores.

Analysis of core samples, particularly from the Alice Arm area can provide useful data on the natural variability in sediment trace metals and an historical picture of previous tailings deposits. Two previous mining operations in Alice Arm and Hastings Arm have affected the trace metal level of the surface sediment over a fairly large area making it difficult to obtain sufficient data on variability in natural background levels. This can be determined by observing patterns in the trace metal concentration in the lower portion of the core samples if core samples extends below the contaminated zone. Also the mineralization which exists in the drainage area, especially Alice Arm and the history of mining activity raises the possibility of other sources of trace metal input, natural and mine derived. Observing the trace metal levels in sediment overlying and beneath the older B.C. Molybdenum deposits helps to identify these potential sources if they exist. Although data is available on the Kitsault mine ore body and tailings effluent, metal levels found in B.C. Molybdenum deposits taken directly from Alice Arm serve to illustrate the range in concentrations that will likely occur from the Kitsault operation following exposure to various environmental factors present in Alice Arm. Although not necessarily entirely available to the biota, trace metal concentrations from the old B.C. Molybdenum deposits can also give some indication of the level of trace metal exposure to the benthic biota during the Kitsault mine operation.

Results from eleven core samples and six surface grabs taken in October 1981 are shown in Appendix 7. Zero values in the Appendix denote sample taken but not analyzed. These have been retained in storage. Figures 7 to 10 illustrate individual core profiles for copper,lead, zinc, cadmium, in relation to molybdenum for each station. Stations have been arranged to progress from the head of Alice Arm, westward to the entrance (Figures 7 and 8), the approaches to Anyox (Figure 9) and into

Hastings Arm (Figure 10). Profiles obtained in 1978 have been included for comparison. In 1981 certain stations in Alice Arm sampled were relocated to correspond to the location of the Kitsault outfall. The 1978 profiles in Figure 7 and 8 correspond to the closest station occupied in 1981. Smith-MacIntyre grab samples taken at various core stations indicate somewhat higher concentrations than the 0-2 cm portion of the equivalent core sample, eg. Stations M9 and M49 (Appendix 7 and Figures 7 and 8). This may be due to removal of the top few centimetres by the shock wave which preceedes the corer or dilution by water present in the top of the core tube. The core tube was never completely full of sediment indicating it did not, at any time, pass beyond the surface layer.

Copper, lead, zinc and cadmium profiles near the Kitsault mine (M-9 to 0-32) generally showed two main peaks, one between 0 and 30 cm, the other in the 30-40 cm portion of the core (Figure 7 and 8). Maximum copper, lead, zinc, cadmium and molybdenum concentrations in the 0-32 cm core depth, Stations M-9 to 0-32 were 123 mg/kg, 435 mg/kg, 561 mg/kg, 14.3 mg/kg and 291 mg/kg, respectively. In the 30-42 cm portion maximums were 98 mg/kg, 236 mg/kg, 556 mg/kg, 5.5 mg/kg and 10.6 mg/kg, respectively. Molybdenum showed a single peak betwen 10 and 20 cm. The copper, which is not a major element in the tailings, levels showed some increase over the natural concentration but less pronounced than lead, zinc, cadmium or molybdenum. The upper peak presumably would represent tailings from the Kitsault mine which began production approximately 7 months earlier. The lower peak would be tailings from the previous B.C. Molybdenum operation which ceased in 1972. In the 1978 core data, maximum concentrations generally occurred at the 20-22 cm core depth. The new deposits from the Kitsault mine probably account for this shift from 1978 plus any natural deposition which had occurred since then. Except for copper, which may be due to the Anyox operation, similar peaks were not observed in Hastings Arm. Below 40-50 cm., concentrations at most stations in Alice Arm except Station B-6, approached background levels. At Station B-6 which is located off the, Kitsault River estuary the pattern was slightly different with, elevated levels of lead, zinc and cadmium extending much deeper in the sediment, down to the maximum core depth of 90-92 cm. Lower concentrations (lead, zinc, cadmium, and molybdenum) in the top 10-12 cm of the core sample at Station B-6 indicates that natural silt from the Kitsault River is not contributing significantly to the trace metal loading in the arm. The pattern shown in the lower core depths (down to 92 cm) suggests that during the B.C. Molybdenum operation tailings were transported to the estuary of the Kitsault River. However, a number of mines had operated in the area prior to B.C. Molybdenum one of which was the Dolly Varden silver mine. The mill site was located about 32 kilometres inland and operated between 1948 and 1959. Tailings were discharged directly into the Kitsault River and ultimately would be transported down to the estuary. This may be responsible for the higher concentrations observed in the lower core depths at Station B-6.

Table 1-A and B shows the average trace metal concentrations found in the 1981 core samples. Data from stations in upper Alice Arm has been separated, based on trace metal distribution, into two portions, 1) the upper portion which primarily contains tailings deposits from the new Kitsault mine, and the previous B.C. Molybdenum operation and 2) the lower portion which, although levels approach natural background, still appears to contain some tailings solids from the B.C. Molybdenum mine. The purpose of this was to isolate any other possible sources of trace metals that may be present particularly from rivers at the head of Alice Arm. Any significant natural inputs should be reflected by higher concentrations in the sediment layer below the B.C. Molybdenum deposits which was not the case.

One particularly interesting feature in the core data from Station H-2 in Hastings Arm is the copper, lead and zinc concentrations found in the upper 22 cm of the core sample. Results suggest that the influence of the Anyox operation extends some distance north into Hastings Arm. Copper concentrations in the upper 22 cm ranged between 76.2 and 119 mg/kg compared to a range of 47.3 to 49.6 in the lower core

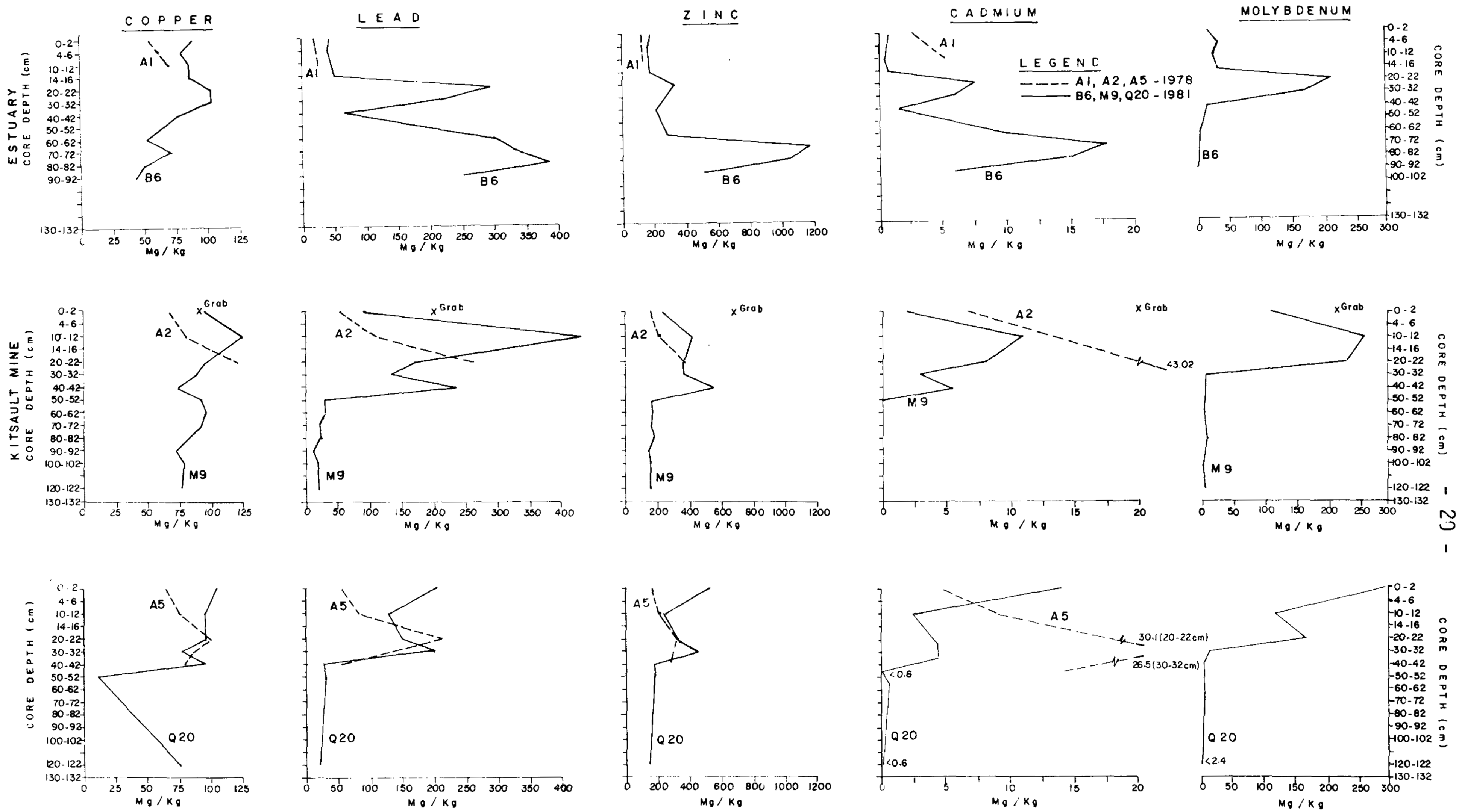

FIGURE 7 SEDIMENT CORE PROFILES - STATIONS B6 TO Q20, ALICE ARM - October 1981

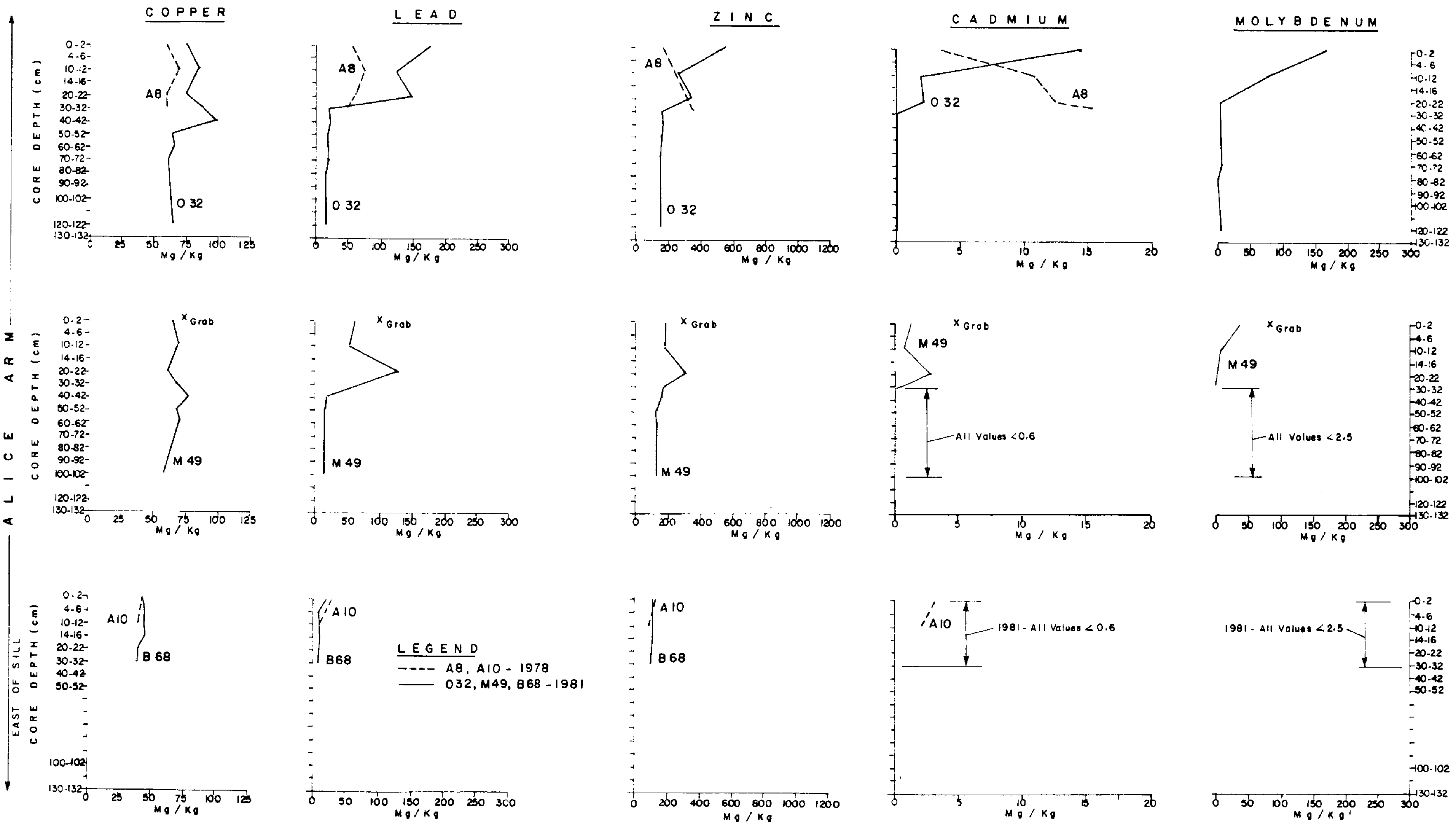

FIGURE 8 SEDIMENT CORE PROFILES - STATIONS O32 TO B68 - ALICE ARM - October 1981

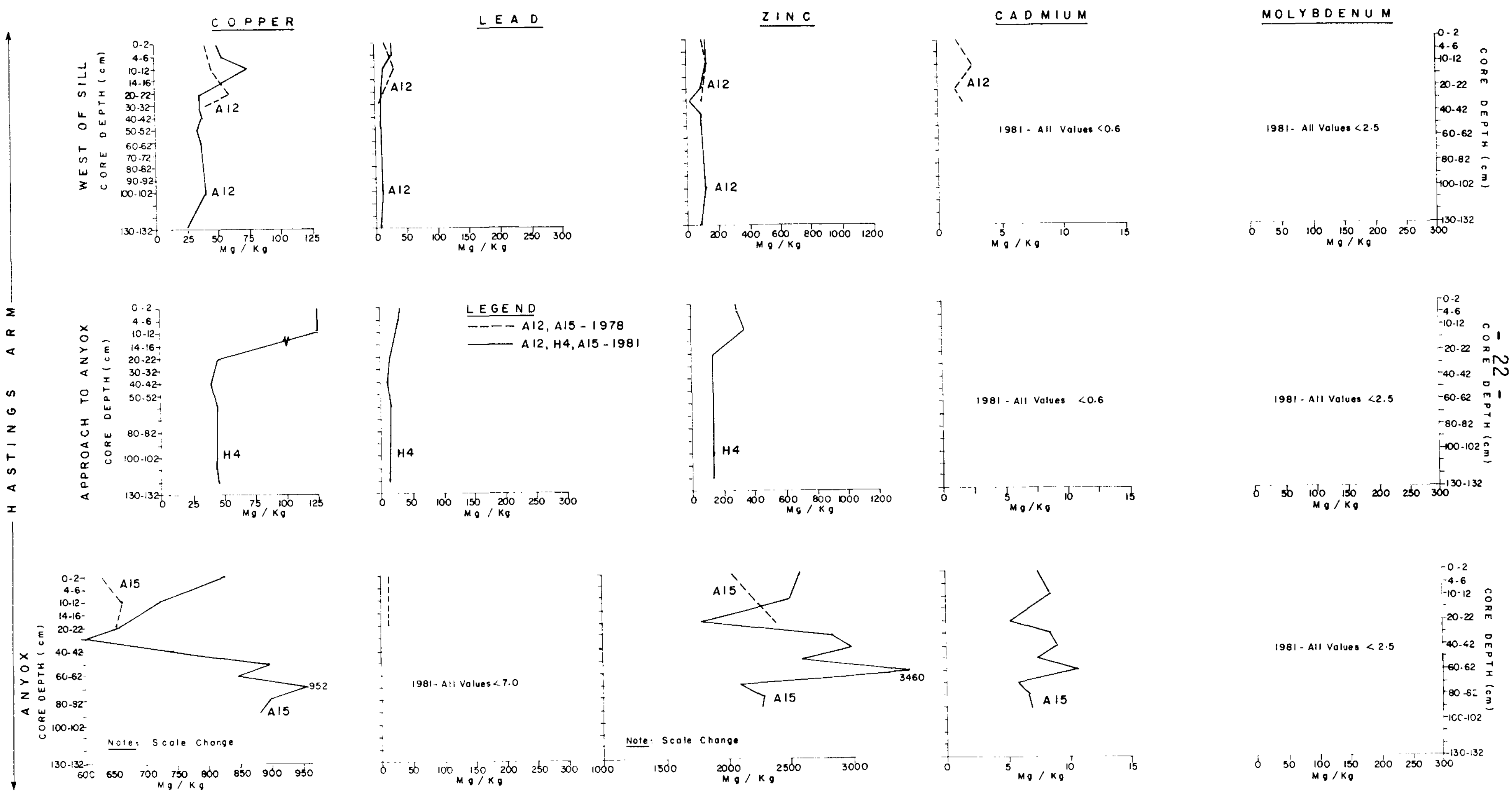

FIGURE 9 SEDIMENT CORE PROFILES - STATIONS A12 TO A15 (ANYOX), HASTINGS ARM - October 1981

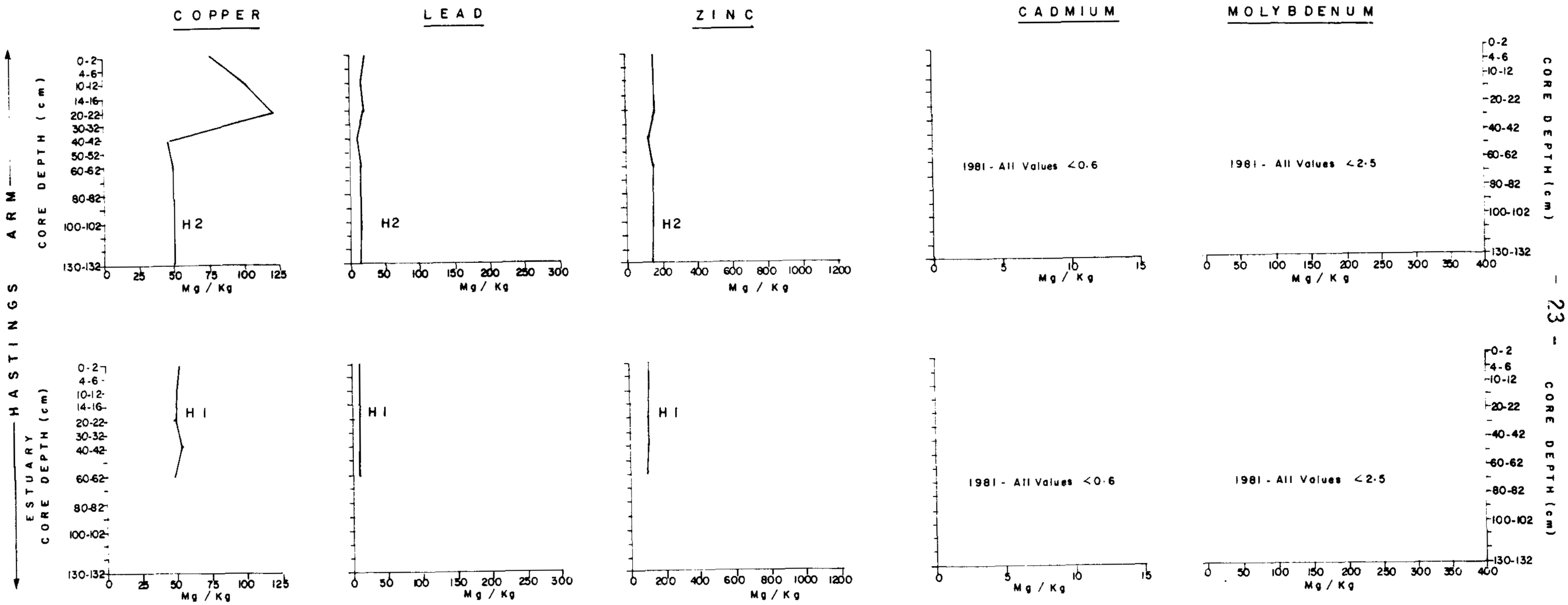

FIGURE 10 SEDIMENT CORE PROFILES - STATIONS H2 TO H1, HASTINGS ARM - October 1981

TABLE 1: AVERAGE TRACE METAL CONTENT - SEDIMENT CORE SAMPLES - CONTAMINATED vs UNCONTAMINATED - ALICE ARM, October 1981.
(A)

LOCATION	CORE DEPTHS (cm)	COPPER	LEAD	ZINC	CADMIUM	ARSENIC	MOLYBDENUM
H1	0 - 62	50.9 ± 2.2	10.9 ± 3.3	103 ± 4.8	L0.6	16.4 ± 1.9	L2.4
H2	0 - 132	70.3 ± 28.4	17.0 ± 4.8	149 ± 14.4	L0.6	13.1 ± 3.2	L2.4
H4	0 - 12	416 ± 126.6	28.6 ± 5.5	300 ± 43.1	L0.6	18 ± 1.4	L2.4
	20 - 122	44.1 ± 1.8	13.5 ± 1.1	134 ± 5.2	L0.6	12 ± 1.9	L2.4
A15	0 - 92	803 ± 115	L6.6	2534 ± 478	L0.6	39 ± 14.6	L2.4
A12	0 - 132	43.1 ± 12.9	13.1 ± 7.6	102 ± 14.4	L0.6	6.9 ± 0.55	L2.4
B68	0 - 32	43.6 ± 3.1	13.1 ± 6.4	110 ± 7.0	L0.6	12.9 ± 2.6	L2.4
M49	0 - 32	65.7 ± 5.4	77.8 ± 34.6	233 ± 67.4	2.3 ± 1.8	20.8 ± 1.9	12.7 ± 16.2
	40 - 132	65.8 ± 9.9	16.1 ± 0.9	137.8 ± 6.6	L0.6	18.6 ± 1.9	L2.4
O32	0 - 22	77.5 ± 6.9	152 ± 26.1	386.3 ± 155.7	6.2 ± 7.0	21.5 ± 5.9	84.7 ± 81.5
	30 - 122	73.3 ± 14.7	18.7 ± 2.1	153.6 ± 8.9	L0.6	22.6 ± 1.0	6.2 ± 1.6
Q20	0 - 32	93.9 ± 14.8	160.7 ± 38.6	385.2 ± 130.3	6.3 ± 5.2	27.0 ± 6.6	146.4 ± 116.5
	40 - 122	59.3 ± 43.9	25.5 ± 4.8	173.7 ± 18.3	L0.6	30.7 ± 2.1	5.7 ± 2.9
M9	0 - 42	94.7 ± 17.9	211.7 ± 136.6	383 ± 121.1	6.8 ± 3.5	26.1 ± 13.8	119.9 ± 117.8
	50 - 122	85.0 ± 9.1	23.0 ± 3.2	162.6 ± 11.5	L0.6	30.7 ± 2.7	4.0 ± 1.5
B6	0 - 92	76.1 ± 20.2	183.3 ± 135.8	454.8 ± 371.8	6.08 ± 6.0	36.0 ± 12.9	47.4 ± 71.5

Continued in Section B ...

TABLE 1: AVERAGE TRACE METAL CONTENT - SEDIMENT CORE SAMPLES - CONTAMINATED vs UNCONTAMINATED - ALICE ARM, October 1981.
(B)

LOCATION	CORE DEPTHS (cm)	NICKEL	CHROMIUM	IRON (%)	MANGANESE	MAGNESIUM (%)	VANADIUM	ALUMINIUM (%)
H1	0 - 62	10.2 ± 1.6	24.1 ± 1.7	3.76 ± 0.15	880 ± 66	1.49 ± 0.08	111 ± 4.9	2.54 ± 0.12
H2	0 - 132	23.3 ± 2.7	43.8 ± 4.3	4.33 ± 0.14	2086 ± 283	1.98 ± 0.08	134 ± 5.1	3.5 ± 0.20
H4	0 - 12	36.4 ± 0.0	61.7 ± 0.6	5.03 ± 0.25	794 ± 29.0	1.98 ± 0.08	121 ± 0.7	3.4 ± 0.04
	20 - 122	44.8 ± 1.7	62.7 ± 3.0	4.00 ± 0.11	76.9 ± 41.2	1.79 ± 0.07	112 ± 4.8	3.3 ± 0.33
A15	0 - 92	8.7 ± 1.1	4.80 ± 5.5	14.9 ± 4.8	640 ± 63.5	2.69 ± 0.41	107 ± 9.4	3.4 ± 0.36
A12	0 - 132	38.0 ± 2.7	67.0 ± 5.0	3.22 ± 0.17	616 ± 33.7	1.35 ± 0.07	90.7 ± 5.2	2.7 ± 0.20
B68	0 - 32	40.4 ± 4.1	69.4 ± 8.1	3.44 ± 0.27	660 ± 69.6	1.46 ± 0.10	96.9 ± 10.5	2.6 ± 0.40
M49	0 - 32	36.4 ± 4.3	56.4 ± 1.9	4.1 ± 0.17	2407 ± 80.6	1.60 ± 0.06	72.0 ± 48.2	2.6 ± 0.07
	40 - 132	42.1 ± 5.9	4.3 ± 0.25	4.3 ± 0.25	2002 ± 609.1	1.66 ± 0.07	101 ± 4.1	2.7 ± 0.09
032	0 - 22	24.7 ± 8.7	37.2 ± 15.0	3.9 ± 0.77	2010 ± 606.9	1.34 ± 0.47	51.7 ± 50.2	2.2 ± 0.88
	30 - 122	37.4 ± 2.4	51.7 ± 2.6	4.6 ± 0.11	2311 ± 230.9	1.64 ± 0.37	117 ± 6.6	2.9 ± 0.19
Q20	0 - 32	21.6 ± 6.8	33.8 ± 11.9	3.9 ± 0.80	1643 ± 617.2	1.31 ± 0.37	86.5 ± 25.5	2.2 ± 0.68
	40 - 122	45.5 ± 18.98	47.9 ± 1.9	5.0 ± 0.13	1600 ± 210.0	1.78 ± 0.04	125 ± 3.5	3.2 ± 0.17
M9	0 - 42	17.0 ± 10.0	32.4 ± 12.3	4.0 ± 1.11	1327 ± 57.8	1.33 ± 0.36	88.7 ± 28.5	2.2 ± 0.73
	50 - 122	32.5 ± 3.4	43.9 ± 3.8	5.0 ± 0.18	1157 ± 73.6	1.72 ± 0.06	122.7 ± 7.7	3.1 ± 0.12
B6	0 - 92	18.0 ± 6.8	29.9 ± 5.2	4.08 ± 0.5	1533 ± 861.0	1.36 ± 0.14	91.4 ± 24.3	2.3 + 0.50

76.2 and 119 mg/kg compared to a range of 47.3 to 49.6 in the lower core depths. It is possible that slag deposits have extended into Hastings Arm through a small passage at the north end of Larcom Island (Figure 4-B).

3.1.1 Comparison of the 1978 and 1981 Core Data

In the following discussion natural background levels are based on values generally encountered in sediment samples which were not affected by either tailings or slag deposits and discounting extreme high and low values.

Copper

Outside Alice Arm, the natural copper content of the sediment lies within a fairly narrow range, between 40 and 55 mg/kg. From the 1978 core data, levels were placed between 30 and 50 mg/kg. (Goyette and Christie 1982). In the Panel report (Burling et al 1981) copper concentration in the earths' crust is given as 70 mg/kg. Several high values, in excess of 100 mg/kg, were observed in Hastings Arm which are probably due to the Anyox smelter. Most concentrations in Hastings Arm ranged between 47 and 53 mg/kg. Seaward of the Hans Point boundary (AATDR) (A12, B68) copper values ranged between 33 and 74 mg/kg (x=43.1 and 43.6 mg/kg, respectively). Within the tailings deposits in Alice Arm, concentrations in the upper (0-30 cm) portion of the core at Stations M9, Q20, and 032 ranged between 75 and 123 mg/kg. Maximum concentrations above 100 mg/kg were found both in 1978 and 1981. Elevated concentrations appear to extend seaward as far as Station M-49. Near Anyox (A-15) copper concentrations in a single core sample ranged between 603 and 952 mg/kg (x=803 ± 115 mg/kg). In 1978 copper concentrations in a 22 cm core sample ranged between 625 and 661 mg/kg.

Lead

From the 1978 core data the natural background concentration for lead was established at about 19.0 mg/kg. Similar results were obtained from the 1981 cores where levels ranged between 25.5 ± 4.8 mg/kg in the lower core depths near the head of Alice Arm to 13.1 ± 7.6 mg/kg near the mouth. The former values appear to contain some light tailings contamination. Natural background normally lies somewhere between 11 mg/kg and 25 mg/kg. According to the Panel report (Burling *et al*, 1981) lead concentration in the earth crust is 16 mg/kg. Lead concentrations found in core samples taken in Alice Arm in 1981 ranged between 77.8 ± 34.6 mg/kg and 212 ± 137 mg/kg. A grab sample taken at Station M-9, off the Kitsault outfall, contained 217 mg/kg, lead.

At Anyox, lead concentrations were less than 6.6 mg/kg throughout the core compared to 9.0 to 11.0 mg/kg found in 1978 at the same station location.

Zinc

Near the Kitsault mine, zinc levels in 1981 in the lower core depths ranged from a mean of 138 ± 6.6 mg/kg to 174 ± 18 mg/kg. Seaward the average was lower, 102 ± 14.4 mg/kg and 110 ± 7.0 mg/kg. The average from the 1978 data was similar at 115 mg/kg. The natural zinc concentrations around Alice Arm should normally range between 90 and 150 mg/kg. Zinc concentration given by the Panel report for the earth's crust are 60 mg/kg (Burling *et al*, 1981)

In 1981 concentrations in the contaminated sediment from Alice Arm ranged from 233 ± 67.4 mg/kg to 386 ± 156 mg/kg. In 1978 the average was 242 mg/kg (Goyette and Christie, 1982). Excluding Station B-6, the maximum zinc concentration near the Kitsault mine was 556 mg/kg at M-9, 40-42 cm core depth (Appendix 7). At Anyox zinc concentrations averaged 2534 ± 478 mg/kg., higher than any other station.

Cadmium

Perhaps the most significant change takes place with cadmium where background levels in both Alice Arm and Hastings Arm were below a detection limit of 0.6 mg/kg. According to the Panel report (Burling et al, 1981) the cadmium concentration in the earth's crust is 0.15 mg/kg. Within the Alice Arm tailings deposits levels in the upper core normally ranged from 2 to 8 mg/kg with maximum concentrations of about 14 mg/kg obtained at core stations Q-20 and Q-32. Off the Kitsault mine, a surface grab at M-9 contained 19.6 mg/kg. In 1978 the average found in the B.C. Molybdenum deposits was 13.6 mg/kg, with a maximum of 43 mg/kg, a value not observed in 1981 (Goyette and Christie, 1982).

Radioisotopes

Radioisotope analysis was done on selected core samples in 1978. This was not repeated on the 1981 samples since the analysis showed no apparent increase resulting from the previous B.C. Molybdenum operation. Levels were at or below natural concentrations reported for the area (see Goyette and Christie, 1982).

Molybdenum

The detection limit for molybdenum in 1980 was 18.5 mg/kg (Goyette and Christie, 1982). This was lowered to 2.5 mg/kg in 1981. For both Alice Arm and Hastings Arm the natural molybdenum content in the marine sediment was below 2.5 mg/kg. Values given by the Panel for the earth's crust was 15 mg/kg. For the upper or contaminated portion of core samples from Alice Arm mean values ranged between 12.7 mg/kg and 146.4 mg/kg. Near the Kitsault mine (M-9, Q-20) maximum levels were 255 and 291 mg/kg, respectively. A grab sample of fresh tailings at M9 contained 209 mg/kg, Mo.

Arsenic

Analysis for arsenic was not done on the 1978 samples and is not considered a major element in the Kitsault tailings which averages about 12.8 mg/kg (see Section 3.2). As seen in Table 1-A arsenic levels in Alice Arm were higher than Hastings Arm, averaging 20 to 31 mg/kg, compared to 12 to 16 mg/kg, respectively. Concentration given by the Panel for the earth's crust was 5 mg/kg. Values for the Kitsault River and Illiance River sediments were given as 29.3 mg/kg and 38.3 mg/kg, respectively (Burling et al, 1981).

Nickel Nickel concentrations in core samples from Hastings Arm averaged from 10.2 ± 1.6 mg/kg near the head (H1) to 23.3 ± 2.7 mg/kg in the middle (H2). Averages were slightly higher at A-12 and B-68, at 38.0 ± 2.7 and 40.4 ± 4.1, respectively. Concentrations of nickel tend to be somewhat lower in both the Anyox and Alice Arm tailings deposits. As suggested in the Panel report (Burling et al, 1981) tailing from the Kitsault mine appear to have a diluting effect on the marine sediment. This was also noted in the 1978 core samples taken from the B.C. Molybdenum deposits (Goyette and Christie, 1982). In 1981 concentrations in the upper core (eg. Station M-9) were generally lower than the deeper portion. A surface grab at M-9 showed a value of 12.5 mg/kg (Appendix 7).

Iron, Chromium, Magnesium, Vanadium and Aluminium

Concentrations of magnesium, vanadium, aluminium appear to be similar throughout the area. Iron concentrations tended to be higher in the Alice Arm tailings deposits and exceptionally high at Anyox (max. 16.2 percent). Chromium appears to show a similar pattern to nickel where the tailings deposits have diluted the sediment concentrations.

3.1.2 Comparison of EPS and Amax Data on Surface Sediment Trace Metals

As part of the monitoring requirements Amax of Canada carries ou an annual sampling program to determine the surface distribution of the tailings in Alice Arm. A series of monitoring lines, AA to HH (Figure 3) are sampled at the 0, 50, 100 metres and middle depths for trace metal content in the sediment. Table 2 compares the copper, lead, zinc, cadmium, arsenic and molybdenum concentrations found in the 0-2 cm core depth by EPS, inside and outside the deposition area, to those obtained Amax from the middle stations on the monitoring lines, ie. AAM to HHM (Amax 1981).

Considering the number of possible variations that can occur, the data shows reasonably close agreement. Comparing data from both sources the range in ratios of surface sediment trace metal content within the deposition area to the natural surface sediment outside is 2:1, 3-16:1, 2-5:1, 1-2:1 and 16-34:1 for Cu, Pb, Zn, As and Mo, respectively.

The sharp increase metal concentrations in the surface layer (0-2 cm) in 1981 indicate that fresh tailings from the Kitsault mine have extended seaward at least to Station Q-32 (Figure 4-A). Visual evidence of fresh deposits was observed from the Pisces IV along the central axis of Alice Arm between Q23 and Q26 (Figure 3) in July 1982 (pers. obs.). Based on lead, cadmium and molybdenum concentrations, company monitoring of the surface sediment metal levels (Amax, 1981) places the seaward extent of the Kitsault mine tailings in mid-channel between monitoring lines E-E an F-F (Hans Point) (Figure 3).

3.2 Amax Tailings Solids

Amax reports that for the initial production period (April to October 1981) metal concentrations in the solid portion of the tailings

TABLE 2: COMPARISON OF EPS AND AMAX 1981 SEDIMENT TRACE METAL DATA ON SURFACE SEDIMENT ALONG THE CENTRAL AXIS OF ALICE ARM, INSIDE AND OUTSIDE THE DEPOSITION AREA.

	Post-Start-up Levels						Pre-Startup Levels			
Metal mg/kg	Inside		Outside		Ratio Tailings to Natural Sediment		Inside EPS		Outside EPS	
	Amax (AAM-EEM)	EPS (B6-032) 0-2 cm	Amax (FFM-HHM)	EPS (A12, B68) 0-2 cm	Amax	EPS	1978	1980	1978	1980
Cu	86.3-92.9	73.7-104	40.3-49.6	43.1-43.6	2:1	2:16	68.4	74.9	44.5	44.4
Pb	89.1-239.6	43.5-204	14.7-19.0	13.1	6-13:1	3-16:1	68.6	-	22.0	-
Zn	265-619.7	176-561	115.8-126.6	102-110	2-5:1	2-5:1	190.3	224	114	126
Cd	3.1-14.8	0.98-14.3	L0.25	L0.6	-	-	7.1	2.5	1.8	0.6
As	10.3-32.0	15.0-32.0	10.2-13.0	6.9-12.9	1-2:1	2:1	-	-	-	-
Mo	115.1-286.3	17.6-291.0	7.2-8.5	L2.4	16-34:1	-	-	86	-	L18.5

effluent were 61.1 (13.3-98.5) ug/g, Cu; 150 (65-214) ug/g, Pb; 428 (194-980) ug/g, Zn; 18.7 (9.0-55.5) ug/g, Cd; 12.8 (1.4-26.4) ug/g, As; and 273 (169-438) ug/g, Mo. Iron concentrations for the same period were 2.0 (1.2-2.5) precent. Radium 226 levels, reported in Becquerels per gram (one equals approx 27 picocuries) were 0.03 (0.01-0.04). Uranium averaged 1.8 ug/g.

Amax (1981) reports, as of December 31, 1981 a total of 1,947,950 tonnes of tailings had been discharged to Alice Arm. The discharge in 1981 averaged about 8,600 tonnes per operating day between May 16 and December 31.

3.2.1 Tailings Leachability

Experiments have been conducted by AMAX (Rescan Environmental Services Ltd., 1982) and the Environmental Protection Service (Wastewater Technology Centre - Burlington, Ontario) to estimate the potential leachability of Kitsault tailings. The Rescan studies were conducted with a seawater medium while the EPS studies used seawater, distilled water, an acidic solution and a synthetic landfill leachate. Both studies involved short term duration tests but procedures differed in solids to liquids ratios, mixing, and tailings sample characteristics. The tailings sample submitted for the EPS test exhibited much higher metal values than the Rescan Tested sample or routine samples obtained by Amax:

Metal Content of Tailings Samples
Submitted for Leaching Tests.

Parameter	LAB	
	Rescan (CanTest)	EPS
	ug/g	
Pb	135	840
Cd	23	110
Zn	735	4791

The EPS sample was checked and the results given above do represent the metals present on a dry weight basis. For a discussion of the procedures followed in each test, the reader is referred to Anon. (1981) and Rescan (1982). The results of the EPS leaching tests are shown in Table 3. Both the Rescan and EPS studies indicated that there was virtually no detectable leaching of metals with the seawater medium under the short term duration test conditions studied.

Tests with other media in the EPS study however, did show some leachability. It is important to note that the EPS leaching protocal was developed in order to assess the potential leaching of wastes that may be placed in municipal landfills. As such, the tests are not directly relevant to tailings and especially Amax's tailings since they are not impounded on land. It is interesting, however, to observe the relative leaching efficiency of each medium. In particular, with distilled water about 17% of the arsenic was leached at 4:1 liquid to solid ratio and about 10% at 20:1 ratio. Insignificant amounts of copper or lead were leached with the distilled water media. With an acidic solution about 9% of the arsenic, 7% of the copper, and 4% of the lead was leached at the 4:1 ratio and about 3% of the arsenic, 18% of the copper, and 15% of the lead was leached at the 20:1 ratio.

The increased leaching efficiency for copper and lead at the higher liquid to solids ratio with the acidic solution medium is probably due to the lower final pH of the mixture. At the higher liquid to solids ratio, the final pH more closely matches the medium pH and, therefore, enhances metal dissolution. Arsenic on the other hand shows increased dissolution with increasing pH as shown below.

Leaching Efficiency of Arsenic from Amax Tailings

pH	Media	% Leaching Efficiency
7.2	Distilled water	17.49
6.95	Distilled water	10.29
5.1	Acidic Solution	8.64
4.55	Acidic Solution	2.57

The EPS study also used the U.S. Environmental Protection Agency (EPA) Extractive Procedure (EP) Toxicity Test pursuant to the procedures outlined in the Resource Conservation and Recovery Act (RCRA). The results from this test are usually used by the EPA in defining hazardous wastes which would be subject to RCRA. The results of an EP Toxicity Test of Amax tailings together with the maximum concentration of contaminants allowed in the EPA regulations are listed below:

EP Toxicity Test of Amax Tailings Results

Parameter	Amax Sample	Criteria
	mg/l	
As	--	5.0
Cd	L0.3	1.0
Pb	L0.1	5.0

The Amax sample met the EP Toxicity Test criteria for the parameters measured, however, the test was developed to assess the hazardous nature of land filled materials and therefore the criteria are not applicable to tailings.

The results given above should be viewed as preliminary indications only of the potential leachability of the Kitsault tailings since they were obtained from analyses of only two samples. The results of the EPS test in particular may not be representative since the tailings sample used in the experiment contained atypical metal values. It is recommended that composite tailings samples be used in any future leachability studies. It is understood that Rescan Environmental Services will be conducting long term, agitation and standard elutrant leaching tests of Kitsault tailings. The results of these tests may provide further insights into the leachability of Kitsault tailings.

They do indicate however, that some leaching may occur in a relatively mild acid medium. This raises the question concerning the potential for certain biota which have an acid medium in the gut, to extract and accumulate metals. If this does occur, whether various metals are confined to certain internal organs, adaquately excreted or built up in the edible portion remains to be answered. It is recommended that studies be undertaken to determine if the physiology of key species present in Alice Arm, upon both short term and long term exposure, are capable of extracting metals from the Amax tailings. Particular attention should be paid to intertidal and subtidal species of bivalves.

3.3 Tissue Trace Metals

Tissue samples for trace metal analysis had been collected from a variety of subtidal and intertidal species in Alice Arm between 1977 and 1980 to establish baseline levels prior to start-up of the Kitsault mine. Tissue samples from various subtidal species had also been collected from three control areas along the B.C. coast. These results have been reported in Part I (Goyette and Christie, 1982).

Results obtained from tissue samples collected in May-June and October 1981, in Alice Arm and Hastings Arm, shortly after start-up of the Kitsault mine are shown in Table 4. All tissue data collected from Alice Arm and Hastings Arm during the pre start-up period and the coastal control areas have also been included for comparison. Statistical data for the May-June and October 1981 survey are given in Appendix 9 and 10, respectively. Raw data are listed in Appendix 11 and 12, respectively.

TABLE 3: RESULTS OF EPS TEST OF KITSAULT TAILINGS LEACHABILITY

TEST	LEACHING MEDIUM	LIQUID TO SOLID RATIO	PARAMETER	MISC * RESULTS	CONCENTRATION (PPM)	RELEASE (MICROG/G)	LEACHING EFFICIENCY (%)
Tailings	-	-	TOT SOLID	.162			
			VOL SOLID	.013			
			AS		24.		
			CD		110.		
			CU		196.		
			MO		1239.		
			PB		840.		
			ZN		4791.		
WTC	Distilled Water	4.1	PH	7.2			
			COND	291.			
			LM ACIDITY				
			AS		.17	.68	17.49
			CD		L .30		
			CU		.05	.20	.63
			MO		L .10		
			PB		L .10		
			ZN		.07	.28	.04
		20:1	PH	6.95			
			COND	120.			
			LM ACIDITY	--			
			AS		.02	.40	10.29
			CD		L .30		
			CU		L .03		
			MO		L .10		
			PB		L .10		
			ZN		L .30		

TABLE 3: RESULTS OF EPS TEST OF KITSAULT TAILINGS LEACHABILITY (cont'd)

TEST	LEACHING MEDIUM	LIQUID TO SOLID RATIO	PARAMETER	MISC * RESULTS	CONCENTRATION (PPM)	RELEASE (MICROG/G)	LEACHING EFFICIENCY (%)
	Acidic Solution	4:1	PH	5.1			
			COND	4490.			
			LM ACIDITY	82.			
			AS		.084	.34	8.64
			CD		L .30		
			CU		.57	2.28	7.18
			MO		L .10		
			PB		1.30	5.20	3.82
			ZN		1.14	4.56	.59
		20:1	PH	4.55			
			COND	3580.			
			LM ACIDITY	82.	--		
			AS		.005	.10	2.57
			CD		L .30		
			CU		.28	5.60	17.64
			MO		L .10		
			PB		1.00	20.00	14.70
			ZN		.65	13.00	1.67
	Synthetic Landfill Leachate	4:1	PH	4.85			
			COND	10000.			
			LM ACIDITY	157.			
			AS		--		
			CD		L.30		
			CU		.32	1.28	4.03
			MO		L.10		
			PB		5.90	23.60	17.34
			ZN		.76	3.04	.39

TABLE 3: RESULTS OF EPS TEST OF KITSAULT TAILINGS LEACHABILITY (cont'd)

TEST	LEACHING MEDIUM	LIQUID TO SOLID RATIO	PARAMETER	MISC * RESULTS	CONCENTRATION (PPM)	RELEASE (MICROG/G)	LEACHING EFFICIENCY (%)
	Synthetic Landfill Leachate	20:1	PH	4.6			
			COND	9800.			
			LM ACIDITY	157.			
			AS		--		
			CD		L .30		
			CU		.09	1.80	5.67
			MO		L .10		
			PB		1.80	36.00	26.46
			ZN		.41	8.20	1.06
	Alice Arm Seawater	4:1	PH	6.6			
			COND	6700.			
			LM ACIDITY	--			
			AS		--		
			CD		L .30		
			CU		L .03		
			MO		L .10		
			PB		L .10		
			ZN		L .30		
		20:1	PH	6.7			
			COND	6000.			
			LM ACIDITY	--			
			AS		--		
			CD		L .30		
			CU		L .03		
			MO		L .10		
			PB		L .10		
			ZN		L .30		

TABLE 3: RESULTS OF EPS TEST OF KITSAULT TAILINGS LEACHABILITY (cont'd)

TEST	LEACHING MEDIUM	LIQUID TO SOLID RATIO	PARAMETER	MISC * RESULTS	CONCENTRATION (PPM)	RELEASE (MICROG/G)	LEACHING EFFICIENCY (%)
EPA	Acidic Solution	20:1	PH	4.95			
			COND	1300.			
			LM ACIDITY	13.25			
			AS		--		
			CD		L .30		
			CU		.06	1.20	3.78
			MO		L .10		
			PB		L .10		
			ZN		.31	6.20	.80

* Tot Solids - Total solids content of waste (ie. the weight of the waste after drying at 104 degree C divided by the weight of the waste as received).

Vol Solids - Volatile solids fraction of the total solids

pH - pH units
conductivity - umho/cm

LM acidity - leaching media acidity meq/l

When referring to Table 4 it should be noted that mean values for 1977 and 1978, shrimp and bivalves are based on composite samples. The 1981 means are based on analysis of individual samples. Composite samples and the number of individuals used to calculate the mean values in 1981 have been indicated as footnotes in the Table 4. Figures 11 to 16 illustrate the mean trace concentrations in selected species sampled between 1977 and 1981. All results are given in dry weight. Mean wet to dry ratios for conversion to wet weight are given in Table 4. On Appendices 9 and 10, for the purpose of calculating the mean all less than values or those below the detection limits were taken to the next lower significant value and treated as a real number eg. L0.5 mg/kg equals 0.49 mg/kg.

Comparing tissue data collected from Alice Arm in May-June and October 1981 to data collected prior to start-up of the Kitsault mine the most striking feature is the pronounced increase in metal concentrations found in the bivalve Yoldia traciaeformis/montereyensis. Copper, lead, zinc and cadmium concentrations in whole body tissue from samples taken in Alice Arm were substantially above those taken in 1978 from similar sites. The average lead concentrations at Station A-1 for example in October 1981 ranged between 173.7 mg/kg and 177.2 mg/kg compared to 60.0 mg/kg in 1978. Zinc concentrations increased from 682 mg/kg in 1978 to 1137 mg/kg and 1276 mg/kg in October 1981.

Concentrations generally were well above maximums found in the surface sediment from the same area. Maximum zinc concentration in a grab sample from Station M-9 for example was 683 mg/kg (Appendix 7). Zinc concentrations greater than 1000 mg/kg however, have been reported by Amax from their annual sediment trace metal monitoring program (Amax 1981). These were recorded off the outfall and station on the north end of line BB at a depth of 100 metres (see Figure 3 for Amax monitoring lines). All other stations in upper Alice Arm were below 600 mg/kg. Metal levels in the tissues also tended to be slightly higher in October compared to the May-June period.

The fact that tissue concentrations are higher than the sediment concentration strongly suggests that the increase in certain metals is due to bioaccumulation rather than contamination of the sample by sediment adhering to the tissue sample or contained in the gut cavity.

The fact that tissue concentrations are higher than the sediment concentration strongly suggests that the increase in certain metals is due to bioaccumulation rather than contamination of the sample by sediment adhering to the tissue sample or contained in the gut cavity.

No significant change was observed between 1978 and 1981 Yoldia tissue samples from Hastings Arm and most metal levels in both years were similar in value.

The increase in tissue concentrations observed in Yoldia was not apparent in the other species sampled in Alice Arm. In general, levels found in May-June and October 1981 were similar to those obtained during baseline studies and did not differ substantially from samples collected in Hasting Arm. The 1981 sample periods however, are within a relatively short period after mine start-up and too early to expect any pattern to develop particularly in muscle tissue.

Bivalves appear to be the more sensitive indicator species in Alice Arm for metal bioaccumulation. Monitoring a variety of species in Alice Arm however, should continue until there is sufficient data available to establish definite trends and to investigate the longer term aspects of metal bioaccumulation.

Pursuant to the AATDR and the provincial pollution control permit (PE-4335) Amax of Canada Ltd. carries out an annual monitoring program to determine tissue metal levels in Alice Arm. Species selected are Mytilus edulis, Clinocarium nuttalii, Yoldia thraciaeformis, Pandalus borealis, Lyopsetta exilis and Hippoglossoides elassodon. In their Annual report covering the first production year, they report no evidence of significant change in metal concentration in all species but Yoldia thraciaeformis (Amax, 1981). Slightly higher levels were noted in Yoldia but were considered inconclusive because of small sample size, susceptibility to sediment contamination and resultant analytical difficulties.

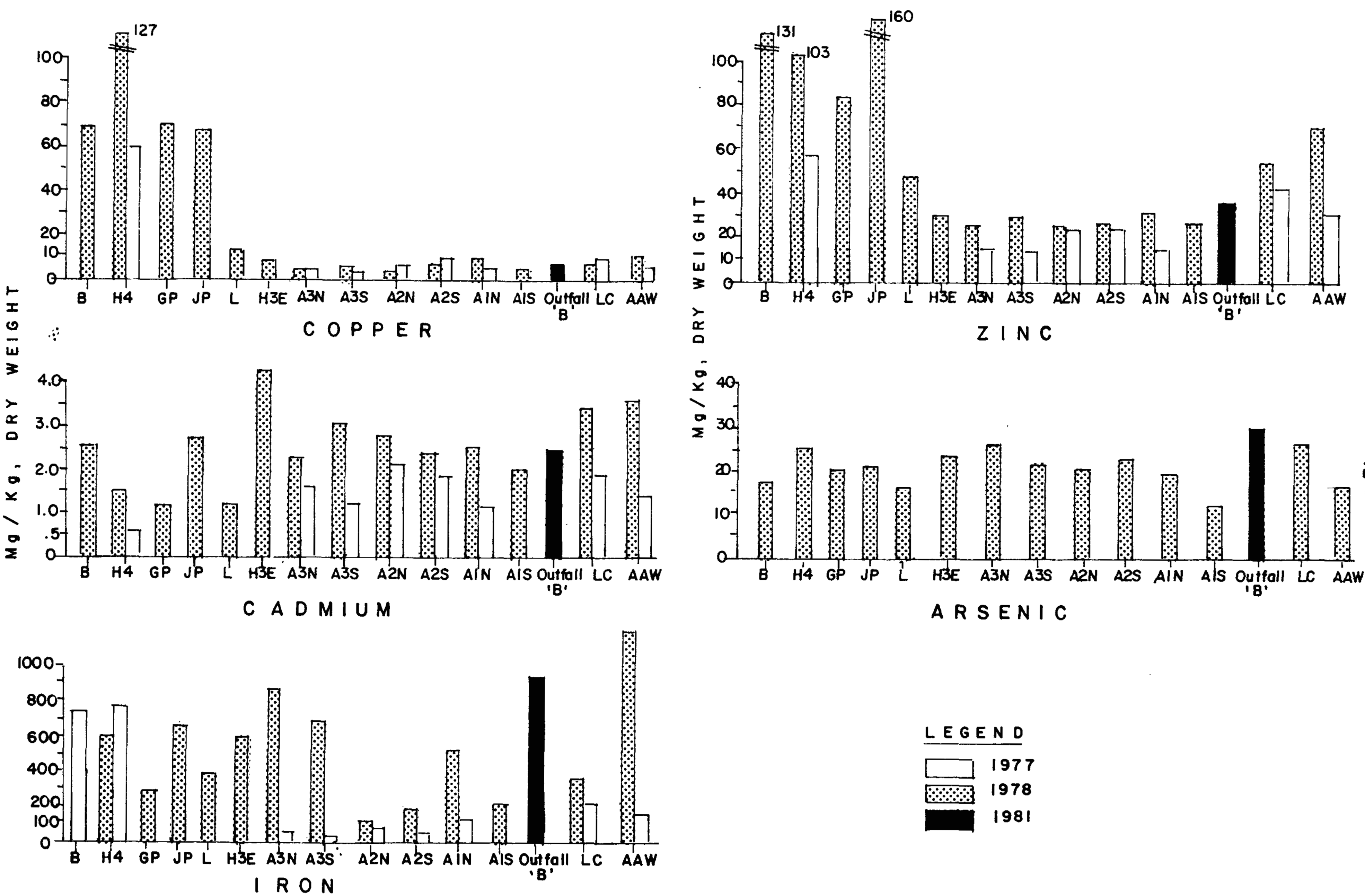

FIGURE II TISSUE TRACE METAL CONCENTRATIONS - Fucus distichus (Alga) in Mg/Kg, Dry Weight

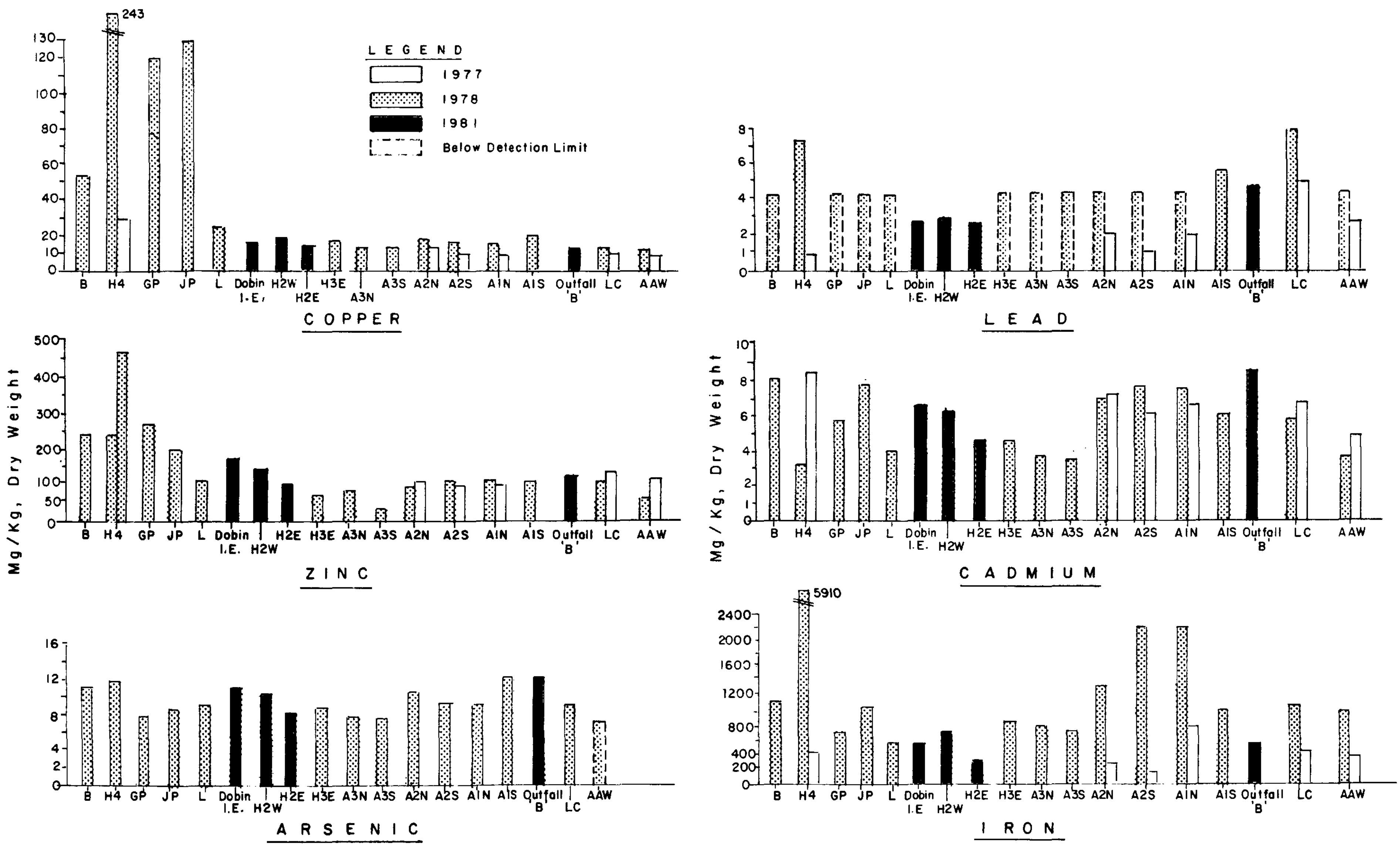

FIGURE 12 TISSUE TRACE METAL CONCENTRATIONS - Mytilus edulis (Mussels) in Mg / Kg, Dry Weight

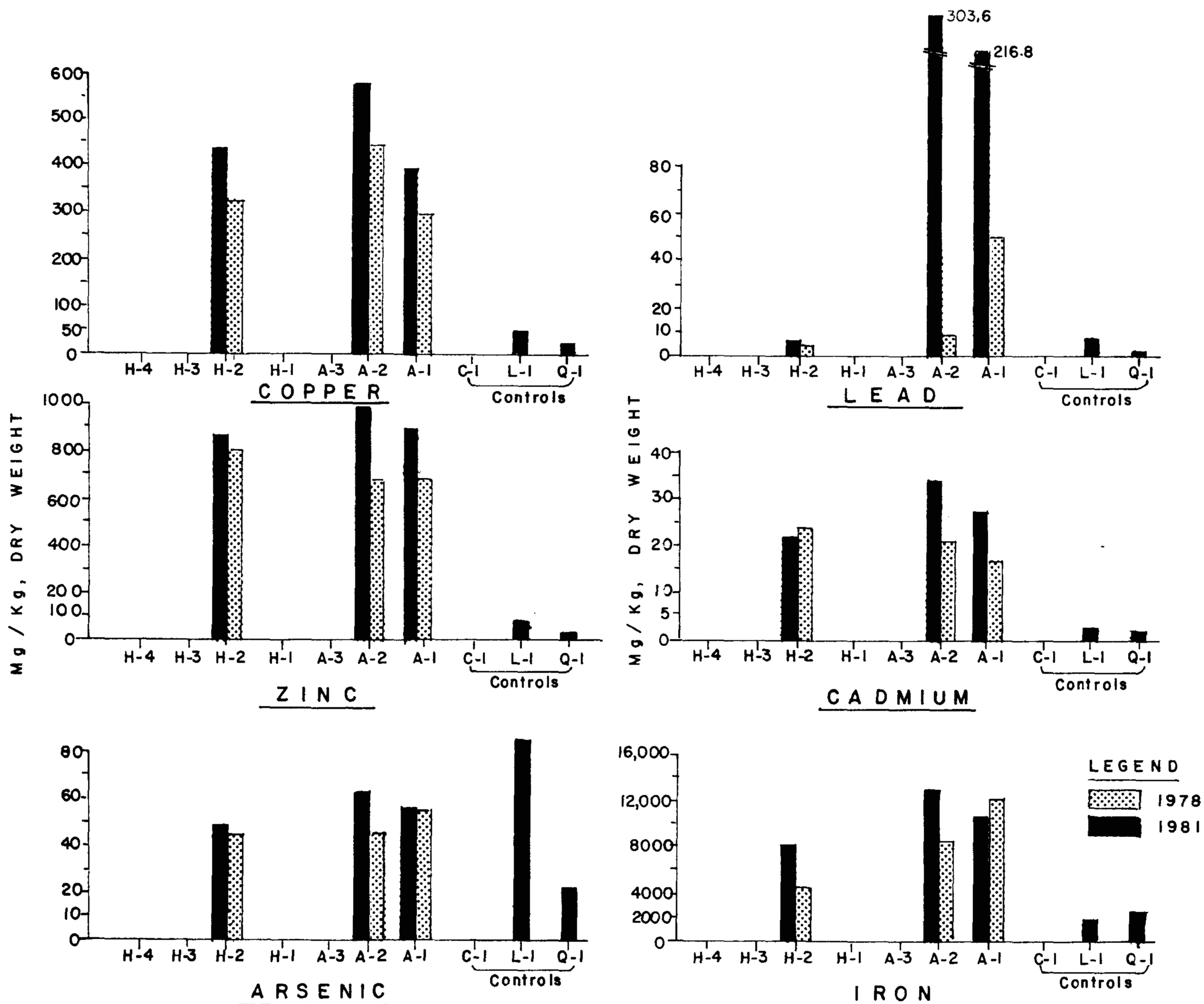

FIGURE 13 TISSUE TRACE METAL CONCENTRATIONS - <u>Yoldia thraciaeformis / montereyensis</u> (Bivalve) in Mg / Kg, Dry Weight

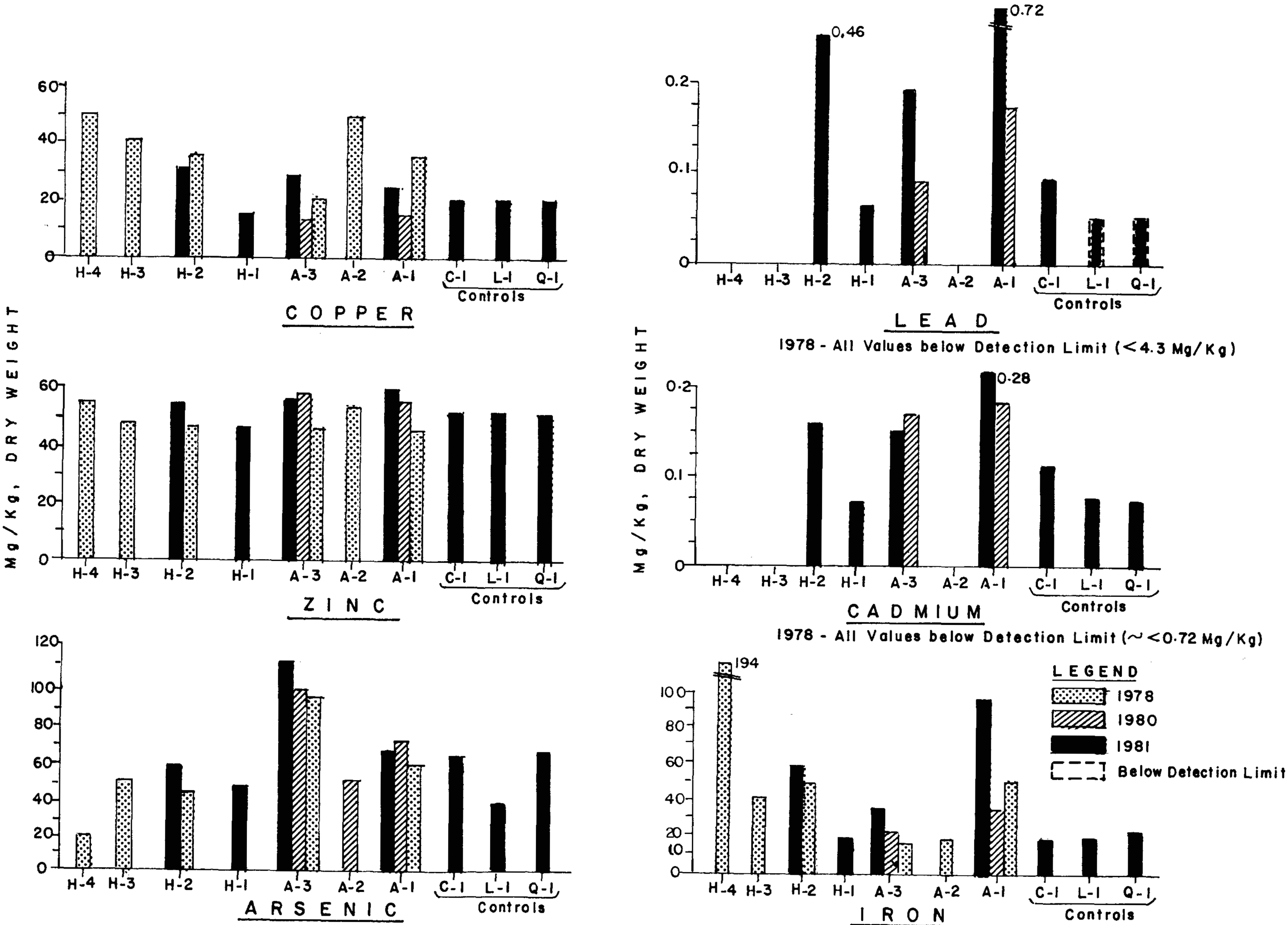

FIGURE 14 TISSUE TRACE METAL CONCENTRATIONS - *Pandalus borealis* (Pink Shrimp) in Mg/Kg, DRY WEIGHT

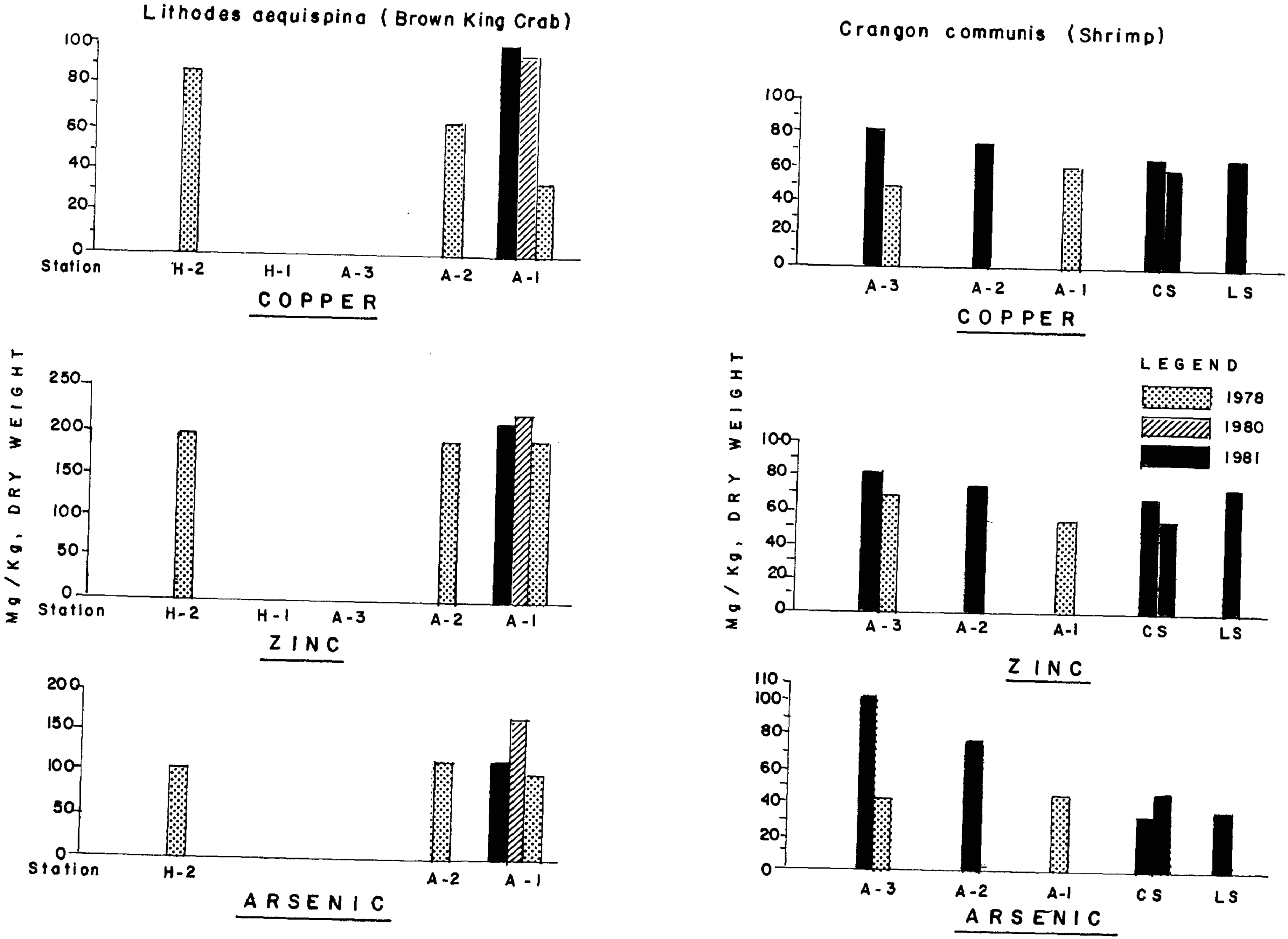

FIGURE 15 TISSUE TRACE METAL CONCENTRATIONS in Mg / Kg, DRY WEIGHT

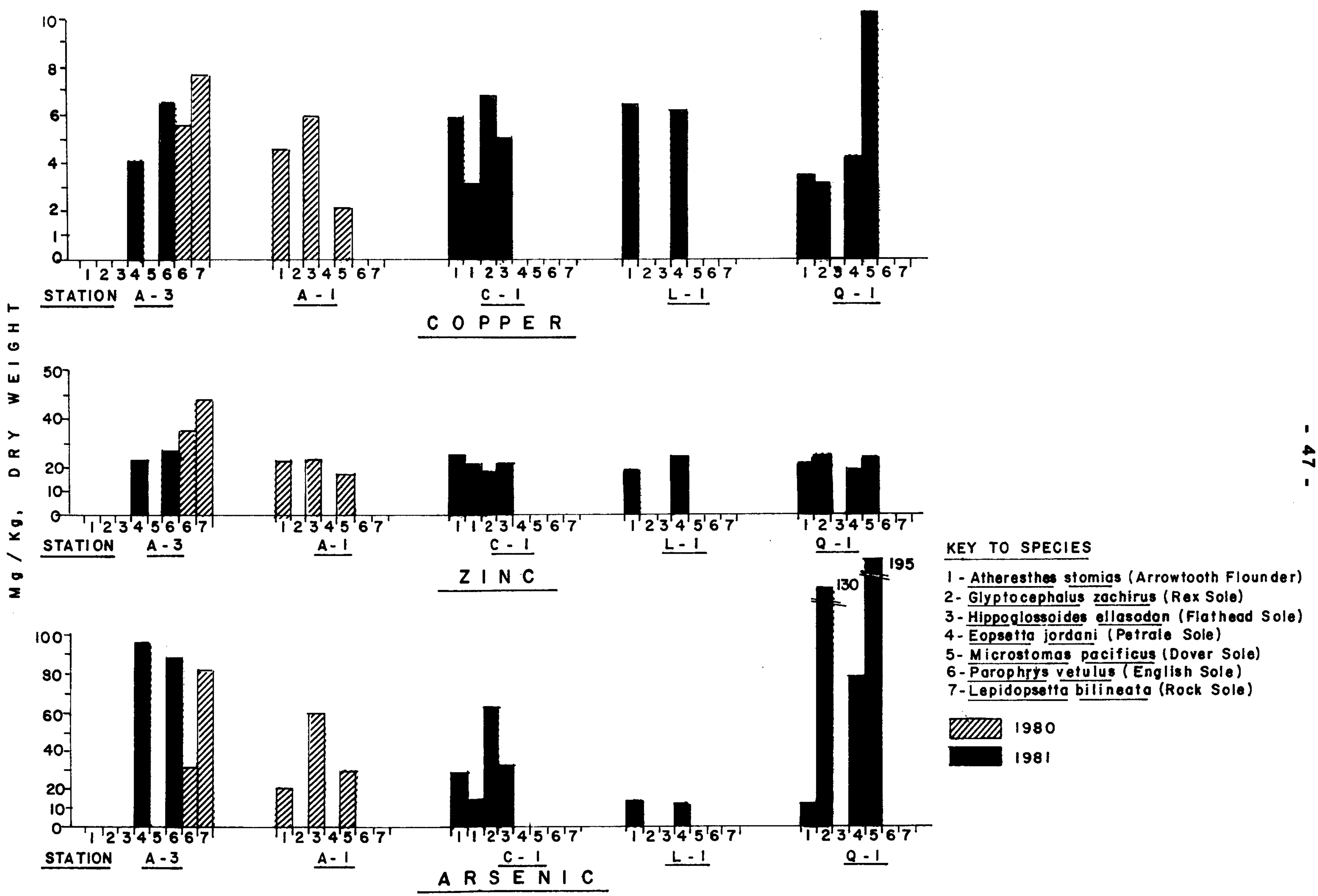

FIGURE 16 TISSUE TRACE METAL CONCENTRATIONS - SOLE (Mixed Species) in Mg / Kg, Dry Weight

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Fucus distichus - Alga - Whole												
ALICE ARM														
AAW	+1977	*M(c)= .00	4.4	<1.00	28.0	1.40	0	.00	.0	.00	150.0	.00	0	0
AAW	1978	M(c)= 6.00	8.6	<4.23	67.1	3.76	16	< 7.14	.0	1.81	2000.0	.00	0	0
LC	1977	M(c)= .00	7.2	1.50	41.0	1.80	0	.00	.0	.00	220.0	.00	0	0
LC	1978	**M(c)= 6.35	5.3	<4.39	51.1	2.90	26	< 7.32	.0	< .98	348.5	.00	0	0
Outfall B. Oct.	1980	M(2)= 4.57	6.5	2.50	36.2	2.50	30	.30	10.0	2.90	936.5	99.15	8880	560
A-1-N	1977	M(c)= .00	3.6	<1.00	17.0	1.10	0	.00	.0	.00	120.0	.00	0	0
A-1-N	1978	M(c)= 7.10	5.9	<4.31	30.6	2.49	19	< 7.19	.0	< .96	513.0	.00	0	0
A-1-S	1978	M(c)= 8.20	3.0	<4.24	25.5	2.02	12	< 7.06	.0	< .94	205.0	.00	0	0
A-2-N	1977	M(c)= .00	5.3	<1.00	24.0	2.10	0	.00	.0	.00	95.0	.00	0	0
A-2-N	1978	M(c)= 6.90	2.7	<4.16	24.1	2.68	20	< 6.93	.0	< .92	115.0	.00	0	0
A-2-S	1977	M(c)= .00	7.4	<1.00	23.0	1.80	0	.00	.0	.00	37.0	.00	0	0
A-2-S	1978	M(c)= 4.10	5.9	<4.27	24.3	2.33	24	< 7.12	.0	< .95	183.0	.00	0	0
A-3-N	1977	M(c)= .00	4.6	<1.00	14.0	1.70	0	.00	.0	.00	42.0	.00	0	0
A-3-N	1978	M(c)= 5.10	4.0	<4.28	24.3	2.17	27	< 7.14	.0	1.38	889.0	.00	0	0
A-3-S	1977	M(c)= .00	3.8	<1.00	13.0	1.20	0	.00	.0	.00	13.0	.00	0	0
A-3-S	1978	M(c)= 4.50	4.6	<4.25	27.9	3.00	21	< 7.08	.0	< .97	682.0	.00	0	0

+ All zeros indicate no analysis.
++ Roman numerals indicate station trawl number.
* M(c)= mean of composite samples.
** M(n) n = number of individuals sampled.
< Indicates EPS laboratory detection limits.

Continued ...

TABLE 4 : COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Fucus distichus - Alga - Whole (continued)												
HASTINGS ARM														
H-2-E	1977	M(c)= .00	10.0	< 1.00	31.0	2.10	0	.00	.0	.00	79.0	.00	0	0
H-2-W	1977	M(c)= .00	5.4	1.40	13.0	1.20	0	.00	.0	.00	57.0	.00	0	0
H-3-E	1978	M(c)= 6.10	6.3	< 4.11	28.8	4.20	24	< 6.84	.0	.94	290.0	.00	0	0
ANYOX														
H-4-N	1977	M(c)= .00	58.0	< 1.00	56.0	.57	0	.00	.0	.00	770.0	.00	0	0
H-4-N	1978	M(c)= 4.80	127.0	< 4.19	103.0	1.49	26	< 6.98	.0	1.26	594.0	.00	0	0
B	1978	M(c)= 5.50	66.9	4.33	131.0	2.50	18	< 7.22	.0	1.20	746.0	.00	0	0
GP	1978	M(c)= 5.70	70.1	< 4.22	80.8	1.29	19	< 7.03	.0	<.94	290.0	.00	0	0
L	1978	M(c)= 4.90	10.8	< 4.47	47.2	1.89	17	< 7.45	.0	<.99	379.0	.00	0	0
JP	1978	M(c)= 4.90	61.2	< 4.35	160.0	2.76	21	< 7.25	.0	<.97	641.0	.00	0	0
		Mytilus edulis - Bivalve - Whole Body												
ALICE ARM														
AAW	1977	M(c)= .00	8.9	2.60	110.0	4.80	0	.00	.0	.00	380.0	.00	0	0
AAW	1978	M(c)= 6.20	12.8	< 4.30	59.3	3.50	7	< 7.20	.0	1.91	1000.0	.00	0	0
LC	1977	M(c)= .00	11.0	5.00	130.0	6.60	0	.00	.0	.00	450.0	.00	0	0
LC	1978	M(c)= 6.30	12.9	7.81	107.0	5.86	9	< 7.30	.0	1.95	1100.0	.00	0	0

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Mytilus edulis - Bivalve - Whole Body (*Continued*)												
ALICE ARM														
LC (Purged)	1978	M(c)= 8.10	22.5	4.84	102.0	6.82	10	< 7.20	.0	1.74	662.0	.00	0	0
Outfall B. May-June	1981	M(10)=11.82	11.2	4.30	125.3	9.46	12	.69	2.6	2.20	465.7	18.45	2491	202
A-1-N	1977	M(c)= .00	9.6	2.10	100.0	6.50	0	.00	.0	.00	810.0	.00	0	0
A-1-N	1978	M(c)= 7.90	14.9	< 4.30	101.0	7.40	9	< 7.20	.0	2.94	2220.0	.00	0	0
A-1-S	1978	M(c)= 7.70	18.3	5.60	107.0	5.90	12	< 7.30	.0	2.23	1010.0	.00	0	0
A-2-N	1977	M(c)= .00	13.0	2.10	110.0	6.90	0	.00	.0	.00	260.0	.00	0	0
A-2-N	1978	M(c)= 7.30	25.5	< 4.35	93.0	6.82	10	< 7.25	.0	3.05	1400.0	.00	0	0
A-2-S	1977	M(c)= .00	10.0	1.10	99.0	6.00	0	.00	.0	.00	150.0	.00	0	0
A-2-S	1978	M(c)= 9.20	14.9	< 4.30	101.0	7.42	9	< 7.20	.0	2.94	2200.0	.00	0	0
A-3-N	1978	M(c)= 6.60	11.6	< 4.30	82.7	3.50	8	< 7.15	.0	1.61	789.5	.00	0	0
A-3-S	1978	M(c)= 6.20	12.0	< 4.30	34.0	3.44	7	< 7.20	.0	1.76	726.0	.00	0	0
HASTINGS ARM														
H-2-E	1977	M(c)= .00	9.6	< 1.00	87.0	4.50	0	.00	.0	.00	260.0	.00	0	0
H-2-E May-June	1981	M(10)= 6.74	13.4	2.28	85.6	5.34	8	.32	1.4	1.30	364.4	17.85	2849	180
H-2-W	1977	M(c)= .00	10.0	< 1.00	89.0	5.80	0	.00	.0	.00	440.0	.00	0	0
H-2-W May-June	1981	M(10)= 7.28	16.2	2.40	131.0	7.06	10	.44	1.9	1.68	694.5	24.85	2684	339
Dobin I.E. May-June	1981	M(10)= 8.38	15.2	2.30	162.3	7.50	11	.38	1.7	1.78	587.9	17.33	3393	275
H-3-E	1978	M(c)= 7.50	14.9	< 4.35	80.7	4.34	8	< 7.30	.0	1.31	837.0	.00	0	0

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Mytilus edulis - Bivalve - Whole Body (Continued)												
ANYOX														
H-4-N	1977	M(c)= .00	27.0	< 1.00	230.0	3.30	0	.00	.0	.00	430.0	.00	0	0
H-4-N	1978	M(c)= 8.50	243.0	7.20	462.0	8.36	11	< 7.20	.0	2.98	5910.0	.00	0	0
B	1978	M(c)= 8.40	53.3	< 4.20	233.0	7.88	11	< 6.90	.0	2.73	1120.0	.00	0	0
GP	1978	M(c)= 7.30	120.0	< 4.30	202.0	5.60	8	< 7.20	.0	1.21	699.0	.00	0	0
L	1978	M(c)= 6.80	23.9	< 4.40	111.0	3.77	9	< 7.30	.0	2.33	1060.0	.00	0	0
JP	1978	M(c)= 7.70	128.0	< 4.20	264.0	7.46	8	< 7.00	.0	2.98	5910.0	.00	0	0
		Macoma sp. - Bivalve - Whole Body												
ALICE ARM														
++A-1-I	Oct. 1981	M(15)= 7.27	69.3	244.47	841.6	10.37	14	35.08	11.3	8.29	6868.0	116.60	6933	808
		Mya arenaria - Bivalve - Whole Body												
ALICE ARM														
Perry Pen.	Oct. 1980	M(12)= 8.17	21.5	1.46	108.6	1.01	7	0.71	11.8	1.71	795.7	26.59	4497	377
		Colus halli - Snail - Whole Body												
ALICE ARM														
A-1-I	Oct. 1981	M(15)= 4.58	50.3	5.48	146.7	4.82	176	1.63	1.6	1.43	655.1	106.37	8079	117
A-2-II	Oct. 1981	M(13)= 4.89	61.3	2.54	80.1	2.67	201	1.05	1.3	1.15	325.1	126.27	8409	75
HASTINGS ARM														
H-2-I	Oct. 1981	M(7)= 5.14	261.1	.09	616.0	15.29	149	.73	2.3	1.23	830.6	205.87	11286	150

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Yoldia scissurata - Bivalve - Whole Body												
ALICE ARM														
A-2-I	May-June 1981	M(3)= 5.57	541.0	163.33	498.7	24.67	15	32.97	9.7	6.90	9650.0	383.67	3273	2107
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(1)= 4.91	60.3	.80	111.0	1.04	41	<1.34	4.0	2.99	2480.0	36.10	3880	1170
		Yoldia thraciaeformis/montereyensis - Bivalve - Whole Body												
ALICE ARM														
A-1-I	Oct. 1978	M(c)= 6.38	292.0	60.00	682.0	13.40	57	<7.30	.0	9.24	1200.0	.00	0	0
A-1-I	May-June 1981	M(3)= 5.20	423.7	173.67	903.0	38.23	27	46.10	13.3	10.33	9763.3	417.67	3523	3300
A-1-I	Oct. 1981	M(15)= 6.76	226.0	177.19	1137.1	11.80	68	31.07	12.4	8.31	8024.0	110.38	6021	873
A-1-II	Oct. 1981	M(14)= 5.35	546.9	299.71	1275.7	31.53	64	37.85	16.9	11.60	14716.4	349.79	6374	2531
A-2-I	Oct. 1978	M(c)= 8.23	435.0	9.14	681.0	17.70	47	<6.86	.0	10.20	8590.0	.00	0	0
A-2-I	May-June 1981	M(11)= 5.66	543.3	141.91	896.4	37.35	52	36.91	12.8	13.05	10050.0	466.18	4065	2656
A-2-1	Oct. 1981	M(10)= 5.50	616.2	465.40	1086.8	30.99	73	61.68	20.7	14.65	14390.0	419.90	7886	2503

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
			MEAN TRACE METAL CONCENTRATION (mg/kg)											
		Yoldia thraciaeformis/montereyensis - Bivalve - Whole Body (continued)												
HASTINGS ARM														
H-2-I	Oct. 1978	M(c)= 7.88	328.0	<4.40	788.0	19.30	47	<7.30	.0	3.82	4690.0	.00	0	0
H-2-I	Oct. 1981	M(13)= 5.52	435.6	4.91	877.0	22.69	48	1.11	6.6	5.91	8041.5	483.54	7248	1887
LAREDO SOUND														
L-1-I	1981	M(9)= 5.79	54.7	8.83	613.4	1.77	107	2.31	6.4	2.41	2026.7	17.04	4680	1068
QUATSINO SOUND														
Q-1-I	1981	M(1)= 4.96	23.2	.64	169.0	1.22	26	1.73	4.1	2.83	2570.0	23.20	3770	1220
		Chionoecetes bairdi - Tanner Crab - Muscle - Leg												
ALICE ARM														
A-1-I	Oct. 1980	M(1)= 4.66	57.9	1.00	131.0	.20	56	<.20	2.0	.50	67.9	26.10	2410	23
A-1-II	May-June 1981	M(2)= 5.40	42.8	2.00	120.0	.30	72	.45	1.0	.80	58.3	62.80	3195	22
A-1-I	Oct. 1981	M(2)= 5.10	44.8	3.00	122.0	.30	145	.90	1.0	1.05	208.4	23.45	4465	78
A-1-II	Oct. 1981	M(3)= 4.60	48.1	1.33	137.3	.87	134	.30	1.3	.93	80.1	25.92	3007	44
A-2-I	Oct. 1981	M(1)= 5.20	77.5	.24	134.0	.50	207	<.20	< 1.0	.60	76.4	47.90	3180	38
A-3-I	Oct. 1980	M(1)= 5.77	53.7	1.00	116.0	.20	111	<.20	4.0	.50	25.9	2.36	6080	13
A-3-I	May-June 1981	M(2)= 7.35	26.7	1.00	109.0	< .05	79	<.20	< 1.0	1.00	24.7	.35	3710	9
A-3-I	Oct. 1981	M(1)= 4.40	73.0	<.05	130.0	.21	119	<.20	< .9	.50	35.5	2.80	3350	15
HASTINGS ARM														
H-1-I	May-June 1981	M(3)= 4.80	85.5	2.00	132.0	.53	137	.23	1.3	.83	106.7	37.07	3373	33
H-2-I	Oct. 1981	M(3)= 4.43	46.1	.68	129.7	.43	125	.27	1.0	.77	49.9	32.89	3140	27

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Lithodes aequispina - Brown King Crab - Muscle - Leg												
ALICE ARM														
A-1-I	Oct. 1978	M(2)= 5.93	32.9	< 4.25	186.5	< .72	96	< 7.15	.0	1.11	10.3	.00	0	0
A-1-I	May 1980	M(1)= 5.61	4.0	.12	17.9	< .05	49	< 7.02	.0	< .70	30.3	.00	0	0
A-1-I	Oct. 1980	M(1)= 4.31	91.8	.05	215.0	.80	164	< .20	2.0	1.30	24.2	9.66	3940	12
A-1-II	Oct. 1981	M(1)= 5.80	99.8	< .05	214.0	.20	115	.40	3.0	1.50	120.0	6.55	4590	67
A-2-I	Oct. 1978	M(3)= 5.79	61.4	< 4.27	187.0	< .72	111	< 7.17	.0	1.26	12.4	.00	0	0
A-2-I	Oct. 1981	M(2)= 5.10	85.7	1.02	172.5	.30	133	< .20	1.0	.80	28.9	10.66	3210	13
HASTINGS ARM														
H-2-1	Oct. 1978	M(1)= 6.93	85.3	< 4.24	189.0	< .71	104	< 7.10	.0	< .94	12.7	.00	0	0
		Crangon communis - Shrimp - Tail Only												
ALICE ARM														
A-1-I	Oct. 1978	M(c)= 4.86	70.0	< 4.40	51.3	.99	43	< 7.40	.0	1.82	124.0	.00	0	0
A-3-I	Oct. 1978	M(c)= 4.51	44.7	< 4.33	67.1	.79	41	< 7.20	.0	1.72	167.8	.00	0	0
A-3-I	Oct. 1981	M(15)= 3.93	81.0	2.00	80.1	.47	102	.21	1.2	1.07	250.8	56.91	3931	109
CHATHAM SOUND														
C-1-I	Oct. 1981	M(10)= 4.09	59.1	.17	52.5	.63	44	3.49	3.9	.79	276.2	27.44	4332	149
LAREDO SOUND														
L-1-I	Oct. 1981	M(4)= 3.70	63.1	.10	70.1	4.03	32	< 1.45	< 6.4	.80	155.8	9.27	3728	84

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Crangon communis - Shrimp - Whole Body												
ALICE ARM														
A-2-I	May-June 1981	M(14)= 3.78	73.4	3.00	73.0	.89	77	.47	1.5	1.18	399.6	43.18	4036	175
A-3-I	Oct. 1978	M(c)= 4.08	55.9	<4.40	72.4	1.05	31	< 7.33	.0	< .68	219.7	.00	0	0
CHATHAM SOUND														
C-1-I	May 1981	M(15)= 4.55	62.9	2.96	66.2	.55	31	.24	6.2	.89	381.3	6.88	3889	195
		Pandalopsis dispar - Sidestripe Shrimp - Muscle												
ALICE ARM														
A-1-I	Oct. 1978	M(c)= 4.79	29.2	<4.23	48.6	1.03	55	< 7.07	.0	2.55	57.7	.00	0	0
A-1-I	Oct. 1980	M(15)= 4.44	16.3	.63	59.6	.29	49	.26	1.2	.70	120.8	8.59	1690	49
A-1-I	May-June 1981	M(7)= 3.91	35.4	.99	55.4	.59	57	.21	< 1.0	.67	44.7	4.52	2021	18
A-1-III	May-Jun 1981	M(15)= 1.39	36.3	.89	57.4	.51	51	.30	1.0	.75	90.6	6.21	1823	53
A-1-I	Oct. 1981	M(8)= 4.30	18.0	1.85	57.1	.23	66	.34	1.3	.94	135.4	7.92	2039	39
A-1-II	Oct. 1981	M(8)= 4.45	16.2	.68	57.2	.22	61	.18	1.1	1.16	209.4	10.34	2074	97
A-2-I	Oct. 1978	M(c)= 4.74	42.9	<4.30	52.2	1.63	67	< 7.20	.0	1.22	46.7	.00	0	0
A-2-I	Oct. 1981	M(12)= 4.55	19.2	.08	56.9	.08	60	.20	1.1	.68	30.7	2.99	1748	13
A-2-II	Oct. 1981	M(15)= 4.40	19.9	.23	55.1	.15	69	.21	1.5	.71	52.5	7.32	1961	24
A-3-I	Oct. 1978	M(c)= 4.97	31.7	<4.35	50.1	< .72	98	< 7.25	.0	1.46	36.2	.00	0	0
A-3-I	May 1980	M(1)= 4.16	48.1	.56	56.4	.39	98	< 7.17	.0	< .72	204.0	.00	0	0
A-3-I	Oct. 1980	M(15)= 4.37	15.4	.12	61.8	.13	80	< .22	1.1	.59	26.7	1.90	2015	14
A-3-I	May-June 1981	M(15)= .00	34.5	.45	56.8	.30	83	.25	1.0	.73	37.5	2.30	2073	18

Continued ...

TABLE 4 : COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Pandalopsis dispar - Sidestripe Shrimp - Muscle (continued)												
HASTINGS ARM														
H-1-I	Oct. 1978	M(c)= 5.08	36.4	<4.40	49.4	1.58	38	<7.30	.0	1.78	44.9	.00	0	0
H-1-I	May-June 1981	M(4)= 4.25	34.2	.10	59.2	.53	41	.20	1.0	.68	44.5	22.98	2020	15
H-1-I	Oct. 1981	M(15)= 4.87	17.8	< .05	55.9	.11	49	.20	1.1	.55	35.4	3.65	2091	17
H-2-I	Oct. 1978	M(c)= 4.87	34.7	<4.33	54.8	1.34	28	<7.27	.0	1.19	91.5	.00	0	0
H-2-I	Oct. 1981	M(15)= 4.44	21.8	.12	55.5	.13	43	.22	1.1	.65	52.1	16.58	1902	31
H-3-I	Oct. 1978	M(c)= 4.89	33.1	<4.40	47.4	< .72	44	<7.30	.0	< .96	29.0	.00	0	0
H-4-I	Oct. 1978	M(c)= 5.04	30.9	<4.35	48.3	< .72	9	<7.20	.0	.96	138.4	.00	0	0
CHATHAM SOUND														
C-1-I	Oct. 1981	M(15)= 4.53	16.9	<.05	46.0	.06	69	<1.49	< 4.0	.84	22.2	.66	1801	12
LAREDO SOUND														
L-1-I	Oct. 1981	M(15)= 4.58	21.6	<.05	44.4	.09	43	<1.46	< 3.9	< .73	16.0	.47	1849	11
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(15)= 4.32	23.1	.06	47.8	.06	40	<1.47	< 3.9	.78	19.4	.64	1644	12
		Pandalopsis dispar - Sidestripe Shrimp - Whole Body												
ALICE ARM														
A-1-III	May-Jun 1981	M(13)= .00	82.9	3.15	65.1	4.60	45	1.29	1.5	1.55	504.2	51.35	4298	263
A-3-I	May-June 1981	M(15)= .00	114.8	1.28	65.0	1.39	53	.23	1.4	1.21	361.8	17.41	4462	185

Continued...

TABLE 4 : COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
			MEAN TRACE METAL CONCENTRATION (mg/kg)											
		Pandalopsis dispar - Sidestripe Shrimp - Whole Body (continued)												
HASTINGS ARM														
H-1-I	Oct. 1978	M(c)= 4.63	96.4	< 4.20	57.5	4.40	23	< 7.00	.0	1.22	264.0	.00	0	0
H-2-I	Oct. 1978	M(c)= 4.44	95.0	< 4.35	81.0	6.58	25	< 7.20	.0	1.53	676.5	.00	0	0
LAREDO SOUND														
L-1-I	Oct. 1981	M(15)= 3.71	85.4	.09	53.7	2.20	29	< 1.48	4.3	1.05	140.4	4.10	3823	133
		Pandalus borealis - Pink Shrimp - Muscle												
ALICE ARM														
A-1-I	Oct. 1978	M(c)= 4.82	33.6	< 4.33	50.3	< .73	57	< 7.23	.0	1.19	48.0	.00	0	0
A-1-I	Oct. 1980	M(30)= 4.32	15.5	.17	56.7	.18	70	< .21	1.4	.57	35.6	6.03	1650	15
A-1-I	May-June 1981	M(5)= 4.08	32.9	.99	65.0	.49	62	< .20	< .9	.84	44.5	19.76	2096	13
A-1-III	May-Jun 1981	M(15)= 4.37	25.1	1.03	55.5	.27	55	.37	1.0	.91	115.2	15.82	1783	55
A-1-II	Oct. 1981	M(16)= 4.23	19.3	.15	55.3	.08	83	.20	.9	.82	126.1	9.96	2095	59
A-2-I	Oct. 1978	M(c)= 4.84	49.6	< 4.30	57.3	.87	52	< 7.20	.0	< .96	19.2	.00	0	0
A-2-II	Oct. 1981	M(15)= 3.94	18.0	.45	59.0	.08	80	.20	1.0	.72	47.9	8.94	1679	18
A-3-I	Oct. 1978	M(c)= 4.63	21.0	< 4.20	47.1	< .69	96	< 6.90	.0	1.73	17.0	.00	0	0
A-3-I	Oct. 1980	M(15)= 4.40	13.0	.09	59.3	.17	99	.21	1.0	.66	22.3	5.91	1866	10
A-3-I	May-June 1981	M(15)= 3.46	33.5	.33	58.2	.23	94	.23	1.0	.75	51.8	4.46	1739	21
A-3-I	Oct. 1981	M(16)= 4.12	23.6	.06	54.8	.07	136	< .20	1.2	.56	17.7	3.30	1798	9

Continued...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Pandalus borealis - Pink Shrimp - Muscle (continued)												
HASTINGS ARM														
H-1-I	Oct. 1981	M(15)= 4.51	16.2	.06	49.7	.07	49	.20	1.0	.48	18.2	3.09	1725	8
H-2-I	Oct. 1978	M(c)= 5.00	34.2	<4.50	49.8	< 7.46	43	<7.50	.0	< .99	46.8	.00	0	0
H-2-I	Oct. 1981	M(8)= 3.91	31.6	.46	55.3	.16	59	.20	1.3	.76	57.3	26.40	1536	30
H-3-I	Oct. 1978	M(c)= 4.61	44.0	<4.25	48.2	< 7.13	48	<7.10	.0	2.12	40.2	.00	0	0
H-4-I	Oct. 1978	M(c)= 5.01	49.8	<4.25	57.2	< .71	20	<7.15	.0	1.00	194.4	.00	0	0
H-4-I	May 1980	M(1)= 4.21	42.9	.59	54.2	.12	21	<7.32	.0	< .73	70.5	.00	0	0
CHATHAM SOUND														
C-1-I	May 1981	M(8)= 4.43	27.4	<.29	57.1	.29	75	.22	1.2	.91	200.3	3.32	2127	88
C-1-I	Oct. 1981	M(15)= 4.27	21.5	.09	52.6	.11	60	<1.48	< 3.9	1.01	18.3	.98	1647	8
LAREDO SOUND														
L-1-I	Oct. 1981	M(15)= 4.27	21.2	.09	53.2	.10	38	<1.46	5.5	1.90	31.9	1.09	1730	7
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(15)= 4.21	20.7	.13	52.1	.07	65	1.47	3.9	.77	20.8	.88	1813	12

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)											
	WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
	Pandalus borealis - Pink Shrimp - Whole Body												
ALICE ARM													
A-1-I Oct. 1978	M(c)= 4.89	102.7	5.03	60.8	2.81	24	< 7.30	.0	1.86	980.7	.00	0	0
A-1-III May-Jun 1981	M(15)= 4.35	109.9	6.58	78.0	2.43	47	2.02	1.9	1.47	1250.5	88.42	4144	542
A-2-I Oct. 1978	M(c)= 4.98	108.0	<4.30	82.4	3.95	28	< 7.20	.0	1.45	564.0	.00	0	0
A-3-I May-June 1981	M(15)= 3.67	102.0	1.17	72.1	1.44	65	.31	1.8	1.30	407.1	22.59	3854	185
HASTINGS ARM													
H-2-I Oct. 1978	M(c)= 4.95	117.0	<4.30	69.1	3.18	29	< 7.10	.0	2.02	670.0	.00	0	0
H-4-I Oct. 1978	M(c)= 5.24	110.0	<4.30	64.3	1.43	16	< 7.20	.0	1.38	901.0	.00	0	0
LAREDO SOUND													
L-1-I Oct. 1981	M(15)= 3.60	95.1	.19	66.1	1.85	26	< 1.48	<3.9	.92	99.7	3.60	2693	72
	Pandalus hypsinotus - Humpback Shrimp - Muscle												
ALICE ARM													
A-3-I Oct. 1978	M(c)= 4.88	29.1	<4.50	56.2	< .75	108	< 7.50	.0	1.59	14.3	.00	0	0
A-3-I May-June 1981	M(15)= .00	35.7	.09	65.4	.18	82	< .22	<1.0	.73	29.8	2.88	1975	13
HASTINGS ARM													
H-5-I May-June 1981	M(12)= 4.42	39.5	.15	78.2	.19	68	< .20	<1.0	.67	27.9	1.50	2005	12
CHATHAM SOUND													
C-1-I May 1981	M(3)= 4.59	112.3	.11	67.2	.17	50	< .30	2.0	.77	113.2	2.04	2390	46

Continued ...

TABLE 4 : COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Pandalus hypsinotus - Humpback Shrimp - Whole Body												
ALICE ARM														
A-3-I	Oct. 1978	M(c)= 3.12	46.3	<4.40	99.8	< .73	39	<7.30	.0	< .97	88.2	.00	0	0
		Atheresthes stomias - Arrowtooth Flounder - Muscle												
ALICE ARM														
A-1-I	May 1980	M(2)= 5.04	4.5	.33	21.3	< .05	18	<7.17	.0	< .72	26.8	.00	0	0
CHATHAM SOUND														
C-1-I	May 1981	M(3)= 5.40	5.7	.70	21.1	< .05	25	.37	1.7	1.17	37.9	.75	1493	16
C-1-I	Oct. 1981	M(2)= 5.32	5.7	< .05	19.2	< .05	11	<1.42	6.1	3.57	67.8	1.35	1645	21
LAREDO SOUND														
L-1-I	Oct. 1981	M(1)= 5.24	6.2	< .05	17.3	< .05	11	<1.47	< 3.9	.80	31.7	.40	1620	21
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(1)= 5.01	3.3	< .05	17.6	< .05	< 7	<1.41	< 3.81	.81	33.4	.14	1490	9
		Eopsetta jordani - Petrale Sole - Muscle												
ALICE ARM														
A-3-I	May-June 1981	M(3)= 5.90	4.4	2.38	22.4	< .05	131	< .23	2.7	2.40	127.7	2.65	1337	14
A-3-I	Oct. 1981	M(3)= 5.60	3.7	.09	22.5	.08	61	< .20	1.0	.90	42.1	1.72	1410	17

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		Eopsetta jordani - Petrale Sole - Muscle (continued)												
LAREDO SOUND														
L-1-I	Oct. 1981	M(1)= 5.08	6.0	<.05	20.8	< .05	<7	< 1.48	<3.9	1.45	38.7	.51	1600	15
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(3)= 5.18	3.8	<.05	16.5	< .05	76	< 1.47	<3.9	1.15	29.4	.41	1417	9
		Glypocephalus zachirus - Rex Sole - Muscle												
CHATHAM SOUND														
C-1-I	May 1981	M(7)= 5.32	6.7	.33	17.2	.17	59	< .20	2.3	.97	52.7	1.15	1339	26
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(1)= 5.84	2.9	<.05	22.5	< .05	128	< 1.49	<4.0	.79	98.8	2.01	1460	46
		Hippoglossoides elassodon - Flathead Sole - Muscle												
ALICE ARM														
A-1-I	Oct. 1978	M(1)= 4.74	4.2	<4.40	23.6	< .73	19	< 7.30	.0	< .98	20.7	.00	0	0
A-1-I	May 1980	M(5)= 5.94	5.6	.41	19.8	.05	52	< 7.20	.0	< .72	12.3	.00	0	0
Somerville	May-June 1981	M(3)= 5.37	2.5	.22	18.7	.05	19	< .20	1.0	1.07	27.3	.37	1133	8
CHATHAM SOUND														
C-1-I	May 1981	M(7)= 5.55	5.0	.52	18.6	.22	29	.23	3.9	2.00	59.3	1.00	1283	30

Continued ...

TABLE 4 : COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		MEAN TRACE METAL CONCENTRATION (mg/kg)												
		Microstomus pacificus - Dover Sole - Muscle												
ALICE ARM														
A-1-I	Oct. 1980	M(1)= 3.61	3.4	.18	15.4	< .05	126	< .20	< 1.0	.50	10.8	1.81	742	6
QUATSINO SOUND														
Q-1-I	Sept. 1981	M(1)= 5.41	10.4	< .05	20.4	< .05	195	< 1.45	< 3.9	1.36	38.3	.58	1760	17
		Parophrys vetulus - English Sole - Muscle												
ALICE ARM														
A-3-I	Oct. 1980	M(6)= 4.61	5.6	.15	33.1	< .05	28	< .20	2.0	.65	24.1	2.37	1232	9
A-3-I	May-June 1981	M(4)= 5.50	3.9	1.31	24.0	< .05	78	.20	< 1.0	1.20	34.0	1.29	1368	11
A-3-I	Oct. 1981	M(3)= 5.13	8.8	.41	27.4	.10	96	< .23	1.7	1.00	37.1	1.88	1297	15
Somerville	May-June 1981	M(1)= 5.00	4.0	.17	20.3	< .05	29	< .20	< 1.0	1.00	19.0	.25	1060	5
		Theragra chalcogramma - Walleye Pollock - Muscle												
ALICE ARM														
A-1-I	Oct. 1978	M(3)= 5.23	10.4	<4.37	26.5	< .73	17	<7.30	.0	1.07	75.8	.00	0	0
A-1-I	May 1980	M(2)= 5.06	6.1	.23	22.8	.14	20	<7.23	.0	< .72	29.0	.00	0	0
A-2-I	Oct. 1978	M(2)= 5.18	6.0	<4.10	25.3	< .68	21	<6.90	.0	1.05	31.8	.00	0	0
A-3-I	Oct. 1978	M(3)= 4.87	6.5	<4.30	38.7	< .72	15	<7.20	.0	1.69	40.1	.00	0	0
A-3-I	May-June 1981	M(3)= 5.30	7.5	.69	27.3	< .05	32	<.20	1.0	2.07	36.8	1.15	1867	9
A-3-I	Oct. 1981	M(1)= 5.30	7.0	.16	25.3	.40	34	<.20	4.0	1.50	49.3	2.63	1470	19

Continued ...

TABLE 4: COMPARISON OF MEAN TRACE METAL CONCENTRATIONS (mg/kg dry weight) IN TISSUES IN ALICE ARM (1977, 1978, 1980, 1981) AND CONTROL AREAS (1981)

SURVEY AND STATION		WET/DRY RATIO	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
		Theragra chalcogramma - Walleye Pollock - Muscle (continued)												
HASTINGS SOUND														
H-3-I	Oct. 1978	M(2)= 5.21	6.6	< 4.25	24.4	<.70	31	< 7.05	.0	1.38	107.0	.00	0	0
H-4-I	Oct. 1978	M(1)= 5.08	17.3	< 4.30	59.3	<.72	< 7	< 7.20	.0	1.74	118.0	.00	0	0
CHATHAM SOUND														
C-1-I	May 1981	M(2)= 5.62	9.8	1.52	31.9	6.04	23	< .20	1.0	2.85	99.3	1.50	1540	3

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APPENDIX 1: Sediment Sampling Stations Coordinates and Depths - Alice Arm, Hastings Arm - October 1981

APPENDIX 1: Sediment Sampling Stations Coordinates and Depths - Alice Arm, Hastings Arm - October 1981

Station	Coordinates		Depth (m)	Core Length (cm)
B6	55° 28.20'N	129° 29.40 W	82	100
			78	grab
B2	28.20'N	28.70'W	69	grab
M9	27.10'N	29.90'W	164	129
			164	grab
L10	27.20'N	30.08'W	164	grab
Q20	26.70'N	31.84'W	275	127
032	26.90'N	33.95'W	369	130
			369	grab
M49	27.10'N	36.95'W	390	175
V64	26.2'N	35.55'W	66	grab
B68	25.6'N	40.30'W	197	33
A12	24.7'N	40.60'W	80	133
A15	24.6'N	48.6'W	52	99
H4	23.5'N	45.8'W	137	125
H2	28.87'N	45.5'W	308	137
H1	35.50'N	47.50'W	147	70

APPENDIX 2: Sediment Standard Reference Materials - EPS Laboratory Results

Appendix 2

Sediment Standard Reference Materials - EPS Laboratory Results

For - Cd, Cu, Pb, Zn (6 month period).

BCSS-1 Marine Sediment[1]

	Certified Value (Mg/g)	Lab. Serv. Value (Mg/g)	% Variation	No. of values	Deviation from Certified Value	% Deviation from Certified Value
Cd	0.25 ± .04	0.5		11	-	-
Cu	18.5 ± 2.7	17.5 ± 1.9	11%	11	- 1	- 5.4 %
Pb	22.7 ± 3.4	20.4 ± 2.0	10%	11	- 2.3	- 10 %
Zn	119 ± 12	102 ± 4	4%	11	- 17	- 14 %

MESS - 1 Marine Sediment [1]

	Certified Value (Mg/g)	Lab. Serv. Value (Mg/g)	% Variation	No. of values	Deviation from Certified Value	% Deviation from Certified Value
Cd	0.59 ± .10	.72 ± .12	17%	6*	+ 1.3	+ 22%
Cu	25.1 ± 3.8	26.1 ± 3.1	12%	12	+ 1	+ 3.9%
Pb	34.0 ± 6.1	38.7 ± 2.3	8%	12	- 5.3	- 16%
Zn	191 ± 17	174 ± 7	4%	12	- 17	- 8.9%

NBS - 1645 River Sediment[1]

	Certified Value (Mg/g)	Lab. Serv. Value (Mg/g)	% Variation	No. of values	Deviation from Certified Value	% Deviation from Certified Value
Cd	10.2 ± 1.5	8.0 ± 2.1	26%	11	- 2.2	- 22%
Cu	109 ± 19	120 ± 12	10%	12	+ 11	+ 10%
Pb	714 ± 28	636 ± 51	8%	12	- 78	- 11%
Zn	1720 ± 169	1670 ± 96	8%	12	- 50	- 2.9%

* Detection Limit lowered - only 6 values for new limit.

Note: 1. Certified values are total. Lab. Serv. values are strong acid leach and should be within or less than certified range.

2. The quantity of element leached depends on the geochemistry and the sample will vary from sample to sample.

[1] BCSS-1 and MESS 1 obtained from the National Research Council of Canada, Division of Chemistry, Marine Analytical Chemistry Standards Program.

[2] 1645 River Sediment obtained from U.S. Department of Commerce, National Bureau of Standards.

APPENDIX 3 - Interlaboratory Analysis of Split Sediment Samples collected by Dobrocky Seatech Ltd. in Alice Arm, August 1981

APPENDIX 3: INTERLABORATORY ANALYSIS OF SPLIT SEDIMENT SAMPLES COLLECTED BY DOBROCKY SEATECH LTD. IN ALICE ARM, AUGUST 81[1]

	Cu		Pb		Zn		Cd		As		Mo	
STATION	EPS	DS	EPS	DS	EPS	DS	EPS	DS	EPS	DS	EPS	DS
OUTFALL STN	81.5	80.04	290.0	308.65	986.0	1035.27	28.07	27.94	1.06	7.73	373.0	410.20
OUTFALL E	97.4	96.70	193.0	213.39	312.0	351.81	5.98	6.27	11.7	20.27	213.0	259.86
OUTFALL W	76.3	76.90	99.9	103.88	231.0	253.40	2.49	2.90	13.1	18.31	108.0	126.07
AAN INT	77.9	80.06	23.3	26.34	175.0	203.80	L .677	.71	16.1	36.11	L 2.5	9.89
50	87.6	88.53	45.3	50.61	193.0	209.85	L .657	.94	25.3	37.67	20.4	29.67
100	85.9	84.10	48.7	50.82	190.0	203.91	L .666	1.36	27.0	30.68	33.1	39.73
AAM	87.5	86.34	86.7	89.09	238.0	265.02	2.64	3.10	11.8	31.96	93.5	115.12
AAS 100	87.5	82.60	109.0	117.23	265.0	278.96	3.72	3.91	14.9	21.08	125.0	143.49
50	74.8	77.36	125.0	116.17	288.0	299.99	4.95	4.63	15.3	20.00	304.0	370.61
AAS INT	117.0	113.46	314.0	338.89	441.0	471.82	10.7	11.62	9.74	11.40	274.0	324.81
BBN INT	71.6	70.77	29.8	17.85	191.0	173.26	L .653	.84	17.0	29.93	6.2	9.65
BBN 50	88.6	90.61	62.4	66.62	202.0	225.07	1.15	1.54	27.6	32.84	81.5	105.36
100	70.2	68.33	287.0	305.37	1010.0	1084.35	28.0	28.96	4.84	6.51	279.0	330.54
BBM	98.7	92.03	195.0	204.64	550.0	561.86	14.5	14.62	5.91	10.31	284.0	331.54
BBS 100	78.5	78.21	94.4	98.17	237.0	262.41	2.42	2.26	22.7	24.66	140.0	177.40
BBS 50	77.2	72.84	77.3	78.72	257.0	273.28	2.83	3.08	27.4	25.05	201.0	241.96
BBS INT	31.6	34.10	16.9	20.11	160.0	180.18	L .644	1.01	13.6	12.98	17.5	26.97
CCN INT	54.8	56.84	33.1	33.20	188.0	175.05	L .667	.81	11.6	16.80	33.2	17.61
50	76.8	76.73	62.7	67.47	190.0	212.37	L .656	.48	21.2	29.70	34.4	57.21
100	80.6	80.44	92.6	98.30	224.0	249.78	1.37	1.14	21.9	30.51	64.1	89.38
CCM	96.0	92.90	208.0	239.08	518.0	547.89	13.9	14.12	15.9	21.13	263.0	329.64
CCS 100	68.1	75.34	38.0	43.71	166.0	195.93	L .653	.40	16.7	23.57	21.4	39.54
50	68.9	74.50	108.0	108.00	226.0	259.75	1.13	.98	10.9	17.57	27.6	50.00
INT	61.1	65.94	25.9	22.56	163.0	187.41	L .553	.37	13.1	19.98	L 2.45	9.92
DDN INT	55.2	61.17	42.6	49.38	148.0	176.42	L .645	.39	9.55	22.56	18.7	36.88
50	68.8	73.98	60.1	61.07	184.0	209.29	L .648	.37	25.5	27.81	31.4	49.65
100	70.3	77.06	77.8	80.01	203.0	228.46	L .661	.64	22.8	27.55	32.6	49.24

[1]EPS replicates of 2 except arsenic, Dobrocky Seatech replicate of 2 or 3, expressed as mean dry weight, ug/g.

APPENDIX 3: INTERLABORATORY ANALYSIS OF SPLIT SEDIMENT SAMPLES COLLECTED BY DOBROCKY SEATECH LTD. IN ALICE ARM, AUGUST 81[1]

STATION	Cu		Pb		Zn		Cd		As		Mo	
	EPS	DS	EPS	DS	EPS	DS	EPS	DS	EPS	DS	EPS	DS
DDM	83.2	86.80	180.0	206.08	510.0	565.04	12.9	13.43	12.5	17.89	255.0	307.69
DDS 100	44.6	46.97	29.1	25.11	124.0	139.89	L .66	.28	9.5	11.55	7.68	22.61
50	39.5	42.64	29.2	22.98	119.0	137.61	L .658	.80	8.49	12.38	5.43	16.90
INT	60.2	68.82	19.4	19.27	160.0	196.19	L .65	.55	14.4	22.52	L 2.44	15.02
EEN INT	35.2	41.58	24.6	20.29	102.0	127.76	L .666	.48	7.69	14.58	4.91	17.54
50	57.7	63.50	40.3	41.24	154.0	182.49	L .653	.72	7.83	12.32	L 2.94	15.00
100	67.6	69.54	54.8	56.50	185.0	200.91	L .661	.36	14.4	18.78	13.3	24.16
EEM	86.5	90.09	178.0	192.89	577.0	619.74	14.3	14.76	11.3	19.97	243.0	286.21
EES 100	41.0	43.73	25.6	19.49	116.0	131.68	L .662	L .25	9.6	12.09	L 2.48	10.00
50	31.9	32.37	15.5	12.44	94.5	111.04	L .661	L .25	8.75	11.03	L 2.48	7.50
INT	33.9	37.13	18.6	22.88	117.0	133.08	L .662	L .30	6.96	10.83	L 2.48	7.92
FFN INT	56.7	62.34	19.6	19.34	153.0	181.99	L .657	1.02	10.00	15.65	L 2.46	10.18
50	40.1	51.42	27.9	28.28	120.0	147.09	L .651	L .25	6.27	7.81	4.63	9.68
100	53.0	57.30	38.7	41.17	142.0	157.95	L .651	L .25	4.63	10.36	8.31	16.44
FFM	36.8	40.32	14.3	14.72	103.0	115.77	L .655	L .25	5.89	13.00	L 2.46	8.48
100	30.8	35.22	7.79	6.73	85.2	102.94	L .663	L .25	4.69	7.00	L 2.48	5.73
50	19.4	20.09	L 9.51	5.50	65.3	72.54	L .648	L .25	4.74	3.03	L 2.43	L 5.00
FFS INT	20.9	80.96	6.59	3.93	64.7	72.00	L .659	L .25	6.41	6.59	L 2.47	L 4.93
STN G	43.6	49.60	21.2	18.98	113.0	126.62	L .659	L .25	4.87	10.19	L 2.47	8.49
HHW INT	34.7	37.96	14.1	13.99	102.0	126.62	L .649	.60	6.09	10.16	L 2.44	14.99
50	46.8	56.57	22.3	21.65	122.0	145.10	L .66	L .25	8.45	12.22	L 2.47	6.47
100	45.6	49.18	18.2	19.00	114.0	126.44	L .664	L .25	6.12	11.47	L 2.49	7.50
HHM	42.4	46.16	17.3	16.20	111.0	118.33	L .657	L .25	7.24	11.98	L 2.46	7.22
HHE 100	41.3	42.64	12.4	13.97	104.0	113.52	L .653	L .25	6.0	7.01	L 2.45	4.99
50	40.9	45.64	15.8	15.54	109.0	120.55	L .667	L .25	6.03	12.03	L 2.5	6.27
INT	40.5	43.88	14.1	13.79	118.0	136.66	L .649	.50	8.56	11.54	L 2.44	7.53
NBS STANDARD	127.0		691.0		1780.0		9.71				L 14.9	

[1]EPS replicates of 2 except arsenic, Dobrocky Seatech replicate of 2 or 3, expressed as mean dry weight, ug/g.

APPENDIX 3: INTERLABORATORY ANALYSIS OF SPLIT SEDIMENT SAMPLES COLLECTED BY DOBROCKY SEATECH LTD. IN ALICE ARM, AUGUST 81[1]

	Ni	Cr	Fe	Mn	Mg	Al
STATION	EPS	EPS	EPS	EPS	EPS	EPS
OUTFALL STN	10.0	13.7	12100	929	7060	13800
OUTFALL E	26.5	34.9	36600	809	11900	21700
OUTFALL W	42.7	56.2	39700	752	14400	26300
AAN INT	31.0	44.8	48900	951	17600	35400
50	28.7	39.6	49300	1200	15800	30200
100	30.1	41.2	48800	1630	15400	30300
AAM	28.4	38.1	44200	1610	14200	28400
AAS 100	24.8	35.6	42220	1310	13400	25900
50	31.5	40.4	39700	758	11800	23000
AAS INT	22.1	36.5	35100	1120	11100	20300
BBN INT	30.1	40.9	45300	989	15800	31300
BBN 50	35.6	42.8	48900	989	15600	31300
100	7.54	--	21100	948	7090	14700
BBM	17.4	24.7	29300	1000	8890	18000
BBS 100	38.5	49.8	43800	961	14400	27900
BBS 50	45.4	60.3	46000	882	14900	27900
BBS INT	101.0	156.0	38700	1000	14500	25000
CCN INT	37.2	46.1	37800	734	14700	29800
50	28.1	43.7	47300	1100	16100	31300
100	32.8	43.0	45900	1360	15500	30000
CCM	18.8	24.1	31000	1020	8120	15600
CCS 100	33.6	52.2	44900	957	16200	29700
50	28.1	51.1	40800	848	15400	28700
INT	43.8	61.1	44100	1070	16800	35700
DDN INT	36.8	45.1	38200	1300	14600	30000
50	33.3	56.4	45700	910	17100	31800
100	30.7	49.4	44300	1260	16400	29900

[1]EPS replicates of 2 except arsenic, Dobrocky Seatech replicate of 2 or 3, expressed as mean dry weight, ug/g.

APPENDIX 3: INTERLABORATORY ANALYSIS OF SPLIT SEDIMENT SAMPLES COLLECTED BY DOBROCKY SEATECH LTD. IN ALICE ARM, AUGUST 81[1]

	Ni	Cr	Fe	Mn	Mg	Al
STATION	EPS	EPS	EPS	EPS	EPS	EPS
DDM	17.7	23.9	29000	1270	8380	15400
DDS 100	28.2	48.0	40100	629	14600	27400
50	25.2	51.1	40200	619	13300	24600
INT	29.4	44.8	42300	917	16600	37900
EEN INT	36.5	43.4	26900	1200	11300	22900
50	37.1	60.5	38000	729	15900	30100
100	36.5	63.9	45300	1110	17700	33900
EEM	20.2	29.2	31300	1260	10100	20400
100	40.8	62.9	36500	861	13500	25400
50	34.3	56.9	32700	838	11900	22500
EES INT	37.8	62.4	39100	1160	13300	31100
FFN INT	42.4	57.5	41300	931	16600	33400
50	43.7	77.7	32600	591	14400	26000
100	49.4	84.9	37600	752	16300	29000
FFM	36.8	58.8	37700	1740	12900	24500
FFS 100	33.7	55.0	33800	726	11600	21400
50	25.2	46.8	32900	662	9260	16500
FFS INT	32.4	43.6	31200	806	8590	16600
STNG	39.5	59.4	35600	1110	13400	23800
HHW INT	44.6	60.4	35400	771	12800	22100
50	35.6	59.1	36200	787	14000	24300
100	36.2	56.7	35200	699	13600	23300
HHM	33.9	57.2	34800	739	13300	24200
HHE 100	32.9	56.7	32200	669	12300	21900
50	35.5	57.5	36200	714	13600	24200
INT	42.1	55.6	35200	925	13900	26800
NBS STANDARD	54.1	22000.0	106000	846	6560	6760

[1]EPS replicates of 2 except arsenic, Dobrocky Seatech replicate of 2 or 3, expressed as mean dry weight, ug/g.

APPENDIX 4: Otter Trawl Coordinates and Depths, Alice Arm and Hastings Arm, May-June and October 1981

APPENDIX 4: OTTER TRAWL COORDINATES AND DEPTHS, ALICE ARM AND HASTINGS ARM, MAY-JUNE AND OCTOBER 1981

TRAWL NO.	DATE	DEPTH (metres)		LATITUDE	LONGITUDE
A-1	May-June &	start:	235	55°26.72'N	129°31.95'W
	October 1981	finish:	182	55°26.83'N	129°30.33'W
A-2	June &	start:	355	55°27.10'N	129°36.86'W
	October 1981	finish:	362	55°27.00'N	129°35.05'W
A-3	June &	start:	55	55°25.11'N	129°40.58'W
	October 1981	finish:	91	55°24.09'N	129°41.08'W
H-1	June &	start:	265	55°33.82'N	129°47.68'W
	October 1981	finish:	247	55°34.82'N	129°47.78'W
H-2	October 1981	start:	307	55°28.91'N	129°45.49'W
		finish:	293	55°29.19'N	129°45.89'W
H-5	June 1981	start:	46	55°22.82'N	129°47.65'W
		finish:	81	55°23.64'N	129°46.63'W
Sommerville	June 1981	start:	50	54°42.48'N	130°16.69'W
Is.		finish:	50	54°42.26'N	130°17.74'W

APPENDIX 5: Intertidal Sampling Station Coordinates - Alice Arm and Hastings Arm, May-June and October 1981

APPENDIX 5: INTERTIDAL SAMPLING STATION COORDINATES - ALICE ARM AND HASTINGS ARM - MAY-JUNE 1981.

STATION	SPECIES	LATITUDE	LONGITUDE
OUTF. BAY	Hyas lyratus	55° 26.74'N	129° 29.65'W
OUTFALL B.	Mytilus edulis	55° 26.74'N	129° 29.65'W
H-2-W	Mytilus edulis	55° 28.34'N	129° 45.95'W
H-2-E	Mytilus edulis	55° 28.42'N	129° 43.70'W
DOBEN IS. E.	Mytilus edulis	55° 27.93'N	129° 45.72'W

APPENDIX 6A - Tissue Standard Reference Materials - EPS
Laboratory Results.

6B - Tissue Trace Metal Analysis -
Interlaboratory Comparisons.

APPENDIX 6A: TISSUE STANDARD REFERENCE MATERIALS - EPS LABORATORY RESULTS

Elements	NBS 1577 - Bovine Liver (1978-1982 Data)		NBS 1566 - Oyster Tissue (1979-1982 Data)	
(ICAP)	Certified (ug/g dry)	Found	Certified (ug/g dry)	Found
As	0.053 ± 0.01	L 2.	13.4 ± 1.9	12.1 ± 1.3
Cd	0.27 ± 0.04	0.31 ± 0.05	3.5 ± 0.4	3.6 ± 0.3
Cr	0.65 ± 0.73	0.60 ± 0.14	0.65 ± 0.27	0.79 ± 0.15
Mn	10.3 ± 1.0	9.59 ± 0.31	17.5 ± 1.2	16.3 + 1.2
Mo	3.1 ± 0.5	3.48 ± 0.16	(L0.2)	0.2 ± 0.1
Cu	193 ± 10	195 ± 10	63.0 ± 3.5	65.5 ± 4.1
Zn	130 ± 10	137 ± 6	852 ± 14	857 ± 46
Fe	270 ± 20	255 ± 8	195 ± 34	162 ± 9
Mg	587 ± 20 (605)	590 ± 29	0.128 ± 0.009	0.118 ± 0.00
(Graphite Furnace)				
Pb	0.34 ± 0.08	0.43 ± 0.02	0.48 ± 0.04	0.45 ± 0.03

APPENDIX 6B: TISSUE TRACE METAL ANALYSIS - INTERLABORATORY COMPARISONS*

	As	Cd	Cu	Mo	Pb	Zn
Chinocardium						
Seatech	4.25(.91)	0.46(.07)	3.82(.7)	L 5	L 0.07	67.9(.17)
Lab #2	5.58(.49)	0.38(.14)	2.42(.08)	L 2	0.72(.26)	75.5(1.37)
EPS Lab	5	0.7(.14)	3.4(.72)	0.2(.04)	L 0.05	79.8(8.6)
Lyopsetta						
Seatech	33.3(2.75)	L0.25	1.49(0.01)	L 5	L 0.07	22.7(9.24)
Lab #2	37.9(1.41)	L0.05	0.97(0.20)	L 2	3.3(.63)	27.2(1.62)
EPS Lab	43(4)	L0.1	1.7(1.2)	L 0.2	0.31(.34)	31.1(26.9)
Mytilus						
Seatech	6.84(2.83)	3.98(.07)	10.3(.67)	L 5	0.31(.2)	84.7(3.45)
Lab #2	8.01(.29)	3.22(.50)	7.88(.14)	L 2	6.2(.72)	88.7(3.99)
EPS Lab	7	3.9(.38)	10.3(.43)	1.0(.14)	1.41(1.30	92.3(6.4)
Pandalus						
Seatech	37.8(5.34)	0.27(.07)	20.4(.32)	L 5	L 0.07	47.2(2.43)
Lab #2	36.0(1.37)	0.28(.07)	20.2(1.23)	L 2	1.55(.57)	64.7(4.70)
EPS Lab	41(1)	0.2(.14)	22.1(.5)	L 0.2	L 0.05	54.4(2.8)

* Taken from Amax 1981

APPENDIX 7: Sediment Trace Metal Analysis Alice Arm
October 1981

APPENDIX 7: SEDIMENT TRACE METAL ANALYSIS, ALICE ARM, OCTOBER 1981.

Station	Core Dp	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Va	Al
H1 - 147m	0-2	52.4	11.5	104.0	<.60	19.0	<2.4	12.9	25.2	37900	952	15000	111.0	25700
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	51.8	11.0	105.0	<.60	18.0	<2.4	10.0	24.1	38000	900	15300	114.0	26200
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	49.0	11.4	99.3	<.60	15.0	<2.4	9.0	22.2	35600	813	14400	105.0	24100
	30-32	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	40-42	53.3	11.2	110.0	<.60	15.0	<2.4	10.1	26.3	39600	926	16000	117.0	26800
	50-52	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	60-62	48.1	9.6	98.1	<.60	15.0	<2.4	8.8	22.8	36700	808	13900	107.0	24200
H2 - 308m	0-2	76.2	25.9	160.0	<.60	15.0	<2.4	24.7	45.1	43400	2360	19900	136.0	35600
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	101.0	18.4	163.0	<.60	14.0	<2.4	26.2	46.8	44600	2270	19800	135.0	34900
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	119.0	19.9	166.0	<.60	19.0	<2.4	24.3	47.6	42000	1610	19300	132.0	33200
	30-32	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	40-42	47.3	11.8	127.0	<.60	12.0	<2.4	18.2	35.3	40700	1790	18200	124.0	31600
	50-52	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	60-62	49.6	15.3	141.0	<.60	10.0	<2.5	21.4	41.5	43900	2150	20300	138.0	36000
	70-72	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	80-82	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	90-92	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	100-102	49.2	13.9	144.0	<.60	10.0	<2.4	22.9	46.5	44600	2110	20600	139.0	37400
	110-112	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	120-122	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	130-132	49.6	14.0	141.0	<.60	12.0	<2.4	25.3	43.9	43600	2310	20300	131.0	33500
H4	0-2	327.0	32.5	270.0	<.60	17.0	<2.4	36.4	61.3	48500	774	19200	122.0	33800
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	506.0	24.7	331.0	<.60	19.0	<2.4	36.4	62.1	52100	815	20400	121.0	34400
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	46.4	14.2	137.0	<.60	10.0	<2.4	44.6	64.0	41400	817	18500	116.0	33900
	30-32	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	40-42	41.7	11.9	125.0	<.60	15.0	<2.4	42.3	57.4	39500	707	16700	105.0	29700
	50-52	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	60-62	44.5	14.9	135.0	<.60	12.0	<2.5	44.5	64.5	40700	774	18100	116.0	33700
	70-72	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	80-82	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	90-92	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	100-102	43.0	13.2	138.0	<.60	11.0	<2.4	47.1	64.0	38400	791	18200	113.0	38400
	110-112	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	120-122	45.0	13.2	133.0	<.60	12.0	<2.4	45.6	63.4	40100	757	17900	109.0	31500
A15 - 52m	0-2	825.0	<6.6	2560.0	7.45	78.0	<2.5	7.4	38.0	157000	532	19200	93.6	27000
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	720.0	<7.0	2500.0	8.33	39.0	<2.4	10.1	47.6	141000	682	27800	103.0	34300
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	656.0	<6.6	1780.0	5.17	32.0	<2.4	8.6	58.7	144000	764	33700	116.0	40100
	30-32	603.0	<6.5	2830.0	8.30	34.0	<2.3	9.8	48.4	146000	669	27000	104.0	33400

APPENDIX 7: SEDIMENT TRACE METAL ANALYSIS, ALICE ARM, OCTOBER 1981.

Station	Core Dp	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Va	Al
A15 - 52m	continued...													
	40-42	745.0	<6.3	2990.0	8.90	33.0	<2.4	<7.0	49.7	137000	679	29600	111.0	36600
	50-52	895.0	<6.6	2580.0	7.20	35.0	<2.5	8.1	48.9	154000	620	25700	103.0	32800
	60-62	844.0	<6.5	3460.0	10.60	33.0	<2.4	8.9	46.6	152000	629	25400	102.0	32700
	70-72	952.0	<6.6	2080.0	5.70	24.0	<2.5	8.4	51.8	137000	633	31600	128.0	37300
	80-82	899.0	<6.5	2290.0	6.70	39.0	<2.5	9.1	41.9	157000	578	24500	105.0	31300
	90-92	879.0	<6.5	2270.0	6.80	43.0	<2.4	10.0	48.5	162000	613	24400	106.0	31600
A12 - 85m	0-2	50.1	26.9	122.0	<.60	7.5	<2.4	36.1	58.8	33100	646	13400	85.3	24500
	4-6	53.5	26.7	120.0	<.60	7.3	<2.5	33.2	60.2	32700	650	13200	87.4	25400
	10-12	74.1	15.6	124.0	<.60	6.5	<2.4	37.0	66.5	34700	655	14200	95.2	26800
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	36.1	8.8	93.2	<.60	6.2	<2.5	38.5	68.6	32200	611	13300	87.6	24900
	30-32	35.5	8.7	22.3	<.60	8.0	<2.4	39.0	69.7	30800	607	13200	88.5	30800
	40-42	38.1	8.7	97.9	<.60	7.1	<2.5	40.9	71.9	32900	623	13900	88.8	25800
	50-52	33.5	8.3	88.1	<.60	6.5	<2.5	36.9	68.0	30700	536	12800	86.5	24700
	60-62	36.7	9.5	97.5	<.60	6.9	<2.4	41.3	71.2	32400	613	13900	93.6	26500
	70-72	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	80-82	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	90-92	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	100-102	39.8	10.5	102.0	<.60	6.6	<2.4	41.7	72.7	33500	619	14600	97.3	27400
	110-112	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	120-122	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	130-132	33.4	7.4	86.1	<.60	6.6	<2.5	35.9	62.1	28800	538	12200	86.2	28800
B68	0-2	43.3	25.9	118.0	<.60	11.0	<2.4	36.9	58.3	33700	698	14000	89.3	24000
	4-6	45.8	11.8	111.0	<.60	15.0	<2.5	41.0	74.1	35700	701	15000	99.5	28000
	10-12	45.2	10.9	111.0	<.60	16.0	<2.4	42.8	75.1	36500	691	15300	106.0	30100
	14-16	47.4	11.8	117.0	<.60	14.0	<2.4	47.1	79.4	37700	727	16100	112.0	31700
	20-22	40.3	9.2	103.0	<.60	9.5	<2.5	37.2	66.7	31900	59	13700	88.2	23300
	30-32	39.8	8.9	101.0	<.60	11.0	<2.5	37.2	62.8	30900	585	13500	86.4	22100
V64	GRAB	22.1	<6.4	71.5	<.60	7.6	<2.4	28.0	41.9	29600	907	9850	53.9	16300
M49 - 390m	GRAB	73.4	97.5	301.0	4.88	22.0	83.5	28.8	43.0	38200	2520	14200	89.0	22800
	0-2	66.2	61.2	191.0	1.24	20.0	36.3	38.5	54.8	41000	2490	16100	100.0	25800
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	59.2	53.7	184.0	.80	18.0	9.3	37.2	54.8	39300	2300	15100	91.7	24500
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	62.1	129.0	312.0	2.29	23.0	2.8	38.2	58.4	42800	2400	16200	95.5	26100
	30-32	67.5	67.5	177.0	<.60	21.0	<2.4	39.5	57.9	42900	2440	16500	101.0	26000
	40-42	77.6	17.1	149.0	<.60	21.0	<2.5	47.2	65.5	45200	2420	17000	105.0	27300
	50-52	68.0	15.8	133.0	<.60	18.0	<2.4	40.0	60.7	40700	1340	15800	95.1	25500
	60-62	71.5	16.4	137.0	<.60	18.0	<2.4	34.6	52.9	40600	1330	15900	99.3	26300
	70-72	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	80-82	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	90-92	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	100-102	58.9	15.0	137.0	<.60	20.0	<2.5	46.5	66.7	44600	2460	17100	103.0	27700
	120-122	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0

APPENDIX 7: SEDIMENT TRACE METAL ANALYSIS, ALICE ARM, OCTOBER 1981.

Station	Core Dp	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Va	Al
M49 - 390m	continued...													
	130-132	52.8	11.8	133.0	<.60	16.0	<2.5	41.5	62.0	42100	2460	17300	104.0	26500
O32 - 369m	0-2	73.7	179.0	561.0	14.30	17.0	168.0	14.6	20.1	28200	1310	7970	47.1	11500
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	85.5	127.0	262.0	2.00	25.0	81.0	29.2	43.6	42900	2390	15600	104.0	26900
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	73.3	150.0	336.0	2.20	28.0	5.1	30.2	48.0	45100	2330	16700	104.0	26700
	30-32	89.0	20.8	163.0	<.60	23.0	7.4	35.4	50.6	45700	2340	16900	108.0	27200
	40-42	98.0	22.1	168.0	<.60	24.0	5.8	33.8	47.1	46100	2460	17300	113.0	28100
	50-52	63.3	17.0	152.0	<.60	22.0	7.6	37.3	53.0	47000	2300	18200	123.0	30200
	60-62	65.9	18.0	153.0	<.60	23.0	7.1	37.4	50.4	46800	2360	17900	116.0	29000
	70-72	62.2	19.4	144.0	<.60	21.0	7.5	37.6	52.8	45400	2300	18200	118.0	29600
	80-82	62.5	16.0	145.0	<.60	22.0	<4.1	40.6	53.0	45500	1840	17800	114.0	28700
	90-92	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	100-102	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	120-122	65.5	17.9	150.0	<.60	23.0	3.9	40.0	55.3	48600	2580	18800	128.0	33100
Q20 - 275m	0-2	104.0	204.0	521.0	14.00	15.0	291.0	11.8	17.8	28200	942	7730	49.3	12200
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	95.5	130.0	241.0	2.50	25.0	116.0	26.8	38.7	43500	1330	15000	102.0	25800
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	96.4	148.0	313.0	4.40	23.0	168.0	22.4	36.4	40000	2010	13800	90.8	23200
	30-32	75.3	198.0	466.0	4.50	34.0	10.6	25.6	42.9	46600	2290	16100	104.0	27100
	40-42	94.5	26.9	180.0	<.60	33.0	6.8	32.9	45.8	51500	1750	18100	127.0	32500
	50-52	10.1	29.4	188.0	.70	30.0	8.0	67.3	48.6	48800	1360	17300	121.0	30500
	60-62	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	70-72	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	80-82	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	90-92	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	120-122	73.2	20.1	153.0	<.60	29.0	<2.4	36.2	49.4	50200	1690	18000	127.0	33800
M9 - 164m	0-2	95.0	84.6	217.0	1.96	31.0	106.0	32.9	421.0	47300	1030	15800	111.0	28400
	4-6	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	10-12	123.0	435.0	409.0	11.00	7.4	255.0	9.6	20.0	27300	798	9410	55.2	15700
	14-16	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	20-22	94.3	172.0	365.0	8.03	16.0	226.0	15.7	23.7	30100	946	9290	60.2	16400
	30-32	87.3	131.0	368.0	2.85	38.0	7.9	27.6	43.7	50900	1710	16300	113.0	29100
	40-42	74.0	236.0	556.0	5.46	38.0	4.6	19.4	40.1	48000	2150	15900	104.0	27300
	50-52	92.5	27.0	169.0	<.06	35.0	3.8	29.9	41.4	49700	1120	16600	117.0	30300
	60-62	95.7	27.1	173.0	<.60	32.0	3.1	30.6	43.0	50400	1180	17200	122.0	3100
	70-72	93.9	23.4	169.0	<.60	32.0	3.7	33.3	44.4	52200	1270	17800	127.0	32600
	80-82	84.1	24.1	175.0	<.60	32.0	6.9	39.1	51.5	52300	1160	17800	136.0	29800
	90-92	73.3	19.5	147.0	<.60	28.0	5.3	29.1	39.5	46900	1040	16400	116.0	29500
	100-102	77.9	20.2	151.0	<.60	28.0	<2.5	31.8	44.2	51000	1120	17800	126.0	32300
	120-122	77.3	20.0	154.0	<.60	28.0	2.9	34.1	42.6	49600	1210	16900	115.0	30900
	GRAB	90.4	217.0	683.0	19.60	33.0	209.0	12.5	10.6	29400	835	5170	24.0	5620

APPENDIX 7 : SEDIMENT TRACE METAL ANALYSIS, ALICE ARM, OCTOBER 1981.

Station	Core Dp	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Va	Al
B2 - 69m	GRAB	44.7	11.5	96.8	<.60	13.0	<2.4	15.7	27.1	36000	624	11100	87.0	19100
B6 - 78m	GRAB	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
B6 - 82m	0-2	88.9	43.5	176.0	.98	32.0	17.6	27.0	36.5	47800	1100	15200	111.0	27300
	4-6	79.7	41.9	167.0	.78	31.0	36.2	23.7	34.1	45000	839	14900	116.0	28000
	10-12	84.0	44.1	167.0	.76	34.0	28.7	22.8	35.3	45500	862	14700	120.0	29500
	14-16	85.1	49.0	178.0	.94	35.0	33.4	26.1	36.3	46200	1050	15000	121.0	29700
	20-22	103.0	295.0	334.0	7.61	17.0	211.0	13.9	25.6	32600	849	11100	79.0	22500
	30-32	103.0	216.0	279.0	5.71	17.0	166.0	15.9	25.2	32600	785	11000	80.0	21900
	40-42	76.5	64.0	209.0	1.61	34.0	14.4	24.1	33.7	42900	932	13700	108.0	26000
	50-52	.0	.0	.0	.00	.0	.0	.0	.0	0	0	0	.0	0
	60-62	50.9	297.0	770.0	10.10	45.0	4.1	10.2	25.7	38300	2600	13300	64.7	16400
	70-72	70.9	332.0	1170.0	17.60	40.0	4.3	14.9	28.0	42900	2640	13700	84.3	21500
	80-82	51.3	384.0	1040.0	14.80	59.0	3.6	9.3	25.0	38400	2660	13300	61.6	15900
	90-92	43.8	250.0	513.0	6.00	52.0	<2.4	10.1	23.9	37100	2550	13300	59.6	15600
L10 - 171m	GRAB	92.0	222.0	514.0	14.50	40.0	182.0	16.3	9.5	29900	814	5360	27.0	6680

APPENDIX 8: Trawl Coordinates and Depths, May-June and October 1981

APPENDIX 8: TRAWL COORDINATES AND DEPTHS, ALICE ARM AND HASTINGS ARM, MAY-JUNE AND OCTOBER 1981

TRAWL NO.	DATE	DEPTH (metres)		LATITUDE	LONGITUDE
A-1	May 31, June 1, 2, 3	Start:	235	55°26.72'N	129°31.95'W
		Finish:	182	26.83'N	30.33'W
A-2	June 2, 3	Start:	355	27.10'N	36.86'W
		Finish:	362	27.00'N	35.05'W
A-3	June 3	Start:	55	25.11'N	40.58'W
		Finish:	91	24.09'N	41.08'W
H-1	June 1	Start:	265	33.82'N	47.68'W
		Finish:	247	34.82'N	47.78'W
H-5	June 3	Start:	46	22.82'N	47.65'W
		Finish:	81	23.64'N	46.63'W
A-1	October 24,25,26	Start:	128	26.72'N	31.95'W
		Finish:	236	26.83'N	30.33'W
A-2	October 24,25,26	Start:	355	27.10'N	36.86'W
		Finish:	362	27.00'N	35.05'W
A-3	October 25	Start:	55	25.11'N	40.58'W
		Finish:	91	24.09'N	41.08'W
H-1	October 24, 25	Start:	265	33.82'N	47.82'W
		Finish:	245	34.82'N	47.78'W
H-2	October 24,25,26	Start:	307	28.91'N	45.49'W
		Finish:	293	29.91'N	45.89'W

APPENDIX 9: Mean Tissue Trace Metal Concentrations (mg/kg dry weight) By Species, Alice Arm and Hastings Arm, May-June 1981

APPENDIX: 9 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					BIVALVE - MYTILUS EDULIS					- WHOLE BODY				
DOBIN I.E.	M(10)	8.38	15.2	2.30	162.3	7.50	11	.38	1.7	1.78	587.9	17.33	3393	275
	S.D.	1.54	1.8	.67	62.1	2.79	3	.06	.7	.40	216.9	4.91	502	115
	Max	12.00	17.3	3.00	281.0	12.00	15	.50	3.0	2.60	922.0	23.00	4230	450
	Min	6.20	12.3	1.00	86.6	2.90	7	.30	1.0	1.20	227.0	8.67	2620	81
H-2-E	M(10)	6.74	13.4	2.28	85.6	5.34	8	.32	1.4	1.30	364.4	17.85	2849	180
	S.D.	1.19	1.5	.69	10.6	1.05	1	.09	.5	.19	108.8	7.89	365	63
	Max	9.60	15.9	4.00	101.0	6.90	10	.40	2.0	1.70	576.0	38.90	3480	284
	Min	5.60	11.4	1.80	68.9	3.90	6	.20	1.0	1.00	229.0	10.90	2140	112
H-2-W	M(10)	7.28	16.2	2.40	131.0	7.06	10	.44	1.9	1.68	694.5	24.85	2684	339
	S.D.	.94	4.9	.70	50.5	3.09	2	.13	1.1	.41	410.3	12.55	455	211
	Max	9.60	25.0	4.00	239.0	13.70	12	.60	4.0	2.70	1580.0	44.90	3480	809
	Min	6.30	8.7	2.00	89.0	4.10	6	.20	.2	1.20	245.0	9.22	1900	103
OUTFALL B.	M(10)	11.82	11.2	4.30	125.3	9.46	12	.69	2.6	2.20	465.7	18.45	2491	202
	S.D.	2.78	3.1	1.06	25.3	1.04	2	.26	2.7	.56	492.1	14.24	352	255
	Max	17.60	17.2	6.00	167.1	11.00	16	1.30	10.0	2.90	1820.0	56.50	3050	898
	Min	9.30	7.8	3.00	93.1	8.20	10	.40	1.0	1.20	198.0	9.32	1920	65
					BIVALVE - YOLDIA SCISSURATA					- WHOLE BODY				
+A-2-I	*M(3)	5.57	541.0	163.33	498.7	24.67	15	32.97	9.7	6.90	9650.0	383.67	3273	2107
	S.D.	.47	312.3	9.07	11.7	13.25	4	5.14	1.2	.53	1067.8	39.31	180	222
	Max	6.10	889.0	173.00	512.0	39.90	19	38.80	11.0	7.50	10800.0	413.00	3460	2290
	Min	5.20	285.0	155.00	490.0	15.80	12	29.10	9.0	6.50	8690.0	339.00	3100	1860
					BIVALVE -Y.THRACIAEFORMIS/MONTEREYENSIS					- WHOLE BODY				
A-1-I	M(3)	5.20	423.7	173.67	903.0	38.23	27	46.10	13.3	10.33	9763.3	417.67	3523	3300
	S.D.	.79	80.4	37.61	98.5	4.77	9	12.22	2.5	2.65	202.3	24.21	309	217
	Max	6.10	482.0	202.00	995.0	43.50	36	59.20	16.0	13.30	9890.0	435.00	3780	3500
	Min	4.60	332.0	131.00	799.0	34.20	18	35.00	11.0	8.20	9530.0	390.00	3180	3070
A-2-I	M(11)	5.66	543.3	141.91	896.4	37.35	52	36.91	12.8	13.05	10050.0	466.18	4065	2656
	S.D.	.66	181.4	76.65	206.3	9.77	11	11.60	2.9	17.38	2196.1	97.11	395	542
	Max	6.70	807.0	336.00	1410.0	48.30	75	50.10	20.0	65.40	13100.0	576.00	4690	3630
	Min	4.70	337.0	37.00	693.0	13.40	41	9.30	9.0	6.50	4710.0	256.00	3380	1460
					CRAB - CHIONOECETES BAIRDI					- MUSCLE-LEG				
A-1-II	M(2)	5.40	42.8	2.00	120.0	.30	72	.45	1.0	.80	58.3	62.80	3195	22
	S.D.	2.26	.7	.00	26.9	.00	21	.21	.0	.14	12.6	62.51	2157	8
	Max	7.00	43.3	2.00	139.0	.30	86	.60	1.0	.90	67.2	107.00	4720	27
	Min	3.80	42.3	2.00	101.0	.30	57	.30	1.0	.70	49.4	18.60	1670	16

Continued ...

APPENDIX: 9 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-3-I	M(2)	7.35	26.7	1.00	109.0	.05	79	.20	1.0	1.00	24.7	.35	3710	9
	S.D.	.35	5.9	.00	17.0	.00	1	.00	.0	.57	1.8	.09	481	1
	Max	7.60	30.9	1.00	121.0	.05	80	.20	1.0	1.40	26.0	.42	4050	9
	Min	7.10	22.6	1.00	97.0	.05	79	.20	1.0	.60	23.5	.29	3370	8
H-1-I	M(3)	4.80	85.5	2.00	132.0	.53	137	.23	1.3	.83	106.7	37.07	3373	33
	S.D.	.69	8.4	.00	24.2	.21	37	.06	.6	.15	56.9	20.12	536	13
	Max	5.60	90.6	2.00	158.0	.70	179	.30	2.0	1.00	164.0	59.20	3950	43
	Min	4.40	75.8	2.00	110.0	.30	111	.20	1.0	.70	50.2	19.90	2890	18
					CRAB - HYAS LYRATUS					- MUSCLE-LEG				
OUTF. BAY	M(4)	5.18	31.1	1.53	359.7	.75	23	.22	1.5	.60	28.3	2.13	4535	11
	S.D.	.56	15.5	1.24	34.8	.33	3	.05	.6	.12	7.2	1.24	714	3
	Max	5.70	50.0	3.00	411.0	1.20	25	.30	2.0	.70	38.4	3.82	5300	15
	Min	4.40	14.9	.13	337.0	.40	19	.20	1.0	.50	21.4	1.09	3640	9
					CRAB - PARALITHODES CAMTSCHATICA					- MUSCLE-LEG				
A-3-I		5.00	52.9	2.00	221.0	.10	28	.20	1.0	1.10	26.2	1.93	2110	13
					SHRIMP - CRANGON COMMUNIS					- WHOLE BODY				
A-2-I	M(14)	3.78	73.4	3.00	73.0	.89	77	.47	1.5	1.18	399.6	43.18	4036	175
	S.D.	.28	8.1	1.18	10.0	.15	29	.15	.5	.16	89.5	22.44	492	30
	Max	4.20	86.6	6.00	96.1	1.20	143	.80	2.0	1.40	574.0	113.00	5150	229
	Min	3.20	57.7	2.00	62.0	.70	45	.20	1.0	.90	274.0	26.40	3370	134
					SHRIMP - PANDALOPSIS DISPAR					- MUSCLE				
A-1-I	M(7)	3.91	35.4	.99	55.4	.59	57	.21	1.0	.67	44.7	4.52	2021	18
	S.D.	.23	9.8	.76	3.9	.36	10	.04	.0	.10	17.9	1.66	319	7
	Max	4.40	54.9	2.00	60.9	1.30	71	.30	1.0	.80	75.8	7.06	2650	30
	Min	3.70	27.1	.05	50.6	.10	42	.20	.9	.50	28.8	3.02	1740	12
A-1-III	M(15)	1.39	36.3	.89	57.4	.51	51	.30	1.0	.75	90.6	6.21	1823	53
	S.D.	2.03	11.6	.89	5.3	.19	8	.13	.0	.20	39.5	2.08	246	18
	Max	4.30	62.2	3.00	66.3	.80	69	.60	1.0	1.10	182.0	10.30	2400	89
	Min	.00	16.2	.05	47.6	.20	40	.20	1.0	.40	40.3	3.05	1490	27
A-3-I	M(15)	++.00	34.5	.45	56.8	.30	83	.25	1.0	.73	37.5	2.30	2073	18
	S.D.	.00	11.0	.60	4.5	.18	20	.16	.0	.10	13.6	.53	268	6
	Max	.00	61.1	2.00	66.6	.70	118	.80	1.0	.90	64.2	3.43	2530	28
	Min	.00	23.4	.05	48.7	.05	57	.20	1.0	.60	14.6	1.47	1640	7
H-1-I	M(4)	4.25	34.2	.10	59.2	.53	41	.20	1.0	.68	44.5	22.98	2020	15
	S.D.	.13	5.0	.11	2.5	.19	8	.00	.0	.10	28.6	12.73	104	5
	Max	4.40	37.2	.26	62.4	.80	51	.20	1.0	.80	84.2	38.70	2140	22
	Min	4.10	26.8	.05	56.4	.40	32	.20	1.0	.60	19.7	11.80	1890	9

Continued ...

APPENDIX: 9 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					SHRIMP - PANDALOPSIS DISPAR					- WHOLE BODY				
A-1-III	M(13)	.00	82.9	3.15	65.1	4.60	45	1.29	1.5	1.55	504.2	51.35	4298	263
	S.D.	.00	17.5	1.28	8.7	2.44	8	.70	.8	.66	302.6	22.09	516	158
	Max	.00	119.0	6.00	79.2	10.90	59	2.40	3.0	3.20	1140.0	94.50	5150	561
	Min	.00	53.7	1.00	47.4	1.50	30	.40	1.0	.60	133.0	27.30	3530	83
A-3-I	M(15)	.00	114.8	1.28	65.0	1.39	53	.23	1.4	1.21	361.8	17.41	4462	185
	S.D.	.00	15.9	.57	8.4	.41	11	.05	.5	.41	154.0	5.16	659	88
	Max	.00	139.0	2.00	89.3	2.40	76	.30	2.0	1.90	648.0	28.00	5390	346
	Min	.00	82.4	.14	56.3	1.00	33	.20	1.0	.70	183.0	9.06	2640	87
					SHRIMP - PANDALUS BOREALIS					- MUSCLE				
A-1-I	M(5)	4.08	32.9	.99	65.0	.49	62	.20	.9	.84	44.5	19.76	2096	13
	S.D.	.30	7.1	.62	7.4	.26	18	.00	.1	.05	8.4	16.04	256	5
	Max	4.50	39.2	1.80	76.0	.92	93	.20	1.0	.90	59.0	46.40	2430	18
	Min	3.70	22.3	.05	57.1	.30	47	.20	.9	.80	36.9	6.79	1780	7
A-1-III	M(15)	4.37	25.1	1.03	55.5	.27	55	.37	1.0	.91	115.2	15.82	1783	55
	S.D.	.14	5.7	.71	6.5	.13	12	.15	.0	.37	76.2	19.64	333	38
	Max	4.60	38.0	2.00	62.6	.60	77	.70	1.0	2.00	307.0	83.90	2720	146
	Min	4.10	15.2	.05	35.8	.10	41	.20	.9	.60	35.8	3.20	1160	19
A-3-I	M(15)	3.46	33.5	.33	58.2	.23	94	.23	1.0	.75	51.8	4.46	1739	21
	S.D.	1.09	10.0	.42	5.1	.13	27	.05	.0	.20	27.6	3.66	220	12
	Max	4.50	49.7	1.00	70.7	.60	141	.30	1.0	1.30	125.0	13.30	2120	51
	Min	.00	19.7	.05	51.2	.08	48	.20	1.0	.60	28.2	1.57	1350	10
					SHRIMP - PANDALUS BOREALIS					- WHOLE BODY				
A-1-III	M(15)	4.35	109.9	6.58	78.0	2.43	47	2.02	1.9	1.47	1250.5	88.42	4144	542
	S.D.	.22	11.8	3.05	9.3	.87	10	1.20	.7	.64	882.2	38.31	258	346
	Max	4.70	135.0	13.20	92.2	4.56	63	4.80	3.0	3.00	3600.0	182.00	4710	1480
	Min	4.00	92.5	3.00	64.5	1.30	21	.90	.9	.80	474.0	41.80	3690	261
A-3-I	M(15)	3.67	102.0	1.17	72.1	1.44	65	.31	1.8	1.30	407.1	22.59	3854	185
	S.D.	.34	18.9	.75	13.7	.63	12	.12	1.4	.33	160.0	6.27	468	74
	Max	4.30	125.0	3.00	109.0	2.40	84	.60	6.0	1.80	737.0	34.40	4800	347
	Min	3.10	61.9	.34	49.7	.70	43	.20	1.0	.70	234.0	12.50	3160	112
					SHRIMP - PANDALUS HYPSINOTUS					- MUSCLE				
A-3-I	M(15)	.00	35.7	.09	65.4	.18	82	.22	1.0	.73	29.8	2.88	1975	13
	S.D.	.00	7.2	.06	4.2	.07	31	.04	.0	.19	12.3	1.08	185	6
	Max	.00	48.3	.26	70.4	.30	138	.30	1.0	1.30	67.1	4.59	2220	33
	Min	.00	22.4	.05	54.6	.06	51	.20	1.0	.50	18.4	1.01	1530	7

Continued ...

APPENDIX: 9 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
H-5-I	M(12)	4.42	39.5	.15	78.2	.19	68	.20	1.0	.67	27.9	1.50	2005	12
	S.D.	.25	7.7	.28	6.6	.15	31	.00	.0	.13	13.1	.56	372	4
	Max	4.90	47.2	1.00	93.4	.50	132	.20	1.0	.90	57.1	2.57	3070	20
	Min	4.10	23.4	.05	71.0	.05	30	.20	1.0	.50	14.2	.87	1550	7
					FISH - EOPSETTA JORDANI					- MUSCLE				
A-3-I	M(3)	5.90	4.4	2.38	22.4	.05	131	.23	2.7	2.40	127.7	2.65	1337	14
	S.D.	.26	1.6	2.00	3.0	.00	14	.06	2.1	1.47	150.1	.61	23	4
	Max	6.20	6.2	4.00	25.9	.05	142	.30	5.0	4.00	301.0	3.08	1350	18
	Min	5.70	3.0	.14	20.3	.05	115	.20	1.0	1.10	38.9	1.95	1310	10
					FISH - HIPPOGLOSSOIDES ELASSODON					- MUSCLE				
SOMERVILLE	M(3)	5.37	2.5	.22	18.7	.05	19	.20	1.0	1.07	27.3	.37	1133	8
	S.D.	.15	1.0	.10	2.2	.00	3	.00	.0	.72	25.3	.31	29	3
	Max	5.50	3.4	.34	21.2	.05	21	.20	1.0	1.90	56.3	.73	1150	10
	Min	5.20	1.4	.16	17.3	.05	16	.20	1.0	.60	9.3	.16	1100	4
					FISH - LYOPSETTA EXILIS					- MUSCLE				
A-3-I	M(2)	5.90	4.6	1.66	18.6	.07	13	.20	1.0	1.60	45.9	2.09	1315	11
	S.D.	.42	1.3	1.90	1.8	.04	5	.00	.0	.85	28.8	1.09	35	6
	Max	6.20	5.5	3.00	19.9	.10	16	.20	1.0	2.20	66.3	2.86	1340	16
	Min	5.60	3.6	.31	17.3	.05	9	.20	1.0	1.00	25.5	1.32	1290	7
					FISH - PAROPHRYS VETULUS					- MUSCLE				
A-3-I	M(4)	5.50	3.9	1.31	24.0	.05	78	.20	1.0	1.20	34.0	1.29	1368	11
	S.D.	.35	.7	1.19	2.7	.00	20	.00	.0	.33	10.5	.18	76	3
	Max	5.80	4.6	3.00	27.8	.05	92	.20	1.0	1.60	45.5	1.41	1470	14
	Min	5.00	3.0	.22	21.8	.05	49	.20	1.0	.80	20.0	1.03	1310	6
SOMERVILLE		5.00	4.0	.17	20.3	.05	29	.20	1.0	1.00	19.0	.25	1060	5
					FISH - THERAGRA CHALCOGRAMMA					- MUSCLE				
A-3-I	M(3)	5.30	7.5	.69	27.3	.05	32	.20	1.0	2.07	36.8	1.15	1867	9
	S.D.	.10	1.8	.54	6.1	.00	8	.00	.0	1.22	11.1	.44	567	2
	Max	5.40	9.6	1.00	33.8	.05	40	.20	1.0	3.40	44.8	1.61	2520	11
	Min	5.20	6.2	.06	21.6	.05	25	.20	1.0	1.00	24.1	.74	1500	7

\+ Roman numerals indicate station trawl number.

++ All zeros indicate no analysis.

* M(n) Mean of n number of individuals sampled.

APPENDIX 10: Mean Tissue Trace Metal Concentrations (mg/kg dry weight)
By Species, Alice Arm and Hastings Arm, October 1981

APPENDIX: 10 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					BIVALVE - MACOMA SP.					- WHOLE BODY				
+A-1-I	* M(15)	7.27	69.3	244.47	841.6	10.37	14	35.08	11.3	8.29	6868.0	116.60	6933	808
	S.D.	1.98	25.3	119.72	216.9	3.22	3	19.76	3.6	3.76	3167.9	44.67	555	322
	Max	10.90	105.0	478.00	1220.0	17.60	19	72.30	19.0	16.80	12800.0	207.00	8260	1330
	Min	2.80	33.3	81.00	577.0	6.30	9	14.90	6.0	3.20	2970.0	60.20	6040	362
					BIVALVE -Y.THRACIAEFORMIS/MONTEREYENSIS					- WHOLE BODY				
A-1-I	M(15)	6.76	226.0	177.19	1137.1	11.80	68	31.07	12.4	8.31	8024.0	110.38	6021	873
	S.D.	.97	209.7	82.45	318.5	7.90	12	18.08	3.8	3.63	3118.9	67.71	1205	379
	Max	9.50	765.0	326.00	1710.0	27.60	89	80.80	20.0	19.00	16400.0	285.00	8330	1980
	Min	5.50	83.8	32.20	715.0	4.28	51	10.00	6.6	2.60	2240.0	47.80	4240	365
A-1-II	M(14)	5.35	546.9	299.71	1275.7	31.53	64	37.85	16.9	11.60	14716.4	349.79	6374	2531
	S.D.	.35	216.8	225.58	450.2	11.88	8	27.35	5.0	3.62	6765.7	193.84	821	945
	Max	5.80	1150.0	837.00	2290.0	51.50	74	85.00	31.0	18.00	34400.0	718.00	7580	4310
	Min	4.70	267.0	57.00	753.0	17.30	46	3.00	10.0	5.80	7160.0	107.00	4780	1130
A-2-I	M(10)	5.50	616.2	465.40	1086.8	30.99	73	61.68	20.7	14.65	14390.0	419.90	7886	2503
	S.D.	.38	284.3	110.92	285.3	10.05	17	20.16	3.7	2.50	3331.8	128.91	868	674
	Max	6.00	1190.0	684.00	1490.0	48.90	108	89.30	27.0	18.10	20300.0	583.00	9490	3420
	Min	4.90	320.0	370.00	723.0	17.50	59	25.00	15.0	10.00	10800.0	159.00	6490	1280
H-2-I	M(13)	5.52	435.6	4.91	877.0	22.69	48	1.11	6.6	5.91	8041.5	483.54	7248	1887
	S.D.	.69	196.6	1.83	496.8	8.72	11	.34	2.8	2.93	17130.9	157.02	1187	876
	Max	6.60	713.0	8.00	2190.0	35.90	60	2.00	11.0	13.00	64900.0	841.00	8700	3430
	Min	4.30	142.0	1.90	335.0	7.50	30	.70	2.8	2.20	1550.0	274.00	5010	803
					CRAB - CHIONOCETES BAIRDI					- MUSCLE-LEG				
A-1-I	M(2)	5.10	44.8	3.00	122.0	.30	145	.90	1.0	1.05	208.4	23.45	4465	78
	S.D.	.00	6.1	1.41	4.2	.00	7	.99	.0	.07	251.2	10.68	587	95
	Max	5.10	49.1	4.00	125.0	.30	150	1.60	1.0	1.10	386.0	31.00	4880	145
	Min	5.10	40.5	2.00	119.0	.30	140	.20	1.0	1.00	30.8	15.90	4050	10
A-1-II	M(3)	4.60	48.1	1.33	137.3	.87	134	.30	1.3	.93	80.1	25.92	3007	44
	S.D.	.20	23.3	.58	10.7	.46	7	.00	.6	.15	44.6	25.35	309	29
	Max	4.80	75.0	2.00	149.0	1.40	141	.30	2.0	1.10	122.0	54.50	3340	73
	Min	4.40	34.1	1.00	128.0	.60	127	.30	1.0	.80	33.2	6.15	2730	16
A-2-I		5.20	77.5	.24	134.0	.50	207	.20	1.0	.60	76.4	47.90	3180	38
A-3-I		4.40	73.0	.05	130.0	.21	119	.20	.9	.50	35.5	2.80	3350	15
H-2-I	M(3)	4.43	46.1	.68	129.7	.43	125	.27	1.0	.77	49.9	32.89	3140	27
	S.D.	.25	9.5	.55	17.0	.21	32	.06	.0	.21	23.3	35.36	609	17
	Max	4.70	53.1	1.00	146.0	.60	147	.30	1.0	1.00	76.6	72.90	3810	47
	Min	4.20	35.3	.05	112.0	.20	89	.20	1.0	.60	33.7	5.86	2620	16

Continued ...

APPENDIX: 10 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					CRAB - LITHODES AEQUISPINA					- MUSCLE-LEG				
A-1-II		5.80	99.8	.05	214.0	.20	115	.40	3.0	1.50	120.0	6.55	4590	67
A-2-I	M(2)	5.10	85.7	1.02	172.5	.30	133	.20	1.0	.80	28.9	10.66	3210	13
	S.D.	.71	24.4	1.38	12.0	.14	9	.00	.0	.00	19.0	8.55	99	10
	Max	5.60	103.0	2.00	181.0	.40	139	.20	1.0	.80	42.3	16.70	3280	20
	Min	4.60	68.5	.05	164.0	.20	126	.20	1.0	.80	15.4	4.61	3140	6
					SEA CUCUMBER - MOLPADIA SP.					- MUS. BANDS				
A-1-I		5.60	15.1	15.00	131.0	2.60	13	13.00	6.0	4.50	2580.0	161.00	7640	513
					SHRIMP - CRANGON COMMUNIS					- TAIL ONLY				
A-3-I	M(15)	3.93	81.0	2.00	80.1	.47	102	.21	1.2	1.07	250.8	56.91	3931	109
	S.D.	.30	9.8	1.27	9.1	.17	19	.04	.5	.17	50.1	22.90	343	22
	Max	4.50	96.3	6.00	98.6	.80	134	.30	2.0	1.30	356.0	124.00	4780	157
	Min	3.60	63.8	.90	65.5	.28	65	.20	.9	.80	164.0	31.60	3630	72
					SHRIMP - PANDALOPSIS DISPAR					- MUSCLE				
A-1-I	M(8)	4.30	18.0	1.85	57.1	.23	66	.34	1.3	.94	135.4	7.92	2039	39
	S.D.	.12	4.2	.99	3.5	.09	6	.12	.5	.29	110.6	3.86	126	30
	Max	4.50	25.2	4.00	64.2	.40	75	.50	2.0	1.50	394.0	14.90	2210	107
	Min	4.10	14.1	1.00	54.2	.10	59	.20	1.0	.70	41.3	3.67	1860	14
A-1-II	M(8)	4.45	16.2	.68	57.2	.22	61	.18	1.1	1.16	209.4	10.34	2074	97
	S.D.	.19	2.7	.69	6.2	.12	11	.06	.5	.55	158.9	5.91	166	83
	Max	4.70	19.3	2.00	71.0	.40	85	.20	2.3	2.20	556.0	22.90	2300	283
	Min	4.20	11.8	.07	52.4	.06	49	.02	.9	.60	72.6	3.96	1850	33
A-2-I	M(12)	4.55	19.2	.08	56.9	.08	60	.20	1.1	.68	30.7	2.99	1748	13
	S.D.	.22	2.0	.04	4.6	.03	14	.00	.3	.33	11.0	.91	96	5
	Max	5.00	23.0	.16	66.6	.11	88	.20	2.0	1.70	46.6	4.69	1870	21
	Min	4.30	15.8	.05	52.4	.05	40	.20	.9	.50	17.3	1.83	1570	7
A-2-II	M(15)	4.40	19.9	.23	55.1	.15	69	.21	1.5	.71	52.5	7.32	1961	24
	S.D.	.13	3.6	.34	4.2	.08	15	.04	1.3	.16	16.1	3.06	223	11
	Max	4.60	25.5	1.10	64.6	.30	106	.30	6.2	1.00	94.6	14.60	2450	57
	Min	4.30	14.7	.05	47.2	.05	53	.20	1.0	.40	26.4	3.65	1580	10
H-1-I	M(15)	4.87	17.8	.05	55.9	.11	49	.20	1.1	.55	35.4	3.65	2091	17
	S.D.	1.62	3.9	.00	6.9	.05	11	.00	.3	.08	20.2	1.58	288	10
	Max	10.70	26.3	.05	75.3	.20	71	.20	2.0	.70	89.6	6.38	2540	45
	Min	4.30	12.6	.05	47.5	.05	35	.20	.9	.40	17.3	1.53	1580	8
H-2-I	M(15)	4.44	21.8	.12	55.5	.13	43	.22	1.1	.65	52.1	16.58	1902	31
	S.D.	.20	3.9	.24	3.3	.05	9	.04	.5	.11	22.4	3.80	184	14
	Max	4.80	27.2	1.00	61.8	.20	68	.30	3.0	.90	107.0	23.40	2190	63
	Min	4.20	11.9	.05	51.6	.05	34	.20	.9	.50	26.4	10.20	1620	15

Continued ...

APPENDIX: 10 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					SHRIMP - PANDALUS BOREALIS					- MUSCLE				
A-1-II	M(16)	4.23	19.3	.15	55.3	.08	83	.20	.9	.82	126.1	9.96	2095	59
	S.D.	.08	3.6	.24	3.7	.05	11	.00	.4	.34	67.6	6.74	250	30
	Max	4.30	25.9	1.00	60.8	.20	112	.20	2.0	1.80	244.0	32.30	2500	117
	Min	4.10	11.8	.05	49.4	.05	67	.20	.1	.50	34.1	4.80	1570	21
A-2-II	M(15)	3.94	18.0	.45	59.0	.08	80	.20	1.0	.72	47.9	8.94	1679	18
	S.D.	.58	3.4	.46	14.1	.05	19	.00	.2	.22	17.2	2.77	129	6
	Max	4.50	22.7	1.00	108.0	.20	141	.20	1.6	1.20	86.3	16.50	1880	30
	Min	1.90	9.4	.05	51.0	.05	63	.20	.9	.50	24.7	5.27	1430	9
A-3-I	M(16)	4.12	23.6	.06	54.8	.07	136	.20	1.2	.56	17.7	3.30	1798	9
	S.D.	.17	4.1	.03	5.6	.04	23	.00	1.0	.12	6.9	2.35	241	4
	Max	4.40	32.8	.18	71.1	.20	177	.20	5.0	.80	34.8	11.40	2170	21
	Min	3.80	18.0	.05	47.8	.05	99	.20	.9	.40	9.2	1.53	1410	4
H-1-I	M(15)	4.51	16.2	.06	49.7	.07	49	.20	1.0	.48	18.2	3.09	1725	8
	S.D.	.22	3.0	.03	4.7	.04	8	.00	.4	.09	6.9	1.29	275	2
	Max	5.00	21.3	.15	55.5	.20	65	.20	2.0	.60	30.0	5.52	2420	11
	Min	4.20	9.7	.05	38.9	.05	39	.20	.1	.30	9.3	1.39	1410	5
H-2-I	M(8)	3.91	31.6	.46	55.3	.16	59	.20	1.3	.76	57.3	26.40	1536	30
	S.D.	.20	11.3	.57	7.4	.08	27	.00	.5	.14	31.1	13.45	216	17
	Max	4.10	55.5	1.40	70.7	.30	99	.20	2.0	1.00	124.0	44.00	1920	67
	Min	3.50	21.3	.05	47.4	.05	1	.20	1.0	.60	29.2	12.30	1170	14
					SNAIL - COLUS HALLI					- WHOLE BODY				
A-1-I	M(15)	4.58	50.3	5.48	146.7	4.82	176	1.63	1.6	1.43	655.1	106.37	8079	117
	S.D.	.52	43.6	5.46	269.5	8.49	45	1.05	.8	.71	540.5	97.80	1704	144
	Max	5.80	194.0	24.00	1120.0	35.00	259	5.00	3.1	3.50	2380.0	352.00	10200	611
	Min	3.60	18.1	2.00	67.0	1.10	118	.70	.9	.80	247.0	37.00	4610	30
A-2-II	M(13)	4.89	61.3	2.54	80.1	2.67	201	1.05	1.3	1.15	325.1	126.27	8409	75
	S.D.	.49	23.7	1.80	9.2	1.17	58	.43	.5	.36	182.6	77.33	1652	56
	Max	6.10	117.0	6.00	99.6	4.70	335	1.60	2.0	1.70	707.0	282.00	11800	204
	Min	4.10	36.0	.00	67.4	.90	86	.40	1.0	.60	108.0	30.50	6030	12
H-2-I	M(7)	5.14	261.1	.09	616.0	15.29	149	.73	2.3	1.23	830.6	205.87	11286	150
	S.D.	.29	312.7	.06	977.6	21.34	57	.56	1.1	.33	961.3	226.31	960	197
	Max	5.60	834.0	.20	2530.0	48.60	255	1.90	4.0	1.80	2830.0	688.00	13100	591
	Min	4.80	70.5	.05	69.3	1.00	90	.30	1.0	.70	116.0	61.90	10100	44
					FISH - EOPSETTA JORDANI					- MUSCLE				
A-3-I	M(3)	5.60	3.7	.09	22.5	.08	61	.20	1.0	.90	42.1	1.72	1410	17
	S.D.	.26	.4	.05	2.3	.03	35	.00	.0	.17	4.0	.24	56	2
	Max	5.90	4.2	.14	24.5	.10	95	.20	1.0	1.00	46.6	2.00	1460	20
	Min	5.40	3.4	.05	20.0	.05	25	.20	1.0	.70	38.9	1.55	1350	16

Continued ...

APPENDIX: 10 MEAN TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight) BY SPECIES, ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Stat	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					FISH - PAROPHRYS VETULUS					- MUSCLE				
A-3-I	M(3)	5.13	8.8	.41	27.4	.10	96	.23	1.7	1.00	37.1	1.88	1297	15
	S.D.	.12	4.8	.52	1.3	.00	79	.06	.6	.20	3.5	1.05	71	2
	Max	5.20	14.3	1.00	28.7	.10	186	.30	2.0	1.20	40.9	3.08	1360	16
	Min	5.00	5.5	.05	26.1	.10	41	.20	1.0	.80	34.1	1.11	1220	13
					FISH - RAJA STELLULATA					- MUSCLE				
A-3-I		4.50	6.4	.26	27.5	.10	184	.20	1.0	1.00	65.3	2.98	1140	33
					FISH - THERAGRA CHALCOGRAMMA					- MUSCLE				
A-3-I		5.30	7.0	.16	25.3	.40	34	.20	4.0	1.50	49.3	2.63	1470	19

+ Roman numerals indicate station trawl number.

* M(n) Mean of n number of individuals sampled.

APPENDIX 11: Tissue Trace Metal Concentrations (mg/kg dry weight), Alice Arm and Hastings Arm, May-June 1981

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					BIVALVE - MYTILUS EDULIS				- WHOLE BODY				
DOBIN I.E.	7.70	16.1	2.00	159.0	7.20	12	+ <.30	<1.0	2.00	731.0	22.20	3320	379
	8.50	15.4	2.00	181.0	6.80	12	.30	2.0	1.50	472.0	15.20	3440	205
	8.70	15.3	1.00	122.0	3.90	7	.40	2.0	1.50	594.0	18.00	2930	287
	7.90	12.7	2.00	123.0	8.90	12	.40	2.0	1.80	387.0	11.80	3670	162
	8.90	13.9	2.00	237.0	9.90	13	.40	2.0	1.50	227.0	8.67	3020	81
	6.90	12.3	3.00	86.6	2.90	7	.30	2.0	1.20	410.0	13.70	3030	205
	12.00	15.2	3.00	152.0	8.00	12	.50	3.0	2.60	806.0	22.00	4230	396
	8.10	17.1	3.00	281.0	12.00	8	.40	1.0	1.70	755.0	21.30	3890	330
	8.90	16.8	2.00	189.0	9.60	15	.40	1.0	2.20	922.0	23.00	3780	450
	6.20	17.3	3.00	92.0	5.80	9	.40	1.0	1.80	575.0	17.40	2620	258
H-2-E	6.70	12.1	2.00	68.9	4.10	8	<.20	1.0	1.40	229.0	10.90	2960	116
	6.20	13.7	3.00	81.2	5.00	8	.40	2.0	1.30	464.0	17.30	2530	244
	6.30	13.7	2.00	87.9	5.20	8	.40	2.0	1.10	295.0	12.80	2710	136
	6.60	13.5	1.80	88.4	6.90	8	.40	1.1	1.20	318.0	14.40	2900	135
	9.60	11.4	2.00	99.0	6.60	10	.40	2.0	1.40	266.0	14.80	3090	112
	5.70	12.6	2.00	90.1	3.90	8	<.20	<1.0	1.00	299.0	13.80	2140	142
	7.90	15.6	2.00	101.0	5.60	8	.30	1.0	1.40	576.0	19.70	2730	284
	5.60	12.2	4.00	84.1	6.00	6	.40	2.0	1.70	417.0	38.90	3480	249
	6.20	15.9	2.00	86.6	5.90	8	.20	<1.0	1.20	325.0	19.10	3150	161
	6.60	13.4	2.00	69.2	4.20	8	.30	<1.0	1.30	455.0	16.80	2800	218
H-2-W	6.90	18.8	3.00	125.0	4.50	9	.50	3.0	1.70	846.0	25.50	2300	399
	7.10	9.7	2.00	117.0	6.60	10	.40	2.0	1.50	762.0	22.90	2460	375
	6.80	8.7	2.00	89.3	4.10	6	<.20	4.0	1.50	351.0	11.90	1900	181
	6.30	19.0	2.00	123.0	4.40	12	.60	2.0	1.40	947.0	29.10	2790	458
	7.70	17.8	3.00	127.0	10.10	11	.40	2.0	1.80	467.0	43.40	2940	222
	7.00	18.2	2.00	98.3	5.40	12	.60	2.0	1.50	969.0	31.50	3220	472
	9.60	25.0	4.00	239.0	13.70	11	.50	<.2	2.70	1580.0	44.90	3480	809
	6.90	15.9	2.00	98.1	9.40	11	.50	2.0	1.90	245.0	9.22	2650	103
	7.90	17.1	2.00	89.0	6.40	8	.40	1.0	1.60	442.0	15.90	2630	209
	6.60	12.2	2.00	204.0	6.00	8	.30	1.0	1.20	336.0	14.20	2470	159
OUTFALL B.	9.30	10.2	4.00	119.0	8.60	12	.50	2.0	1.20	198.0	11.10	2390	71
	11.40	11.0	5.00	93.1	8.20	11	.50	2.0	2.30	249.0	11.20	2330	93
	9.80	9.5	5.00	167.1	10.10	12	.60	3.0	1.80	238.0	9.32	2060	65
	17.60	16.3	5.00	112.0	9.70	10	1.30	2.0	2.90	1820.0	56.50	3050	898
	9.80	7.8	3.00	146.0	10.60	12	.70	1.0	2.50	363.0	13.10	1920	143
	15.80	9.3	6.00	98.8	9.40	13	.80	2.0	2.90	552.0	20.30	2830	276
	10.30	11.0	5.00	159.0	8.20	10	.70	1.0	1.50	229.0	24.10	2800	83
	10.50	9.3	3.00	110.0	10.30	16	.40	2.0	2.40	243.0	10.70	2650	79
	12.70	10.8	3.00	113.0	11.00	14	.50	<1.0	2.20	245.0	10.50	2360	90
	11.00	17.2	4.00	135.0	8.50	13	.90	10.0	2.30	520.0	17.70	2520	226

Continued ...

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					BIVALVE - YOLDIA SCISSURATA				- WHOLE BODY				
* A-2-I	5.20	449.0	155.00	494.0	15.80	15	38.80	9.0	7.50	10800.0	413.00	3100	2290
	5.40	285.0	173.00	512.0	18.30	12	31.00	9.0	6.70	9460.0	399.00	3260	2170
	6.10	889.0	162.00	490.0	39.90	19	29.10	11.0	6.50	8690.0	339.00	3460	1860
					BIVALVE -Y.THRACIAEFORMIS/MONTEREYENSIS				- WHOLE BODY				
A-1-I	4.90	482.0	188.00	995.0	43.50	28	44.10	16.0	13.30	9530.0	435.00	3610	3500
	6.10	457.0	202.00	799.0	37.00	36	59.20	13.0	9.50	9870.0	390.00	3780	3330
	4.60	332.0	131.00	915.0	34.20	18	35.00	11.0	8.20	9890.0	428.00	3180	3070
A-2-I	6.70	364.0	37.00	900.0	13.40	75	9.30	9.0	6.50	4710.0	256.00	3380	1460
	5.40	394.0	185.00	939.0	44.10	58	49.60	13.0	8.00	12900.0	449.00	4060	2530
	5.60	408.0	174.00	1410.0	39.00	51	44.80	14.0	9.40	9930.0	422.00	4040	2920
	5.20	807.0	119.00	792.0	45.90	53	35.40	13.0	7.40	9480.0	558.00	4270	2810
	4.70	617.0	126.00	1120.0	43.90	46	46.20	14.0	9.20	13100.0	559.00	4140	3630
	6.70	550.0	90.00	741.0	31.30	50	35.20	11.0	7.60	9160.0	453.00	3780	2650
	5.50	791.0	137.00	859.0	48.30	41	36.60	13.0	7.40	10900.0	576.00	3580	2280
	6.20	723.0	156.00	862.0	40.00	41	38.50	20.0	7.70	9940.0	393.00	4010	2410
	5.90	634.0	336.00	767.0	39.50	56	50.10	13.0	65.40	10400.0	413.00	4690	2990
	5.50	351.0	95.00	777.0	31.10	41	29.60	11.0	8.00	9630.0	567.00	4640	3010
	4.90	337.0	106.00	693.0	34.40	65	30.70	10.0	7.00	10400.0	482.00	4130	2530
					CRAB - CHIONOECETES BAIRDI				- MUSCLE-LEG				
A-1-II	7.00	43.3	2.00	139.0	.30	57	.30	1.0	.90	49.4	18.60	4720	16
	3.80	42.3	2.00	101.0	.30	86	.60	1.0	.70	67.2	107.00	1670	27
A-3-I	7.60	22.6	1.00	121.0	<.05	80	<.20	<1.0	1.40	26.0	.29	4050	9
	7.10	30.9	1.00	97.0	<.05	79	<.20	<1.0	.60	23.5	.42	3370	8
H-1-I	4.40	90.0	2.00	158.0	.60	111	<.20	1.0	1.00	50.2	19.90	2890	18
	4.40	90.6	2.00	128.0	.70	179	<.20	2.0	.80	106.0	32.10	3280	43
	5.60	75.8	2.00	110.0	.30	120	.30	<1.0	.70	164.0	59.20	3950	37
					CRAB - HYAS LYRATUS				- MUSCLE-LEG				
OUTF. BAY	5.40	22.9	3.00	337.0	.70	19	<.20	2.0	.70	21.4	1.09	5300	9
	5.70	14.9	1.00	352.0	.40	25	<.20	<1.0	.70	27.1	1.33	4860	9
	4.40	50.0	2.00	339.0	1.20	22	.30	1.0	.50	38.4	3.82	3640	15
	5.20	36.7	.13	411.0	.70	24	<.20	2.0	.50	26.3	2.26	4340	10
					CRAB - PARALITHODES CAMTSCHATICA				- MUSCLE-LEG				
A-3-I	5.00	52.9	2.00	221.0	.10	28	<.20	1.0	1.10	26.2	1.93	2110	13

Continued ...

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					SHRIMP - CRANGON COMMUNIS				- WHOLE BODY				
A-2-I	3.80	60.4	3.00	96.1	.80	54	.40	2.0	1.00	274.0	34.00	3790	138
	4.00	72.5	3.00	76.5	.80	143	.40	1.0	1.20	412.0	40.00	4280	172
	3.50	72.9	3.00	84.6	.80	74	.80	2.0	1.40	470.0	53.20	4280	209
	3.20	73.2	3.00	63.9	.70	107	.60	2.0	1.30	476.0	39.60	3460	186
	4.20	81.6	3.00	66.3	1.10	69	.60	2.0	1.30	574.0	113.00	4200	219
	3.40	65.1	2.00	66.0	.70	52	.30	1.0	1.10	378.0	27.90	3600	163
	3.90	79.4	2.00	69.1	1.20	69	.40	1.0	1.10	419.0	57.60	3930	194
	3.70	78.4	2.00	62.0	1.00	87	<.20	2.0	1.00	310.0	34.60	3370	149
	4.00	57.7	2.00	71.3	.90	45	.50	<1.0	.90	306.0	29.90	4560	135
	3.90	75.8	3.00	78.9	.70	64	.50	2.0	1.40	364.0	35.30	3950	170
	4.00	86.6	3.00	83.2	1.00	55	.60	2.0	1.30	524.0	26.60	4490	229
	3.80	80.4	6.00	66.7	1.00	74	.50	1.0	1.20	377.0	34.50	3860	170
	4.00	72.9	5.00	75.1	.90	66	.30	1.0	1.30	419.0	51.90	5150	181
	3.50	70.7	2.00	62.2	.90	123	.50	1.0	1.00	291.0	26.40	3580	134
					SHRIMP - PANDALOPSIS DISPAR				- MUSCLE				
A-1-I	3.80	40.9	1.00	53.3	.50	50	<.20	<1.0	.70	30.7	7.06	1980	13
	3.80	33.9	1.80	55.7	.54	62	<.20	<.9	.80	53.1	3.41	1890	18
	3.90	54.9	<.05	60.2	1.30	71	<.20	<1.0	.70	29.8	4.39	2200	12
	3.70	27.1	1.00	52.7	.10	52	<.20	<1.0	.70	28.8	3.02	1740	13
	4.40	27.7	2.00	60.9	.70	42	.20	<1.0	.60	57.1	6.69	2650	26
	3.80	31.2	1.00	54.3	.50	67	.30	<1.0	.70	37.6	3.47	1740	17
	4.00	31.9	<.05	50.6	.50	57	.20	<1.0	.50	75.8	3.63	1950	30
A-1-III	4.20	26.2	1.00	51.3	.40	53	.20	<1.0	.50	146.0	8.70	1840	69
	4.30	16.2	<.05	47.6	.30	47	<.20	<1.0	.40	48.5	3.05	1490	33
	3.90	41.3	<.05	54.6	.30	42	.20	<1.0	1.00	61.2	4.48	1590	45
	4.10	37.7	1.00	61.8	.60	50	.40	1.0	.90	139.0	10.30	1980	83
	4.30	34.4	<.05	56.0	.40	48	<.20	<1.0	.70	67.8	4.54	1830	34
	++.00	40.1	2.00	62.2	.50	40	.50	<1.0	.70	96.8	6.81	1640	69
	.00	54.9	1.00	61.6	.60	45	.40	<1.0	.80	92.1	5.81	1530	55
	.00	40.7	1.00	63.8	.70	69	.60	<1.0	.90	182.0	8.97	1820	89
	.00	38.5	1.00	54.8	.20	51	.30	<1.0	1.10	91.1	5.81	1870	54
	.00	26.5	<.05	52.4	.70	59	<.20	<1.0	.60	57.5	3.86	1560	34
	.00	33.1	3.00	53.9	.40	62	.40	1.0	.90	98.1	5.36	1870	54
	.00	23.0	1.00	55.0	.60	51	<.20	<1.0	.90	40.3	5.69	1950	27
	.00	37.1	<.05	56.6	.40	40	<.30	<1.0	.60	71.7	5.79	2160	45
	.00	32.4	.17	66.3	.80	61	<.20	<1.0	.70	64.4	5.32	1820	45
	.00	62.2	2.00	62.5	.80	53	<.20	1.0	.50	103.0	8.70	2400	59
A-3-I	.00	30.4	.12	61.4	.20	93	<.20	<1.0	.80	32.8	2.44	2360	15
	.00	26.7	1.00	59.3	.40	97	<.20	<1.0	.80	64.2	3.43	2430	28
	.00	27.4	<.05	56.4	.20	62	<.20	<1.0	.70	39.5	2.57	2530	19
	.00	23.4	<.05	52.8	.40	118	<.20	<1.0	.60	50.2	2.10	2290	23
	.00	33.8	<.05	59.4	.60	104	<.20	<1.0	.80	23.7	2.04	2110	12
	.00	36.4	1.00	55.2	.10	64	<.20	<1.0	.80	40.5	2.46	1910	23

Continued ...

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-3-I	continued...												
	.00	27.2	.10	51.0	.30	73	<.20	1.0	.90	30.8	1.74	1640	16
	.00	58.0	2.00	66.6	.70	97	<.30	<1.0	.80	36.6	2.84	2340	20
	.00	36.9	1.00	58.4	.20	87	<.20	<1.0	.60	26.1	2.32	1820	12
	.00	26.4	<.05	48.7	.20	57	<.20	<1.0	.70	51.5	1.47	1880	22
	.00	28.2	.14	53.7	<.05	79	<.20	<1.0	.70	25.1	1.87	1860	12
	.00	30.6	1.00	59.4	.20	62	<.20	<1.0	.70	42.8	2.05	2150	21
	.00	37.6	<.05	57.8	.20	74	<.20	<1.0	.60	14.6	2.00	1850	7
	.00	34.1	<.05	53.6	.40	63	.80	<1.0	.80	55.2	3.15	2070	24
	.00	61.1	<.05	57.8	.40	111	<.20	<1.0	.60	28.2	2.02	1850	13
H-1-I	4.20	26.8	<.05	56.4	.50	38	<.20	<1.0	.60	28.5	13.50	2000	14
	4.40	37.2	<.05	59.6	.80	51	<.20	<1.0	.80	45.7	27.90	1890	14
	4.10	36.9	.26	62.4	.40	32	<.20	<1.0	.70	84.2	38.70	2140	22
	4.30	35.9	<.05	58.5	.40	42	<.20	<1.0	.60	19.7	11.80	2050	9
					SHRIMP - PANDALOPSIS DISPAR				- WHOLE BODY				
A-1-III	.00	99.4	2.00	65.6	3.90	51	1.00	<1.0	1.20	393.0	37.00	3920	238
	.00	80.1	6.00	68.6	3.80	38	2.20	2.0	1.70	961.0	55.40	4150	561
	.00	73.2	4.00	65.4	5.30	50	1.70	1.0	1.80	768.0	45.60	3550	402
	.00	89.2	1.00	67.2	3.10	38	.50	<1.0	2.10	177.0	39.00	3790	100
	.00	67.1	2.00	64.2	1.50	30	1.30	2.0	3.20	377.0	27.30	3530	162
	.00	119.0	3.00	79.2	10.90	59	1.40	3.0	1.60	410.0	94.50	4740	245
	.00	99.5	3.00	77.8	5.40	44	.90	1.0	1.20	491.0	71.00	4520	228
	.00	77.2	4.00	61.8	7.20	49	1.10	<1.0	.90	394.0	39.60	4460	204
	.00	92.4	4.00	66.0	5.30	44	2.40	3.0	2.00	1140.0	91.80	4150	555
	.00	53.7	3.00	47.4	2.30	46	.50	2.0	1.10	268.0	41.10	5150	147
	.00	64.7	2.00	51.3	2.80	38	.40	<1.0	.60	133.0	34.80	4280	83
	.00	74.3	3.00	64.5	5.00	50	1.00	1.0	1.60	340.0	31.20	5000	160
	.00	88.5	4.00	67.5	3.30	43	2.40	1.0	1.20	702.0	59.20	4640	340
A-3-I	.00	125.0	1.00	64.1	1.50	58	<.30	2.0	1.80	286.0	12.00	2640	132
	.00	115.0	2.00	57.2	1.00	51	<.20	2.0	1.90	311.0	25.10	4590	167
	.00	96.5	1.00	71.4	1.20	33	.20	2.0	1.50	648.0	28.00	5390	346
	.00	127.0	.14	57.3	1.30	76	<.20	<1.0	.70	183.0	9.06	3600	87
	.00	124.0	1.00	89.3	1.00	46	.20	1.0	.80	222.0	13.90	3970	90
	.00	139.0	1.00	59.4	1.40	61	<.20	1.0	1.10	412.0	22.00	4720	211
	.00	116.0	2.00	67.4	1.30	49	<.30	1.0	1.80	609.0	19.70	4900	336
	.00	89.6	2.00	56.3	1.80	33	.20	1.0	1.30	559.0	19.70	4950	300
	.00	111.0	1.00	68.8	2.00	48	.20	<1.0	.80	318.0	15.40	4320	141
	.00	128.0	1.00	64.8	1.10	59	.30	1.0	1.60	468.0	19.60	4820	234
	.00	122.0	2.00	57.5	1.10	50	<.20	<1.0	.90	193.0	14.50	4350	101
	.00	122.0	1.00	72.0	1.50	58	<.20	2.0	1.00	328.0	17.60	4490	167
	.00	100.0	2.00	63.9	1.00	57	<.20	2.0	1.00	225.0	12.90	4620	120
	.00	125.0	1.00	64.5	1.20	57	.30	2.0	1.20	443.0	18.70	4730	226
	.00	82.4	1.00	61.8	2.40	60	<.30	1.0	.80	222.0	13.00	4840	112

Continued ...

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					SHRIMP - PANDALUS BOREALIS - MUSCLE								
A-1-I	4.20	37.6	1.80	59.3	.92	93	<.20	<.9	.80	41.9	6.79	1970	7
	3.70	36.6	1.00	76.0	.40	56	<.20	<1.0	.90	42.1	15.20	1780	14
	4.10	39.2	1.00	66.3	.30	61	<.20	<1.0	.80	36.9	8.53	2030	8
	3.90	28.9	<.05	66.2	.30	47	<.20	<.9	.90	42.4	21.90	2270	18
	4.50	22.3	1.10	57.1	.51	52	<.20	<.9	.80	59.0	46.40	2430	18
A-1-III	4.50	23.3	1.00	55.3	.17	77	.30	<.9	.70	51.3	3.27	1640	28
	4.20	26.4	2.00	56.4	.30	54	.30	<1.0	.80	238.0	20.90	2020	125
	4.40	26.1	1.00	58.8	.20	41	.70	1.0	1.30	97.2	10.40	1810	43
	4.20	20.7	2.00	58.3	.20	51	.40	1.0	1.00	50.2	5.17	1640	27
	4.40	23.8	1.00	57.6	.20	49	.50	<1.0	1.20	307.0	19.00	1900	146
	4.60	38.0	2.00	57.5	.30	54	.30	<1.0	.90	155.0	20.30	2720	81
	4.10	23.0	2.00	61.6	.20	46	.50	<1.0	.90	110.0	12.50	1830	48
	4.40	24.1	1.00	58.9	.30	51	.60	<1.0	.80	157.0	12.90	1800	70
	4.40	30.9	1.00	62.6	.14	68	<.20	<1.0	2.00	73.2	8.26	1860	36
	4.30	28.6	1.00	56.7	.30	61	.50	<1.0	.70	65.9	83.90	1830	22
	4.30	21.3	<.05	56.0	.20	75	.30	<1.0	.60	35.8	3.20	1590	19
	4.50	15.2	.16	35.8	.50	42	<.20	<1.0	.60	70.9	8.86	1160	33
	4.40	21.6	1.00	47.5	.30	43	.20	<1.0	.60	112.0	7.73	1430	56
	4.60	20.3	.20	52.2	.10	71	.30	<1.0	.60	150.0	11.10	1710	71
	4.30	32.9	<.05	56.8	.60	46	<.30	<1.0	1.00	54.5	9.82	1810	27
A-3-I	4.30	29.4	<.05	56.0	.20	92	<.20	<1.0	.60	35.4	13.30	1830	16
	.00	49.7	<.05	56.9	.20	126	<.20	<1.0	.60	34.6	1.97	1760	13
	3.00	33.2	<.05	55.8	.30	48	<.20	<1.0	.60	54.5	3.17	1350	16
	3.90	42.7	.11	51.2	.60	85	<.20	<1.0	.80	82.6	6.36	1820	30
	4.00	31.5	.12	62.1	.30	109	<.20	<1.0	.90	125.0	11.60	2120	51
	3.40	44.3	.07	61.0	.20	137	<.20	1.0	.60	45.3	6.73	1710	18
	4.50	49.6	.07	70.7	.30	63	<.30	1.0	1.00	91.2	5.46	1690	42
	3.90	25.4	.14	53.3	.10	85	<.20	1.0	1.30	48.0	1.99	1410	20
	4.10	19.7	.07	60.5	.10	97	.30	<1.0	.70	29.5	1.57	2120	14
	3.20	23.4	1.00	53.9	.20	104	<.20	1.0	.70	30.8	1.81	1840	10
	2.90	39.2	1.00	57.2	.30	87	<.20	<1.0	.60	52.8	2.52	1750	15
	4.20	37.7	1.00	65.8	.10	68	<.20	<1.0	.60	28.2	2.63	1440	13
	4.10	20.3	.11	57.2	.20	67	<.30	1.0	.60	31.6	1.75	1690	16
	3.30	24.6	1.00	57.6	.08	141	<.30	<1.0	.80	51.2	3.67	1740	19
	3.10	31.6	.06	53.8	.30	97	<.20	<1.0	.90	35.6	2.37	1810	16
					SHRIMP - PANDALUS BOREALIS - WHOLE BODY								
A-1-III	4.20	111.0	4.20	66.3	2.48	42	1.40	.9	1.10	653.0	102.00	4330	333
	4.00	100.0	12.00	91.4	3.30	53	4.50	3.0	2.90	2860.0	133.00	4140	1190
	4.40	123.0	6.70	76.4	2.77	57	2.20	2.1	1.50	1110.0	68.60	4530	464
	4.40	98.1	5.00	77.5	1.80	55	1.60	1.0	1.40	1060.0	97.90	3960	482
	4.20	108.0	5.10	79.6	2.11	45	2.20	2.0	1.30	822.0	42.80	3950	348
	4.30	110.0	7.60	83.1	4.56	46	3.00	2.9	1.60	1690.0	90.50	4290	591
	4.40	118.0	6.00	77.4	1.60	37	1.00	2.0	1.30	1120.0	103.00	3970	508

Continued ...

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-1-III	continued...												
	4.70	104.0	5.30	64.5	1.35	21	1.10	1.5	1.00	640.0	69.50	4270	337
	4.20	105.0	4.00	69.5	3.40	63	1.30	3.0	1.20	576.0	41.80	3930	269
	4.60	135.0	4.20	88.6	1.95	44	1.20	1.0	.90	759.0	69.20	4020	360
	4.50	116.0	8.00	72.5	2.60	46	2.00	2.0	1.60	1530.0	130.00	4210	683
	4.00	92.5	13.20	90.6	2.86	56	4.80	2.5	3.00	3600.0	182.00	4710	1480
	4.30	97.0	4.40	70.4	2.34	50	1.40	1.1	1.20	1040.0	81.40	3690	446
	4.70	126.0	3.00	70.4	1.30	37	.90	2.0	.80	474.0	46.70	4020	261
	4.40	105.0	10.00	92.2	2.10	49	1.70	2.0	1.30	823.0	67.90	4140	381
A-3-I	3.70	114.0	2.00	69.0	1.90	78	<.20	4.0	1.50	307.0	13.60	3540	148
	4.30	111.0	1.00	80.3	2.40	72	.20	2.0	1.80	234.0	21.40	4800	114
	3.10	123.0	1.00	72.3	.80	71	.30	1.0	1.00	402.0	29.60	4210	189
	3.70	96.3	1.00	68.9	1.00	57	.40	1.0	1.30	560.0	20.40	3990	257
	3.70	114.0	.34	71.6	1.70	45	.30	1.0	1.80	375.0	26.50	3760	146
	3.50	101.0	1.00	69.4	.80	57	.20	1.0	1.00	237.0	12.50	3630	115
	3.90	104.0	1.00	76.7	2.10	71	.20	1.0	.90	287.0	17.90	4280	139
	3.30	116.0	1.00	60.6	1.20	43	.40	2.0	1.30	358.0	18.80	4130	169
	3.90	90.7	1.00	64.1	1.00	69	.40	1.0	1.60	731.0	24.00	4070	347
	4.10	99.6	.37	109.0	1.90	59	.50	1.0	1.30	503.0	19.60	3160	204
	3.70	118.0	.46	73.1	.70	84	<.20	<1.0	.70	261.0	17.60	3540	112
	3.40	90.2	.45	59.1	2.40	76	<.30	<1.0	1.00	359.0	28.30	4440	159
	3.90	61.9	3.00	49.7	.80	56	.20	6.0	1.30	374.0	29.60	3190	175
	3.80	65.8	2.00	69.9	.90	58	.60	2.0	1.60	737.0	34.40	3560	339
	3.10	125.0	2.00	88.4	2.00	74	.30	2.0	1.40	381.0	24.60	3510	157
					SHRIMP - PANDALUS HYPSINOTUS - MUSCLE								
A-3-I	.00	43.2	.12	65.6	.20	57	<.20	<1.0	1.30	31.1	4.59	2000	15
	.00	32.6	.26	69.3	.20	51	<.20	<1.0	.60	26.4	2.84	1980	11
	.00	40.2	.08	60.3	.20	55	<.30	<1.0	.50	28.7	3.07	1530	11
	.00	30.1	<.05	70.3	.20	66	<.30	<1.0	.70	22.2	3.57	2220	9
	.00	37.9	<.05	66.5	.10	85	<.20	<1.0	.90	29.7	2.78	2210	10
	.00	41.5	<.05	66.7	.20	106	<.20	<1.0	.60	29.4	3.79	2200	9
	.00	48.3	.12	68.5	.30	122	<.20	<1.0	.80	43.5	2.63	2020	17
	.00	44.0	.08	70.4	.30	51	<.20	<1.0	.60	33.7	4.05	2040	15
	.00	22.4	.14	54.6	.10	56	<.20	<1.0	.60	25.1	1.50	1880	9
	.00	34.3	<.05	62.8	.20	60	<.20	<1.0	.70	67.1	4.57	2050	33
	.00	36.0	.08	67.3	.06	75	<.30	<1.0	.70	19.9	1.67	1950	9
	.00	26.8	<.05	65.1	.20	138	<.20	<1.0	.80	18.4	2.10	1940	9
	.00	29.7	<.05	61.6	.20	128	<.20	<1.0	.60	31.7	1.01	1670	12
	.00	29.2	.06	66.7	.20	69	<.20	<1.0	.80	20.0	2.74	1980	12
	.00	39.4	<.05	65.9	.10	109	<.20	<1.0	.80	20.6	2.28	1950	7
H-5-I	4.80	45.7	<.05	73.6	.50	90	<.20	<1.0	.80	36.0	1.22	1820	15
	4.40	43.0	<.05	83.7	.20	37	<.20	<1.0	.60	35.6	1.19	2130	16
	4.30	47.0	<.05	84.2	.11	30	<.20	<1.0	.70	42.5	1.69	1840	20
	4.10	47.2	<.05	72.4	.05	46	<.20	<1.0	.80	15.2	1.34	1550	8
	4.40	37.6	<.05	74.1	.30	107	<.20	<1.0	.60	22.7	2.57	1800	10

Continued ...

APPENDIX: 11 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, MAY-JUNE 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
H-5-I	continued...												
	4.30	39.7	1.00	71.0	.10	53	<.20	<1.0	.80	29.9	1.67	1890	13
	4.90	31.2	<.05	80.1	.40	132	<.20	<1.0	.50	15.2	.87	2150	7
	4.40	44.7	<.05	75.9	.20	86	<.20	<1.0	.60	57.1	2.51	2060	17
	4.50	29.7	<.05	78.2	.06	42	<.20	<1.0	.50	17.2	.91	3070	8
	4.10	23.4	.35	71.8	<.05	51	<.20	<1.0	.90	21.8	1.01	1940	12
	4.60	44.5	<.05	93.4	.20	82	<.20	<1.0	.60	27.6	1.71	1900	9
	4.30	39.7	<.05	79.7	.10	61	<.20	<1.0	.60	14.2	1.28	1910	7
					FISH - EOPSETTA JORDANI				- MUSCLE				
A-3-I	6.20	6.2	4.00	21.1	<.05	135	<.20	2.0	2.10	301.0	3.08	1350	18
	5.80	3.0	3.00	25.9	<.05	115	<.20	<1.0	1.10	43.3	2.92	1310	13
	5.70	4.1	.14	20.3	<.05	142	<.30	5.0	4.00	38.9	1.95	1350	10
					FISH - HIPPOGLOSSOIDES ELASSODON				- MUSCLE				
SOMERVILLE	5.50	3.4	.34	21.2	.05	21	<.20	1.0	1.90	56.3	.73	1150	10
	5.40	2.7	.16	17.3	<.05	21	<.20	<1.0	.60	16.4	.22	1150	10
	5.20	1.4	.17	17.5	<.05	16	<.20	<1.0	.70	9.3	.16	1100	4
					FISH - LYOPSETTA EXILIS				- MUSCLE				
A-3-I	5.60	3.6	.31	17.3	<.05	9	<.20	<1.0	1.00	25.5	1.32	1290	16
	6.20	5.5	3.00	19.9	.10	16	<.20	<1.0	2.20	66.3	2.86	1340	7
					FISH - PAROPHRYS VETULUS				- MUSCLE				
A-3-I	5.00	4.3	.22	22.4	<.05	90	<.20	<1.0	.80	20.0	1.39	1310	6
	5.80	4.6	1.00	21.8	<.05	92	<.20	<1.0	1.20	35.1	1.33	1470	14
	5.60	3.0	1.00	27.8	<.05	81	<.20	<1.0	1.20	35.3	1.41	1380	12
	5.60	3.8	3.00	23.9	<.05	49	.20	<1.0	1.60	45.5	1.03	1310	11
SOMERVILLE	5.00	4.0	.17	20.3	<.05	29	<.20	<1.0	1.00	19.0	.25	1060	5
					FISH - THERAGRA CHALCOGRAMMA				- MUSCLE				
A-3-I	5.30	6.7	1.00	33.8	<.05	40	<.20	<1.0	1.80	41.4	1.61	2520	10
	5.40	9.6	.06	21.6	<.05	32	<.20	1.0	1.00	24.1	.74	1500	7
	5.20	6.2	1.00	26.6	<.05	25	<.20	1.0	3.40	44.8	1.10	1580	11

* Roman numerals indicate station trawl number.

+< Indicates EPS laboratory detection limits.

++ All zeros indicate no analysis.

APPENDIX 12: Tissue Trace Metal Concentrations (mg/kg dry weight), Alice Arm and Hastings Arm, October 1981

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					BIVALVE - MACOMA SP.				- WHOLE BODY				
+ A-1-I	6.90	56.2	266.00	662.0	7.49	9	51.50	14.8	10.30	7860.0	129.00	6650	715
	10.90	38.2	152.00	871.0	10.90	13	16.00	7.0	5.30	4450.0	94.80	7040	577
	2.80	105.0	439.00	1140.0	15.10	19	72.30	19.0	16.80	12800.0	159.00	6280	1330
	3.30	85.6	316.00	835.0	9.30	15	27.20	12.0	11.10	8220.0	169.00	6670	1220
	7.70	69.5	152.00	822.0	7.63	13	14.90	9.7	5.80	4250.0	60.20	6590	411
	8.30	33.3	101.00	628.0	10.40	13	21.30	11.3	6.00	2970.0	64.30	6040	481
	7.20	45.6	109.00	1160.0	13.30	11	15.00	7.0	3.80	3510.0	71.70	6760	527
	7.30	99.8	259.00	1220.0	17.60	10	21.10	16.0	10.60	12400.0	109.00	7690	917
	8.70	66.6	238.00	635.0	6.40	15	23.30	10.0	7.80	6310.0	106.00	8260	658
	7.50	93.0	478.00	934.0	11.10	16	64.00	12.0	9.10	7640.0	207.00	7320	1000
	7.60	34.4	81.00	577.0	9.70	13	19.60	6.0	3.20	3120.0	77.30	6650	633
	8.50	96.1	288.00	632.0	8.20	16	41.70	12.0	9.20	9210.0	134.00	7200	941
	6.90	83.6	311.00	866.0	9.40	16	46.10	14.0	13.20	8920.0	140.00	6650	1270
	7.30	85.1	320.00	1020.0	12.70	16	62.90	10.0	7.70	7300.0	159.00	7170	1080
	8.20	46.8	157.00	622.0	6.30	13	29.30	9.0	4.40	4060.0	68.70	7020	362
					BIVALVE -Y.THRACIAEFORMIS/MONTEREYENSIS				- WHOLE BODY				
A-1-I	7.40	83.8	63.60	1030.0	4.28	63	10.40	9.8	5.40	4150.0	61.80	4860	577
	5.80	298.0	155.00	1710.0	27.60	87	45.90	10.0	7.40	8490.0	238.00	7980	1980
	5.90	255.0	213.00	1230.0	18.50	53	27.00	11.0	7.30	7520.0	85.20	6750	1000
	6.90	99.6	183.00	1250.0	6.10	68	30.40	14.0	8.70	9870.0	94.50	5720	794
	7.50	155.0	254.00	1310.0	8.20	74	46.90	12.0	7.90	8340.0	77.50	5960	778
	7.30	765.0	220.00	715.0	20.90	74	24.80	12.0	7.80	9340.0	285.00	8330	1210
	6.00	674.0	184.00	792.0	27.20	60	46.00	15.0	19.00	7400.0	124.00	7860	1070
	6.50	91.1	184.00	799.0	5.80	54	32.20	10.0	6.10	6640.0	78.00	5430	875
	6.20	160.0	326.00	921.0	7.20	66	80.80	17.0	8.10	16400.0	102.00	5310	945
	6.40	115.0	66.00	1610.0	12.30	51	21.40	10.0	9.10	6800.0	56.30	4860	590
	5.50	163.0	296.00	981.0	11.50	77	22.80	20.0	11.50	9370.0	154.00	4240	982
	6.80	135.0	150.00	1250.0	6.70	62	24.50	13.0	7.90	7570.0	64.60	5490	638
	7.00	107.0	134.00	828.0	7.41	65	14.70	8.2	5.60	6380.0	107.00	6030	668
	6.70	110.0	32.20	1040.0	5.56	89	10.00	6.6	2.60	2240.0	47.80	5810	365
	9.50	179.0	197.00	1590.0	7.80	84	28.20	18.0	10.20	9850.0	80.00	5680	618
A-1-II	5.20	425.0	248.00	1060.0	19.80	52	36.90	16.0	14.20	12000.0	573.00	6650	2440
	4.70	491.0	442.00	1270.0	51.10	71	41.00	18.0	12.40	17600.0	257.00	5920	1620
	4.90	387.0	197.00	1550.0	29.70	74	63.20	14.0	7.80	11100.0	110.00	5710	1150
	5.80	1150.0	57.00	849.0	27.30	64	8.40	14.0	13.70	12100.0	524.00	7580	4310
	5.80	753.0	259.00	1200.0	21.20	64	16.30	12.0	5.80	8320.0	107.00	5880	1130
	5.60	628.0	169.00	1130.0	31.00	67	13.90	15.0	9.30	13800.0	192.00	4780	2280
	5.40	599.0	662.00	1440.0	36.60	70	65.00	18.0	10.00	15100.0	718.00	7430	2400
	5.50	517.0	837.00	2070.0	51.50	60	28.00	31.0	14.00	34400.0	527.00	6430	2920
	5.00	569.0	64.00	841.0	25.20	70	3.00	16.0	17.00	8850.0	212.00	7540	4250
	5.10	590.0	409.00	2290.0	51.40	46	78.10	19.0	10.20	18300.0	190.00	5280	2010
	5.50	320.0	258.00	1380.0	31.40	60	55.00	16.0	10.00	19400.0	498.00	6450	3000
	5.40	267.0	334.00	957.0	21.80	70	85.00	22.0	18.00	15100.0	449.00	6490	2740
	5.80	551.0	95.00	753.0	17.30	70	8.10	10.0	7.10	7160.0	304.00	6710	2580

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-1-II	continued...												
	5.20	410.0	165.00	1070.0	26.10	57	28.00	16.0	12.90	12800.0	236.00	6380	2600
A-2-I	6.00	466.0	379.00	1040.0	17.50	60	43.00	17.0	16.00	11300.0	407.00	6490	2590
	5.30	509.0	503.00	1370.0	40.50	100	61.80	18.0	13.50	13800.0	299.00	7560	1710
	5.40	903.0	492.00	941.0	36.70	108	55.90	22.0	13.40	13900.0	474.00	8510	3090
	5.30	782.0	370.00	944.0	35.40	69	25.00	22.0	16.80	14300.0	554.00	7920	2780
	5.90	1190.0	684.00	767.0	48.90	71	81.90	23.0	14.00	12300.0	384.00	8450	2060
	5.30	783.0	374.00	873.0	29.30	64	44.80	19.0	12.80	10800.0	368.00	8040	2390
	5.70	370.0	375.00	1450.0	18.50	68	76.50	19.0	14.20	15400.0	428.00	6890	2510
	6.00	320.0	381.00	723.0	34.30	60	61.00	15.0	10.00	11900.0	159.00	8200	1280
	4.90	401.0	607.00	1490.0	22.50	59	89.30	27.0	18.10	20300.0	583.00	7310	3200
	5.20	438.0	489.00	1270.0	26.30	73	77.60	25.0	17.70	19900.0	543.00	9490	3420
H-2-I	4.30	171.0	5.40	355.0	12.30	30	2.00	<7.0	9.00	64900.0	841.00	8700	3430
	5.00	713.0	8.00	2190.0	32.60	50	1.00	11.0	7.00	5030.0	506.00	8150	2990
	4.40	651.0	1.90	1260.0	35.90	35	1.20	5.0	3.40	1910.0	313.00	6560	1000
	5.10	438.0	3.00	658.0	22.60	56	++<.70	4.0	3.50	2550.0	384.00	5010	1270
	5.60	617.0	4.00	714.0	24.60	50	1.30	3.0	3.30	2820.0	412.00	7930	1470
	6.60	160.0	4.60	1400.0	7.50	48	1.40	2.8	2.20	1550.0	274.00	5550	803
	5.40	431.0	4.00	718.0	23.20	59	<.70	6.0	5.00	3060.0	334.00	6170	1520
	6.30	610.0	6.00	795.0	32.50	38	<.90	8.0	4.50	2140.0	439.00	7170	1030
	6.10	561.0	4.00	726.0	28.00	49	1.30	5.0	5.90	3650.0	516.00	7400	1930
	6.00	303.0	2.90	536.0	19.30	60	<1.00	5.0	7.00	3880.0	534.00	8160	2030
	5.50	510.0	7.00	805.0	26.50	60	<1.00	10.0	8.00	4840.0	702.00	8330	2670
	5.50	356.0	7.00	909.0	18.80	60	1.00	9.0	5.00	2520.0	485.00	6600	1360
	6.00	142.0	6.00	335.0	11.20	30	<1.00	10.0	13.00	5690.0	546.00	8490	3030
					CRAB - CHIONOCETES BAIRDI				- MUSCLE-LEG				
A-1-I	5.10	40.5	2.00	125.0	.30	140	<.20	1.0	1.10	30.8	31.00	4880	10
	5.10	49.1	4.00	119.0	.30	150	1.60	<1.0	1.00	386.0	15.90	4050	145
A-1-II	4.40	34.1	1.00	128.0	.60	127	.30	<1.0	.80	122.0	17.10	2950	73
	4.80	75.0	2.00	135.0	1.40	135	.30	2.0	1.10	85.1	54.50	3340	43
	4.60	35.1	<1.00	149.0	.60	141	.30	1.0	.90	33.2	6.15	2730	16
A-2-I	5.20	77.5	.24	134.0	.50	207	<.20	<1.0	.60	76.4	47.90	3180	38
A-3-I	4.40	73.0	<.05	130.0	.21	119	<.20	<.9	.50	35.5	2.80	3350	15
H-2-I	4.40	35.3	1.00	146.0	.60	140	.30	1.0	1.00	33.7	5.86	2620	16
	4.20	53.1	1.00	112.0	.20	147	.30	<1.0	.60	39.3	19.90	3810	18
	4.70	50.0	<.05	131.0	.50	89	<.20	<1.0	.70	76.6	72.90	2990	47

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
					CRAB - LITHODES AEQUISPINA				- MUSCLE-LEG				
A-1-II	5.80	99.8	<.05	214.0	.20	115	.40	3.0	1.50	120.0	6.55	4590	67
A-2-I	5.60	68.5	2.00	164.0	.40	126	<.20	<1.0	.80	42.3	16.70	3280	20
	4.60	103.0	<.05	181.0	.20	139	<.20	1.0	.80	15.4	4.61	3140	6
					SEA CUCUMBER - MOLPADIA SP.				- MUS. BANDS				
A-1-I	5.60	15.1	15.00	131.0	2.60	13	13.00	6.0	4.50	2580.0	161.00	7640	513
					SHRIMP - CRANGON COMMUNIS				- TAIL ONLY				
A-3-I	3.80	71.0	2.00	68.3	.40	109	<.20	<1.0	1.10	223.0	42.90	4500	98
	3.60	92.0	6.00	86.7	.70	116	.30	2.0	1.30	263.0	124.00	3790	106
	3.60	65.4	.90	74.8	.28	86	.30	<.9	1.00	238.0	59.20	3760	108
	4.40	87.4	3.10	81.5	.66	95	<.20	<.9	.90	222.0	31.60	3870	98
	4.20	76.7	2.00	91.0	.30	131	<.20	1.0	1.10	271.0	40.40	3740	117
	3.80	77.4	2.00	81.7	.40	86	.20	2.0	.90	214.0	63.40	3630	91
	4.00	81.7	2.00	73.0	.70	65	.20	2.0	1.30	248.0	34.10	3810	119
	3.80	74.6	1.00	83.4	.30	117	<.20	<1.0	1.00	311.0	74.40	3680	135
	4.50	90.3	2.00	89.5	.40	91	<.20	1.0	1.10	276.0	65.60	4390	119
	3.80	63.8	2.00	98.6	.40	94	<.20	2.0	1.30	301.0	59.50	3740	132
	3.70	80.1	2.00	83.9	.44	134	<.20	<.9	1.10	257.0	59.00	3810	114
	4.40	80.2	1.00	65.5	.80	98	<.20	<1.0	1.10	356.0	43.80	4780	157
	3.70	89.8	2.00	78.4	.50	98	<.20	<1.0	1.20	245.0	48.60	3970	96
	3.80	88.7	1.00	72.7	.30	84	<.20	<1.0	.80	173.0	37.60	3810	75
	3.90	96.3	1.00	73.0	.50	119	<.20	<1.0	.80	164.0	69.50	3680	72
					SHRIMP - PANDALOPSIS DISPAR				- MUSCLE				
A-1-I	4.50	15.2	2.00	59.5	.20	61	.40	1.0	.90	166.0	9.41	1990	52
	4.30	14.1	1.00	54.2	.20	70	<.20	1.0	.70	83.5	5.22	1860	23
	4.30	17.1	4.00	58.0	.40	68	.50	2.0	1.50	394.0	14.90	2170	107
	4.10	23.5	1.80	55.6	.26	63	.30	1.5	.80	109.0	6.36	2210	32
	4.30	25.2	1.00	54.4	.10	75	.30	<1.0	1.20	86.4	6.44	2090	26
	4.20	18.8	2.00	54.3	.20	68	.50	2.0	1.00	122.0	12.00	2110	32
	4.30	14.1	2.00	64.2	.20	59	.20	1.0	.70	80.8	5.36	1980	25
	4.40	16.3	1.00	56.3	.30	60	.30	1.0	.70	41.3	3.67	1900	14
A-1-II	4.40	17.7	.14	60.1	<.20	64	<.02	1.0	.90	101.0	9.68	2050	49
	4.70	15.6	.14	71.0	.40	85	.20	1.0	.70	72.6	3.96	1980	36
	4.50	13.9	1.00	52.6	.20	65	<.20	1.0	1.30	235.0	11.30	2070	90
	4.70	18.2	1.00	56.2	.40	61	<.20	<1.0	.80	215.0	10.70	2300	110
	4.30	19.3	1.00	58.0	.23	50	<.20	2.3	2.20	273.0	12.20	2130	127
	4.50	11.8	2.00	53.2	.20	60	<.20	<1.0	1.70	556.0	22.90	2300	283
	4.30	14.3	.07	52.4	.06	55	<.20	<.9	.60	78.7	4.64	1910	33
	4.20	18.8	.09	54.3	.10	49	<.20	1.0	1.10	144.0	7.38	1850	50

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-2-I	4.30	18.6	<.05	60.2	<.05	40	<.20	<1.0	.50	17.3	2.88	1650	7
	4.60	19.9	<.05	52.9	.05	57	.20	1.0	.60	28.9	2.87	1640	12
	5.00	20.3	<.05	55.7	.10	52	<.20	1.0	.60	43.9	4.69	1790	17
	4.30	21.9	.11	56.2	.05	50	<.20	<1.0	.60	45.4	4.22	1680	19
	4.80	23.0	<.05	58.0	.11	51	<.20	<.9	.50	18.9	2.88	1570	8
	4.80	15.8	.08	58.0	<.05	86	<.20	2.0	1.70	27.3	3.57	1870	11
	4.40	18.8	.11	52.8	.08	57	<.20	<.9	.60	40.4	3.42	1860	17
	4.50	18.6	.07	63.5	.10	88	<.20	<1.0	.60	20.9	1.83	1810	9
	4.50	16.5	.09	52.7	.10	57	<.20	<1.0	.60	29.2	2.09	1810	16
	4.50	19.8	<.05	52.4	.09	56	<.20	<1.0	.50	18.0	1.90	1730	11
	4.50	19.6	<.05	53.3	.11	62	<.20	<1.0	.60	31.5	2.20	1730	13
	4.40	17.9	.16	66.6	.10	65	<.20	1.0	.80	46.6	3.38	1830	21
A-2-II	4.30	15.5	1.10	51.6	.17	60	.30	1.8	.70	58.4	7.22	1850	25
	4.30	22.5	1.00	55.7	.10	68	.20	2.0	.70	38.8	3.65	1580	16
	4.30	23.5	.16	58.3	.10	58	<.20	1.0	.80	71.9	10.90	1950	25
	4.30	25.5	.10	54.6	.13	61	.30	6.2	1.00	43.6	6.53	1850	57
	4.30	17.1	.13	56.1	<.05	58	<.20	<1.0	.60	42.3	4.57	1900	18
	4.30	18.4	.08	47.2	.30	53	.20	<1.0	.90	58.0	8.01	1630	24
	4.40	25.0	.08	54.3	.20	56	<.20	<1.0	.60	62.2	14.60	2080	26
	4.40	14.7	.18	64.6	.20	86	<.20	<1.0	.80	94.6	7.70	1940	37
	4.50	21.4	<.05	59.5	.20	85	<.20	<1.0	.40	26.4	5.03	2270	10
	4.30	19.8	<.05	55.9	.21	60	<.20	1.1	.90	43.4	4.87	1860	13
	4.60	14.7	.08	57.0	.10	83	<.20	<1.0	.60	50.9	5.64	2450	23
	4.60	20.3	.06	57.1	.10	71	<.20	<1.0	.80	49.2	12.20	2180	23
	4.50	22.4	.12	52.2	.30	106	<.20	<1.0	.60	49.9	5.40	2030	16
	4.60	17.3	.12	53.1	.11	71	<.20	<1.0	.60	56.7	6.31	1910	24
	4.30	21.1	.10	49.2	<.05	53	<.20	<1.0	.60	40.6	7.21	1930	16
H-1-I	4.50	16.1	<.05	57.5	.06	50	<.20	2.0	.40	17.3	2.54	1990	10
	4.50	12.7	<.05	53.6	.09	67	<.20	<1.0	.60	25.1	2.48	2400	13
	4.60	16.0	<.05	58.7	.10	51	<.20	1.0	.60	40.9	5.10	2360	21
	4.40	16.4	<.05	52.6	.07	46	<.20	<1.0	.60	19.5	1.53	1670	10
	10.70	22.2	<.05	56.3	<.05	47	<.20	<.9	.50	23.1	2.34	2020	9
	4.40	17.6	<.05	47.5	<.05	41	<.20	1.0	.60	18.4	2.41	1820	8
	4.40	12.6	<.05	60.3	.20	60	.20	<1.0	.60	31.1	2.78	1910	14
	4.80	15.5	<.05	49.2	.10	40	<.20	<1.0	.60	22.9	4.39	2150	12
	4.30	26.3	<.05	58.9	.18	38	<.20	1.4	.70	70.8	6.23	1950	32
	4.30	21.8	<.05	51.3	.10	52	<.20	<1.0	.50	41.7	6.38	2020	20
	4.30	14.1	<.05	47.8	.07	35	<.20	<1.0	.40	25.3	3.01	1580	10
	4.50	22.0	<.05	59.1	.08	37	<.20	<1.0	.50	38.0	4.08	2540	16
	4.40	19.0	<.05	75.3	.10	62	<.20	<1.0	.50	89.6	5.86	2500	45
	4.40	18.7	<.05	52.3	.13	44	<.20	<1.0	.50	29.6	2.69	2240	16
	4.60	15.8	<.05	58.7	.20	71	<.20	<1.0	.60	37.4	2.91	2220	18
H-2-I	4.40	24.4	<.05	56.5	.10	38	<.20	3.0	.70	32.1	11.30	2140	18
	4.20	24.2	<.05	51.8	.10	39	<.20	1.0	.70	58.1	20.10	1620	34
	4.40	22.6	<.05	53.6	.20	48	<.30	1.0	.60	43.9	18.60	1810	24
	4.30	22.4	<.05	53.2	.10	41	<.20	1.0	.60	47.7	14.00	1680	25

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
H-2-I	continued...												
	4.40	20.9	.10	51.6	.19	34	<.20	<.9	.60	107.0	19.50	1860	63
	4.30	21.1	1.00	53.8	.09	39	<.20	<.9	.60	50.7	13.70	1770	26
	4.30	27.2	<.05	55.1	.10	40	.20	<1.0	.90	78.7	23.40	1850	48
	4.70	11.9	<.05	53.3	.20	55	<.20	<1.0	.50	32.7	14.00	1900	19
	4.20	24.0	<.05	52.1	.20	45	<.20	1.0	.80	44.2	15.20	1840	26
	4.30	25.2	<.05	59.4	.10	42	<.20	<1.0	.60	35.1	16.30	2160	23
	4.30	21.7	<.05	54.5	.20	36	<.30	1.0	.70	36.1	14.50	1870	24
	4.80	18.4	<.05	61.8	.10	43	.30	<1.0	.70	76.2	22.00	2190	52
	4.60	25.6	.15	58.0	.09	45	<.20	<1.0	.60	72.0	18.70	2010	42
	4.70	19.8	<.05	61.4	.10	68	.20	<1.0	.60	40.1	17.20	2130	26
	4.70	17.0	.05	55.7	<.05	38	<.20	<1.0	.50	26.4	10.20	1700	15
					SHRIMP - PANDALUS BOREALIS				- MUSCLE				
A-1-II	4.10	21.1	<.05	60.8	<.05	112	<.20	2.0	.90	157.0	8.26	2210	71
	4.20	17.5	<.05	51.9	.20	84	<.20	<1.0	.80	42.1	8.27	2000	24
	4.20	19.8	.13	56.8	<.05	77	<.20	1.0	.80	164.0	7.88	2080	65
	4.30	15.0	.19	50.0	<.05	79	<.20	<1.0	1.40	145.0	32.30	2300	74
	4.30	15.4	.07	54.0	.06	75	<.20	<.1	.70	57.7	6.57	2150	28
	4.10	21.3	<.05	59.3	.12	67	<.20	<.1	.60	127.0	16.40	2500	63
	4.30	11.8	.08	49.4	<.05	77	.20	<1.0	.90	244.0	9.51	1950	117
	4.20	20.6	<.05	53.4	<.05	82	<.20	<1.0	.80	34.1	7.03	1840	21
	4.20	14.2	.06	53.6	<.05	86	<.20	<1.0	.60	81.7	4.82	2410	39
	4.20	21.9	<.05	57.7	.20	91	<.20	<1.0	.70	88.0	6.52	2330	39
	4.30	22.1	<.05	53.3	<.05	73	<.20	<1.0	.50	58.8	5.53	1570	25
	4.10	19.3	<.05	51.5	<.05	79	<.20	<1.0	.50	120.0	6.29	1770	52
	4.20	19.9	<.05	55.4	.06	98	<.20	<1.0	.60	98.5	4.80	1930	52
	4.30	22.3	.17	58.3	.05	76	<.20	<1.0	.70	133.0	10.60	2080	63
	4.30	20.8	.25	59.5	.09	96	<.20	<.9	.80	235.0	12.70	2070	95
	4.30	25.9	1.00	59.8	.10	79	<.20	1.0	1.80	231.0	11.90	2330	115
A-2-II	4.10	22.7	1.00	60.0	<.05	92	<.20	<.9	.60	41.1	8.73	1810	15
	4.30	14.5	1.00	51.0	.20	83	<.20	<1.0	.70	86.3	10.30	1880	30
	4.10	17.8	1.00	52.4	.20	67	<.20	1.0	1.00	41.8	5.27	1700	17
	4.00	19.1	<.05	57.2	<.05	76	<.20	<.9	.60	24.7	8.41	1580	9
	4.10	20.6	.07	54.3	<.05	81	<.20	<.9	.50	40.2	10.10	1730	15
	4.10	16.7	<.05	61.5	<.05	63	<.20	<1.0	.50	29.7	6.13	1750	11
	4.00	22.1	1.00	64.1	.08	84	.20	<1.0	.80	69.2	12.60	1690	23
	4.50	9.4	.07	55.1	.05	141	<.20	<1.0	.70	40.4	7.83	1690	15
	4.00	15.7	.11	51.7	<.05	72	<.20	<1.0	.90	35.2	8.02	1590	13
	4.00	19.1	.21	108.0	.10	86	<.20	<1.0	.50	69.5	16.50	1750	28
	3.90	19.6	1.00	52.0	<.05	71	<.20	<.9	.60	63.3	9.25	1510	23
	4.00	14.6	<.05	56.2	<.05	86	.20	<1.0	1.00	34.2	6.25	1430	13
	4.10	19.0	1.00	52.5	<.05	65	.20	<.9	.70	41.9	8.95	1510	15
	4.00	18.8	<.05	53.1	<.05	63	<.20	<1.0	1.20	47.0	7.89	1750	15
	1.90	19.6	.13	55.2	.11	67	<.20	1.6	.50	53.6	7.83	1820	21

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-3-I	4.00	22.8	.06	53.6	<.05	177	<.20	<1.0	.50	12.6	2.46	1680	7
	4.00	24.7	.07	54.7	.06	142	<.20	<1.0	.60	14.6	2.66	1670	6
	4.00	20.5	<.05	50.6	<.05	149	<.20	<.9	.40	10.6	2.85	1650	4
	4.40	24.2	<.05	59.0	<.05	109	<.20	<1.0	.60	16.3	5.33	2170	8
	4.10	22.1	<.05	58.5	<.05	162	<.20	1.0	.80	29.8	3.14	2170	17
	4.10	19.5	.07	51.0	<.05	133	<.20	<1.0	.40	12.8	2.03	1480	7
	4.10	29.0	<.05	53.6	<.05	165	<.20	<1.0	.50	12.3	1.53	1760	6
	4.40	22.7	.07	61.0	<.05	146	<.20	<1.0	.60	19.1	2.84	2100	8
	4.30	20.1	<.05	50.5	<.05	153	<.20	<1.0	.50	14.4	1.62	1530	7
	4.30	26.0	.07	53.8	.20	133	<.20	<1.0	.50	24.4	11.40	1930	9
	4.00	18.0	.18	47.8	<.05	110	<.20	<1.0	.50	19.7	2.24	1410	7
	4.10	23.1	<.05	51.1	.05	113	<.20	<1.0	.60	16.2	2.57	2080	8
	4.00	32.8	<.05	55.9	.12	134	<.20	<.9	.80	19.8	2.76	1740	9
	4.00	21.9	<.05	51.9	<.05	138	<.20	<.9	.50	9.2	1.91	1690	4
	3.80	20.5	<.05	52.7	.09	113	<.20	<.9	.60	16.2	3.59	1790	8
	4.30	30.2	<.05	71.1	<.05	99	<.20	5.0	.50	34.8	3.87	1920	21
H-1-I	4.50	16.0	<.05	55.5	<.05	42	<.20	2.0	.60	22.5	5.52	1740	9
	4.40	18.5	.15	53.4	<.05	44	<.20	1.0	.50	15.3	4.71	1740	8
	4.30	17.6	<.05	50.1	<.05	40	<.20	1.6	.40	9.7	4.63	1420	5
	4.50	20.7	.07	52.8	.20	48	<.20	<1.0	.50	17.7	3.16	1600	11
	4.80	9.7	<.05	38.9	<.05	48	<.20	<1.0	.50	18.3	1.39	1940	9
	4.20	18.2	<.05	49.7	<.05	57	<.20	<.9	.40	11.1	2.12	1630	7
	5.00	12.1	<.05	46.0	<.05	45	<.20	<1.0	.50	12.9	2.96	2420	6
	4.40	15.1	<.05	45.4	<.05	44	<.20	<1.0	.50	14.7	1.92	1410	6
	4.80	13.0	<.05	49.7	<.05	55	<.20	<1.0	.60	9.3	2.89	1940	5
	4.60	15.8	<.05	52.4	<.05	39	.20	.9	.40	22.3	3.40	1980	8
	4.40	16.1	<.05	46.5	<.05	65	<.20	<1.0	.50	27.5	4.85	1660	10
	4.40	16.0	<.05	46.0	<.05	39	<.20	<1.0	.30	13.3	1.69	1420	6
	4.30	21.3	.05	48.7	.09	61	<.20	<1.0	.50	18.8	2.33	1710	9
	4.60	16.4	<.05	55.3	<.05	54	<.20	<1.0	.40	29.7	1.99	1840	8
	4.40	16.5	<.05	55.5	.10	54	<.20	.1	.60	30.0	2.80	1430	9
H-2-I	4.00	23.4	<.05	48.8	<.05	68	<.20	<1.0	.70	30.9	13.50	1430	16
	4.10	27.3	<.05	52.7	.20	1	<.20	<1.0	.60	52.0	44.00	1920	29
	3.90	37.4	<.05	58.9	.30	99	<.20	1.0	1.00	66.3	42.00	1640	32
	3.50	28.1	<.05	53.8	.20	69	<.20	<1.0	.60	54.8	19.60	1540	28
	3.90	23.4	1.00	52.1	.10	61	<.20	2.0	.80	33.1	12.30	1530	17
	4.10	21.3	1.00	70.7	.10	67	<.20	1.0	.70	29.2	14.70	1170	14
	4.00	36.5	<.05	58.2	.13	51	<.20	1.4	.80	67.9	25.90	1640	37
	3.80	55.5	1.40	47.4	.21	55	<.20	2.0	.90	124.0	39.20	1420	67
					SNAIL - COLUS HALLI				- WHOLE BODY				
A-1-I	3.60	194.0	6.70	1120.0	35.00	168	1.10	3.1	1.40	964.0	46.20	5100	53
	4.20	36.7	2.30	75.4	2.07	259	1.70	1.2	1.40	488.0	97.60	6860	92
	4.00	83.7	6.00	74.8	1.35	175	2.60	2.1	2.30	882.0	352.00	7960	172
	5.10	27.7	2.00	73.7	2.60	201	1.00	1.0	1.30	326.0	74.10	10000	45
	4.30	18.5	2.60	72.6	2.73	219	1.30	<.9	.80	426.0	54.00	10200	60

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
A-1-I	continued...												
	4.60	50.1	6.00	79.7	2.20	131	1.10	<1.0	1.00	270.0	37.00	7480	30
	4.90	52.7	24.00	110.0	7.70	249	5.00	3.0	3.50	2380.0	299.00	9490	611
	4.40	47.3	7.00	87.1	3.60	161	1.70	2.0	1.80	803.0	112.00	8710	112
	4.40	65.0	6.00	79.9	2.30	156	2.10	<1.0	1.60	948.0	57.50	6970	166
	5.80	21.5	2.00	71.7	2.00	147	.70	<1.0	.90	247.0	38.40	4610	33
	4.80	18.1	4.00	73.2	3.20	222	1.50	1.0	1.10	401.0	63.30	7420	71
	4.20	32.2	2.00	73.6	2.30	169	1.00	<1.0	.80	405.0	69.30	9230	65
	4.90	40.6	3.00	67.5	1.10	118	1.10	<1.0	1.00	326.0	62.90	8110	57
	4.90	37.3	5.60	73.7	2.29	118	1.50	1.4	1.00	653.0	193.00	9780	135
	4.60	28.9	3.00	67.0	1.90	151	1.10	3.0	1.50	308.0	39.20	9270	51
A-2-II	4.40	83.1	6.00	74.3	2.50	197	1.60	1.0	1.20	707.0	79.70	9150	204
	5.40	70.0	<1.00	73.3	1.60	206	.50	<1.0	.60	154.0	46.70	8100	29
	6.10	37.1	2.00	99.6	4.70	201	1.40	1.0	1.70	272.0	226.00	8660	46
	4.80	66.3	<.05	69.8	2.30	200	.40	<1.0	.70	108.0	30.50	6890	12
	4.90	73.1	2.00	85.0	2.80	195	.80	<1.0	.80	196.0	157.00	9540	29
	5.10	36.0	4.00	86.7	3.95	175	1.10	1.8	1.20	483.0	132.00	11800	114
	4.80	39.3	4.00	87.9	4.70	335	1.50	<2.0	1.60	494.0	125.00	6510	118
	4.90	42.2	2.00	78.3	2.20	188	.70	2.0	1.10	176.0	140.00	7550	33
	4.90	49.4	.00	82.4	1.80	171	.60	<1.0	.80	157.0	83.20	10100	33
	4.10	117.0	3.00	74.5	.90	231	1.60	1.0	1.50	412.0	282.00	6770	109
	4.60	53.3	5.00	89.0	1.90	86	1.20	2.0	1.20	527.0	216.00	9560	130
	5.00	82.6	2.00	67.4	2.20	268	1.40	1.0	1.50	281.0	77.00	6030	64
	4.60	47.4	2.00	73.7	3.10	154	.80	1.0	1.10	259.0	46.40	8660	56
H-2-I	4.80	85.5	.11	73.3	2.70	123	<.30	2.0	1.80	1220.0	291.00	11600	591
	5.00	70.5	<.09	83.7	5.70	134	.70	2.0	1.20	285.0	688.00	10100	82
	5.30	78.3	<.20	71.0	1.00	90	<.90	<4.0	1.20	116.0	61.90	10700	46
	5.30	577.0	<.05	1400.0	48.60	155	1.90	3.0	.70	684.0	90.40	11500	59
	5.60	834.0	<.05	2530.0	44.20	144	.50	3.0	1.40	543.0	115.00	11300	101
	5.20	109.0	<.06	84.6	2.30	94	.40	1.0	1.20	2830.0	127.00	13100	127
	4.80	73.7	<.05	69.3	2.50	255	.40	<1.0	1.10	136.0	67.80	10700	44
					FISH - EOPSETTA JORDANI				- MUSCLE				
A-3-I	5.50	4.2	<.05	22.9	.10	62	<.20	1.0	1.00	46.6	2.00	1420	20
	5.90	3.4	.07	20.0	.10	96	<.20	<1.0	1.00	38.9	1.62	1460	16
	5.40	3.5	.14	24.5	<.05	25	<.20	<1.0	.70	40.7	1.55	1350	16
					FISH - PAROPHRYS VETULUS				- MUSCLE				
A-3-I	5.20	14.3	.05	28.7	.10	60	<.20	2.0	1.20	34.1	1.46	1310	13
	5.00	6.7	1.00	27.5	.10	186	<.30	2.0	1.00	36.4	1.11	1360	16
	5.20	5.5	.17	26.1	.10	41	<.20	1.0	.80	40.9	3.08	1220	15

Continued ...

APPENDIX: 12 TISSUE TRACE METAL CONCENTRATIONS (mg/kg dry weight), ALICE ARM AND HASTINGS ARM, OCTOBER 1981.

Station	Wet/Dry	Cu	Pb	Zn	Cd	As	Mo	Ni	Cr	Fe	Mn	Mg	Al
FISH - RAJA STELLULATA - MUSCLE													
A-3-I	4.50	6.4	.26	27.5	.10	184	<.20	1.0	1.00	65.3	2.98	1140	33
FISH - THERAGRA CHALCOGRAMMA - MUSCLE													
A-3-I	5.30	7.0	.16	25.3	.40	34	<.20	4.0	1.50	49.3	2.63	1470	19

\+ Roman numerals indicate station trawl number.

++< Indicates EPS laboratory detection limits.

APPENDIX 13 - Alice Arm Tailings Deposit
Regulations (AATDR) - April 10, 1979

Registration
SOR/79-345 10 April, 1979

FISHERIES ACT

Alice Arm Tailings Deposit Regulations

P.C. 1979-1112 4 April, 1979

His Excellency the Governor General in Council, on the recommendation of the Minister of Fisheries and the Environment, pursuant to subsections 33(12) and (13) and 33.1(3) of the Fisheries Act, is pleased hereby to make the annexed Regulations respecting the authorization to deposit deleterious substances in mill process effluent from the operation of the Kitsault Mine into the waters of Alice Arm, British Columbia.

REGULATIONS RESPECTING THE AUTHORIZATION TO DEPOSIT DELETERIOUS SUBSTANCES IN MILL PROCESS EFFLUENT FROM THE OPERATION OF THE KITSAULT MINE INTO THE WATERS OF ALICE ARM, BRITISH COLUMBIA

Short Title

1. These Regulations may be cited as the Alice Arm Tailings Deposit Regulations.

Interpretation

2. (1) In these Regulations,

"Act" means the *Fisheries Act*;

"Kitsault Mine" means the mine located within the aggregate of the areas, all situated in the Skeena Mining Division, Cassiar Land District, in the Province of British Columbia, to which Mineral Leases Numbers M 157 to M 191 inclusive (dated February 23, 1967 and issued by the Minister of Petroleum Resources of the Province of British Columbia) apply.

(2) In these Regulations, the following words and expressions, namely,

(*a*) "composite sample",
(*b*) "deposit",
(*c*) "final discharge point",
(*d*) "mill process effluent",
(*e*) "mine",
(*f*) "Minister", and
(*g*) "total suspended matter",

have the meanings assigned to those words and expressions in the *Metal Mining Liquid Effluent Regulations*.

Enregistrement
DORS/79-345 10 avril 1979

LOI SUR LES PÊCHERIES

Règlement sur les rejets de stériles dans le bras Alice

C.P. 1979-1112 4 avril 1979

Sur avis conforme du ministre des Pêches et de l'Environnement et en vertu des paragraphes 33(12) et (13) et 33.1(3) de la Loi sur les pêcheries, il plaît à Son Excellence le Gouverneur général en conseil d'établir le Règlement autorisant le rejet dans les eaux du bras Alice d'effluents des installations de préparation du minerai de la mine Kitsault, en Colombie-Britannique, et des substances nocives qu'ils contiennent, ci-après.

RÈGLEMENT AUTORISANT LE REJET DANS LES EAUX DU BRAS ALICE D'EFFLUENTS DES INSTALLATIONS DE PRÉPARATION DU MINERAI DE LA MINE KITSAULT, EN COLOMBIE-BRITANNIQUE, ET DES SUBSTANCES NOCIVES QU'ILS CONTIENNENT

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement sur les rejets de stériles dans le bras Alice.*

Définitions

2. (1) Dans le présent règlement,

«Loi» désigne la *Loi sur les pêcheries*;

«mine Kitsault» désigne la mine située sur les concessions minières n^{os} M 157 à M 191 inclusivement, (datées du 23 février 1967 et émises par le ministre des Ressources pétrolières de la Colombie-Britannique), toutes situées dans la Division minière de Skeena du district de Cassiar, en Colombie-Britannique.

(2) Dans le présent règlement, les termes et expressions

a) «échantillon composite»,
b) «rejeter»,
c) «point de rejet final»,
d) «effluents des installations de préparation du minerai»,
e) «mine»,
f) «Ministre», et
g) «matière totale en suspension»

ont le sens qui leur est attribué dans le *Règlement sur les effluents liquides des mines de métaux.*

Application

3. (1) These Regulations apply to the deposit of mill process effluent emanating from the operation of the Kitsault Mine into the waters of Alice Arm, British Columbia.

(2) The *Metal Mining Liquid Effluent Regulations* do not apply to the deposit of mill process effluent emanating from the operation of the Kitsault Mine into the waters of Alice Arm, British Columbia.

Substances Prescribed as Deleterious Substances

4. For the purpose of paragraph (*c*) of the definition "deleterious substance" in subsection 33(11) of the Act, the following substances contained in mill process effluent from the operations or processes of the Kitsault Mine are hereby prescribed as deleterious substances:

(*a*) arsenic;
(*b*) copper;
(*c*) lead;
(*d*) nickel;
(*e*) zinc;
(*f*) total suspended matter;
(*g*) radium 226; and
(*h*) cadmium.

Authorization

5. Subject to the conditions set out in sections 6 to 10, the operator of the Kitsault Mine is hereby authorized to deposit into the waters of Alice Arm total suspended matter in any concentration contained in mill process effluent and the deleterious substances prescribed by paragraphs 4(*a*) to (*e*) and 4(*g*) and (*h*) contained in mill process effluent, if

(*a*) the deposit is made in such a manner that the solid portion of the tailings from the mill process effluent does not pass west of a north-south line at 129°39′45″ west longitude that runs through the vicinity of Hans Point, British Columbia; and

(*b*) the solid portion of the tailings from the mill process effluent is not deposited on

(i) the bed of any part of the estuaries of the Illiance River or the Kitsault River, or

(ii) the bed of Alice Arm at any place that is less than 100 m below mean sea level, except as provided in section 7.

De-aeration and Treatment

6. (1) The mill process effluent shall be de-aerated and otherwise treated prior to being deposited into the waters of Alice Arm to prevent solid tailings particles contained therein from moving upward from the final discharge point of any outfall structure.

(2) Except as provided in section 7, the deposit of mill process effluent shall be made in such a manner that solid tailings particles do not remain in suspension in the waters of Alice Arm above a depth of 100 m (mean sea level).

Application

3. (1) Le présent règlement s'applique au rejet dans le bras Alice d'effluents des installations de préparation du minerai de la mine Kitsault, en Colombie-Britannique.

(2) Le *Règlement sur les effluents liquides des mines de métaux* ne s'applique pas au rejet dans le bras Alice d'effluents des installations de préparation du minerai de la mine Kitsault, en Colombie-Britannique.

Substances déclarées nocives

4. Aux fins de l'alinéa *c*) de la définition de «substance nocive», au paragraphe 33(11) de la Loi, sont déclarées nocives les substances suivantes contenues dans les effluents des installations de préparation du minerai provenant des opérations ou des procédés de la mine Kitsault:

a) l'arsenic;
b) le cuivre;
c) le plomb;
d) le nickel;
e) le zinc;
f) les matières totales en suspension;
g) le radium 226; et
h) le cadmium.

Autorisation

5. Sous réserve des conditions visées aux articles 6 à 10, l'exploitant de la mine Kitsault est autorisé à rejeter les effluents des installations de préparation du minerai dans le bras Alice, peu importe leur concentration en matières totales en suspension, ainsi que les substances nocives prescrites aux alinéas 4*a*) à *e*) et 4*g*) et *h*)

a) si ces rejets sont effectués de manière que la fraction solide des stériles de ces effluents ne franchit pas vers l'ouest la ligne tracée dans le sens nord-sud à la longitude 129°39′45″O, dans le voisinage de la pointe Hans, en Colombie-Britannique; et

b) si cette fraction solide des stériles n'est pas rejetée

(i) sur le fond de l'estuaire des rivières Illiance ou Kitsault, ou

(ii) sur le fond du bras Alice partout où il est à moins de 100 m sous le niveau moyen de la mer, sauf dans les cas prévus à l'article 7.

Désaération et traitement

6. (1) Les effluents des installations de préparation du minerai doivent être désaérés ou autrement traités avant leur rejet dans le bras Alice, pour empêcher les particules solides de stériles qu'ils contiennent de remonter vers le point de rejet final des exutoires.

(2) Sauf dans les cas prévus à l'article 7, le rejet des effluents des installations de préparation du minerai doit se faire de manière que les particules solides de stériles ne restent pas en suspension dans le bras Alice à moins de 100 m sous le niveau moyen de la mer.

Outfall Structure

7. (1) Subject to the terms of an order of the Minister referred to in subsection (2), the final discharge point of any outfall structure for the deposit of mill process effluent from the Kitsault Mine shall be not less than 50 m below mean sea level.

(2) Where the Minister has evidence that the deposit of mill process effluent is not made in accordance with subparagraph 5(*b*)(ii) or subsection 6(2), the Minister may, by an order made under subsection 33.1(2) of the Act, require the operator of the Kitsault Mine to extend the final discharge point of any outfall structure to a depth between 50 and 100 m below mean sea level.

(3) Solid tailings particles may

(*a*) be deposited on that portion of the bed of Alice Arm in the vicinity of the final discharge point of the outfall structure where the bed is at a depth of less than 100 m but more than 50 m below mean sea level; and

(*b*) be suspended in the waters of Alice Arm in the vicinity of the final discharge point of the outfall structure where the water is less than 100 m deep but more than 50 m deep (mean sea level).

(4) Where the Minister has made an order referred to in subsection (2) that requires the final discharge point of any outfall structure to extend to a depth greater than 50 m below mean sea level, the reference to 50 m below mean sea level in paragraphs (3)(*a*) and (*b*) shall be deemed to be references to the depth specified in the order.

Solid Portion of Mill Process Effluent

8. The mill process effluent shall not be deposited into the waters of Alice Arm unless

(*a*) the solid portion of the mill process effluent originates from ore mined from the Kitsault Mine; and

(*b*) the solid portion of mill process effluent deposited since the date of the coming into force of these Regulations does not exceed in weight 100,000,000 t.

Liquid Portion of Mill Process Effluent

9. (1) The mill process effluent shall not be deposited into the waters of Alice Arm unless, before any dilution of the liquid portion of the mill process effluent after it leaves the mill,

(*a*) the liquid portion of the mill process effluent passes the acute lethality test for fish, described in the schedule, and

(*b*) the monthly arithmetic mean of the dissolved concentration of any deleterious substance prescribed by section 4 contained in the liquid portion of the mill process effluent, listed in column I of an item of the table to this section, is less than the concentration set out in column II of that item and the daily dissolved concentration of the substance monitored in accordance with subsection (2) is less than the concentration, set out in column III of that item,

using composite samples.

Exutoires

7. (1) Sous réserve des conditions de l'ordonnance du Ministre visée au paragraphe (2), le point de rejet final des exutoires pour le rejet des effluents des installations de préparation du minerai de la mine Kitsault doit être à au moins 50 m sous le niveau moyen de la mer.

(2) Lorsque le Ministre a la preuve que le rejet des effluents des installations de préparation du minerai ne se conforme pas au sous-alinéa 5*b*)(ii) ou au paragraphe 6(2), il peut, au moyen d'une ordonnance décrétée en vertu du paragraphe 33.1(2) de la Loi, exiger de l'exploitant de la mine Kitsault la relocalisation de tout point de rejet final de l'exutoire à une profondeur variant entre 50 et 100 m sous le niveau moyen de la mer.

(3) Les particules solides de stériles peuvent

a) être rejetées sur la partie du fond du bras Alice, dans le voisinage du point de rejet final de l'exutoire, si le fond se trouve à plus de 50 et à moins de 100 m sous le niveau moyen de la mer; et

b) rester en suspension dans le bras Alice, dans le voisinage du point de rejet final de l'exutoire, à une profondeur variant entre 50 et 100 m sous le niveau moyen de la mer.

(4) Lorsque le Ministre a rendu l'ordonnance visée au paragraphe (2) qui exige la relocalisation du point de rejet final de l'exutoire à une profondeur de plus de 50 m sous le niveau moyen de la mer, cette profondeur est censée viser la limite de 50 m paraissant aux alinéas (3)*a*) et *b*).

Fraction solide des effluents des installations de préparation du minerai

8. Les effluents des installations de préparation du minerai ne peuvent être rejetés dans le bras Alice que

a) si leur fraction solide provient de minerais extraits de la mine Kitsault; et

b) jusqu'à ce que leur fraction solide représente 100,000,000 t depuis la date d'entrée en vigueur du présent règlement.

Fraction liquide des effluents des installations de préparation du minerai

9. (1) Les effluents des installations de préparation du minerai peuvent être rejetés dans le bras Alice si des examens d'échantillons composites établissent que la fraction liquide de ces effluents, avant sa dilution à la sortie des installations

a) satisfait au contrôle de létalité aiguë pour les poissons, décrit en annexe; et

b) si les moyennes arithmétiques mensuelles de la concentration des substances visées à l'article 4, contenues dans cette fraction liquide et figurant au tableau du présent article sont moindres que celles visées à la colonne II, et si la concentration journalière dissoute des substances contrôlées conformément au paragraphe (2) est inférieure à celles visées à la colonne III.

(2) The daily dissolved concentration referred to in paragraph (1)(*b*) shall be monitored at the intervals and in the manner directed in writing by the Minister pursuant to subsection 33(14) of the Act.

TABLE

Item	Column I Substance	Column II Monthly Arithmetic Mean Concentration	Column III Daily Concentration
1.	arsenic	0.40 mg/ℓ	0.60 mg/ℓ
2.	copper	0.05 mg/ℓ	0.10 mg/ℓ
3.	lead	0.05 mg/ℓ	0.10 mg/ℓ
4.	nickel	0.20 mg/ℓ	0.4 mg/ℓ
5.	zinc	0.10 mg/ℓ	0.20 mg/ℓ
6.	radium 226	10.0 p Ci/ℓ	20.0 p Ci/ℓ
7.	cadmium	0.01 mg/ℓ	0.02 mg/ℓ

Recovery of Lead, Zinc, or Cadmium

10. Prior to and during the operation of the Kitsault Mine, the operator thereof shall, through research, work diligently toward the development of methods to recover and, if it is practical to do so, shall recover lead, zinc and cadmium from the tailings for sale as concentrates or for disposal on land as separate tailings.

SCHEDULE

THE MEASUREMENT OF ACUTE LETHALITY IN THE LIQUID PORTION OF MILL PROCESS EFFLUENT

1. (1) For the purposes of this schedule, the applicable portions of section 231 of the publication Standard Methods for the Examination of Water and Wastewater, 13th edition (1971), published jointly by the American Public Health Association, American Water Works Association and the Water Pollution Control Federation shall be used as a basis for this test procedure except as otherwise provided in this schedule.

(2) The bioassay sample shall be the liquid portion of a composite sample.

(3) When the bioassay sample is transported or stored, the sample shall be kept in filled, sealed containers excluding any air.

(4) The sample shall not be aerated during storage and shall not be held more than five days prior to the commencement of this test procedure.

(5) Rainbow trout (*Salmo gairdneri* Richardson) shall be used as the test species of fish.

(6) Only healthy stocks of fish acclimated to fresh water shall be used as test fish.

(2) La concentration journalière dissoute visée à l'alinéa (1)*b*) doit être contrôlée aux intervalles et de la manière ordonnés par écrit par le Ministre conformément au paragraphe 33(14) de la Loi.

TABLEAU

Article	Colonne I Substance	Colonne II Moyenne arithmétique mensuelle de la concentration	Colonne III Concentration journalière
1.	Arsenic	0.40 mg/ℓ	0.60 mg/ℓ
2.	Cuivre	0.05 mg/ℓ	0.10 mg/ℓ
3.	Plomb	0.05 mg/ℓ	0.10 mg/ℓ
4.	Nickel	0.02 mg/ℓ	0.04 mg/ℓ
5.	Zinc	0.10 mg/ℓ	0.20 mg/ℓ
6.	Radium 226	10.0 p Ci/ℓ	20.0 p Ci/ℓ
7.	Cadmium	0.01 mg/ℓ	0.02 mg/ℓ

Récupération du plomb, du zinc ou du cadmium

10. Avant et pendant l'exploitation de la mine Kitsault, l'exploitant doit diligemment entreprendre la recherche nécessaire à la mise au point de méthodes de récupération du plomb, du zinc et du cadmium à partir des stériles et, si possible, les appliquer, afin de vendre ces métaux sous forme de concentrés ou de les épandre séparément sur le sol, sous forme de stériles distincts.

ANNEXE

CONTRÔLE DE LA LÉTALITÉ AIGUË DE LA FRACTION LIQUIDE DES EFFLUENTS DES INSTALLATIONS DE PRÉPARATION DU MINERAI

1. (1) Aux fins de la présente annexe, les parties applicables de la section 231 du recueil «Standard Methods for the Examination of Water and Wastewater», 13e édition (1971), publiée conjointement par l'American Public Health Association, l'American Water Works Association et la Water Pollution Control Federation servant de fondement opératoire au présent contrôle, sous réserve des dispositions de la présente annexe.

(2) L'échantillon soumis au contrôle biologique doit être la fraction liquide d'un échantillon composite.

(3) L'échantillon soumis au contrôle biologique qui est transporté ou entreposé, doit être conservé dans des contenants hermétiques, remplis de manière à exclure toute trace d'air.

(4) L'échantillon ne doit pas entrer au contact de l'air pendant l'entreposage et ne doit pas être conservé plus de cinq jours avant le début des contrôles.

(5) L'espèce utilisée dans le contrôle doit être la truite arc-en-ciel (*Salmo gairdneri* Richardson).

(6) Seules des truites acclimatées à l'eau douce et en bonne santé doivent être utilisées pour le contrôle.

(7) Individual test fish shall weigh between 0.5 and 10 g and the length of the largest fish in a test vessel shall not be more than two times the length of the smallest fish in the same test vessel.

(8) A minimum of five test fish shall be exposed to a 100% concentration of the bioassay sample for a period of 96 hours and an equal number of control fish shall be exposed to control water during that period.

(9) The test is rendered invalid if more than 10% of the fish in the control water die.

(10) For every one g of fish, there shall be at least one ℓ of bioassay sample or control water for every 24 hours that the fish are exposed to the sample or control water.

(11) The water depth in any test vessel shall not be less than 15 cm.

(12) Immediately prior to the commencement of this test procedure, the pH of the bioassay sample shall be measured and if it is outside the pH range of 6.5 to 7.5, the pH shall be adjusted to 7.0 ± 0.5.

(13) If the dissolved oxygen concentration of the bioassay sample is less than 7 mg per litre, the sample shall be aerated, prior to the commencement of this procedure test, for not more than two hours at a rate of 5.0 to 7.5 cc of air per minute per litre.

(14) An aeration rate of 5.0 to 7.5 cc per minute per litre shall be applied to the bioassay sample and control water throughout the duration of the test.

(15) The temperature of the bioassay sample and the control water shall be 15 ± 1°C throughout the duration of the test.

(16) The total number of dead fish shall be counted after 96 hours or at the termination of the test and dead fish shall be removed at least once each day.

(17) If a sample of incoming water to the mine kills 10% or more of the fish placed in the sample during a 96 hour period when tested in accordance with the test procedure contained in this schedule, the bioassay sample is invalid.

2. A bioassay sample passes the acute lethality test if not more than 50% of the fish die when tested in accordance with the test procedure set out in section 1 of this schedule.

(7) Les poissons servant au contrôle doivent peser entre 0.5 et 10 g, et, dans un récipient donné, la longueur du plus gros poisson ne doit pas être plus du double de celle du plus petit poisson.

(8) Au moins cinq poissons doivent séjourner pendant 96 h dans l'échantillon soumis au contrôle biologique. Les témoins, en nombre égal, à ceux qui servent au contrôle, doivent rester dans le milieu témoin pendant le même nombre d'heures.

(9) Le contrôle est nul si plus de 10% des poissons témoins meurent.

(10) La proportion à observer est de 1ℓ d'échantillon soumis au contrôle biologique ou de 1ℓ de milieu témoin par gramme de poisson et par période de 24 h.

(11) La profondeur de l'eau dans les récipients utilisés doit être d'au moins 15 cm.

(12) On doit mesurer le pH de l'échantillon soumis au contrôle biologique immédiatement avant le début du contrôle. Si le pH est inférieur à 6.5 ou supérieur à 7.5, on doit l'ajuster à 7.0 avec un écart 0.5.

(13) Si la teneur en oxygène dissous dans l'échantillon soumis au contrôle biologique est inférieure à 7 mg/ℓ, cet échantillon doit être aéré, avant le début du contrôle, pendant une période ne dépassant pas 2 h, à raison de 5.0 à 7.5 cm^3/min/ℓ d'air.

(14) On doit aérer l'échantillon soumis au contrôle biologique et le milieu témoin à raison de 5.0 à 7.5 cm^3/min/ℓ pendant toute la durée du contrôle.

(15) On doit s'assurer que la température de l'échantillon soumis au contrôle biologique et du milieu témoin restent à 15 avec un écart de 1° C pendant toute la durée du contrôle.

(16) On doit noter le nombre total de poissons morts après 96 h, ou à la fin du contrôle. On doit retirer les poissons morts au moins une fois par jour.

(17) Si au moins 10% des poissons meurent dans un échantillon des eaux d'alimentation de la mine au cours d'un contrôle de 96 h, conforme à la présente méthode, on doit rejeter l'échantillon soumis au contrôle biologique.

2. L'échantillon soumis au contrôle biologique satisfait au contrôle de létalité aiguë réalisé selon l'article 1 de la présente annexe si la mortalité des poissons ne dépasse pas 50%.

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