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Final Reports of Principal Investigators

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OUTER CONTINENTAL SHELF
ENVIRONMENTAL ASSESSMENT PROGRAM

FINAL REPORTS OF PRINCIPAL INVESTIGATORS

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Anchorage, Alaska

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Outer Continental Shelf Environmental Assessment Program

Final Reports of Principal Investigators

VOLUME 46 JULY 1986

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SOURCE, COMPOSITION, AND FLUX OF ORGANIC DETRITUS IN LOWER COOK INLET

by

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Pacific Marine Environmental Laboratory
National Oceanic and Atmospheric Administration

Final Report
Outer Continental Shelf Environmental Assessment Program
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I. ABSTRACT

A series of sediment trap deployments was combined with intensive water column sampling to obtain measurements of the production and input of organic detritus to the sea floor in relation to the bio-physical environments of lower Cook Inlet. During four of five one-week cruises from March through August, 1978, three sediment-trap arrays were deployed in environmentally distinct areas of the lower Inlet. The samples provided measurements of downward fluxes of total particulate matter; organic carbon and nitrogen; chlorophyll a and pheophorbide a; fecal pellets; and other microscopically identifiable particles including phytoplankton cells, crustacean molts, and microzooplankton. Total particulate fluxes measured by use of sediment traps were in good agreement with rates of average accumulation of sediments determined by Pb-210 dating. Total particulate fluxes measured by use of sediment traps were in good agreement with rates of average accumulation of sediments determined by Pb-210 dating. Total particulate fluxes ranged between 72 g/m^{2}day in an area and season of high runoff to 1.9 g/m^{2}day in the central Inlet where upwelling of clear water is evident.

The measurements of pigment content in sediment-trap material and in the overlying euphotic zone permitted us to calculate the percent of phytoplankton stock lost to the bottom per day, and the fraction of that loss which was grazed by zooplankton. The average daily loss of phytoplankton material to the bottom was about 5-8%, of which about 83% was attributed to grazing and subsequent fecal pellet production.

Comparisons of organic carbon and nitrogen content (dry-weight percent) of the sediment trap samples among the three sampling locations generally reflected the primary productivity in overlying waters. Kachemak Bay (eastern Inlet) samples averaged 2.8% carbon compared with an average of 1.3% in the central Inlet and Kamishak Bay (western Inlet). Similar comparisons for nitrogen were 0.36% at Kachemak Bay and 0.15% at the other locations. Very high primary productivity (as high as 7.8 g C/m^{2}day) persisted over several months at Kachemak Bay, which accounted for the larger proportion or organic carbon and nitrogen. The total supplies of organic carbon to the bottom over the four-month study were 60 g C/m^2 at Kachemak Bay, 17 g C/m^2 in central Inlet, and 40 g C/m^2 in Kamishak Bay. These values account for approximately 12% of the total primary production over the same period.

These results indicate the transfer of substantial organic matter (which presumably is a needed nutrition source for the benthos) from surface waters to the benthos, much of it via zooplankton fecal pellets. Such particles, if contaminated with oil, act as transfer agents for oil from the surface thus impacting the benthic community.

II. INTRODUCTION

The organic detrital program conducted in lower Cook Inlet for OCSEAP was designed to provide insight into the sources, composition, and vertical fluxes of organic particles contributed to the benthic food web. A series of sediment trap deployments was combined with intensive water column sampling to obtain measurement of the production and input of organic detritus to the sea floor in relation to the bio-physical environments of lower Cook Inlet.

The region of study is extremely rich in commercially harvested populations of snow, king, and Dungeness crabs, shrimp, razor clams, and scallops (BLM 1976). Such benthic organisms are potentially vulnerable to contamination by accidental oil spills and chronic low-level pollution associated with petroleum development in lower Cook Inlet. The larval stages of these and other benthic species are planktonic and rely directly or indirectly on phytoplankton as their food source. Adults in the benthic community ultimately depend on organic production in the overlying waters to supply their nutritional requirements. Phytoplankton grazed by zooplankton enters the detrital food web via fecal pellet production and deposition. Whole cells may also reach the benthos directly by sinking.

When oil enters seawater, emulsions of tiny droplets can adsorb onto suspended particles, become entrained in the water column, and ultimately be deposited on the bottom. The process is one of initial adsorbtion, followed by flocculation of oil-sediment emulsions by electrostatic interactions (Bassin and Ichiye 1977). These oil-particulate aggregates are distributed throughout the water column as sinking particles (Forrester 1971). The quantity of oil that can be sedimented by a given amount of suspended matter is dependent on the physical-chemical nature of the particles as well as the amount of naturally occurring organic matter associated with the particles (Poirier and Thiel 1941, Meyers and Quinn 1973). Laboratory studies using mixtures of Cook Inlet sediments and crude oil indicated that a maximum amount of oil equal to 11% of the sediment weight could be accommodated by particles in suspension (Feely et al. 1978). Oil coated onto the surface of particles is one of the principal ways in which petroleum contaminants may be ingested by marine organisms (NAS 1975). Following the wreck of the tanker Arrow, Conover (1971) found that zooplankton could consume up to 20% of the oil particles smaller than 1 mm in diameter and sediment them as fecal material. Parker (1970) also reported that copepods and barnacle larvae incorporated oil into fecal pellets. Thus, sorption and ingestion may act as precipitation mechanisms to transfer otherwise buoyant oil particles to the detrital food web.

The overall purpose of the present study was to define the seasonal composition and fluxes of organic detritus in relation to the phytoplankton standing stock and productivity of lower Cook Inlet. A major emphasis has been placed on the use of plant pigments as tracer molecules to estimate the daily contribution of phytoplankton to the sea floor. Phytoplankton material can reach the bottom in two important ways:

a. cells may sink directly,
b. cells may be ingested by zooplankton, metabolically processed, repackaged, and eliminated as fecal material.

Smayda (1970) reviewed the literature and reported highly variable sinking rates for phytoplankton cells (0-30 m day^{-1}) depending on cell buoyancy, cell shape, ability to swim in response to stimuli, and nutrient concentration. It was concluded (Smayda 1971) that sinking speeds observed in the laboratory are too low to account for the apparently rapid transport of phytoplankton remains to the sea floor. He suggested that fast sinking fecal pellets ($\approx$100-200 m day^{-1}) were an explanation for this rapid transport. The importance of large particles such as fecal pellets is supported by a theoretical treatment by McCave (1975) and a rigorous field investigation by Bishop et al. (1977).

We have attempted to assess the relative importance and absolute magnitude of direct algal sinking and fecal pellet production by zooplankton grazers in lower Cook Inlet. The analysis was based on the use of chlorophyll concentration as a measure of phytoplankton abundance and on the knowledge that planktonic herbivores degrade chlorophyll to pheophorbide, an easily measured chlorophyll derivative (Currie 1962, Nemoto and Saijo 1968, Nemoto 1972, Jeffrey 1974).

$$\text{CHLOROPHYLL a} \xrightarrow{\text{-Mg}} \text{PHEOPHYTIN a} \xrightarrow{\text{-phytol chain}} \text{PHEOPHORBIDE a}$$

$$\text{CHLOROPHYLL a} \xrightarrow{\text{-phytol chain}} \text{CHLOROPHYLLIDE a} \xrightarrow{\text{-Mg}} \text{PHEOPHORBIDE a}$$

Pathways of chlorophyll degradation.

The use of chlorophyll degradation products as an index of grazing pressure on phytoplankton populations was first suggested by Lorenzen (1967). Mackas and Bohrer (1976) investigated the diel feeding patterns of zooplankton by analyzing their gut contents for degraded chlorophyll pigments. A laboratory study by Shuman and Lorenzen (1975) demonstrated that grazed chlorophyll was totally converted to pheophorbide on a mole for mole basis. This knowledge was used (Shuman 1978) to estimate grazing and sinking losses from phytoplankton populations during a Puget Sound sediment trap study.

A similar approach was followed during the present Cook Inlet study. A conceptual model was designed to outline and summarize the major processes considered (Fig. 1). The intent was to measure algal biomass and production in the water column and relate it to the fluxes of chlorophyll, pheophorbide, organic carbon, nitrogen, and fecal pellets, whole phytoplankton cells, and other discrete particles sinking to the sea bed.

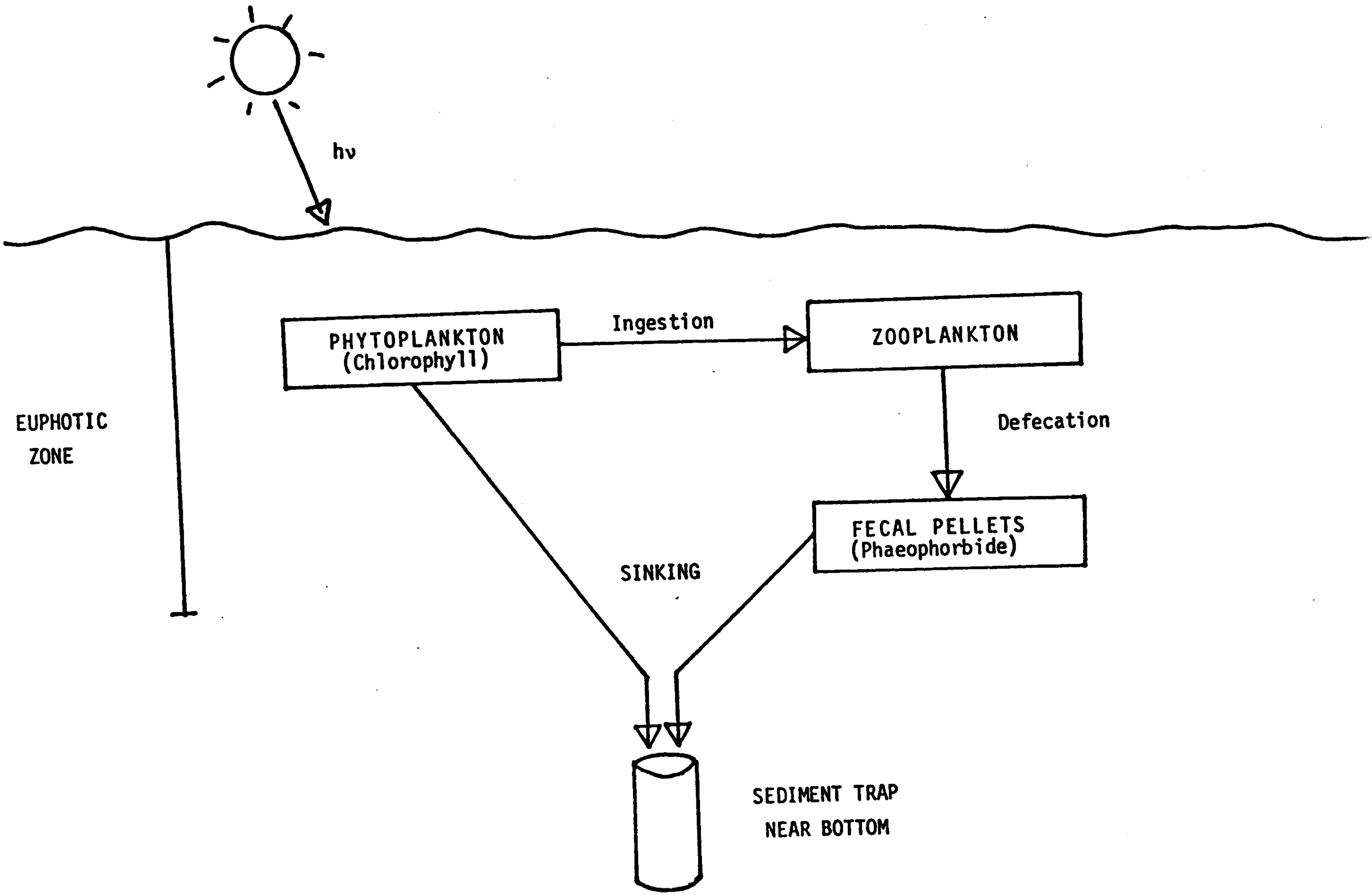
III. CURRENT STATE OF KNOWLEDGE AND STUDY AREA

The circulation of lower Cook Inlet is a primary determinant of the basic biological productivity of the system. It supplies plant nutrients; provides gyres which act as "traps" for development of abundant plankton populations; carries large loads of suspended particles which attenuate light and primary production; and mixes water vertically to remove phytoplankton from the euphotic zone or, alternatively, relaxes mixing to permit stratification of the water column and maintain phytoplankton in the euphotic zone.

A. Circulation and Physical Characteristics

Descriptions of various aspects of the physical oceanography of Cook Inlet appear in several publications and reports (cf. Knull and Williamson, 1969; Kinney, et al., 1970; Evans, et al., 1972; Gatto, 1976; Burbank, 1977; and Muench, et al., 1978). Cook Inlet is a positive tidal estuary approximately 350 km long by 80-90 km wide in the lower (southern) portion (Fig. 2). Mean diurnal tidal ranges are about 5-6 m in lower Cook Inlet and tidal current speeds are characteristically moderate to strong (occasionally exceeding 3 m sec^{-1}). The instantaneous flow field in the lower inlet is dominated by tidal and wind-driven currents which are superposed on the mean flow as described below. Prevailing winter winds are northeasterly, and summer winds are southerly and lighter, interrupted by occasional storms, especially in late summer. Storms or other inter-

FIGURE 1. PIGMENT LOSS FROM THE EUPHOTIC ZONE AS AN INDICATION OF GRAZING.



mittent strong winds can temporarily alter the normal circulation pattern significantly.

The pattern of mean flow in the spring and summer was described by Muench, et al., 1978 (Fig. 2) and by Gatto, 1976. High-salinity (31-32‰), low-temperature (7-8.5°C) surface water from the Gulf of Alaska enters lower Cook Inlet through Kennedy Entrance at the southeast, flows westerly following bathymetry, and merges with a strong southerly flow on the western side of the inlet. Water comprising this southerly flow during the summer is characterized by lower salinity (29-31‰), higher temperature (8-11°C) and large concentrations of suspended particles which are carried south from the upper inlet. Weaker northerly currents occur in the eastern and central portions of the lower inlet and bend westward across the axis of the inlet to join the southerly flow. Water in the eastern and central inlet originates in the Gulf of Alaska, enters through Kennedy Entrance with the strong westward component, and branches northward.

Data presented by Knull and Williamson (1969) suggest a gyre system in outer Kachemak Bay. Spring and summer circulation in outer Kachemak Bay was studied by Burbank (1977) who used drogues and described two counter rotating gyres which occur part of the time. A large clockwise gyre was observed in the western half of the outer bay and a slightly smaller counter clockwise gyre occurred in the eastern half. Water is exchanged around the entire perimeter of the gyres but consists primarily of gulf water from the south and loss of water to the north. The latter contains fresh water at the surface originating from runoff in inner Kachemak Bay and forms a current flowing northwestward along the northeast coast. Burbank (1977) estimated residence time of water in outer Kachemak Bay to be as long as 15 days. Knull and Williamson (1969) estimated a flushing time for the entire Kachemak Bay of 27 days based on salinity and river runoff which is in reasonably good agreement with Burbank's estimate of residence time. This relatively long residence time of water is a factor which contributes to the development of a large spring and summer phytoplankton population in outer Kachemak Bay. In contrast, adjacent areas to the west where water is more thoroughly mixed, populations are diluted and displaced from the system rather rapidly.

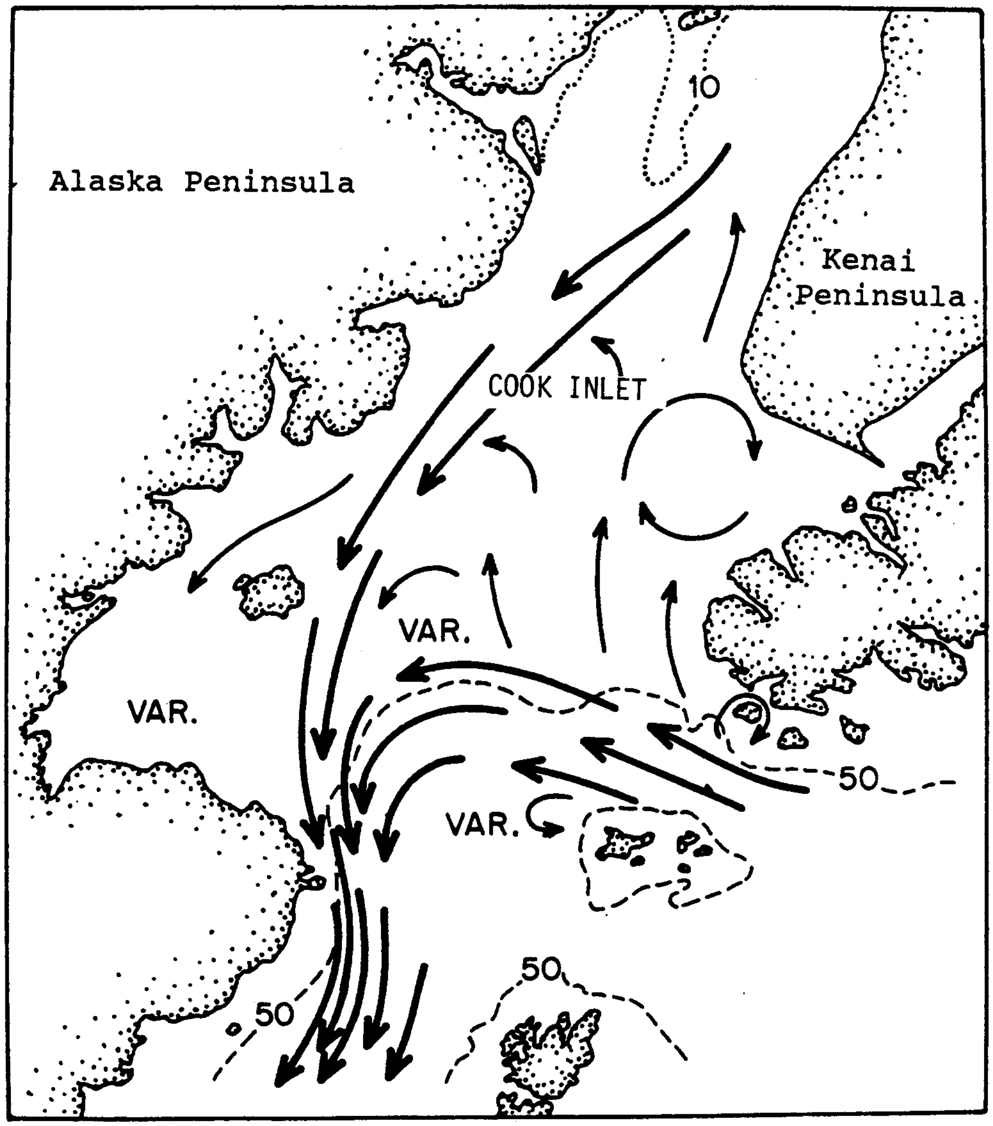


Figure 2. Diagram of spring and summer mean flow in lower Cook Inlet (after Muench, et al., 1978).

Another feature of the Cook Inlet environment of importance to biological production is the heavy load of suspended matter which is transported southward from the upper inlet. Approximately the western third of the lower inlet contains highly turbid, low salinity water in spring and summer, a characteristic that has been well documented by Evans, et al. (1972); Gatto (1976); Larrance et al. (1977); and Feely, et al. (1978). Feely, et al. (1978) reported concentrations of total suspended matter as high as 8 mg l^{-1} near Kamishak Bay and 100 mg l^{-1} south of the forelands. Larrance, et al. (1977) measured euphotic zone depths (depth to which 1% of the incident light penetrates) of less than 1 m south of the forelands. Such highly turbid water severely restricts primary productivity in the western and northern portions of lower Cook Inlet.

B. Phytoplankton and Primary Production

Knull and Williamson (1969) surveyed net phytoplankton in Kachemak Bay in April, July and October. In the outer bay, *Fragilaria* and *Thalassiosira* were dominant in April, being replaced by *Chaetoceros* in July, especially *C. debilis*. In late October *Chaetoceros decipiens*, *Schroderella delicatula*, and *Coscinodiscus* spp. shared dominance at outer bay stations. This general pattern was similar to that reported by Larrance, et al. (1977). Microflagellates were included in the latter report but not in Knull and Williamson's data because water bottles instead of nets were used for sampling. Microflagellates were ubiquitous and ranked among the two or three most numerous groups of organisms in lower Cook Inlet during spring and summer, 1976. In terms of diatoms, there was a sequence of dominance starting with several *Thalassiosira* species (especially *T. aestivalis*) forming the initial spring bloom, followed by *Chaetoceros* (especially *C. debilis*) in July. This sequence began first in Kachemak Bay in early May and seemed to progress westward across the lower inlet, so that the *Thalassiosira-Chaetoceros* sequence in Kamishak Bay lagged about a month behind Kachemak Bay. The highest cell concentrations reported were on the order of 10^6 cells l^{-1} of *Thalassiosira* in Kachemak Bay in early May.

A more or less classical seasonal pattern of primary productivity for temperate waters was documented in the lower inlet by Larrance, et al. (1977). Large increases from April to July in primary productivity and phytoplankton standing stocks were accompanied by declining nutrients (especially nitrate) and increasing incident light. Production was apparently light-limited before April, and became somewhat nutrient-limited in July in some areas, particularly in Kachemak Bay. Maximum productivity at locations along a cross-inlet section between Kachemak and Kamishak Bays occurred sequentially from east to west as with the species succession. Productivity maxima occurred in Kachemak Bay in early May, in mid-inlet in late May and in Kamishak Bay in July. The large amount of non-living suspended particles on the western side of the inlet probably delayed the phytoplankton bloom in Kamishak Bay, and advection (including upwelling described by Muench, et al., 1978) prevented the buildup of large populations in the middle of the inlet. The relationship between productivity and turbidity was discussed by Larrance, et al. (1977) and was inferred from correlation between productivity and light transmittance measurements. There was an increase of productivity with an increase in light transmission (assumed to coincide with fewer suspended particles).

IV. FIELD AND LABORATORY METHODS

A. Field Schedule and Strategy

Five cruises to lower Cook Inlet were conducted between March and August 1978. The overall project aim was to determine vertical fluxes and composition of organic detritus and to relate these to regional differences in the primary production and standing stock of phytoplankton in lower Cook Inlet. During each cruise a cross-inlet transect consisting of seven stations was sampled to obtain physical, chemical, and biological information from the water column. In addition to this transect, a grid of closely spaced stations was occupied in Kachemak Bay during four of the cruises to monitor finer scaled environmental variability. On the last four cruises dual sediment traps of PMEL design were deployed at three stations and retrieved after approximately five days.

1. NOAA Ship Schedule

Cruises were conducted according to the following schedule:

Dates	Vessel	NOS	PMEL
March 23-27	SURVEYOR	RP-4-SU-78-A	LC1781
May 7-14	MILLER FREEMAN	RP-4-MF-78A I	LC1782
June 6-13	MILLER FREEMAN	RP-4-MF-78A III	LC1783
July 12-20	MILLER FREEMAN	RP-4-MF-78A V	LC1784
August 13-20	SURVEYOR	RP-4-SU-78B	LC1785

* Numbers assigned for internal PMEL use. These numbers will be used in the text of this report.

2. Station Locations

Seven stations (Fig. 3) were routinely occupied each day except for the first and last days of each cruise when sediment traps were deployed and recovered. These stations were spaced at intervals of about 18 km across the inlet between Kamishak Bay and Kachemak Bay. In addition, a grid of closely spaced stations in the Kachemak Bay area was occupied on all cruises except LC1781. The nominal locations for stations 1-7 are given below:

Station	Latitude (N)	Longitude (W)
1	59° 14.0'	153° 40.0'
2	59° 17.0'	153° 20.0'
3	59° 20.0'	153° 00.0'
4	59° 23.0'	152° 40.0'
5	59° 26.6'	152° 20.0'
6	59° 30.0'	152° 00.0'
7	59° 33.3'	151° 40.0'

The Kachemak Bay grid of stations varied in number from 8 to 18 and in the precise location depending on the cruise. All grid stations were 1-2 miles from the nearest station and centered around station 7. Plant pigments, salinity, temperature, and nutrients in the upper 25 m of water were commonly measured during the Kachemek Bay grid sampling. The grid was completed in every case within 9 hours.

B. Sediment Trap Methodology

The sediment traps and moorings were designed, fabricated, and tested in our laboratory for use during this study. Each mooring consisted of a 1700 kg steel and concrete anchor, an AMFR acoustic release, dual gimballed sediment traps, a streamlined (torpedo-shaped) subsurface float with about 500 kg buoyancy, and tethering cables, chains, and hardware (Fig. 4). Several features were incorporated into the mooring's design to reduce the effects of currents, meet sampling requirements of the study, and minimize damage to the gear of local commercial fishermen. Unusually heavy anchors were used to prevent shifting along the bottom. These anchors were smooth concrete hemispheres to reduce the chances for entanglement with fish trawls.

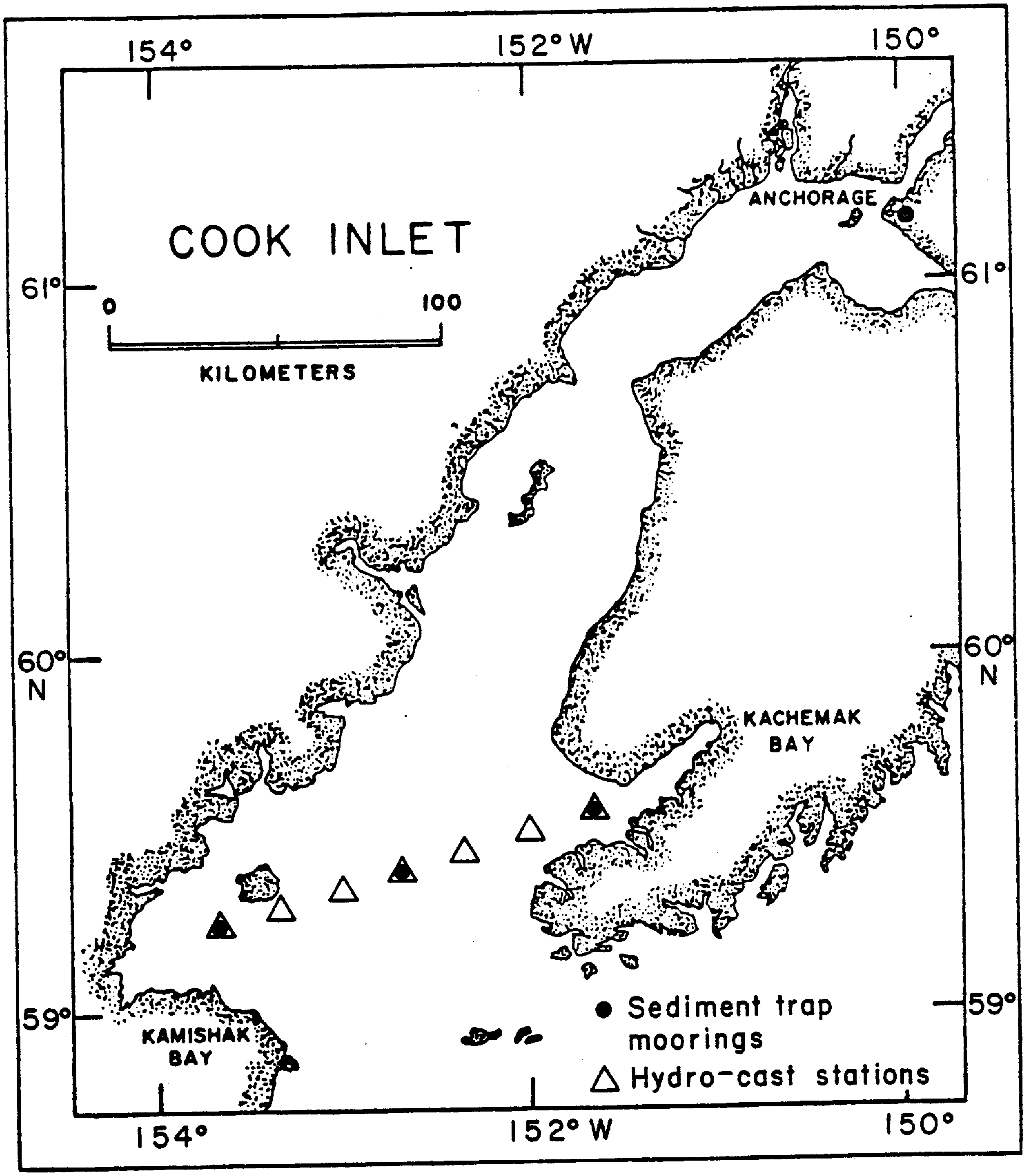


Figure 3. Station locations, lower Cook Inlet, 1978.

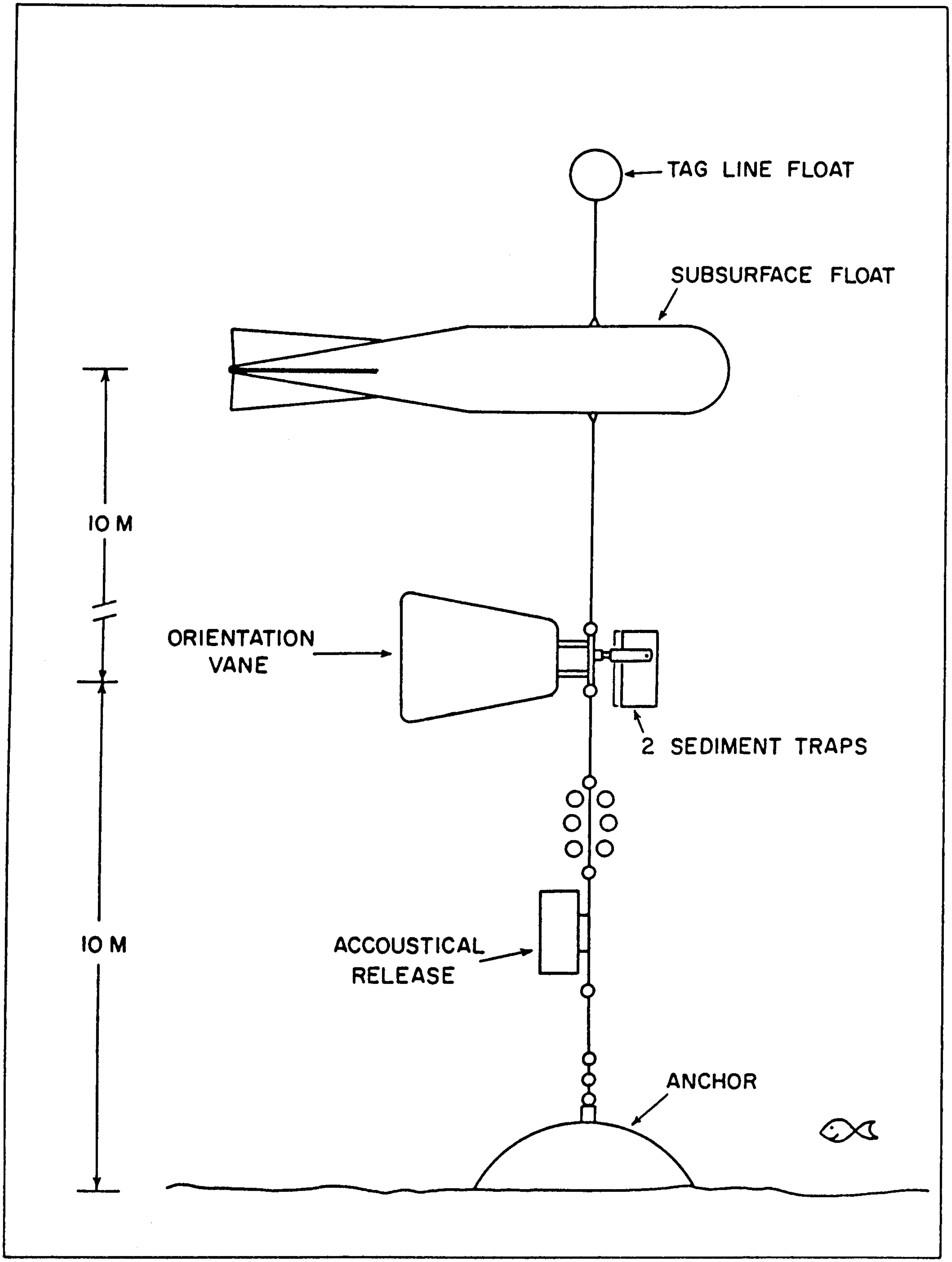


Figure 4. Sediment trap mooring, lower Cook Inlet, 1978.

Sediment traps were polyvinylchloride cylinders and each included a butterfly-valve closure actuated by a battery powered electronic timer housed in the trap casing below the sample chamber (Fig. 5). The sample chamber had a depth of approximately 40 cm and a mouth diameter of 15 cm. The aspect ratio of 2.7 corresponded well to Gardner's (1977) recommendations, and the overall dimensions were similar to those of Shuman (1978). Each trap employed a baffle across the mouth to decrease turbulent intrusions and to discourage disturbance by fish and other animals. A small cup was packed with sodium azide and mounted to the side of each trap. The azide diffused through a membrane filter into the sample compartment and provided a continuous anti-bacteriological effect.

Prior to deployment, each trap was filled with membrane filtered seawater and set in the open position with the timer activated. Surface contamination was avoided by covering the mouth with a plastic bag. This bag was held securely to the trap by rubber bands intertwined with a Morton^R salt lick. The salt lick dissolved about 30 minutes after deployment and effectively opened the trap by allowing the bag to float away.

Two traps were mounted on a swivel in each mooring and gimballed to maintain the trap mouths in a horizontal plane (Fig. 5). The entire array was free to rotate about the mooring line, keeping the traps oriented upstream. This attachment method was used to provide uniform sampling unaltered by inclination of the mooring line or current direction.

Three sediment-trap moorings were deployed at the start of each cruise (except LC1781) and retrieved at the end of the cruise. Sampling times were five or six days. The deployments were made at stations 1, 4, and 7 on each cruise (Fig. 3). Sediment traps were positioned 10 m above the bottom to reduce the effect of bottom sediment resuspension. All moorings were successfully deployed and recovered throughout the study. The overall success rate for obtaining adequate samples in the traps was 63%. All the traps on the last cruise (LC1785) functioned properly and all the samples were obtained. Of twelve moorings set during the study, reliable samples were obtained from ten.

Upon recovery of the sediment traps, the sample was drained and washed into a volumetric cylinder, measured, and transferred to a 10-liter polyethylene jug. The contents of the jug were gently, but thoroughly, shaken immediately before drawing aliquot portions of the water-particle suspension for pigment, micro-

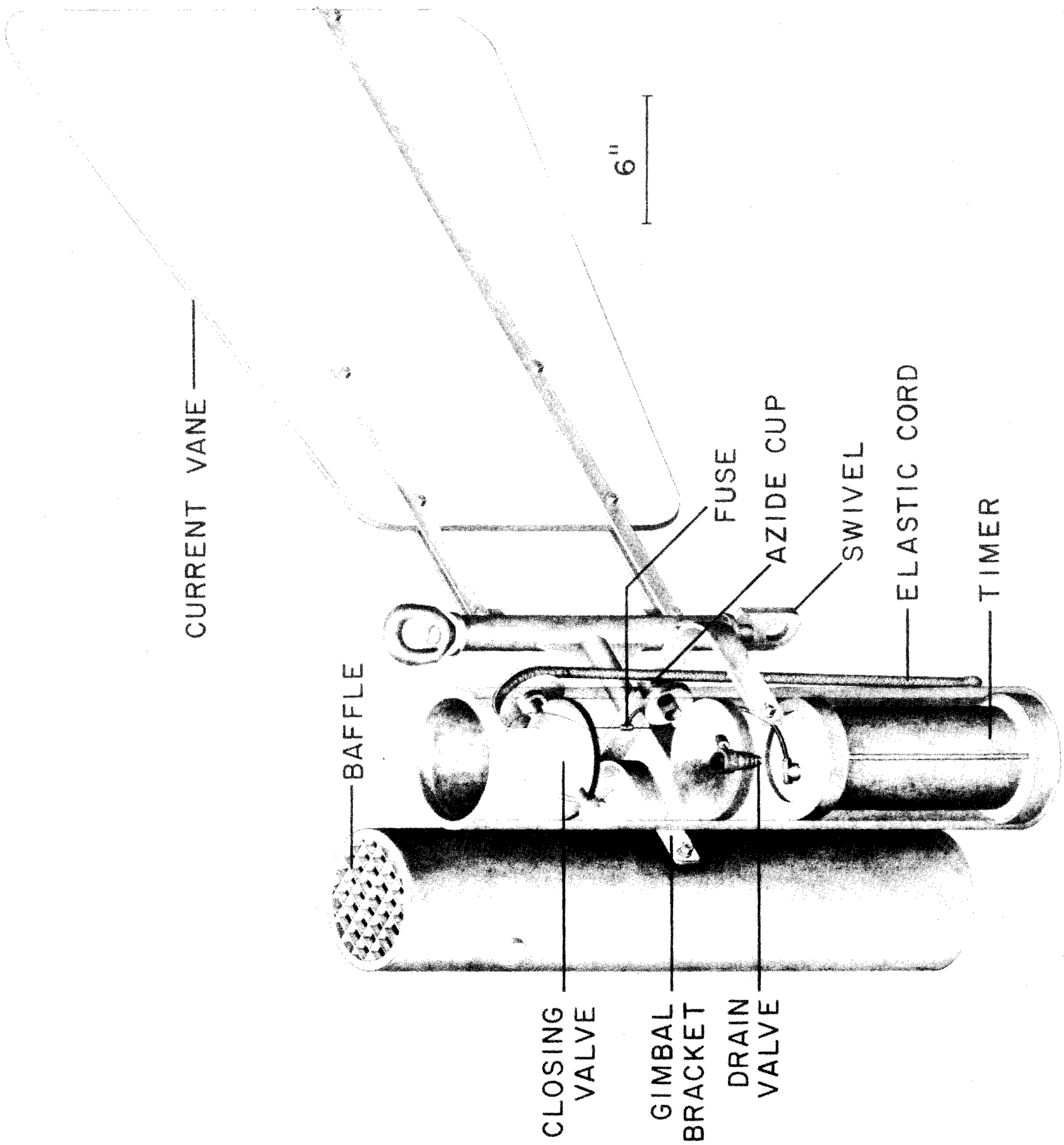


Fig. 5 - Dual sediment traps with current vane, lower Cook Inlet, 1978

scopical, and stable-isotope analyses. One subsample was taken from each sediment trap for microscopical examination, and one was taken for isotopic analysis. As many as five (depending on the sample) replicate portions of material from each nuclepore filter were analyzed for carbon and nitrogen. The pigment analyses (at least three replicates from each trap) were conducted immediately after subsampling by fluorometric methods identical to those used for chlorophyll and pheopigments in seawater (Lorenzen 1966). The subsamples for microscopical examination were preserved in a 0.6% acetate buffered formaldehyde solution and returned to Seattle for determination of numbers of fecal pellets, phytoplankton cells, zooplankton carapaces, and other identifiable particles. Large material was routinely enumerated with a dissecting microscope at 24X power. Smaller particles such as phytoplankton cells were counted with an inverted microscope at 160X power. A subsample for isotopic analysis was filtered through glass-fiber filters and returned to Seattle for analyses of stable carbon and nitrogen isotopes by mass spectrometry after combustion and conversion of organic carbon and nitrogen to CO_2 and N_2. The remainder of the sediment trap sample was filtered through preweighed 142 mm 0.4 m Nuclepore ^{R} filters, washed with deionized water, dried in a desiccator, and reweighed in the laboratory to obtain the weight of total particulate matter (TPM) caught in the sediment trap. To obtain the total particulate nitrogen and carbon content (as weight-% of the TPM), portions of the material collected on the Nuclepore filter were carefully removed, weighed, and analyzed by the micro-Dumas combustion method using a Hewlett Packard C-H-N analyzer (Sharp 1974). Replicate subsamples were treated with 1N HCL and desiccated prior to C-H-N analysis to provide a measure of the organic carbon and nitrogen content of the sediments.

C. Water Sampling and Analyses

Station sampling began following deployment of sediment trap moorings. Routine CTD-rosette casts were made to obtain temperature and salinity profiles. Water samples were collected from several depths with 5-liter PVC Niskin bottles. Aliquots withdrawn from these samplers were used to measure various biological and chemical parameters. Subsamples for phytoplankton species enumeration were preserved in a 0.6% acetate buffered formaldehyde solution and returned to the laboratory for analysis by inverted microscope techniques (Lund, Kipling, and LeCren 1958). Samples for chlorophyll and pheopigment concentrations were analyzed aboard ship using fluorometric methods (Turner Fluorometer model 111) following the discrete sample technique of Lorenzen (1966). Seawater samples for determination of dissolved inorganic nutrients (nitrate, nitrite, silicate, phosphate, ammonium) were frozen and returned to the University of Washington Department of Oceanography, where they were treated by Auto-Analyzer methods adapted from Strickland and Parsons (1972). Total particulate carbon and nitrogen were measured at stations 1, 4, and 7 once during every cruise (except LC1781). Aliquots from several depths were processed through precombusted silver filters and placed in a desiccator to await examination by C-H-N analyzer in Seattle.

Half-day primary productivity experiments were at stations 1, 4, and 7 using standard carbon-14 methodology (Strickland and Parsons 1972). Samples were taken from eight light depths ranging from 100% to 1% of surface light intensity. The exact sampling depths were chosen based on underwater quantum sensor and secchi disk readings. The quantum sensor (Lamda Instruments model LI-192S) was responsive to light in the photosynthetically active portion of the spectrum (approx. 400-700 nm). Sampling depths for sunrise incubations were selected according to previous day light profiles. Two light bottles and one dark bottle were drawn from each water bottle, inoculated with ^{14}C, and placed in a seawater-cooled incubator under comparable neutral density light screens. The carbon-14 radioactivity in the resulting samples was determined by liquid scintillation spectrometry (Packard Tricarb^{R}, model C2425). During each cruise, sunlight was continuously monitored with a quantum sensor similar to that used for underwater profiling.

V. RESULTS AND DISCUSSION

The phytoplankton and primary productivity measurements in 1978 were taken for two purposes: (1) to compare with the 1976 data for obtaining some qualitative guide to annual differences in the seasonal cycle; and (2) to supply needed information for application with sediment-trap data to determine what proportion of production in the overlying water is being transported to the vicinity of the bottom. The results presented below are limited and germane to those objectives.

A. Phytoplankton Species

The sequence of occurrence of numerically dominant phytoplankton groups near the sea surface (1-m depth) during spring and summer, 1978, was roughly similar to that in 1976 (Larrance, et al., 1977). Although microflagellates were always among the four most numerous groups in 1976, they were even more abundant in 1978 and were the most numerous group in all the samples. In

1978, their concentrations ranged between $3 \cdot 10^4$ to $3 \cdot 10^6$ cells l^{-1} which accounted for 60-99% fo total cell counts (Fig. 6). (Microflagellates were not counted, however, in samples from stations 1 and 2 for March because of interference from high concentrations of inorganic particles.) They reached their peak abundances in May and June, particularly in Kachemak Bay (station 7) when diatom blooms were also in progress.

As in 1976, the most important diatoms were *Thalassiosira* spp. and *Chaetoceros* spp. which reached peak abundances in sequence. In March, diatoms were present in low numbers ranging between a few hundred to less than 10^4 cells l^{-1}. *Thalassiosira* was among the four most abundant groups at all stations and was top ranked at stations 2, 4 and 7 (Table 1). *Chaetoceros* was present in the middle and eastern side of the inlet in low numbers. On May 11, a large bloom of *Thalassiosira aestivalis* ($2 \cdot 10^5$ cells l^{-1}) was developed in Kachemak Bay along with about half as many *Chaetoceros* spp. At other stations the numbers of these algae were only a few percent of those at station 7. By June 8, diatom dominance in Kachemak Bay had shifted to *Chaetoceros debilis* with *Thalassiosira* reduced to about half of its May concentrations. A bloom of *Thalassiosira* was also underway in the western inlet in June, with only slightly higher *Chaetoceros* numbers than in May. By July 14, *Thalassiosira* had diminished to much lower abundances and *Chaetoceros* spp. (especially *C. debilis*) was the top ranked group at all stations in the middle and eastern inlet. *Chaetoceros* was still very abundant in August while *Thalassiosira* was present in moderate numbers.

The pattern described was basically the same as that discerned in 1976: *Thalassiosira* blooms followed closely by *Chaetoceros* blooms. The sequence begins early (May) in Kachemak Bay and appears to spread westward.

In addition to these two dominant groups, *Melosira sulcata* appears to be an indicator of the highly turbid, less saline water flowing south from the upper inlet (Larrance, et al., 1977). In 1978, it was present primarily in the western and middle inlet which are influenced by southward flowing upper inlet water. *Cylindrotheca closterium* was more prominent in the 1978 samples than in 1976.

All species identified in the samples are listed in Table 2.

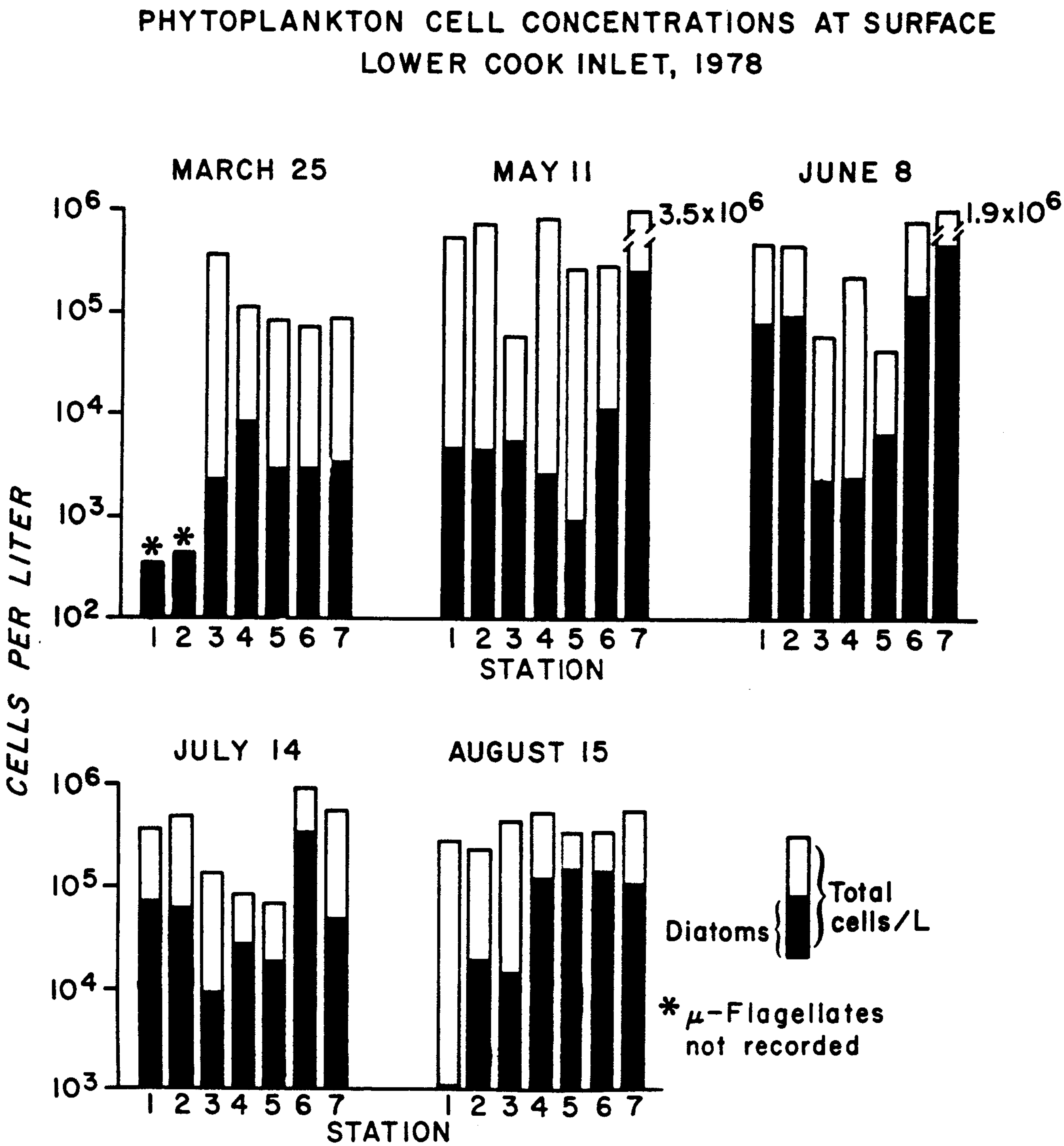


Figure 6. Surface phytoplankton cell concentrations, lower Cook Inlet, 1978.

Table 1. Important phytoplankton groups at 1-m depth in lower Cook Inlet, March-August 1978. Concentrations in 10^3 cells per l.

	Chaetoceros spp.	*Cylindrotheca closterium*	*Ditylum brightwellii*	*Melosira sulcata*	*Navicula distans*	*Nitzschia* spp.	*Thalassionema nitzschioides*	*Thalassiosira* spp.	Dinoflagellates
March 25									
1			< 0.1	0.1				0.1	
2			0.1					0.1	
3	0.2	0.1	0.3			0.7	0.3	0.3	0.2
4	1.3	1.2	0.5	0.4	0.1	0.3	1.5	3.7	0.1
5	0.1	1.6	< 0.1		0.1	0.1	0.5	0.4	0.2
6	< 0.1	0.6	< 0.1		1.2	0.2	0.3	0.2	0.1
7	0.2	1.0	< 0.1	0.2	0.2	0.2	0.3	1.1	0.3
May 11									
1			0.2	1.9			0.2	0.8	< 0.1
2	0.1	< 0.1	0.2	2.1	0.2	0.1	0.5	1.6	0.2
3	1.8		0.5				1.3	1.7	0.2
4	0.1	0.1			< 0.1			1.1	1.7
5	0.1				0.1		< 0.1	0.1	0.4
6	3.7	0.1	< 0.1		0.2	0.1	0.7	5.2	0.4
7	89.0	1.0	0.8		0.6		7.8	200.0	
June 8									
1	1.0	< 0.1	0.4		< 0.1	< 0.1	0.5	77.0	0.1
2	0.7	< 0.1	0.3	0.2			0.3	89.0	0.6
3	0.2	< 0.1	< 0.1	0.2	< 0.1		0.6	0.6	0.7
4		< 0.1		0.2	0.1		1.6	0.4	0.3
5	0.5	0.1	1.0		0.2		0.3	5.6	0.2
6	43.0		0.4		1.8	0.3	6.6	83.0	0.7
7	330.0		0.2			0.8	0.4	110.0	4.2
July 14									
1		68.0	0.1	0.1			0.8	2.0	0.1
2	2.4	7.0	31.0		< 0.1	3.4	2.9	16.0	3.2
3	7.2	0.8	< 0.1			0.3	0.3	0.2	0.3
4	22.0	< 0.1	0.3	0.1	< 0.1	0.3	1.2	2.2	0.2
5	15.0	< 0.1	0.2		< 0.1	0.3	0.7	0.8	0.1
6	310.0	4.4	0.6		2.7	2.7	5.0	1.9	0.5
7	29.0	6.9	0.1		0.3	2.0	10.0		0.7

(continued)

Table 1. (Contd.)

	Chaetoceros spp.	*Cylindrotheca closterium*	*Ditylum brightwellii*	*Melosira sulcata*	*Navicula distans*	*Nitzschia* spp.	*Thalassionema nitzschioides*	*Thalassiosira* spp.	Dinoflagellates
August 15									
1								0.1	1.1
2	4.6	5.6	0.2	0.2	< 0.1		0.1	5.4	2.0
3	1.2	2.7	0.3		< 0.1	0.4	0.2	8.3	0.2
4	88.0	1.0	0.3		0.2		6.2	25.0	0.5
5	110.0	2.2	< 0.1		0.1	0.7	14.0	7.1	0.4
6	120.0	0.2			0.3		6.8	0.2	0.2
7	80.0						0.5		1.9

Table 2. Phytoplankton species identified in near-surface water, lower Cook Inlet, 1978.

Achananthes longipes

Actinoptychus spp.
Actinoptychus splendens
Actinoptychus undulatus

Biddulphia sp.
Biddulphia aurita

Cerataulina bergonii

Chaetoceros spp.
Chaetoceros affinis
Chaetoceros atlanticus
Chaetoceros atlanticus var. *audax*
Chaetoceros compressus
Chaetoceros concavicornis
Chaetoceros constrictus
Chaetoceros crucifer
Chaetoceros danicus
Chaetoceros debilis
Chaetoceros decipiens
Chaetoceros didymus
Chaetoceros difficilis
Chaetoceros laciniosus
Chaetoceros lorenzianus
Chaetoceros pelagicus
Chaetoceros radicans
Chaetoceros secundus
Chaetoceros similis
Chaetoceros socialis
Chaetoceros teres
Chaetoceros vistulae

Cocconeis sp.
Cocconeis scutellum

Corethron hystrix

Coscinodiscus spp.
Coscinodiscus centralis var. *pacifica*
Coscinodiscus concinnus
Coscinodiscus curvatulus
Coscinodiscus lineatus
Coscinodiscus marginatus
Coscinodiscus oculus-iridis
Coscinodiscus radiatus
Coscinodiscus stellaris

Cylindrotheca closterium
Cylindrotheca fusiformis

Ditylum brightwelli

Eucampia zoodiacus

Fragillariopsis spp.

Gyrosigma spp.
Gyrosigma spencerii

Leptocylindrus danicus

Licmophora abbreviata

Melosira spp.
Melosira sulcata

Navicula spp.
Navicula distans

Nitzschia spp.
Nitzschia delicatissima
Nitzschia longissima
Nitzschia seriata

Paralia sulcata

Pleurosigma nicobaricum

Rhizosolenia spp.
Rhizosolenia alata
Rhizosolenia alata var. *curvirostris*
Rhizosolenia delicatula
Rhizosolenia fragilissima
Rhizosolenia setigera
Rhizosolenia stolterfothii

Skeletonema costatum

Stephanopyxis nipponica

(Contd.)

Table 2. (Contd.)

Streptotheca thamesis
Thalassionema nitzschoides
Thalassiosira spp.
Thalassiosira aestivalis
Thalassiosira angstii
Thalassiosira condensata
Thalassiosira decipiens
Thalassiosira eccentrica
Thalassiosira gravida
Thalassiosira leptopus
Thalassiosira lineata
Thalassiosira nordenskioldii
Thalassiosira pacifica
Thalassiosira polychorda
Thalassiosira rotula
Thalassiosira subtilis
Thalassiothrix frauenfeldii
Tropodoneis antarctica var. *polyplasta*
Miscellaneous Centric spp.
Miscellaneous Pennate spp.

B. Primary Productivity and Nutrients

The general features of the seasonal and spatial patterns of primary productivity measured in 1978 agree with 1976 observations (Larrance, et al. 1977). Typical cross-channel profiles of temperature, salinity, sigma-t, chlorophyll-a, and nutrients are illustrated in the Appendix. Winter conditions prevail in March: high nutrients, low chlorophyll and productivity and cold, well mixed water (Figs. 7 and 8; Appendix). In May, near-surface water in Kachemak Bay was thermally stratified and a large phytoplankton bloom was in progress. Daily productivity averaged about 7 g C/m^2 and nitrate and silicate were roughly half of the March values. At other stations nutrients were significantly lower, and productivity and chlorophyll were slightly higher than in March. Incident radiation had also increased (Table 3).

A large bloom was in progress in the western inlet (Kamishak Bay) in June where productivity averaged 4.6 g C/m^{2}day, almost identical to the values measured in Kachemak Bay at that time. Productivity in mid-inlet was slightly higher than in May. Chlorophyll on the eastern side of the inlet had reached large values as a result of the sustained bloom and relatively low flushing rates of outer Kachemak Bay. Nutrients in the western inlet decreased dramatcally between May and June, but remained moderately high in the central inlet where deeper, nutrient-rich, cold water rises to the surface.

The Kamishak Bay bloom had subsided to about ⅓ of its June value by July but the Kachemak Bay productivity remained high until August. It was not until August, that high productivity (averaged 5.3 g C/m^{2}day) was observed in the central inlet.

The major factors responsible for initiating blooms in lower Cook Inlet are water stratification, incident radiation, and water clarity. No blooms occurred unless the water column was thermally stratified, incident light averaged over 20 einsteins/m^{2}day and the euphotic zone was deeper than about 10 m. These conditions occur first in Kachemak Bay where water resides in a gyre system relatively longer than in the central and western portions of the inlet. This longer residence time and lower mixing rates permits surface water to warm in the spring and retains phytoplankton populations where their concentrations can build to high levels. Because the major component of Kachemak Bay water originates in the Gulf of Alaska, it does not contain the heavy load of

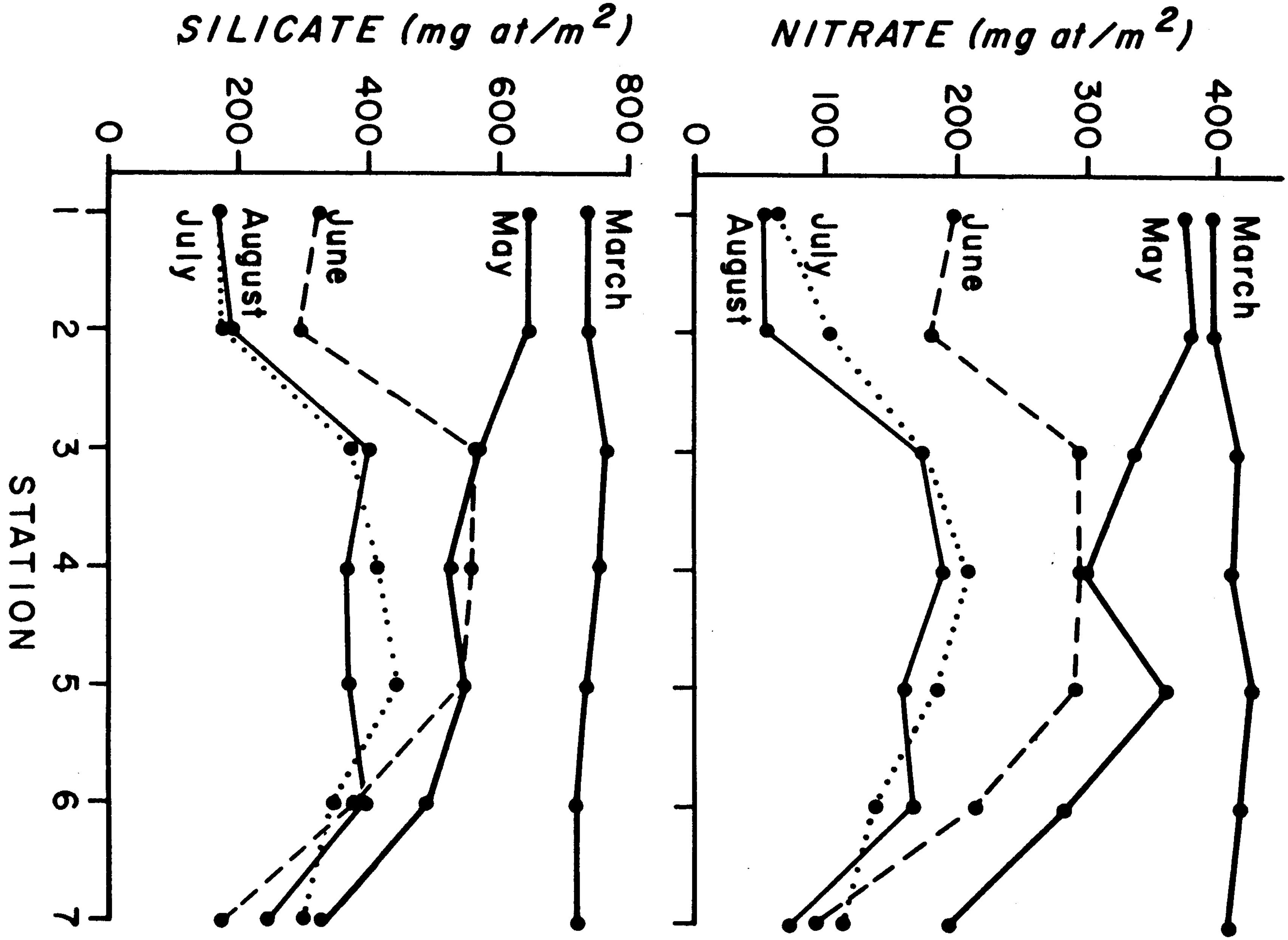


Figure 7. Nitrate and silicate in the upper 25 m, lower Cook Inlet, 1978.

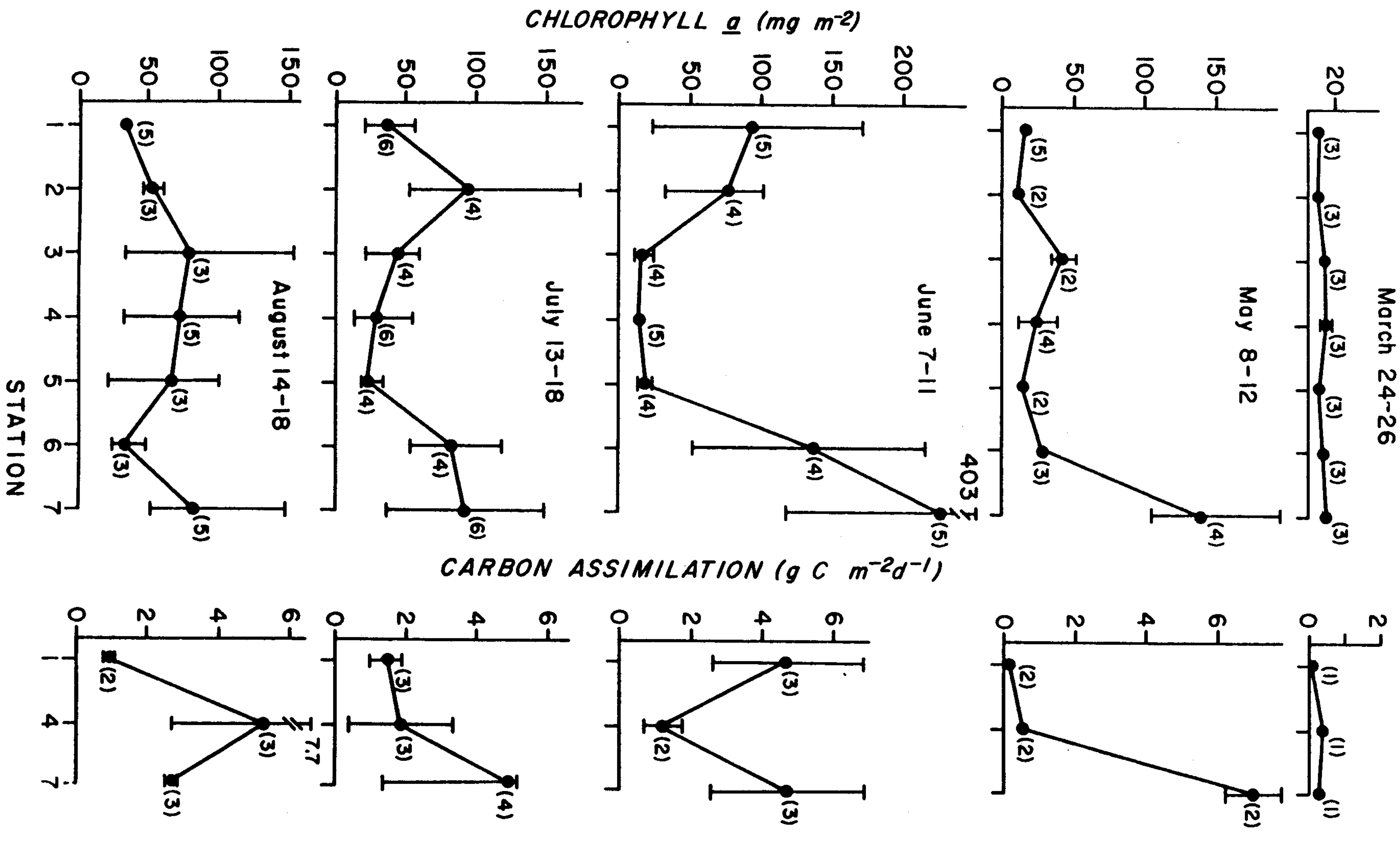


Figure 8. Chlorophyll in the upper 25 m and carbon assimilation in the euphotic zone of lower Cook Inlet, 1978. Bars indicate total range of observations; ( ) indicates number of profiles measured; plotted points are mean values.

Table 3. Chlorophyll, primary productivity, nutrients, and light.

Cruise/ Station	Local Date	Chlorophyll a (mg/m^2)	Primary Production (mg C / m^2-dy)	Nitrate (mg-at / m^2)	Silicate (mg-at / m^2)	Incident Radiation (einsteins / m^2-dy)	1% Light Depth (m)
LCI781/1	24 MAR	6.5	31	395	734	23.0	5
2		7.0		397	737		5
3		11.6		413	763		19
4		11.3		411	758		19
5		8.7		427	736		24
6		11.5		419	720		
7		13.5		409	722		
7	25 MAR	12.7	283	403	724	15.4	24
6		12.5					24
5		9.3					27
4		9.5					27
3		10.5					22
2		7.4					
1		7.7					
1	26 MAR	7.3				13.7	
2		5.4					4
3		13.2					11
4		17.2	391				24
5		8.4					27
6		9.9					27
7		13.0					23

Table 3. (Contd.)

Cruise/ Station	Local Date	Chlorophyll a (mg/m^2)	Primary Production (mg C / m^2-dy)	Nitrate (mg-at / m^2)	Silicate (mg-at / m^2)	Incident Radiation (einsteins / m^2-dy)	1% Light Depth (m)
LCI782/1	8 MAY	13.9					2
1	9 MAY	15.9	86	383	642	18.9	3
7		104.7	6255	175	357		15
6		28.6					24
4		33.7					19
7	10 MAY	136.4		177	326	17.2	
4		39.0		315	541		23
1		12.6		366	642		6
7	11 MAY	197.2	7815	293	281	28.5	15(1)
6		32.9		292	496		
5		16.8		361	620		30
4		10.9	557	308	538		32
3		50.8		337	588		19
2		11.4		379	648		5
1		13.5		384	682		5
1	12 MAY	19.7	204	368	616	28.0	5(1)
2		9.0		381	639		7
3		34.5		340	557		24
4		11.9	473	277	489		27
5		11.1		361	581		35
6		26.4		275	480		24
7		122.4		137	292		16

Table 3. (Contd.)

Cruise/ Station	Local Date	Chlorophyll a (mg/m^2)	Primary Production (mg C / m^2-dy)	Nitrate (mg-at / m^2)	Silicate (mg-at / m^2)	Incident Radiation (einsteins / m^2-dy)	1% Light Depth (m)
LCI783/7	7 JUN	116.8		116	222	52.9	8
1		22.9		229	390		11
4		15.6		297	530		20
1	8 JUN	39.2	2598	255	454	34.2	11(1)
2		31.7		274	477		
3		16.1		298	573		22
4		13.0	641	289	570		22
5		13.6		298	561		31
6		51.4		230	398		20
7		156.9		89	168		13
1	9 JUN	79.5	4406	167	282	26.0	11(1)
2		100.6		139	203		
3		15.2		291	566		24
4		15.5		296	565		27
5		22.4		283	518		27
6		148.5		204	336		19
7		295.9	6877	102	185		11
7	10 JUN	402.7	4585	75	147	50.6	11(1)
6		130.5		206	393		
5		17.3		290	558		35
4		13.4	1759	300	573		35
3		10.5		297	548		29

Table 3. (Contd.)

Cruise/ Station	Local Date	Chlorophyll a (mg/m^2)	Primary Production (mg C / m^2-dy)	Nitrate (mg-at / m^2)	Silicate (mg-at / m^2)	Incident Radiation (einsteins / m^2-dy)	1% Light Depth (m)
2		75.8		129	196		13
1		170.7		168	261		11
1	11 JUN	157.5	6849	145	219	49.4	11(1)
2		97.0					
3		19.0					35
4		13.0					40
5		22.4					50
6		215.8					19
7		161.6	2560	80	136		14
LCI784/1	13 JUL	34.3				21.1	
4		13.7					30
7		71.5					12
7	14 JUL	147.8	5089	77	181	47.3	12(1)
6		118.6		127	276		11
5		18.7		192	442		33
4		41.5	3298	197	394		20
3		21.4		204	396		19
2		51.6		147	250		15
1		25.2		61	153		10
1	15 JUL	33.2	1845	46	143	25.4	10(1)
2		65.2					11
3		43.6					14
4		16.3	778	223	451		17

Table 3. (Contd.)

Cruise/ Station	Local Date	Chlorophyll a (mg/m^2)	Primary Production $\left(\frac{mg\ C}{m^2\text{-}dy}\right)$	Nitrate $\left(\frac{mg\text{-}at}{m^2}\right)$	Silicate $\left(\frac{mg\text{-}at}{m^2}\right)$	Incident Radiation $\left(\frac{einsteins}{m^2\text{-}dy}\right)$	1% Light Depth (m)
5		19.4					27
6		72.0					15
7		141.3					12
7	16 JUL	40.8	3441	90	259	43.1	12(1)
6		90.6		135	368		
5		34.7		192	465		16
4		28.9	1381	225	388		14
3		54.2		141	358		14
2		172.2		65	124		16
1		21.8		90	202		11
1	17 JUL	42.7	958	78	207	10.8	11(1)
4		55.2					
7		107.0	4654	120	348		15
7	18 JUL	36.6	1320	165	417	10.1	15(1)
6		53.4		151	381		
5		20.3		174	423		
4		19.8		196	434		16
3		59.6		189	357		15
2		88.3		96	159		15
1		55.3	1601	38	151		15
LCI785/1	14 AUG	34.3		29	133		
4		70.5		79	292		15

Table 3. (Contd.)

Cruise/ Station	Local Date	Chlorophyll a (mg/m^2)	Primary Production (mg C / m^2-dy)	Nitrate (mg-at / m^2)	Silicate (mg-at / m^2)	Incident Radiation (einsteins / m^2-dy)	1% Light Depth (m)
7		71.7		90	283		21
7	15 AUG	71.9	2840	37	174	46.1	21(1)
6		48.3		177	398		24
5		100.2		151	377		18
4		68.0	5388	180	393		30
3		50.0		186	420		19
2		45.9		37	131		
1		30.2		38	157		18
1	16 AUG	36.6	785	63	180	12.2	18(1)
4		115.2		192	378		14
7		72.5	2726	105	284		24
7	17 AUG	52.4	2516	115	326	51.6	24(1)
6		28.7		152	385		19
5		78.8		159	342		22
4		75.5	7690	148	372		18
3		153.8		146	380		
2		60.2		66	193		12
1		31.9		69	187		12
1	18 AUG	35.5	1075	68	201	44.2	12(1)
2		49.7		59	243		
3		34.6		188	400		14
4		33.4	2689	170	385		17

Table 3. (Contd.)

Cruise/ Station	Local Date	Chlorophyll *a* (mg/m^2)	Primary Production $\left(\frac{mg\ C}{m^2\text{-}dy}\right)$	Nitrate $\left(\frac{mg\text{-}at}{m^2}\right)$	Silicate $\left(\frac{mg\text{-}at}{m^2}\right)$	Incident Radiation $\left(\frac{einsteins}{m^2\text{-}dy}\right)$	1% Light Depth (m)
5		21.5		172	391		30
6		25.0		174	408		24
7		146.4		22	141		

(1) For morning incubations the 1% light depth was chosen based on the previous day's value.

suspended particles present in the upper Cook Inlet water which sweeps the western side. Kachemak Bay, therefore, is relatively clear prior to the spring bloom. The western inlet, however, remained highly turbid with silt and other non-living particles until June when it cleared sufficiently to permit a phytoplankton bloom. The central inlet is an upwelling area (Muench, et al., 1978) which does not easily stratify.

Nutrients (primarily nitrate, ammonium and silicate) do not appear to decrease to limiting levels except in Kachemak Bay, and perhaps, to a lesser extent, in Kamishak Bay. High rates of grazing by fecal-pellet-producing zooplankton are evident by the content of sediment trap samples. It is likely, therefore, that considerable nutrient regeneration by zooplankton occurs and helps to support the observed production of algae, even though observed nutrient concentrations remain low. Nutrients are also supplied by mixing with Gulf of Alaska water entering Cook Inlet. Nutrient concentrations in the central inlet decrease to moderate levels by July, but not to the extent which would significantly limit production.

C. Sediment Trap Studies

Sediment trap samples were analyzed for total particulate matter, plant pigments, organic carbon, nitrogen, and numbers of fecal pellets, phytoplankton cells, and other identifiable particles. Adequate samples resulted from 15 of the 24 sediment traps deployed. Because of the use of replicate traps, useable samples were obtained from 10 of the 12 moorings set out in Cook Inlet. Replicate trap samples were obtained at 5 stations. Variability was large, but in line with that found in other studies (Spencer et al. 1978). The coefficient of variation for total particulate flux averaged 36% in the central inlet and and 16% in Kachemak and Kamishak Bays. See Table 4 for five sets of paired values. Dry weights for the total samples ranged from about 0.2 to 6 g and provided sufficient material for the required chemical and microscopical analyses.

Total Particulate Flux--Total particulate flux measurements help clarify the different cross-channel sedimentary environments. Comparisons with sedimentation rates independently estimated from Pb-210 data (Richard A. Feely, RU #152, personal comm.) provide a field calibration technique for verifying sediment trap efficacy. Long-term sedimentation rates measured by Feely from May-August 1978 at a mooring situated near our station 1 provide added confirmation that our short-term deployments measured representative particulate flux.

Rates of sedimentation for each cruise and station are summarized in Table 4. Particulate flux in Kachemak Bay was remarkably uniform and reflected the high biological productivity present there throughout the study. Observed settling rates were more variable in Kamishak Bay. The extremely high May value (72 g/m^2-day) was correlated with heavy suspended loads carried down from the upper inlet at that time of year.

Time-averaged sedimentation rates during the May-August period were calculated and compared with long-term accumulation rates found from cores analyzed for Pb-210 activity (Table 5). Given the uncertainties involved, there is good agreement between estimates by the two methods. Kachemak Bay is characterized by high phytoplankton concentrations during late spring and summer, with less sedimentation likely during the winter. The measured flux during the biologically productive period, therefore, can be expected to be higher than the long-term estimates derived from Pb-210 geochronology. In contrast, during the early spring, Kamishak Bay water has high concentrations of glacially derived suspended matter transported from the upper inlet. Summertime inputs due to local organic production are relatively low. Sediment traps were in place during both sedimentary periods, and the two methods of estimate are in closer agreement. It is therefore likely that the sediment traps are measuring typical particle flux and that these particles accumulate in the sediments of Kachemak and Kamishak Bays.

Sediment traps were deployed by R. A. Feely (RU#152) for an 85-day sampling period at a station (his ST-1) approximately 10 miles west of our Kamishak Bay site. This long-term flux was estimated to be about 21 g/m^2-day, and it compares reasonably well with our time-averaged value for Kamishak Bay. The 21g/m^2 -day figure is a long-term (85 days) sediment trap measurement by Feely and should not be confused with the Pb-210 estimate (27g/m^2 -day) listed in Table 5. These data provide complimentary evidence that short-term deployments measured typical flux in the region.

<u>Microscopic Investigations</u>--Microscopic examination and enumeration of particulate components in sediment trap samples provide information about the quality and quantity of organic particles sinking to the sea floor (Table 6). By far, the major portion of material was in the form of recognizable fecal

Table 4. Total sedimentation rate at lower Cook Inlet stations, May-August 1978. Paired values are from replicate sediment traps.

Location	Time	Total Particulate Flux (g/m^2-day)	
Kamishak Bay (Sta. 1)	May	72.0	
	June	-	
	July	6.4	
	August	13.2	17.1
Central Inlet (Sta. 4)	May	11.3	7.5
	June	17.6	26.6
	July	1.9	
	August	13.2	6.1
Kachemak Bay (Sta. 7)	May	17.3	
	June	22.1	
	July	-	
	August	19.5	16.5

Table 5. Average sedimentation rates in lower Cook Inlet estimated from sediment trap data (May-August 1978) and long-term Pb-210 radiometry.

Location	Station No.	Average Sedimentation (Sediment Traps) g/m^2-day	Average Accumulation (Pb-210 Radiometry) g/m^2-day
Kamishak Bay	1	30.7	27.1
Central Inlet	4	11.1	no data
Kachemak Bay	7	20.0	10.5

Table 6. Daily particulate flux (numbers/m^2) settling near bottom in lower Cook Inlet, 1978.

		FECAL PELLETS $\times 10^6$	DIATOMS $\times 10^6$	TINTINNIDS $\times 10^6$	DINOFLAGELLATES $\times 10^6$	MOLTS $\times 10^6$	LARVAE						
							Copepods	Barnacles	Clams	Polychaetes	Crabs	Snails	Octopus
Kachemak	May	0.360	13.41	0.114	0.023	0.027	X		X				
	Jun	0.932	15.82	0.408	0.024	0.016	X	X	X	X	X		
	Jul	-----	-----	-----	-----	-----	-	-	-	-	-	-	-
	Aug	3.110	9.40	2.355	0.240	0.046	X	X	X		X	X	
Central	May	0.247	154.07	0.148	0.018	0.001				X			
	Jun	2.010	14.23	0.489	0.073	0.006	X	X			X		
	Jul	0.079	7.27	0.041	0.010	0.001	X		X				
	Aug	0.119	196.22	0.118	0.012	0.004	X		X			X	
Kamishak	May	0.092	20.05	0.199	0.133	0.000	X						
	Jun	-----	-----	-----	-----	-----	-	-	-	-	-	-	-
	Jul	0.750	9.29	0.367	0.208	0.016	X		X	X		X	
	Aug	1.830	6.75	1.158	0.025	0.034	X	X	X			X	X

pellets. Scanning electron micrographs of these products of zooplankton grazing activity reveals many broken remains of diatom frustules (Fig. 9). The flux of intact fecal pellets averaged for all cruises and stations was about one million pellets/m^2 day. The maximum flux ($3.11 \times 10^6/m^2$ day) was measured in Kachemak Bay during August. The dimensions of individual pellets averaged about 200 µm long by 50 µm wide. As a rule, the largest pellets were found in Kachemak Bay. Shuman (1978) reported mean sinking rates for similarly sized fecal pellets to be about 150 m/day. At this speed it would take only one-half day for a fecal pellet to sink from the surface to the bottom of even our deepest station. Our sediment traps are, therefore, likely measuring fecal input which is closely coupled in time to the actual grazing events. In addition to intact fecal pellets, there were often quantities of amorphous debris which appeared to come from broken pellets. This unidentifiable debris could easily be "manufactured" under the dissecting scope by physically breaking whole fecal pellets with a probe.

Honjo and Roman (1978) observed rapid bacterial colonization of the surface membrane of fecal pellets exposed to seawater. The rate of membrane rupture increased from 3 hours at 20°C to 20 day at 5°C. Thus, in Cook Inlet, rapid transport to the bottom and relatively cold temperatures insure the arrival of fresh fecal material to the benthos. Copepod fecal pellets have been shown to reflect the chemical composition of ingested food and represent a rich energy source for detritus (Cowey and Corner 1966). Johannes and Satomi (1966) studied the nutritive value of fecal pellets produced by an omnivorous marine crustacean fed on diatoms and concluded that the feces were rich in assimilable protein. The authors suggested that food residues are converted into assimilable bacteria in the posterior portion of the crustacean gut, and that fecal pellets represent a major potential food source for marine animals.

Besides fecal pellets and debris, other large particles included crustacean molt material and, also, a variety of juvenile invertebrates (Table 6). Fluxes of molt material ranged from 0 to $4.6 \times 10^5/m^2$day, and were most common in Kachemak and Kamishak Bays during August. This corresponded with the period

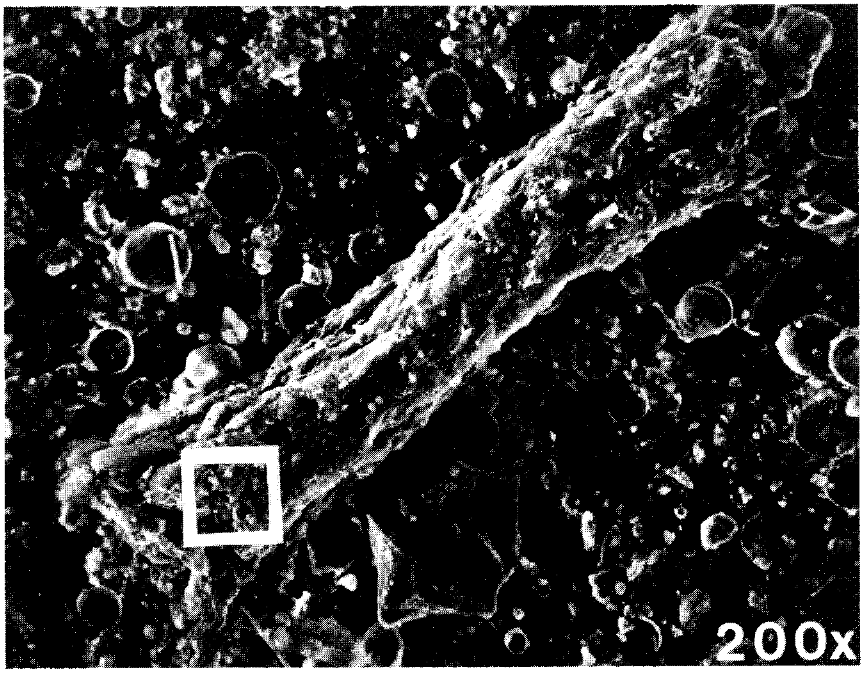


Figure 9. Scanning electron micrographs of fecal pellets. Whole fecal pellet (lower, 2000x); diatom fragments in lower inset (upper, 20,000x).

of greatest fecal pellet flux for these two regions of Cook Inlet.

Occasionally, larvae of barnacles, clams, polychaete worms, snails, and other bottom settling invertebrate juveniles were found in the traps. These larvae begin life as members of the plankton and, after development, settle downward to take up a benthic existence. The presence of these organisms in the traps hints at a potential method for measuring settling and recruitment rates of invertebrates to specific subtidal habitats. For example, about 16,000 lamellibranch (clam) larvae/m^2day were deposited at Kamishak Bay in July; almost 6000 barnacle cyprids/m^2day were deposited there in August. This kind of data would be useful to specialists in benthic population dynamics.

Smaller particles in the traps were enumerated with an inverted microscope. These included primarily phytoplankton cells and tintinnid protozoans. Diatom cells and resting spores were by far the most abundant phytoplankters in the traps. The input rates of diatoms were on the order of 10-20 x 10^6 cells/m^2day, except for May and August, when large fluxes of small pennate diatoms predominated in the center of the inlet. Relatively few dinoflagellates and no microflagellates were observed in the samples, probably due to the ability of these cells to swim against gravity. Contrary to Shuman's (1978) observation that dominant phytoplankton species were not significantly found in sediment traps, our data strongly demonstrate a flux of the important diatom species to the bottom. This apparent discrepancy may be due to the greater water depth and correspondingly longer sinking times in Shuman's area of study.

The occurrence of large numbers of tintinnid loricae in the traps is significant and may give some indication of the natural mortality experienced by this group of active phytoplankton grazers. Tintinnids are ciliated protozoans, each housed in a pseudo-chitonous organic sheath called a lorica. Many coastal and neritic tintinnids, including important genera found in the sediment traps, decorate their loricae with mineral particles scavenged from the water column (Gold and Morales 1976). This provides another potential biological mechanism for concentrating oiled particles and transferring them to the sea floor.

Pigment Studies--A major goal of the present study has been to quantify the loss rate of phytoplankton material to the sea floor in terms of the algal biomass in the overlying water. As outlined in the introductory conceptual model, the purpose has also been to provide an assessment of the relative importance of the grazing and sinking loss functions. The chlorophyll a molecule is particularly well-suited for use in this inquiry because it supplies some index of overall plant biomass. Most significantly, chlorophyll a and its degradation products can also function as tracer molecules to study the fate of phytoplankton material in the marine environment. Since chlorophyll is completely degraded to pheophorbide in the herbivore gut (Shuman and Lorenzen 1975), the amount of chlorophyll eaten can be directly calculated from the pheophorbide content. Because our calculations are done on a weight rather than a molar basis, the total conversion of chlorophyll to pheophorbide would involve a 34% weight-loss correction from the original weight of chlorophyll. This 34% decrease represents the molecular weight loss of the central Mg atom and the phytol chain from the chlorophyll molecule. The total loss of chlorophyll from the water column to the traps is calculated as:

$$\underset{\text{from water column}}{\text{Total Chlorophyll lost}} = \underset{\text{(sinking)}}{\text{Chlorophyll in trap}} + \underset{\text{(grazing)}}{\frac{\text{Pheophorbide in trap}}{.66}}$$

where the corrected pheophorbide value represents the grazed chlorophyll lost. We have ignored any possible small disappearance of chlorophyll degradation products in the dark.

By measuring the chlorophyll and chlorophyll degradation products in the sediment traps, it is therefore possible to arrive at not only the total phytoplankton biomass lost to the bottom, but also to assess the relative contribution of grazing and sinking to that loss. The grazing losses estimated here are almost exclusively due to grazing pressure exerted by fecal-pellet-producing zooplankton. Grazing by tintinnids and other microzooplankton species which void their waste products in an unconsolidated form is not adequately accounted for because the traps do not effectively sample those products.

The total algal biomass lost from the water column is reported as equivalent chlorophyll flux which is the sum of chlorophyll and adjusted pheophorbide (Table 7). The greatest absolute chlorophyll losses were always measured in Kachemak Bay which is consistent with the characterization of that area as one of extremely rich organic production. On the average, plant-pigment fluxes were almost six times greater for Kachemak Bay than for the other two Cook

Table 7. Phytoplankton standing stock and grazing losses calculated from pigment analyses of particles collected in sediment traps, lower Cook Inlet, 1978.

Location	Month	Total Particulate Matter (TPM) g m^{-2} day^{-1}	Chlorophyll Equivalents mg m^{-2} day^{-1}	Standing Stock Lost %	Grazing Loss %	$\frac{\text{TPM}}{\text{Chl-}a\text{ Equivalents}}$ mg mg^{-1}
KAMISHAK BAY (Sta. 1)	May	72.0	1.6	9.9	90	45,570
	Jun	-	-	-	-	-
	Jul	6.4	3.0	7.2	61	2,126
	Aug	15.2	3.1	9.2	81	4,844
CENTRAL INLET (Sta. 4)	May	9.4	1.9	4.1	89	4,836
	Jun	22.1	5.0	18.2	85	4,545
	Jul	1.9	1.0	2.6	88	1,845
	Aug	9.6	1.5	1.6	87	6,375
KACHEMAK BAY (Sta. 7)	May	17.3	17.2	8.5	79	1,005
	Jun	22.1	14.4	5.7	81	1,529
	Jul	-	-	-	-	-
	Aug	18.0	11.3	7.6	89	1,590

Inlet sites. Also, the ratio of total particulate flux to pigment flux indicates the higher relative organic richness of the Kachemak Bay sediments.

The total equivalent chlorophyll flux was compared to the time-averaged chlorophyll content of the overlying waters during the period of sediment trap deployment to obtain an estimate of the portion of the phytoplankton population lost each day by sinking or grazing (Table 7). At Kachemak and Kamishak Bays, the daily loss to the phytoplankton standing stock amounted to about 8% (s.d. = 1.5%). Loss rate values for the central inlet were much more variable but averaged about 6.5% (s.d. = 7.5%). Of this total plant material lost to the bottom, an average of 83% (s.d. = 8.6%) was attributed to grazing and subsequent fecal pellet production. The balance resulted from either direct algal sinking or possibly the presence of a few undigested chlorophyll bearing cells in the fecal pellets.

These values for the proportion of the phytoplankton population sedimented to the sea floor per day, as well as the relative dominance of grazing, agree quite well with Shuman's (1978) conclusions for a small Puget Sound embayment. The conclusions of both studies are consistent with the argument that grazing, and not direct sinking of algal cells, represents the major loss from the phytoplankton population.

The relationship between estimated chlorophyll grazed and fecal pellets found in the traps was explored to test whether increased grazing indexed by pheophorbide content could be linked with more direct evidence of zooplankton grazing. Positive statistical correlation was found between chlorophyll grazed and fecal pellet volume (Fig. 10). Although errors in fecal pellet flux measurements were introduced because of pellets broken during the collection and preservation process, the relationship is considered good corollary evidence that high grazing pressures are reflected in high pheophorbide concentrations in the traps. Pigment content of fecal pellets at station 7 was relatively high which indicates that fecal pellets produced in Kachemak Bay may be richer in phytoplankton remains than those at station 1 and 4. This view is consistent with data showing higher total particulate:pigment ratios in the sediment traps at stations 1 and 4 and suggests that zooplankton grazers may be ingesting relatively more inorganic (non-chlorophyll bearing) particles there than at station 7.

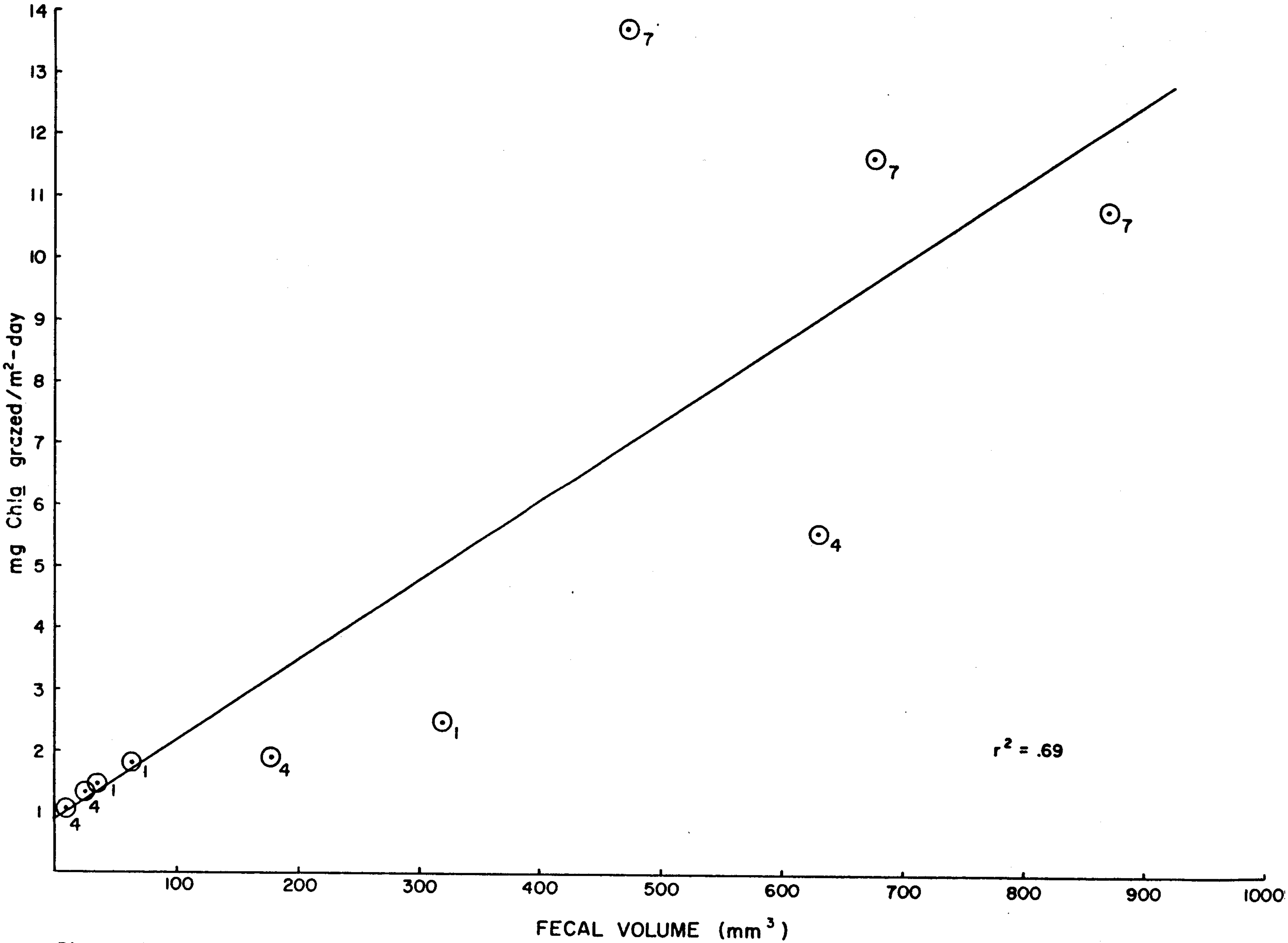


Figure 10. Relationship between grazed chlorophyll and fecal pellet volume, lower Cook Inlet, 1978.

Carbon and Nitrogen Content--A comparison was made between untreated sediment trap samples and samples treated with dilute HCL to determine the relative importance of inorganic carbon (primarily in the form of calcium carbonate) to the total carbon measured. A T-test for paired means demonstrated that untreated samples yielded significantly higher carbon content than treated samples. An average of all samples showed that approximately 13% of the total carbon determined could be attributed to inorganic sources. For purposes of this report, we discuss only total carbon values for evaluating fluxes and relationships in the data.

Carbon and nitrogen contents were initially calculated as percentage composition by weight of the total particulate sample analyzed. This weight-percent data was then converted to elemental flux by multiplying the total particulate flux (Table 8). Carbon and nitrogen weight-percent data are useful in comparing the relative organic content of sediments collected at each station. In all cases, Kachemak Bay sediments had the highest relative carbon and nitrogen content. Samples from Kachemak Bay averaged over twice the carbon and nitrogen content of the other two Cook Inlet sites (2.8% vs. 1.3% carbon, .36% vs. .15% nitrogen by weight). These data are consistent with higher particulate:pigment ratios at stations 1 and 4 than at Kachemak Bay. The low percentages of organic carbon and nitrogen in the samples is indicative of high fluxes of inorganic mineral material at all stations. This conclusion is in concurrence with that of Honjo (1978) for a sediment trap study in the Sargasso Sea. Bottom sediment analyses conducted by R. A. Feely (RU#152) near our Kachemak Bay station, however, indicate a carbon content of only about 1% by weight. The lower carbon content of sediments compared to sediment trap samples probably reflects oxidation and utilization of organic matter in the surficial sediments. Average total carbon fluxes were 0.333, 0.142, and 0.503 g/m^2 at stations 1, 4, and 7, respectively (Table 8). At Kachemak Bay, this would translate to a total of perhaps 60 g C/m^2 delivered to the bottom over the four-month period of this study, a value equal to about 11% of the estimated water column primary productivity during the same period. For Kamishak Bay a total of 40 g C/m^2 (amounting to 19% of the area primary production) was sedimented over the four months; the central inlet value was 17 g C/m^2 (6% of the primary production).

Table 8. Particulate carbon and nitrogen in sediment trap samples, lower Cook Inlet, 1978.

Location	Month	Carbon wt.- %	Carbon Flux mg m^{-2} day^{-1}	Nitrogen wt.- %	Nitrogen Flux mg m^{-2} day^{-1}	Carbon / Chlorophyll Ratio	Carbon / Nitrogen Ratio
KAMISHAK BAY (Sta. 1)	May	0.85	612	0.075	50.4	387	12.9
	Jun	1.52*	-	0.182*	-	-	8.1*
	Jul	2.11	135	0.281	18.0	45	7.5
	Aug	1.66	252	0.180	27.3	81	9.6
CENTRAL INLET (Sta. 4)	May	1.12	105	0.107	10.1	54	12.1
	Jun	1.69	373	0.183	40.2	74	9.2
	Jul	0.74	14	0.064	1.2	14	11.5
	Aug	0.78	76	0.066	6.4	51	12.8
KACHEMAK BAY (Sta. 7)	May	2.60	450	0.358	61.9	26	8.8
	Jun	2.68	592	0.299	66.1	41	9.0
	Jul	3.34*	-	0.426*	-	-	7.7*
	Aug	2.60	468	0.360	64.8	41	7.2

* values obtained from traps that did not close properly

A consideration of some important chemical ratios in the water column and in the sediment traps yields some insights into changes in the nature of organic matter as it is transferred to the benthos. Commonly, lower carbon:chlorophyll values were encountered in the sediment traps than in the overlying waters. The porphyrin ring of the chlorophyll is particularly stable, and other organic compounds are more easily assimilated by grazers. This stability supports the use of chlorophyll degradation products as tracer molecules in the marine environment.

A second important index is the carbon:nitrogen ratio. In every case, the C:N value was higher in the sediment traps than in the overlying water column. As plant material is metabolized during the digestive process, nitrogen-rich organic compounds are preferentially used, and C:N ratios increase. Knauer et al. (1979) reached a similar conclusion from sediment trap studies conducted in the Northeast Pacific Ocean.

VI. SUMMARY

The use of sediment traps has enabled us to determine the input rates of a variety of chemically and microscopically defined particles to the benthic food web of lower Cook Inlet. Areal and seasonal variations in flux and quality of material were determined and related to algal biomass and productivity in the overlying waters. Comparisons of particulate flux measured by sediment traps with long-term accumulation rates estimated by Pb-210 geochronology were quite favorable and lend confidence to the validity of the experimental approach.

Of the three sites studied, the greatest amount of organic material in trap samples was in Kachemak Bay. This is verified by chemical measures (i.e. pigment, carbon, and nitrogen fluxes), as well as by visual observations (i.e. fecal pellet and phytoplankton cell numbers). The sedimented material in Kachemak Bay was richer than in other areas of Cook Inlet in both organic carbon and nitrogen. Somewhat lower organic inputs occurred at Kamishak Bay, and the mid-channel region received even smaller quantities. These conclusions are in accord with the general distribution of primary productivity discerned by this and other studies, and they are also consistent with the overall patterns of benthic productivity in lower Cook Inlet.

By relating the pigment content of sediment trap samples to the chlorophyll concentration in the water column it was possible to calculate the proportion of the standing stock of phytoplankton input to the benthic regime each day. In addition, we were able to examine the nature of the material and demonstrate that zooplankton grazing and the subsequent production and sinking of fecal pellets is the dominant mechanism for transporting phytoplankton detritus to the sea floor.

Of further note is the characterization of Kachemak Bay as a region of sustained high levels of primary productivity throughout the May-August period. This relatively uniform production of phytoplankton biomass is reflected in the remarkable constancy of the observed organic input to the bottom. Total particulate matter flux, carbon and nitrogen fluxes, and pigment input rates are all comparatively high but show little variability from month to month (especially when compared to the other two Cook Inlet areas). Carbon:chlorophyll ratios and carbon:nitrogen ratios are also relatively constant over the four-month interval. The continued high water-column productivity marks Kachemak Bay as an area of high and constant input of organic matter to the bottom during spring and summer and helps explain the large benthic populations and profitable commercial fisheries found there.

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APPENDIX:

Cross channel distributions of physical and chemical variables in lower Cook Inlet, 1978.

Figure A-1. Temperature, salinity, sigma-t, and chlorophyll-a, 24 March.

Figure A-2. Nutrients, 24 March.

Figure A-3. Temperature, salinity, sigma-t, and chlorophyll-a, 12 May.

Figure A-4. Nutrients, 12 May.

Figure A-5. Temperature, salinity, sigma-t, and chlorophyll-a, 10 June.

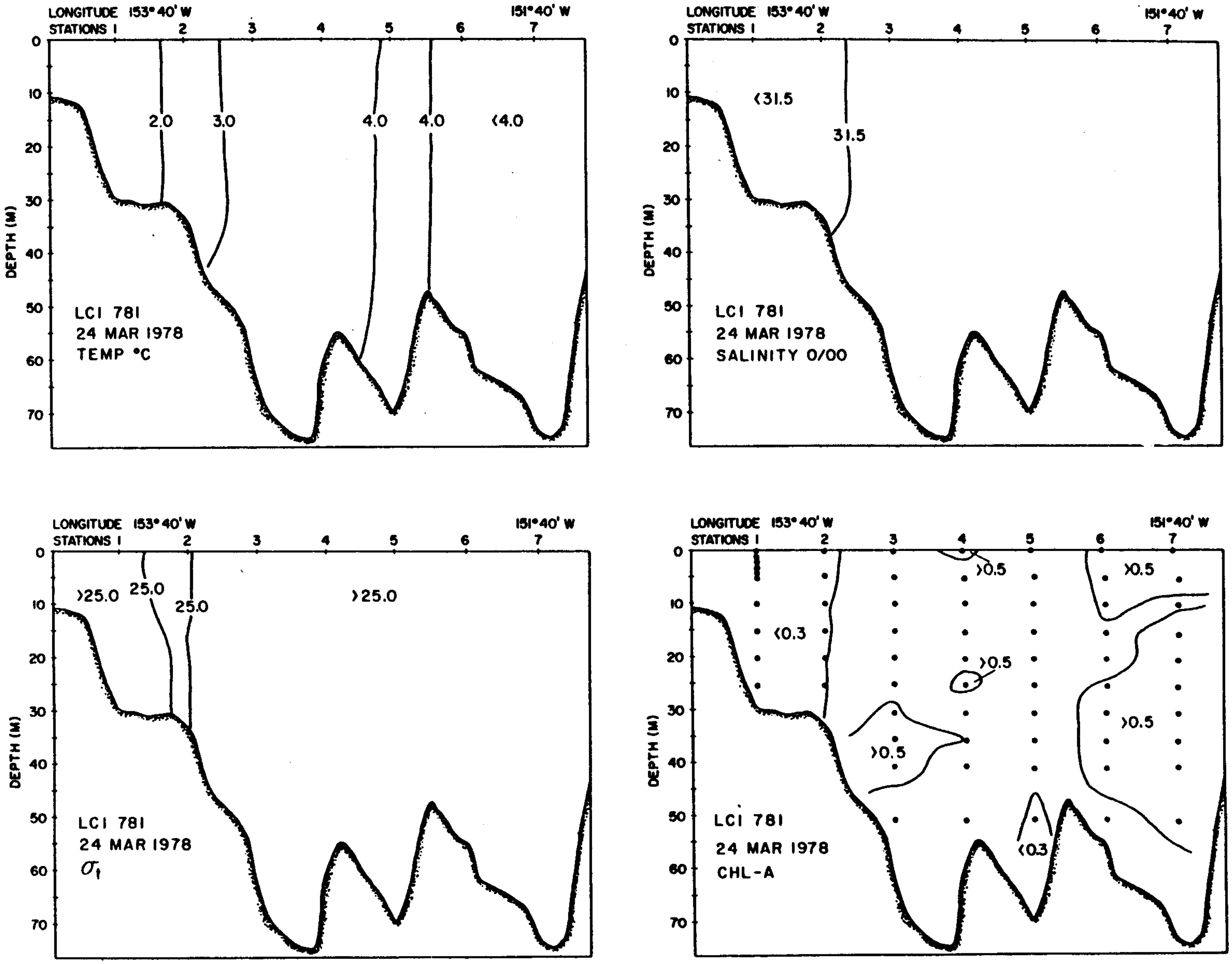
Figure A-6. Nutrients, 10 June.

Figure A-7. Temperature, salinity, sigma-t, and chlorophyll-a, 14 July.

Figure A-8. Nutrients, 14 July.

Figure A-9. Temperature, salinity, sigma-t, and chlorophyll-a, 15 August.

Figure A-10. Nutrients, 15 August.



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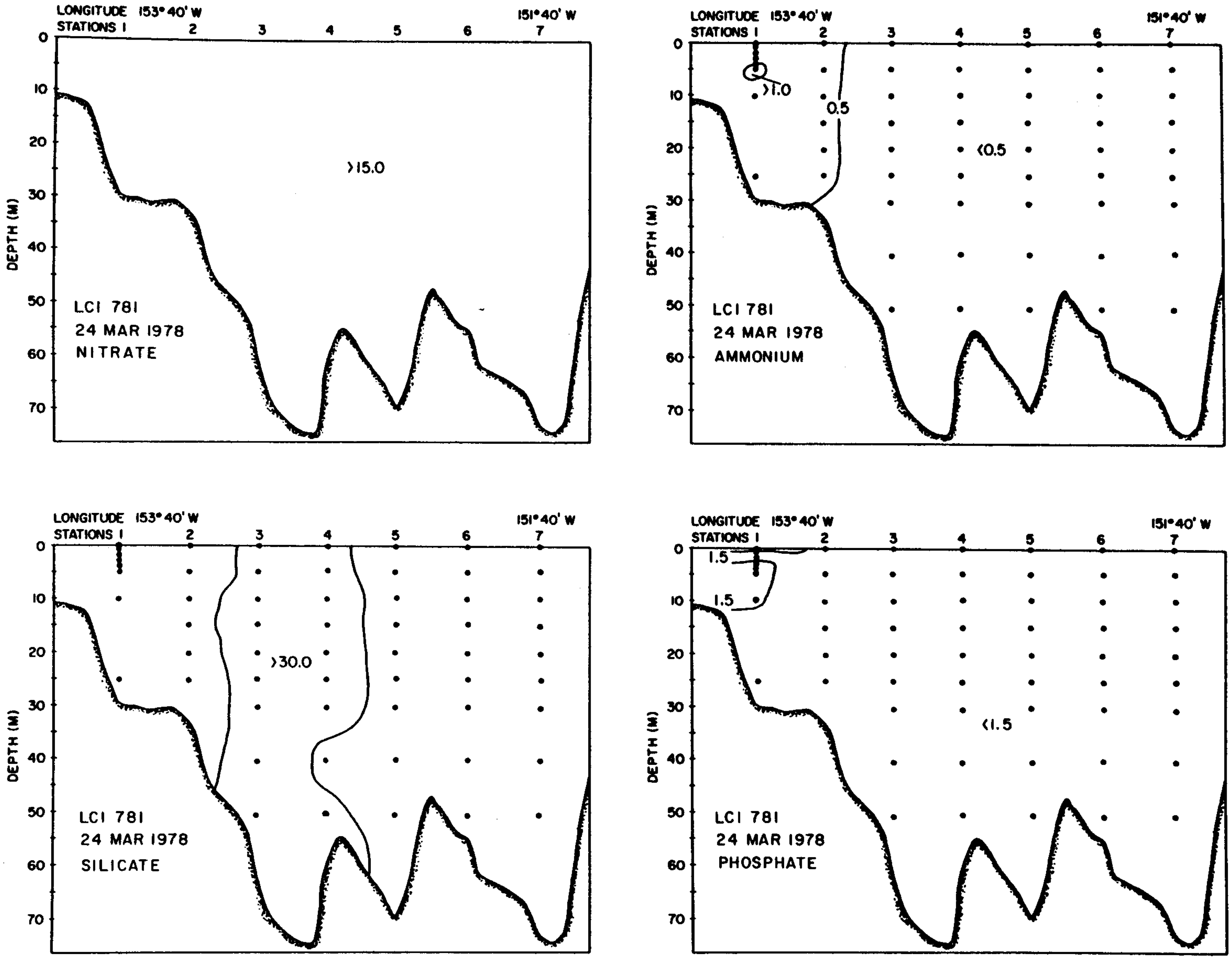

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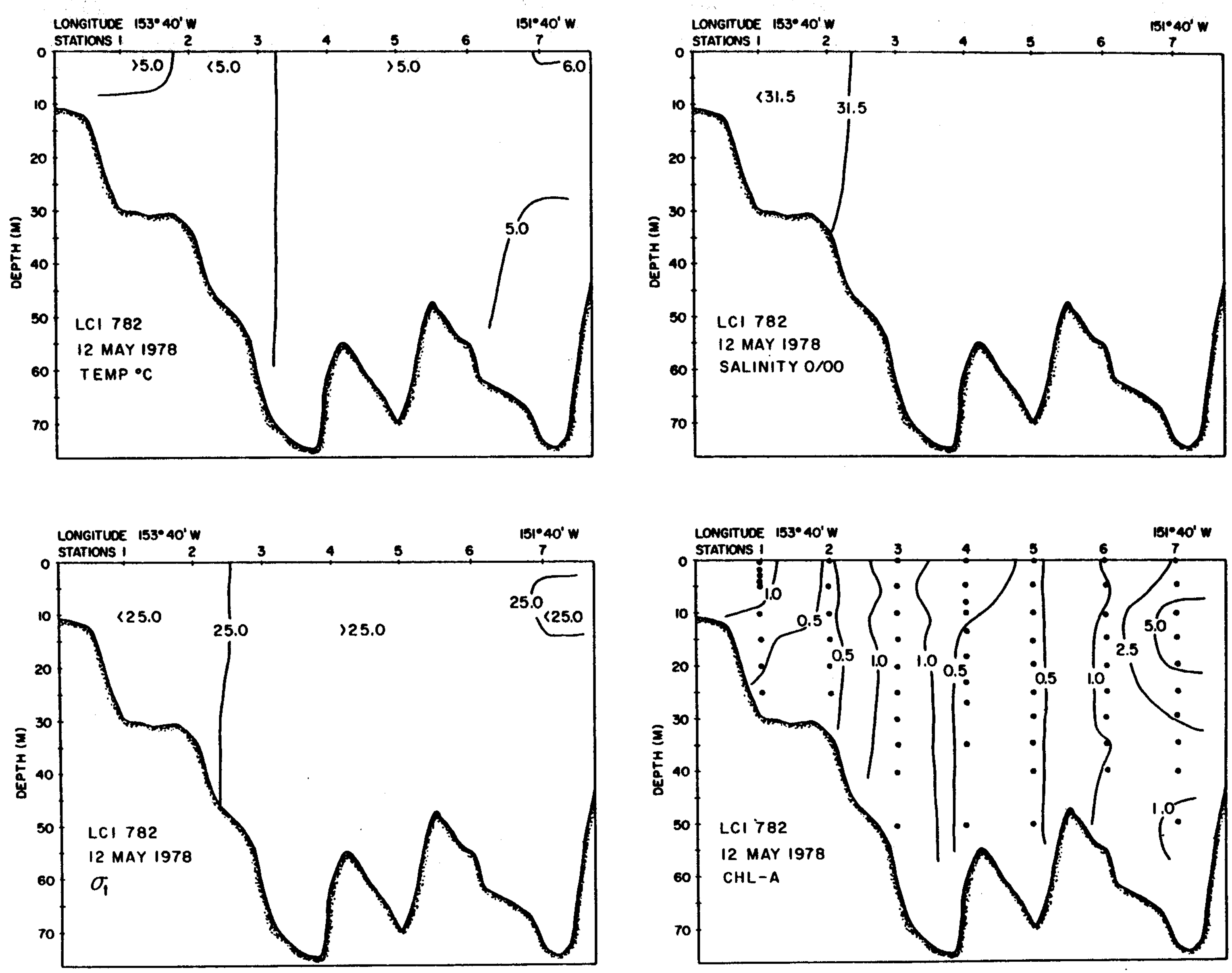

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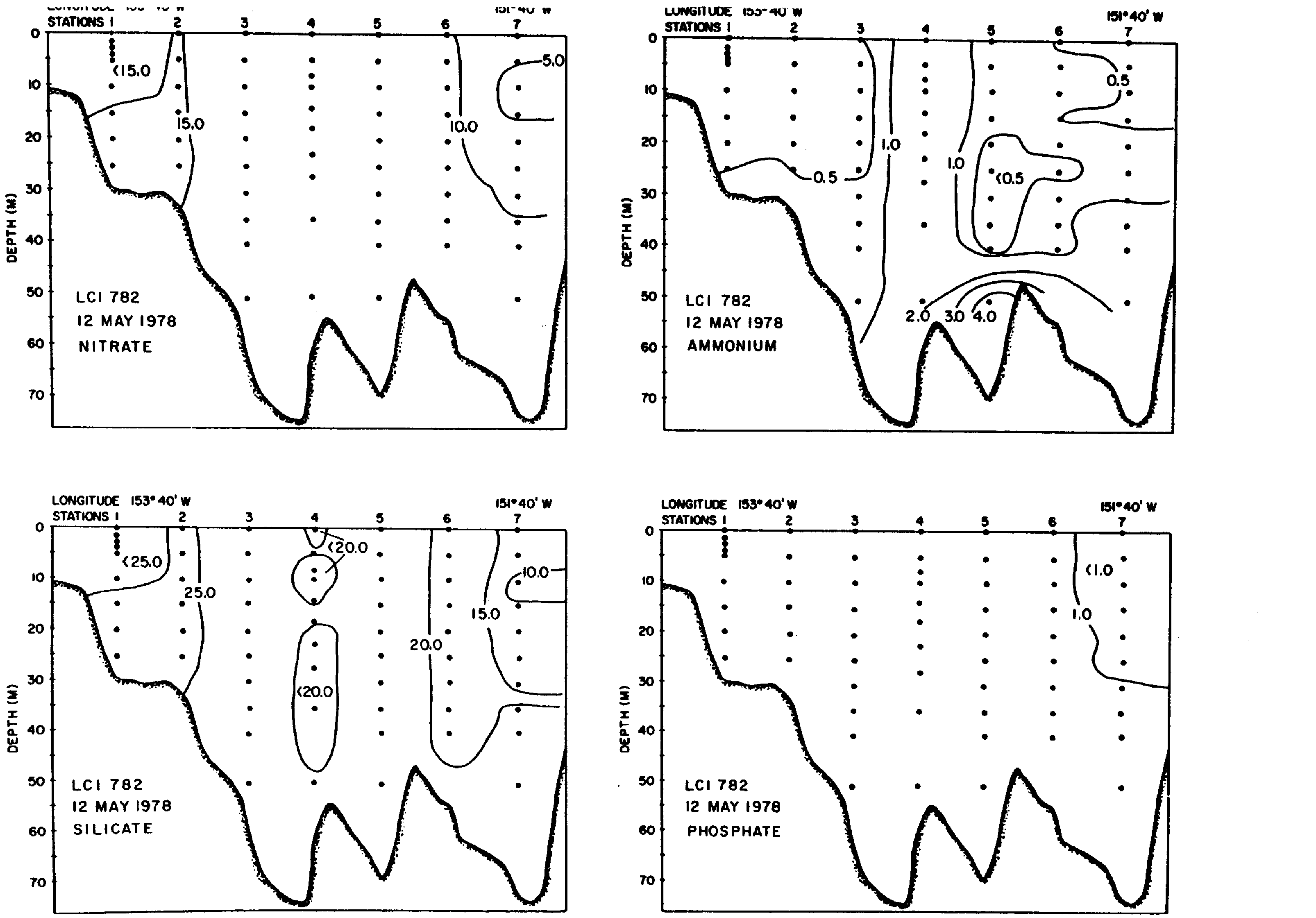

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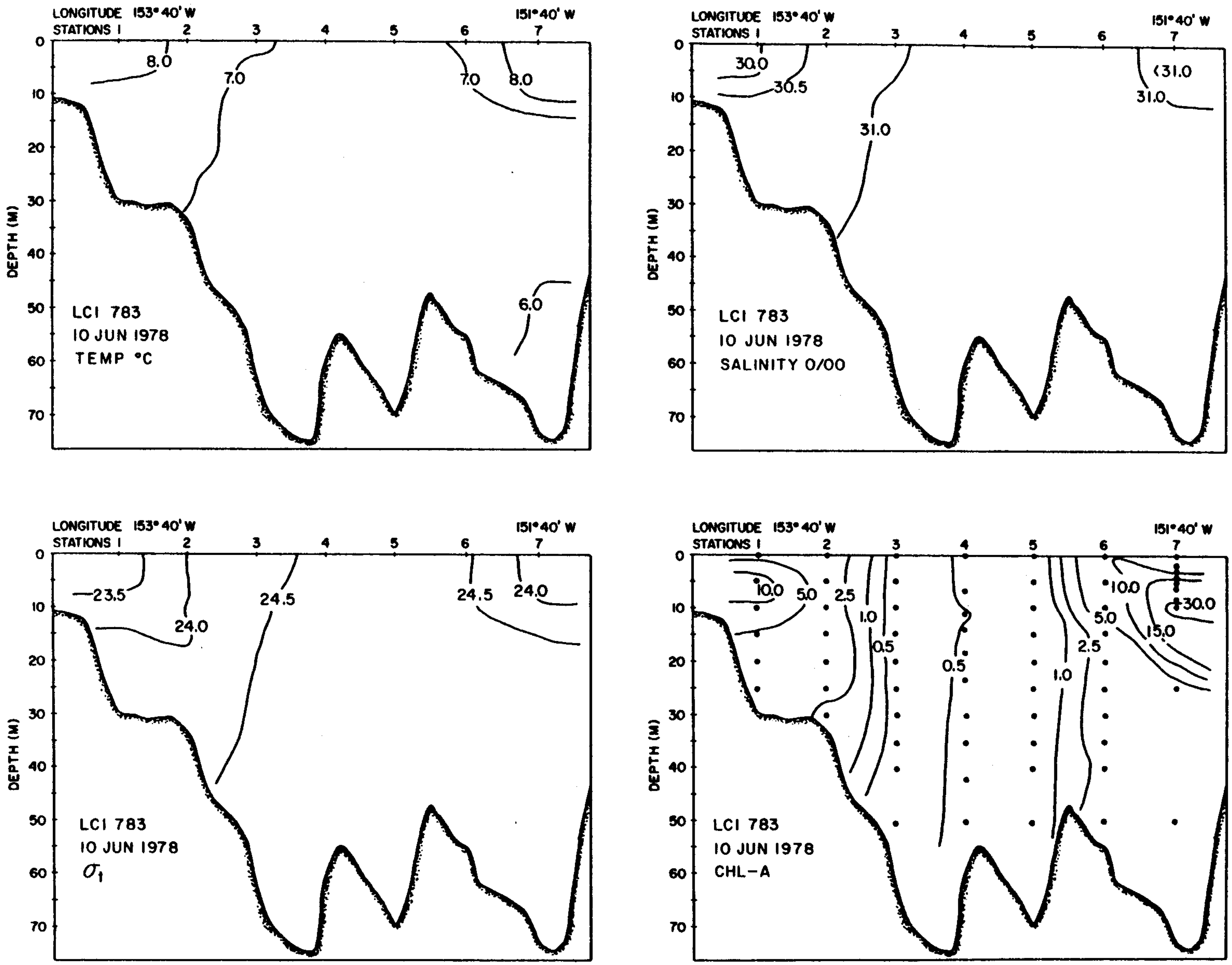

Figure A-5. Temperature, salinity, sigma-t, and chlorophyll-a, 10 June.

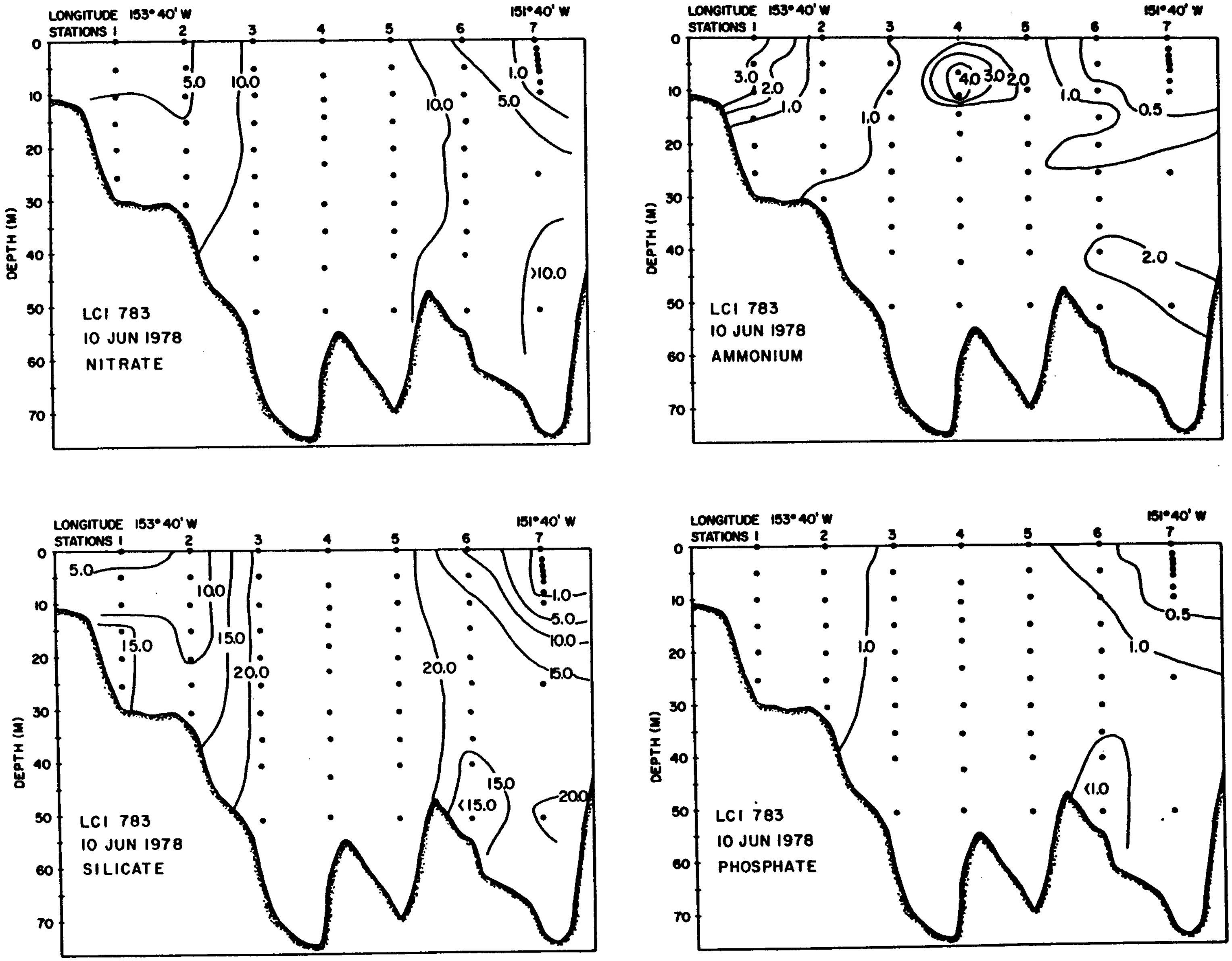

Figure A-6. Nutrients, 10 June.

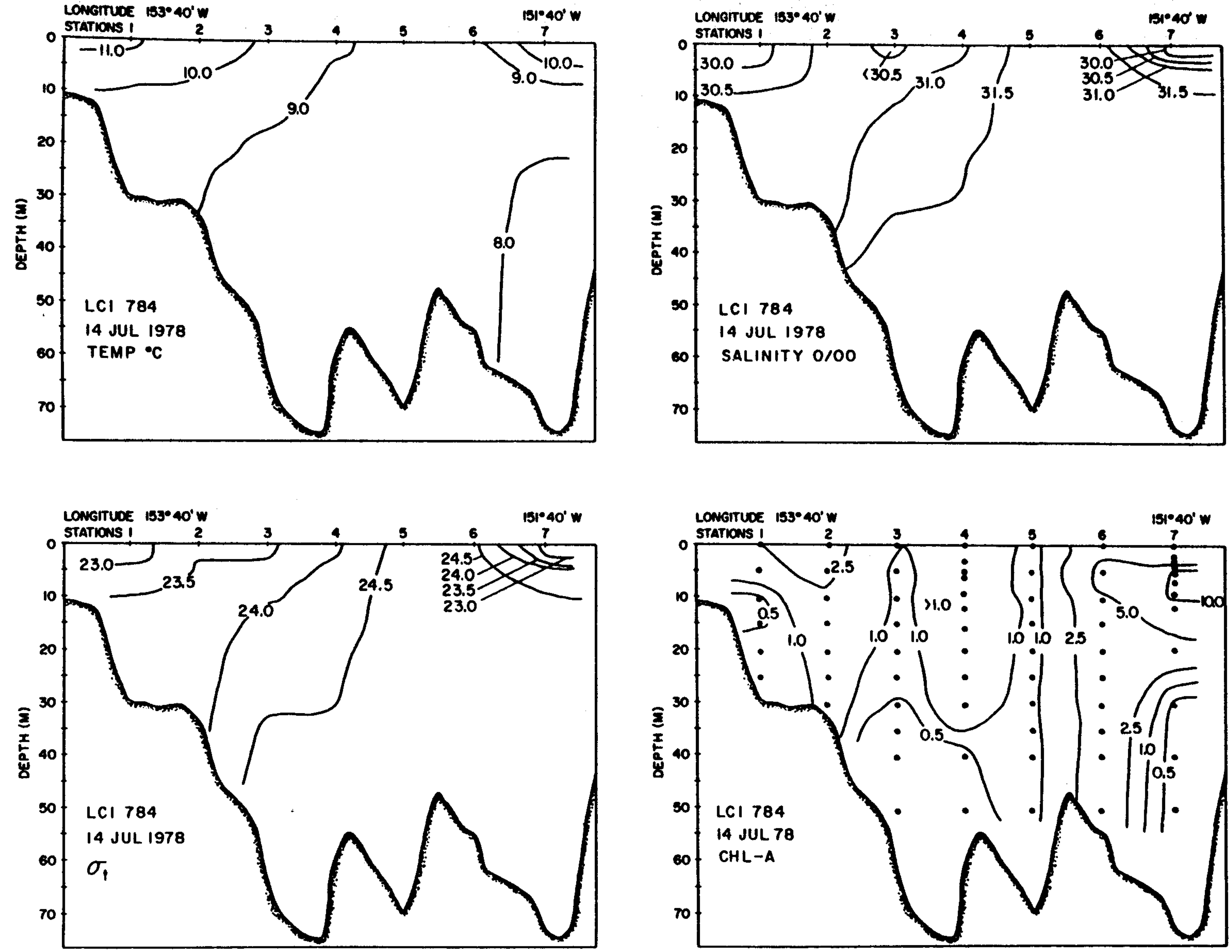

Figure A-7. Temperature, salinity, sigma-t, and chlorophyll-a, 14 July.

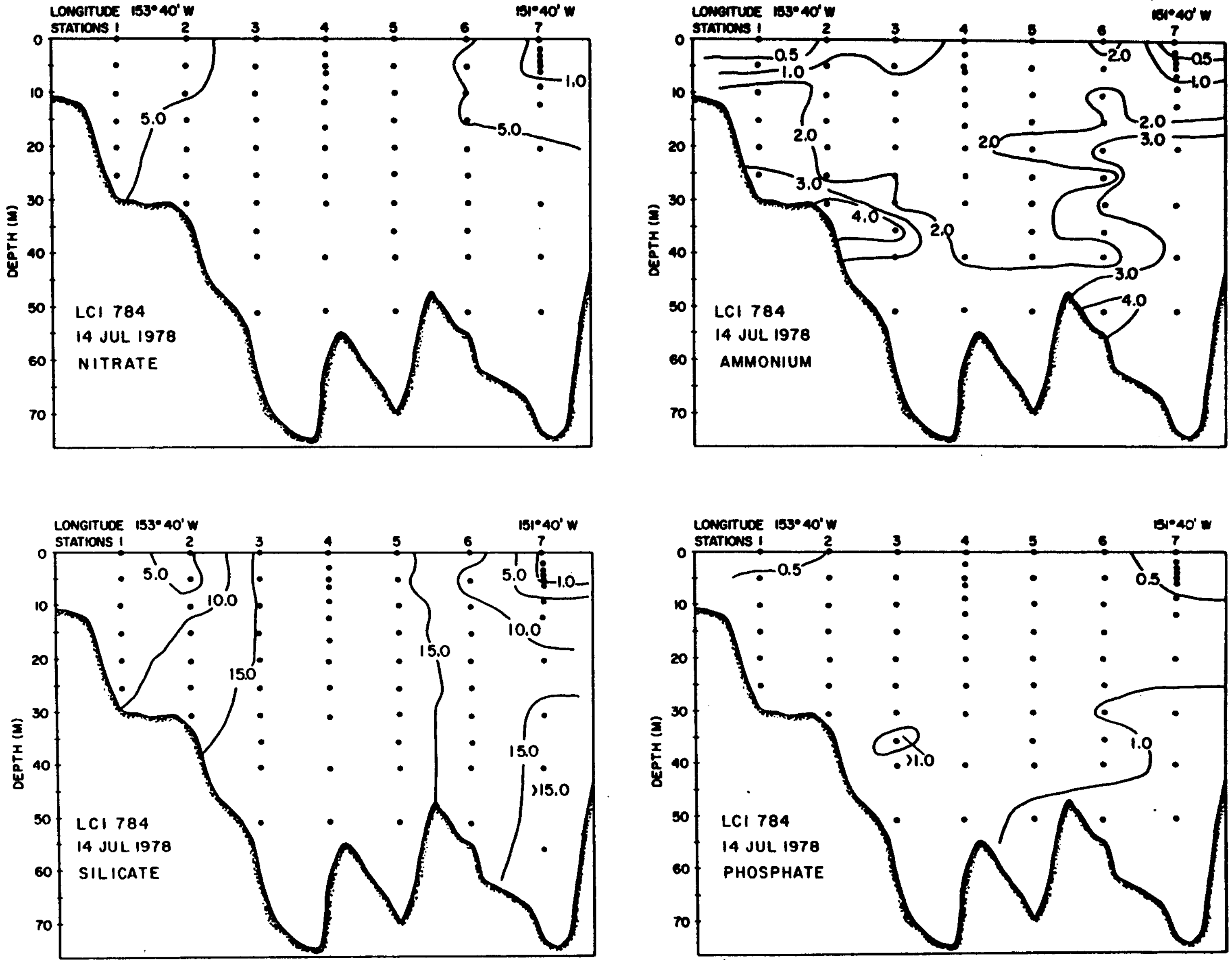

Figure A-8. Nutrients, 14 July.

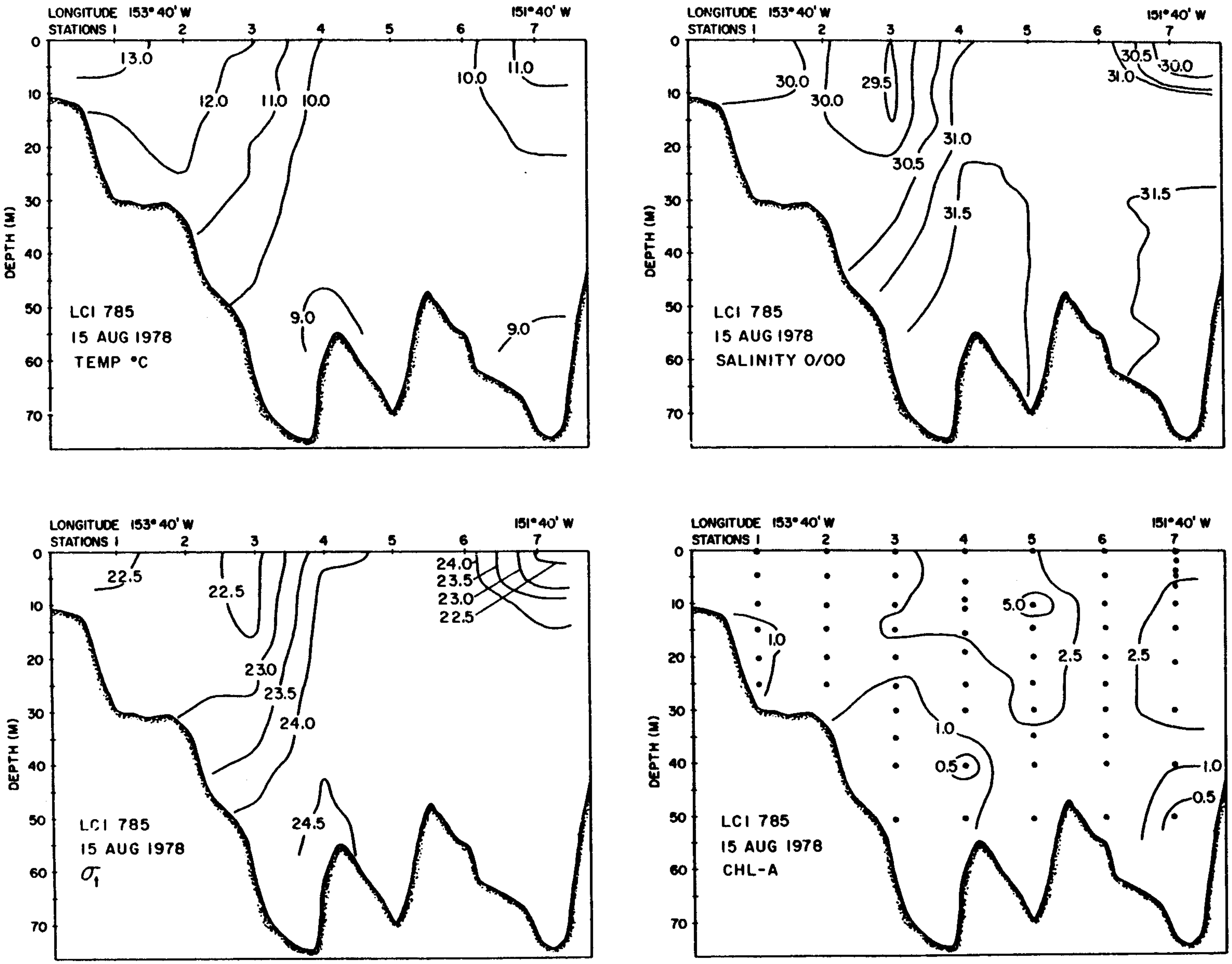

Figure A-9. Temperature, salinity, sigma-t, and chlorophyll-a, 15 August.

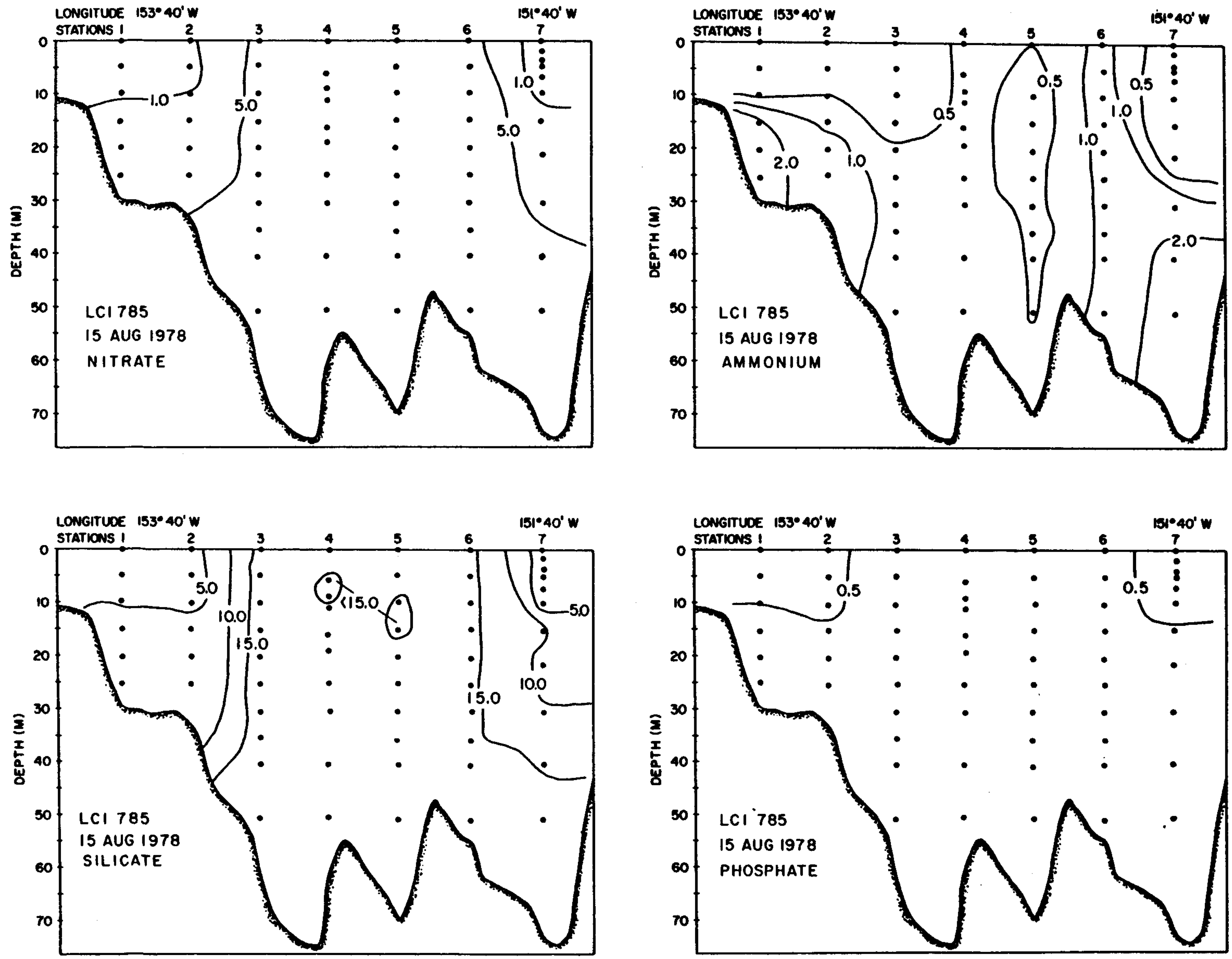

Figure A-10. Nutrients, 15 August.

LOWER COOK INLET MEROPLANKTON

by

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Department of Oceanography
University of Washington

Final Report
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I. SUMMARY

This study is a contribution to the understanding of quantitative seasonal changes of eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet. Early life history stages of important components of the food webs of Lower Cook Inlet, Kachemak Bay, and Kamishak Bay have been identified. Temporal and spatial dynamics and distributions of important ecosystem components, the ichthyoplankters and meroplanktonic stages of shrimps and crabs, have been tabulated, depicted, and described. Timing and use of specific areas within Lower Cook Inlet by early life history stages of fishes, shrimps, and crabs have been tabulated, depicted, and evaluated.

II. INTRODUCTION

A. Nature and Scope

This study was planned as a reconnaissance-level survey of early life history stages of fishes, shrimps, and crabs in Lower Cook Inlet. The study was intended to obtain knowledge of the quantitative temporal and spatial changes in composition of dominant organisms.

B. Objectives

The objective of this study was to use MARMAP methods to contribute to an understanding of quantitative seasonal changes of eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet. Specific objectives are:

1. Identify early life history stages of important components of the food webs of Lower Cook Inlet, Kachemak, and Kamishak Bays.

2. Describe temporal and spatial dynamics and distributions of these important ecosystem components, specifically ichthyoplankters and meroplanktonic stages of shrimp and crabs.

3. Evaluate timing and use of specific areas within Lower Cook Inlet and its bays by these early life history stages of fishes, shrimp, and crabs.

III. CURRENT STATE OF KNOWLEDGE

An annotated literature review has been compiled (Tables 1, 2, and 3) of references relevant to species in the Lower Cook Inlet meroplankton. Most of the references, many dealing with areas outside Cook Inlet waters (Appendix A), have been used to identify the fish eggs, fish, crab, and shrimp larvae of commercial or ecosystem importance.

Meroplankton research in Kachemak Bay, Lower Cook Inlet, and Kamishak Bay is relatively recent, coinciding with current interest in petroleum exploration. Damkaer (1977) studied the holozooplankton in this region, so did not identify commercially or ecosystem important decapod larvae or planktonic fish eggs and larvae.

Haynes and Wing (1977) studied the king crab *(Paralithodes camtschatica)*, humpy shrimp *(Pandalus goniurus)* and northern pink shrimp *(Pandalus borealis)* distribution and abundance in Inner and Outer Kachemak Bay. Their observations suggest that the major releasing sites for king crab and the two species of pandalid shrimp are in the central and southern portions of Outer Kachemak Bay. The greatest abundance of stage I larvae of king crab and humpy shrimp occurred during the May 10-13 sampling period. Larvae of northern pink shrimp were apparently released earlier, since 59% of the larvae collected during May 10-13 were already stage II.

In studies of post-larval king crab by Sundberg and Clausen (1977) in the Kachemak Bay area, the greatest number of crabs collected by skimmer trawl and suction dredge occurred along the shoreline between Anchor Point and Bluff Point, the northern border of Outer Kachemak Bay, and they were associated with water less than 27 m, rocky substrates, and abundant epifauna.

Alaska Department of Fish and Game (1975), Barr (1970), Greenwood (1959), and Ronholt (1963) have each reported on the commercially important species of shrimp and crabs in the Kachemak Bay-Lower Cook Inlet area.

A recent comprehensive summary of literature pertaining to the effects of petroleum on marine organisms and environments is Malins (1977).

IV. STUDY AREA

The study area is Lower Cook Inlet, Alaska. The sampling station locations were more widely spread in 1976-1977 than in 1978 (Figures 1, 2a and b, Tables 4 and 5).

V. SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

All samples of early life history stages of fishes, shrimps, and crabs were taken from project vessels in and near Lower Cook Inlet, Alaska. All seasons were sampled at 10 station locations from 6 April 1976 to 26 February 1977. Spring, summer, and autumn were sampled at 32 station locations from 19 May to 27 September 1978.

In 1976-1977, 10 routine sampling locations were established in the Lower Cook Inlet region (Figure 1). Seven cruises were made from April 1976 through February 1977; bad weather prevented sampling four stations (Table 6).

Plankton samples were obtained by using open bongo nets in double-oblique hauls using MARMAP[1] methods. The diameter of the nets was 60 cm and the mesh sizes were 333 and 505 μm. The volume of water filtered was estimated as the product of the area of the net opening and the distance measured by a calibrated flow meter in the mouth of each net. The assumption was implicit that the efficiency of filtration was 100%. If one flow meter failed, the other meter reading was used; in two instances, when both meters failed, an estimate was made using the duration relative to other hauls.

The samples were sorted to remove fish eggs, fish larvae and juveniles, shrimps, and crabs. In most cases the entire sample was examined; subsamples were taken when organisms in a group were very abundant.

The organisms were identified to the lowest practicable taxonomic category and life history stage. The concentrations of the organisms were recorded and reported in data submissions destined for the National Oceanographic Data Center, as abundance per cubic meter, with a minimum concentration of 0.001.

The concentrations of organisms taken with paired 333 and 505 μm meshes did not appear to differ as might occur with extrusion of small organisms or with escapement of large organisms (Figure 3). Therefore, the catches of the paired nets for each haul were combined as the geometric means of the two concentrations. Those mean concentrations per cubic meter were transformed, based on the depth of each sample, to abundance per 10 square meters for graphical and tabular presentations (Appendix B). The mean concentrations were also transformed to abundance per 1000 cubic meters (Appendix C).

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[1] Smith, Paul E., and Sally L. Richardson. 1977. Manual of methods for resource survey and appraisal. Southwest Fisheries Center. Administrative Report No. LJ-77-11. 233 pp.

A rule for rounding was used such that any observation greater than 0 was rounded up to 1.

The geometric mean abundance per 10 square meters was plotted at station locations for each season for abundant groups of fishes, shrimps, and crabs (Appendix D). The appropriate life history stages were summed within each station and the geometric mean computed over cruises for the spring and summer seasons in which more than one cruise was made.

The annual abundance per 10 square meters was plotted at station locations for abundant groups of fishes, shrimps, and crabs (Appendix E). The annual abundance was computed as the sum of organisms in specified categories within each station over seven cruises.

In 1978, 32 station locations were sampled between 19 May and 27 September in Lower Cook Inlet. Three station locations were in Inner Kachemak Bay, 9 in Outer Kachemak Bay, 11 in Lower Central Cook Inlet, and 9 in Kamishak Bay (Figure 2b). Seven cruises were made; bad weather prevented sampling some station locations on all cruises (Table 7).

In 1978, two vessels were used. The *Humdinger* is a 37-foot troller, chartered by OCSEAP and used in open water stations; the *Whaler* is a 21.5-foot boat. Zooplankton and ichthyoplankton were sampled during most cruises on board the *Humdinger* with a bongo net in a double-oblique tow. The bongo net consisted of a double-mouthed frame, each mouth with an inside diameter of 60 cm and a mouth area of 0.2827 m^2, made of fiberglass and weighing about 95 lb. A 50-lb cannonball weight was attached to the bottom of the frame. A 505 μm mesh net with an open area ratio (OAR) of 8:1 and a 333 μm mesh net, 8:1 OAR, were attached to the frame. PVC collecting cups and collars were attached to the cod ends of each net.

Beginning on 13 August, additional samples were taken at each station with a neuston net. The neuston net consisted of a stainless steel box frame with a mouth opening 50 cm wide by 30 cm (area 0.15 m^2), weighing about 25 lb. A 505 μm mesh net with 8:1 OAR was attached to the frame.

A Hydro-Products winch was used to deploy the nets on the *Humdinger*. The winch did not have a power-out cabability, so the MARMAP-required deployment for bongo nets of 50 m/min was estimated. There was a 30-second sinking time and a retrieval rate of approximately 40 m/min, the slowest speed the winch would operate without stalling. Ship speed was adjusted to seek a 45° wire angle during sinking and retrieval. Towing speed was approximately 2 knots. Sampling depth was generally within 10 m above the bottom to the surface. The fishing depth of the net was determined by the product of the cosine of the wire angle at depth and the amount of wire out. Volumes of water filtered were estimated using ship's speed until the 11 August cruise, when a flow meter was attached in each mouth opening of the bongo frame.

A 20 cm diameter bongo net with mouth area 0.0314 m^2 was towed from a davit mounted on the port side of the *Whaler*. The net frame was similar in construction to the 60 cm bongo, but smaller scale and made of PVC plastic pipe. On one cruise, four inshore stations were sampled using nets with meshes of 165 μm and 333 μm. New nets of 505 μm mesh were used thereafter. A small Hydro-Products winch was mounted forward. A 10-lb lead weight was attached to the end of the line below the net. The drum is free-wheeling on the winch so wire was played out at approximately 50 m/min by controlling speed with the hand brake. The net was towed at the slowest speed the engines on the *Whaler* could be idled, about 2 knots. Retrieval rate was approximately 30 m/min, the slowest speed the winch would run. Other procedures were similar to those of the 60 cm bongo net.

Nets were washed down on board the *Humdinger* with a hose attached to a low-pressure salt water pump, while those aboard the *Whaler* were washed by pouring seawater over them. Samples were preserved on board the vessels with sodium borate buffered 4% formalin. Within 24 hours, samples were represerved with a fresh solution of 4% formalin, propylene phenoxytol, and propylene glycol.

The catches of fishes, shrimps, and crabs by bongo nets at each station location on each cruise have been expressed as abundance per 10 m^2 for graphical and tabular presentations (Appendix F); the abundance per 1000 m^3 was also computed (Appendix G). The catches by neuston nets have been expressed as abundance per 1000 m^3 (Appendix H).

The geometric mean abundance per 10 m^2 was computed and plotted for the four locations, Inner Kachemak Bay, Outer Kachemak Bay, Lower Central Cook Inlet, and Kamishak Bay, at three seasons, spring, summer, and autumn (Appendix I). The appropriate life history stages were summed within each location within each season, including the several cruises made within a season. Since many samples were averaged to produce the means, abundance could be less than 0.5 per 10 m^2. Abundance less than 0.5 per 10 m^2 was considered to be 0.4 per 10 m^2 and was plotted as the symbol, T, for trace.

Analysis of variance techniques employed the terminology of Snedecor and Cochran[1] and the computational programs of Nie et al.[2] The abundance data were transformed before the analyses by adding 1 to each observation and taking the common logarithm. The probability level $P = 0.05$ was used to assess statistical significance.

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[1]Snedecor, George W., and William G. Cochran. 1967. Statistical Methods. Sixth Edition. The Iowa State University Press. 593 pp.

[2]Nie, Norman H., C. Hadlai Hull, Jean G. Jenkins, Karin Steinbrenner, and Dale H. Bent. 1975. SPSS: Statistical Package for the Social Sciences. Second Edition. McGraw-Hill Book Company. 675 pp.

VI. RESULTS

The results of the 1976-1977 reconnaissance-level survey include taxonomic lists and density distribution maps of planktonic eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet. The taxonomic categories of fishes, pandalid shrimp, and commercially important species of crab larvae collected in the Lower Cook Inlet region have been tabulated (Tables 8, 9, and 10). In some cases the early life history stages could not be identified to species reliably and have been reported in more inclusive categories. The more abundant and important categories were selected for further analysis (Appendices B and C).

The planktonic fish eggs are considered in four nominal size categories based on the diameter of the chorion: less than 1 mm, about 1 mm, about 2 mm, and about 3 mm (Table 11). The fish eggs in the category less than 1 mm are between 0.73 and 0.88 in diameter. The fish eggs in this category are probably *Limanda aspera*, the yellowfin sole. They were caught from May through August and were most abundant in the July samples near Kachemak Bay and Kamishak Bay.

The fish eggs in the category about 1 mm are between 0.89 and 1.28 mm in diameter. The fish eggs in this category are probably a complex of four fishes: *Isopsetta isolepis*, the butter sole; *Parophrys vetulus*, the English sole; *Platichthys stellatus*, the starry flounder; and *Psettichthys melanostictus*, the sand sole. They were caught from April through August and were most abundant in the May samples near Kachemak Bay and Kamishak Bay.

The fish eggs in the category about 2 mm are between 1.30 and 2.54 mm in diameter. The fish eggs in this category are probably *Theragra chalcogramma*, the walleye pollock, and three flatfishes, *Atheresthes stomias*, the arrowtooth flounder, *Glyptocephalus zachirus*, the rex sole, and *Lyopsetta exilis*, the slender sole. They were caught from April through August and were most abundant in the May samples at scattered locations in the Lower Cook Inlet region.

The fish eggs in the category about 3 mm are 2.56 mm and larger in diameter. The fish eggs in this category are *Hippoglossoides* of an undetermined species, probably *H. elassodon*, the flathead sole. They were caught from May through August and were most abundant in the May samples at locations near the mouth of Cook Inlet.

The larvae of *Ammodytes hexapterus*, the Pacific sand lance, were caught from April through May and again in February. These larvae were most abundant in May in Kachemak Bay. No juvenile *Ammodytes* were observed.

The larvae of *Clupea harengus pallasi*, the Pacific herring, were caught in July and August. These larvae were most abundant in July at the most northern station location. One juvenile herring was taken in October at the same location.

The larvae of the Gadidae, the codfishes, are probably *Theragra chalcogramma*, the walleye pollock, and *Gadus macrocephalus*, the Pacific cod. The gadid larvae were caught from April through July and were most abundant in May toward the mouth of Cook Inlet. One gadid juvenile was taken in August near Kachemak Bay.

The larvae identified as *Hippoglossoides* sp. are probably one species, *H. elassodon*, the flathead sole. The larvae of *Hippoglossoides* were caught from May through August and were most abundant in May and July in Kamishak Bay and toward the mouth of Cook Inlet. One juvenile *Hippoglossoides* was taken in August near Kamishak Bay.

The larvae of *Mallotus villosus*, the capelin, were caught on every cruise except late May. The capelin larvae were most abundant in July and August near Kachemak Bay and Kamishak Bay, but were taken at all sampling locations. One juvenile capelin was taken in August and another in February.

The larvae of the family Osmeridae, the smelts, probably include *Thaleichthys pacificus*, the eulachon, *Spirinchus thaleichthys*, the longfin smelt, some small *Mallotus*, and other smelt. The larvae of Osmeridae were caught on five cruises, but not in April and late May. The osmerid larvae were most abundant in July and August and were widely scattered over the Lower Cook Inlet region. One juvenile osmerid was taken in February.

The early life history stages of *Pandalopsis dispar*, the side-stripe shrimp, were taken on all cruises except October. Stages I, II, III, and IV were represented in the samples; stage V and juveniles were not represented.

The early life history stages of *Pandalus borealis*, the northern pink shrimp, were taken from April through August. Stages I, II, III, IV, V, and juveniles were represented; stages VI and VII were not represented.

The early life history stages of the shrimp *Pandalus danae* were taken in July and August. Stages II and V were represented; stages I, III, IV, VI, and juveniles were not represented.

The early life history stages of *Pandalus goniurus*, the humpy shrimp, were taken from April through July. Stages I, II, III, IV, and juveniles were represented; stages V, VI, and VII were not represented.

The early life history stages of *Pandalus hypsinotus*, the coon-stripe shrimp, were taken in May. Stage I was represented; stages II, III, IV, V, VI, and juveniles were not represented.

The early life history stages of the shrimp *Pandalus platyceros* were taken in February. Stage II was represented; stages I, III, IV, and juveniles were not represented.

The early life history stages of the shrimp *Pandalus stenolepis* were taken from May through August. Stages I, II, III, IV, V, and VI were represented; the juveniles were not represented.

The early life history stages of the shrimp *Pandalus montagui tridens* were taken from April through July. Stages I, II, and III were represented; stage IV and juveniles were not represented.

The early life history stages of non-commercial crabs of the category Anomura were taken on all cruises. The zoea and megalopa stages were represented.

The early life history stages of non-commercial crabs of the category Brachyura, the true crabs, were taken from May through February. The zoea and megalopa stages were represented.

The early life history stages of *Cancer magister*, the Dungeness crab, were taken from July through October. Stages I, II, III, V, and megalopa were represented; stage IV was not represented.

The early life history stages of *Cancer* spp. were taken on all cruises. Stages I, II, III, IV, V, and megalopa were represanted.

The early life history stages of *Chionoecetes bairdi*, the tanner crab, were taken from April through October. Stages I and II and the megalopa were represented.

The early life history stages of *Paralithodes camtschatica*, the red king crab, were taken from April through July, and again in February. Stages I, II, III, and the megalopa were represented.

The most abundant shrimp was *Pandalus goniurus*, with *Pandalus borealis* and *Pandalus montagui tridens* next most abundant. The non-commercial Anomura and Brachyura were very abundant, and the small *Cancer* spp. were the most abundant crabs identified. *Paralithodes camtschatica* was the most abundant commercial crab, with *Chionoecetes bairdi* next in abundance.

The seasonal density distributions of early life history stages of selected categories are presented, as abundance per 10 m^2, on maps of the Lower Cook Inlet region (Appendix D).

The four categories of fish eggs are all present in spring and summer, but absent in fall and winter. The larvae of *Ammodytes* were present in winter and spring, but absent in summer and fall. The larvae of *Clupea harengus pallasi* were present only in summer. The larvae of the Gadidae were present in spring and summer, but absent in fall and winter. The larvae of *Hippoglossoides* sp. were present in spring and summer, but absent in fall and winter. The larvae of *Mallotus villosus* were present in all seasons, but appeared most abundant in summer. The larvae of Osmeridae were present in all seasons, but appeared most abundant in summer.

The zoea of *Pandalopsis dispar* were present in winter, spring, and summer, but absent in fall. The zoea of *Pandalus borealis* and *Pandalus montagui tridens* were present in spring and summer, but absent in fall and winter. The zoea of *Pandalus danae* were present only in summer. The zoea of *Pandalus goniurus* and *Pandalus hypsinotus* were present only in spring. The zoea of *Pandalus platyceros* were present only in winter. The zoea of *Pandalus stenolepis* were present in spring and summer.

The zoea of Anomura were present in all seasons, but appeared least abundant in the fall and winter. The zoea of the Brachyura were present in all seasons, but appeared least abundant in fall. The zoea of *Cancer magister* were present in summer and fall, but absent in winter and spring. The zoea of *Cancer* spp. were present in all seasons, but appeared most abundant in summer. The zoea of *Chionoecetes bairdi* were present in spring and summer, but absent in fall and winter. The zoea of *Paralithodes camtschatica* were present in winter and spring, but absent in summer and fall.

The annual density distributions of early life history stages of selected categories are presented, as abundance per 10 m^2, on maps of the Lower Cook Inlet region (Appendix E).

The fish eggs about 1 mm in diameter appeared the most abundant size category. Most eggs appeared in Kachemak Bay and Kamishak Bay. The larvae of *Mallotus villosus* appeared more abundant than the larvae of other fishes. The larvae were generally widely distributed.

Stages I and II of *Pandalopsis dispar, Pandalus borealis,* and *Pandalus hypsinotus* appeared most abundant in Kachemak Bay. The early life history stages of *Pandalus danae* were few and scattered. The early stages of *Pandalus goniurus* were abundant in Kachemak Bay and Kamishak Bay. The distributions of *Pandalus montagui tridens* and *Pandalus stenolepis* were predominately toward the mouth of Cook Inlet, below Kachemak Bay and Kamishak Bay. The early life history stages of *Pandalus platyceros* were relatively scarce.

The zoea and megalopa of the Anomura and Brachyura appeared most abundant in central Lower Cook Inlet and less abundant to the north. The early stages of *Cancer magister* were in Kachemak Bay, but the later stages were taken toward the southwest. The early life history stages of *Cancer* spp. were abundant in central Lower Cook Inlet, but appeared less abundant toward the north and outside the inlet, as well as in Kamishak Bay.

Stage I of *Chionoecetes bairdi* appeared most abundant in Kachemak Bay, but stage II was taken only toward the south. The megalopa were widely distributed, but occurred most frequently in central Lower Cook Inlet.

Stages I and II of *Paralithodes camtschatica* appeared most abundant in Kachemak Bay and Kamishak Bay. Stage III appeared most abundant in Kamishak Bay. The megalopa occurred at one station toward the north.

The results of the 1978 sampling program cover the region from Kamishak Bay across central Lower Cook Inlet into Kachemak Bay. That region included most of the early life history stages of most species in 1976-1977. The more abundant and important taxonomic categories were selected for further analysis (Appendices F, G, and H). The quantitative density distributions of early life history stages of the selected categories for three seasons in 1978 are presented, as abundance per 10 m^2, on maps of the region (Appendix I).

The temporal changes over three seasons in species composition and density at each of the four sampling sites are compared for fish eggs, fish larvae, shrimps, and crabs (Appendix J). The temporal changes over three seasons of relative abundance of life history stages of shrimps and crabs at each of the four sampling sites are also compared (Appendix K).

Analysis of variance techniques were used to examine the statistical significance of differences between the four sampling sites and the three seasons (Table 12). The analysis was attempted for each taxonomic category of fish eggs, fish larvae, shrimps, and crabs, but almost one-half of the categories considered had too few observations greater than zero to allow the analysis. In general, the more abundant categories were those for which the null hypotheses, that seasons or sites did not differ, could be rejected. However, patterns of apparent differences between sites and seasons are evident for several categories with few positive observations if one considers any positive catch to be different from zero.

Bongo net catches made at the same location during daylight and darkness within a 24-hour span have been compared for fish eggs, fish larvae, shrimps, and crabs (Figure 4). No striking day-night differences are evident.

Bongo and neuston net catches made at the same location and time have been compared for fish eggs, fish larvae, shrimps, and crabs (Figure 5). The deeper-sampling bongo net took many more crabs and fish larvae than did the surface-sampling neuston net. The neuston net seems to have taken more fish eggs per unit volume sampled than the bongo net.

VII. DISCUSSION

A. Important Species, Important Habitats, and Critical Periods

The important species in the ichthyoplankton and meroplankton of Lower Cook Inlet are primarily those harvested by commercial and sports fishermen (Table 13). Secondarily, some species are of ecosystem importance because they serve as food for the harvested species.

The harvested fishes common in this study are primarily flatfishes, codfishes, herring, and smelts. The harvested crabs are the Dungeness, king, and snow crabs. The harvested shrimps are coonstripe, dock, northern pink, side-stripe, and spot. Forage fishes include herring, sand lance, and smelts.

The habitat sampled for ichthyoplankton and meroplankton in this study was the pelagic domain of open ocean above the sea floor.

The critical periods for habitat use by ichthyoplankton and meroplankton in Lower Cook Inlet differ between areas, species, and life history stages within species (Table 14). There was no season sampled in which important species were not represented by early life history stages in the plankton.

B. Potential for Impact from OCS Oil and Gas Exploration, Development, and Production

B.I. Drilling Platforms

B.I.A. Acute Oil Spills

B.I.A.1. Kachemak Bay

B.I.A.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.A.1.b. Use by Key Species Including Life History Stages

The pelagic domain of Kachemak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi,* Gadidae, *Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimp include *Pandalopsis dispar, Pandalus borealis, Pandalus danae, Pandalus goniurus, Pandalus hypsinotus, Pandalus stenolepis,* and *Pandalus montagui tridens.* The crabs having early life history stages in Kachemak Bay include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi.*

B.I.A.1.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kachemak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in Kachemak Bay in spring, summer, fall, and winter.

B.I.A.1.d. Potential for Long Residence Times of Contaminant

Kachemak Bay has the greatest potential for long residence times of a contaminant relative to Kamishak Bay, Lower Central Zone, Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.A.1.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.A.2. Lower Central Zone

B.I.A.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.A.2.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diamter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus platyceros*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.A.2.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.A.2.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.A.2.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.A.3. Kamishak Bay

B.I.A.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.A.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kamishak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diamter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi, Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimp include *Pandalus borealis, Pandalus danae, Pandalus goniurus,* and *Pandalus stenolepis.* The crabs having early life history stages in Kamishak Bay include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi.*

B.I.A.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kamishak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.A.3.d. Potential for Long Residence Times of Contaminant

Kamishak Bay has a potential for long residence times of contaminant second only to Kachemak Bay and greater than the Lower Central Zone, the Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.A.3.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.A.4. Kennedy Entrance

B.I.A.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.A.4.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diamter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.A.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.A.4.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.I.A.4.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.A.5. Kalgin Island Area

B.I.A.5.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.A.5.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.A.5.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.A.5.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.A.5.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.B. Drill Cuttings and Drilling Muds

B.I.B.1. Lower Central Zone

B.I.B.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.B.1.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diamter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus platyceros*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.B.1.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.B.1.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.B.1.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.B.2. Kamishak Bay

B.I.B.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.B.2.b. Use by Key Species Including Life History Stages

The pelagic domain of Kamishak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi, Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimp include *Pandalus borealis, Pandalus danae, Pandalus goniurus,* and *Pandalus stenolepis*. The crabs having early life history stages in Kamishak Bay include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi*.

B.I.B.2.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kamishak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.B.2.d. Potential for Long Residence Times of Contaminant

Kamishak Bay has a potential for long residence times of contaminant second only to Kachemak Bay and greater than the Lower Central Zone, the Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.B.2.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.B.3. Kennedy Entrance

B.I.B.3.a. Habitat Location and Type

The habitat in which inchthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.B.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon, Mallotus villosus,* and Osmeridae.

Early life history stages of pandalid shrimps include *Pandalopsis dispar, Pandalus borealis, Pandalus goniurus, Pandalus stenolepis,* and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Branchyura, *Paralithodes camtschatica, Cancer* spp., and *Chionoecetes bairdi.*

B.I.B.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.B.3.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.I.B.3.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.B.4. Kalgin Island Area

B.I.B.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.B.4.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi,* Gadidae, *Hippoglossoides elassodon, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar, Pandalus borealis, Pandalus danae,* and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica, Cancer* spp., and *Chionoecetes bairdi.*

B.I.B.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.B.4.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.B.4.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.C. Entrainment by Cooling Systems

B.I.C.1. Lower Central Zone

B.I.C.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.C.1.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi,* Gadidae, *Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar, Pandalus borealis, Pandalus danae, Pandalus goniurus, Pandalus hypsinotus, Pandalus platyceros, Pandalus stenolepis,* and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi*.

B.I.C.1.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.C.1.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.C.1.e. Relative Sensitivities of Key Species

The relative sensitivities of key species to entrainment by cooling systems is not known to us.

B.I.C.2. Kamishak Bay

B.I.C.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.C.2.b. Use by Key Species Including Life History Stages

The pelagic domain of Kamishak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimp include *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, and *Pandalus stenolepis*. The crabs having early life history stages in Kamishak Bay include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.C.2.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kamishak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.C.2.d. Potential for Long Residence Times of Contaminant

Kamishak Bay has a potential for long residence times of contaminant second only to Kachemak Bay and greater than the Lower Central Zone, the Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.C.2.e. Relative Sensitivities of Key Species

The relative sensitivities of key species to entrainment by cooling systems is not known to us.

B.I.C.3. Kennedy Entrance

B.I.C.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.C.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.C.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.C.3.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.I.C.3.e. Relative Sensitivities of Key Species

The relative sensitivities of key species to entrainment by cooling systems is not known to us.

B.I.C.4. Kalgin Island Area

B.I.C.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.C.4.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes* *hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.C.4.c. <u>Seasonality-Critical Periods of Use</u>

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.C.4.d. <u>Potential for Long Residence Times of Contaminant</u>

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.C.4.e. <u>Relative Sensitivities of Key Species</u>

The relative sensitivities of key species to entrainment by cooling systems is not known to us.

B.I.D. <u>Chronic Contamination from Formation Waters</u>

B.I.D.1. <u>Lower Central Zone</u>

B.I.D.1.a. <u>Habitat Location and Type</u>

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.D.1.b. <u>Use by Key Species Including Life History Stages</u>

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus platyceros*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.D.1.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.D.1.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.D.1.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.D.2. Kamishak Bay

B.I.D.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.D.2.b. Use by Key Species Including Life History Stages

The pelagic domain of Kamishak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi, Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimp include *Pandalus borealis, Pandalus danae, Pandalus goniurus,* and *Pandalus stenolepis.* The crabs having early life history stages in Kamishak Bay include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi.*

B.I.D.2.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kamishak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, and fall.

B.I.D.2.d. Potential for Long Residence Times of Contaminant

Kamishak Bay has a potential for long residence times of contaminant second only to Kachemak Bay and greater than the Lower Central Zone, the Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.D.2.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.D.3. Kennedy Entrance

B.I.D.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.D.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.D.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.D.3.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.I.D.3.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities of contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.D.4. Kalgin Island Area

B.I.D.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.I.D.4.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.I.D.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.I.D.4.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.I.D.4.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.I.E. Interference with Fishing Activities

B.I.E.1. Lower Central Zone

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.I.E.2. Kamishak Bay

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.I.E.3. Kennedy Entrance

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.I.E.4. Kalgin Island Area

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.II. Potential Shore-Based Facilities-Tanker Terminals

B.II.A. Kachemak Bay

B.II.A.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.II.A.b. Use by Key Species Including Life History Stages

The pelagic domain of Kachemak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kachemak Bay include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.II.A.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kachemak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in Kachemak Bay in spring, summer, fall, and winter.

B.II.A.d. Potential for Long Residence Times of Contaminant

Kachemak Bay has the greatest potential for long residence times of a contaminant relative to Kamishak Bay, Lower Central Zone, Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.II.A.e. Relative Sensitivities of Key Species

It is not clear that shore-based facilities would affect pelagic species.

B.II.B. Kennedy Entrance

B.II.B.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.II.B.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.II.B.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.II.B.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.II.B.e. Relative Sensitivities of Key Species

It is not clear that shore-based facilities would affect pelagic species.

B.II.C. Kalgin Island Area

B.II.C.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.II.C.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon, Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar, Pandalus borealis, Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica, Cancer* spp., and *Chionoecetes bairdi*.

B.II.C.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.II.C.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.II.C.e. Relative Sensitivities of Key Species

It is not clear that shore-based facilities would affect pelagic species.

B.III. Pipelines

B.III.A. Laying Operations

B.III.A.1. Kachemak Bay

B.III.A.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.A.1.b. Use by Key Species Including Life History Stages

The pelagic domain of Kachemak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kachemak Bay include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.III.A.1.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kachemak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in Kachemak Bay in spring, summer, fall, and winter.

B.III.A.1.d. Potential for Long Residence Times of Contaminant

Kachemak Bay has the greatest potential for long residence times of a contaminant relative to Kamishak Bay, Lower Central Zone, Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.III.A.1.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.A.2. Lower Central Zone

B.III.A.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.A.2.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus platyceros*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi.*

B.III.A.2.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.III.A.2.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.III.A.2.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.A.3. Kennedy Entrance

B.III.A.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.A.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar, Pandalus borealis, Pandalus goniurus, Pandalus stenolepis,* and *Pandalus montagui tridens.* The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica, Cancer* spp., and *Chionoecetes bairdi.*

B.III.A.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.III.A.3.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.III.A.3.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.A.4. Kalgin Island Area

B.III.A.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.A.4.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.III.A.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.III.A.4.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.III.A.4.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.B. Pipeline Breaks and Chronic Leaks

B.III.B.1. Kachemak Bay

B.III.B.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.B.1.b. Use by Key Species Including Life History Stages

The pelagic domain of Kachemak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kachemak Bay include Anomura, Branchyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.III.B.1.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kachemak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in Kachemak Bay in spring, summer, fall, and winter.

B.III.B.1.d. Potential for Long Residence Times of Contaminant

Kachemak Bay has the greatest potential for long residence times of a contaminant relative to Kamishak Bay, Lower Central Zone, Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.III.B.1.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.B.2. Lower Central Zone

B.III.B.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.B.2.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus platyceros*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.III.B.2.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.III.B.2.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.III.B.2.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.B.3. Kennedy Entrance

B.III.B.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.B.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Branchyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.III.B.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.III.B.3.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.III.B.3.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.III.B.4. Kalgin Island Area

B.III.B.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.III.B.4.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.III.B.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.III.B.4.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.III.B.4.e. Relative Sensitivities of Key Species

It does not seem likely that pelagic organisms would be greatly affected by pipeline laying operations.

B.IV. Tanker Routes

B.IV.A. Tanker Spills Along Routes

B.IV.A.1. Kachemak Bay

B.IV.A.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.IV.A.1.b. Use by Key Species Including Life History Stages

The pelagic domain of Kachemak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kachemak Bay include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.IV.A.1.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kachemak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in Kachemak Bay in spring, summer, fall, and winter.

B.IV.A.1.d. Potential for Long Residence Times of Contaminant

Kachemak Bay has the greatest potential for long residence times of a contaminant relative to Kamishak Bay, Lower Central Zone, Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.IV.A.1.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.IV.A.2. Lower Central Zone

B.IV.A.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.IV.A.2.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, *Pandalus hypsinotus*, *Pandalus platyceros*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in the Lower Central Zone include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.IV.A.2.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.IV.A.2.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.IV.A.2.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.IV.A.3. Kamishak Bay

B.IV.A.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.IV.A.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kamishak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, *Hippoglossoides elassodon*, *Limanda aspera*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimp include *Pandalus borealis*, *Pandalus danae*, *Pandalus goniurus*, and *Pandalus stenolepis*. The crabs having early life history stages in Kamishak Bay include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.IV.A.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kamishak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, and fall.

B.IV.A.3.d. Potential for Long Residence Times of Contaminant

Kamishak Bay has a potential for long residence times of contaminant second only to Kachemak Bay and greater than the Lower Central Zone, the Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.IV.A.3.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.IV.A.4. Kennedy Entrance

B.IV.A.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.IV.A.4.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae.

Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.IV.A.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.IV.A.4.a. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.IV.A.4.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.IV.A.5. Kalgin Island Area

B.IV.A.5.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.IV.A.5.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.IV.A.5.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.IV.A.5.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.IV.A.5.e. Relative Sensitivities of Key Species

Some general conclusions from bioassay data have been drawn about relative sensitivities to contaminants (Lois Killewich, personal communication): "Pelagic organisms are more sensitive than benthos, and intertidal species are the least sensitive. Among life stages, immature ones are often more sensitive than adults, particularly in the case of crustaceans." Therefore, these immature stages of pelagic organisms must be considered to be relatively highly sensitive.

B.IV.B. Interference with Fishing Activities

B.IV.B.1. Kachemak Bay

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.IV.B.2. Lower Central Zone

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.IV.B.3. Kennedy Entrance

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.IV.B.4. Kalgin Island Area

The early life history stages of fishes, shrimps, and crabs are not subject to fishing in Lower Cook Inlet.

B.V. Physical Disturbance

B.V.1. Kachemak Bay

B.V.1.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.V.1.b. Use by Key Species Including Life History Stages

The pelagic domain of Kachemak Bay is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi,* Gadidae, *Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. Early life history stages of pandalid shrimp include *Pandalopsis dispar, Pandalus borealis, Pandalus danae, Pandalus goniurus, Pandalus hypsinotus, Pandalus stenolepis,* and *Pandalus montagui tridens.* The crabs having early life history stages in Kachemak Bay include Anomura, Brachyura, *Paralithodes camtschatica, Cancer magister, Cancer* spp., and *Chionoecetes bairdi.*

B.V.1.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kachemak Bay in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in Kachemak Bay in spring, summer, fall, and winter.

B.V.1.d. Potential for Long Residence Times of Contaminant

Kachemak Bay has the greatest potential for long residence times of a contaminant relative to Kamishak Bay, Lower Central Zone, Kalgin Island Area, and Kennedy Entrance (J. D. Schumacher, personal communication).

B.V.1.e. Relative Sensitivities of Key Species

Pelagic organisms should not be greatly affected by the physical disturbance caused by aircraft and boat traffic.

B.V.2. Lower Central Zone

B.V.2.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.V.2.b. Use by Key Species Including Life History Stages

The pelagic domain of the Lower Central Zone is used by relatively many early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus, Clupea harengus pallasi,* Gadidae, *Hippoglossoides elassodon, Limanda aspera, Mallotus villosus,* and Osmeridae. The early life histories of pandalid shrimp include *Pandalopsis dispar, Pandalus borealis, Pandalus danae, Pandalus goniurus, Pandalus hypsinotus, Pandalus platyceros, Pandalus stenolepis,* and *Pandalus montagui tridens.* The crabs having early life history stages in the Lower Central Zone include Anomura, Brachura, *Paralithodes camtschatica*, *Cancer magister*, *Cancer* spp., and *Chionoecetes bairdi*.

B.V.2.c. Seasonality-Critical Periods of Use

In the Lower Central Zone of Cook Inlet fish eggs were observed in spring, summer, and fall. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring, summer, and winter. Early life history stages of crabs were observed in spring, summer, and fall.

B.V.2.d. Potential for Long Residence Times of Contaminant

The Lower Central Zone has a potential for long residence times of a contaminant less than Kachemak Bay or Kamishak Bay and greater than the Kalgin Island Area and Kennedy Entrance (J. D. Schumacher, personal communication).

B.V.2.e. Relative Sensitivities of Key Species

Pelagic organisms should not be greatly affected by the physical disturbance caused by aircraft and boat traffic.

B.V.3. Kennedy Entrance

B.V.3.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.V.3.b. Use by Key Species Including Life History Stages

The pelagic domain of Kennedy Entrance is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1, 2, and 3 mm diameter. The fish larvae include *Ammodytes hexapterus*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus goniurus*, *Pandalus stenolepis*, and *Pandalus montagui tridens*. The crabs having early life history stages in Kennedy Entrance include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.V.3.c. Seasonality-Critical Periods of Use

Fish eggs were observed in Kennedy Entrance in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.V.3.d. Potential for Long Residence Times of Contaminant

Kennedy Entrance has the least potential for long residence times of contaminant, less than Kachemak Bay, Kamishak Bay, the Lower Central Zone, and the Kalgin Island Area (J. D. Schumacher, personal communication).

B.V.3.e. Relative Sensitivities of Key Species

Pelagic organisms should not be greatly affected by the physical disturbance caused by aircraft and boat traffic.

B.V.4. Kalgin Island Area

B.V.4.a. Habitat Location and Type

The habitat in which ichthyoplankton and meroplankton occur is the pelagic domain of open ocean above the sea floor.

B.V.4.b. Use by Key Species Including Life History Stages

The pelagic domain of the Kalgin Island Area is used by a considerable number of early life history stages of fishes, shrimps, and crabs. The fish eggs include those less than 1 mm diameter and those about 1 and 2 mm diameter. The fish larvae include *Ammodytes hexapterus*, *Clupea harengus pallasi*, Gadidae, *Hippoglossoides elassodon*, *Mallotus villosus*, and Osmeridae. Early life history stages of pandalid shrimps include *Pandalopsis dispar*, *Pandalus borealis*, *Pandalus danae*, and *Pandalus goniurus*. The crabs having early life history stages in the Kalgin Island Area include Anomura, Brachyura, *Paralithodes camtschatica*, *Cancer* spp., and *Chionoecetes bairdi*.

B.V.4.c. Seasonality-Critical Periods of Use

Fish eggs were observed in the Kalgin Island Area in spring and summer. Fish larvae were observed in spring, summer, fall, and winter. Early life history stages of shrimps were observed in spring and summer. Early life history stages of crabs were observed in spring, summer, fall, and winter.

B.V.4.d. Potential for Long Residence Times of Contaminant

The Kalgin Island Area has a potential for long residence times of contaminant less than Kachemak Bay, Kamishak Bay, and the Lower Central Zone, but greater than Kennedy Entrance (J. D. Schumacher, personal communication).

B.V.4.e. Relative Sensitivities of Key Species

Pelagic organisms should not be greatly affected by the physical disturbance caused by aircraft and boat traffic.

VIII. CONCLUSIONS

The objectives of this study have been realized. An extensive sampling and analysis program has provided a large body of new observations on quantitative seasonal changes of eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet.

Early life history stages of important components of the food webs of Lower Cook Inlet, Kachemak, and Kamishak Bays, especially fish eggs, fish larvae, shrimps, and crabs, have been identified, quantified, and tabulated. The temporal and spatial dynamics and distributions of ichthyoplankters and planktonic stages of shrimps and crabs have been tabulated, depicted, and discussed. The timing and use of areas within Lower Cook Inlet--Kachemak Bay, Lower Central Zone, Kamishak Bay, Kennedy Entrance, and Kalgin Island Area--by early life history stages of fishes, shrimps, and crabs have been tabulated, depicted, and evaluated.

The substantial results of this study can be used in the present form to answer many questions related to management of the Lower Cook Inlet ecosystem. These results can also be analyzed in other ways to support informed management decisions about questions yet unasked about resource use conflicts.

ACKNOWLEDGEMENTS

I would like to thank the following staff and students. Kendra Daly, Leanne Stahl, Dave Roetcisoender, Gordy Vernon, Paul Walline, and Marc Weinstein collected the samples. Samples were sorted by Scott Augustine, Gordy Vernon, Debbie Wencker, and Brian Williams. Fish eggs and larvae were identified by Leanne Stahl, crab larvae by Kendra Daly and Marc Weinstein, shrimp larvae by Dave Murphy and Dave Roetcisoender. Data was converted to computer format for NODC by Dave Roetcisoender, computer output of tables and figures by Dale Kisker with Jerry Hornof as consultant. Dave Roetcisoender and Leanne Stahl assisted in compilation of this report with typing by Lynne Ross.

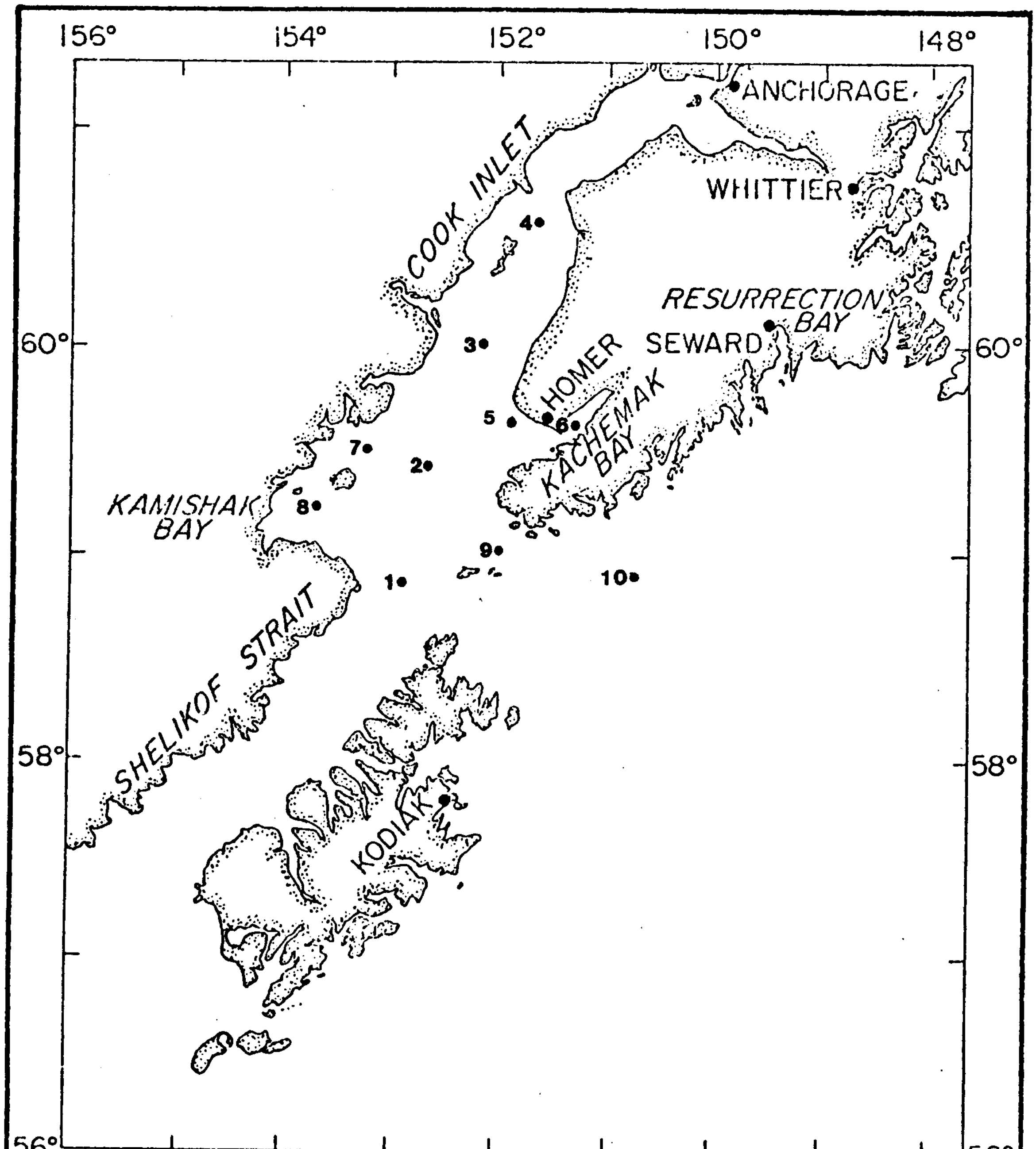

Figure 1. Station locations in the Lower Cook Inlet area, 1976-1977.

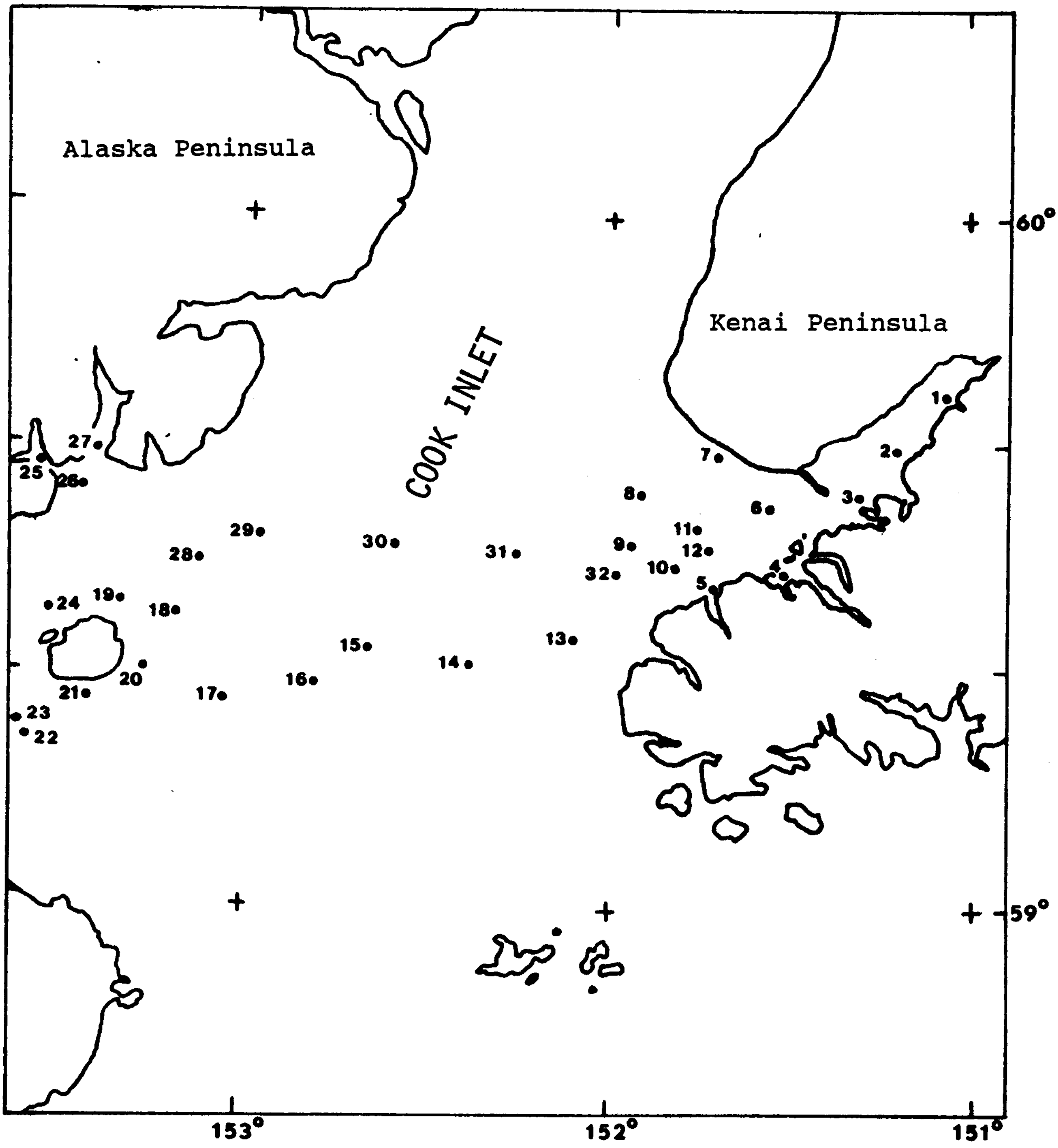

Figure 2a. Station locations in Lower Cook Inlet, 1978.

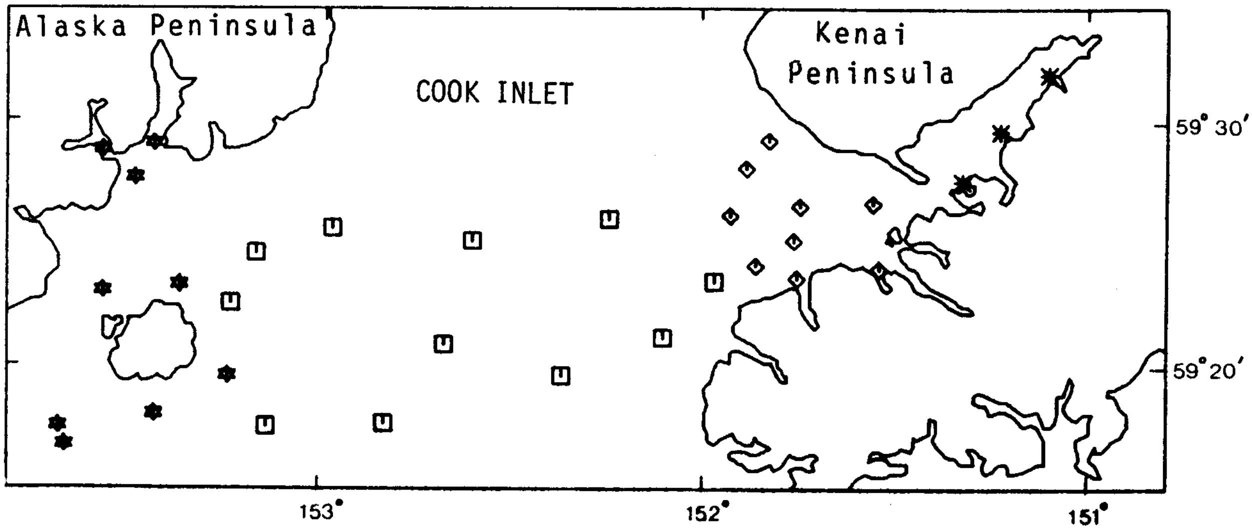

Figure 2b. Sampling areas in Lower Cook Inlet, 1978.

✱ = INNER KACHEMAK BAY
◈ = OUTER KACHEMAK BAY
◻ = LOWER CENTRAL ZONE
✸ = KAMISHAK BAY

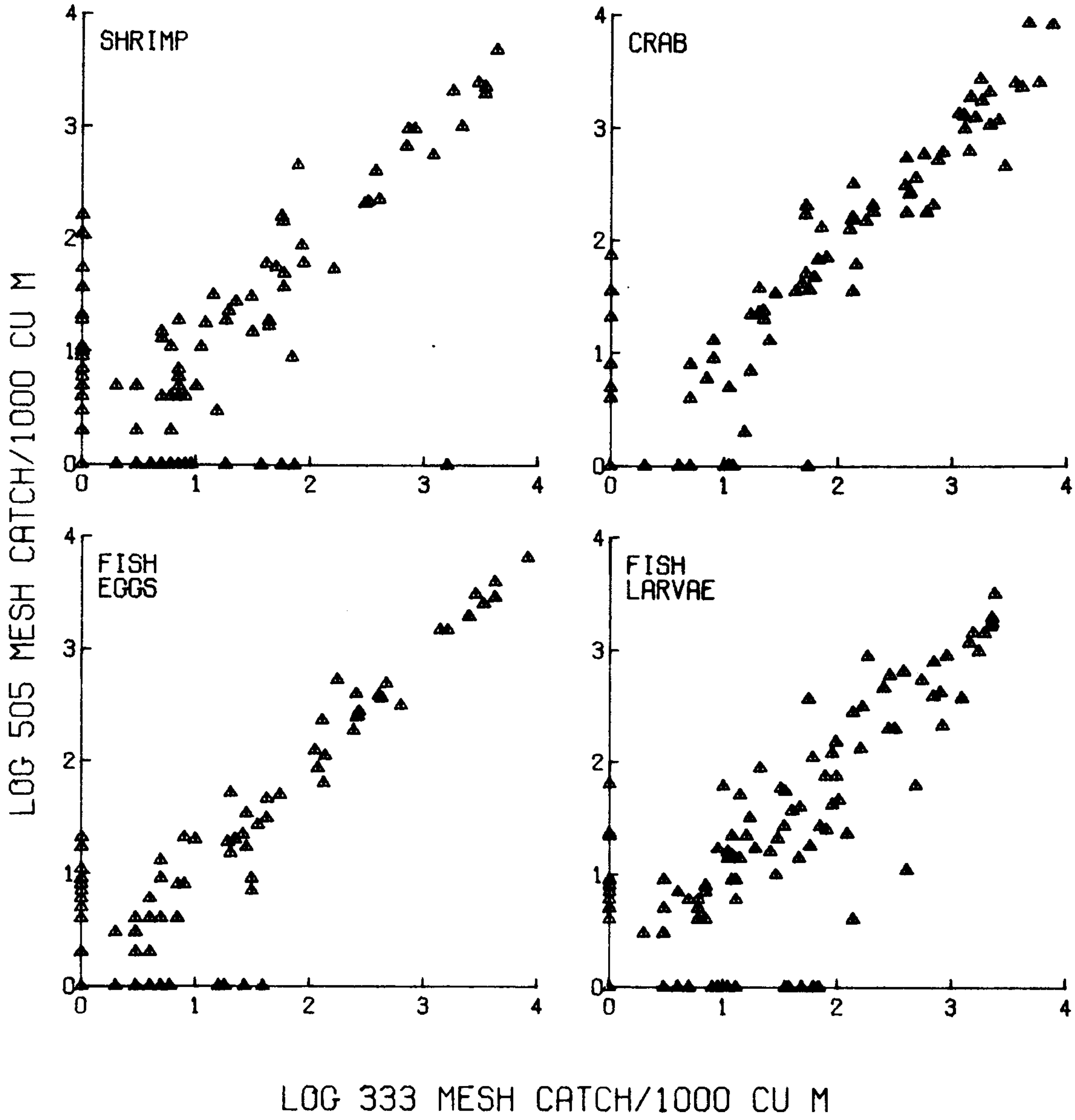

Figure 3. Comparison of concentrations between 333 and 505 μm mesh nets.

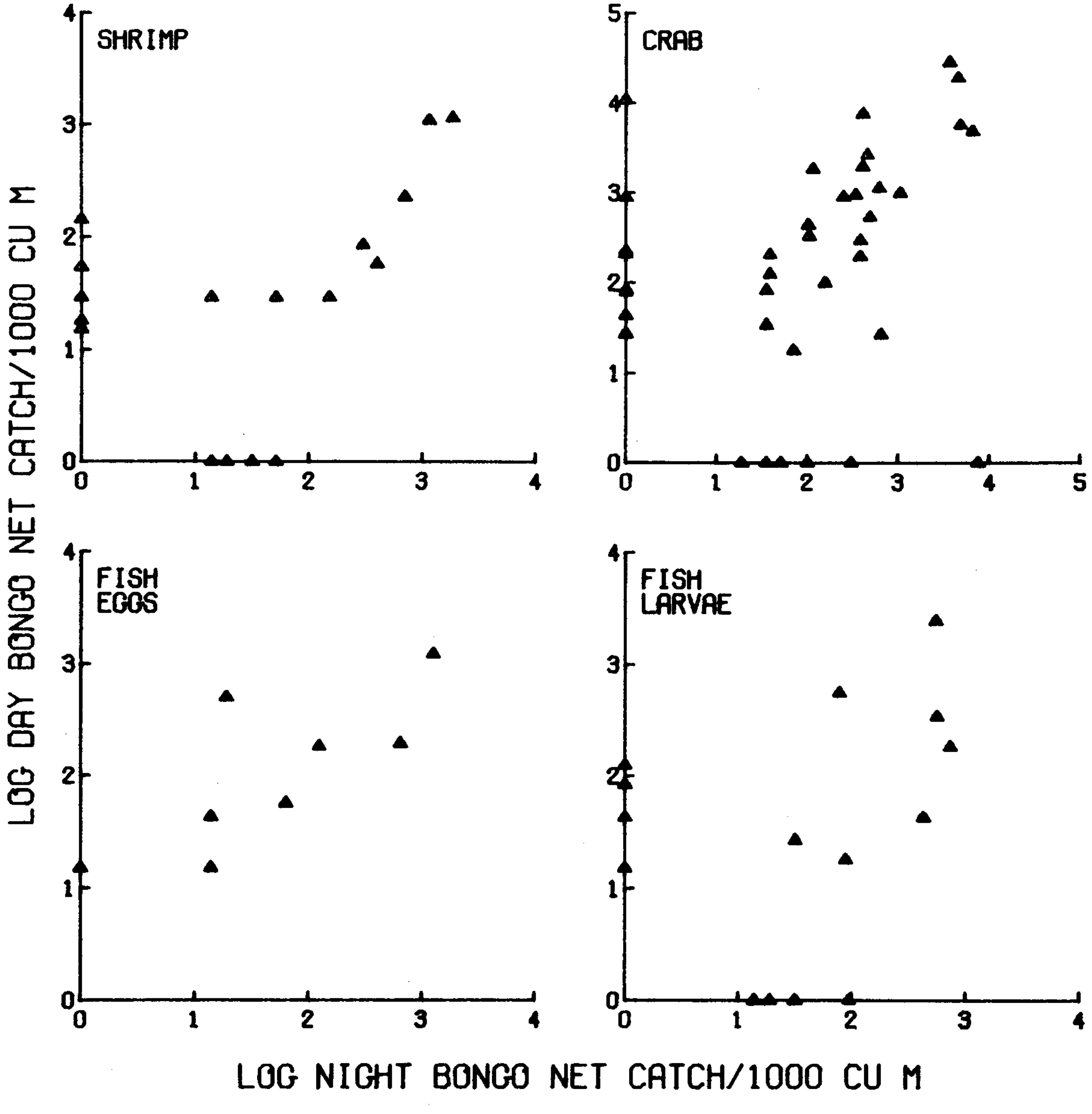

Figure 4. Bongo net catches during daylight and darkness at the same location within a 24-hour period.

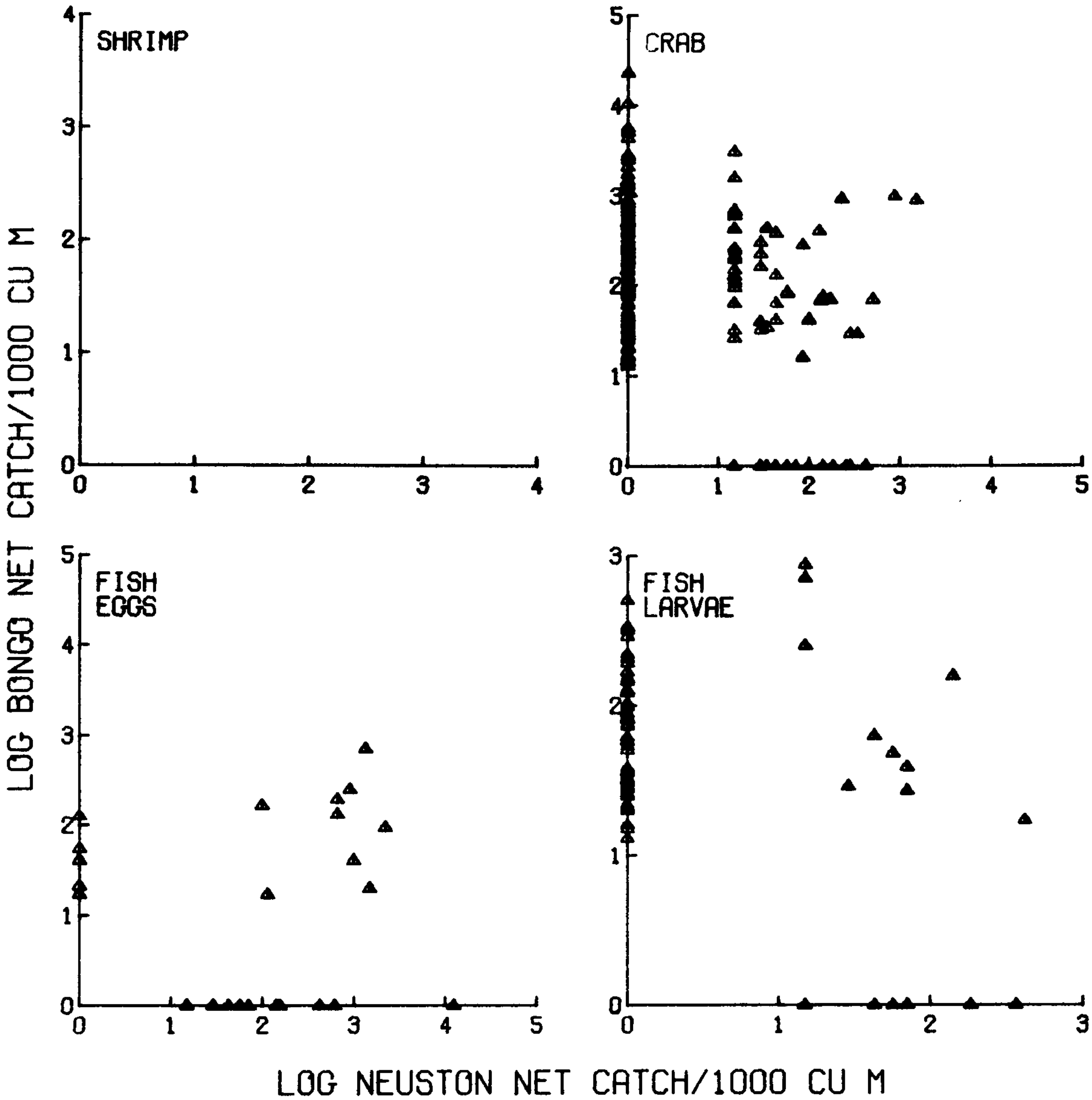

Figure 5. Bongo and neuston net catches at the same location and time.

Table 1. Annotated literature review; fish eggs and larvae

References	Area of Study	Nature of Study	Specific Features of Interest
Ahlstrom, 1972	California	Distribution of *Bathylagus stilbius*, *Stenobrachius leucopsarus*, and four non-Alaskan species in the California Current Region	Illustrations of planktonic larvae.
Ahlstrom and Moser, 1975	California	Distribution of flatfishes in the California Current Region	Brief descriptions of planktonic eggs and larvae, figures.
Bell and St. Pierre, 1970	North Pacific	Eggs and larvae of *Hippoglossus hippoglossus stenolepis*	Descriptions of eggs and larvae, figures, life history, and commercial fisheries.
Blackburn, 1973	Puget Sound, Washington	Ichthyoplankton survey of Skagit Bay	Species list, key to elongate fishes (Ammodytidae, Bathymasteridae, Clupeidae, Engraulidae, Osmeridae, Pholidae, and Stichaeidae), descriptions of larvae for elongate and non-elongate fishes (Cottidae, Hexagrammidae, and Pleuronectidae), figures.
Budd, 1940	Monterey Bay, California	Development of eggs and early larvae of *Parophrys vetulus*, *Pleuronichthys decurrens*, *Pleuronichthys coenosus*, and three non-Alaskan species	Descriptions of eggs and larvae, figures. Eggs and larvae from the plankton.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Damkaer, 1977	Prince William Sound, Gulf of Alaska, Lower Cook Inlet	Abundance and distribution of zooplankton	Samples taken jointly with RU 424 and collaborates with total zooplankton abundance and distribution.
Delacy, Hitz, and Dryfoos, 1964	Puget Sound, Washington coast	Reproduction of several *Sebastes* species	Descriptions of ovarian eggs, larval descriptions, figures of nine species, and life history. Eggs and larvae from the plankton.
Efremenko and Lisovenko, 1972	Gulf of Alaska	Intraovarian and pelagic larvae of some Alaskan *Sebastes* species	Descriptions of intraovarian and pelagic larvae, figures. Larvae from the plankton.
English, 1976	Alaskan waters	Pelagic fish eggs and larvae, shrimp and crab larvae	Keys in table form, figures.
Fraser and Hansen, eds., 1967	North Atlantic	Larvae of Ammodytidae	Keys and descriptions of larvae, figures.
Gorbunova, 1954	NW Pacific Ocean and Bering Sea	Reproduction and development of *Theragra chalcogramma*	Life history, descriptions of eggs, larvae, and juveniles; brief sections describing larvae and juveniles of *Gadus morhua macrocephalus*, *Eleginus gracilis*, and *Boreogadus saida*; figures.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Gorbunova, 1962	NW Pacific Ocean (?)	Spawning and development of Hexagrammidae	Text in Russian, English abstract; descriptions of embryonic and larval development for *Pleurogrammus monopterygius, Hexagrammos octogrammus, Hexagrammos lagocephalus;* descriptions of larvae for *Hexagrammos stelleri, Hexagrammos decagrammus, and Hexagrammos superciliosus;* larval key and figures.
Hickman, 1959	Puget Sound, Washington	Larval development of *Psettichthys melanostictus*	Descriptions of larvae and early juveniles; figures. Larvae from the plankton.
Howe and Richardson, 1978	NE Pacific Ocean	Characteristics of juvenile and adult Cottidae fishes.	Compilation of taxonomic characteristics of 40 genera of Cottidae including meristic variation in fin spines, fin rays and vertebrae both from samples collected and the literature. Artificial keys to cottid genera and species.
Kobayashi, 1961	Okhotsk Sea, North Pacific Ocean	Larvae and young of *Ptilichthys goodei*	Text in Japanese, English summaries of descriptions of larvae and young; figures.
Malins, 1977	Arctic and Subarctic	Compilation of studies on the effects of petroleum on marine organisms	Various effects on organisms including toxic, pathological and sublethal, and the metabolism of petroleum hydrocarbons by bacteria, algae, invertebrates, fish, marine birds and mammals as well as ecosystems.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
McAllister, 1963	World-wide	Systematics of Osmeridae fishes	Synonymies, descriptions and keys to subfamilies, genera, species and subspecies, with illustrations and distribution maps for each species.
Miller, 1969	San Juan Is., Washington	Life history of *Hippoglossoides elassodon*	Life history, descriptions of egg and larval development, and photographs. Eggs artificially spawned and from the plankton, raised in the lab.
Morris, 1956	Monterey Bay, California	Early larvae of four *Sebastes* species: *S. goodei, S. jordani, S. paucispinus*, and *S. saxicola*	Descriptions of larvae and figures. Larvae raised in the lab.
Moser, 1967	Southern California	Reproduction and development of *Sebastes paucispinis* and comparison with other rockfishes	Descriptions of ovarian eggs and intraovarian and planktonic larvae, figures of larvae and early juveniles. Larvae from the plankton.
Moser, 1974	Southern California	Development and distribution of larvae and juveniles of *Sebastolobus*	Descriptions of larvae and juveniles, figures. Larvae from the plankton.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Moser and Ahlstrom, 1974	World-wide	Systematic investigations of larval stages of Myctophidae	Descriptions of larvae, figures. Larvae from the plankton.
O'Connell, 1953	California	Life history of *Scorpaenichthys marmoratus*	Life history, descriptions of unfertilized egg, larvae, and young; figures. Artificially spawned eggs, larvae from the plankton.
Orcutt, 1950	Monterey Bay, California	Life history of *Platichthys stellatus*	Descriptions of eggs, larvae, and young; figures, life history and commercial fishery. Eggs artificially spawned and reared in the lab.
Phillips, 1977	Strait of Georgia	Taxonomic guide	Summary of taxonomic characteristics of five species of *Oncorhynchus* with illustrations to facilitate rapid identification.
Quast and Hall, 1972	Alaska	List of fishes of Alaska	Species lists, distributions, and references.
Richardson and DeHart, 1975	Oregon coast	Larvae, young, and adults of *Ptilichthys goodei*	Descriptions of larvae, young, and adults; figure of larva. Larvae from the plankton.
Richardson and Washington, 1978	NE Pacific Ocean	Characteristics of larval Cottidae	Compilation of taxonomic characteristics and illustrations of 14 genera of Cottidae taken in plankton collections off Oregon and 11 genera taken from the literature.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Saville, 1964	North Atlantic	Eggs and larvae of Clupeidae	Keys to eggs and larvae, descriptions and figures of larvae.
Templeman, 1948	Newfoundland	Life history of *Mallotus villosus*	Life history, descriptions of eggs and larvae; figures of larvae. Larvae from the plankton.
Trautman, 1973	Auke Bay, Alaska	Taxonomic guide	Methods of preserving specimens and description of characters used in identifying five species of presmolt Pacific salmon. Includes keys and illustrations.

Table 2. Annotated literature review; crabs

References	Area of Study	Nature of Study	Specific Features of Interest
Hart, 1935	Nanaimo, British Columbia	Larvae of *Lophopanopeus bellus bellus*, *Hemigrapsis nudis* and *H. oregonensis*	Descriptions of larval stages, and figures of crabs with larvae similar to commercially important species.
Hart, 1960	Nanaimo, British Columbia	Larvae of *Oregonia gracilis* and *Hyas lyratus*	Descriptions of larval stages, and figures of crabs with larvae similar to commercially important species.
Hart, 1971	British Columbia	Key to planktonic larvae of families of decapod Crustacea	Figures.
Haynes, 1973	Bristol Bay, Alaska	Larvae of *Chionoecetes bairdi* and *C. opilio*	Descriptions of prezoea and first stage; figures. Larvae raised at sea and preserved.
Haynes and Wing, 1977	Kachemak Bay, Alaska	Distribution of king crab and pandalid shrimp larvae	Geographical, seasonal and diel vertical migration of larvae and comparison of water current patterns with distribution of larvae.
Hoffman, 1968	Auke Bay, Alaska	Larvae of *Paralithodes platypus*	Descriptions of larval stages and figures. Larvae raised in the lab.
Karinen and Rice, 1974	Auke Bay, Alaska	Effects of oil on tanner crabs	Most significant effect of oil on crabs was the autotomy of limbs, or death in high concentrations.

Table 2. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Kurata, 1956	Hokkaido, Japan	Larvae of *Paralithodes brevipes*	Text in Japanese, brief English summaries of larval stages, figures. Larvae similar to commercially important species.
Kurata, 1963a	Hokkaido, Japan	Larvae of *Erimacrus isenbeckii* and *Telmessus cheiragonus*	Text in Japanese, brief English summaries of larval stages, figures. Larvae similar to commercially important species.
Kurata, 1963b	Hokkaido, Japan	Larvae of *Chionoecetes opilio elongatus* and *Hyas coarctatus alutaceus*	Text in Japanese, brief English summaries of larval stages, figures. Larvae similar to commercially important species.
Kurata, 1964	Hokkaido, Japan	Larvae of *Paralithodes camtschatica, P. brevipes* and *P. platypus*	Text in Japanese, brief English summaries of larval stages; figures.
Lough, 1975	Newport Bay, Oregon	Keys to larvae of *Cancer magister, C. productus* and *C. oregonensis*	Includes keys to families, and species of crabs with larvae similar to commercially important species.
Marukawa, 1933	Japanese waters	Descriptions of adult *Paralithodes camtschatica* biology and fishery	Illustrations of larval stages but no descriptions in English.
Motoh, 1973	Sea of Japan	Larvae of *Chionoecetes opilio*	Descriptions of larval stages; figures. Larvae raised in the lab.

Table 2. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Poole, 1966	Eureka, California	Larvae of *Cancer magister*	Descriptions of larval stages; figures. Larvae raised in the lab.
Sato and Tanaka, 1949	Hokkaido, Japan	Larvae of *Paralithodes camtschatica*	Descriptions of larval stages; figures. Larvae raised in the lab.
Sundberg and Clausen, 1977	Kachemak Bay and Lower Cook Inlet, Alaska	Distribution of post-larval *Paralithodes camtschatica*	Abundance and distribution of post-larval king crabs sampled with bottom skimmer trawl and diver-operated suction dredge and comparison between abundance and substrate.
Trask, 1970	Humboldt Bay, California	Larvae of *Cancer productus*	Descriptions of larval stages, figures and comparison with *Cancer magister* larvae. Larvae raised in the lab.

Table 3. Annotated literature review; shrimps

References	Area of Study	Nature of Study	Specific Features of Interest
Alaska Dept. of Fish and Game, 1975	Kachemak Bay, Alaska	Circulation, ecology, commercial fishing, potential impact of oil spill, conservation of renewable energy resources	*Pandalus borealis*, *P. goniurus*, *P. hypsinotus* and *Pandalopsis dispar* were the four species of shrimp caught commercially with the first two comprising 93% of trawl catches. *Pandalus hypsinotus* comprises 90% of pot catches. King crab, Tanner crab and Dungeness crab caught commercially.
Barr, 1970	Lower Cook Inlet Kenai Peninsula and Kodiak Is.	Commercial species of Alaskan shrimp	Key to species, life history, figures, domestic and foreign fisheries.
Berkeley, 1930	Nanaimo, British Columbia	Larvae of *Pandalopsis dispar*, *Pandalus borealis*, *P. danae*, *P. hypsinotus*, *P. platyceros*	Descriptions of larval stages, and adults, figures, key to species. First stage larva raised in the lab, later stages from plankton.
Greenwood, 1959	Lower Cook Inlet, Shelikof Strait, and Kodiak Is., Alaska	Exploratory research	*Pandalus borealis*, *Pandalopsis dispar* and *Pandalus hypsinotus* were 3 most abundant commercially important shrimp.
Haynes, 1976	Kasitsna Bay, Alaska	Larvae of *Pandalus hypsinotus*	Descriptions of larval stages, figures and comparison of zoeal stages by other authors. Larvae raised in the lab.

Table 3. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Haynes, 1978	Kachemak Bay, Alaska	Larvae of *Pandalus goniurus*	Descriptions of larval stages, figures and comparison of zoeal stages by other authors. Larvae raised in situ in Kachemak Bay.
Haynes and Wing, 1977	Kachemak Bay Alaska	Distribution of king crab and pandalid shrimp larvae	Geographical, seasonal and diel vertical migration of larvae and comparison of water current patterns with distribution of larvae.
Ivanov, 1965	Russian waters	Larvae of *Pandalus tridens, Eualus macilentus, E. barbatus, Spirontocaris spina, Lebbeus groenlandicus*	First stage illustrated, text in Russian.
Ivanov, 1971	Russian waters	Larvae of *Pandalus goniurus*	First stage illustrated, text in Russian.
Kurata, 1964	Hokkaido, Japan	Larvae of *Pandalus borealis, P. hypsinotus* and *Pandalopsis coccinata*	Text in Japanese, brief English summaries of larval stages, figures.
Lee, 1969	Seattle, Washington	Larvae of *Pandalus jordani*	Descriptions of larval stages, figures and comparisons of zoeal stages by other authors. Larvae raised in the lab.
Modin and Cox, 1967	Crescent City, California	Larvae of *Pandalus jordani*	Descriptions of larval stages and figures. Larvae raised in the lab.

Table 3. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Needler, 1938	Nanaimo, British Columbia	Larvae of *Pandalus stenolepis*	Descriptions of larval stages and figures. 1st and 2nd stages raised in the lab, 2nd to 7th from the plankton.
Price and Chew, 1972	Dabob Bay, Washington	Larvae of *Pandalus platyceros*	Descriptions of larval stages and figures. Larvae raised in the lab.
Rathbun, 1904	Arctic Alaska to Southern California	Adult decapod crustaceans	Descriptions, figures, keys and distributions.
Ronholt, 1963	Southern Alaskan waters	Exploratory research	*Pandalus borealis*, *Pandalopsis dispar*, and *Pandalus hypsinotus* were the 3 most abundant commercially important shrimp in the Lower Cook Inlet area.

Table 4. Station locations in 1976-1977.

Station	Latitude (N)	Longitude (W)	Chart Depth (m)	Location
1	58° 53.0'	152° 48.0'	174	Lower Cook Inlet
2	59° 22.0'	152° 40.0'	62	Lower Cook Inlet
3	60° 00.0'	152° 10.0'	58	Lower Cook Inlet
4	60° 40.0'	151° 40.0'	36	Cook Inlet
5	59° 35.0'	151° 49.0'	36	Outer Kachemak Bay
6	59° 36.0'	151° 18.0'	77	Inner Kachemak Bay
7	59° 30.0'	153° 10.0'	35	Lower Cook Inlet
8	59° 14.0'	153° 40.0'	29	Kamishak Bay
9	59° 02.0'	151° 58.0'	196	Kennedy Entrance
10	58° 52.0'	150° 51.0'	210	Gulf of Alaska

Table 5. Station locations in 1978.

Station	Latitude (N)	Longitude (W)	Depth (m)	
1	59° 44.0'	151° 04.0'	36	Inner Kachemak Bay
2	59° 40.0'	151° 12.0'	64	Inner Kachemak Bay
3	59° 36.0'	151° 18.0'	79	Inner Kachemak Bay
4	59° 28.5'	151° 32.0'	18	Outer Kachemak Bay
5	59° 28.0'	151° 44.5'	18	Outer Kachemak Bay
6	59° 34.0'	151° 32.5'	73	Outer Kachemak Bay
7	59° 39.0'	151° 48.0'	29	Outer Kachemak Bay
8	59° 37.0'	151° 52.0'	26	Outer Kachemak Bay
9	59° 33.0'	151° 55.0'	35	Outer Kachemak Bay
10	59° 29.0'	151° 51.0'	60	Outer Kachemak Bay
11	59° 34.0'	151° 44.0'	73	Outer Kachemak Bay
12	59° 31.0'	151° 45.0'	84	Outer Kachemak Bay
13	59° 23.0'	152° 06.0'	53	Lower Central Cook Inlet
14	59° 20.0'	152° 22.0'	79	Lower Central Cook Inlet
15	59° 22.5'	152° 40.0'	59	Lower Central Cook Inlet
16	59° 16.3'	152° 49.5'	88	Lower Central Cook Inlet
17	59° 15.9'	153° 08.5'	53	Lower Central Cook Inlet
18	59° 26.0'	153° 14.0'	37	Lower Central Cook Inlet
19	59° 27.5'	153° 22.0'	27	Kamishak Bay
20	59° 20.0'	153° 14.0'	48	Kamishak Bay
21	59° 17.0'	153° 26.0'	26	Kamishak Bay
22	59° 14.0'	153° 40.0'	29	Kamishak Bay
23	59° 15.9'	153° 41.0'	27	Kamishak Bay
24	59° 27.0'	153° 34.0'	20	Kamishak Bay
25	59° 38.0'	153° 35.0'	5	Kamishak Bay
26	59° 36.0'	153° 29.0'	5	Kamishak Bay
27	59° 39.0'	153° 26.0'	5	Kamishak Bay
28	59° 30.0'	153° 10.0'	35	Lower Central Cook Inlet
29	59° 32.0'	152° 58.0'	41	Lower Central Cook Inlet
30	59° 31.0'	152° 36.0'	60	Lower Central Cook Inlet
31	59° 33.0'	152° 14.0'	48	Lower Central Cook Inlet
32	59° 28.0'	151° 58.0'	66	Lower Central Cook Inlet

Table 6. Samples taken at ten locations on seven cruises in four seasons in Lower Cook Inlet, April 1976 through February 1977.

	Spring			Summer		Fall	Winter
Station	6-13 Apr	6-9 May	22-30 May	8-15 Jul	24-31 Aug	17-29 Oct	21-26 Feb
1	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X
8		X	X	X	X	X	X
9	X	X		X	X	X	X
10	X		X	X	X		X

Table 7. Samples taken in 1978 at 32 station locations in four areas of Lower Cook Inlet on seven cruises in three seasons with bongo and neuston nets: X indicates bongo net and O indicates neuston net.

Area	Station	Spring		Summer		Autumn		
		19 May-9 Jun	26 Jun-6 Jul	11 Jul-16 Jul	6 Aug-14 Aug	22 Aug-29 Aug	31 Aug-2 Sep	20 Sep-27 Sep
Inner Kachemak	1	X	X		X	XO	XO	XO
	2	X	X		X	XO	XO	XO
	3	X	X		X	XO	XO	XO
Outer Kachemak	4		X	X	X	XO	XO	XO
	5					XO	XO	XO
	6	X	X	X	X	XO	XO	XO
	7	X	X	X	X		XO	XO
	8	X	X	X	X	XO	XO	XO
	9	X	X	X	X	XO	XO	XO
	10	X	X	X	X	XO		XO
	11	X	X	X	X	XO	XO	XO
	12	X	X	X	X		XO	XO
Lower Central	13	X	X	X	X	XO		
	14	X	X	X	X	XO		
	15	X	X	X	X	XO		
	16	X	X	X	X	XO		
	17		X	X	X			
	18	X		X	X	XO		
	28	X	X	X	XO	XO		
	29	X	X	X	XO	XO		
	30	X	X	X	XO	XO		
	31	X	X	X	XO	XO		
	32	X	X	X	XO	XO		
Kamishak	19	X	X	X				XO
	20	X	X	X				XO
	21	X	X	X				XO
	22	X	X	X				XO
	23	X	X	X				XO
	24	X	X	X				XO
	25		X	X				
	26		X	X				
	27		X					

Table 8. Fishes collected in the Lower Cook Inlet region, April 1976 through September 1978.

Family Clupeidae - herrings

Clupea harengus pallasi Valenciennes Pacific herring

Family Salmonidae - trouts

Oncorhynchus gorbuscha (Walbaum) pink salmon

Family Osmeridae - smelts

Mallotus villosus (Müller) capelin
Spirinchus thaleichthys (Ayres) longfin smelt
Thaleichthys pacificus (Richardson) eulachon

Family Bathylagidae - deepsea smelts

Bathylagus schmidti (Rass) northern smoothtongue

Family Myctophidae - lanternfishes

Protomyctophum thompsoni (Chapman) bigeye lanternfish
Stenobrachius leucopsarus (Eigenmann and Eigenmann) northern lampfish

Family Gadidae - codfishes

Gadus sp. Pacific cod
Theragra chalcogramma (Pallas) walleye pollock

Family Zoarcidae - eelpouts

One unidentified species

Family Macrouridae - rattails

One unidentified species

Family Gasterosteidae - sticklebacks

Gasterosteus aculeatus Linnaeus threespine stickleback
Pungitius pungitius (Linnaeus) ninespine stickleback

Family Scorpaenidae - rockfishes

Sebastes spp. rockfish
Sebastolobus sp. thornyhead

Table 8. (cont.)

Family Hexagrammidae - greenlings

Hexagrammos spp. greenling
Hexagrammos stelleri Tilesius whitespotted greenling

Family Cottidae - sculpins

Artedius spp. (Type 1 and Type 2)
Clinocottus sp.
Icelinus borealis Gilbert northern sculpin
Leptocottus armatus Girard Pacific staghorn sculpin
Myoxocephalus sp.
Scorpaenichthys marmoratus (Ayres) cabezon
Cottidae ("Cottid 2" from Blackburn 1973)

Family Agonidae - poachers

Agonus acipenserinus Tilesius sturgeon poacher
Two unidentified species

Family Cyclopteridae - lumpfishes and snailfishes

Eumicrotremus orbis (Günther) Pacific spiny lumpsucker
Liparis sp. snailfish

Family Bathymasteridae - ronquils

Family Stichaeidae - pricklebacks

Anoplarchus sp. cockscomb
Chirolophis sp. warbonnet
Delolepis gigantea Kittlitz giant wrymouth
Lumpenus spp. prickleback
Lyconectes aleutensis Gilbert dwarf wrymouth

Family Ptilichthyidae - quillfishes

Ptilichthys goodei Bean quillfish

Family Pholidae - gunnels

Family Zaproridae - prowfishes

Zaprora silenus Jordan prowfish

Family Ammodytidae - sand lances

Ammodytes hexapterus Pallas Pacific sand lance

Table 8. (cont.)

Family Tetragonuridae - squaretails

Family Pleuronectidae - righteye flounders

Atheresthes stomias (Jordan and Gilbert) arrowtooth flounder
Glyptocephalus zachirus Lockington rex sole
Hippoglossoides elassodon Jordan and Gilbert flathead sole
Isopsetta isolepis (Lockington) butter sole
Lepidopsetta bilineata (Ayres) rock sole
Limanda aspera (Passas) yellowfin sole
Lyopsetta exilis (Jordan and Gilbert) slender sole
Microstomus pacificus (Lockington) dover sole
Platichthys stellatus (Pallas)? starry flounder
Psettichthys melanostictus Girard sand sole

Table 9. Commercially important species of crab larvae collected in the Lower Cook Inlet region, April 1976 through September 1978.

Order Decapoda

Suborder Reptantia

Section Anomura

Family Lithodidae

Paralithodes camtschatica (Tilesius) Alaska king crab

Section Brachyura

Superfamily Brachyrhyncha

Family Cancridae

Cancer magister Dana Dungeness crab

Superfamily Oxyrhyncha

Family Majidae

Subfamily Oregoniinae

Chionoecetes bairdi Rathbun tanner crab

Table 10. Pandalid shrimp collected in the Lower Cook Inlet region, April 1976 through September 1978.

Order Decapoda

Suborder Natantia

Section Caridea

Family Pandalidae

Pandalopsis dispar Rathbun side stripe shrimp

Pandalus borealis Kröyer northern pink shrimp

Pandalus danae Stimpson dock shrimp

Pandalus goniurus Stimpson humpy shrimp

Pandalus hypsinotus Brandt coon stripe shrimp

Pandalus montagui tridens Rathbun no common name

Pandalus platyceros Brandt spot shrimp

Pandalus stenolepis Rathbun no common name

Table 11. List of possible fish for egg size categories collected in the Lower Cook Inlet region, April 1976 through September 1978.

<1 mm category (0.73 - 0.88 mm)

Limanda aspera (Pallas) yellowfin sole

∿1 mm category (0.89 - 1.28 mm)

Gadus macrocephalus Tilesius Pacific cod
Isopsetta isolepis (Lockington) butter sole
Parophrys vetulus Girard English sole
Platichthys stellatus (Pallas) starry flounder
Psettichthys melanostictus Girard sand sole

∿2 mm category (1.30 - 2.54 mm)

Bathylagus schmidti (Rass) northern smoothtongue
Glyptocephalus zachirus Lockington rex sole
Lyopsetta exilis (Jordan and Gilbert) slender sole
Microstomus pacificus (Lockington) dover sole
Pleuronectes quadrituberculatus Pallas Alaska plaice
Theragra chalcogramma (Pallas) walleye pollock

∿3 mm category (2.56 - 3.90 mm)

Hippoglossoides elassodon Jordan and Gilbert flathead sole

Table 12. Results of tests of the null hypotheses that seasons and sites did not differ: * indicates a statistically significant difference, $P < 0.05$; N indicates no difference.

Taxonomic Category		Sites	Seasons
Fish Eggs:	<1 mm	*	*
	1 mm	N	*
Fish Larvae:	*Ammodytes*	N	N
	Clupea	N	N
	Gadidae	N	N
	Limanda	N	N
	Mallotus	*	*
	Osmeridae	*	*
Crabs:	Anomura zoea	*	*
	megalopa	N	*
	Brachyura zoea	*	*
	megalopa	*	*
	Cancer magister I	N	N
	II	*	N
	III	*	N
	Cancer spp. I	*	*
	II	*	*
	III	N	*
	IV	*	*
	V	N	N
	megalopa	*	N
	Chionoecetes II	N	N
Shrimps:	*P. borealis* IV	N	N
	P. goniurus V	N	N

Table 13. Use by key species and life history stages of six locations in Lower Cook Inlet, 1976-1977 and 1978.

Key Species and Life History Stages	Inner Kachemak 76-77	Inner Kachemak 78	Outer Kachemak 76-77	Outer Kachemak 78	Lower Central 76-77	Lower Central 78	Kamishak 76-77	Kamishak 78	Kennedy Entrance 76-77	Kalgin Island 76-77
Fish Eggs										
<1 mm	X	X	X	X	X	X	X	X	X	X
∿1 mm	X	X	X	X	X	X	X	X	X	X
∿2 mm	X	X	X	X	X	X	X	X	X	X
∿3 mm		X	X		X				X	
Ammodytes hexapterus										
larvae	X	X	X	X	X	X	X	X	X	X
juveniles										
Clupea harengus pallasi										
larvae		X		X		X	X	X		X
juveniles										X
Gadidae										
larvae			X	X	X	X			X	X
juveniles			X			X				
Hippoglossoides elassodon										
larvae	X	X	X	X	X	X	X	X	X	X
juveniles							X			

Table 13 continued

Key Species and Life History Stages	LOCATION: Inner Kachemak 76-77	Inner Kachemak 78	Outer Kachemak 76-77	Outer Kachemak 78	Lower Central 76-77	Lower Central 78	Kamishak 76-77	Kamishak 78	Kennedy Entrance 76-77	Kalgin Island 76-77
Limanda aspera										
larvae	X	X		X		X	X	X		
juveniles										
Mallotus villosus										
larvae	X	X	X	X	X	X	X	X	X	X
juveniles	X				X					
Osmeridae										
larvae	X	X	X	X	X	X	X	X	X	X
juveniles										X
Pandalopsis dispar										
stage I	X		X	X					X	
stage II	X			X		X				
stage III	X			X	X	X			X	X
stage IV									X	
stage V										
juveniles										
Pandalus borealis										
stage I	X	X	X		X		X		X	
stage II	X	X	X		X		X		X	
stage III		X	X	X	X		X			
stage IV	X	X	X	X		X	X	X	X	X
stage V			X	X		X	X			
stage VI										
stage VII										
juveniles										X

Table 13 continued

Key Species and Life History Stages	LOCATION: Inner Kachemak 76-77	Inner Kachemak 78	Outer Kachemak 76-77	Outer Kachemak 78	Lower Central 76-77	Lower Central 78	Kamishak 76-77	Kamishak 78	Kennedy Entrance 76-77	Kalgin Island 76-77
Pandalus danae										
stage I										
stage II		X					X	X		
stage III								X		
stage IV										
stage V						X				X
stage VI										
juveniles										
Pandalus goniurus										
stage I	X	X	X				X		X	X
stage II	X	X	X			X	X	X		
stage III		X	X	X	X	X	X	X		
stage IV	X			X		X		X		
stage V				X		X		X		
stage VI										
stage VII										
juveniles	X									
Pandalus hypsinotus										
stage I	X		X							
stage II				X						
stage III						X				
stage IV				X						
stage V										
stage VI										
juveniles										

Table 13 continued

Key Species and Life History Stages	LOCATION Inner Kachemak 76-77	Inner Kachemak 78	Outer Kachemak 76-77	Outer Kachemak 78	Lower Central 76-77	Lower Central 78	Kamishak 76-77	Kamishak 78	Kennedy Entrance 76-77	Kalgin Island 76-77
Pandalus platyceros										
stage I										
stage II					X					
stage III										
stage IV										
juveniles										
Pandalus stenolepis										
stage I					X	X			X	
stage II					X	X	X		X	
stage III	X				X	X				
stage IV						X			X	
stage V										
stage VI									X	
juveniles										
Pandalus montagui tridens										
stage I			X		X				X	
stage II					X					
stage III						X			X	
stage IV										
juveniles										
Anomura										
zoea	X	X	X	X	X	X	X	X	X	X
megalopa	X	X	X	X	X	X	X	X	X	X
Brachyura										
zoea	X	X	X	X	X	X	X	X	X	X
megalopa	X	X	X	X	X	X	X	X	X	X

Table 13 continued

Key Species and Life History Stages	LOCATION									
	Inner Kachemak		Outer Kachemak		Lower Central		Kamishak		Kennedy Entrance	Kalgin Island
	76-77	78	76-77	78	76-77	78	76-77	78	76-77	76-77
Paralithodes camtschatica										
stage I	X		X		X		X		X	X
stage II	X		X		X	X	X	X		
stage III		X		X		X	X	X		
stage IV		X		X		X		X		
megalopa						X				X
Cancer magister										
stage I	X	X		X		X				
stage II		X	X	X		X		X		
stage III				X		X		X		
stage IV						X				
stage V				X		X				
megalopa				X		X				
Cancer spp.										
stage I	X	X	X	X	X	X	X	X	X	X
stage II	X	X	X	X	X	X	X	X	X	X
stage III	X	X	X	X	X	X	X	X	X	X
stage IV	X		X	X	X	X	X	X	X	X
stage V	X	X	X	X	X	X	X		X	X
megalopa	X		X	X	X	X	X	X	X	X
Chionoecetes bairdi										
stage I	X	X	X	X	X	X	X	X		X
stage II				X		X				
megalopa	X			X	X	X	X		X	X

Table 14. Seasonality-critical periods of use by area during four seasons in Lower Cook Inlet in 1976, 1977, and 1978.

	1976-1977-1978			
Inner Kachemak Bay	Spring	Summer	Fall	Winter
Fish eggs				
<1 mm	X	X	X	
∿1 mm	X	X		
∿2 mm	X			
∿3 mm	X			
Ammodytes hexapterus	X			X
Clupea harengus pallasi	X			
Gadidae				
Hippoglossoides elassodon	X	X		
Limanda aspera	X	X	X	
Mallotus villosus	X	X	X	X
Osmeridae	X	X		X
Pandalopsis dispar	X	X		
Pandalus borealis	X	X		
Pandalus danae	X			
Pandalus goniurus	X	X		
Pandalus hypsinotus	X			
Pandalus platyceros				
Pandalus stenolepis		X		
Pandalus montagui tridens				
Anomura	X	X	X	X
Brachyura	X	X	X	X
Paralithodes camtschatica	X			X
Cancer magister	X	X		
Cancer spp.	X	X	X	X
Chionoecetes bairdi	X	X		

Table 14 continued

Outer Kachemak Bay	1976-1977-1978 Spring	Summer	Fall	Winter
Fish eggs				
<1 mm	X	X	X	
∿1 mm	X	X	X	
∿2 mm	X		X	
∿3 mm	X			
Ammodytes hexapterus	X	X		X
Clupea harengus pallasi		X		
Gadidae	X	X		
Hippoglossoides elassodon	X	X		
Limanda aspera	X	X	X	
Mallotus villosus	X	X	X	X
Osmeridae	X	X	X	X
Pandalopsis dispar	X	X		X
Pandalus borealis	X	X		
Pandalus danae				
Pandalus goniurus	X			
Pandalus hypsinotus	X	X		
Pandalus platyceros				
Pandalus stenolepis				
Pandalus montagui tridens	X			
Anomura	X	X	X	X
Brachyura	X	X	X	
Paralithodes camtschatica	X			X
Cancer magister	X	X	X	
Cancer spp.	X	X	X	
Chionoecetes bairdi	X		X	

Table 14. continued

Lower Central Cook Inlet	Spring	Summer	Fall	Winter
	1976-1977-1978			
Fish eggs				
<1 mm	X	X	X	
~1 mm	X	X		
~2 mm	X	X		
~3 mm	X			
Ammodytes hexapterus	X	X		
Clupea harengus pallasi	X	X		
Gadidae	X	X		
Hippoglossoides elassodon	X	X		
Limanda aspera	X	X	X	
Mallotus villosus	X	X	X	
Osmeridae	X	X	X	X
Pandalopsis dispar	X			
Pandalus borealis	X	X		
Pandalus danae	X			
Pandalus goniurus	X	X		
Pandalus hypsinotus		X		
Pandalus platyceros				X
Pandalus stenolepis	X	X		
Pandalus montagui tridens	X			
Anomura	X	X	X	
Brachyura	X	X	X	
Paralithodes camtschatica	X			
Cancer magister	X	X	X	
Cancer spp.	X	X	X	
Chionoecetes bairdi	X	X		

Table 14 continued

Kamishak Bay	Spring	Summer	Fall	Winter
	1976-1977-1978			
Fish eggs				
<1 mm	X	X	X	
∿1 mm	X	X		
∿2 mm	X	X		
∿3 mm				
Ammodytes hexapterus	X			
Clupea harengus pallasi	X	X		
Gadidae				
Hippoglossoides elassodon	X	X		
Limanda aspera	X	X		
Mallotus villosus	X	X	X	
Osmeridae	X	X	X	X
Pandalopsis dispar				
Pandalus borealis	X	X		
Pandalus danae	X	X		
Pandalus goniurus	X	X		
Pandalus hypsinotus				
Pandalus platyceros				
Pandalus stenolepis		X		
Pandalus montagui tridens				
Anomura	X	X	X	
Brachyura	X	X	X	
Paralithodes camtschatica	X	X		
Cancer magister	X	X	X	
Cancer spp.	X	X	X	
Chionoecetes bairdi	X			

Table 14 continued

Kennedy Entrance	1976-1977-1978 Spring	Summer	Fall	Winter
Fish eggs				
<1 mm		X		
∿1 mm	X	X		
∿2 mm	X	X		
∿3 mm	X	X		
Ammodytes hexapterus	X			
Clupea harengus pallasi				
Gadidae	X	X		
Hippoglossoides elassodon		X		
Limanda aspera				
Mallotus villosus	X	X		
Osmeridae		X	X	X
Pandalopsis dispar	X	X		
Pandalus borealis	X	X		
Pandalus danae				
Pandalus goniurus	X			
Pandalus hypsinotus				
Pandalus platyceros				
Pandalus stenolepis	X	X		
Pandalus montagui tridens	X	X		
Anomura	X	X		
Brachyura	X	X		X
Paralithodes camtschatica	X			
Cancer magister		X	X	
Cancer spp.		X	X	
Chionoecetes bairdi	X	X		

Table 14 continued

Kalgin Island	Spring	Summer	Fall	Winter
	1976-1977-1978			
Fish eggs				
<1 mm		X		
∿1 mm	X			
∿2 mm	X	X		
∿3 mm				
Ammodytes hexapterus	X			X
Clupea harengus pallasi		X	X	
Gadidae	X			
Hippoglossoides elassodon		X		
Limanda aspera				
Mallotus villosus		X		
Osmeridae		X		X
Pandalopsis dispar		X		
Pandalus borealis		X		
Pandalus danae		X		
Pandalus goniurus	X			
Pandalus hypsinotus				
Pandalus platyceros				
Pandalus stenolepis				
Pandalus montagui tridens				
Anomura	X	X	X	X
Brachyura	X	X		X
Paralithodes camtschatica	X	X		
Cancer magister		X		X
Cancer spp.		X	X	X
Chionoecetes bairdi	X	X		

APPENDIX A

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APPENDIX B

Density per 10 square meters

1976-1977.

FISH EGGS/10 SQ M

STATION	SIZE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	<1 MM	0	0	0	4	0	0	0
	1 MM	0	2	0	1	0	0	0
	2 MM	1	2	2	0	0	0	0
	3 MM	0	87	96	0	0	0	0
2	<1 MM	0	1	0	2	0	0	0
	1 MM	0	0	12	35	0	0	0
	2 MM	0	1	1	1	0	0	0
	3 MM	0	0	1	0	0	0	0
3	<1 MM	0	0	0	2	0	0	0
	1 MM	11	80	281	0	0	0	0
	2 MM	0	11	8	1	0	0	0
	3 MM	0	0	0	0	0	0	0
4	<1 MM	0	0	0	3	0	0	0
	1 MM	0	0	3	0	0	0	0
	2 MM	0	0	1	0	0	0	0
	3 MM	0	0	0	0	0	0	0
5	<1 MM	0	0	1	438	30	0	0
	1 MM	1	100	138	90	2	0	0
	2 MM	0	5	5	0	0	0	0
	3 MM	0	0	3	0	0	0	0
6	<1 MM	0	0	16	291	21	0	0
	1 MM	21	5550	2701	3	1	0	0
	2 MM	2	0	0	0	0	0	0
	3 MM	0	0	0	0	0	0	0
7	<1 MM	0	0	62	290	0	0	0
	1 MM	101	96	1485	52	0	0	0
	2 MM	0	1	2	0	1	0	0
	3 MM	0	0	0	0	0	0	0
8	<1 MM		0	144	811	0	0	0
	1 MM		938	712	49	0	0	0
	2 MM		10	1	0	0	0	0
	3 MM		0	0	0	0	0	0

CONTINUATION-FISH EGGS/10 SQ M

9	<1 MM	0	0		3	0	0	0
	1 MM	1	30		3	0	0	0
	2 MM	1	3		1	0	0	0
	3 MM	0	26		1	1	0	0
10	<1 MM	0		4	0	1		0
	1 MM	3		4	2	0		0
	2 MM	0		27	1	0		0
	3 MM	0		14	2	0		0

HIPPOGLOSSOIDES SP./10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	45	7	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	1	2	1	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	0	1	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	6	1	0	0	0
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	2	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	48	0	0	0
	JUV	0	0	0	0	1	0	0
8	LAR		0	0	15	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		8	2	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	12	0		0
	JUV	0		0	0	0		0

GADIDAE/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	26	5	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	13	2	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-GADIDAE/10 SQ M

3	LAR	0	0	1	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	1	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	1	0	0	0
	JUV	0	0	0	0	1	0	0
6	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	14	4		4	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	0	0		0
	JUV	0		0	0	0		0

OSMERIDAE/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	0	752	659	2	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	3	0	571	137	0	29
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	21	29	0	0
	JUV	0	0	0	0	0	0	1
4	LAR	0	0	0	351	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	368	224	0	1
	JUV	0	0	0	0	0	0	0
6	LAR	0	1	0	0	275	0	1
	JUV	0	0	0	0	0	0	0

CONTINUATION-OSMERIDAE/10 SQ M

7	LAR	0	0	0	51	8	2	1
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	2	2	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		207	49	2	4
	JUV	0	0		0	0	0	0
10	LAR	0		0	238	17		0
	JUV	0		0	0	0		0

MALLOTUS VILLOSUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	5	11	0	2505	233	17	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	0	633	85	9	0
	JUV	0	0	0	0	1	0	0
3	LAR	0	0	0	346	11	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	412	2	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	560	272	0	1
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	14	1383	1	0
	JUV	0	0	0	0	0	0	1
7	LAR	0	0	0	299	21	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	40	144	7	0
	JUV		0	0	0	0	0	0
9	LAR	7	0		170	49	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	85	15		0
	JUV	0		0	0	0		0

CLUPEA HARENGUS PALLASI/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	31	4	0	0
	JUV	0	0	0	0	0	1	0
5	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	5	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	0	0		0
	JUV	0		0	0	0		0

AMMODYTES HEXAPTERUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	5	0	8	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	2	30	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	13	28	3	0	0	0	13
	JUV	0	0	0	0	0	0	0

CONTINUATION-AMMODYTES HEXAPTERUS/10 SQ M

4	LAR	0	1	5	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	1	324	155	0	0	0	7
	JUV	0	0	0	0	0	0	0
6	LAR	10	394	1	0	0	0	22
	JUV	0	0	0	0	0	0	0
7	LAR	9	1	24	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		47	9	0	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	1	2		0	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	1		0	0	0		0
	JUV	0		0	0	0		0

ANOMURA/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	ZOE	12	346	438	534	854	0	0
	MEG	0	0	0	0	30	0	0
2	ZOE	0	199	3363	181	132	17	0
	MEG	0	0	0	16	14	0	0
3	ZOE	0	0	25	674	2	0	6
	MEG	0	0	0	0	4	1	0
4	ZOE	0	1	1	15	7	0	0
	MEG	0	0	0	1	4	0	0
5	ZOE	0	951	777	1084	1170	7	1
	MEG	0	0	0	0	3	8	0
6	ZOE	22	248	7	238	304	0	50
	MEG	0	0	0	9	4	0	0
7	ZOE	0	33	208	550	16	1	0
	MEG	0	0	0	0	4	1	0
8	ZOE		47	953	16	222	1	0
	MEG		0	0	0	10	1	0
9	ZOE	0	86		547	24	0	0
	MEG	0	0		24	1	0	0
10	ZOE	0		16	12	0		0
	MEG	0		0	0	0		0

BRACHYURA/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	ZOE	0	274	1479	1216	53	0	0
	MEG	0	0	0	365	7	0	0
2	ZOE	0	330	3767	402	231	0	0
	MEG	0	0	0	96	34	0	0

CONTINUATION-BRACHYURA/10 SQ M

3	ZOE	0	35	1030	773	73	0	1
	MEG	0	0	0	65	5	0	0
4	ZOE	0	0	63	16	199	0	0
	MEG	0	0	0	1	1	0	0
5	ZOE	0	286	3535	1529	1056	1	0
	MEG	0	0	0	46	9	0	0
6	ZOE	0	1131	5639	606	395	0	267
	MEG	0	0	0	0	10	0	0
7	ZOE	0	32	256	2446	0	2	0
	MEG	0	0	0	69	1	0	0
8	ZOE		9	3026	22	414	0	0
	MEG		0	0	2	10	0	0
9	ZOE	0	122		1310	5	0	1
	MEG	0	0		1554	1	0	0
10	ZOE	0		113	28	3		0
	MEG	0		0	102	1		0

CANCER MAGISTER/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	1	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	1	2	0
	MEG	0	0	0	0	1	63	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	1	0	0
	MEG	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	3	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	1	0	0
6	I	0	0	0	2	0	0	0
	II	0	0	0	0	1	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

CONTINUATION-CANCER MAGISTER/10 SQ M

8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	2	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	MEG		0	0	0	2	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	MEG	0	0		0	1	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	MEG	0		0	0	0		0

CANCER SPP./10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	9	8	3112	0	0	0
	II	0	0	0	1093	0	0	0
	III	0	0	0	89	37	0	0
	IV	0	0	0	3	90	0	0
	V	0	0	0	0	122	0	0
	MEG	0	0	0	0	20	0	0
2	I	0	1	0	267	4	0	0
	II	0	0	0	369	11	0	0
	III	0	0	0	22	168	0	0
	IV	0	0	0	0	796	0	0
	V	0	0	0	0	318	0	0
	MEG	0	0	0	0	27	13	0

CONTINUATION-CANCER SPP./10 SQ M

3	I	0	0	0	6426	1	0	1
	II	0	0	0	899	1	0	0
	III	0	0	0	37	12	0	0
	IV	0	0	0	0	36	0	0
	V	0	0	0	0	25	0	0
	MEG	0	0	0	0	1	0	0
4	I	0	0	0	10	0	0	0
	II	0	0	0	4	3	0	0
	III	0	0	0	0	6	0	0
	IV	0	0	0	0	39	0	0
	V	0	0	0	0	6	0	0
	MEG	0	0	0	0	1	0	0
5	I	0	0	0	6378	1	0	0
	II	0	0	0	359	1	0	0
	III	0	0	0	3	34	0	0
	IV	1	0	0	0	339	0	0
	V	0	0	3	0	113	0	0
	MEG	0	0	0	0	44	8	0
6	I	0	0	0	134	3	0	41
	II	0	0	0	9	7	0	0
	III	0	0	0	0	60	0	0
	IV	0	0	0	0	185	0	0
	V	0	0	0	0	130	0	0
	MEG	0	0	0	0	48	0	0
7	I	0	0	0	4	0	0	0
	II	0	0	0	1	2	0	0
	III	0	0	0	0	10	0	0
	IV	0	0	0	0	15	0	0
	V	0	0	0	0	7	0	0
	MEG	0	0	0	0	1	11	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	80	0	0
	IV		0	0	0	494	0	0
	V		0	0	0	288	0	0
	MEG		0	0	0	2	2	0
9	I	0	0		164	0	0	0
	II	0	0		87	0	0	0
	III	0	0		158	7	0	0
	IV	0	0		0	35	0	0
	V	0	0		0	181	1	0
	MEG	0	0		0	70	0	0

CONTINUATION-CANCER SPP./10 SQ M

10	I	0		0	2	0		0
	II	0		0	63	0		0
	III	0		0	27	1		0
	IV	0		0	2	3		0
	V	0		0	0	14		0
	MEG	0		0	0	3		0

CHIONOECETES BAIRDI/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	1	23	3	0	0	0
	II	0	0	0	211	0	0	0
	MEG	0	2	10	0	3	2	0
2	I	0	0	378	0	0	0	0
	II	0	0	0	1	0	0	0
	MEG	0	10	0	0	8	0	0
3	I	0	1	10	3	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	2	0	0	1	0	0
4	I	0	1	0	2	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	0	1	0	0	0	0
5	I	0	763	942	0	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
6	I	0	0	419	0	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	0	0	0	1	0	0
7	I	0	0	18	0	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	1	0	0	0	0	0
8	I		0	22	0	0	0	0
	II		0	0	0	0	0	0
	MEG		1	2	0	0	0	0

CONTINUATION-CHIONOECETES BAIRDI/10 SQ M

9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	MEG	1	2		0	2	0	0
10	I	0		40	0	0		0
	II	0		0	6	0		0
	MEG	1		5	0	0		0

PARALITHODES CAMTSCHATICA/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	7	0	0	0	0
	II	0	0	6	0	0	0	0
	III	0	0	5	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
2	I	0	0	2	0	0	0	0
	II	0	0	30	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	1	0	0	0
3	I	0	2	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	7	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	546	0	0	0	0	10
	II	0	322	153	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

CONTINUATION-PARALITHODES CAMTSCHATICA/10 SQ M

6	I	1	259	0	0	0	0	4
	II	1	143	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	434	37	0	0	0	0
	II	0	1	461	0	0	0	0
	III	0	0	51	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	1	0	0	0
8	I		361	0	0	0	0	0
	II		7	85	0	0	0	0
	III		0	104	0	0	0	0
	IV		0	0	0	0	0	0
	MEG		0	0	0	0	0	0
9	I	0	39		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	MEG	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	MEG	0		0	0	0		0

PANDALOPSIS DISPAR/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	3	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	6
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	1	0	0	0	0	0	0
	II	0	2	0	0	0	0	0
	III	0	0	0	0	1	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALOPSIS DISPAR/10 SQ M

7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	1	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		1	0	0	0
	IV	0	0		0	1	0	0
	V	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		1	0	0		0
	II	0		0	0	0		0
	III	0		1	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS BOREALIS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	34	0	0	0	0	0
	II	0	23	10	0	0	0	0
	III	0	0	55	0	0	0	0
	IV	0	0	2	1	0	0	0
	V	0	0	0	2	1	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	5	0	0

CONTINUATION-PANDALUS BOREALIS/10 SQ M

2	I	0	1	1	0	0	0	0
	II	0	1	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	156	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	1	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	1	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	1	0	0
5	I	0	211	18	0	0	0	0
	II	0	76	5	0	0	0	0
	III	0	0	42	0	0	0	0
	IV	0	0	5	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	1	618	0	0	0	0	0
	II	0	18	5	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	1	2	0	0
	V	0	0	0	1	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS BOREALIS/10 SQ M

7	I	0	17	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	1	0	0	0
	IV	0	0	0	53	0	0	0
	V	0	0	0	1	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	1	0	0	0	0
	II		0	1	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	1	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	VII		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	69		0	0	0	0
	II	0	34		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		5	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	VII	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		1	0	0		0
	III	0		5	7	0		0
	IV	0		2	8	0		0
	V	0		0	2	0		0
	VI	0		0	0	0		0
	VII	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS DANAE/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	1	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	2	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS DANAE/10 SQ M

6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	1	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS GONIURUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	1	6	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	1146	42	0	0	0	0
	II	0	172	1176	0	0	0	0
	III	0	0	666	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS GONIURUS/10 SQ M

6	I	1	2109	9	0	0	0	0
	II	0	0	9	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	7	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	1	0	0	0
7	I	0	88	699	0	0	0	0
	II	0	0	3666	0	0	0	0
	III	0	0	322	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		874	1	0	0	0	0
	II		15	27	0	0	0	0
	III		0	6	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	VII		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	38		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	VII	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		1	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	VII	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS HYPSINOTUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	1	3	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS HYPSINOTUS/10 SQ M

6	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS PLATYCEROS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	1
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS PLATYCEROS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS STENOLEPIS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	9	6	1	0	0	0
	II	0	0	3	5	0	0	0
	III	0	0	0	9	0	0	0
	IV	0	0	0	7	0	0	0
	V	0	0	0	2	0	0	0
	VI	0	0	0	1	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	1	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS STENOLEPIS/10 SQ M

4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	2	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	1	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	36		11	0	0	0
	II	0	2		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		1	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	1	0	0
	JUV	0	0		0	0	0	0

CONTINUATION-PANDALUS STENOLEPIS/10 SQ M

10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	1	0		0
	IV	0		0	1	0		0
	V	0		0	1	0		0
	VI	0		0	0	1		0
	JUV	0		0	0	0		0

PANDALUS MONTAGUI TRIDENS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	153	7	0	0	0	0
	II	0	0	76	0	0	0	0
	III	0	0	5	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	1	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS MONTAGUI TRIDENS/10 SQ M

6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	1	510		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		1	0	0	0
	IV	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		21	0	0		0
	II	0		18	0	0		0
	III	0		4	0	0		0
	IV	0		0	0	0		0
	JUV	0		0	0	0		0

APPENDIX C

Density per 1000 cubic meters

1976-1977.

FISH EGGS/1000 CU M

STATION	SIZE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	<1 MM	0	0	0	2	0	0	0
	1 MM	0	1	0	1	0	0	0
	2 MM	1	1	2	0	0	0	0
	3 MM	0	51	91	0	0	0	0
2	<1 MM	0	1	0	7	0	0	0
	1 MM	0	0	30	118	0	0	0
	2 MM	0	2	3	1	0	0	0
	3 MM	0	0	1	0	0	0	0
3	<1 MM	0	0	0	2	0	0	0
	1 MM	13	123	485	0	0	0	0
	2 MM	0	16	14	1	0	0	0
	3 MM	0	0	0	0	0	0	0
4	<1 MM	0	0	0	5	0	0	0
	1 MM	0	0	6	0	0	0	0
	2 MM	0	0	1	0	0	0	0
	3 MM	0	0	0	0	0	0	0
5	<1 MM	0	0	2	1566	100	0	0
	1 MM	3	399	306	320	6	0	0
	2 MM	0	21	12	0	0	0	0
	3 MM	0	0	7	0	0	0	0
6	<1 MM	0	0	18	399	43	0	0
	1 MM	35	7400	3001	3	1	0	0
	2 MM	3	0	0	0	0	0	0
	3 MM	0	0	0	0	0	0	0
7	<1 MM	0	0	172	1451	0	0	0
	1 MM	252	275	4125	258	0	0	0
	2 MM	0	4	4	0	1	0	0
	3 MM	0	0	0	0	0	0	0
8	<1 MM		0	449	3526	0	0	0
	1 MM		2931	2224	215	0	0	0
	2 MM		31	3	0	0	0	0
	3 MM		0	0	0	0	0	0

CONTINUATION-FISH EGGS/1000 CU M

9	<1 MM	0	0		1	0	0	0
	1 MM	1	23		2	0	0	0
	2 MM	1	2		1	0	0	0
	3 MM	0	20		1	1	0	0
10	<1 MM	0		4	0	1		0
	1 MM	3		4	1	0		0
	2 MM	0		30	1	0		0
	3 MM	0		16	2	0		0

HIPPOGLOSSOIDES SP./1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	43	5	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	1	7	1	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	0	1	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	13	4	0	0	0
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	3	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	238	0	0	0
	JUV	0	0	0	0	1	0	0
8	LAR		0	0	66	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		4	1	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	11	0		0
	JUV	0		0	0	0		0

GADIDAE/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	15	4	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	24	4	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-GADIDAE/1000 CU M

3	LAR	0	0	2	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	1	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	4	0	0	0
	JUV	0	0	0	0	3	0	0
6	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	9	3		2	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	0	0		0
	JUV	0		0	0	0		0

OSMERIDAE/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	0	501	404	1	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	5	0	1904	195	0	42
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	26	61	0	0
	JUV	0	0	0	0	0	0	1
4	LAR	0	0	0	586	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	1315	746	0	2
	JUV	0	0	0	0	0	0	0
6	LAR	0	2	0	0	550	0	1
	JUV	0	0	0	0	0	0	0

CONTINUATION-OSMERIDAE/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
7	LAR	0	0	0	254	17	6	2
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	7	7	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		103	42	1	2
	JUV	0	0		0	0	0	0
10	LAR	0		0	229	12		0
	JUV	0		0	0	0		0

MALLOTUS VILLOSUS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	4	6	0	1670	143	10	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	0	2110	121	13	0
	JUV	0	0	0	0	1	0	0
3	LAR	0	0	0	417	24	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	687	2	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	1999	907	0	2
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	19	2766	2	0
	JUV	0	0	0	0	0	0	1
7	LAR	0	0	0	1495	44	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	174	424	24	0
	JUV		0	0	0	0	0	0
9	LAR	5	0		85	42	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	81	11		0
	JUV	0		0	0	0		0

CLUPEA HARENGUS PALLASI/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	52	4	0	0
	JUV	0	0	0	0	0	2	0
5	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	22	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	0	0		0
	JUV	0		0	0	0		0

AMMODYTES HEXAPTERUS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	4	0	8	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	4	76	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	16	43	6	0	0	0	37
	JUV	0	0	0	0	0	0	0

CONTINUATION-AMMODYTES HEXAPTERUS/1000 CU M

4	LAR	0	2	12	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	1	1296	344	0	0	0	18
	JUV	0	0	0	0	0	0	0
6	LAR	17	525	1	0	0	0	31
	JUV	0	0	0	0	0	0	0
7	LAR	22	2	68	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		145	29	0	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	1	1		0	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	1		0	0	0		0
	JUV	0		0	0	0		0

ANOMURA/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	ZOE	10	203	417	356	524	0	0
	MEG	0	0	0	0	19	0	0
2	ZOE	0	375	8408	602	189	26	0
	MEG	0	0	0	55	20	0	0
3	ZOE	0	0	44	811	4	0	18
	MEG	0	0	0	0	9	2	0
4	ZOE	0	1	2	25	8	0	0
	MEG	0	0	0	2	4	0	0
5	ZOE	0	3805	1726	3871	3699	21	2
	MEG	0	0	0	0	10	22	0
6	ZOE	38	330	6	326	609	0	71
	MEG	0	0	0	13	8	0	0
7	ZOE	0	95	577	2751	33	3	0
	MEG	0	0	0	0	7	3	0
8	ZOE		146	2980	69	653	2	0
	MEG		0	0	0	30	2	0
9	ZOE	0	66		273	21	0	0
	MEG	0	0		12	1	0	0
10	ZOE	0		20	12	0		0
	MEG	0		0	0	0		0

BRACHYURA/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	ZOE	0	161	1409	811	32	0	0
	MEG	0	0	0	244	4	0	0
2	ZOE	0	623	9418	1340	330	0	0
	MEG	0	0	0	322	48	0	0

CONTINUATION-BRACHYURA/1000 CU M

3	ZOE	0	54	1776	931	152	0	1
	MEG	0	0	0	78	10	0	0
4	ZOE	0	0	207	26	221	0	0
	MEG	0	0	0	1	1	0	0
5	ZOE	0	1144	7855	5462	3526	2	0
	MEG	0	0	0	165	29	0	0
6	ZOE	0	1508	6266	833	791	0	409
	MEG	0	0	0	0	20	0	0
7	ZOE	0	92	710	12226	19	6	0
	MEG	0	0	0	343	1	0	0
8	ZOE		27	11332	95	1219	0	0
	MEG		0	0	10	30	0	0
9	ZOE	0	93		655	4	0	1
	MEG	0	0		777	1	0	0
10	ZOE	0		125	27	2		0
	MEG	0		0	98	1		0

CANCER MAGISTER/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	1	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	1	1	0
	MEG	0	0	0	0	1	37	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	2	0	0
	MEG	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	12	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	4	0	0
6	I	0	0	0	3	0	0	0
	II	0	0	0	0	2	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

CONTINUATION-CANCER MAGISTER/1000 CU M

8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	7	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	MEG		0	0	0	5	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	MEG	0	0		0	1	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	MEG	0		0	0	0		0

CANCER SPP./1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	5	7	2075	0	0	0
	II	0	0	0	729	0	0	0
	III	0	0	0	60	23	0	0
	IV	0	0	0	2	55	0	0
	V	0	0	0	0	75	0	0
	MEG	0	0	0	0	12	0	0
2	I	0	1	0	956	6	0	0
	II	0	0	0	1230	16	0	0
	III	0	0	0	73	240	0	0
	IV	0	0	0	0	1137	0	0
	V	0	0	0	0	455	0	0
	MEG	0	0	0	0	39	20	0

CONTINUATION-CANCER SPP./1000 CU M

3	I	0	0	0	7742	2	0	1
	II	0	0	0	1063	3	0	0
	III	0	0	0	45	26	0	0
	IV	0	0	0	0	76	0	0
	V	0	0	0	0	52	0	0
	MEG	0	0	0	0	2	0	0
4	I	0	0	0	17	0	0	0
	II	0	0	0	0	3	0	0
	III	0	0	0	0	7	0	0
	IV	0	0	0	0	43	0	0
	V	0	0	0	0	7	0	0
	MEG	0	0	0	0	1	0	0
5	I	0	0	0	22779	5	0	0
	II	0	0	0	1281	5	0	0
	III	0	0	0	9	115	0	0
	IV	1	0	0	0	1128	0	0
	V	0	0	0	0	376	0	0
	MEG	0	0	0	0	145	23	0
6	I	0	0	0	183	7	0	58
	II	0	0	0	12	13	0	0
	III	0	0	0	0	121	0	0
	IV	0	0	0	0	370	0	0
	V	0	0	0	0	260	0	0
	MEG	0	0	0	0	96	0	0
7	I	0	0	0	20	0	0	0
	II	0	0	0	1	5	0	0
	III	0	0	0	0	21	0	0
	IV	0	0	0	0	32	0	0
	V	0	0	0	0	14	0	0
	MEG	0	0	0	0	1	37	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	235	0	0
	IV		0	0	0	1454	0	0
	V		0	0	0	848	0	0
	MEG		0	0	0	7	6	0
9	I	0	0		82	0	0	0
	II	0	0		44	0	0	0
	III	0	0		79	6	0	0
	IV	0	0		0	30	0	0
	V	0	0		0	157	1	0
	MEG	0	0		0	61	0	0

CONTINUATION-CANCER SPP./1000 CU M

10	I	0		0	1	0		0
	II	0		0	61	0		0
	III	0		0	26	1		0
	IV	0		0	1	2		0
	V	0		0	0	10		0
	MEG	0		0	0	2		0

CHIONOECETES BAIRDI/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	1	22	2	0	0	0
	II	0	0	0	141	0	0	0
	MEG	0	1	9	0	2	1	0
2	I	0	0	945	0	0	0	0
	II	0	0	0	3	0	0	0
	MEG	0	18	0	0	11	0	0
3	I	0	1	17	4	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	2	0	0	2	0	0
4	I	0	1	0	3	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	0	1	0	0	0	0
5	I	0	3053	2094	0	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
6	I	0	0	466	0	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	0	0	0	2	0	0
7	I	0	0	51	0	0	0	0
	II	0	0	0	0	0	0	0
	MEG	0	2	0	0	0	0	0
8	I		0	68	0	0	0	0
	II		0	0	0	0	0	0
	MEG		2	5	0	0	0	0

CONTINUATION-CHIONOECETES BAIRDI/1000 CU M

9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	MEG	1	2		0	1	0	0
10	I	0		45	0	0		0
	II	0		0	5	0		0
	MEG	1		5	0	0		0

PARALITHODES CAMTSCHATICA/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	6	0	0	0	0
	II	0	0	5	0	0	0	0
	III	0	0	4	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
2	I	0	0	5	0	0	0	0
	II	0	0	74	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	3	0	0	0
3	I	0	3	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	8	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	2183	0	0	0	0	25
	II	0	1287	339	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

CONTINUATION-PARALITHODES CAMTSCHATICA/1000 CU M

6	I	2	345	0	0	0	0	5
	II	1	190	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	1240	102	0	0	0	0
	II	0	4	1282	0	0	0	0
	III	0	0	140	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	1	0	0	0
8	I		1129	0	0	0	0	0
	II		20	266	0	0	0	0
	III		0	326	0	0	0	0
	IV		0	0	0	0	0	0
	MEG		0	0	0	0	0	0
9	I	0	30		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	MEG	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	MEG	0		0	0	0		0

PANDALOPSIS DISPAR/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	4	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	21
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	1	0	0	0	0	0	0
	II	0	3	0	0	0	0	0
	III	0	0	0	0	1	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALOPSIS DISPAR/1000 CU M

7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	1	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		1	0	0	0
	IV	0	0		0	1	0	0
	V	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		1	0	0		0
	II	0		0	0	0		0
	III	0		1	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS BOREALIS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	20	0	0	0	0	0
	II	0	14	10	0	0	0	0
	III	0	0	52	0	0	0	0
	IV	0	0	2	1	0	0	0
	V	0	0	0	1	1	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	3	0	0

CONTINUATION-PANDALUS BOREALIS/1000 CU M

2	I	0	1	1	0	0	0	0
	II	0	1	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	187	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	1	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	2	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	2	0	0
5	I	0	842	39	0	0	0	0
	II	0	302	12	0	0	0	0
	III	0	0	93	0	0	0	0
	IV	0	0	12	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	2	824	0	0	0	0	0
	II	0	24	5	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	1	4	0	0
	V	0	0	0	1	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS BOREALIS/1000 CU M

7	I	0	49	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	5	0	0	0
	IV	0	0	0	266	0	0	0
	V	0	0	0	5	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	2	0	0	0	0
	II		0	3	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	6	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	VII		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	53		0	0	0	0
	II	0	26		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		2	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	VII	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		1	0	0		0
	III	0		5	7	0		0
	IV	0		2	8	0		0
	V	0		0	2	0		0
	VI	0		0	0	0		0
	VII	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS DANAE/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	1	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	2	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS DANAE/1000 CU M

6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	5	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS GONIURUS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	2	11	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	4583	93	0	0	0	0
	II	0	687	2612	0	0	0	0
	III	0	0	1480	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS GONIURUS/1000 CU M

6	I	1	2812	10	0	0	0	0
	II	0	0	10	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	6	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	2	0	0	0
7	I	0	251	1942	0	0	0	0
	II	0	0	10182	0	0	0	0
	III	0	0	894	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		2730	2	0	0	0	0
	II		46	85	0	0	0	0
	III		0	17	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	VII		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	29		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	VII	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		1	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	VII	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS HYPSINOTUS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	5	6	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS HYPSINOTUS/1000 CU M

6	I	0	2	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS PLATYCEROS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	2
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS PLATYCEROS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS STENOLEPIS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	5	6	1	0	0	0
	II	0	0	3	3	0	0	0
	III	0	0	0	6	0	0	0
	IV	0	0	0	5	0	0	0
	V	0	0	0	1	0	0	0
	VI	0	0	0	1	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	2	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS STENOLEPIS/1000 CU M

4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	3	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	1	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	28		6	0	0	0
	II	0	1		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		1	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	1	0	0
	JUV	0	0		0	0	0	0

CONTINUATION-PANDALUS STENOLEPIS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	1	0		0
	IV	0		0	1	0		0
	V	0		0	1	0		0
	VI	0		0	0	1		0
	JUV	0		0	0	0		0

PANDALUS MONTAGUI TRIDENS/1000 CU M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	90	7	0	0	0	0
	II	0	0	72	0	0	0	0
	III	0	0	5	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	1	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	5	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS MONTAGUI TRIDENS/1000 CU M

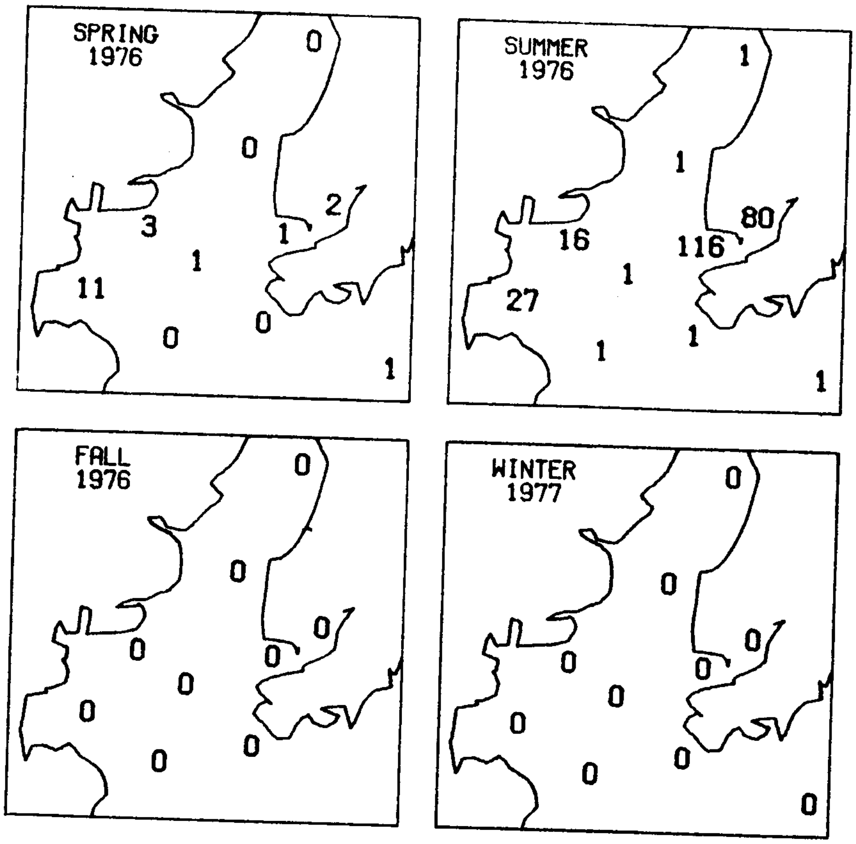
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	1	393		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		1	0	0	0
	IV	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		24	0	0		0
	II	0		20	0	0		0
	III	0		4	0	0		0
	IV	0		0	0	0		0
	JUV	0		0	0	0		0

APPENDIX D

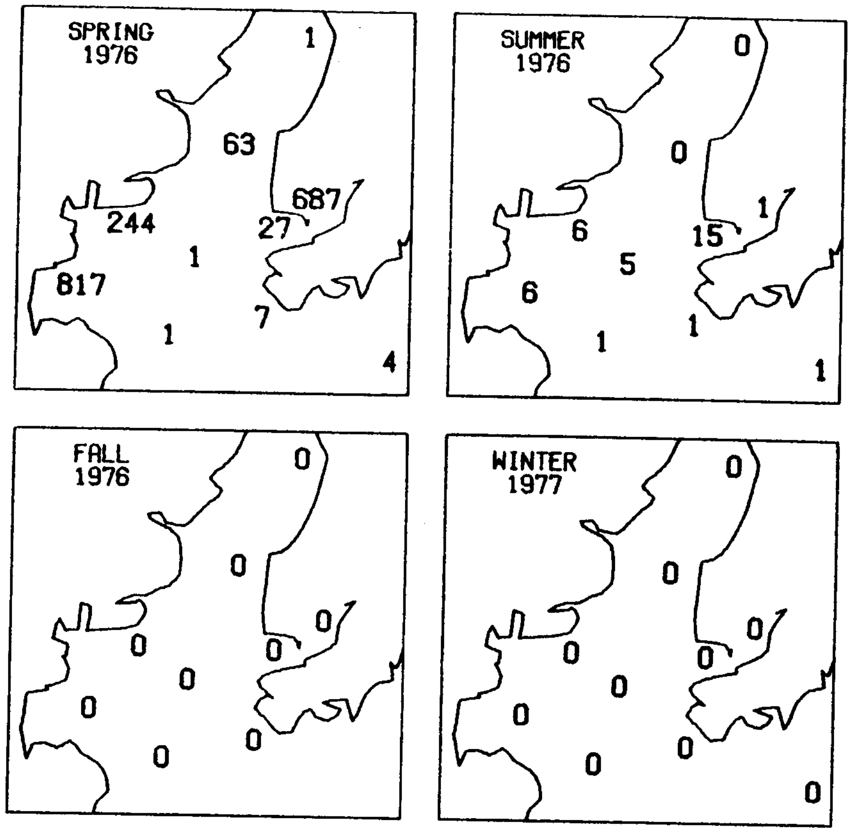
Density distributions per 10 square meters

for four seasons, 1976-1977.

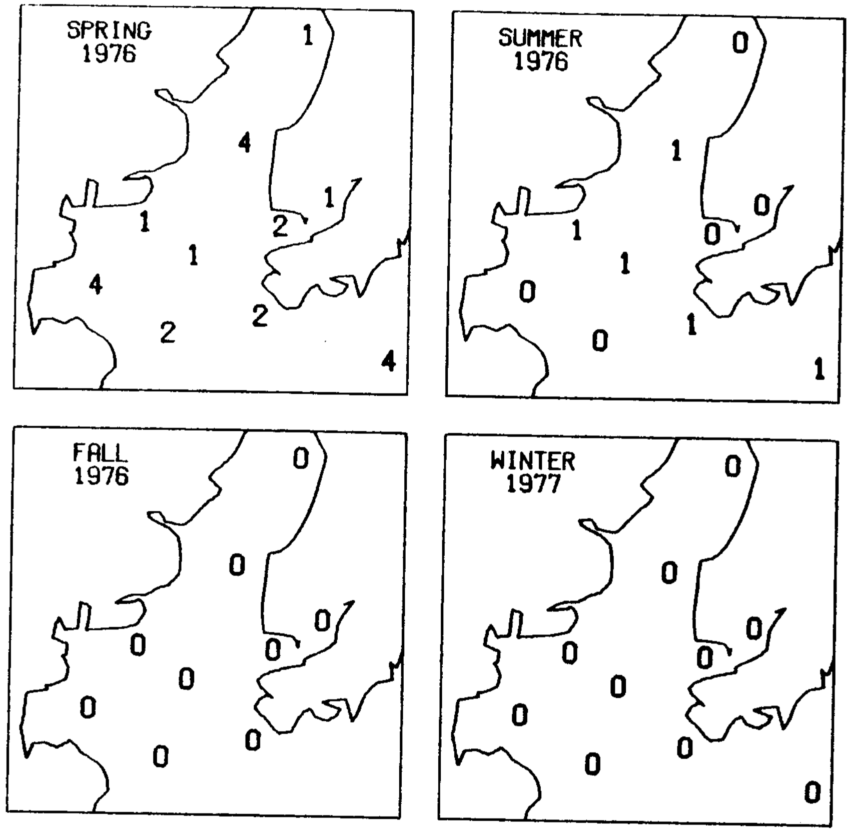
FISH EGGS
<1MM DIAM/10 SQ M



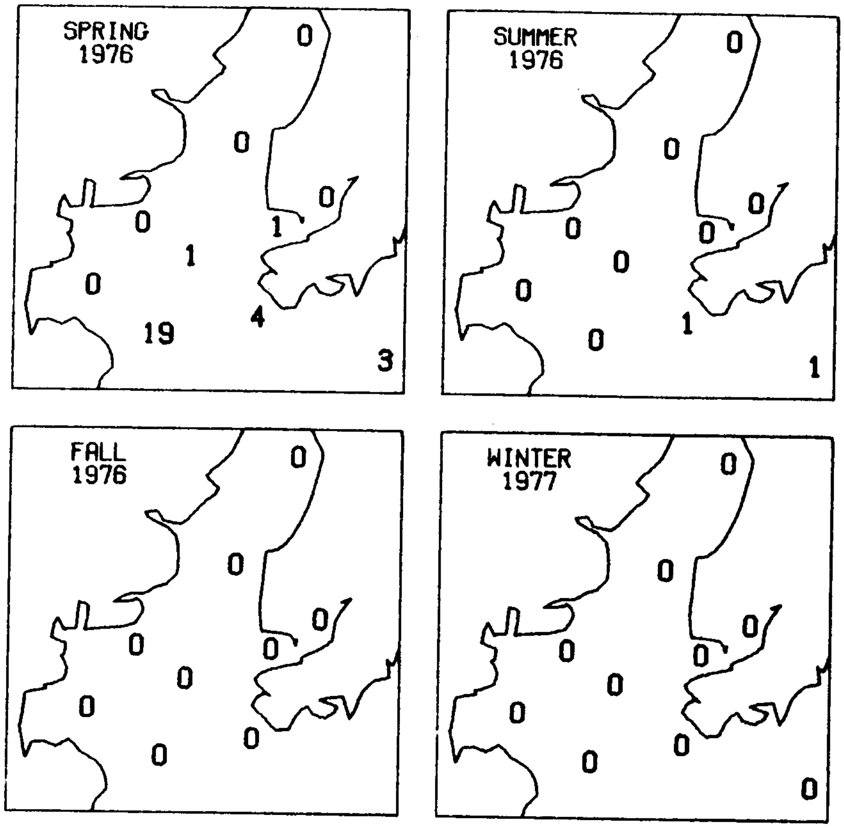
FISH EGGS
~1MM DIAM/10 SQ M



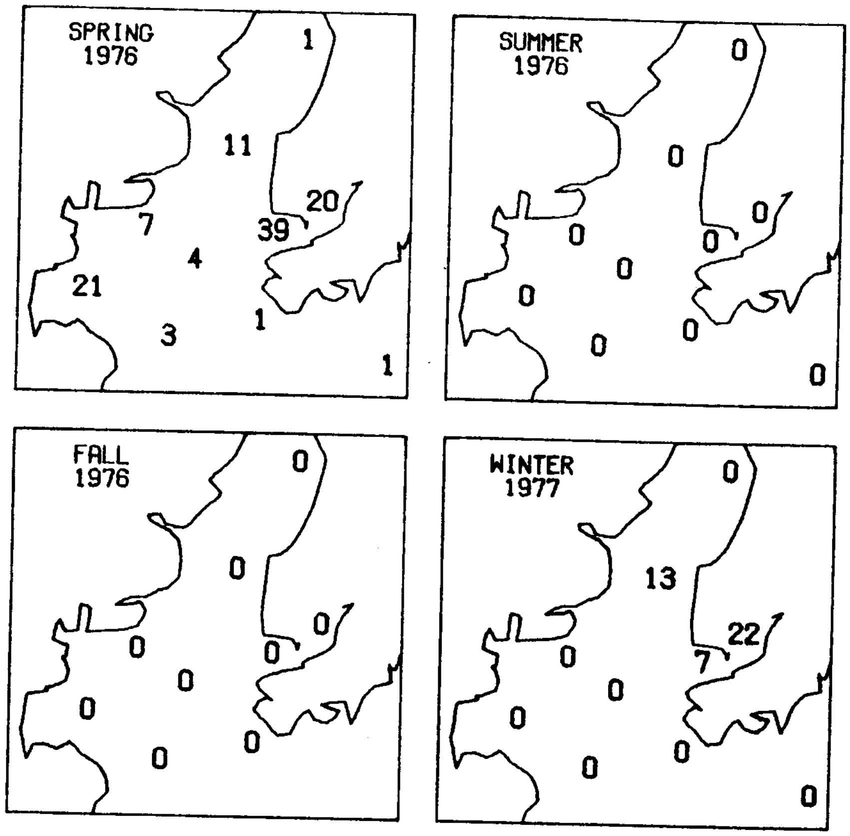
FISH EGGS
~2MM DIAM/10 SQ M



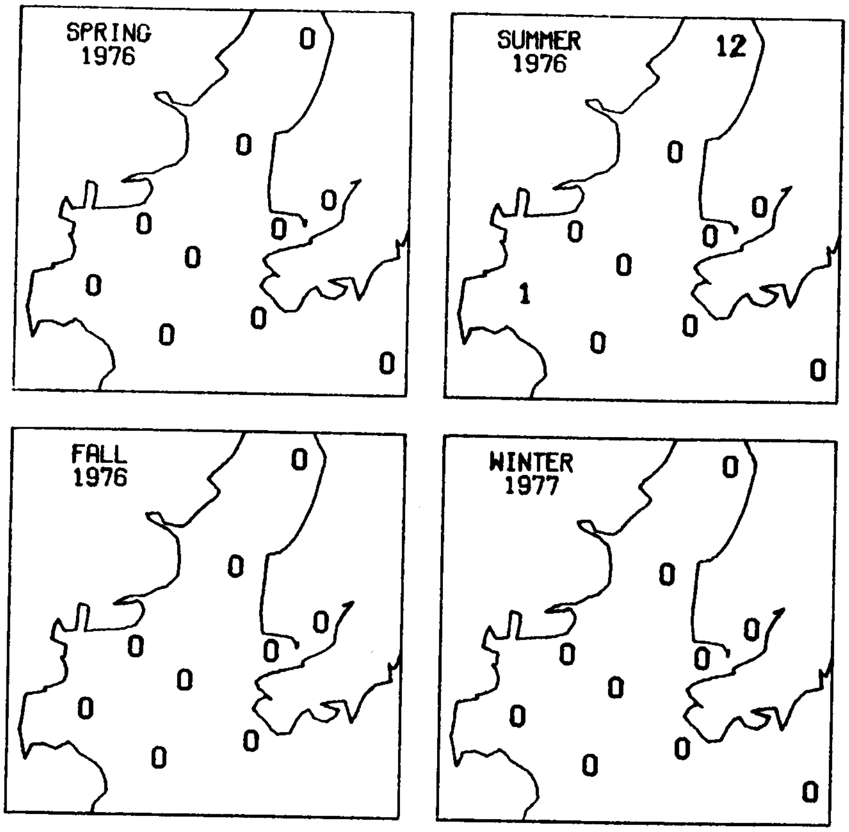
FISH EGGS
~3MM DIAM/10 SQ M



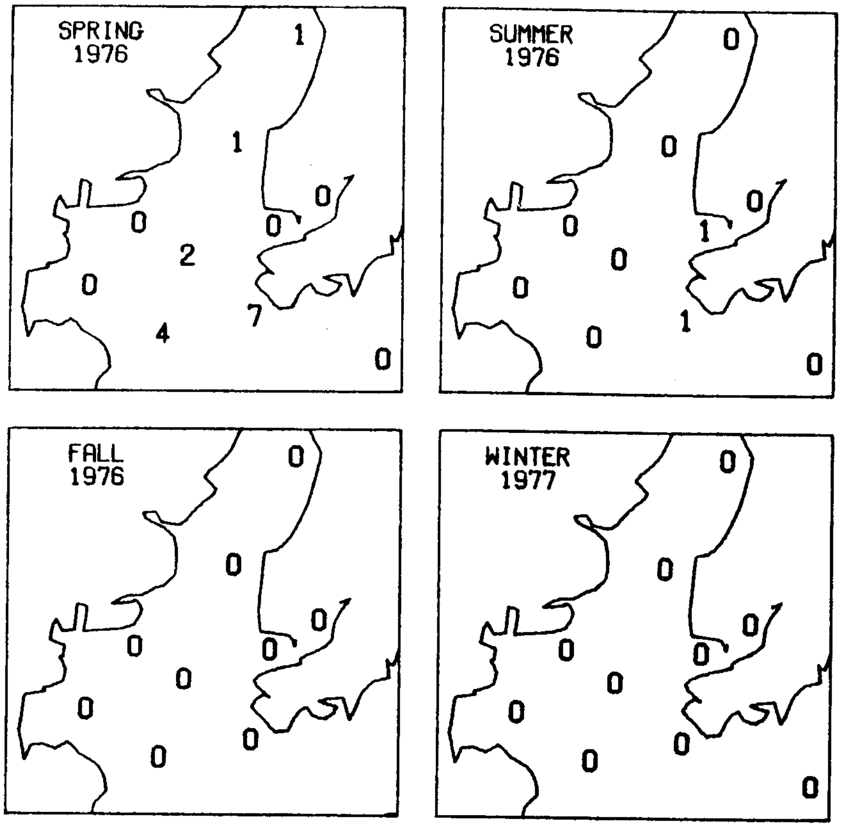
AMMODYTES HEXAPTERUS
LARVA/10 SQ M



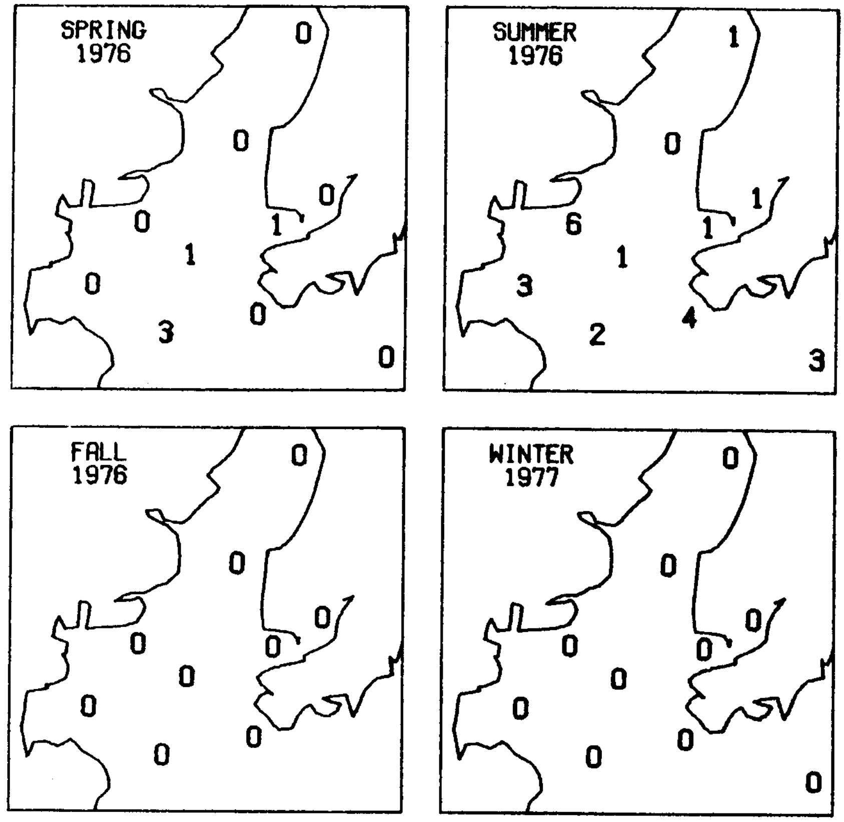
CLUPEA HARENGUS PALLASI
LARVA/10 SQ M



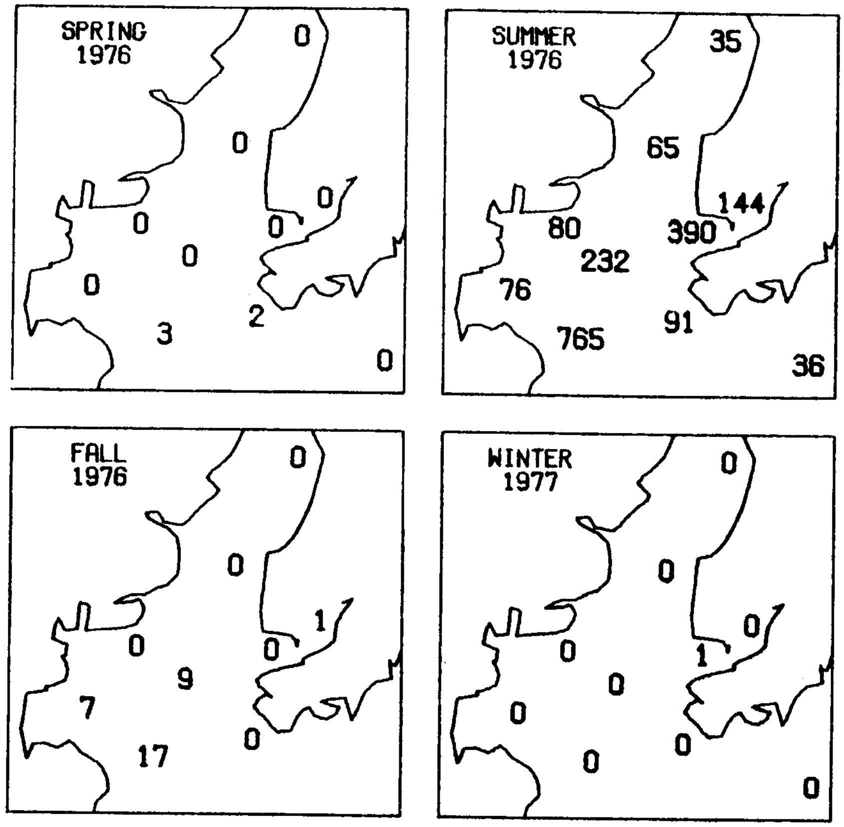
GADIDAE
LARVA/10 SQ M



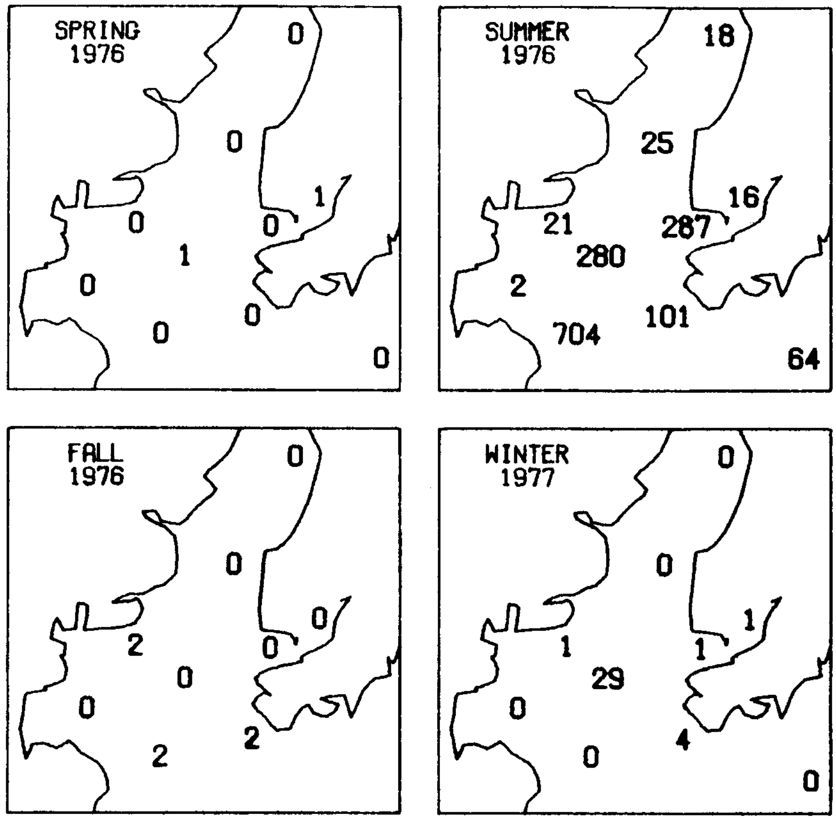
HIPPOGLOSSOIDES SP.
LARVA/10 SQ M



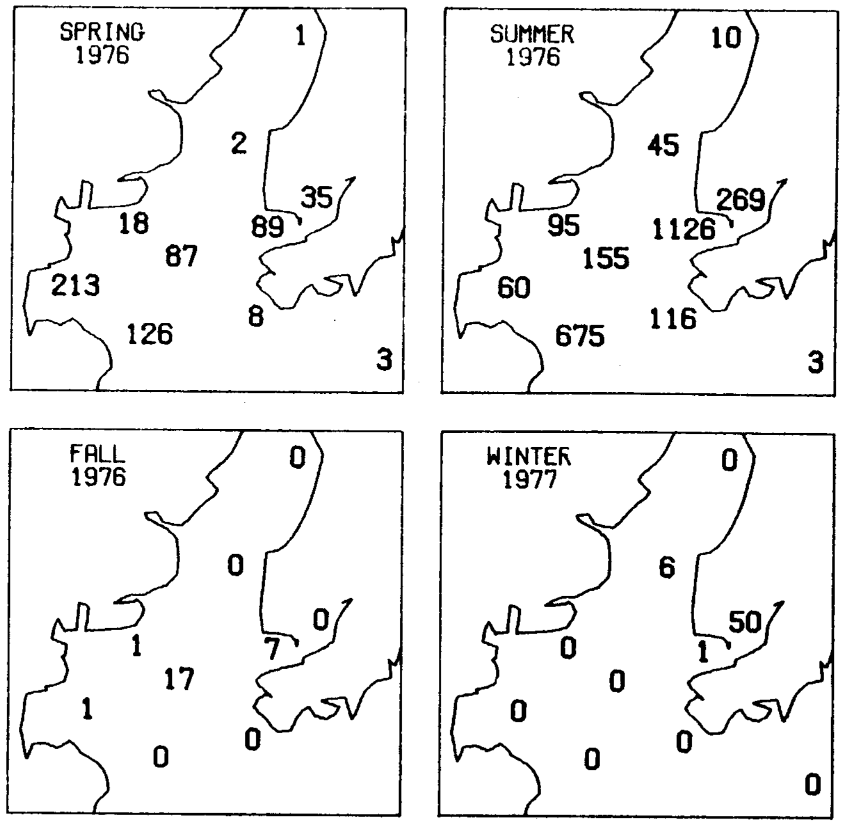
MALLOTUS VILLOSUS
LARVA/10 SQ M



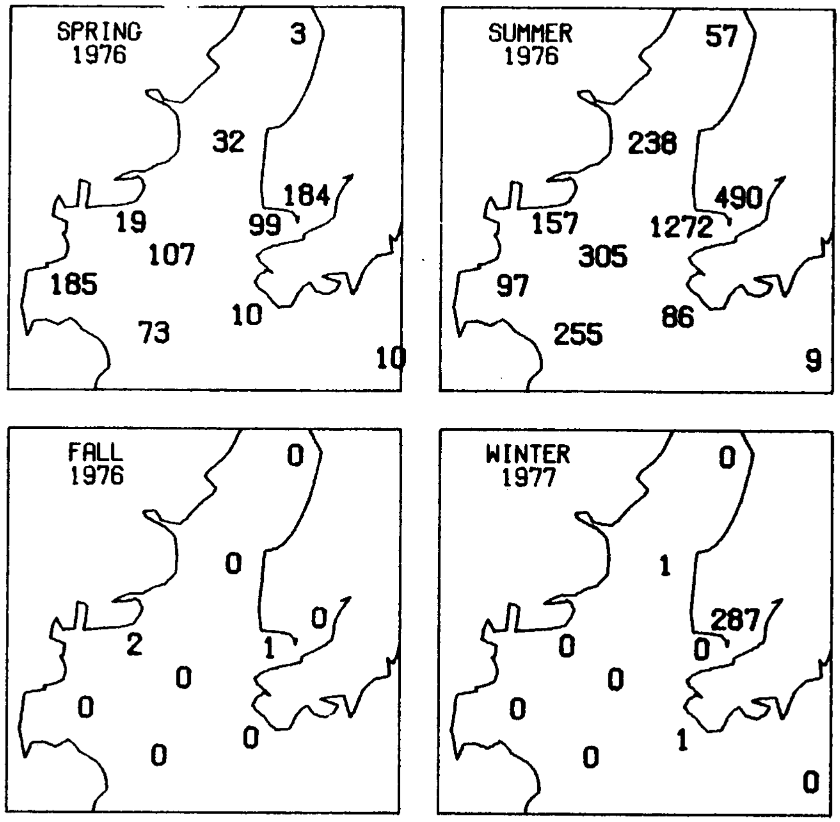
OSMERIDAE
LARVA/10 SQ M



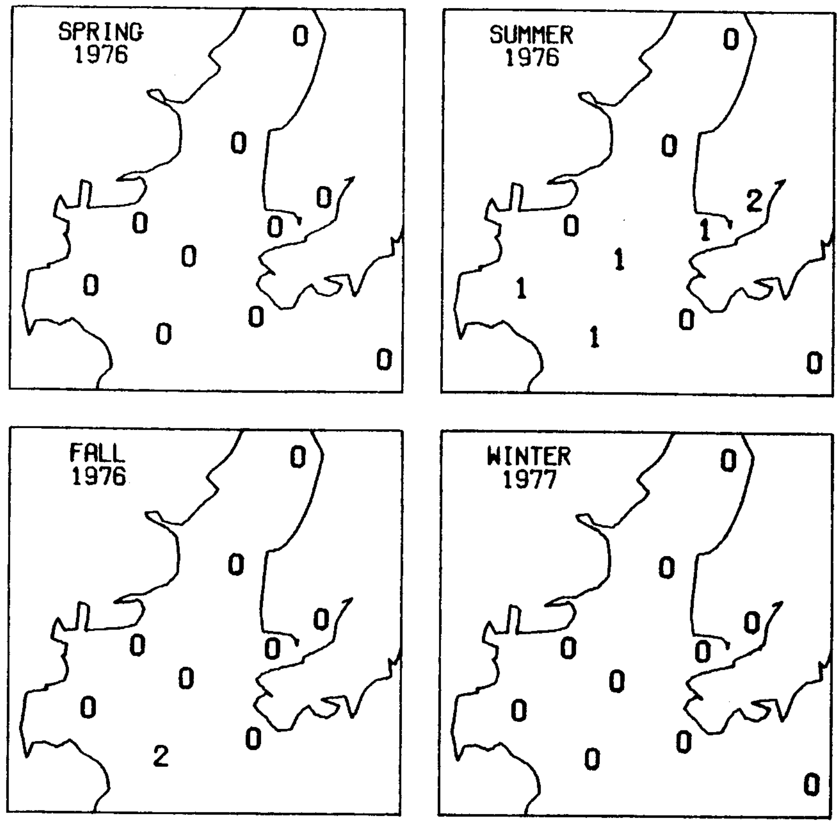
ANOMURA
ZOEA/10 SQ M



BRACHYURA
ZOEA/10 SQ M

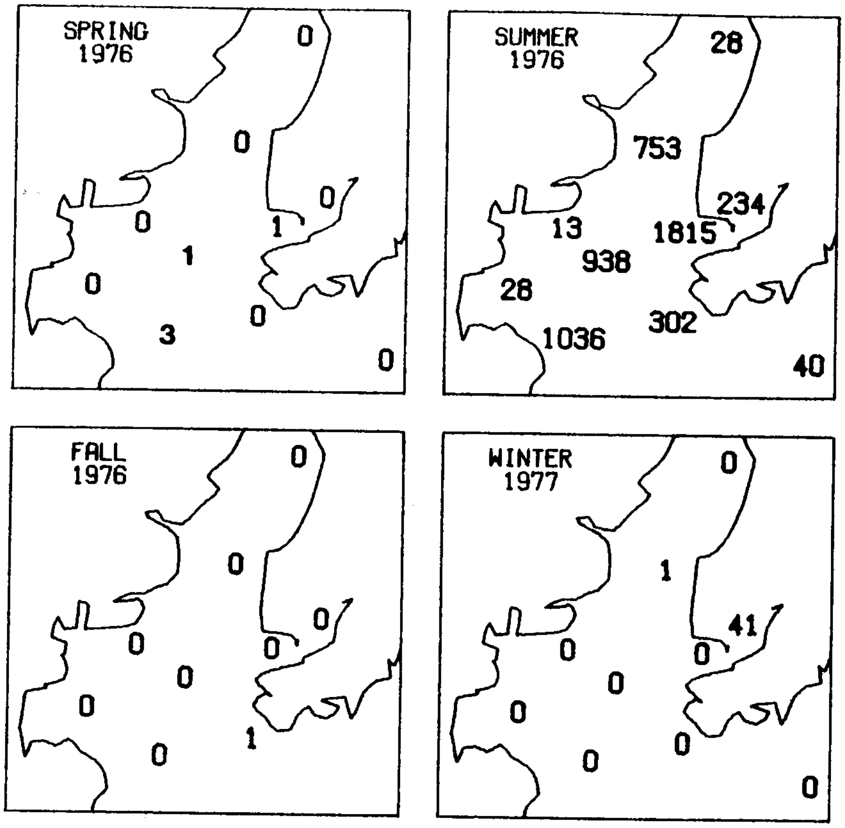


CANCER MAGISTER
ZOEA/10 SQ M

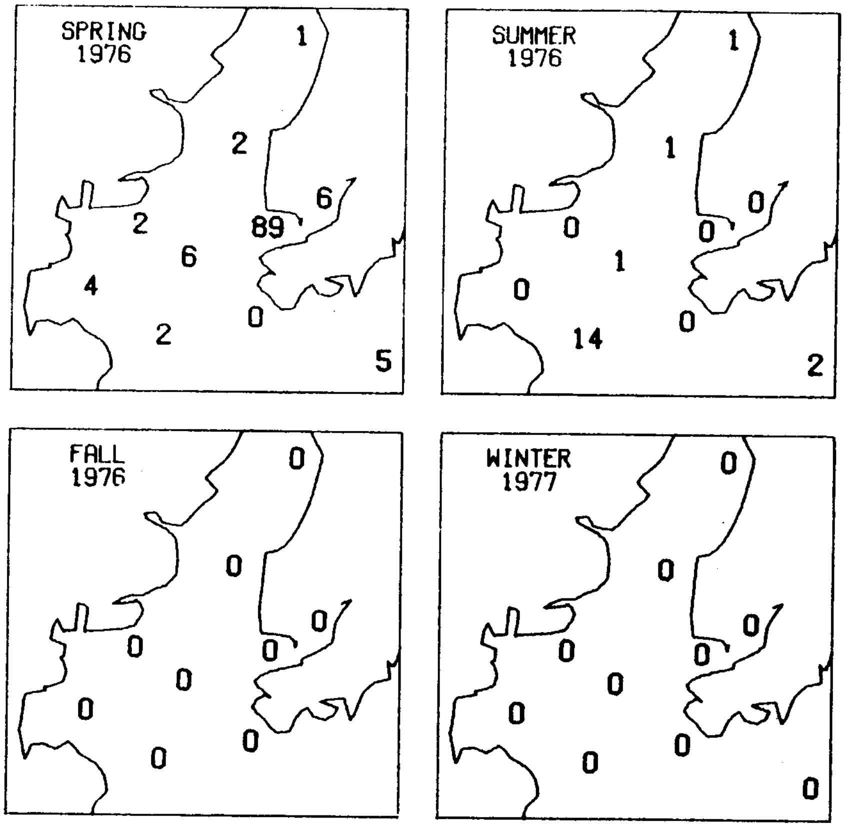


CANCER SPP

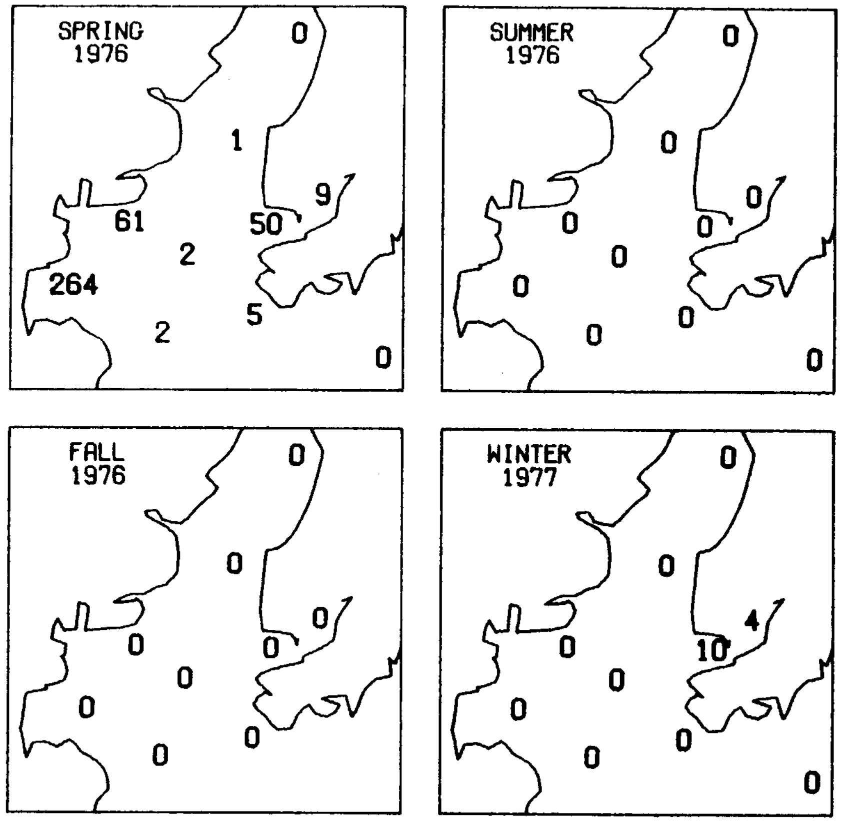
ZOEA/10 SQ M



CHIONOECETES BAIRDI
ZOEA/10 SQ M

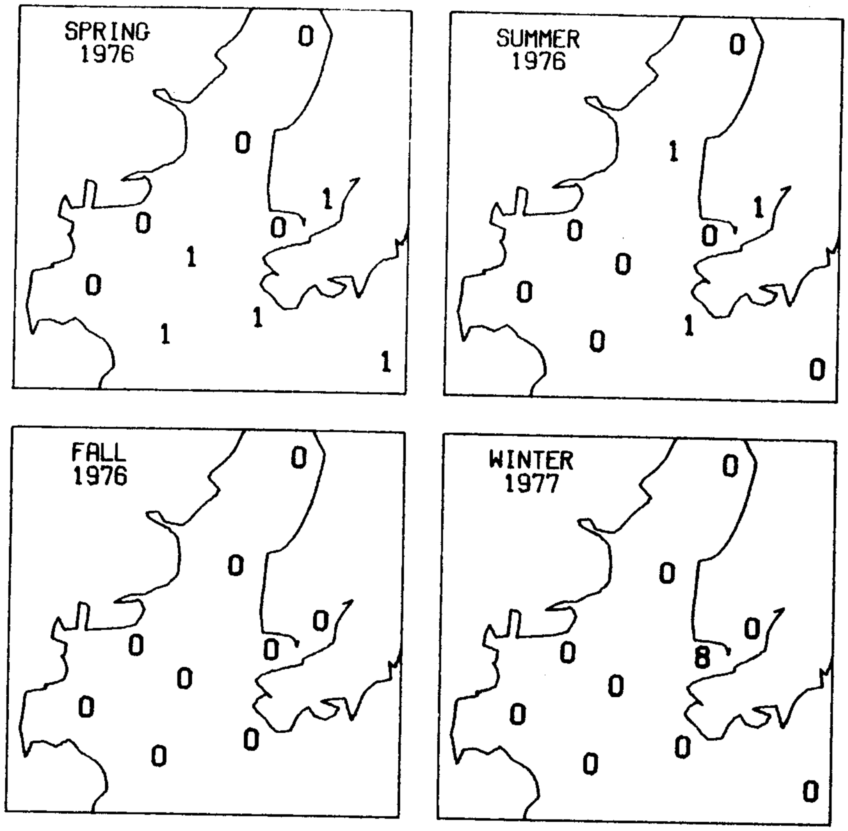


PARALITHODES CAMTSCHATICA
ZOEA/10 SQ M

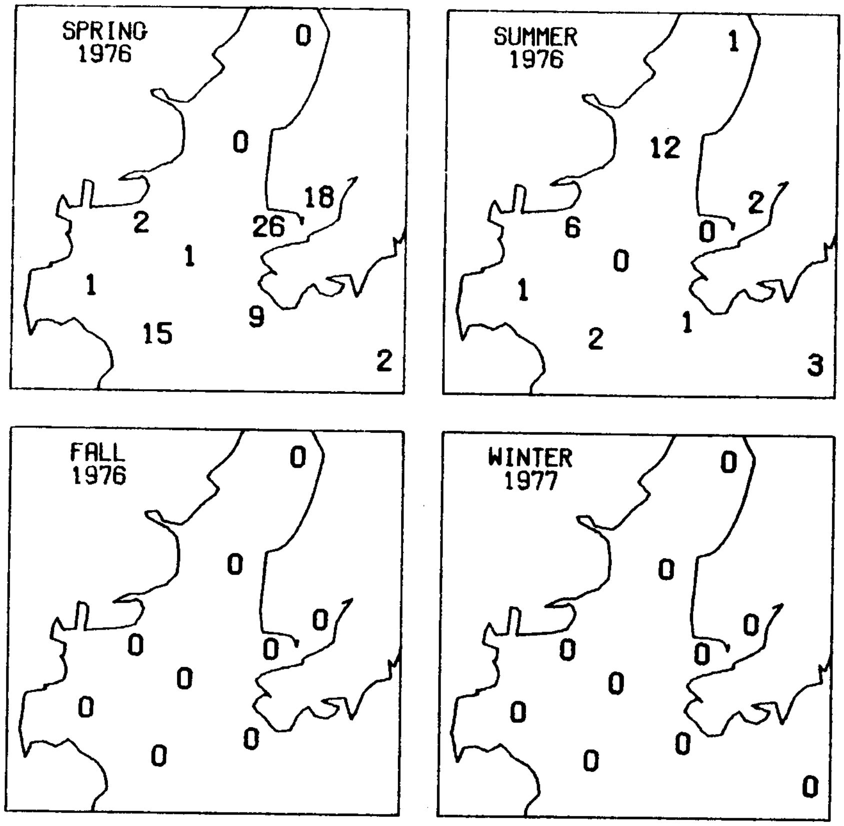


PANDALOPSIS DISPAR

ZOEA/10 SQ M

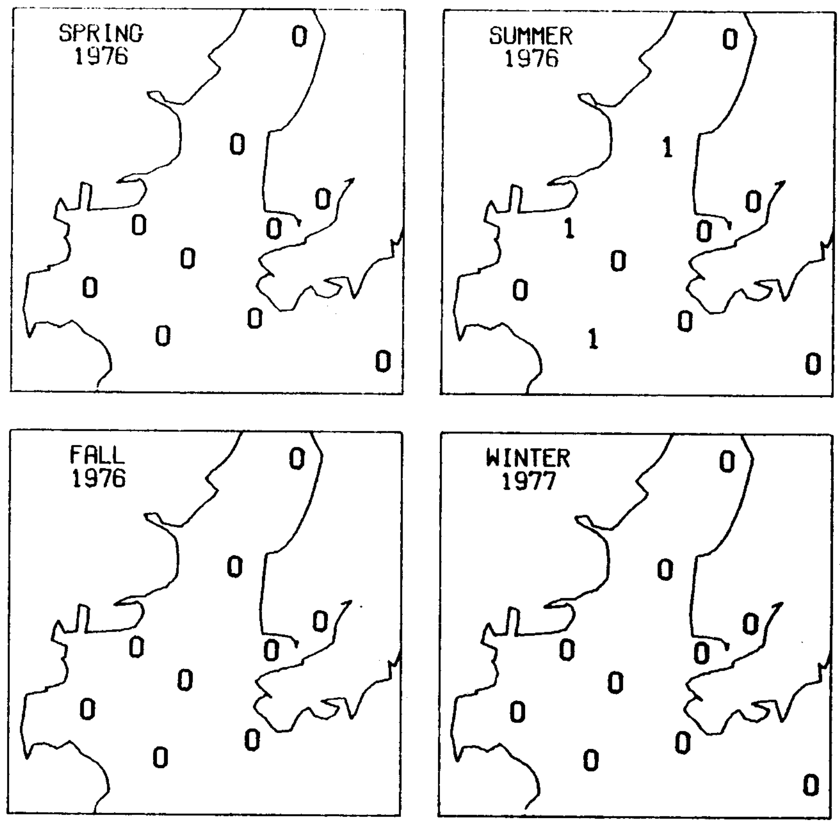


PANDALUS BOREALIS
ZOEA/10 SQ M

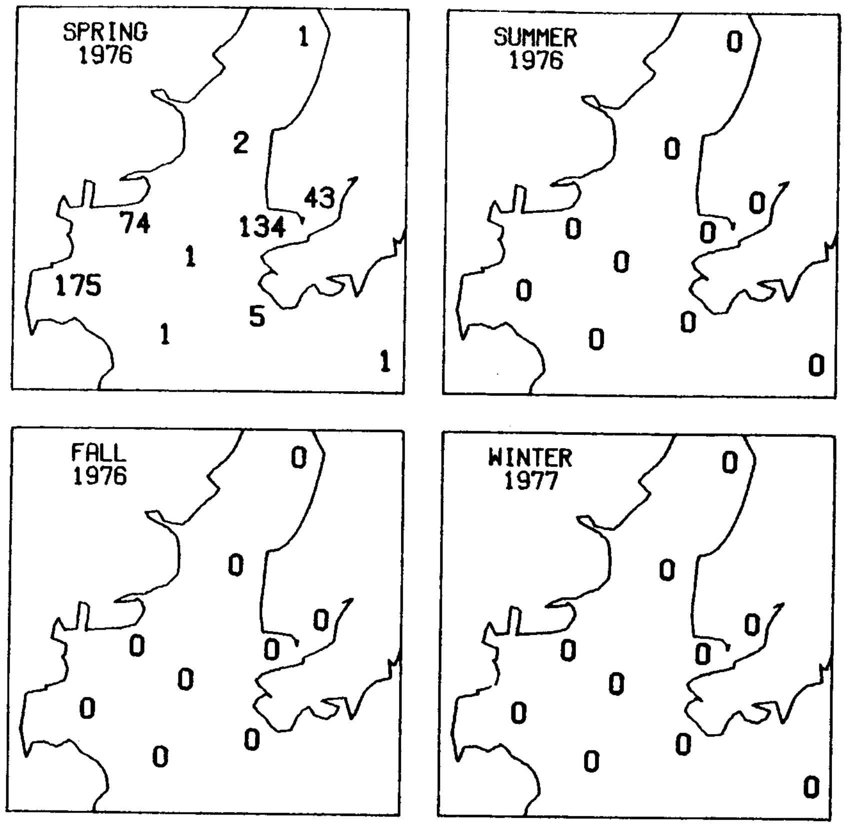


PANDALUS DANAE

ZOEA/10 SQ M

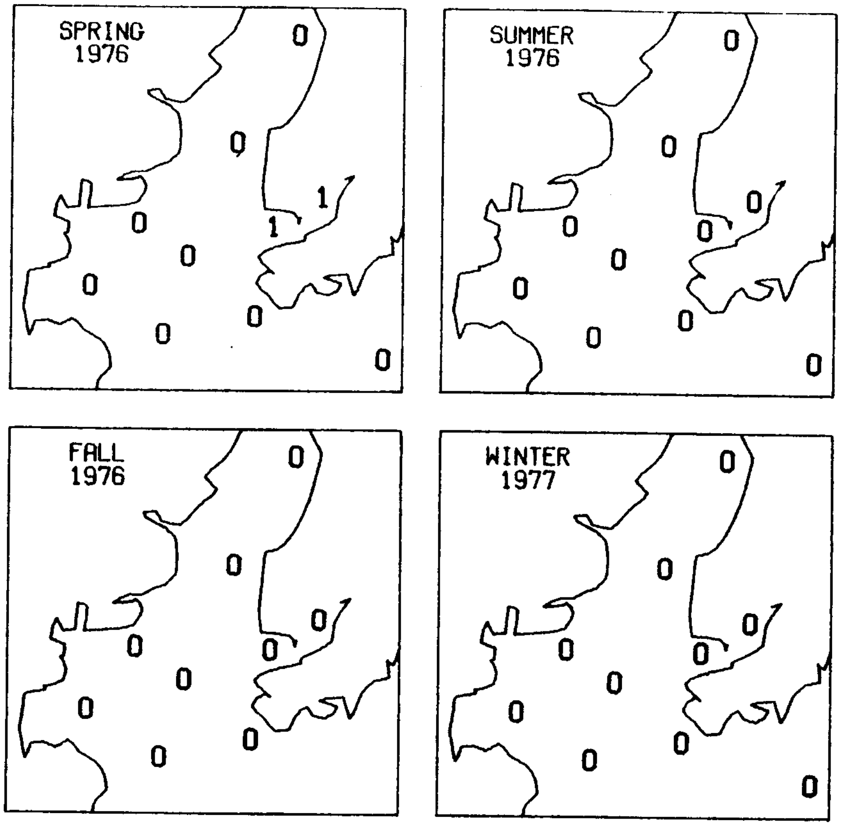


PANDALUS GONIURUS
ZOEA/10 SQ M

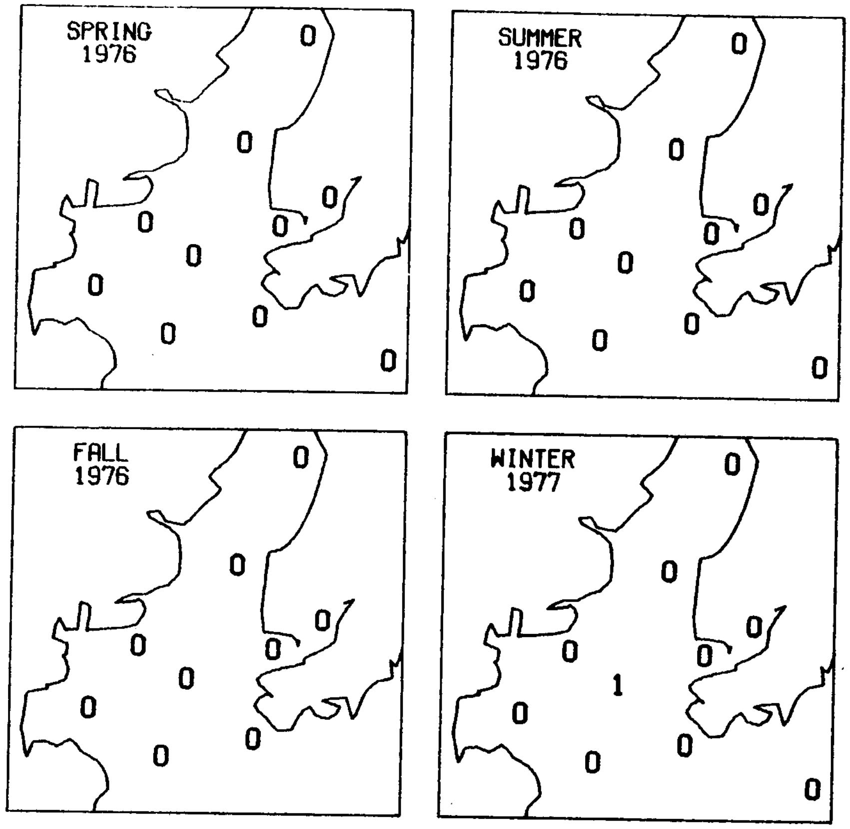


PANDALUS HYPSINOTUS

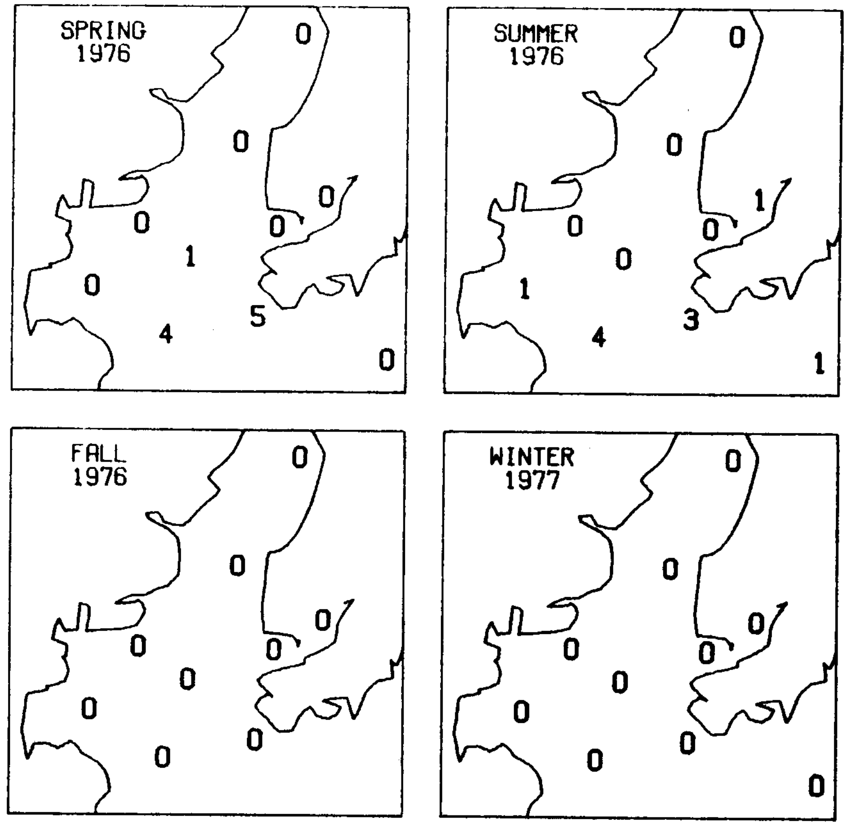
ZOEA/10 SQ M



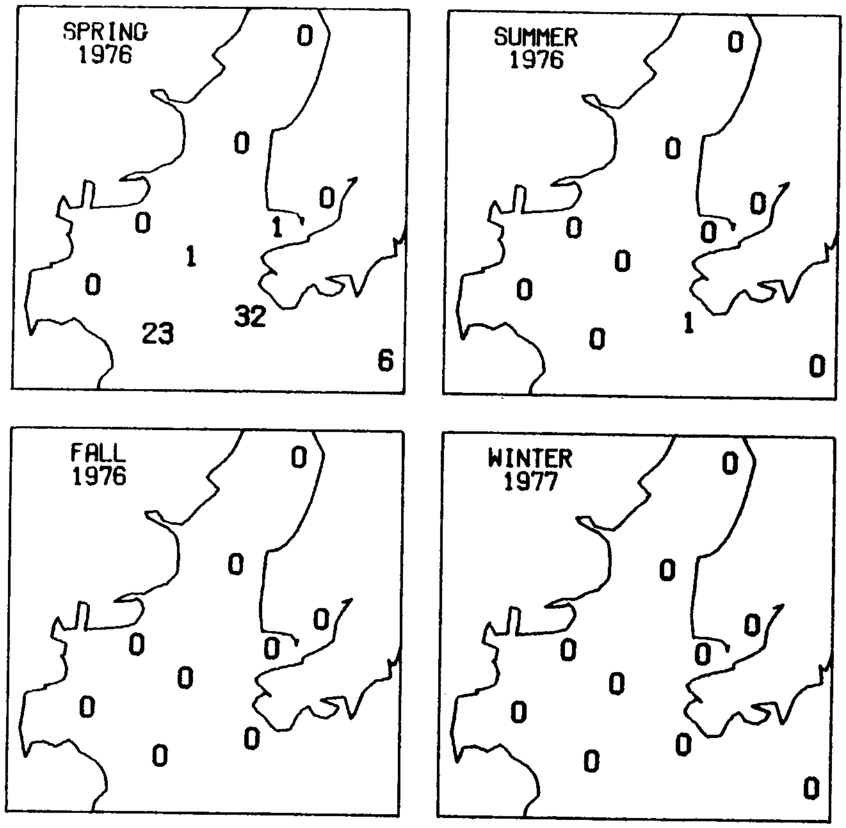
PANDALUS PLATYCEROS
ZOEA/10 SQ M



PANDALUS STENOLEPIS
ZOEA/10 SQ M



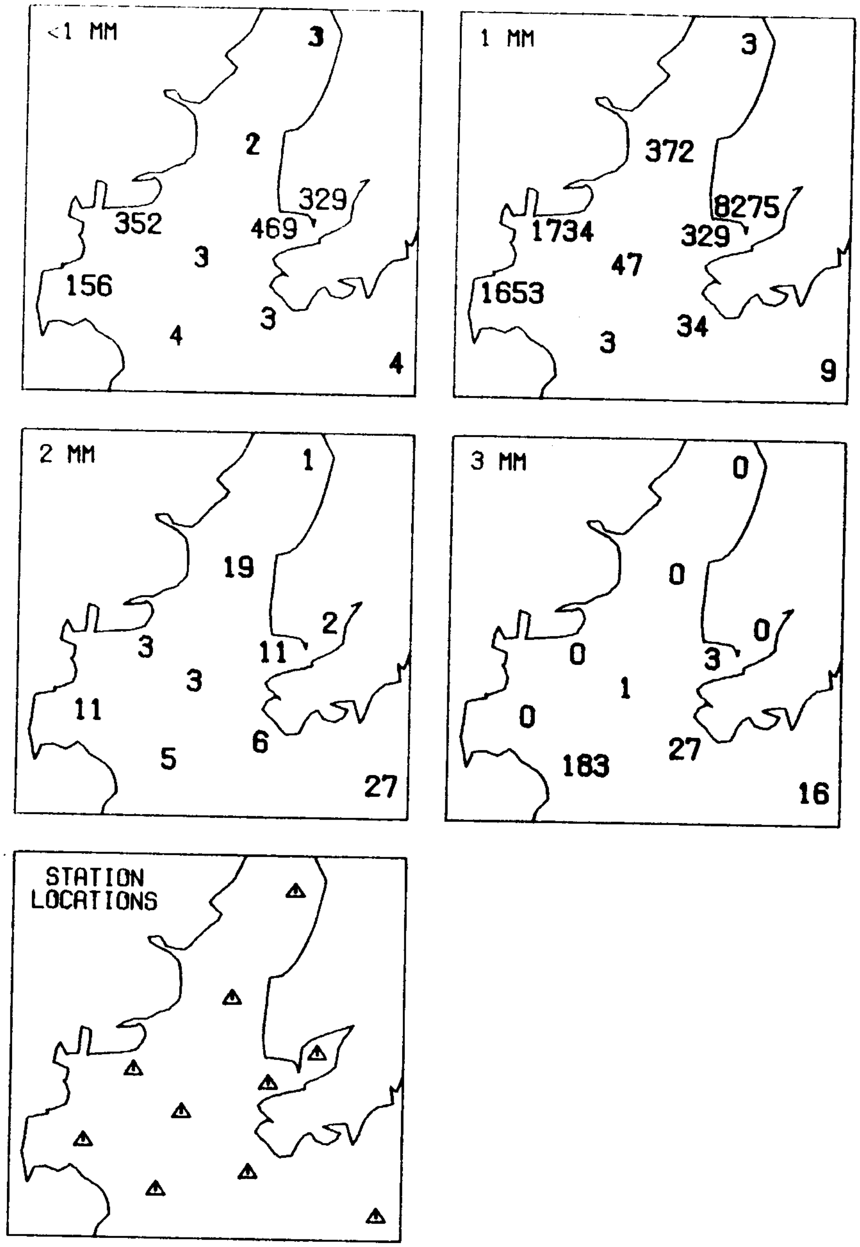
PANDALUS MONTAGUI TRIDENS
ZOEA/10 SQ M



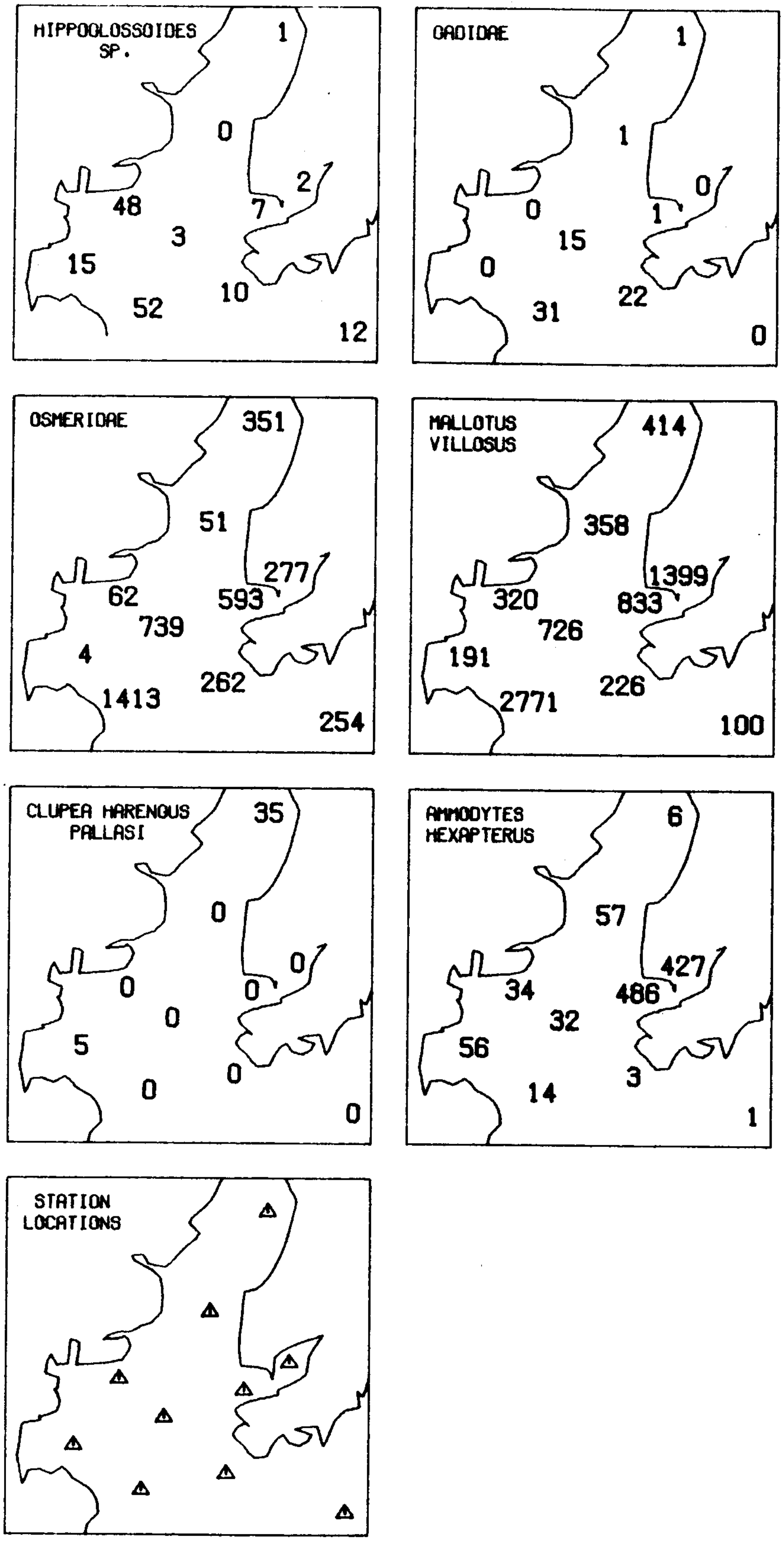
APPENDIX E

Density distributions per 10 square meters for one year, 1976-1977.

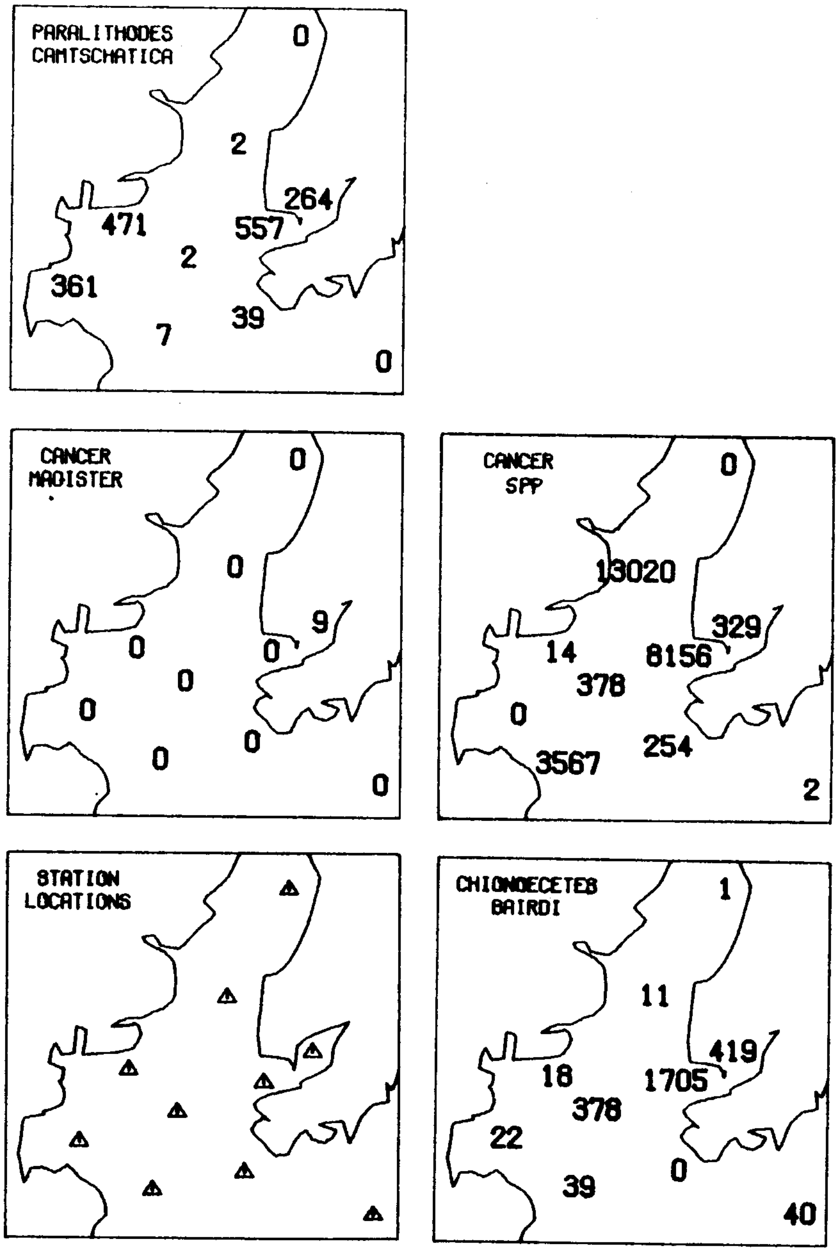
FISH EGGS
ANNUAL ABUNDANCE/10 SQ M



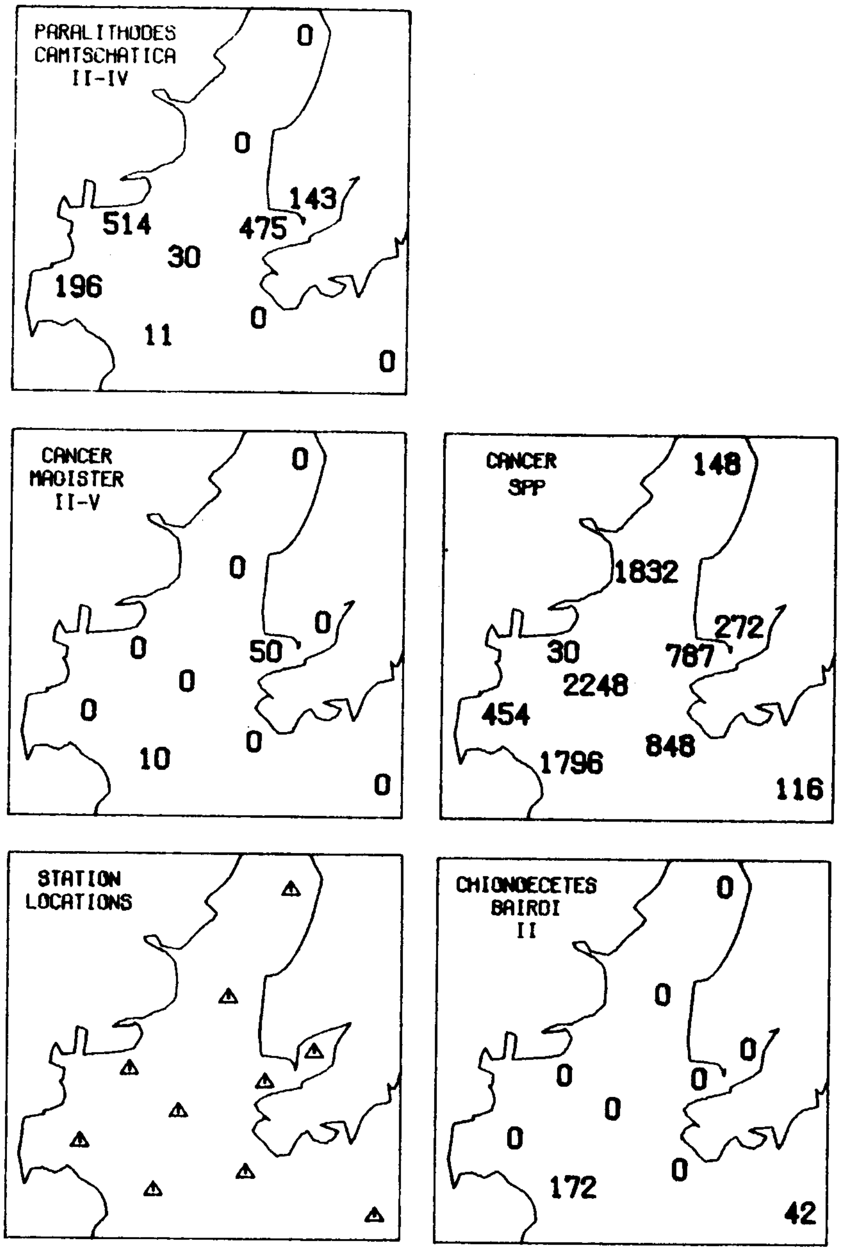
FISH LARVAE
ANNUAL ABUNDANCE/10 SQ M



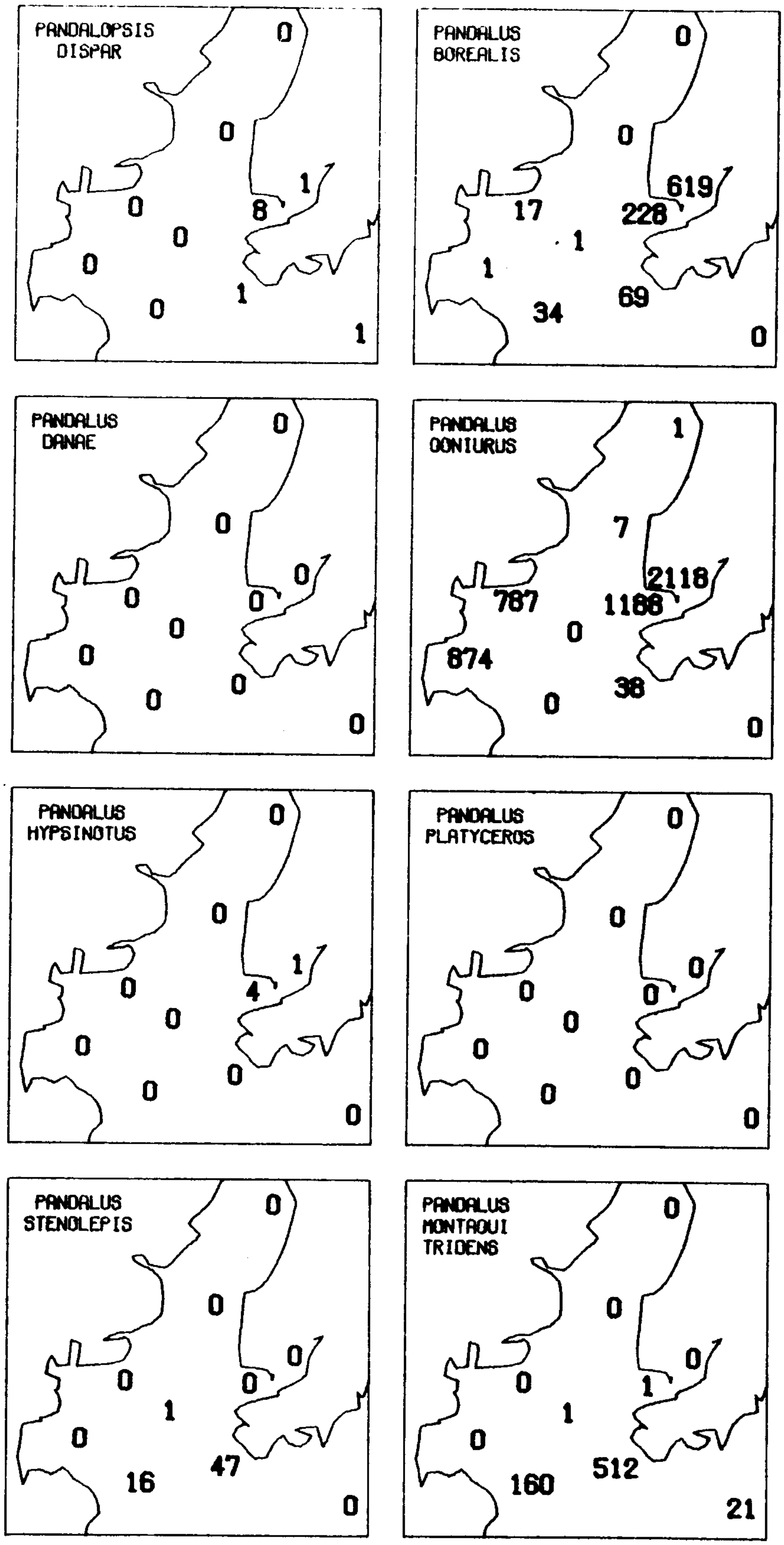
CRABS (STAGE I)
ANNUAL ABUNDANCE/10 SQ M



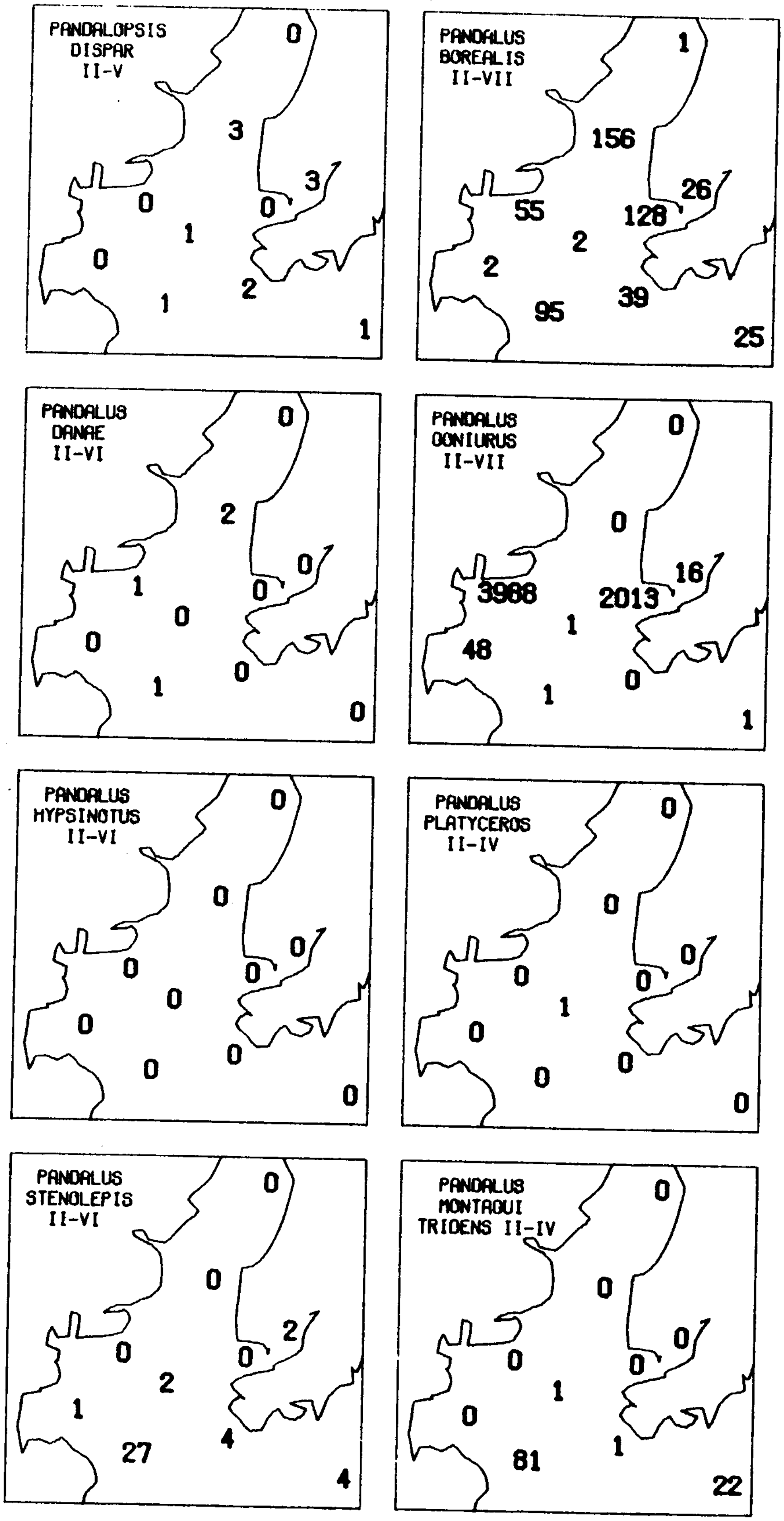
CRABS (LATE ZOEA)
ANNUAL ABUNDANCE/10 SQ M



SHRIMP (STAGE I)
ANNUAL ABUNDANCE/10 SQ M



SHRIMP (LATE ZOEA)
ANNUAL ABUNDANCE/10 SQ M



APPENDIX F

Density per 10 square meters, 1978.

FISH EGGS/10 SQ M

STATION	SIZE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	<1 MM	1	93	0	0	65	0	0
	1 MM	17	0	0	0	0	0	0
2	<1 MM	51	370	0	0	0	59	0
	1 MM	291	23	0	0	0	0	0
	3 MM	2	0	0	0	0	0	0
3	<1 MM	0	152	0	0	0	117	0
	1 MM	72	0	0	0	0	0	0
	2 MM	4	0	0	0	0	0	0
	3 MM	4	0	0	0	0	0	0
4	<1 MM	0	445	495	100	0	0	0
6	<1 MM	151	350	24	24	0	0	0
	1 MM	123	12	0	0	0	0	0
7	<1 MM	108	17	91	225	0	28	0
	1 MM	20	0	7	0	0	0	0
8	<1 MM	148	0	0	0	150	0	0
	1 MM	913	8	0	0	0	0	0
9	<1 MM	72	44	49	28	46	0	0
	1 MM	505	35	8	0	0	0	0
	2 MM	0	0	0	0	0	0	18
10	<1 MM	10	250	41	0	22	0	0
	1 MM	0	21	0	0	0	0	0
11	<1 MM	18	1433	27	532	136	12	0
	1 MM	0	43	0	33	11	0	0
12	<1 MM	0	352	10	181	0	0	0
	1 MM	11	23	0	0	0	0	0
13	<1 MM	0	0	0	11	0	0	0
	1 MM	0	0	0	11	0	0	0
14	<1 MM	11	12	0	0	0	0	0
	1 MM	11	0	0	0	0	0	0

CONTINUATION-FISH EGGS/10 SQ M

15	<1 MM	0	0	12	11	0	0	0
	1 MM	54	20	12	0	0	0	0
16	<1 MM	0	23	0	0	0	0	0
	1 MM	0	11	25	0	0	0	0
17	<1 MM	0	11	0	0	0	0	0
	1 MM	0	100	10	0	0	0	0
18	<1 MM	215	0	39	0	0	0	0
	1 MM	174	0	0	0	0	0	0
	2 MM	8	0	0	0	0	0	0
19	<1 MM	1570	640	113	0	0	0	0
	1 MM	815	38	0	0	0	0	0
	2 MM	7	0	0	0	0	0	0
20	<1 MM	41	164	55	0	0	0	0
	1 MM	309	297	0	0	0	0	0
	2 MM	0	0	9	0	0	0	0
21	<1 MM	456	258	34	0	0	0	0
	1 MM	194	33	6	0	0	0	0
22	<1 MM	826	801	51	0	0	0	0
	1 MM	79	94	0	0	0	0	0
23	<1 MM	541	476	40	0	0	0	9
	1 MM	46	35	0	0	0	0	0
24	<1 MM	1090	482	40	0	0	0	0
	1 MM	623	36	0	0	0	0	0
25	<1 MM	0	137	11	0	0	0	0
	1 MM	0	3	0	0	0	0	0
26	<1 MM	0	666	24	0	0	0	0
	1 MM	0	43	0	0	0	0	0
27	<1 MM	0	76	0	0	0	0	0
	1 MM	0	4	0	0	0	0	0
28	<1 MM	179	252	194	0	0	0	0
	1 MM	192	52	10	0	0	0	0

CONTINUATION-FISH EGGS/10 SQ M

29	<1 MM	29	330	170	0	0	0	0
	1 MM	227	217	50	0	0	0	0
30	<1 MM	9	22	43	11	0	0	0
	1 MM	120	66	64	0	0	0	0
	2 MM	0	0	11	0	0	0	0
31	<1 MM	15	0	0	0	0	0	0
	1 MM	68	0	20	0	0	0	0
32	<1 MM	160	12	29	0	13	0	0
	1 MM	813	0	0	0	0	0	0

AMMODYTES HEXAPTERUS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	LAR	8	0	0	0	0	0	0
2	LAR	13	0	0	0	0	0	0
3	LAR	127	0	0	0	0	0	0
6	LAR	28	0	0	0	0	0	0
7	LAR	73	9	0	0	0	0	0
8	LAR	186	0	0	0	0	0	0
9	LAR	50	18	0	0	0	0	0
10	LAR	10	0	10	0	0	0	0
11	LAR	281	95	0	0	0	0	0
12	LAR	110	47	0	0	0	0	0
13	LAR	0	0	10	0	0	0	0
14	LAR	22	0	0	0	0	0	0
15	LAR	534	49	0	0	0	0	0
16	LAR	27	23	0	0	0	0	0
17	LAR	0	22	0	0	0	0	0
18	LAR	25	0	10	0	0	0	0
20	LAR	46	41	0	0	0	0	0
21	LAR	0	8	0	0	0	0	0
22	LAR	6	0	0	0	0	0	0
23	LAR	4	0	0	0	0	0	0

CONTINUATION-AMMODYTES HEXAPTERUS/10 SQ M

28	LAR	13	0	0	0	0	0	0
29	LAR	7	0	0	0	0	0	0
30	LAR	25	0	0	0	0	0	0
31	LAR	30	10	0	0	0	0	0
32	LAR	45	0	0	0	0	0	0

CLUPEA HARENGUS PALLASI/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	LAR	0	10	0	0	0	0	0
2	LAR	0	35	0	0	0	0	0
10	LAR	0	0	10	0	0	0	0
18	LAR	0	0	0	9	0	0	0
19	LAR	0	19	97	0	0	0	0
21	LAR	0	8	0	0	0	0	0
22	LAR	0	119	0	0	0	0	0
23	LAR	0	329	24	0	0	0	0
24	LAR	0	14	0	0	0	0	0
25	LAR	0	321	0	0	0	0	0
26	LAR	0	342	47	0	0	0	0
27	LAR	0	76	0	0	0	0	0
28	LAR	0	0	48	0	0	0	0

CONTINUATION-CLUPEA HARENGUS PALLASI/10 SQ M

31	LAR	0	10	0	0	0	0	0

GADIDAE/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
8	LAR	26	0	0	0	0	0	0
11	LAR	27	0	0	0	0	0	0
12	LAR	11	0	0	0	0	0	0
14	LAR	33	0	0	0	0	0	0
15	LAR	154	0	0	0	0	0	0
	JUV	0	20	0	0	0	0	0
16	LAR	46	0	0	0	0	0	0
28	LAR	0	0	10	0	0	0	0
30	JUV	0	0	0	11	0	0	0
31	LAR	15	0	0	0	0	0	0
	JUV	0	20	0	0	0	0	0

HIPPOGLOSSOIDES ELASSODON/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
3	LAR	4	0	0	0	0	0	0
6	LAR	47	0	0	0	0	0	0
8	LAR	26	0	0	0	0	0	0
11	LAR	9	0	0	0	0	0	0

CONTINUATION-HIPPOGLOSSOIDES ELASSODON/10 SQ M

12	LAR	11	0	0	0	0	0	0
13	LAR	0	12	0	0	0	0	0
16	LAR	9	0	0	0	0	0	0
18	LAR	25	0	0	0	0	0	0
19	LAR	7	0	0	0	0	0	0
22	LAR	39	0	0	0	0	0	0
23	LAR	8	0	0	0	0	0	0
26	LAR	13	0	0	0	0	0	0
29	LAR	7	0	0	0	0	0	0

LIMANDA ASPERA/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
2	LAR	5	11	0	72	83	0	0
3	LAR	0	22	0	0	0	0	0
6	LAR	0	12	0	0	0	0	0
11	LAR	0	10	0	21	0	12	0
17	LAR	0	0	10	0	0	0	0
18	LAR	0	0	126	0	0	0	0
19	LAR	22	6	8	0	0	0	0
20	LAR	0	0	27	0	0	0	0
21	LAR	0	8	25	0	0	0	0

CONTINUATION-LIMANDA ASPERA/10 SQ M

22	LAR	13	26	51	0	0	0	0
23	LAR	11	84	40	0	0	0	0
24	LAR	0	0	32	0	0	0	0
28	LAR	0	17	87	0	0	0	0
29	LAR	0	47	20	11	10	0	0

MALLOTUS VILLOSUS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	LAR	3	62	0	0	130	0	0
2	LAR	5	498	0	0	0	0	135
3	LAR	10	11	0	0	93	350	0
4	LAR	0	345	19	400	0	0	43
6	LAR	0	945	275	60	160	59	0
7	LAR	0	349	273	17	0	47	33
8	LAR	0	225	104	24	60	19	8
9	LAR	0	280	387	95	19	0	9
10	LAR	0	511	82	32	121	0	0
11	LAR	9	477	746	54	497	24	0
12	LAR	0	199	170	126	0	137	58
13	LAR	0	489	480	96	96	0	0
14	LAR	0	1557	696	95	36	0	0

CONTINUATION-MALLOTUS VILLOSUS/10 SQ M

15	LAR	0	922	284	43	19	0	0
16	LAR	0	1621	312	47	76	0	0
17	LAR	0	45	184	11	0	0	0
18	LAR	0	0	667	35	10	0	0
19	LAR	0	659	355	0	0	0	0
20	LAR	0	10	329	0	0	0	0
21	LAR	0	275	176	0	0	0	0
22	LAR	0	307	34	0	0	0	0
23	LAR	0	154	40	0	0	0	26
24	LAR	0	94	130	0	0	0	0
25	LAR	0	13	11	0	0	0	0
26	LAR	0	422	147	0	0	0	0
27	LAR	0	18	0	0	0	0	0
28	LAR	0	261	619	0	9	0	0
29	LAR	0	1265	260	53	0	0	0
30	LAR	0	244	139	53	0	0	0
31	LAR	0	110	146	22	88	0	0
32	LAR	0	1356	99	77	250	0	0

OSMERIDAE/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
2	LAR	0	23	0	0	0	0	0
3	LAR	0	11	0	0	93	0	0
4	LAR	0	85	5	150	0	0	0
6	LAR	0	303	48	12	0	23	12
7	LAR	0	247	243	6	0	19	0
8	LAR	0	242	67	8	0	0	0
9	LAR	0	166	90	19	9	0	0
10	LAR	0	156	31	11	44	0	0
11	LAR	0	181	155	11	102	36	11
12	LAR	0	141	40	14	0	35	11
13	LAR	0	186	230	0	11	0	0
14	LAR	0	277	557	12	12	0	0
15	LAR	0	245	159	0	0	0	0
16	LAR	0	340	50	24	13	0	0
17	LAR	0	0	10	0	0	0	0
18	LAR	0	0	29	17	0	0	0
19	LAR	0	19	65	0	0	0	0
20	LAR	0	0	55	0	0	0	0
21	LAR	0	33	4	0	0	0	0
22	LAR	0	17	0	0	0	0	0

CONTINUATION-OSMERIDAE/10 SQ M

* 24	LAR	0	0	0	0	0	0	0
25	LAR	0	3	4	0	0	0	0
26	LAR	0	24	0	0	0	0	0
27	LAR	0	8	0	0	0	0	0
28	LAR	0	9	10	0	0	0	0
29	LAR	0	132	0	21	0	0	0
30	LAR	0	78	171	0	43	0	0
31	LAR	0	20	49	11	375	0	0
32	LAR	0	444	79	22	25	0	0

ANOMURA/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	ZOE	104	421	0	78	130	55	107
2	ZOE	224	3381	0	500	663	529	0
3	ZOE	510	141	0	0	278	583	468
	MEG	0	22	0	0	93	0	0
4	ZOE	0	25	33	0	0	0	87
5	ZOE	0	0	0	0	55	0	33
6	ZOE	943	8773	2294	469	837	784	372
	MEG	0	0	0	36	36	12	12
7	ZOE	4545	0	0	167	0	38	57
	MEG	0	0	0	33	0	9	0
8	ZOE	8949	67	89	16	0	222	121
	MEG	0	0	30	8	0	9	0
9	ZOE	2138	1960	115	198	221	66	428
	MEG	0	0	33	28	0	0	0
10	ZOE	2640	83	449	235	110	0	66
	MEG	0	0	0	21	0	0	11
11	ZOE	200	1317	7500	750	3929	1799	1997
	MEG	0	0	0	54	0	12	0
12	ZOE	1630	7325	7040	3598	0	2582	1690
	MEG	44	0	160	78	0	12	0
13	ZOE	3090	186	1400	75	75	0	0
	MEG	0	140	40	43	0	0	0
14	ZOE	1628	1448	2357	107	119	0	0
	MEG	0	24	128	0	24	0	0
15	ZOE	1051	1050	1592	0	19	0	0
	MEG	0	10	45	21	0	0	0

CONTINUATION-ANUMURA/10 SQ M

16	ZOE	93	181	287	333	13	0	0
	MEG	0	0	112	71	0	0	0
17	ZOE	0	490	1859	66	0	0	0
	MEG	0	0	41	0	0	0	0
18	ZOE	1475	0	5568	103	625	0	0
	MEG	0	0	155	0	10	0	0
19	ZOE	622	262	751	0	0	0	0
20	ZOE	466	574	730	0	0	0	0
	MEG	0	0	9	0	0	0	0
21	ZOE	172	833	193	0	0	0	8
22	ZOE	1861	1082	137	0	0	0	0
	MEG	0	0	0	0	0	0	16
23	ZOE	354	952	234	0	0	0	18
	MEG	0	0	0	0	0	0	9
24	ZOE	90	641	356	0	0	0	0
25	ZOE	0	132	4	0	0	0	0
26	ZOE	0	281	12	0	0	0	0
27	ZOE	0	30	0	0	0	0	0
28	ZOE	939	6410	968	270	1303	0	0
	MEG	0	0	39	0	9	0	0
29	ZOE	440	113	1080	477	600	0	0
	MEG	0	0	0	32	0	0	0
30	ZOE	2289	434	555	221	96	0	0
31	ZOE	365	0	195	183	199	0	0
	MEG	0	10	39	0	0	0	0
32	ZOE	916	216	1340	735	113	0	0
	MEG	0	0	157	11	0	0	0

BRACHYURA/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	ZOE	113	401	0	736	0	0	0
	MEG	1	0	0	0	0	0	0
2	ZOE	704	1250	0	572	414	59	0
3	ZOE	785	98	0	0	370	817	0
4	ZOE	0	95	67	200	1575	0	0
	MEG	0	15	33	0	0	0	0
5	ZOE	0	0	0	0	2530	0	0
6	ZOE	2831	6907	956	253	222	199	12
	MEG	0	187	191	60	12	0	0
7	ZOE	16181	545	243	83	0	234	0
	MEG	470	0	0	2667	0	0	0
8	ZOE	1337	200	474	16	20	102	8
	MEG	0	0	1570	568	0	0	0
9	ZOE	2138	13440	0	10	516	33	0
	MEG	0	0	115	425	37	0	9
10	ZOE	3920	167	449	21	585	0	0
	MEG	80	0	449	853	0	0	0
11	ZOE	218	580	2185	108	407	290	52
	MEG	0	0	726	152	0	0	11
12	ZOE	3613	10143	2080	98	0	80	35
	MEG	0	0	4800	450	0	0	11
13	ZOE	4442	2186	120	0	447	0	0
	MEG	97	0	4440	502	0	0	0
14	ZOE	4223	1653	86	12	131	0	0
	MEG	0	12	771	251	0	0	0
15	ZOE	2119	667	45	0	145	0	0
	MEG	18	10	91	53	0	0	0

CONTINUATION-BRACHYURA/10 SQ M

16	ZOE	2725	1054	62	0	177	0	0
	MEG	0	0	100	665	0	0	0
17	ZOE	0	646	102	11	0	0	0
	MEG	0	0	0	55	0	0	0
18	ZOE	1044	0	5568	165	175	0	0
	MEG	0	0	155	0	0	0	0
19	ZOE	96	80	420	0	0	0	0
	MEG	0	0	0	0	0	0	8
20	ZOE	730	410	91	0	0	0	0
	MEG	0	21	18	0	0	0	0
21	ZOE	50	3917	932	0	0	0	0
22	ZOE	328	400	966	0	0	0	0
	MEG	13	0	0	0	0	0	0
23	ZOE	130	364	1106	0	0	0	18
	MEG	0	14	0	0	0	0	0
24	ZOE	7	706	1611	0	0	0	5
	MEG	0	7	16	0	0	0	0
25	ZOE	0	3	0	0	0	0	0
	MEG	0	0	4	0	0	0	0
26	ZOE	0	55	6	0	0	0	0
27	ZOE	0	14	0	0	0	0	0
28	ZOE	326	4738	1626	130	19	0	0
	MEG	0	279	77	20	0	0	0
29	ZOE	95	47	160	53	250	0	0
	MEG	0	0	0	11	0	0	0
30	ZOE	2153	87	288	23	53	0	0
	MEG	0	0	53	23	0	0	0
31	ZOE	2310	360	234	0	44	0	0
	MEG	0	0	76	6	0	0	0

CONTINUATION-BRACHYURA/10 SQ M

32	ZOE	916	384	906	0	414	0	0
	MEG	0	0	512	55	0	0	0

CANCER MAGISTER/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	II	3	0	0	0	0	0	0
2	II	0	185	0	0	0	0	0
3	I	28	0	0	0	0	C	0
	II	14	43	0	0	0	0	0
4	II	0	15	0	0	0	C	0
6	I	38	0	0	0	0	0	0
	II	0	560	191	0	0	0	0
7	II	0	136	121	0	0	0	0
8	I	1131	0	0	0	0	0	0
	II	0	467	59	0	0	9	0
9	I	173	0	17	0	0	0	0
	II	0	2800	329	0	0	0	0
	III	0	0	214	0	0	0	0
	V	0	0	0	0	37	0	0
10	II	0	167	41	0	0	0	0
	III	0	0	163	0	0	0	0
	MEG	0	0	0	0	33	0	0
11	II	0	213	726	C	0	0	0
	III	0	0	219	0	0	0	0
	V	0	0	0	0	0	12	0
12	I	352	0	0	0	0	0	0
13	II	0	1878	0	0	0	0	0
	III	0	188	0	0	0	0	0

CONTINUATION-CANCER MAGISTER/10 SQ M

14	I	44	0	0	0	0	0	0
	V	0	0	0	0	12	0	0
15	II	0	10	0	0	0	0	0
16	II	0	0	87	0	0	0	0
	III	0	0	62	24	0	0	0
	IV	0	0	25	0	0	0	0
	V	0	0	0	24	0	0	0
17	II	0	22	163	0	0	0	0
	III	0	0	20	0	0	0	0
19	II	0	30	0	0	0	0	0
	III	0	0	8	0	0	0	0
20	II	20	205	0	0	0	0	0
21	II	0	33	17	0	0	0	0
22	II	39	77	0	0	0	0	0
	III	0	9	0	0	0	0	0
23	II	8	7	0	0	0	0	0
24	II	0	14	0	0	0	0	0
26	II	0	6	0	0	0	0	0
28	II	19	0	77	0	0	0	0
29	II	15	19	0	0	0	0	0
30	II	0	0	11	0	0	0	0
	III	0	0	21	0	0	0	0
31	II	243	0	39	0	0	0	0
32	II	550	0	237	0	0	0	0
	III	0	0	197	0	0	0	0
	V	0	0	0	0	13	0	0
	MEG	0	0	0	0	13	0	0

CANCER SPP/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	I	71	113	0	0	65	0	0
	III	0	0	0	116	0	0	0
	ZOE	3	0	0	0	0	0	0
2	I	20	1621	0	72	0	0	0
	II	0	231	0	72	0	0	0
	V	0	0	0	0	63	59	0
	ZOE	10	0	0	0	0	0	0
3	I	592	444	0	0	0	0	0
	II	0	206	0	0	0	0	0
	III	0	0	0	0	0	117	0
	V	0	0	0	0	185	0	0
	ZOE	28	0	0	0	0	0	0
4	I	0	1325	67	0	0	0	0
	II	0	255	224	0	0	0	43
	III	0	0	76	0	0	0	0
	V	0	0	0	0	150	0	0
5	I	0	0	0	0	0	87	0
6	I	982	42933	3632	12	0	23	0
	II	0	25200	17014	0	12	12	0
	III	0	373	1529	120	12	35	0
	IV	0	0	0	457	0	12	0
	V	0	0	0	97	25	293	0
	MEG	0	0	0	0	25	246	90
7	I	0	16901	3156	50	0	0	8
	II	0	954	2468	17	0	9	41
	III	0	136	728	83	0	9	0
	IV	0	0	0	550	0	19	0
	V	0	0	0	267	0	84	16
	ZOE	13793	0	0	0	0	0	0
	MEG	0	0	0	0	0	216	0
8	I	11931	6533	711	0	0	0	0
	II	0	1067	859	0	10	0	0
	III	0	67	415	112	20	0	0
	IV	0	0	0	232	90	0	0
	V	0	0	0	32	640	37	0
	ZOE	617	0	0	0	0	0	0
	MEG	0	0	0	0	80	28	6

CONTINUATION-CANCER SPP/10 SQ M

9	I	3755	7560	346	0	74	0	0
	II	0	1120	511	0	0	0	0
	III	0	280	99	38	0	0	0
	IV	0	0	0	47	74	0	9
	V	0	0	0	28	1769	55	9
	ZOE	289	0	99	0	0	0	0
	MEG	0	0	0	0	553	66	134
10	I	11040	1720	204	11	0	0	11
	II	0	261	1346	0	0	0	11
	III	0	0	1835	21	0	0	0
	IV	0	0	0	139	33	0	0
	V	0	0	0	65	484	0	0
	MEG	0	0	0	451	0	0	165
11	I	545	3355	1966	76	0	0	11
	II	0	2036	16967	87	0	12	31
	III	0	43	5752	217	0	12	31
	IV	0	0	0	369	90	12	0
	V	0	0	0	98	632	121	11
	MEG	0	0	0	0	0	156	20
12	I	1763	10894	2400	39	0	12	0
	II	0	6010	5920	59	0	12	0
	III	0	752	3680	235	0	12	0
	IV	0	0	0	2171	0	0	23
	V	0	0	0	509	0	80	35
	MEG	0	0	0	0	0	80	199
13	I	0	6419	0	11	0	0	0
	II	0	140	960	11	0	0	0
	III	0	0	560	32	0	0	0
	IV	0	0	0	64	0	0	0
	V	0	0	0	43	43	0	0
	ZOE	2697	0	0	0	0	0	0
	MEG	0	0	0	0	138	0	0
14	I	1699	1014	171	24	0	0	0
	II	0	0	515	36	12	0	0
	III	0	0	643	84	12	0	0
	IV	0	0	86	60	24	0	0
	V	0	0	43	47	131	0	0
	ZOE	44	0	0	0	0	0	0
	MEG	0	0	43	0	47	0	0

CONTINUATION-CANCER SPP/10 SQ M

15	I	181	177	1092	43	0	0	0
	II	0	79	2593	43	0	0	0
	III	0	0	1865	117	0	0	0
	IV	0	0	91	181	19	0	0
	V	0	0	0	11	183	0	0
	ZOE	18	0	0	0	0	0	0
	MEG	0	0	0	0	96	0	0
16	I	18	1451	199	0	0	0	0
	II	18	45	548	190	0	0	0
	III	0	11	449	617	0	0	0
	IV	0	0	37	3800	0	0	0
	V	0	0	0	237	13	0	0
	ZOE	0	0	50	0	0	0	0
	MEG	0	0	12	24	76	0	0
17	I	0	2250	1185	0	0	0	0
	II	0	245	899	154	0	0	0
	III	0	0	163	121	0	0	0
	IV	0	0	0	253	0	0	0
	V	0	0	0	11	0	0	0
	ZOE	0	0	102	0	0	0	0
18	I	83	0	1624	35	0	0	0
	II	66	0	309	123	0	0	0
	III	0	0	1237	131	0	0	0
	IV	0	0	0	219	20	0	0
28	V	0	0	0	26	20	0	0
	MEG	0	0	0	0	20	0	0
19	I	37	13	105	0	0	0	0
	II	7	0	56	0	0	0	0
	III	0	0	32	0	0	0	0
	MEG	0	0	0	0	0	0	8
20	I	56	2950	785	0	0	0	0
	II	0	205	858	0	0	0	0
	III	0	0	310	0	0	0	0
	IV	0	0	9	0	0	0	0
21	I	0	83	378	0	0	0	0
	II	0	0	8	0	0	0	0
	III	0	0	17	0	0	0	0
	MEG	0	0	0	0	0	0	16

CONTINUATION-CANCER SPP/10 SQ M

22	I	0	43	9	0	0	0	0
	II	0	0	9	0	0	0	0
	III	0	0	60	0	0	0	0
	ZOE	52	0	0	0	0	0	8
23	I	4	0	24	0	0	0	0
	II	0	7	0	0	0	0	0
	MEG	0	0	0	0	0	0	9
24	I	3	7	105	0	0	0	0
	II	0	0	49	0	0	0	0
25	II	0	0	4	0	0	0	0
27	I	0	2	0	0	0	0	0
28	I	83	9755	348	0	0	0	0
	II	0	19510	852	10	0	0	0
	III	0	1115	387	160	19	0	0
	IV	0	0	0	190	28	0	0
	V	0	0	0	90	9	0	0
	MEG	0	0	0	0	9	0	0
29	I	66	605	1080	0	10	0	0
	II	0	1313	2680	96	0	0	0
	III	0	10	1040	148	0	0	0
	IV	0	0	0	170	30	0	0
	V	0	0	0	74	0	0	0
	MEG	0	0	0	40	0	0	0
30	I	171	3991	1664	0	0	0	0
	II	0	5382	2336	35	0	0	0
	III	0	187	277	128	0	0	0
	IV	0	0	0	163	10	0	0
	V	0	0	0	128	96	0	0
	MEG	0	0	0	0	53	0	0
31	I	5594	1960	623	0	33	0	0
	II	0	690	6115	11	33	0	0
	III	0	0	1168	22	44	0	0
	IV	0	0	0	129	22	0	0
	V	0	0	0	32	287	0	0
	ZOE	0	20	0	0	0	0	0
	MEG	0	0	0	11	55	0	0

CONTINUATION-CANCER SPP/10 SQ M

32	I	15665	2160	591	0	25	0	0
	II	0	864	3466	0	13	0	0
	III	0	24	2127	0	13	0	0
	IV	0	0	0	22	25	0	0
	V	0	0	0	55	1191	0	0
	MEG	0	0	0	22	239	0	0

CHIONOECETES BAIRDI/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	I	179	0	0	0	0	0	0
2	I	2519	0	0	0	0	0	0
3	I	2176	0	0	0	0	0	0
5	MEG	0	0	0	0	55	0	0
6	I	755	0	0	0	0	0	0
7	I	1411	0	0	0	0	0	0
	II	157	0	0	0	0	0	0
8	I	6023	200	0	0	0	0	0
	II	0	67	0	0	0	0	0
9	I	4565	280	0	0	0	0	0
	II	0	1960	0	0	0	0	0
10	I	0	10	0	0	0	0	0
11	I	246	0	0	0	0	0	0
12	I	0	376	0	0	0	0	0
	II	44	0	0	0	0	0	0
14	II	44	0	0	0	0	0	0
	MEG	44	0	0	0	0	0	0

CONTINUATION-CHIONOECETES BAIRDI/10 SQ M

15	I	724	0	0	0	0	0	0
	MEG	36	0	0	0	0	0	0
18	I	0	136	0	0	0	0	0
	II	0	34	37	0	0	0	0
	MEG	37	0	0	0	0	0	0
20	I	71	0	0	0	0	0	0
22	I	26	0	0	0	0	0	0
24	I	3	0	0	0	0	0	0
28	I	128	0	0	0	0	0	0
29	I	315	0	0	0	0	0	0
30	I	137	0	0	0	0	0	0
31	I	2067	0	0	0	0	0	0
32	I	733	0	0	0	0	0	0

PARALITHODES CAMTSCHATICA/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	III	7	0	0	0	0	0	0
	IV	10	0	0	0	0	0	0
3	III	14	0	0	0	0	0	0
	IV	14	0	0	0	0	0	0
7	III	157	0	0	0	0	0	0
	IV	470	0	0	0	0	0	0
8	III	514	0	0	0	0	0	0
	IV	103	0	0	0	0	0	0
9	III	58	0	0	0	0	0	0

CONTINUATION-PARALITHODES CAMTSCHATICA/10 SQ M

10	III	240	0	0	0	0	0	0
	IV	80	0	0	0	0	0	0
11	III	9	0	0	0	0	0	0
	IV	46	0	0	0	0	0	0
12	IV	220	0	0	0	0	0	0
13	II	97	0	0	0	0	0	0
	III	97	0	0	0	0	0	0
	IV	97	0	0	0	0	0	0
14	MEG	44	0	0	0	0	0	0
16	III	37	0	0	0	0	0	0
	IV	18	0	0	0	0	0	0
20	II	5	0	0	0	0	0	0
22	III	13	0	0	0	0	0	0
	IV	0	9	0	0	0	0	0
23	III	4	0	0	0	0	0	0
28	MEG	13	0	0	0	0	0	0
30	MEG	34	0	0	0	0	0	0
31	IV	122	0	0	0	0	0	0

PANDALOPSIS DISPAR/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
6	I	0	12	0	0	0	0	0
	II	0	12	0	0	0	0	0
7	II	10	0	0	0	0	0	0
9	I	15	0	0	0	0	0	0
	II	15	0	0	0	0	0	0
	III	15	0	0	0	0	0	0
10	I	0	10	0	0	0	0	0
12	I	11	0	0	19	0	0	0
15	II	0	10	0	0	0	0	0
31	III	15	0	0	0	0	0	0

PANDALUS BOREALIS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	II	11	0	0	0	0	0	0
	III	61	0	0	0	0	0	0
	IV	11	0	0	0	0	0	0
2	I	10	0	0	0	0	0	0
	II	5	0	0	0	0	0	0
	III	10	0	0	0	0	0	0
3	I	14	0	0	0	0	0	0
	II	110	0	0	0	0	0	0
	III	276	0	0	0	0	0	0
	IV	69	11	0	0	0	0	0
6	IV	76	70	0	0	0	0	0
8	III	6	0	0	0	0	0	0
	IV	109	0	0	0	0	0	0

CONTINUATION-PANDALUS BOREALIS/10 SQ M

9	IV	145	0	0	0	0	0	0
11	IV	372	10	9	0	0	0	0
	V	9	0	0	0	0	0	0
12	IV	22	0	0	0	0	0	0
13	IV	36	12	0	0	0	0	0
14	V	44	0	0	0	0	0	0
15	IV	0	20	34	0	0	0	0
16	IV	9	0	0	12	0	0	0
17	IV	0	67	0	0	0	0	0
20	IV	0	72	183	0	0	0	0
22	IV	0	17	0	0	0	0	0
23	IV	0	28	0	0	0	0	0
26	IV	0	12	0	0	0	0	0
28	IV	0	52	0	0	0	0	0
29	IV	0	10	0	0	0	0	0
30	V	0	11	0	0	0	0	0

PANDALUS DANAE/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
3	II	28	0	0	0	0	0	0
16	V	0	34	0	0	0	0	0
25	II	0	5	0	0	0	0	0

CONTINUATION-PANDALUS DANAE/10 SQ M

26	III	0	0	0	0	0	0	0

PANDALUS GONIURUS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	II	22	0	0	0	0	0	0
	III	133	0	0	0	0	0	0
2	I	20	0	0	0	0	0	0
	II	25	0	0	0	0	0	0
	III	25	0	0	0	0	0	0
3	I	55	0	0	0	0	0	0
	II	83	0	0	0	0	0	0
	III	124	0	0	0	0	0	0
6	III	38	0	0	0	0	0	0
	IV	76	0	0	0	0	0	0
7	III	39	0	0	0	0	0	0
	IV	39	0	0	0	0	0	0
8	III	32	0	0	0	0	0	0
	IV	540	0	0	0	0	0	0
9	III	43	0	0	0	0	0	0
	IV	347	0	0	0	0	0	0
	V	15	0	0	0	0	0	0
11	III	73	0	0	0	0	0	0
	IV	554	0	0	0	0	0	0
12	III	33	0	0	0	0	0	0
	IV	55	0	0	0	0	0	0
	V	0	11	0	0	0	0	0
13	IV	12	0	0	0	0	0	0
14	IV	11	0	0	0	0	0	0

CONTINUATION-PANDALUS GONIURUS/10 SQ M

15	II	9	0	0	0	0	0	0
	III	82	0	0	0	0	0	0
	IV	54	0	0	0	0	0	0
17	V	0	11	0	0	0	0	0
18	IV	8	0	0	0	0	0	0
19	III	7	0	0	0	0	0	0
	IV	15	0	0	0	0	0	0
	V	0	13	0	0	0	0	0
20	II	5	0	0	0	0	0	0
	III	5	0	0	0	0	0	0
	IV	30	72	0	0	0	0	0
	V	0	143	0	0	0	0	0
21	II	6	0	0	0	0	0	0
	III	6	0	0	0	0	0	0
	IV	17	0	0	0	0	0	0
	V	0	0	8	0	0	0	0
22	III	26	0	0	0	0	0	0
	IV	79	17	0	0	0	0	0
	V	0	51	0	0	0	0	0
23	IV	30	0	0	0	0	0	0
	V	0	7	16	0	0	0	0
28	V	0	43	19	0	0	0	0
29	IV	7	0	0	0	0	0	0
30	IV	43	0	0	0	0	0	0
	V	0	22	11	0	0	0	0

PANDALUS HYPSINOTUS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
4	II	0	0	5	0	0	0	0
6	VI	0	0	24	0	0	0	0
12	VI	0	0	20	0	0	0	0
29	III	0	0	10	0	0	0	0

PANDALUS MONTAGUI TRIDENS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
16	III	9	0	0	0	0	0	0

PANDALUS STENOLEPIS/10 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
13	I	0	35	0	0	0	0	0
	II	0	0	10	0	0	0	0
	III	0	0	50	0	0	0	0
	IV	0	0	20	0	0	0	0
14	I	0	12	0	0	0	0	0
15	III	0	0	12	0	0	0	0
16	II	0	11	12	0	0	0	0
	III	0	11	12	0	0	0	0
	IV	0	11	0	12	0	0	0
32	I	0	12	0	0	0	0	0

APPENDIX G

Density per 1000 cubic meters, 1978.

FISH EGGS/1000 CU M

STATION	SIZE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	<1 MM	3	250	0	0	250	0	0
	1 MM	36	0	0	0	0	0	0
2	<1 MM	131	842	0	0	0	125	0
	1 MM	745	53	0	0	0	0	0
	3 MM	6	0	0	0	0	0	0
3	<1 MM	0	292	0	0	0	167	0
	1 MM	139	0	0	0	0	0	0
	2 MM	7	0	0	0	0	0	0
	3 MM	7	0	0	0	0	0	0
4	<1 MM	0	4450	4952	1000	0	0	0
6	<1 MM	225	500	26	34	0	0	0
	1 MM	183	17	0	0	0	0	0
7	<1 MM	449	74	414	900	0	94	0
	1 MM	82	0	34	0	0	0	0
8	<1 MM	621	0	0	0	714	0	0
	1 MM	5071	42	0	0	0	0	0
9	<1 MM	278	125	176	83	132	0	0
	1 MM	1944	100	29	0	0	0	0
	2 MM	0	0	0	0	0	0	54
10	<1 MM	15	511	76	0	40	0	0
	1 MM	0	42	0	0	0	0	0
11	<1 MM	26	2077	36	845	194	19	0
	1 MM	0	62	0	52	16	0	0
12	<1 MM	0	435	12	206	0	0	0
	1 MM	17	29	0	0	0	0	0
13	<1 MM	0	0	0	23	0	0	0
	1 MM	0	0	0	23	0	0	0
14	<1 MM	13	17	0	0	0	0	0
	1 MM	13	0	0	0	0	0	0

CONTINUATION-FISH EGGS/1000 CU M

15	<1 MM	0	0	20	22	0	0	0
	1 MM	113	38	20	0	0	0	0
16	<1 MM	0	27	0	0	0	0	0
	1 MM	0	13	31	0	0	0	0
17	<1 MM	0	23	0	0	0	0	0
	1 MM	0	204	21	0	0	0	0
18	<1 MM	743	0	133	0	0	0	0
	1 MM	600	0	0	0	0	0	0
	2 MM	28	0	0	0	0	0	0
19	<1 MM	7852	4000	536	0	0	0	0
	1 MM	4074	240	0	0	0	0	0
	2 MM	37	0	0	0	0	0	0
20	<1 MM	107	390	130	0	0	0	0
	1 MM	813	707	0	0	0	0	0
	2 MM	0	0	22	0	0	0	0
21	<1 MM	4556	1292	160	0	0	0	0
	1 MM	1944	167	40	0	0	0	0
22	<1 MM	4345	3481	214	0	0	0	0
	1 MM	414	407	0	0	0	0	0
23	<1 MM	6762	2267	192	0	0	0	40
	1 MM	571	167	0	0	0	0	0
24	<1 MM	18167	2680	236	0	0	0	0
	1 MM	13722	200	0	0	0	0	0
25	<1 MM	0	2737	214	0	0	0	0
	1 MM	0	53	0	0	0	0	0
26	<1 MM	0	6056	235	0	0	0	0
	1 MM	0	389	0	0	0	0	0
27	<1 MM	0	2533	0	0	0	0	0
	1 MM	0	133	0	0	0	0	0
28	<1 MM	778	935	645	0	0	0	0
	1 MM	833	194	32	0	0	0	0

CONTINUATION-FISH EGGS/1000 CU M

29	<1 MM	89	972	466	0	0	0	0
	1 MM	689	639	143	0	0	0	0
30	<1 MM	21	43	67	20	0	0	0
	1 MM	292	130	100	0	0	0	0
	2 MM	0	0	17	0	0	0	0
31	<1 MM	40	0	0	0	0	0	0
	1 MM	180	0	53	0	0	0	0
32	<1 MM	226	17	45	0	16	0	0
	1 MM	1145	0	0	0	0	0	0

AMMODYTES HEXAPTERUS/1000 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	LAR	18	0	0	0	0	0	0
2	LAR	33	0	0	0	0	0	0
3	LAR	245	0	0	0	0	0	0
6	LAR	42	0	0	0	0	0	0
7	LAR	306	37	0	0	0	0	0
8	LAR	1036	0	0	0	0	0	0
9	LAR	194	50	0	0	0	0	0
10	LAR	15	0	20	0	0	0	0
11	LAR	402	138	0	0	0	0	0
12	LAR	169	58	0	0	0	0	0
13	LAR	0	0	20	0	0	0	0
14	LAR	25	0	0	0	0	0	0
15	LAR	1113	94	0	0	0	0	0
16	LAR	36	27	0	0	0	0	0
17	LAR	0	45	0	0	0	0	0
18	LAR	86	0	33	0	0	0	0
20	LAR	120	98	0	0	0	0	0
21	LAR	0	42	0	0	0	0	0
22	LAR	34	0	0	0	0	0	0
23	LAR	48	0	0	0	0	0	0

CONTINUATION-AMMODYTES HEXAPTERUS/1000 SQ M

28	LAR	56	0	0	0	0	0	0
29	LAR	22	0	0	0	0	0	0
30	LAR	62	0	0	0	0	0	0
31	LAR	80	26	0	0	0	0	0
32	LAR	64	0	0	0	0	0	0

CLUPEA HARENGUS PALLASI/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	LAR	0	28	0	0	0	0	0
2	LAR	0	79	0	0	0	0	0
10	LAR	0	0	20	0	0	0	0
18	LAR	0	0	0	31	0	0	0
19	LAR	0	120	462	0	0	0	0
21	LAR	0	42	0	0	0	0	0
22	LAR	0	518	0	0	0	0	0
23	LAR	0	1567	115	0	0	0	0
24	LAR	0	80	0	0	0	0	0
25	LAR	0	6421	0	0	0	0	0
26	LAR	0	3111	470	0	0	0	0
27	LAR	0	2533	0	0	0	0	0
28	LAR	0	0	161	0	0	0	0

CONTINUATION-CLUPEA HARENGUS PALLASI/1000 CU M

31	LAR	0	26	0	0	0	0	0

GADIDAE/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
8	LAR	143	0	0	0	0	0	0
11	LAR	39	0	0	0	0	0	0
12	LAR	17	0	0	0	0	0	0
14	LAR	38	0	0	0	0	0	0
15	LAR	321	0	0	0	0	0	0
	JUV	0	38	0	0	0	0	0
16	LAR	61	0	0	0	0	0	0
28	LAR	0	0	32	0	0	0	0
30	JUV	0	0	0	20	0	0	0
31	LAR	40	0	0	0	0	0	0
	JUV	0	51	0	0	0	0	0

HIPPOGLOSSOIDES ELASSODON/1000 SQ M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
3	LAR	7	0	0	0	0	0	0
6	LAR	70	0	0	0	0	0	0
8	LAR	143	0	0	0	0	0	0
11	LAR	13	0	0	0	0	0	0

CONTINUATION-HIPPOGLOSSOIDES ELASSODON/1000 SQ M

12	LAR	17	0	0	0	0	0	0
13	LAR	0	23	0	0	0	0	0
16	LAR	12	0	0	0	0	0	0
18	LAR	66	0	0	0	0	0	0
19	LAR	37	0	0	0	0	0	0
22	LAR	207	0	0	0	0	0	0
23	LAR	95	0	0	0	0	0	0
28	LAR	56	0	0	0	0	0	0
29	LAR	22	0	0	0	0	0	0

LIMANDA ASPERA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	8 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
2	LAR	13	26	0	143	143	0	0
3	LAR	0	42	0	0	0	0	0
6	LAR	0	17	0	0	0	0	0
11	LAR	0	15	0	34	0	19	0
17	LAR	0	0	21	0	0	0	0
18	LAR	0	0	433	0	0	0	0
19	LAR	111	40	38	0	0	0	0
20	LAR	0	0	65	0	0	0	0
21	LAR	0	42	120	0	0	0	0

CONTINUATION-LIMANDA ASPERA/1000 CU M

22	LAR	69	111	214	0	0	0	0
23	LAR	143	400	192	0	0	0	0
24	LAR	0	0	190	0	0	0	0
26	LAR	0	64	290	0	0	0	0
29	LAR	0	139	57	30	28	0	0

MALLOTUS VILLOSUS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	LAR	6	167	0	0	500	0	0
2	LAR	13	1132	0	0	0	0	250
3	LAR	20	21	0	0	125	500	0
4	LAR	0	3450	190	4000	0	0	333
6	LAR	0	1350	299	85	167	61	0
7	LAR	0	1518	1241	67	0	156	148
8	LAR	0	1125	516	120	286	74	38
9	LAR	0	800	1382	278	53	0	27
10	LAR	0	1042	157	67	220	0	0
11	LAR	13	692	1051	86	710	38	0
12	LAR	0	246	207	143	0	143	72
13	LAR	0	977	960	204	191	0	0
14	LAR	0	2224	928	129	47	0	0

CONTINUATION-MALLOTUS VILLOSUS/1000 CU M

15	LAR	0	1774	490	67	35	0	0
16	LAR	0	1907	385	62	88	0	0
17	LAR	0	91	365	20	0	0	0
18	LAR	0	0	2300	125	31	0	0
19	LAR	0	4120	1692	0	0	0	0
20	LAR	0	24	783	0	0	0	0
21	LAR	0	1375	840	0	0	0	0
22	LAR	0	1333	143	0	0	0	0
23	LAR	0	733	192	0	0	0	120
24	LAR	0	520	762	0	0	0	0
25	LAR	0	263	214	0	0	0	0
26	LAR	0	3833	1470	0	0	0	0
27	LAR	0	600	0	0	0	0	0
28	LAR	0	968	2064	0	31	0	0
29	LAR	0	3722	743	152	0	0	0
30	LAR	0	478	217	102	0	0	0
31	LAR	0	282	395	50	205	0	0
32	LAR	0	1883	152	97	317	0	0

USMERIDAE/1003 CC M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
2	LAR	0	53	0	0	0	0	0
3	LAR	0	21	0	0	125	C	0
4	LAR	0	850	48	1500	0	0	0
6	LAR	0	433	52	17	0	24	12
7	LAR	0	1074	1103	0	0	62	0
8	LAR	0	1208	333	40	0	0	0
9	LAR	0	475	323	56	26	0	0
10	LAR	0	319	59	22	80	0	0
11	LAR	0	262	216	17	145	57	15
12	LAR	0	174	49	16	0	36	14
13	LAR	0	372	469	0	21	0	0
14	LAR	0	396	743	16	16	0	0
15	LAR	0	472	274	0	0	0	0
16	LAR	0	400	62	31	15	0	0
17	LAR	0	0	21	0	C	0	0
18	LAR	0	0	100	62	0	0	0
19	LAR	0	120	306	0	0	C	0
20	LAR	0	0	130	0	0	0	0
21	LAR	0	167	20	0	0	C	0
22	LAR	0	74	0	0	0	0	0

CONTINUATION-OSMERIDAE/1000 CU M

24	LAR	0	0	48	0	0	0	0
25	LAR	0	53	71	0	0	0	0
26	LAR	0	222	0	0	0	0	0
27	LAR	0	267	0	0	0	0	0
28	LAR	0	32	32	0	0	0	0
29	LAR	0	389	0	61	0	0	0
30	LAR	0	152	267	0	82	0	0
31	LAR	0	51	132	25	872	0	0
32	LAR	0	617	121	28	32	0	0

ANOMURA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	ZOE	226	1139	0	250	500	250	333
2	ZOE	575	7684	0	1000	1143	1125	0
3	ZOE	980	271	0	0	375	833	600
	MEG	0	42	0	0	125	0	0
4	ZOE	0	250	333	0	0	0	667
5	ZOE	0	0	0	0	500	0	250
6	ZOE	1408	12533	2494	661	872	817	388
	MEG	0	0	0	51	38	12	12
7	ZOE	18939	0	0	667	0	125	259
	MEG	0	0	0	133	0	31	0
8	ZOE	49714	333	444	80	0	889	577
	MEG	0	0	148	40	0	37	0
9	ZOE	8222	5600	412	583	632	194	1297
	MEG	0	0	118	83	0	0	0
10	ZOE	4000	170	863	489	200	0	120
	MEG	0	0	0	44	0	0	20
11	ZOE	286	1908	10564	1190	5613	2811	2853
	MEG	0	0	0	86	0	19	0
12	ZOE	2508	9043	8565	4069	0	2690	2087
	MEG	68	0	195	69	0	12	0
13	ZOE	8828	372	2857	159	149	0	0
	MEG	0	279	62	91	0	0	0
14	ZOE	2126	2069	3143	145	156	0	0
	MEG	0	34	171	0	31	0	0
15	ZOE	2189	2019	2745	0	35	0	0
	MEG	0	19	76	43	0	0	0

CONTINUATION-ANUMOKA/1000 CU M

16	ZOE	122	213	354	438	15	0	0
	MEG	0	0	138	94	0	0	0
17	ZOE	0	1000	3872	120	0	0	0
	MEG	0	0	85	0	0	0	0
18	ZOE	5086	19200	375	2500	0	0	0
	MEG	0	0	533	0	31	0	0
19	ZOE	3111	1640	3577	0	0	0	0
20	ZOE	1227	1366	1739	0	0	0	0
	MEG	0	0	22	0	0	0	0
21	ZOE	1722	4167	920	0	0	0	40
22	ZOE	9793	4704	571	0	0	0	0
	MEG	0	0	0	0	0	0	64
23	ZOE	4428	4533	1115	0	0	0	80
	MEG	0	0	0	0	0	0	40
24	ZOE	1500	3560	2095	0	0	0	0
25	ZOE	0	2632	71	0	0	0	0
26	ZOE	0	2556	116	0	0	0	0
27	ZOE	0	1000	0	0	0	0	0
28	ZOE	4083	23742	3226	900	4344	0	0
	MEG	0	0	129	0	31	0	0
29	ZOE	1333	333	3086	1364	1714	0	0
	MEG	0	0	0	91	0	0	0
30	ZOE	5583	651	867	368	184	0	0
31	ZOE	960	0	526	425	462	0	0
	MEG	0	26	105	0	0	0	0
32	ZOE	1290	300	2061	930	143	0	0
	MEG	0	0	242	14	0	0	0

BRACHYURA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	ZOE	245	1083	0	2375	0	0	0
	MEG	3	0	0	0	0	0	0
2	ZOE	1804	2842	0	1143	714	125	0
3	ZOE	1510	188	0	0	500	1167	0
4	ZOE	0	950	667	2000	10500	0	0
	MEG	0	150	333	0	0	0	0
5	ZOE	0	0	0	0	23000	0	0
6	ZOE	4225	9867	1039	356	231	207	12
	MEG	0	267	208	85	13	0	0
7	ZOE	75755	2370	1103	333	0	781	0
	MEG	1959	0	0	10667	0	0	0
8	ZOE	7428	1000	2370	80	95	407	38
	MEG	0	0	7852	2840	0	0	0
9	ZOE	6222	38400	0	28	1474	97	0
	MEG	0	0	412	1250	105	0	27
10	ZOE	5939	340	863	44	700	0	0
	MEG	121	0	863	1778	0	0	0
11	ZOE	312	985	3077	172	581	453	74
	MEG	0	0	1026	241	0	0	15
12	ZOE	5559	12522	2536	111	0	83	43
	MEG	0	0	5854	511	0	0	14
13	ZOE	12690	4372	245	0	694	0	0
	MEG	276	0	9061	1068	0	0	0
14	ZOE	4911	2362	114	16	172	0	0
	MEG	0	17	1028	339	0	0	0
15	ZOE	4415	1283	76	0	263	0	0
	MEG	38	19	157	109	0	0	0

CONTINUATION-BRACHYURA/1000 CU M

16	ZOE	3585	1240	77	0	206	0	0
	MEG	0	0	123	875	0	0	0
17	ZOE	0	1318	213	20	0	0	0
	MEG	0	0	0	100	0	0	0
18	ZOE	3600	0	19200	594	531	0	0
	MEG	0	0	533	0	0	0	0
19	ZOE	481	500	2000	0	0	0	0
	MEG	0	0	0	0	0	0	32
20	ZOE	1920	976	217	0	0	0	0
	MEG	0	49	43	0	0	0	0
21	ZOE	500	19583	4440	0	0	0	0
22	ZOE	1724	1741	4107	0	0	0	0
	MEG	69	0	0	0	0	0	0
23	ZOE	1619	1733	5269	0	0	0	80
	MEG	0	67	0	0	0	0	0
24	ZOE	111	3920	9476	0	0	0	45
	MEG	0	40	95	0	0	0	0
25	ZOE	0	53	0	0	0	0	0
	MEG	0	0	71	0	0	0	0
26	ZOE	0	500	59	0	0	0	0
27	ZOE	0	467	0	0	0	0	0
28	ZOE	1417	17548	5419	433	62	0	0
	MEG	0	1032	256	67	0	0	0
29	ZOE	289	139	457	152	714	0	0
	MEG	0	0	0	31	0	0	0
30	ZOE	5250	170	450	41	102	0	0
	MEG	0	0	83	41	0	0	0
31	ZOE	6080	923	632	0	102	0	0
	MEG	0	0	210	15	0	0	0

CONTINUATION-BRACHYURA/1000 CU M

32	ZOE	1290	533	1394	0	524	0	0
	MEG	0	0	788	69	0	0	0

CANCER MAGISTER/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	II	6	0	0	0	0	0	0
2	II	0	421	0	0	0	0	0
3	I	53	0	0	0	0	0	0
	II	26	83	0	0	0	0	0
4	II	0	150	0	0	0	0	0
6	I	56	0	0	0	0	0	0
	II	0	800	208	0	0	0	0
7	II	0	592	552	0	0	0	0
8	I	6286	0	0	0	0	0	0
	II	0	2333	296	0	0	37	0
9	I	667	0	59	0	0	0	0
	II	0	8000	1176	0	0	0	0
	III	0	0	765	0	0	0	0
	V	0	0	0	0	105	0	0
10	II	0	340	78	0	0	0	0
	III	0	0	314	0	0	0	0
	MEG	0	0	0	0	60	0	0
11	II	0	308	1026	0	0	0	0
	III	0	0	308	0	0	0	0
	V	0	0	0	0	0	19	0
12	I	542	0	0	0	0	0	0
13	II	0	2319	0	0	0	0	0
	III	0	232	0	0	0	0	0

CONTINUATION-CANCER MAGISTER/1000 CU M

14	I	51	0	0	0	0	C	0
	V	0	0	0	0	16	0	0
15	II	0	19	0	0	0	C	0
16	II	0	0	108	0	0	0	0
	III	0	0	77	31	0	0	0
	IV	0	0	31	0	0	0	0
	V	0	0	0	31	0	0	0
17	II	0	45	340	0	0	0	0
	III	0	0	42	0	0	0	0
19	II	148	0	0	0	0	0	0
	III	0	0	36	0	0	0	0
20	II	53	488	0	0	0	0	0
21	II	0	167	80	0	0	0	0
22	II	207	333	0	0	0	0	0
	III	0	37	0	0	0	0	0
23	II	95	33	0	0	0	0	0
24	II	0	80	0	0	0	0	0
26	II	0	56	C	0	0	0	0
28	II	83	0	258	0	0	0	0
29	II	44	56	C	0	0	0	0
30	II	0	0	17	0	0	0	0
	III	0	0	33	0	0	0	0
31	II	640	0	105	0	0	0	0
32	II	774	0	364	0	0	0	0
	III	0	0	303	0	0	0	0
	V	0	0	0	0	16	0	0
	MEG	0	0	0	0	16	C	0

CANCER SPP/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	I	154	306	0	0	250	0	0
	III	0	0	0	375	0	0	0
	ZOE	6	0	0	0	0	0	0
2	I	52	3684	0	143	0	0	0
	II	0	526	0	143	0	0	0
	V	0	0	0	0	143	125	0
	ZOE	26	0	0	0	0	0	0
3	I	1139	854	0	0	0	0	0
	II	0	396	0	0	0	0	0
	III	0	0	0	0	0	167	0
	V	0	0	0	0	250	0	0
	ZOE	53	0	0	0	0	0	0
4	I	0	13250	667	0	0	0	0
	II	0	2550	2238	0	0	0	333
	III	0	0	762	0	0	0	0
	V	0	0	0	0	1000	0	0
5	I	0	0	0	0	0	667	0
6	I	1465	61333	3948	17	0	24	0
	II	0	36000	18494	0	13	12	0
	III	0	533	1662	169	13	36	0
	IV	0	0	0	644	0	12	0
	V	0	0	0	136	26	305	0
	MEG	0	0	0	0	26	256	94
7	I	0	73481	14345	200	0	0	37
	II	0	4148	11310	67	0	31	185
	III	0	592	3310	333	0	31	0
	IV	0	0	0	2200	0	62	0
	V	0	0	0	1067	0	281	74
	ZOE	57469	0	0	0	0	0	0
	MEG	0	0	0	0	0	719	0
8	I	66286	32667	3556	0	0	0	0
	II	0	5333	4296	0	48	0	0
	III	0	333	2074	560	95	0	0
	IV	0	0	0	1160	428	0	0
	V	0	0	0	160	3048	148	0
	ZOE	3428	0	0	0	0	0	0
	MEG	0	0	0	0	361	111	38

CONTINUATION-CANCER SPP/1000 CU M

9	I	14444	21600	1235	0	210	0	0
	II	0	3200	1824	0	0	0	0
	III	0	800	353	111	0	0	0
	IV	0	0	0	139	210	0	27
	V	0	0	0	83	5053	161	27
	ZOE	1111	0	353	0	0	0	0
	MEG	0	0	0	0	1579	194	405
10	I	16727	3511	392	22	0	0	20
	II	0	532	2588	0	0	0	20
	III	0	0	3529	44	0	0	0
	IV	0	0	0	289	60	0	0
	V	0	0	0	178	880	0	0
	MEG	0	0	0	0	820	0	300
11	I	779	4862	2769	121	0	0	15
	II	0	2954	23897	138	0	19	44
	III	0	62	8102	345	0	19	44
	IV	0	0	0	586	129	19	0
	V	0	0	0	155	903	189	15
	MEG	0	0	0	0	0	243	29
12	I	2712	13449	2927	44	0	12	0
	II	0	7420	7220	67	0	12	0
	III	0	928	4488	267	0	12	0
	IV	0	0	0	2467	0	0	29
	V	0	0	0	578	0	83	43
	MEG	0	0	0	0	0	83	246
13	I	0	12837	0	23	0	0	0
	II	0	279	1959	23	0	0	0
	III	0	0	1143	68	0	0	0
	IV	0	0	0	136	0	0	0
	V	0	0	0	91	85	0	0
	ZOE	8276	0	0	0	0	0	0
	MEG	0	0	0	0	276	0	0
14	I	1975	1448	228	32	0	0	0
	II	0	0	686	48	16	0	0
	III	0	0	857	113	16	0	0
	IV	0	0	114	81	31	0	0
	V	0	0	57	64	172	0	0
	ZOE	51	0	0	0	0	0	0
	MEG	0	0	57	0	62	0	0

CONTINUATION-CANCER SPP/1000 CU M

15	I	377	340	1882	67	0	0	0
	II	0	151	4470	87	0	0	0
	III	0	0	3216	239	0	0	0
	IV	0	0	157	370	35	0	0
	V	0	0	0	22	333	0	0
	ZOE	38	0	0	0	0	0	0
	MEG	0	0	0	0	175	0	0
16	I	24	1707	246	0	0	0	0
	II	24	53	677	250	0	0	0
	III	0	13	554	812	0	0	0
	IV	0	0	46	5000	0	0	0
	V	0	0	0	312	15	0	0
	ZOE	0	0	62	0	0	0	0
	MEG	0	0	15	31	88	0	0
17	I	0	4591	2468	0	0	0	0
	II	0	500	1872	280	0	0	0
	III	0	0	340	220	0	0	0
	IV	0	0	0	460	0	0	0
	V	0	0	0	20	0	0	0
	ZOE	0	0	213	0	0	0	0
18	I	286	0	5600	125	0	0	0
	II	228	0	1067	438	0	0	0
	III	0	0	4267	469	0	0	0
	IV	0	0	0	781	62	0	0
	V	0	0	0	94	62	0	0
	MEG	0	0	0	0	62	0	0
19	I	185	80	500	0	0	0	0
	II	37	0	269	0	0	0	0
	III	0	0	154	0	0	0	0
	MEG	0	0	0	0	0	0	32
20	I	147	7024	1870	0	0	0	0
	II	0	488	2043	0	0	0	0
	III	0	0	739	0	0	0	0
	IV	0	0	22	0	0	0	0
21	I	0	417	1800	0	0	0	0
	II	0	0	40	0	0	0	0
	III	0	0	80	0	0	0	0
	MEG	0	0	0	0	0	0	80

CONTINUATION-CANCER SPP/1000 CU M

22	I	0	185	36	0	0	0	0
	II	0	0	36	0	0	0	0
	III	0	0	250	0	0	0	0
	ZOE	276	0	0	0	0	0	32
23	I	48	0	115	0	0	0	0
	II	0	33	0	0	0	0	0
	MEG	0	0	0	0	0	0	40
24	I	56	40	619	0	0	0	0
	II	0	0	286	0	0	0	0
25	II	0	0	71	0	0	0	0
27	I	0	67	0	0	0	0	0
28	I	361	36129	1161	0	0	0	0
	II	0	72256	2839	33	0	0	0
	III	0	4129	1290	533	62	0	0
	IV	0	0	0	633	94	0	0
	V	0	0	0	300	31	0	0
	MEG	0	0	0	0	31	0	0
29	I	200	1778	3086	0	28	0	0
	II	0	3861	7657	273	0	0	0
	III	0	28	2971	424	0	0	0
	IV	0	0	0	485	86	0	0
	V	0	0	0	212	0	0	0
	MEG	0	0	0	0	114	0	0
30	I	417	7826	2600	0	0	0	0
	II	0	10553	3650	61	0	0	0
	III	0	170	433	224	0	0	0
	IV	0	0	0	286	20	0	0
	V	0	0	0	224	184	0	0
	MEG	0	0	0	0	102	0	0
31	I	14720	5026	1684	0	77	0	0
	II	0	1769	16526	25	77	0	0
	III	0	0	3156	50	103	0	0
	IV	0	0	0	300	51	0	0
	V	0	0	0	75	667	0	0
	ZOE	0	51	0	0	0	0	0
	MEG	0	0	0	25	128	0	0

CONTINUATION-CANCER SPP/1000 CU M

32	I	22064	3000	909	0	32	0	0
	II	0	1200	5333	0	16	0	0
	III	0	33	3273	0	16	0	0
	IV	0	0	0	28	32	0	0
	V	0	0	0	69	1508	0	0
	MEG	0	0	0	28	302	0	0

CHIONOECETES BAIRDI/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	I	390	0	0	0	0	0	0
2	I	6458	0	0	0	0	0	0
3	I	4185	0	0	0	0	0	0
5	MEG	0	0	0	0	500	0	0
6	I	1127	0	0	0	0	0	0
7	I	5878	0	0	0	0	0	0
	II	653	0	0	0	0	0	0
8	I	44571	1000	0	0	0	0	0
	II	0	333	0	0	0	0	0
9	I	17556	800	0	0	0	0	0
	II	0	5600	0	0	0	0	0
10	I	0	21	0	0	0	0	0
11	I	351	0	0	0	0	0	0
12	I	0	464	0	0	0	0	0
	II	68	0	0	0	0	0	0
14	II	51	0	0	0	0	0	0
	MEG	51	0	0	0	0	0	0

CONTINUATION-CHIONOECETES BAIRDI/1000 CU M

15	I	1509	0	0	0	0	0	0
	MEG	75	0	0	0	0	0	0
16	I	0	160	0	0	0	0	0
	II	0	40	46	0	0	0	0
	MEG	49	0	0	0	0	0	0
20	I	187	0	0	0	0	0	0
22	I	138	0	0	0	0	0	0
24	I	56	0	0	0	0	0	0
28	I	556	0	0	0	0	0	0
29	I	956	0	0	0	0	0	0
30	I	333	0	0	0	0	0	0
31	I	5440	0	0	0	0	0	0
32	I	1032	0	0	0	0	0	0

PARALITHODES CAMTSCHATICA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	III	15	0	0	0	0	0	0
	IV	21	0	0	0	0	0	0
3	III	26	0	0	0	0	0	0
	IV	26	0	0	0	0	0	0
7	III	653	0	0	0	0	0	0
	IV	1959	0	0	0	0	0	0
8	III	2857	0	0	0	0	0	0
	IV	571	0	0	0	0	0	0
9	III	222	0	0	0	0	0	0

CONTINUATION-PARALITHODES CAMTSCHATICA/1000 CU M

10	III	364	0	0	0	0	0	0
	IV	121	0	0	0	0	0	0
11	III	13	0	0	0	0	0	0
	IV	65	0	0	0	0	0	0
12	IV	339	0	0	0	0	0	0
13	II	276	0	0	0	0	0	0
	III	276	0	0	0	0	0	0
	IV	276	0	0	0	0	0	0
14	MEG	51	0	0	0	0	0	0
16	III	49	0	0	0	0	0	0
	IV	24	0	0	0	0	0	0
20	II	13	0	0	0	0	0	0
22	III	69	0	0	0	0	0	0
	IV	0	37	0	0	0	0	0
23	III	48	0	0	0	0	0	0
28	MEG	56	0	0	0	0	0	0
30	MEG	83	0	0	0	0	0	0
31	IV	320	0	0	0	0	0	0

PANDALOPSIS DISPAR/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
6	I	0	17	0	0	0	0	0
	II	0	17	0	0	0	0	0
7	II	41	0	0	0	0	0	0
9	I	56	0	0	0	0	0	0
	II	56	0	0	0	0	0	0
	III	56	0	0	0	0	0	0
10	I	0	21	0	0	0	0	0
12	I	17	0	0	22	0	0	0
15	II	0	19	0	0	0	0	0
31	III	40	0	0	0	0	0	0

PANDALUS BOREALIS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	II	24	0	0	0	0	0	0
	III	133	0	0	0	0	0	0
	IV	24	0	0	0	0	0	0
2	I	26	0	0	0	0	0	0
	II	13	0	0	0	0	0	0
	III	26	0	0	0	0	0	0
3	I	26	0	0	0	0	0	0
	II	212	0	0	0	0	0	0
	III	530	0	0	0	0	0	0
	IV	132	21	0	0	0	0	0
6	IV	113	100	0	0	0	0	0
8	III	36	0	0	0	0	0	0
	IV	607	0	0	0	0	0	0

CONTINUATION-PANDALUS BOREALIS/1000 CU M

9	IV	556	0	0	0	0	0	0
11	IV	532	15	13	0	0	0	0
	V	13	0	0	0	0	0	0
12	IV	34	0	0	0	0	0	0
13	IV	103	23	0	0	0	0	0
14	V	51	0	0	0	0	0	0
15	IV	0	38	59	0	0	0	0
16	IV	12	0	0	16	0	0	0
17	IV	0	136	0	0	0	0	0
20	IV	0	171	435	0	0	0	0
22	IV	0	74	0	0	0	0	0
23	IV	0	133	0	0	0	0	0
26	IV	0	111	0	0	0	0	0
28	IV	0	194	0	0	0	0	0
29	IV	0	28	0	0	0	0	0
30	V	0	22	0	0	0	0	0

PANDALUS DANAE/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
3	II	53	0	0	0	0	0	0
16	V	0	40	0	0	0	0	0
25	II	0	105	0	0	0	0	0

CONTINUATION-PANDALUS DANAE/1000 CU M

26	III	0	56	0	0	0	0	0

PANDALUS GONIURUS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	II	48	0	0	0	0	0	0
	III	290	0	0	0	0	0	0
2	I	52	0	0	0	0	0	0
	II	65	0	0	0	0	0	0
	III	65	0	0	0	0	0	0
3	I	106	0	0	0	0	0	0
	II	159	0	0	0	0	0	0
	III	238	0	0	0	0	0	0
6	III	56	0	0	0	0	0	0
	IV	113	0	0	0	0	0	0
7	III	163	0	0	0	0	0	0
	IV	163	0	0	0	0	0	0
8	III	178	0	0	0	0	0	0
	IV	3000	0	0	0	0	0	0
9	III	167	0	0	0	0	0	0
	IV	1333	0	0	0	0	0	0
	V	56	0	0	0	0	0	0
11	III	104	0	0	0	0	0	0
	IV	792	0	0	0	0	0	0
12	III	51	0	0	0	0	0	0
	IV	85	0	0	0	0	0	0
	V	0	14	0	0	0	0	0
13	IV	34	0	0	0	0	0	0
14	IV	13	0	0	0	0	0	0

CONTINUATION-PANDALUS GONIURUS/1000 CU M

15	II	19	0	0	0	0	0	0
	III	170	0	0	0	0	0	0
	IV	113	0	0	0	0	0	0
17	V	0	23	0	0	0	0	0
18	IV	28	0	0	0	0	0	0
19	III	37	0	0	0	0	0	0
	IV	74	0	0	0	0	0	0
	V	0	80	0	0	0	0	0
20	II	13	0	0	0	0	0	0
	III	13	0	0	0	0	0	0
	IV	80	171	0	0	0	0	0
	V	0	341	0	0	0	0	0
21	II	56	0	0	0	0	0	0
	III	56	0	0	0	0	0	0
	IV	167	0	0	0	0	0	0
	V	0	0	40	0	0	0	0
22	III	138	0	0	0	0	0	0
	IV	414	74	0	0	0	0	0
	V	0	222	0	0	0	0	0
23	IV	381	0	0	0	0	0	0
	V	0	33	77	0	0	0	0
28	V	0	161	64	0	0	0	0
29	IV	22	0	0	0	0	0	0
30	IV	104	0	0	0	0	0	0
	V	0	43	17	0	0	0	0

PANDALUS HYPSINOTUS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
4	II	0	0	46	0	0	0	0
6	VI	0	0	26	0	0	0	0
12	VI	0	0	24	0	0	0	0
29	III	0	0	28	0	0	0	0

PANDALUS MONTAGUI TRIDENS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
16	III	12	0	0	0	0	0	0

PANDALUS STENOLEPIS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
13	I	0	70	0	0	0	0	0
	II	0	0	20	0	0	0	0
	III	0	0	102	0	0	0	0
	IV	0	0	41	0	0	0	0
14	I	0	17	0	0	0	0	0
15	III	0	0	20	0	0	0	0
16	II	0	13	15	0	0	0	0
	III	0	13	15	0	0	0	0
	IV	0	13	0	16	0	0	0
32	I	0	17	0	0	0	0	0

APPENDIX H

Density per 1000 cubic meters for 1978 neuston net samples.

FISH EGGS/1000 CU M

STATION	SIZE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	<1 MM				0	901	155	0
	1 MM				0	14	0	0
2	<1 MM				0	56	0	0
3	<1 MM				0	155	98	141
4	<1 MM				0	12507	422	14
	3 MM				0	0	14	0
5	<1 MM				0	14	14	0
6	<1 MM				0	42	70	14
7	<1 MM				0	0	2211	0
	1 MM				0	0	56	0
8	<1 MM				0	1338	620	0
	1 MM				0	14	8	0
	2 MM				0	0	0	14
9	<1 MM				0	662	14	0
	1 MM				0	14	0	0
10	<1 MM				0	986	0	0
	1 MM				0	28	0	0
11	<1 MM				0	662	1479	56
	1 MM				0	0	14	0
12	<1 MM				0	0	28	0
28	<1 MM				28	0	0	0
31	<1 MM				0	14	0	0
32	<1 MM				28	113	0	0
	1 MM				0	14	0	0

LIMANDA ASPERA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
4	LAR				0	0	14	0

MALLOTUS VILLOSUS/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
2	LAR				0	0	0	14
4	LAR				0	0	366	0
7	LAR				0	0	141	0
8	LAR				0	0	0	70
11	LAR				0	14	0	0
14	LAR				0	56	0	0
22	LAR				0	0	0	14
28	LAR				14	0	0	0

OSMERIDAE/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
4	LAR				0	0	183	0
7	LAR				0	0	42	70
8	LAR				0	42	0	56
9	LAR				0	70	14	0

CONTINUATION-USMERIDAE/1000 CU M

14	LAR	0	422	0	0
22	LAR	0	0	0	14
23	LAR	0	0	0	70
31	LAR	0	14	0	0
32	LAR	28	0	0	0

ANOMURA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
1	MEG				0	14	14	0
3	ZOE				0	0	C	14
	MEG				0	14	0	28
4	ZOE				0	0	0	14
	MEG				0	98	0	0
5	MEG				0	0	0	14
6	MEG				0	28	0	0
7	ZOE				0	0	0	14
11	MEG				0	14	0	0
19	MEG				0	0	0	14
23	MEG				0	0	0	98
31	ZOE				14	0	0	0
	MEG				28	0	0	0
32	ZOE				225	0	0	0

BRACHYURA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
4	ZOE				0	0	0	14
10	ZOE				0	4	0	0
28	ZOE				33	14	0	0
	MEG				133	0	0	0
30	MEG				98	0	0	0

CONTINUATION-BRACHYURA/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
31	MEG				84	0	0	0
32	MEG				169	0	0	0

CANCER MAGISTER/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
6	MEG				0	42	0	0
9	V				0	0	14	0
11	MEG				0	14	0	0
12	MEG				0	0	14	0
14	MEG				0	56	0	0
15	MEG				0	14	0	0
31	MEG				14	0	0	0
32	V				28	0	0	0
	MEG				70	0	0	0

CANCER SPP/1000 CU M

STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	6 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
4	I				0	0	14	0
	II				0	0	0	28
	V				0	873	0	0
	MEG				0	422	254	0
5	I				0	14	0	0
6	MEG				0	0	0	14

CONTINUATION-CANCER SPP/1000 CU M

7	I	0	0	56	0
	II	0	0	28	0
	III	0	0	14	0
	IV	0	0	42	0
	V	0	0	84	0
	MEG	0	0	0	183
8	IV	0	0	0	14
	V	0	14	14	0
	MEG	0	42	14	0
9	I	0	0	28	0
	II	0	0	14	0
	III	0	0	42	0
	IV	0	0	14	0
	V	0	0	28	0
	MEG	0	14	14	127
11	IV	0	42	0	0
	V	0	1507	0	0
	MEG	0	282	0	0
12	MEG	0	0	56	14
20	V	0	0	0	14
21	MEG	0	0	0	56
22	MEG	0	0	0	28
23	MEG	0	0	0	42
24	MEG	0	0	0	42
28	I	33	0	0	0
	II	33	0	0	0
	MEG	0	14	0	0
29	V	14	0	0	0
30	V	28	0	0	0
	MEG	14	0	0	0

CONTINUATION-CANCER SPP/1000 CU M

31	III				0	14	0	0
	IV				23	0	0	0
	V				141	0	0	0
	MEG				14	0	0	0
32	I				14	0	0	0
	IV				282	0	0	0
	V				507	0	0	0
	MEG				338	0	0	0

CHIONOECETES BAIRDI/1000 CU M

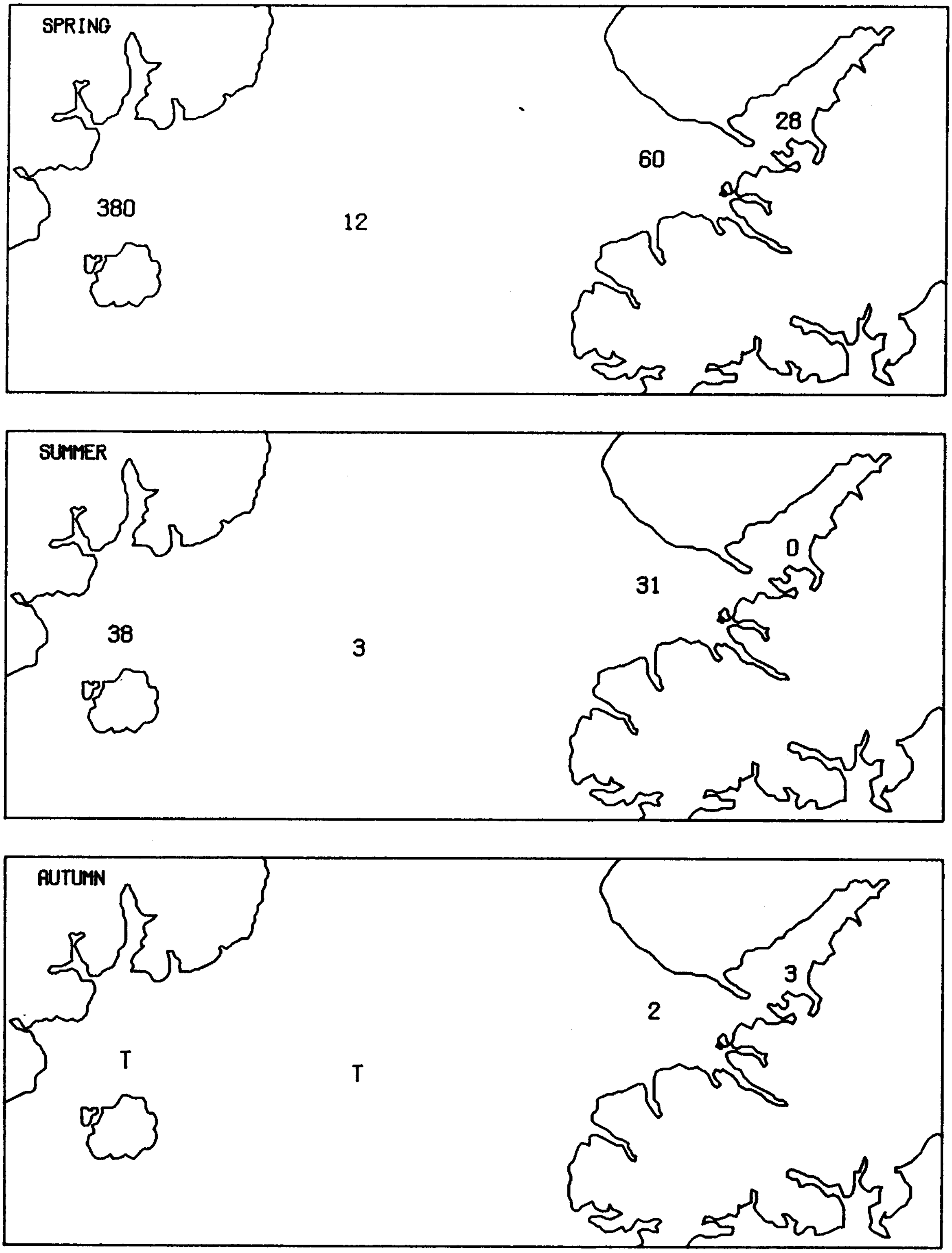
STATION	STAGE	19 MY 9 JN	26 JN 6 JL	11 JL 16 JL	5 AG 14 AG	22 AG 29 AG	31 AG 2 SP	20 SP 27 SP
32	MEG				141	0	0	0

APPENDIX I

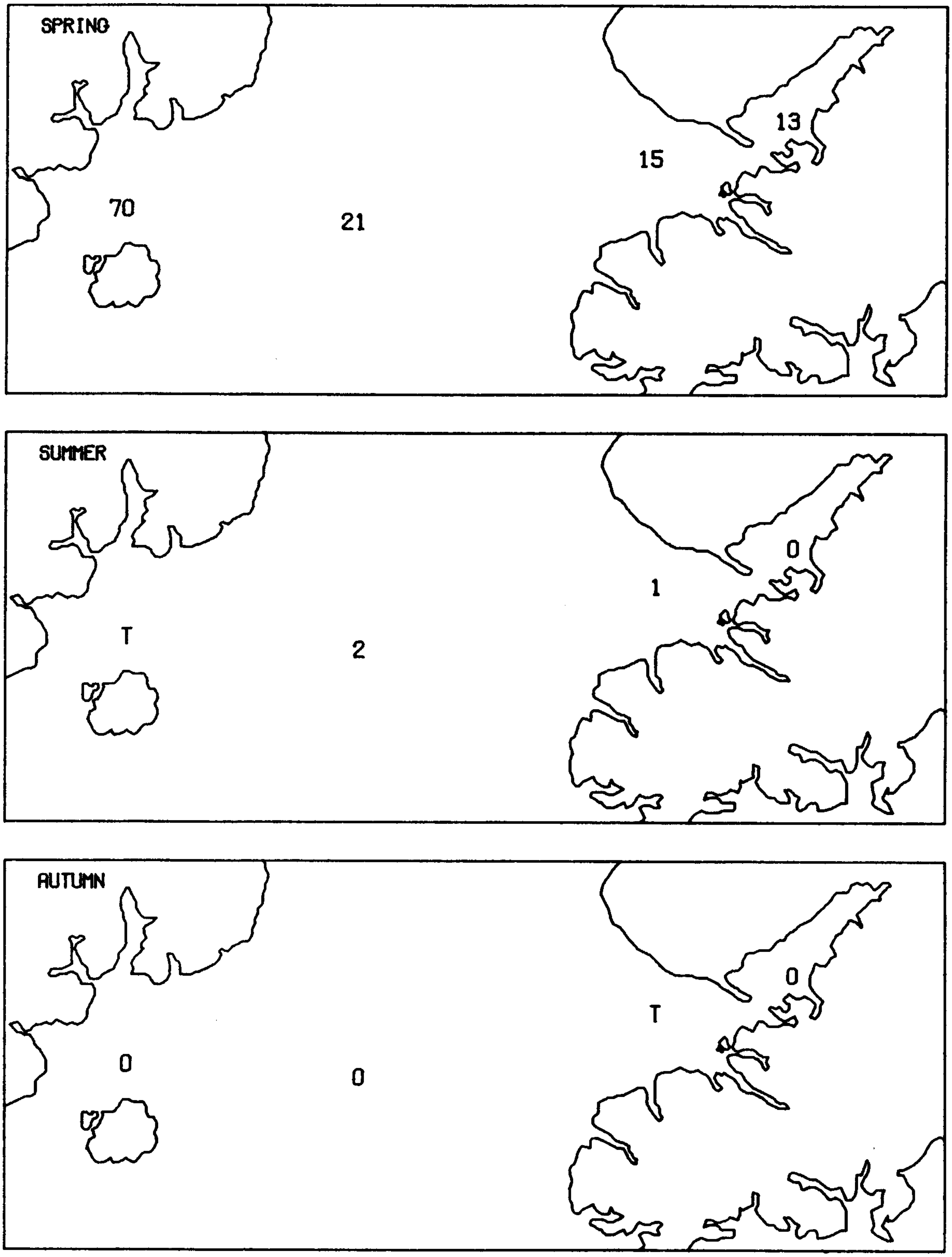
Density distributions per 10 square meters

for three seasons in four areas, 1978.

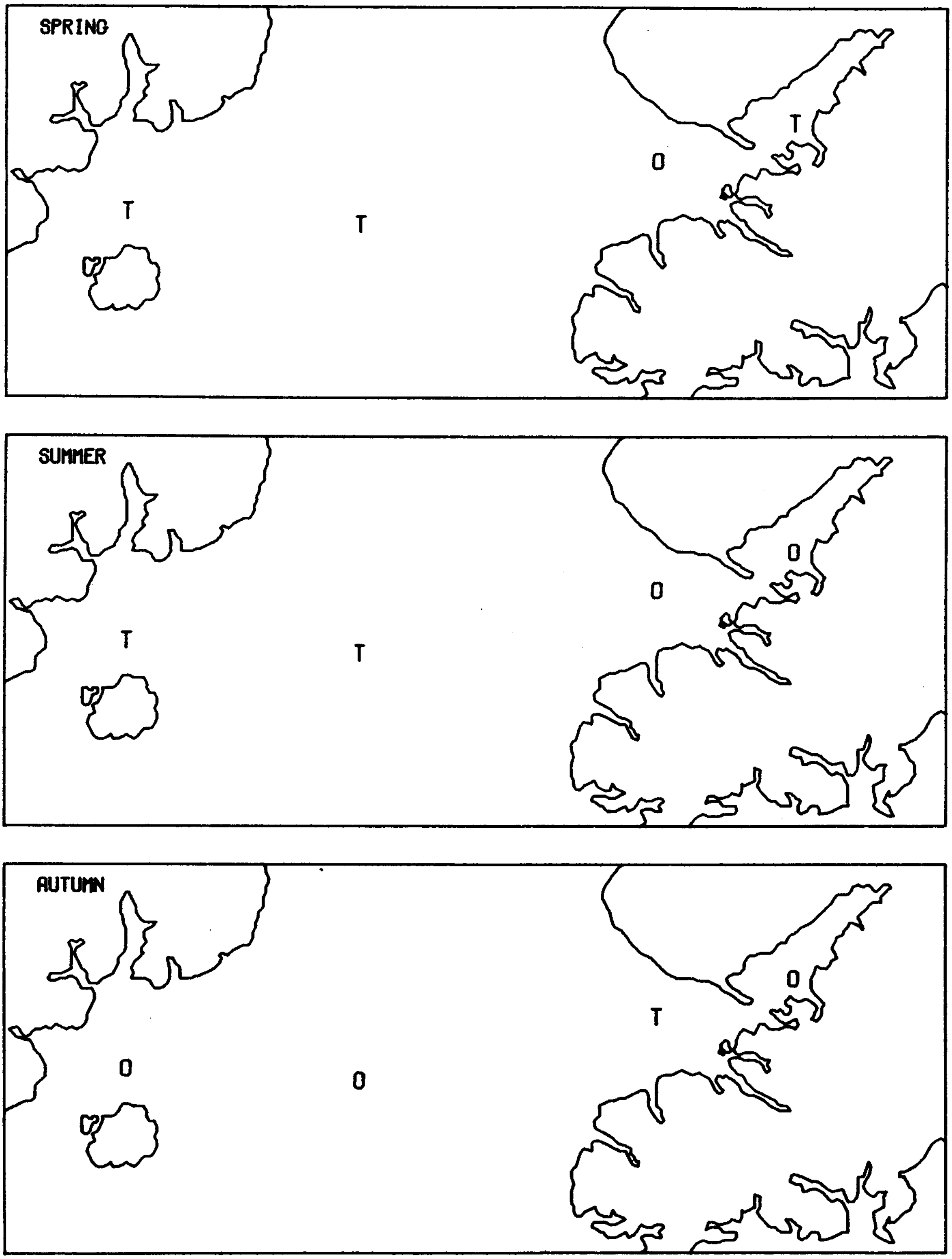
FISH EGGS
<1MM DIAM/10 SQ M



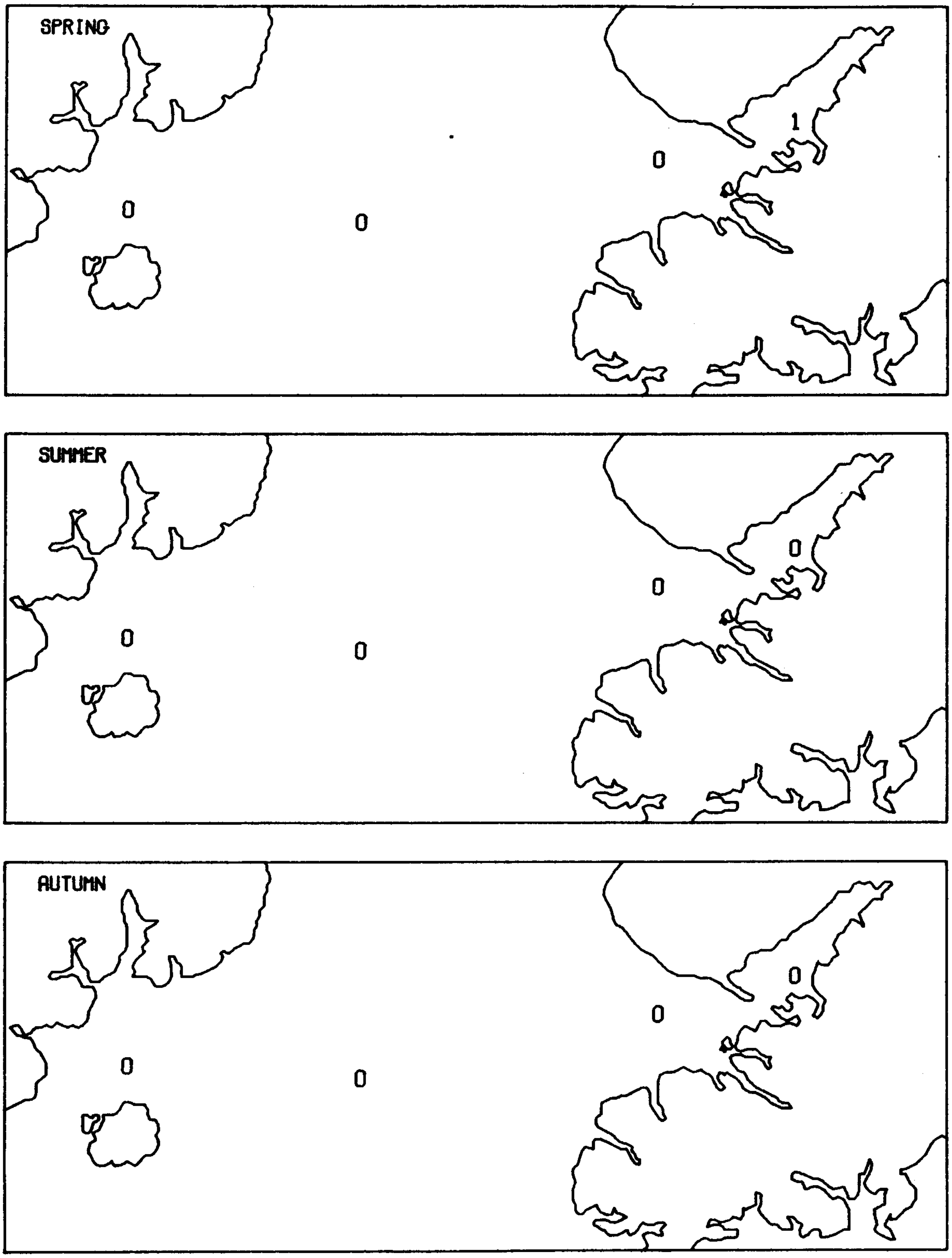
FISH EGGS
1MM DIAM/10 SQ M



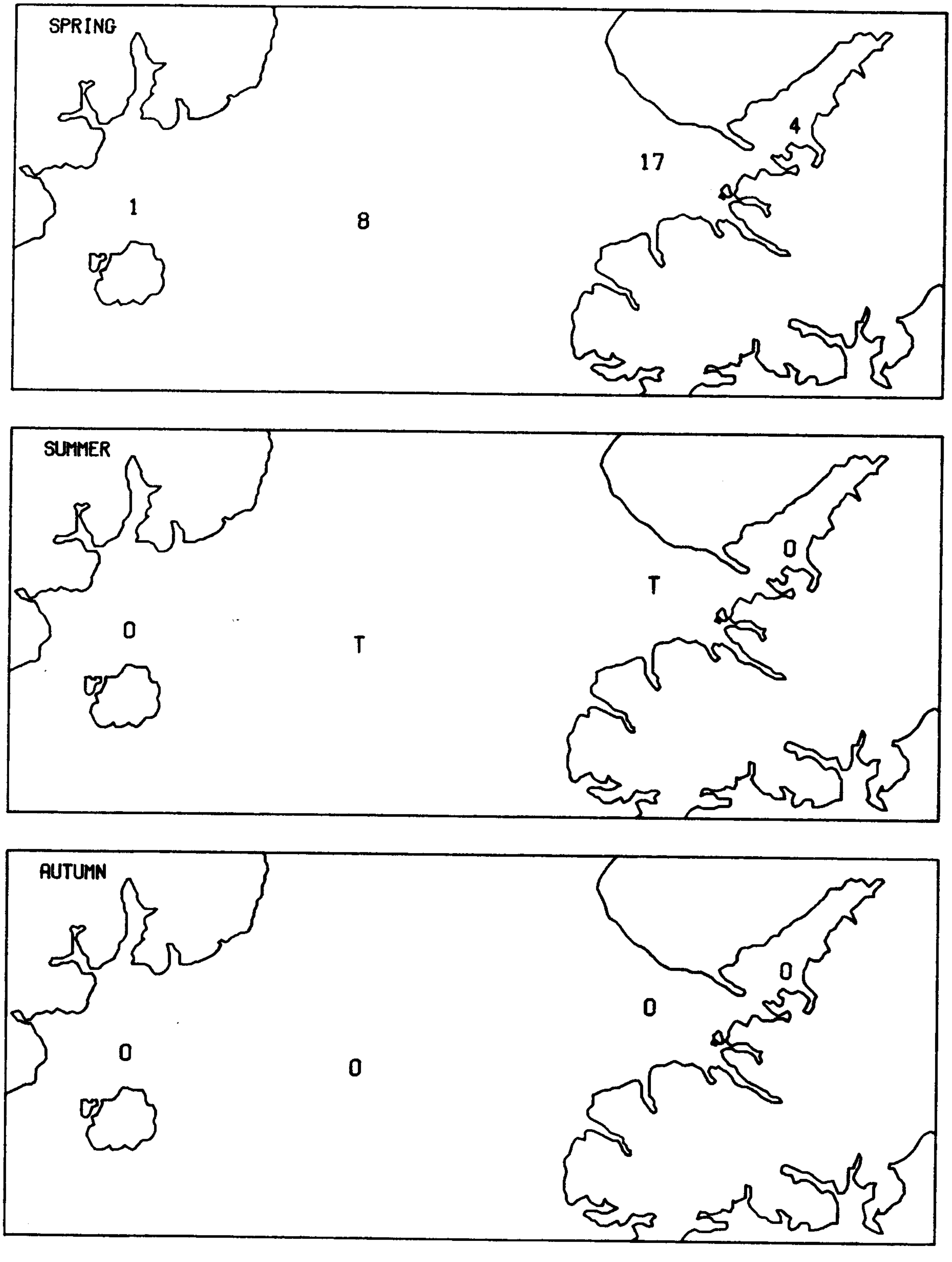
FISH EGGS
2MM DIAM/10 SQ M



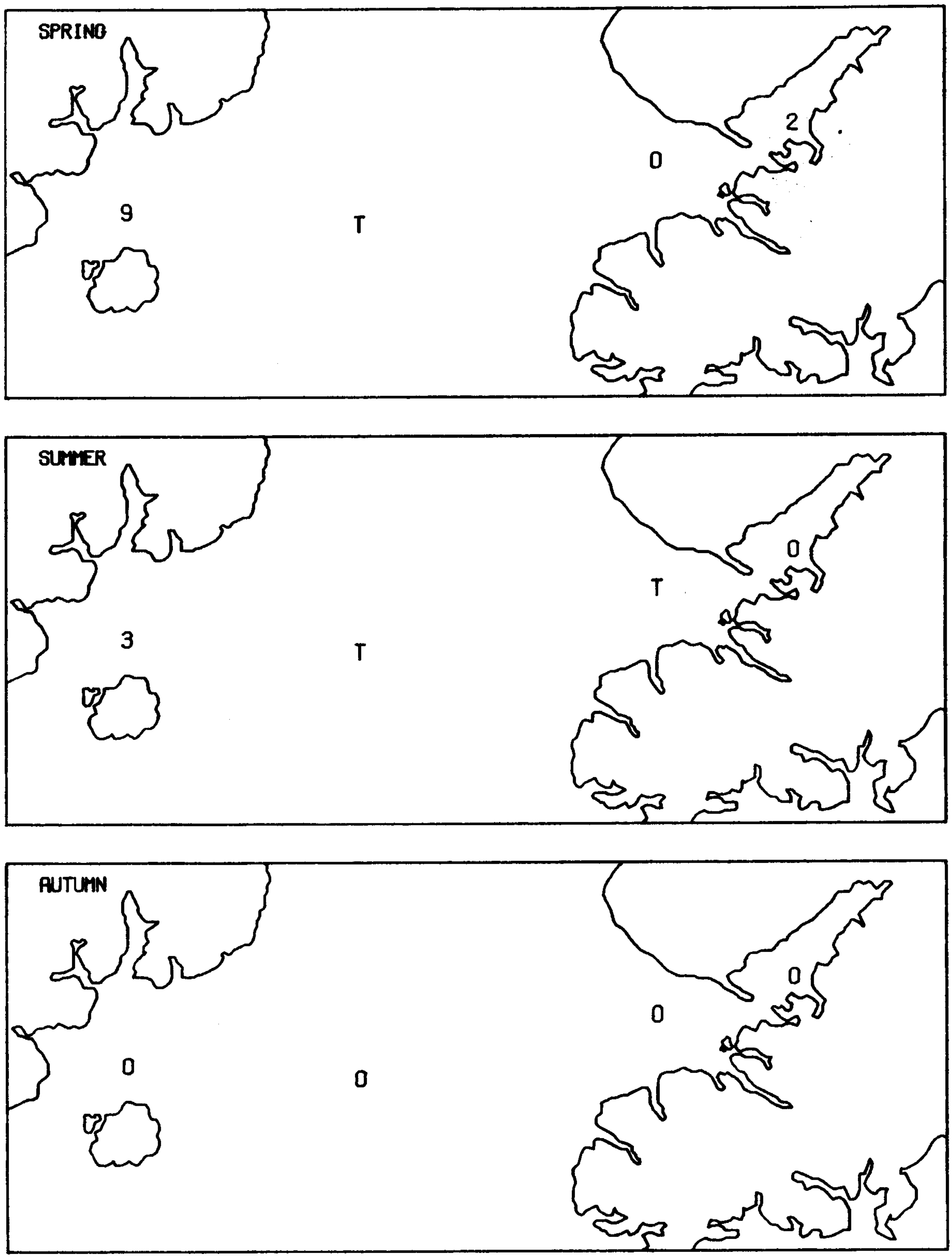
FISH EGGS
3MM DIAM/10 SQ M



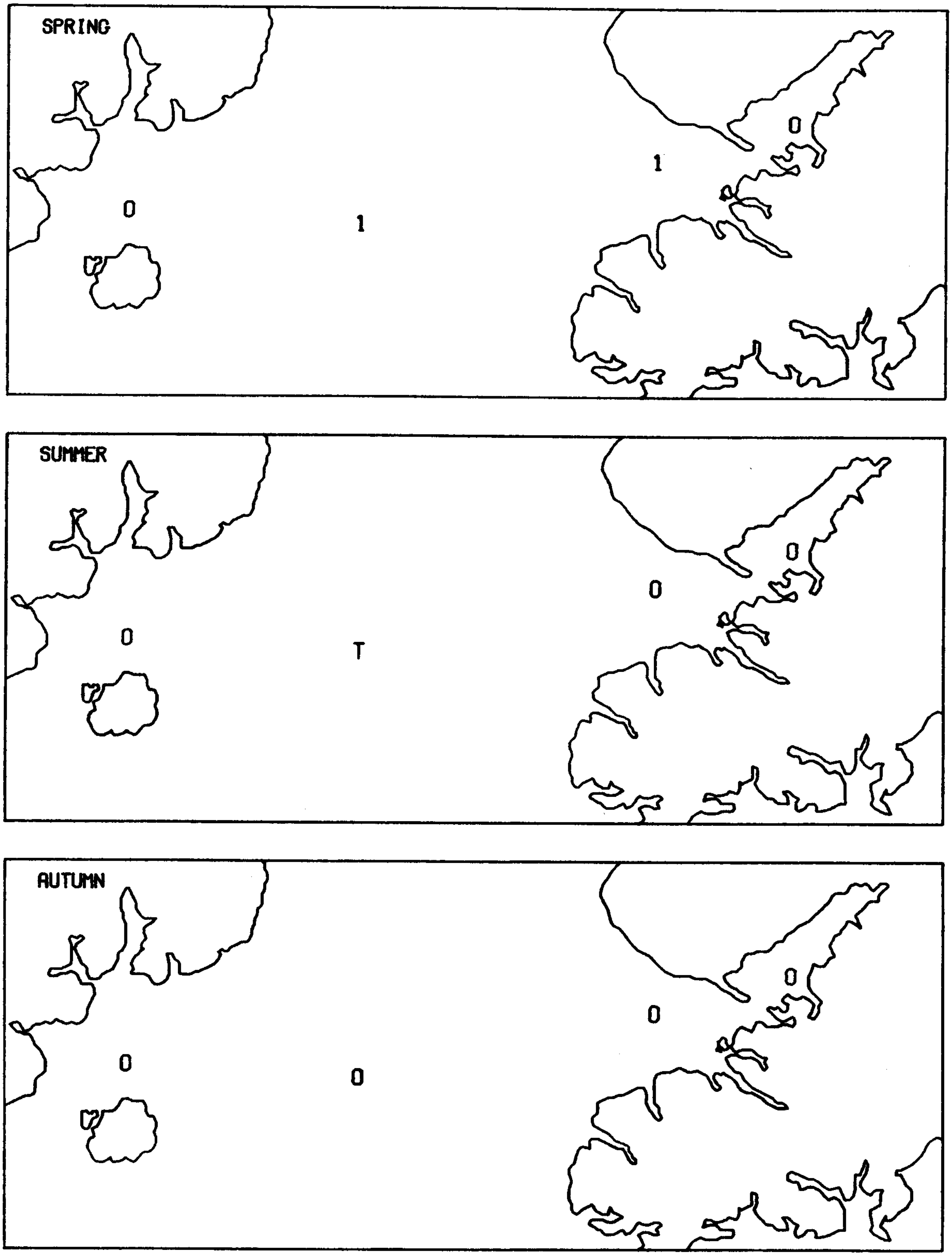
AMMODYTES HEXAPTERUS
LARVA/10 SQ M



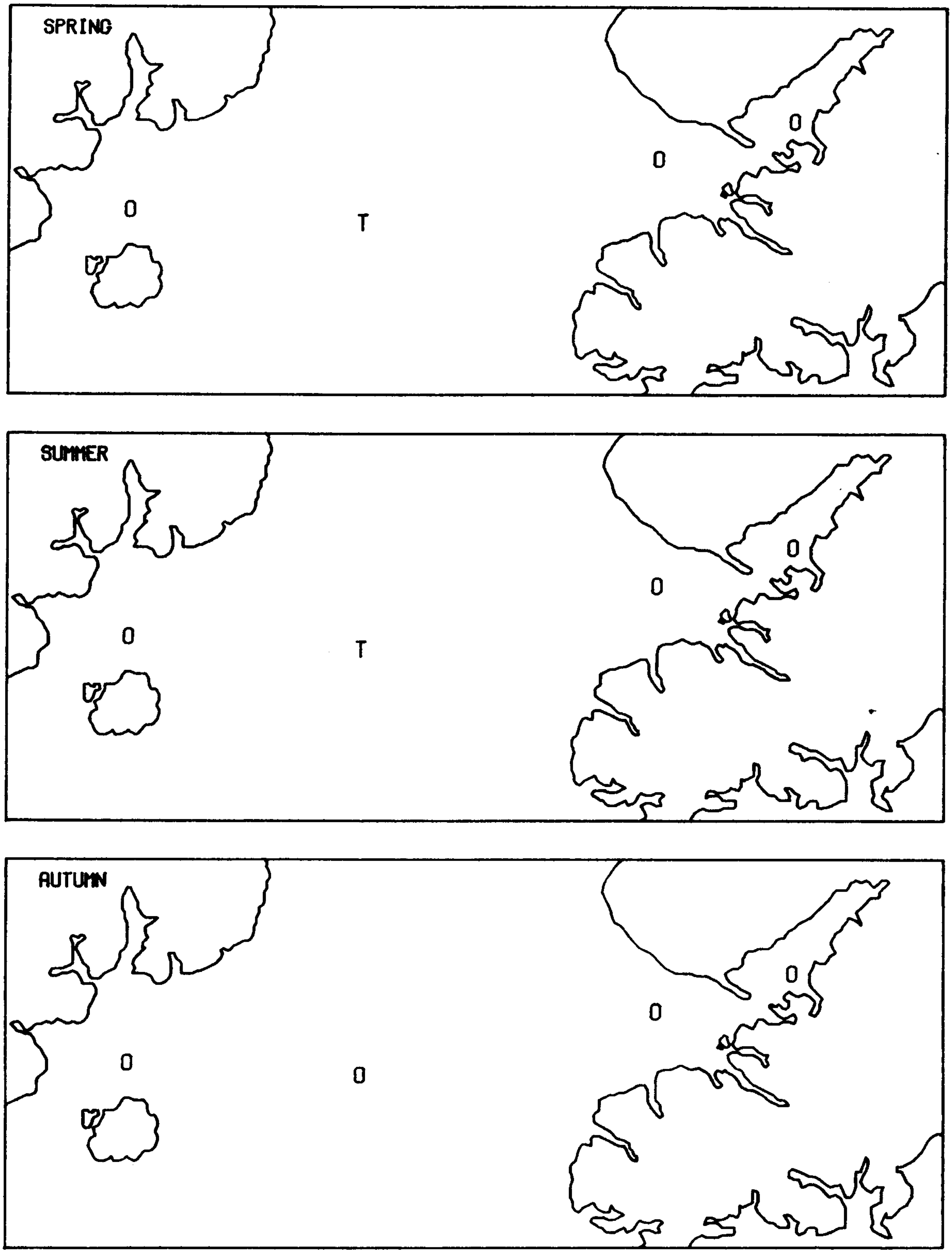
CLUPEA HARENGUS PALLASI
LARVA/10 SQ M



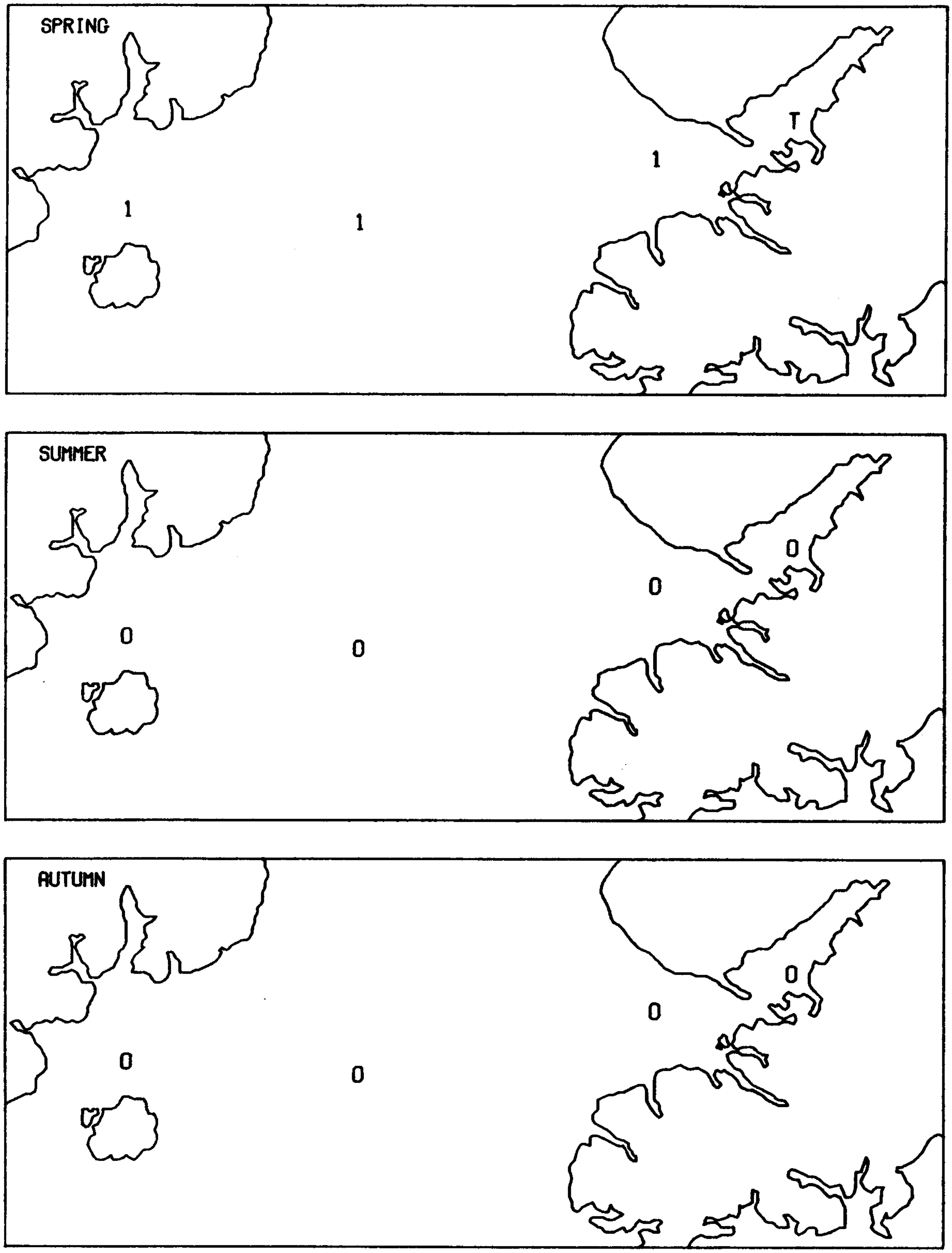
GADIDAE
LARVA/10 SQ M



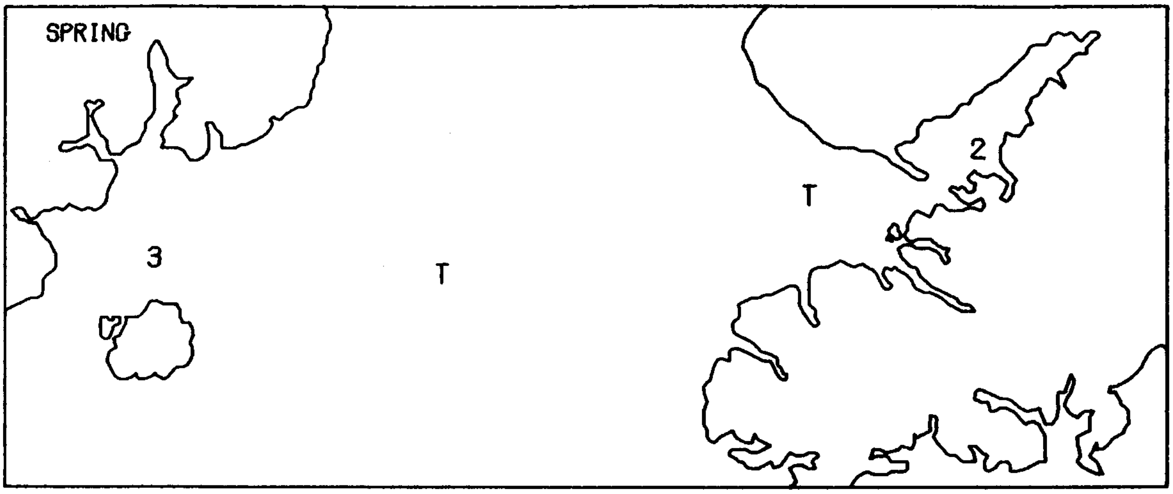
GADIDAE
JUVENILE/10 SQ M

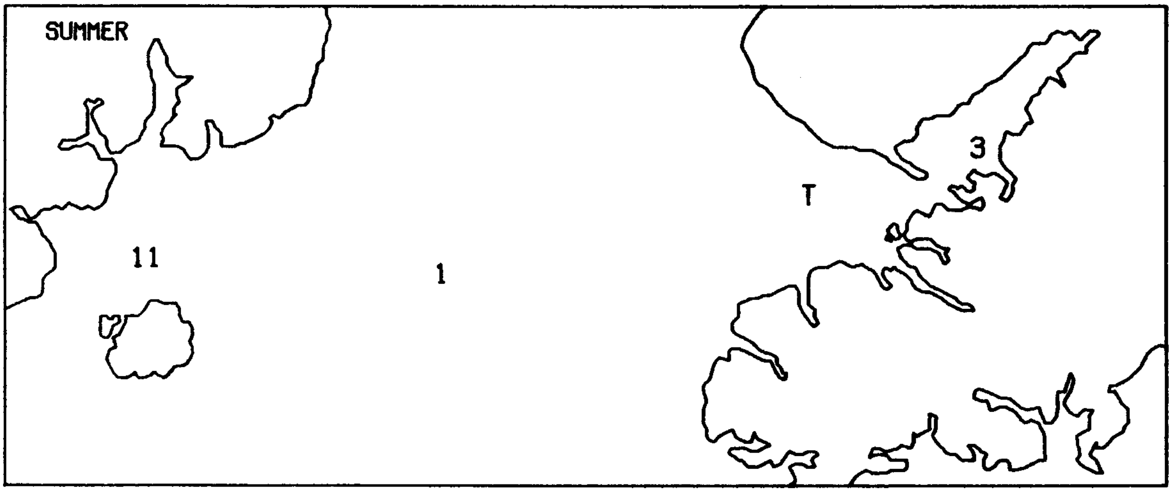


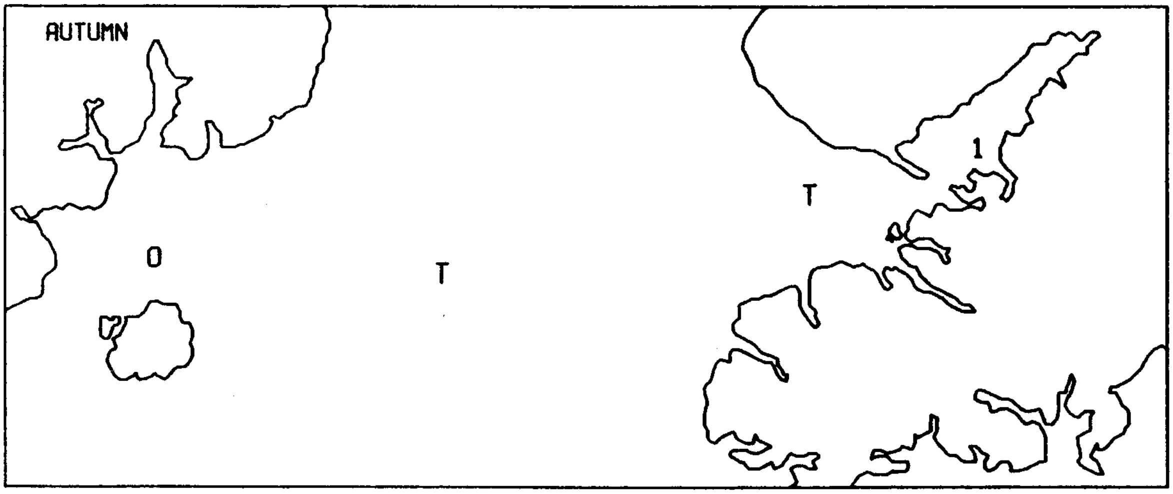
HIPPOGLOSSOIDES ELASSODON
LARVA/10 SQ M



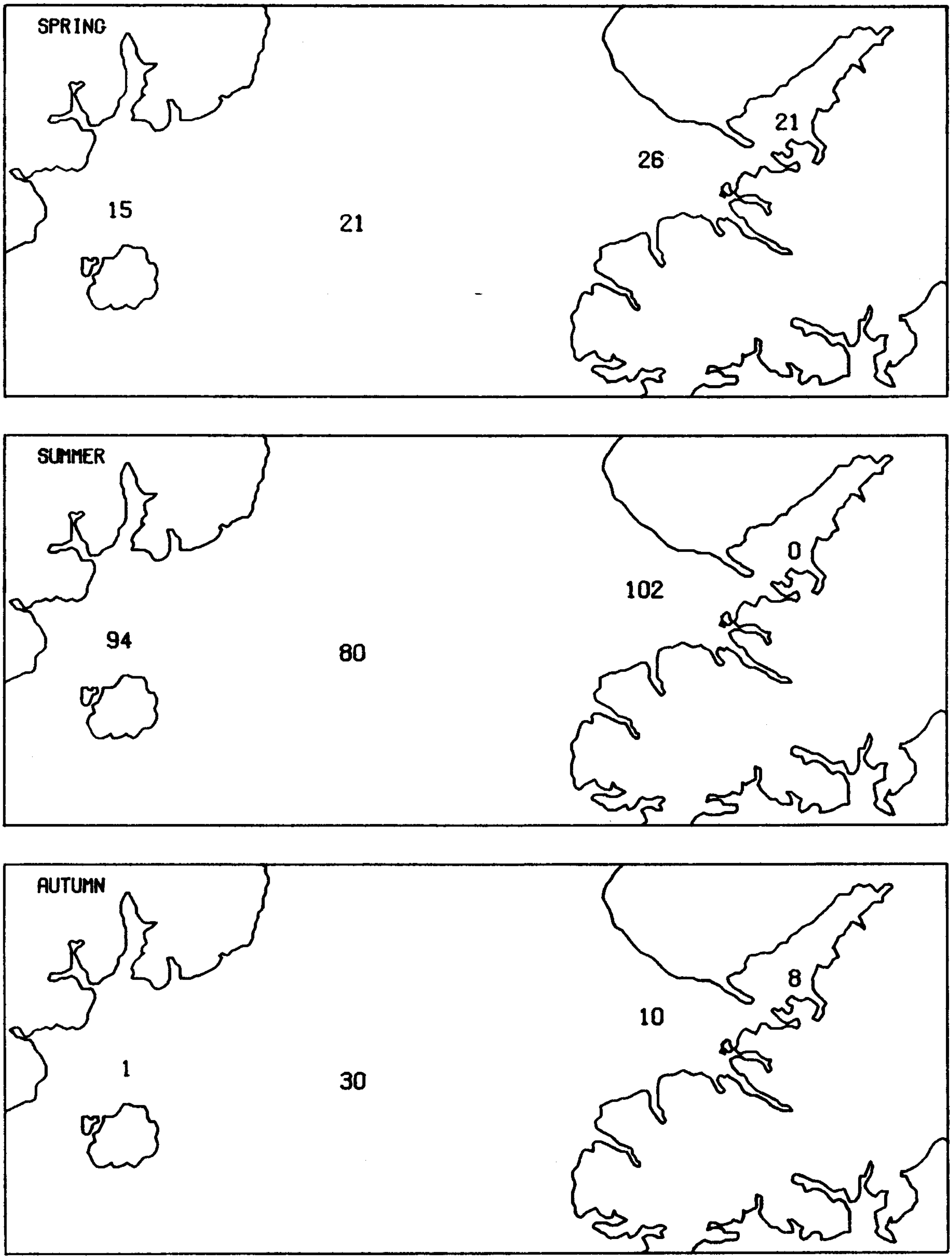
LIMANDA ASPERA
LARVA/10 SQ M



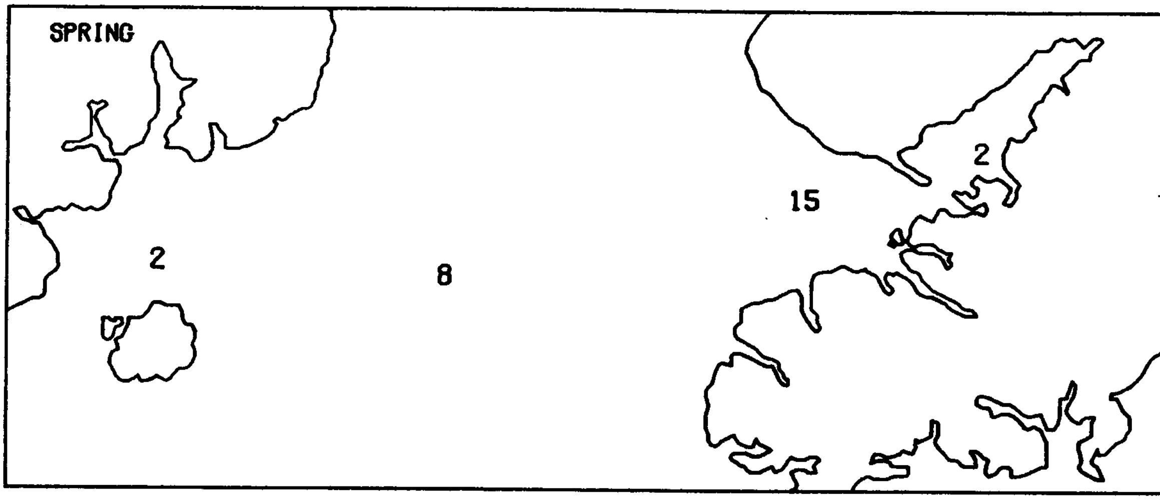


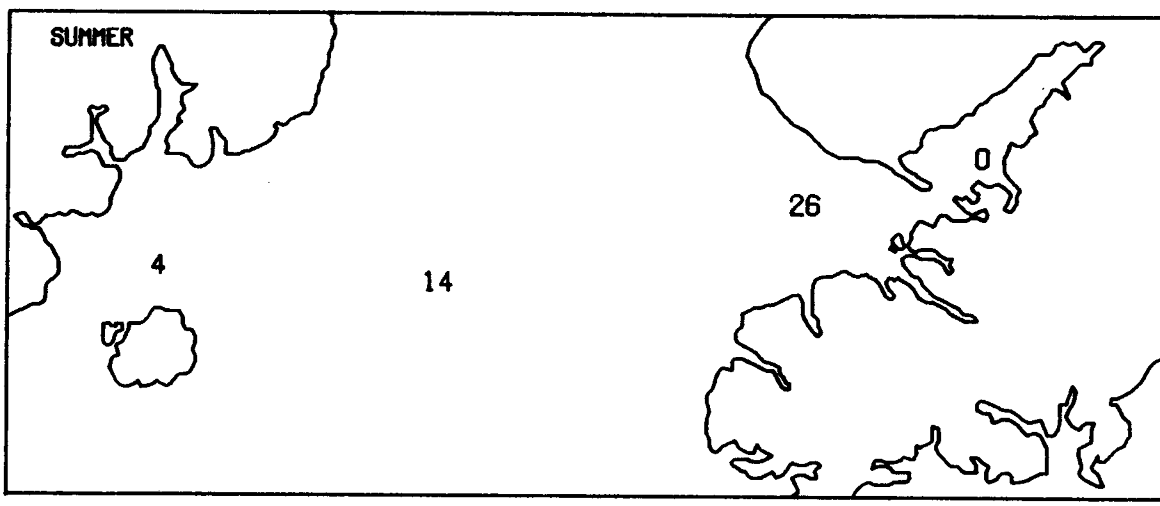


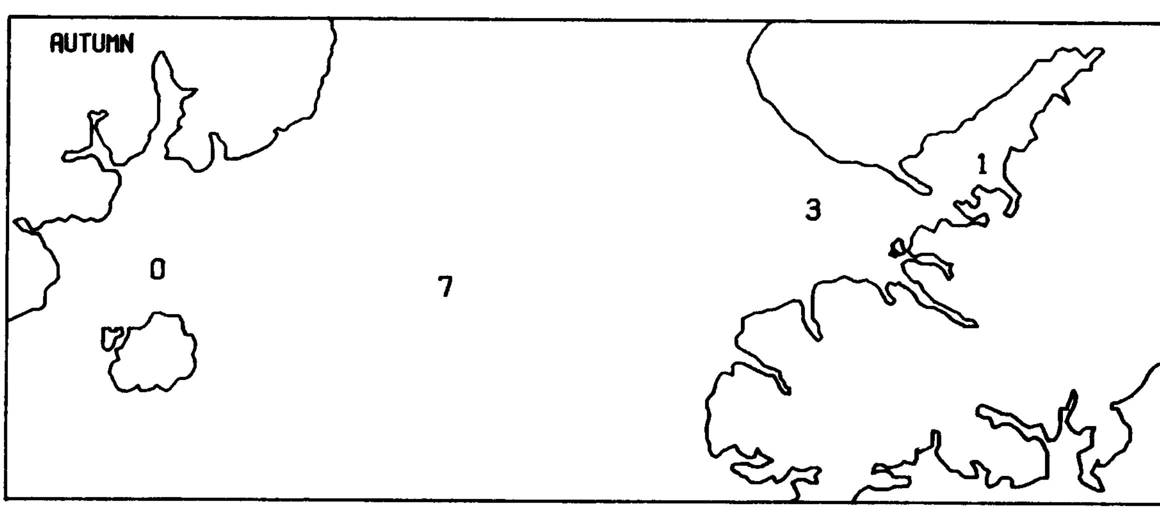
MALLOTUS VILLOSUS
LARVA/10 SQ M



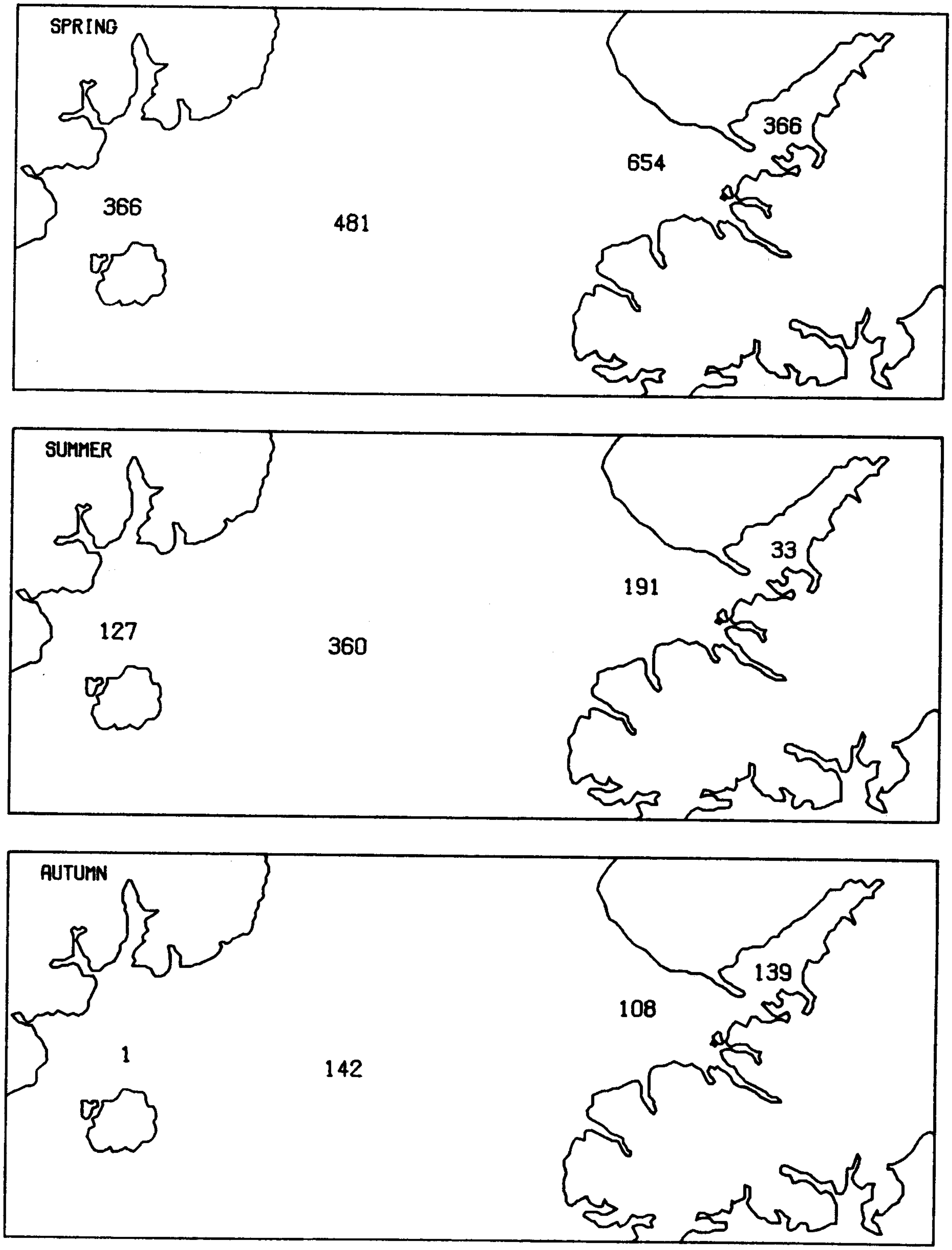
OSMERIDAE
LARVA/10 SQ M





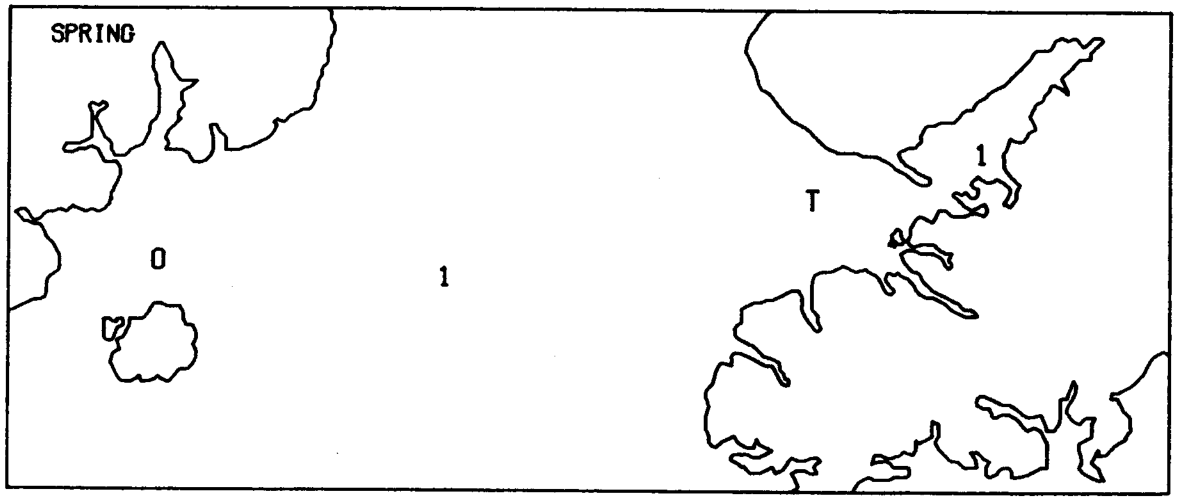


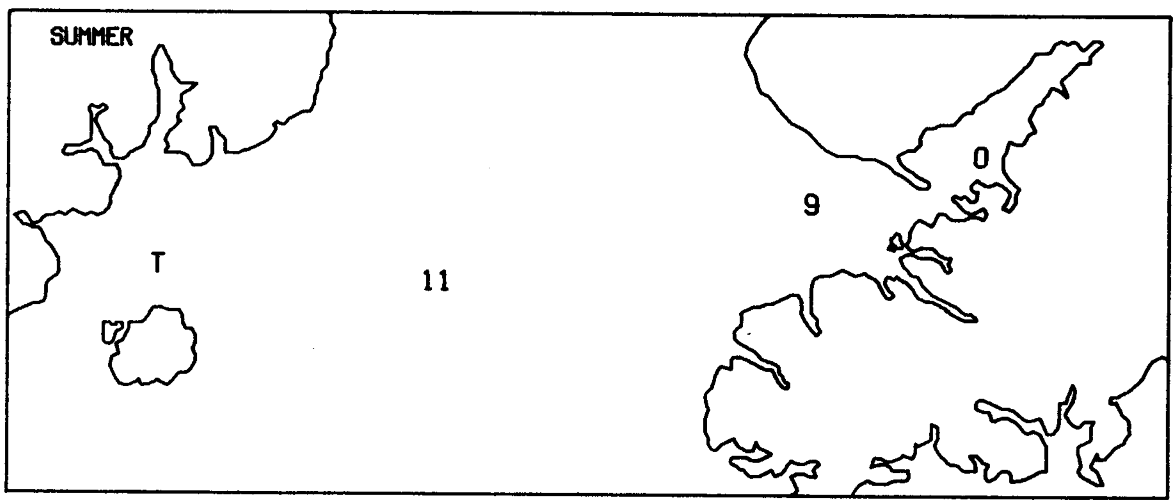
ANOMURA
ZOEA/10 SQ M

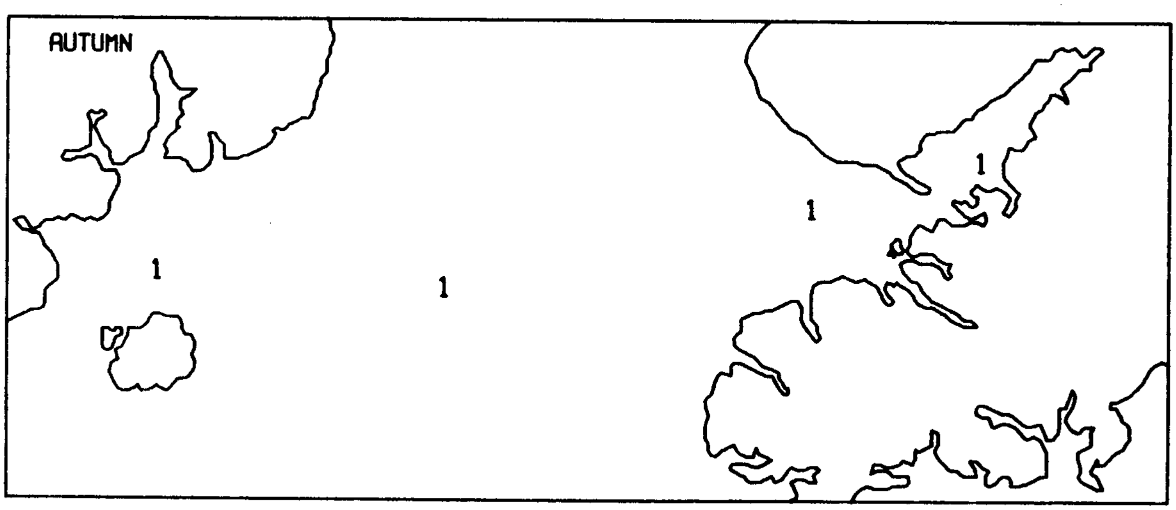


ANOMURA

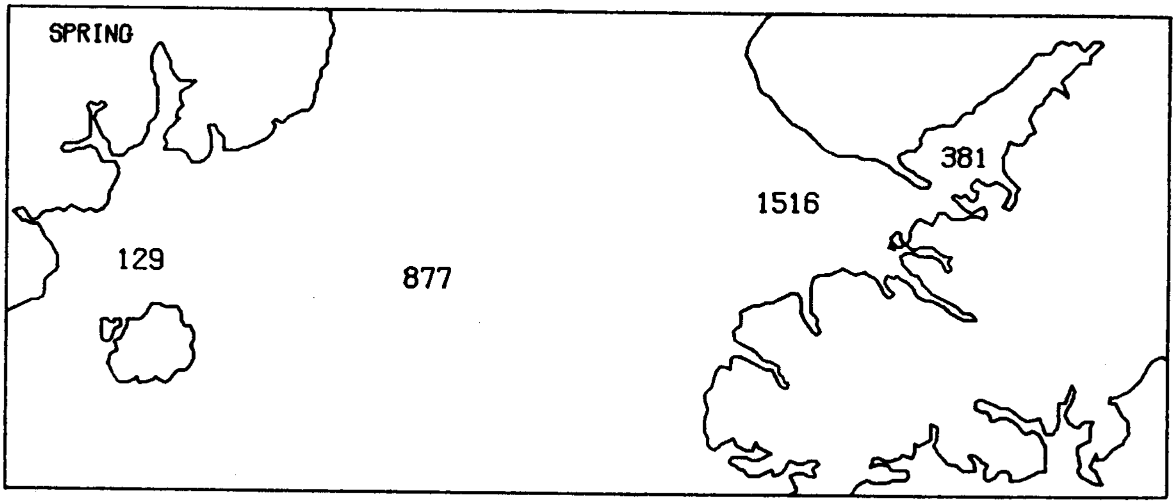
MEGALOPA/10 SQ M

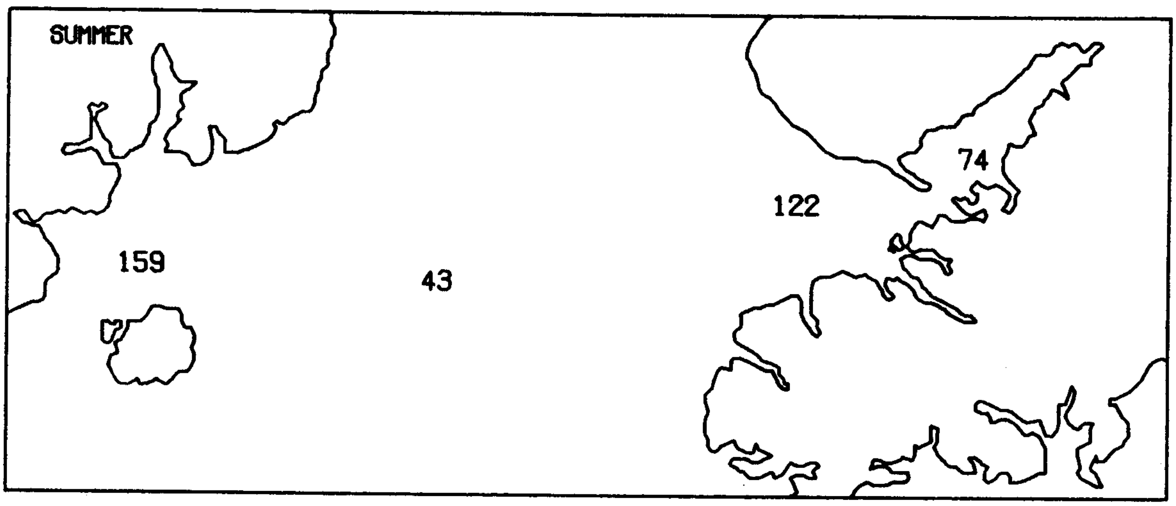


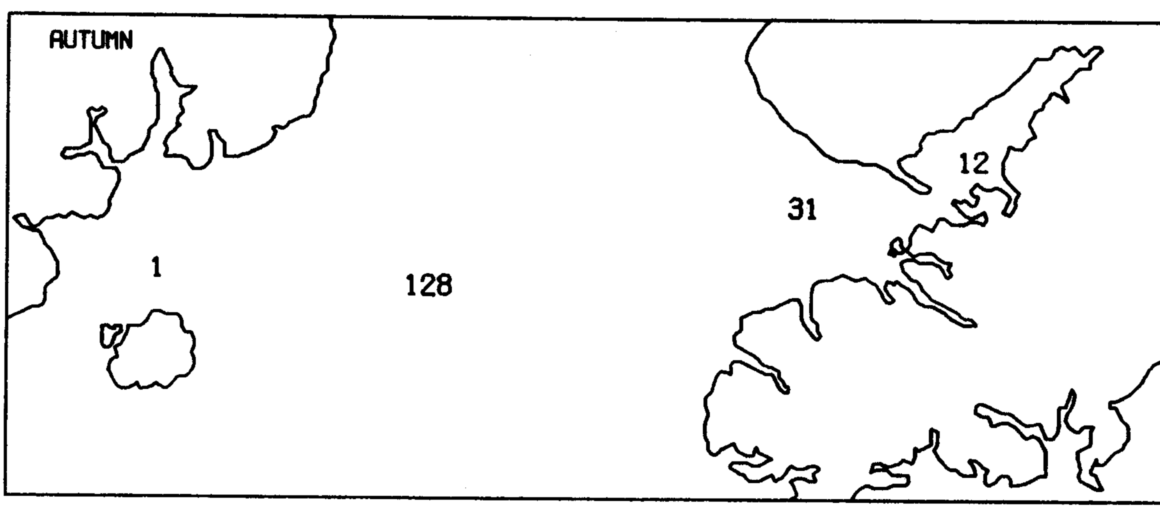




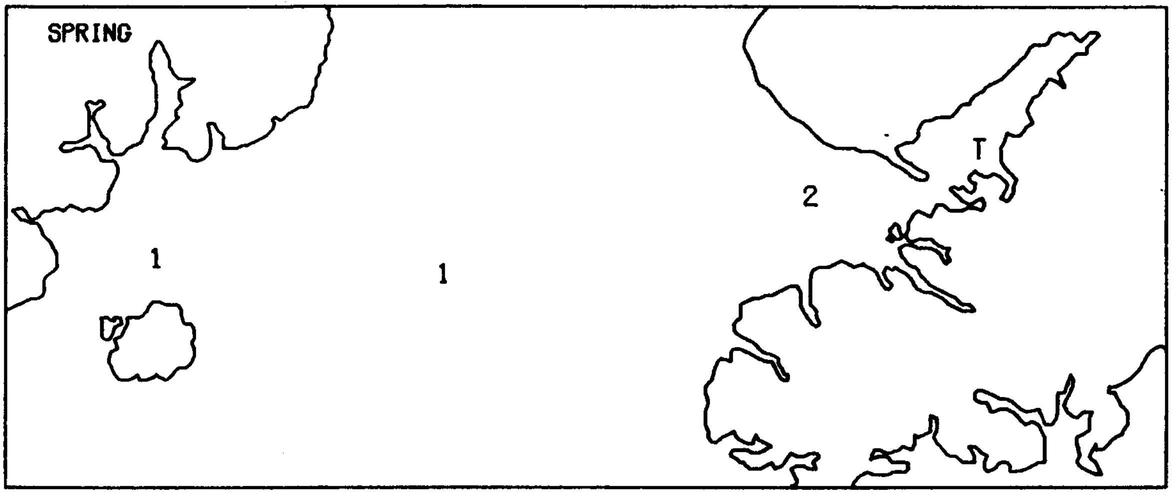
BRACHYURA
ZOEA/10 SQ M

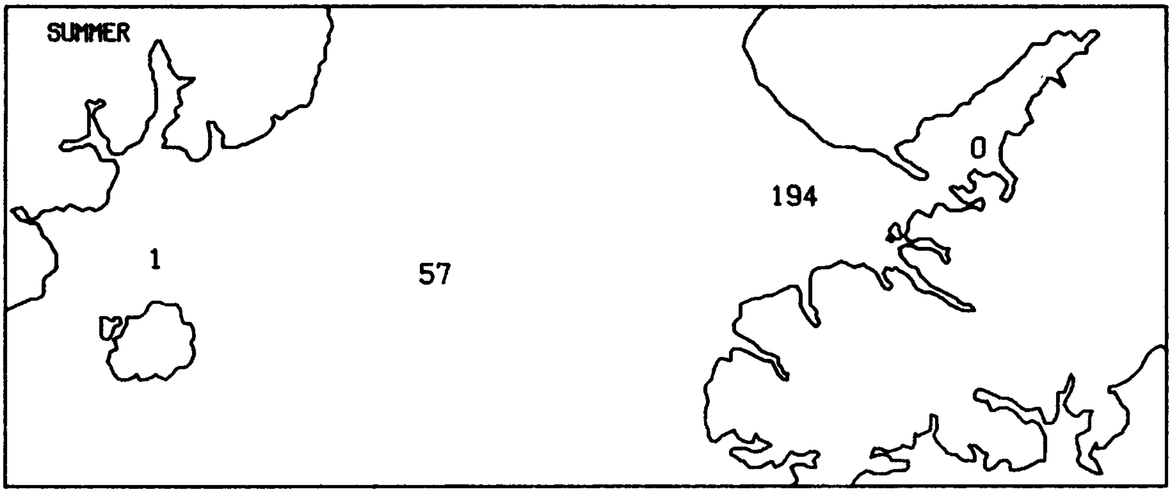


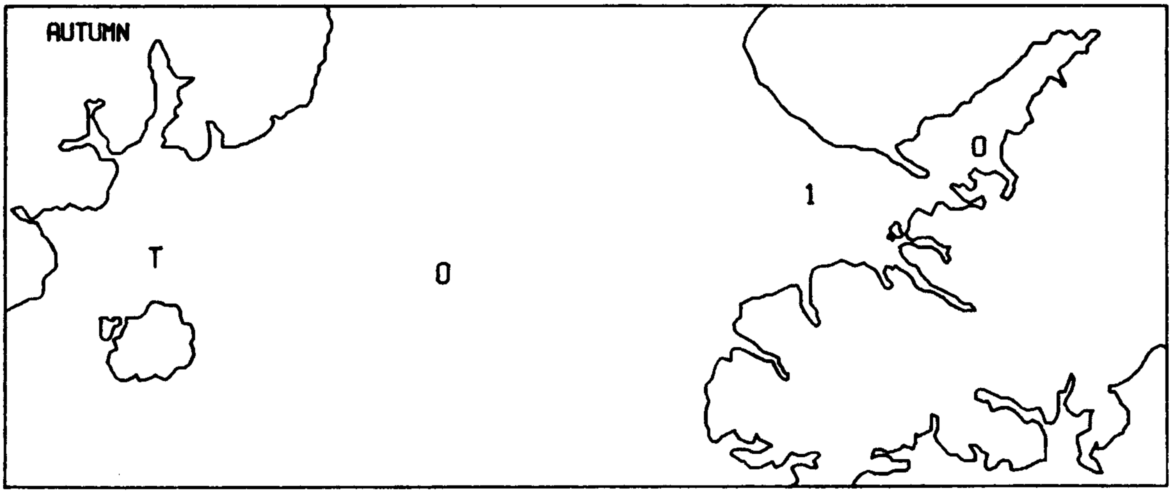




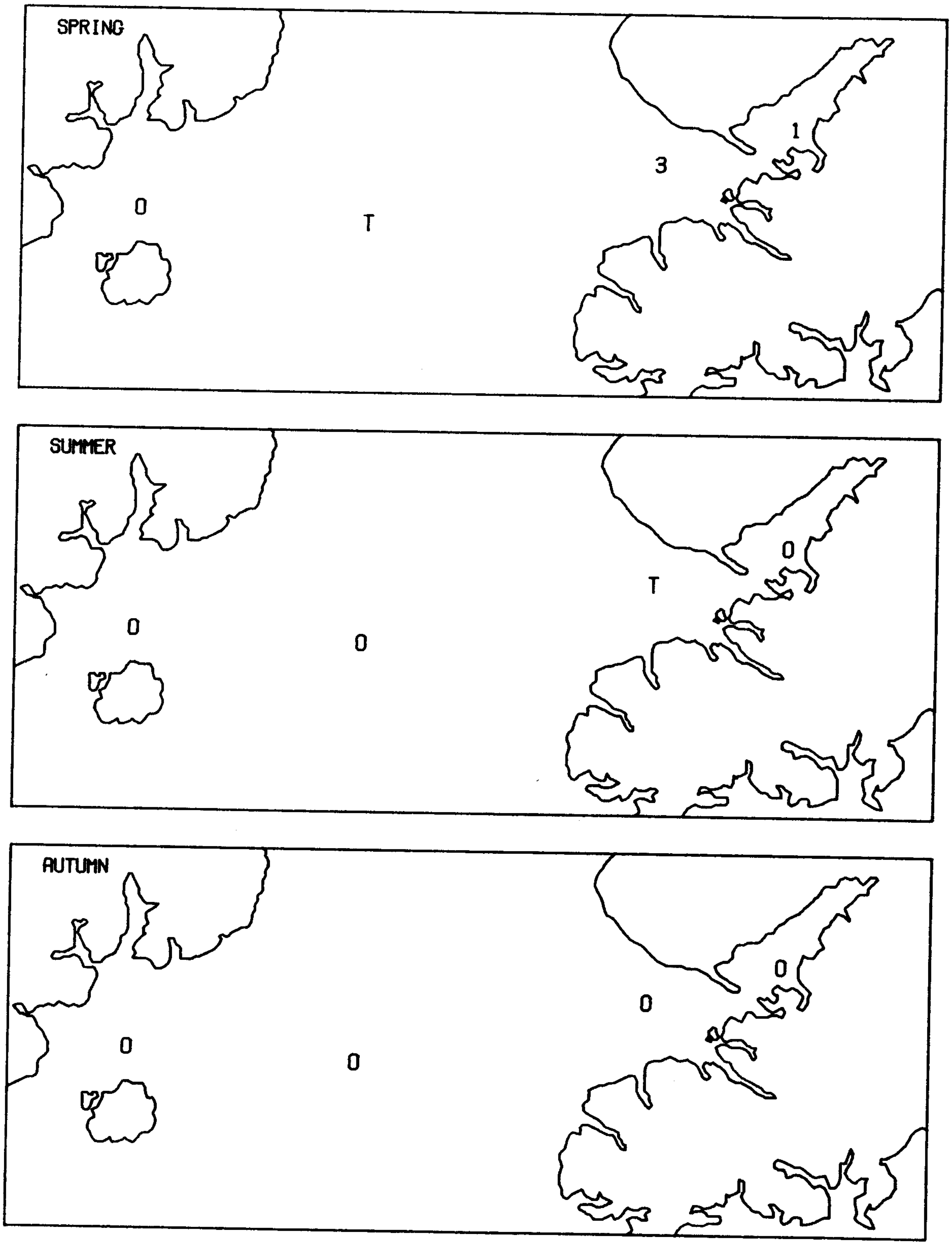
BRACHYURA
MEGALOPA/10 SQ M



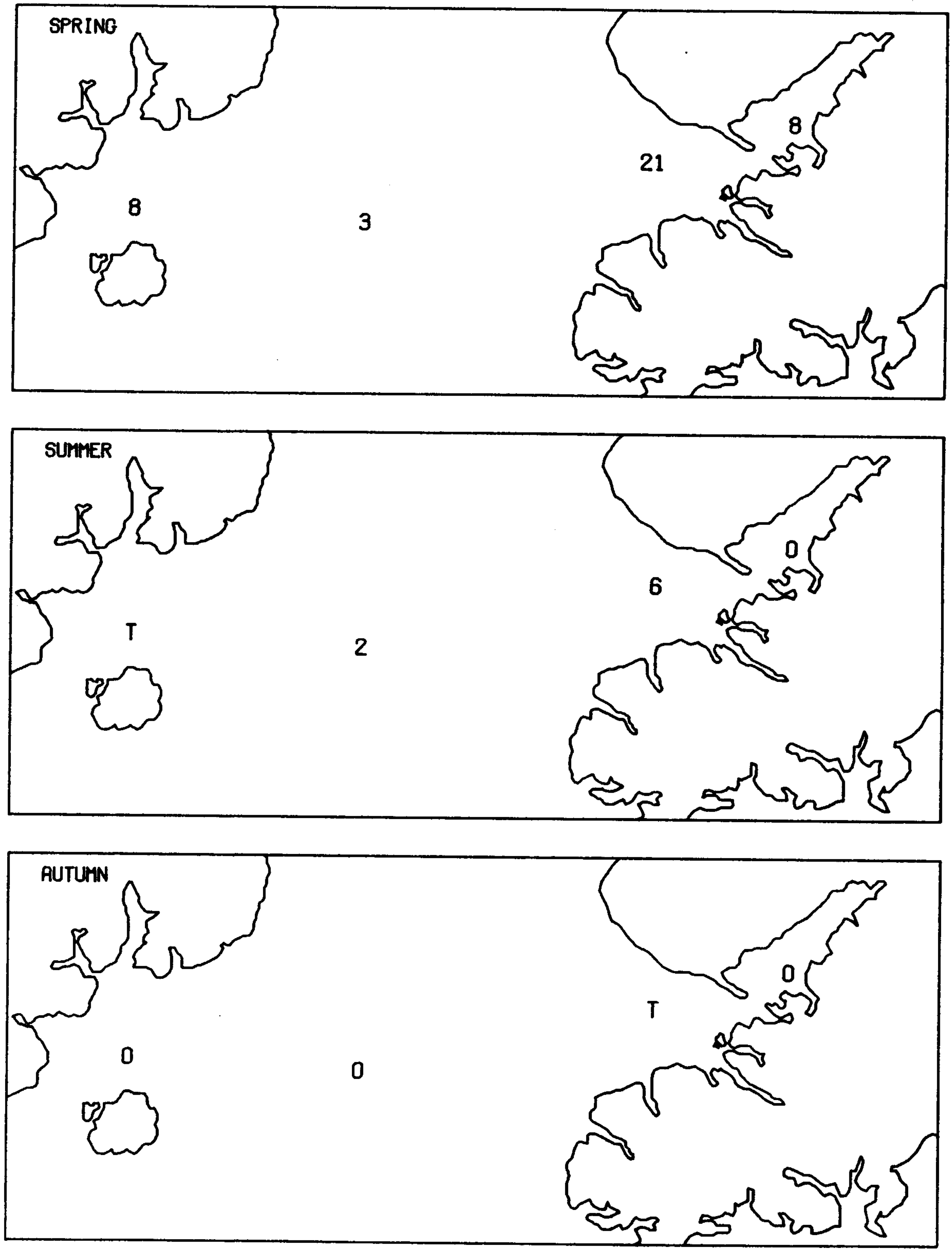




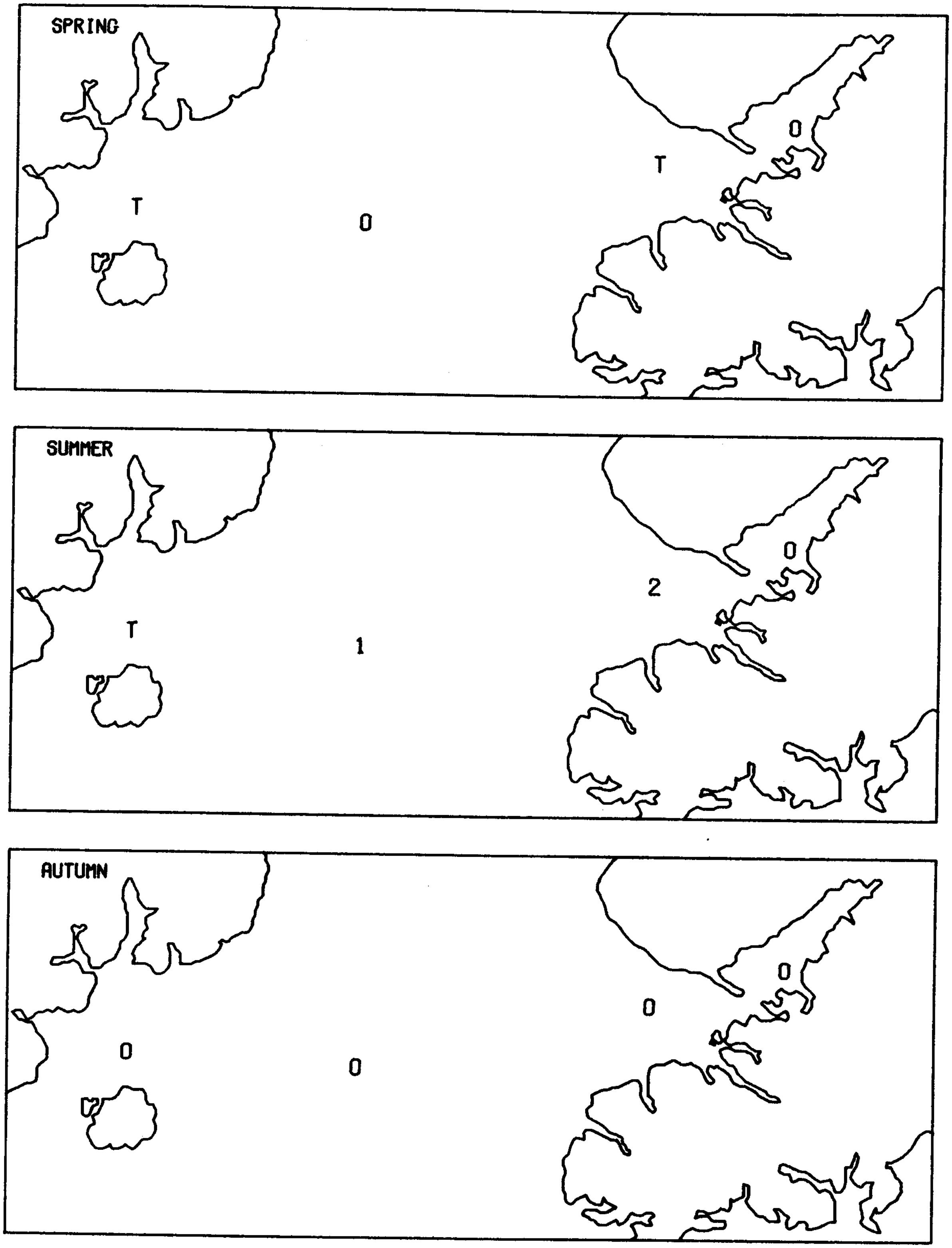
CANCER MAGISTER
STAGE I/10 SQ M



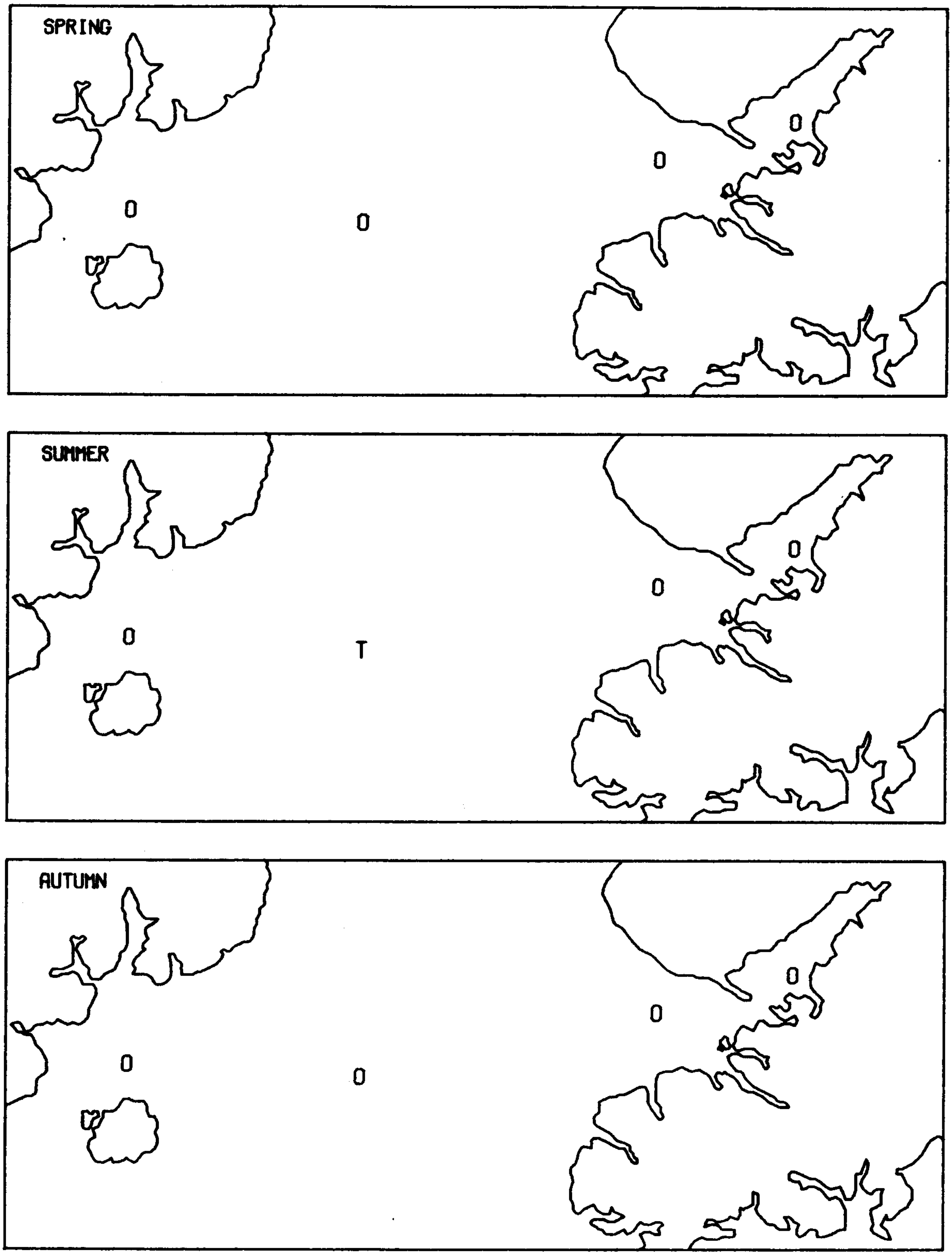
CANCER MAGISTER
STAGE II/10 SQ M



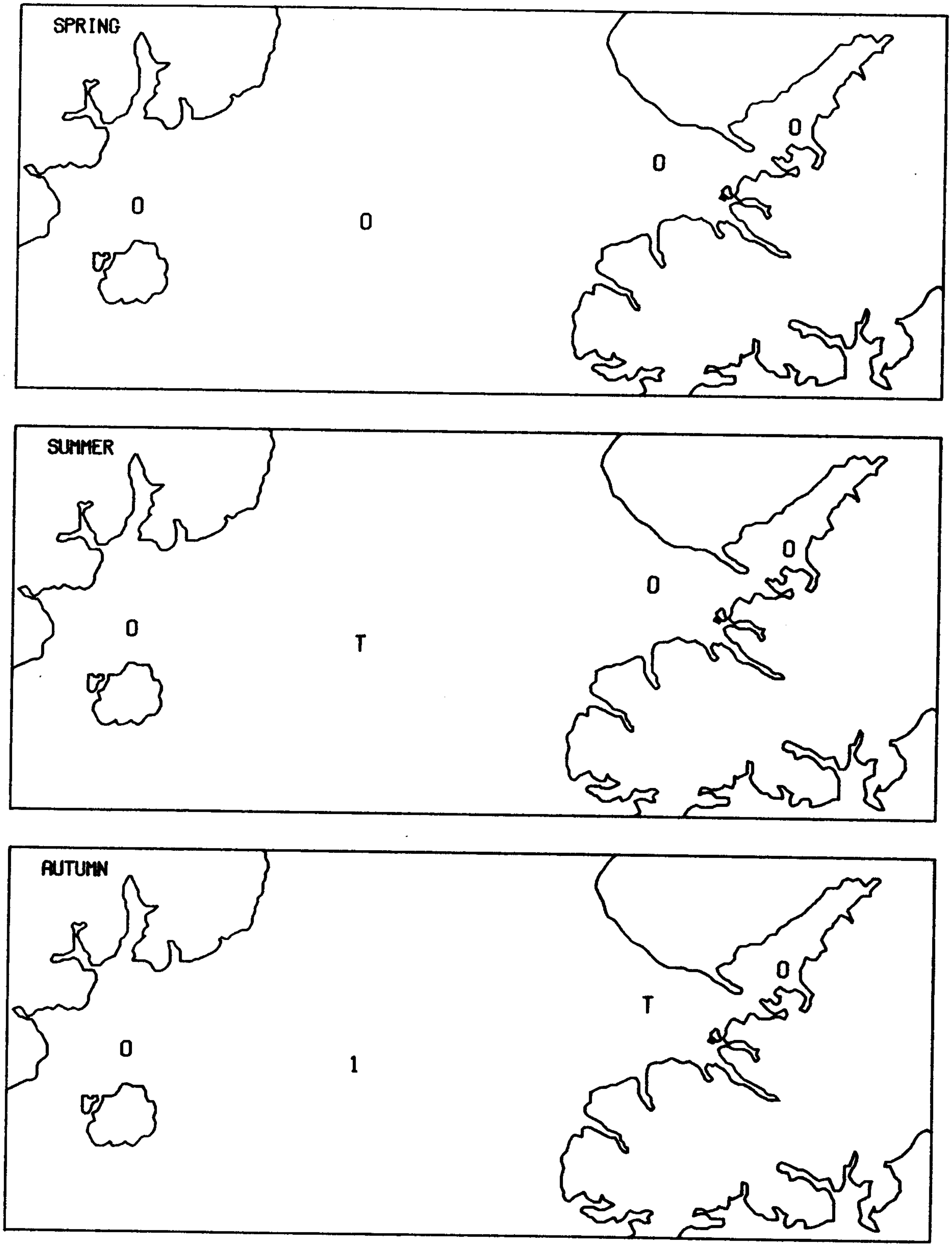
CANCER MAGISTER
STAGE III/10 SQ M



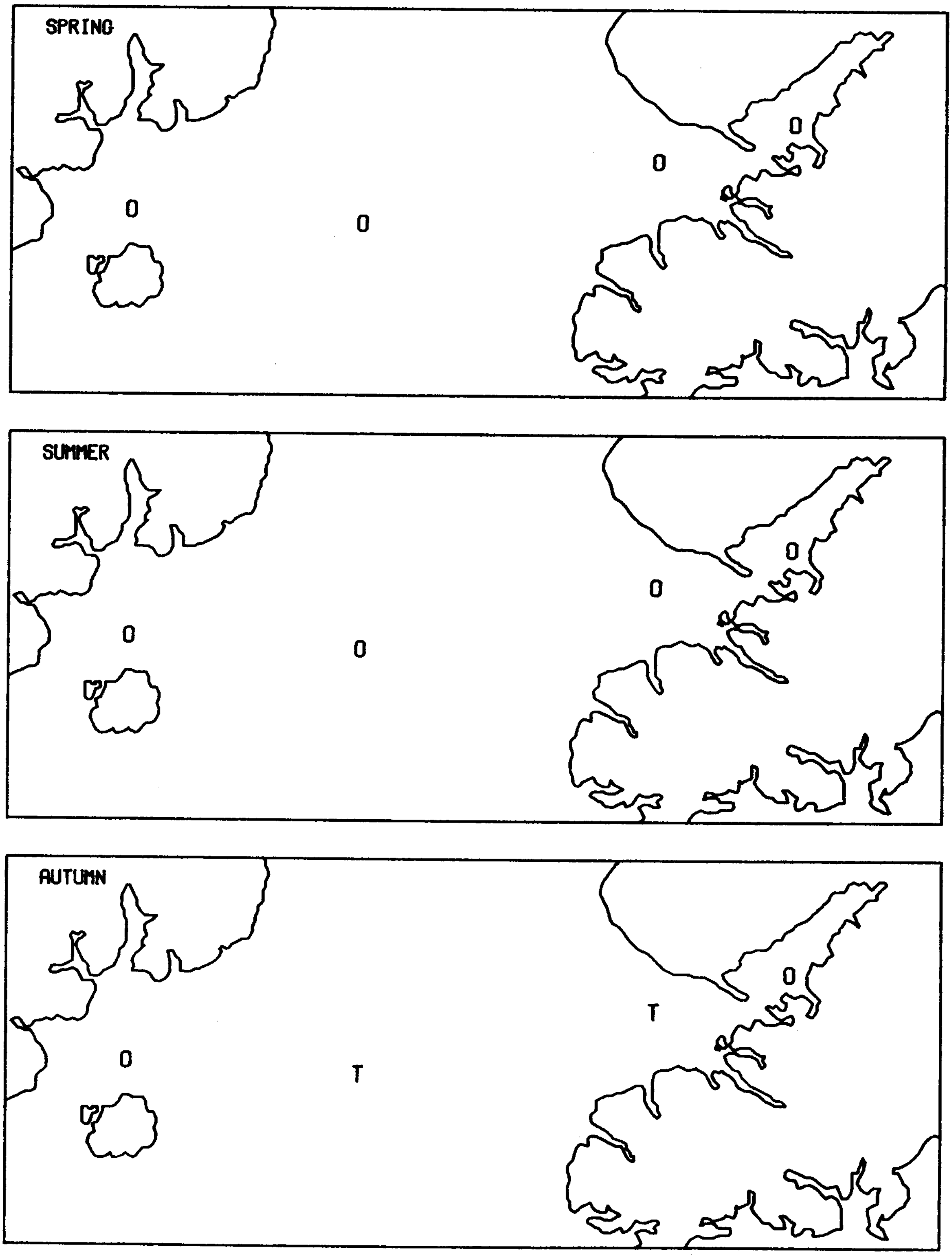
CANCER MAGISTER
STAGE IV/10 SQ M



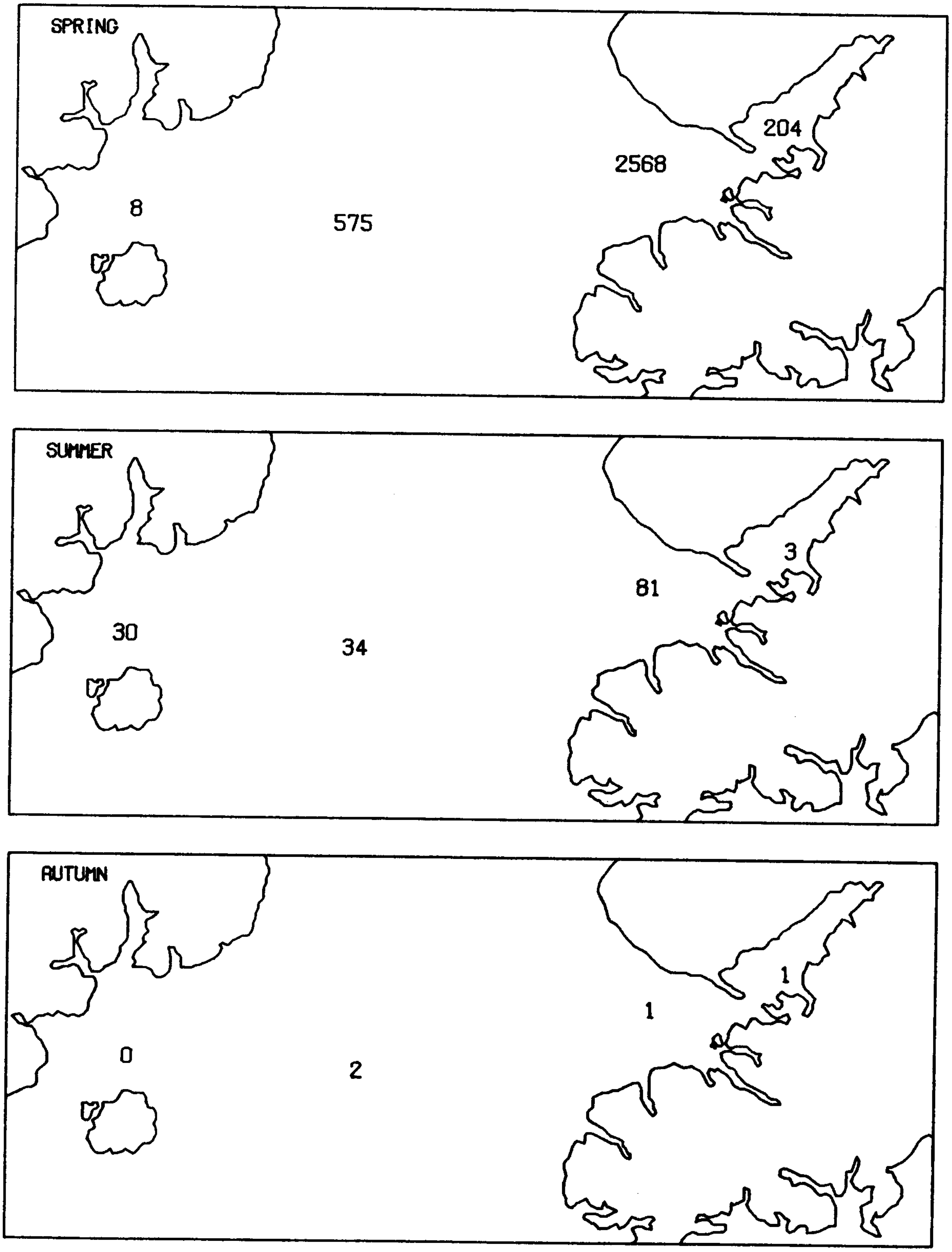
CANCER MAGISTER
STAGE V/10 SQ M



CANCER MAGISTER
MEGALOPA/10 SQ M



CANCER SPP.
STAGE I/10 SQ M



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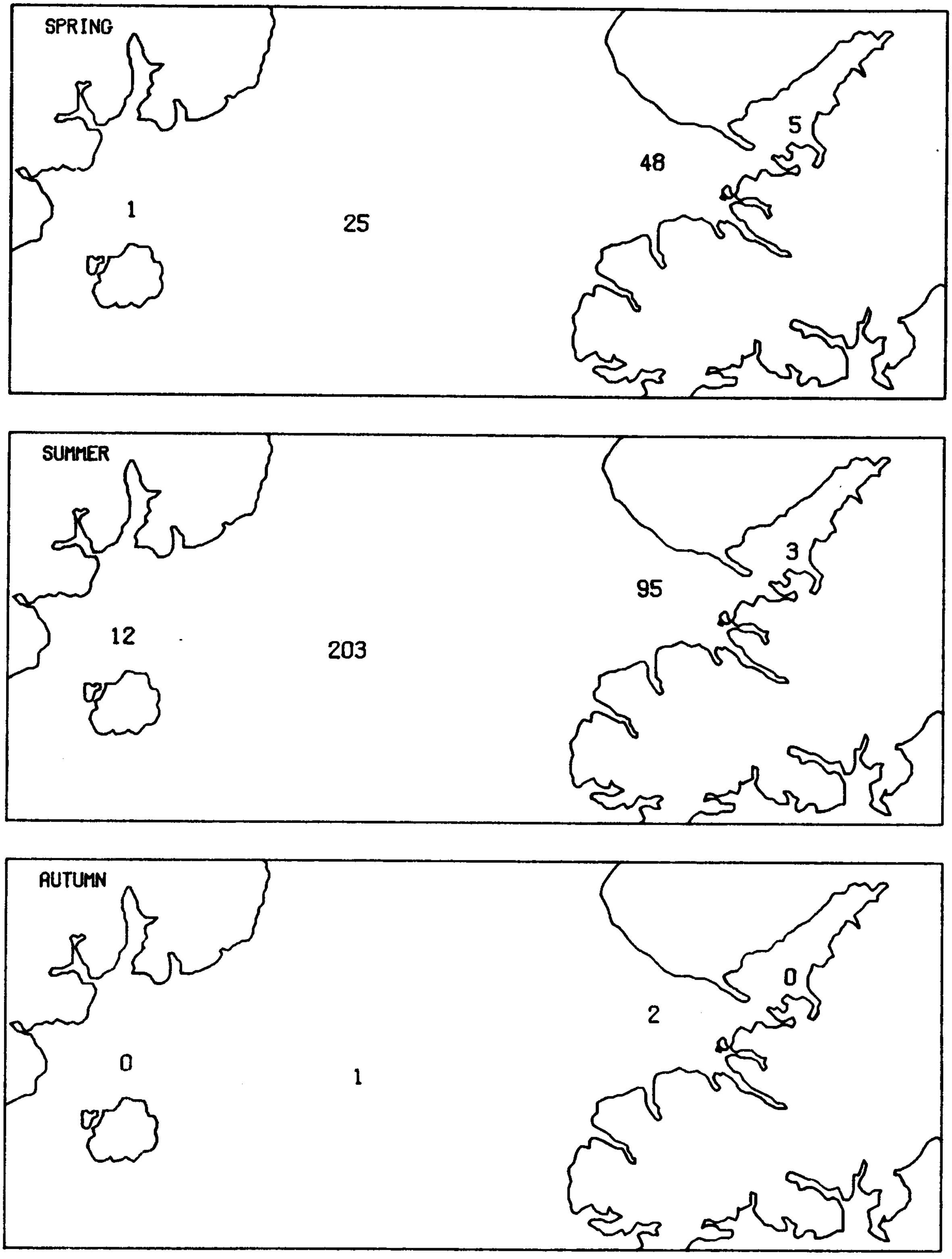
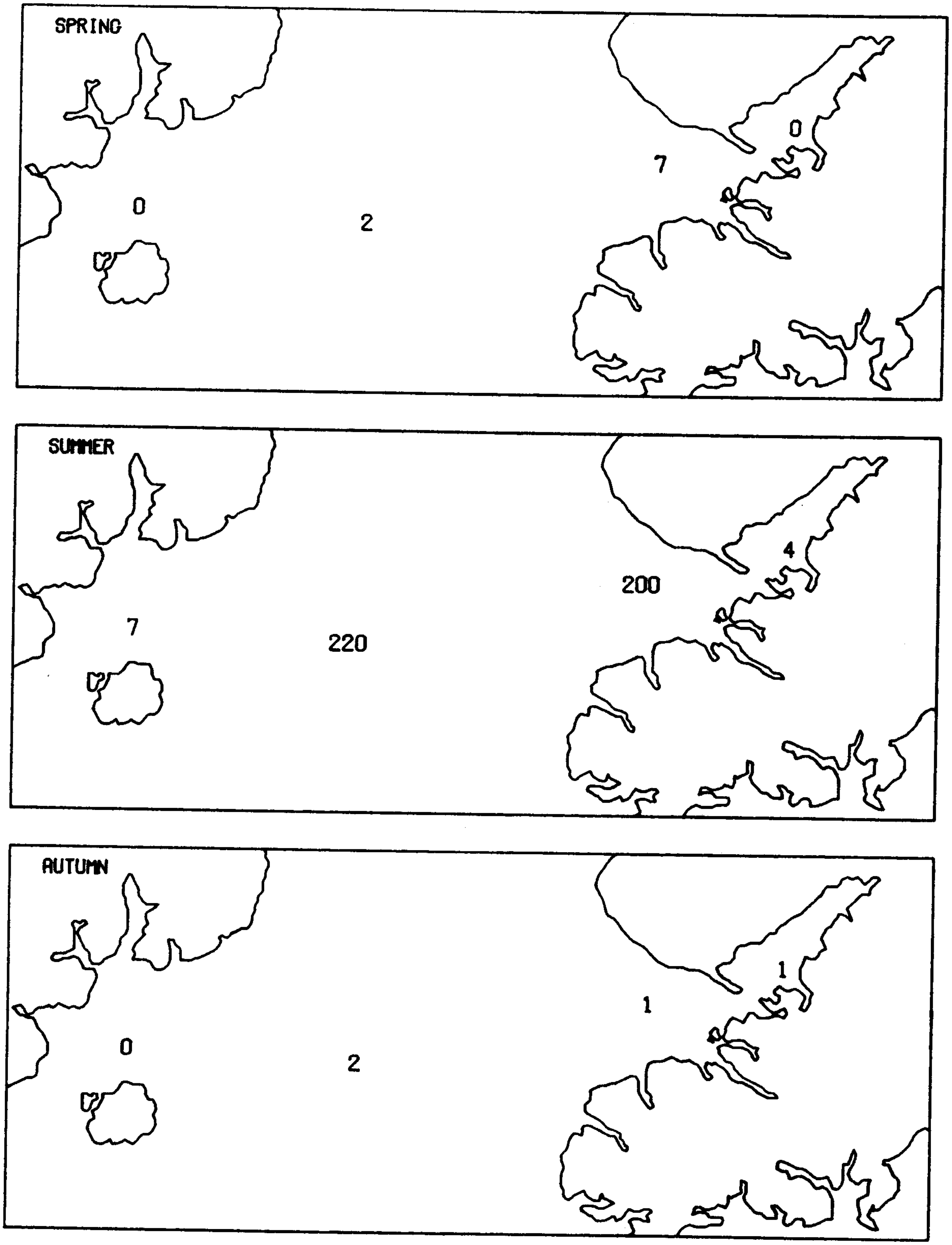
STAGE II/10 SQ M



CANCER SPP.
STAGE III/10 SQ M



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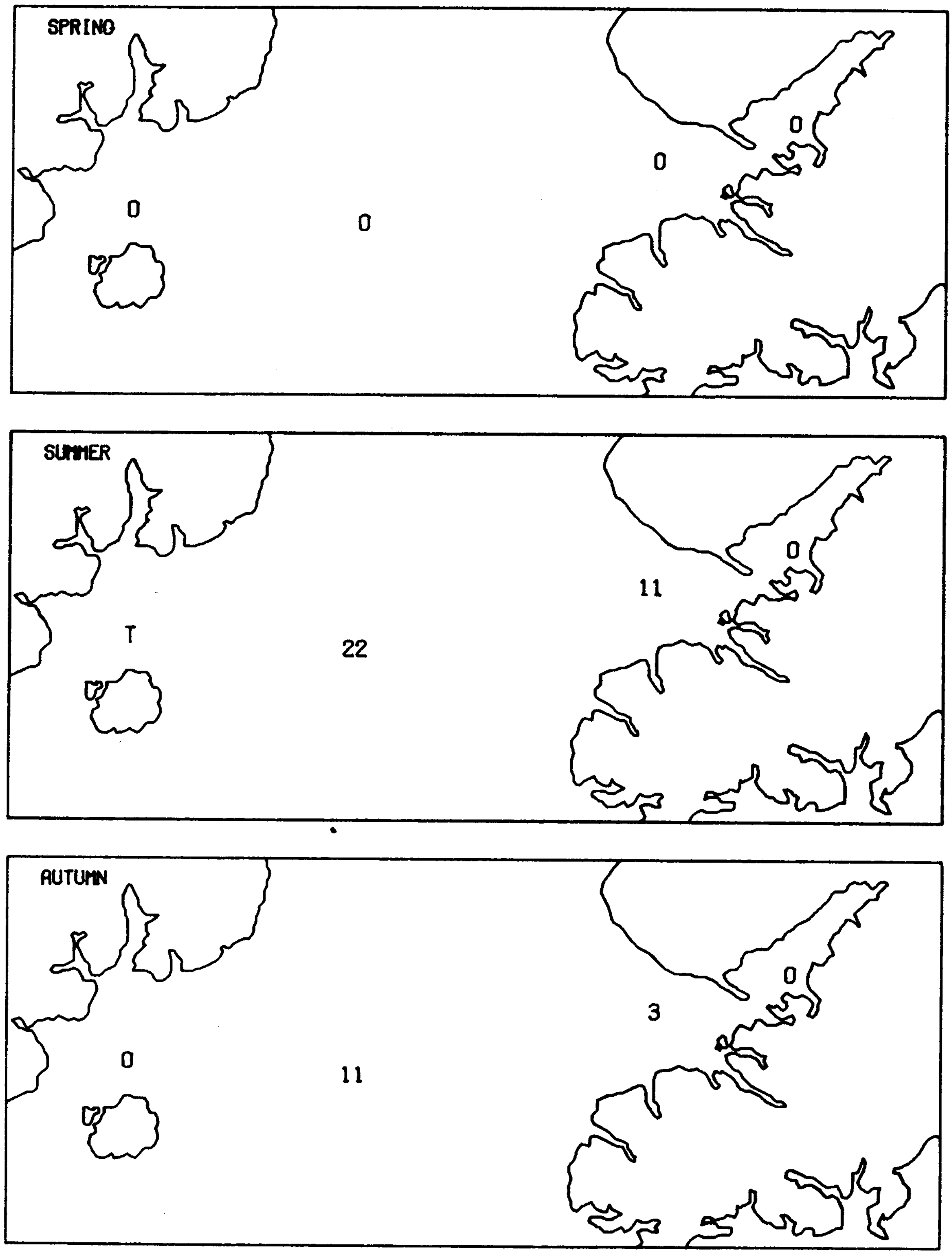
STAGE IV/10 SQ M



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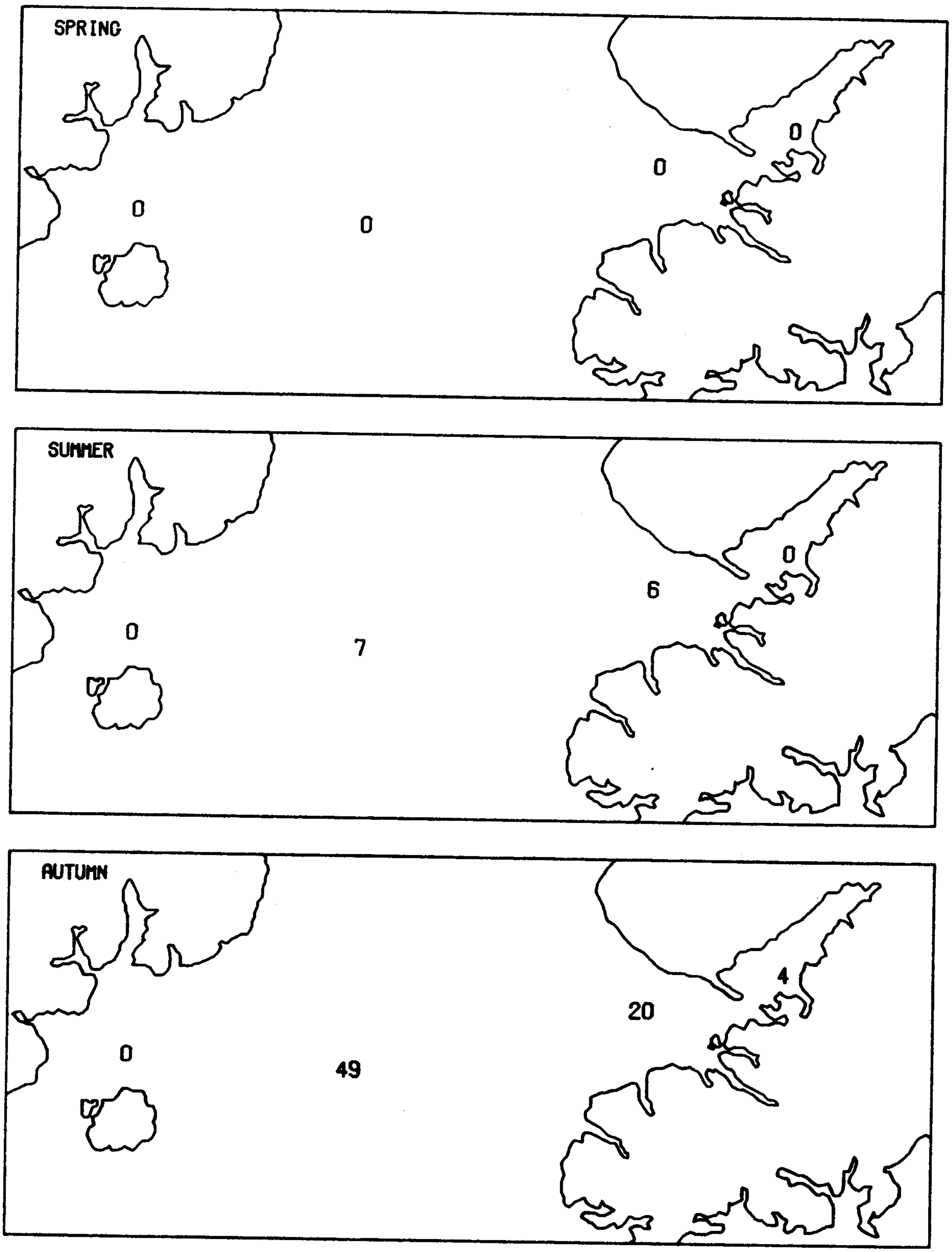
STAGE V/10 SQ M



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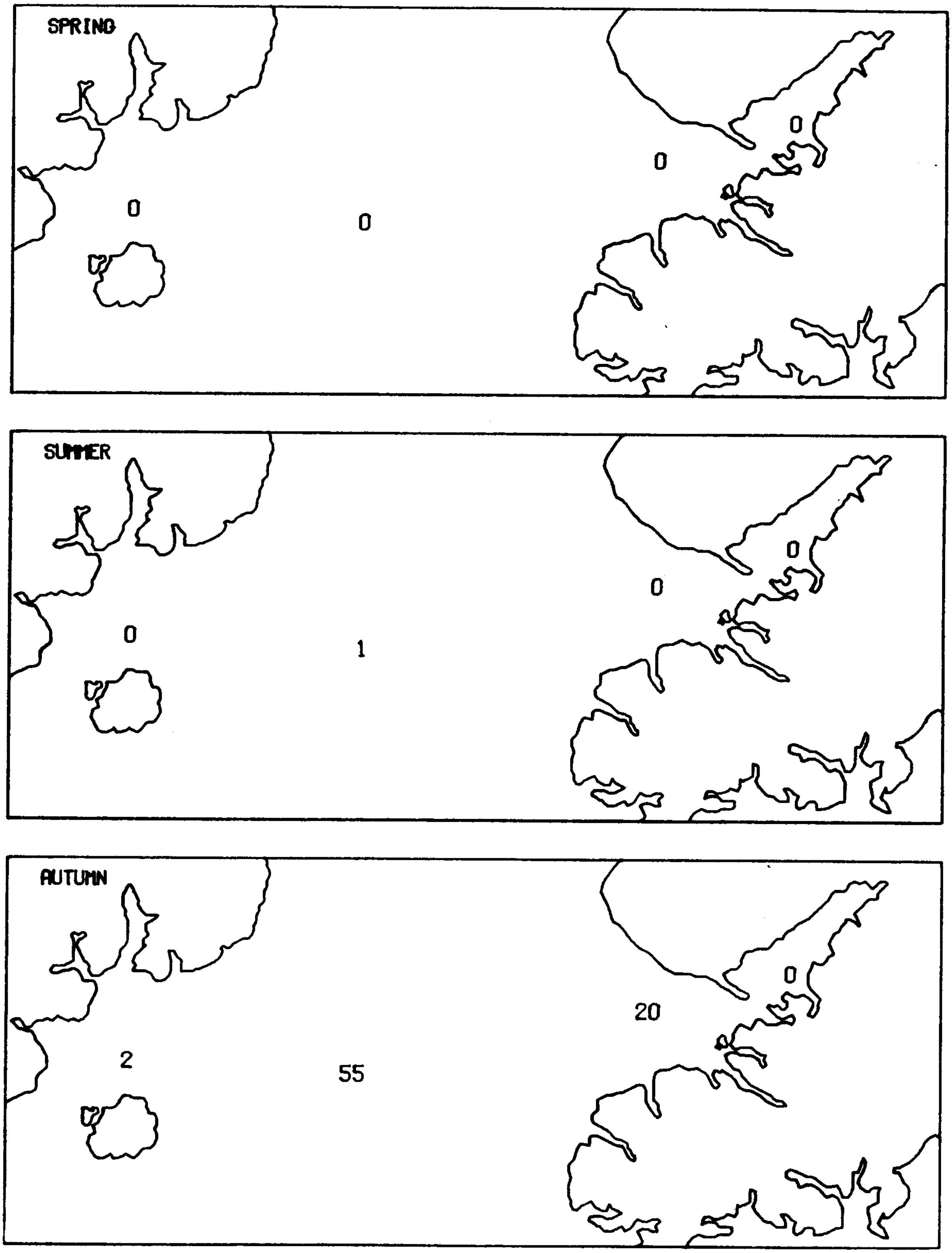
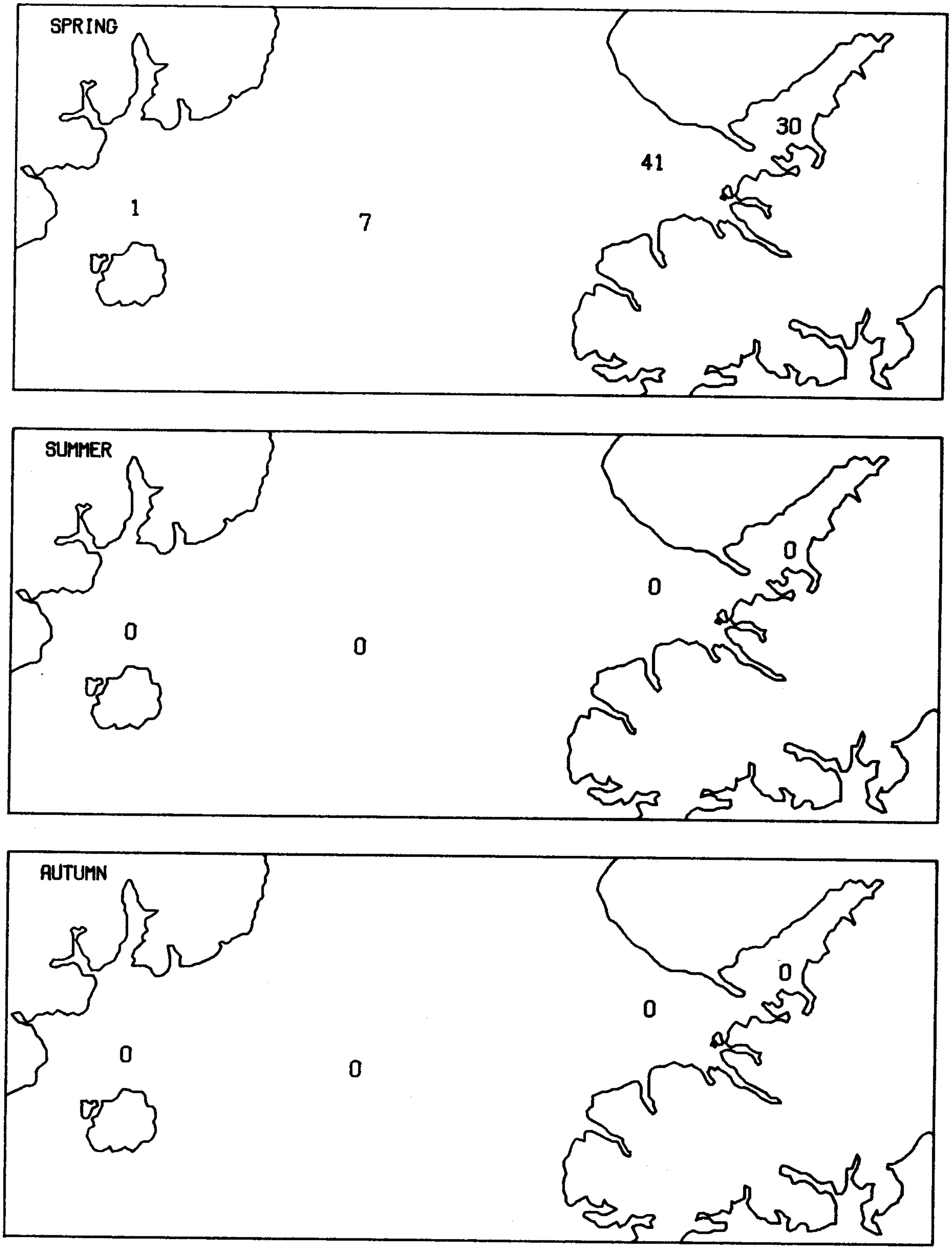
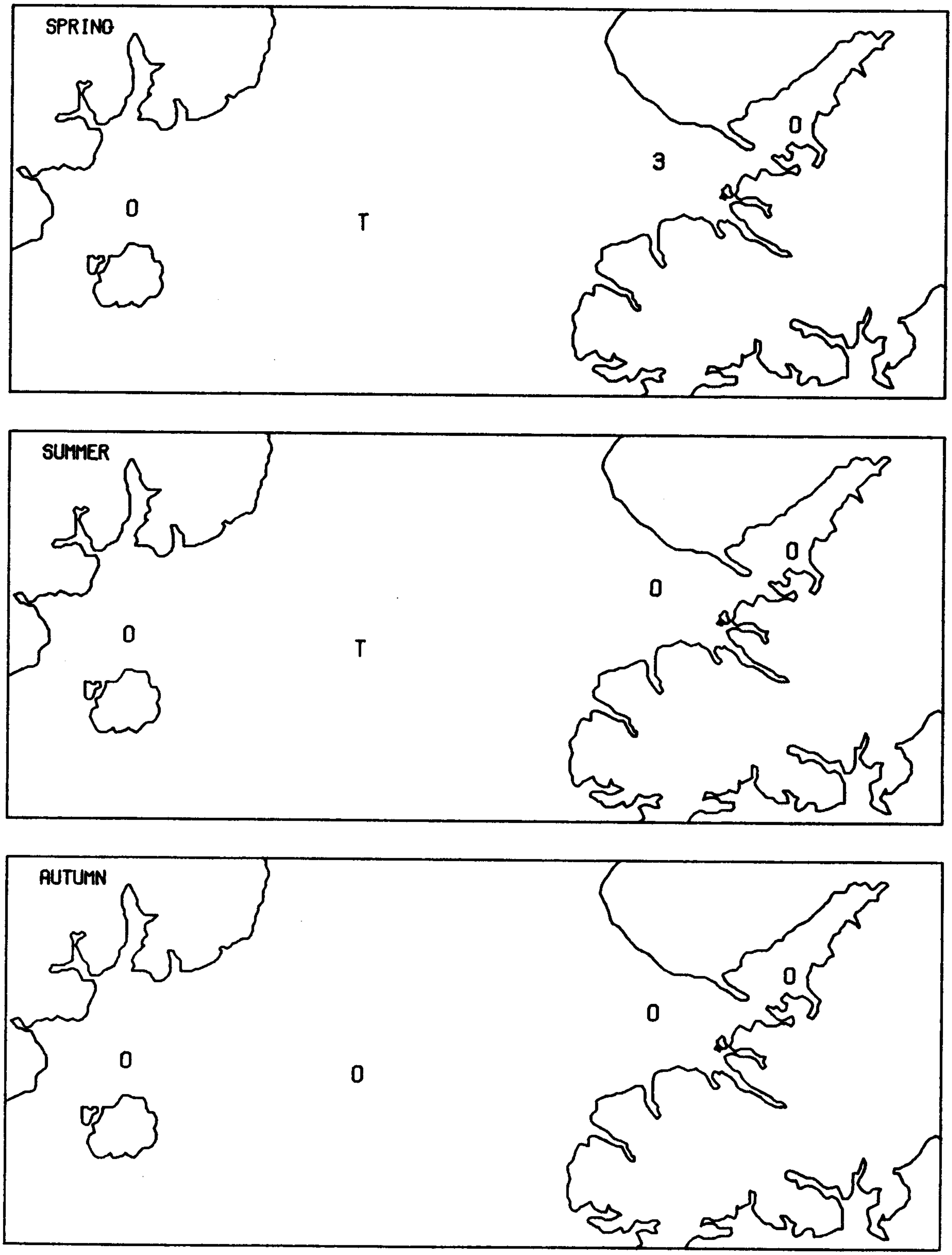
MEGALOPA/10 SQ M



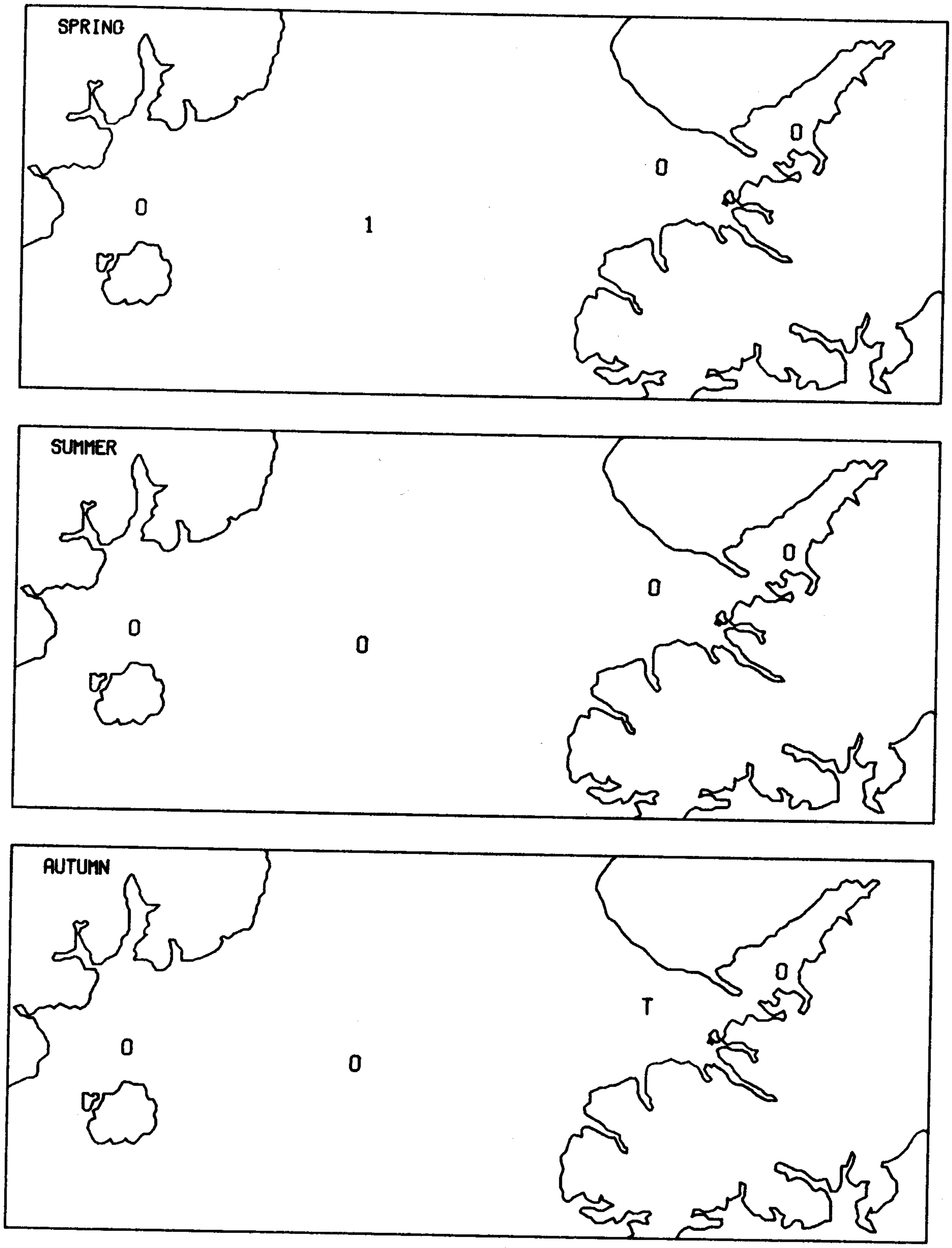
CHIONOECETES BAIRDI
STAGE I/10 SQ M



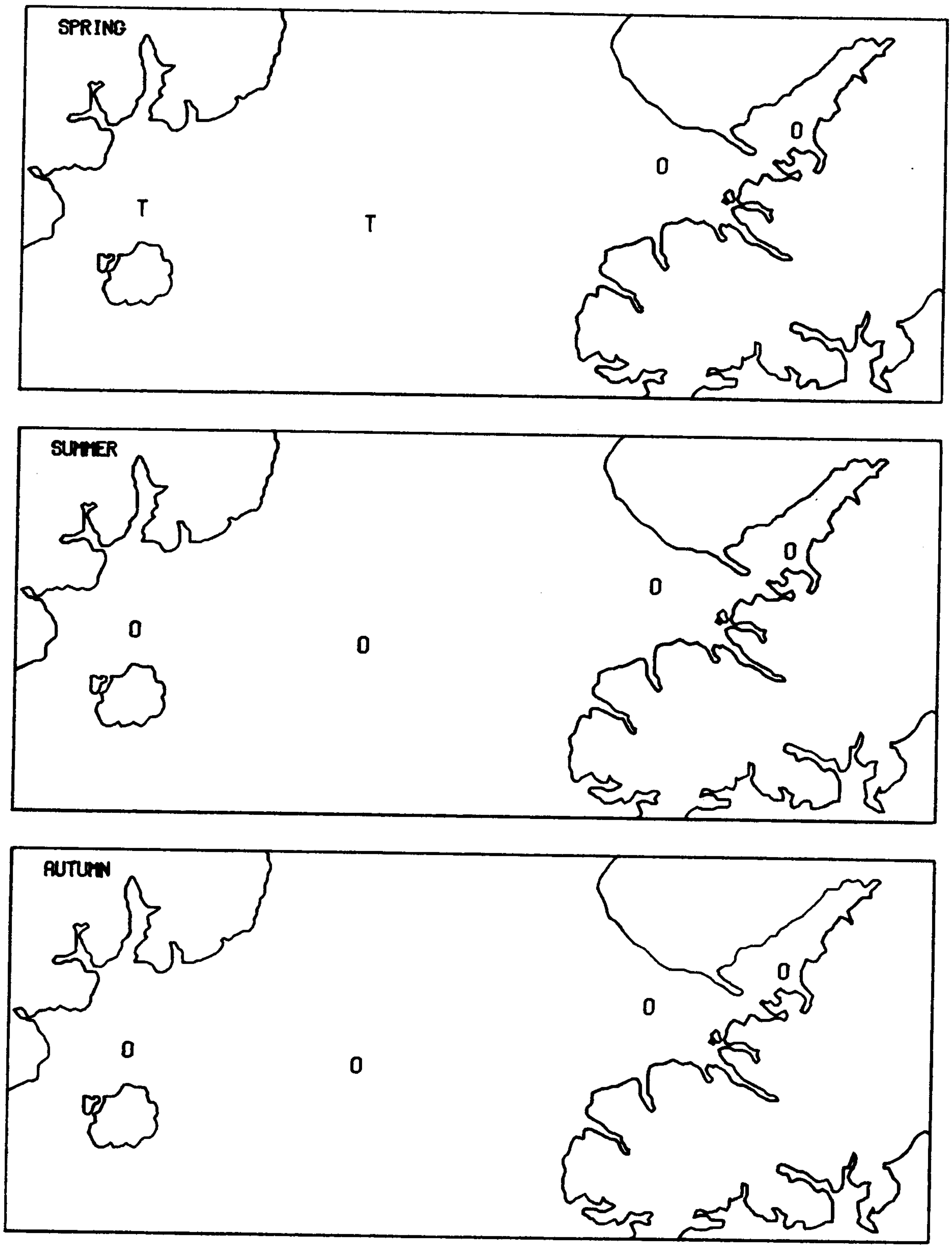
CHIONOECETES BAIRDI
STAGE II/10 SQ M



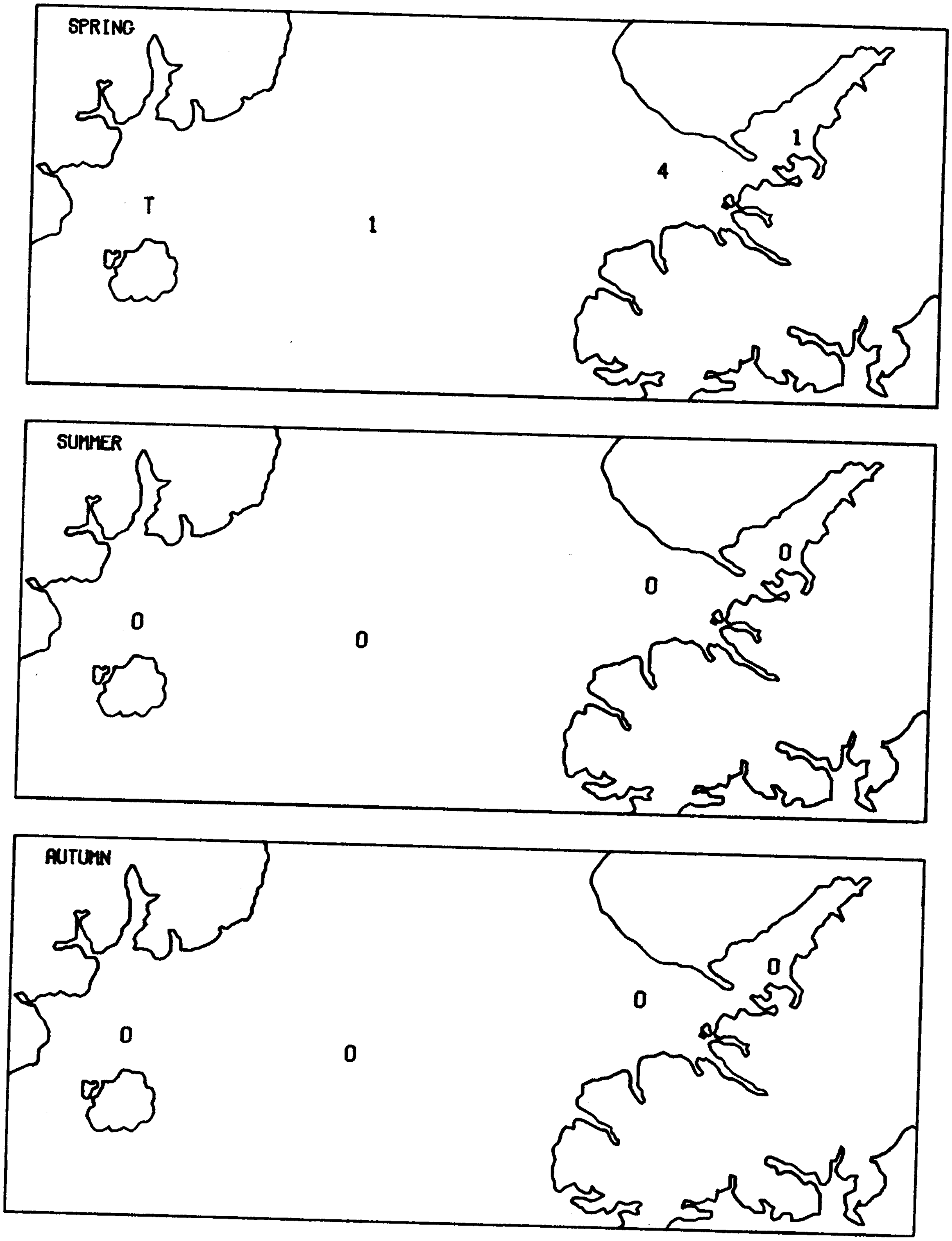
CHIONOECETES BAIRDI
MEGALOPA/10 SQ M



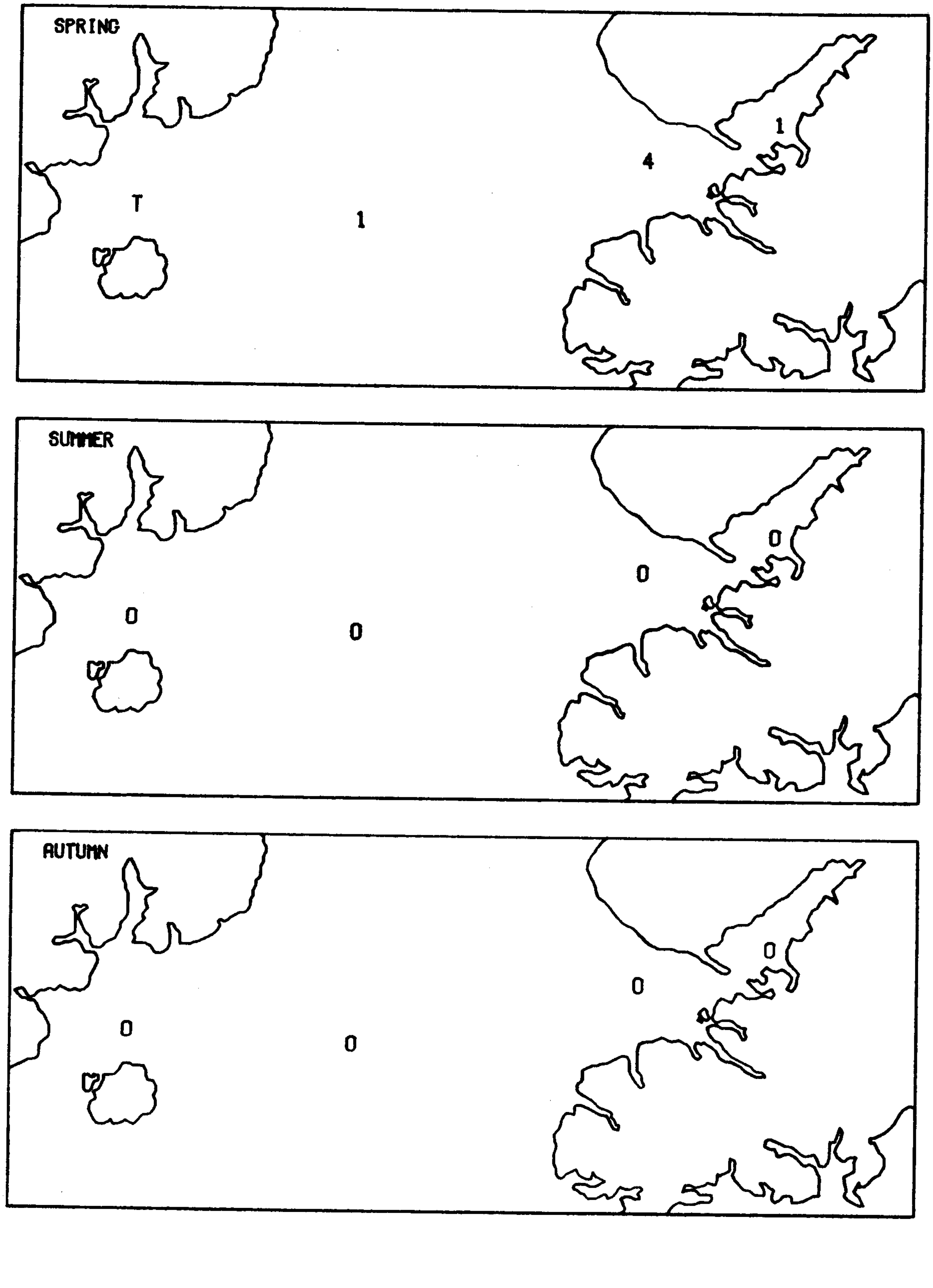
PARALITHODES CAMTSCHATICA
STAGE II/10 SQ M



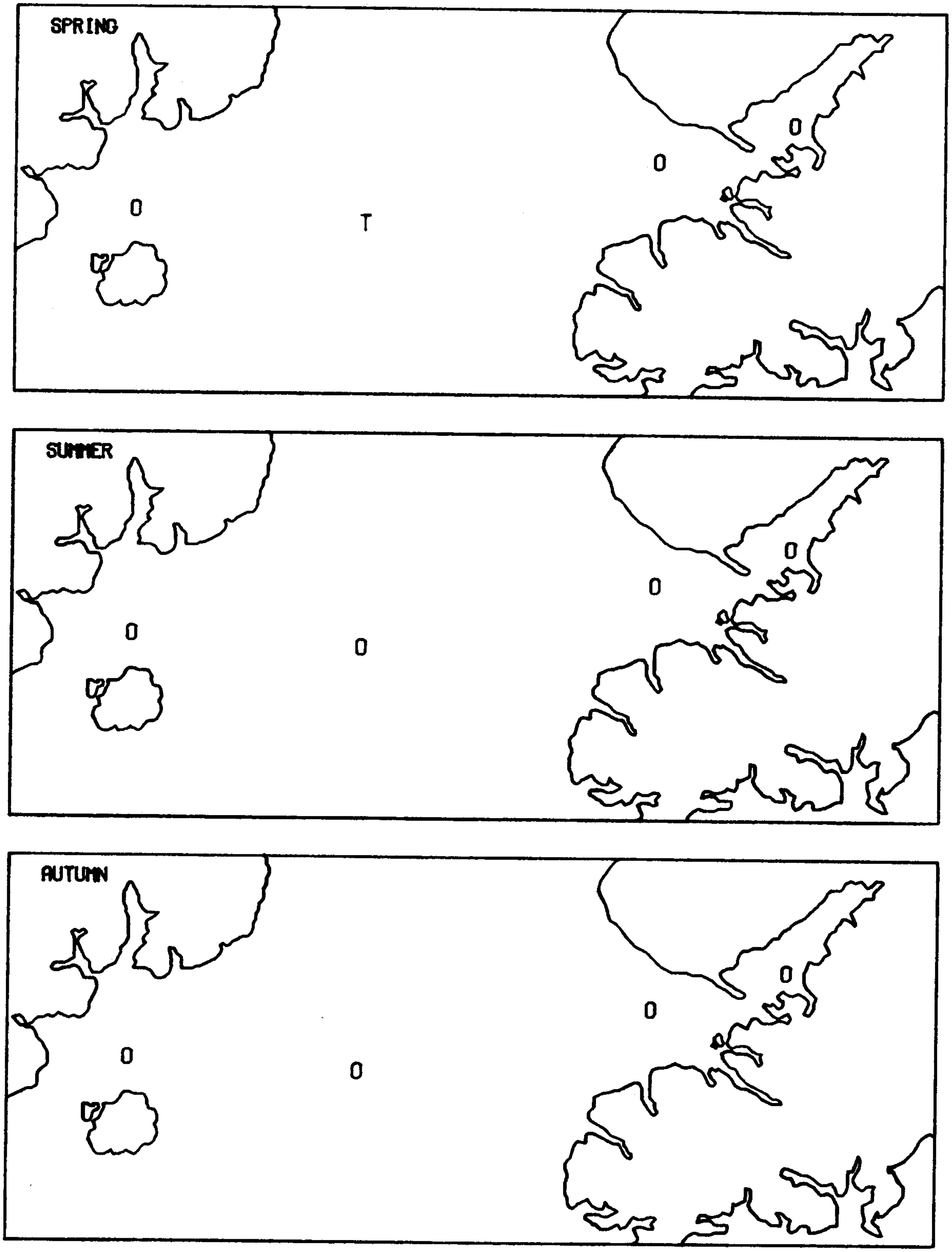
PARALITHODES CAMTSCHATICA
STAGE III/10 SQ M



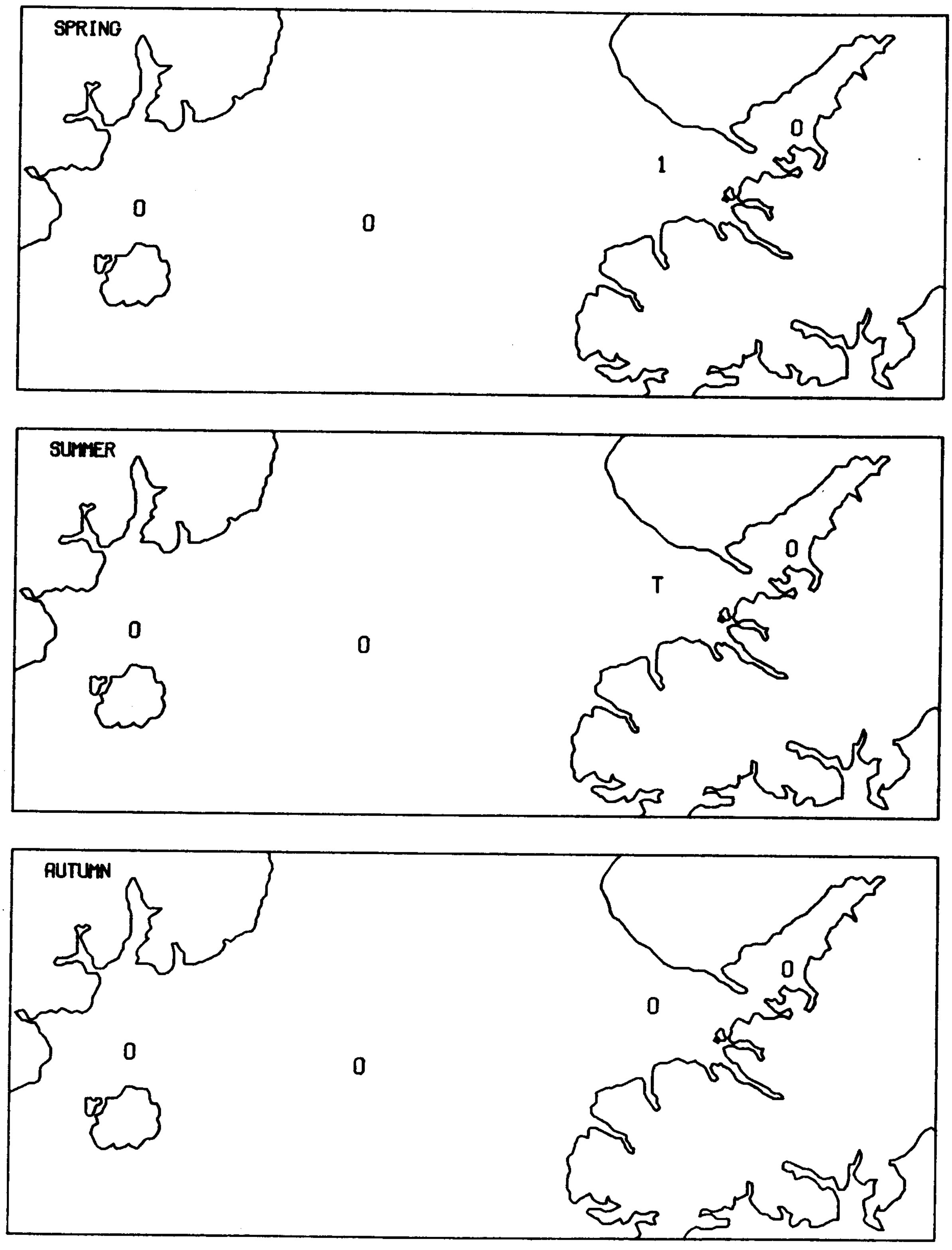
PARALITHODES CAMTSCHATICA
STAGE IV/10 SQ M



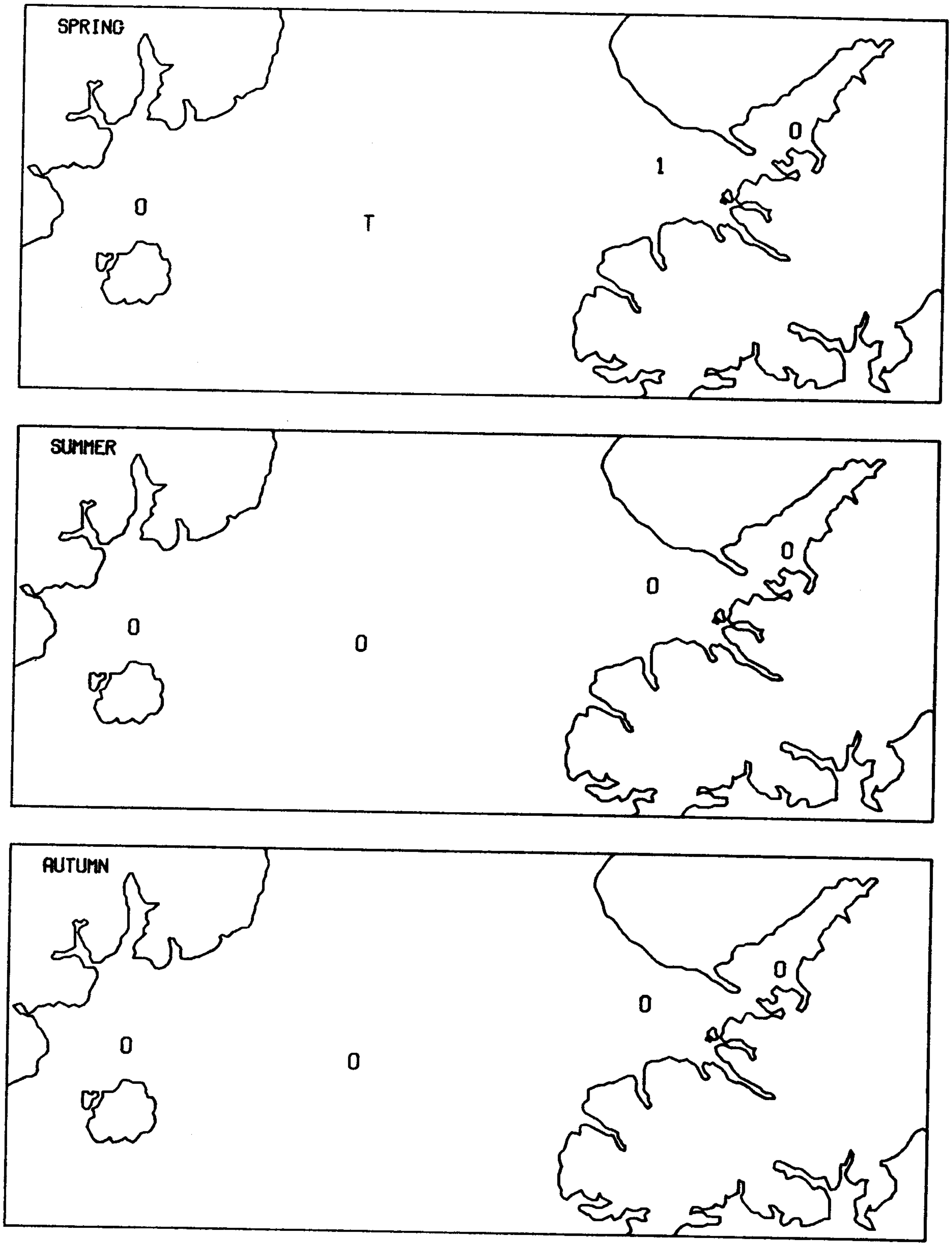
PARALITHODES CAMTSCHATICA
MEGALOPA/10 SQ M



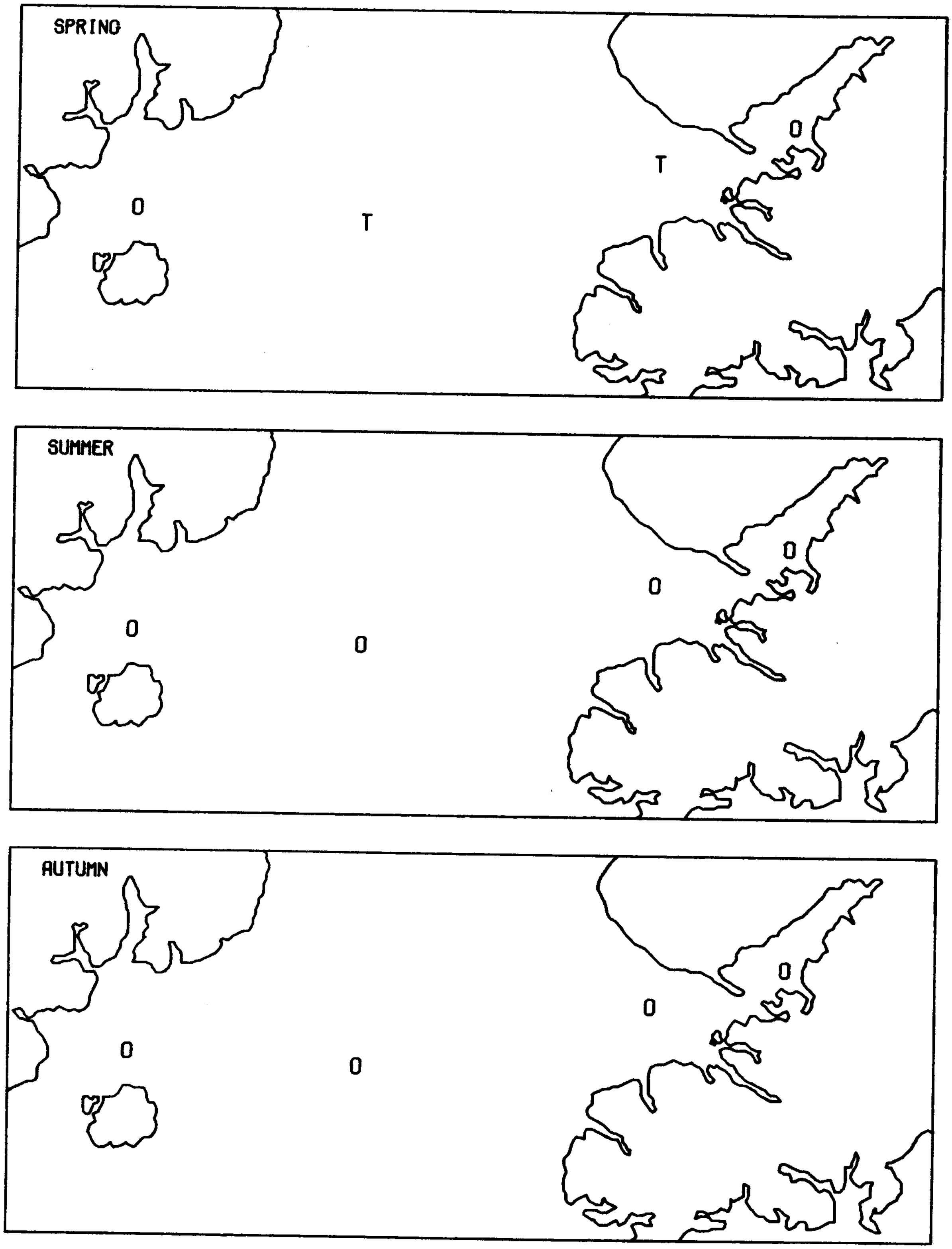
PANDALOPSIS DISPAR
STAGE I/10 SQ M



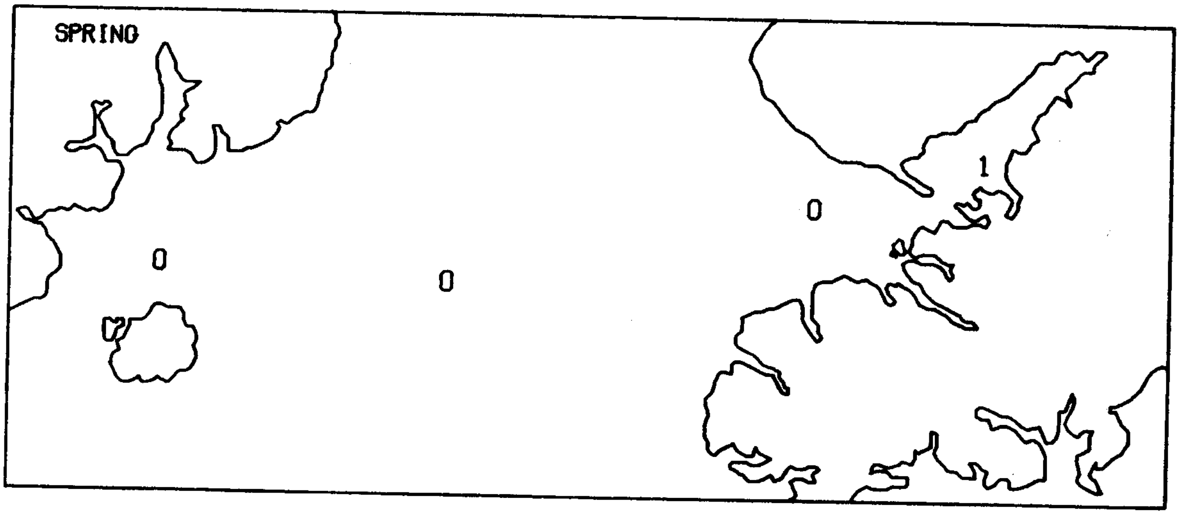
PANDALOPSIS DISPAR
STAGE II/10 SQ M

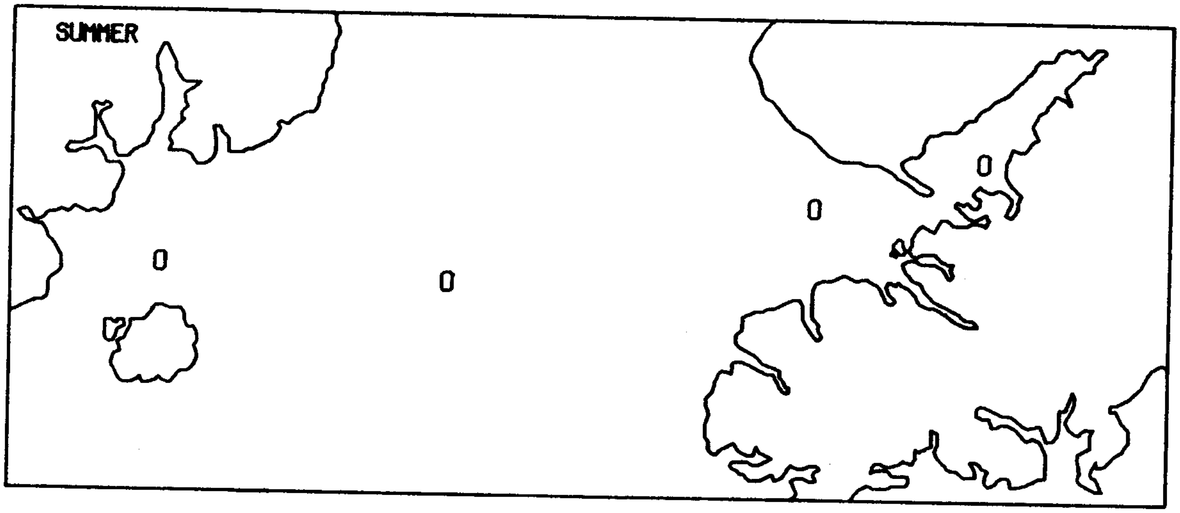


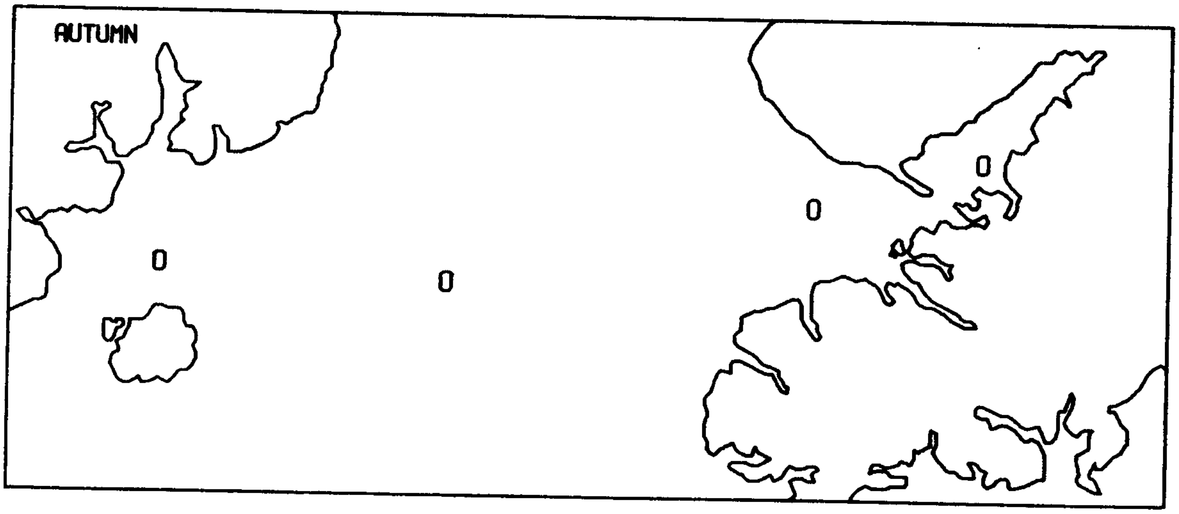
PANDALOPSIS DISPAR
STAGE III/10 SQ M



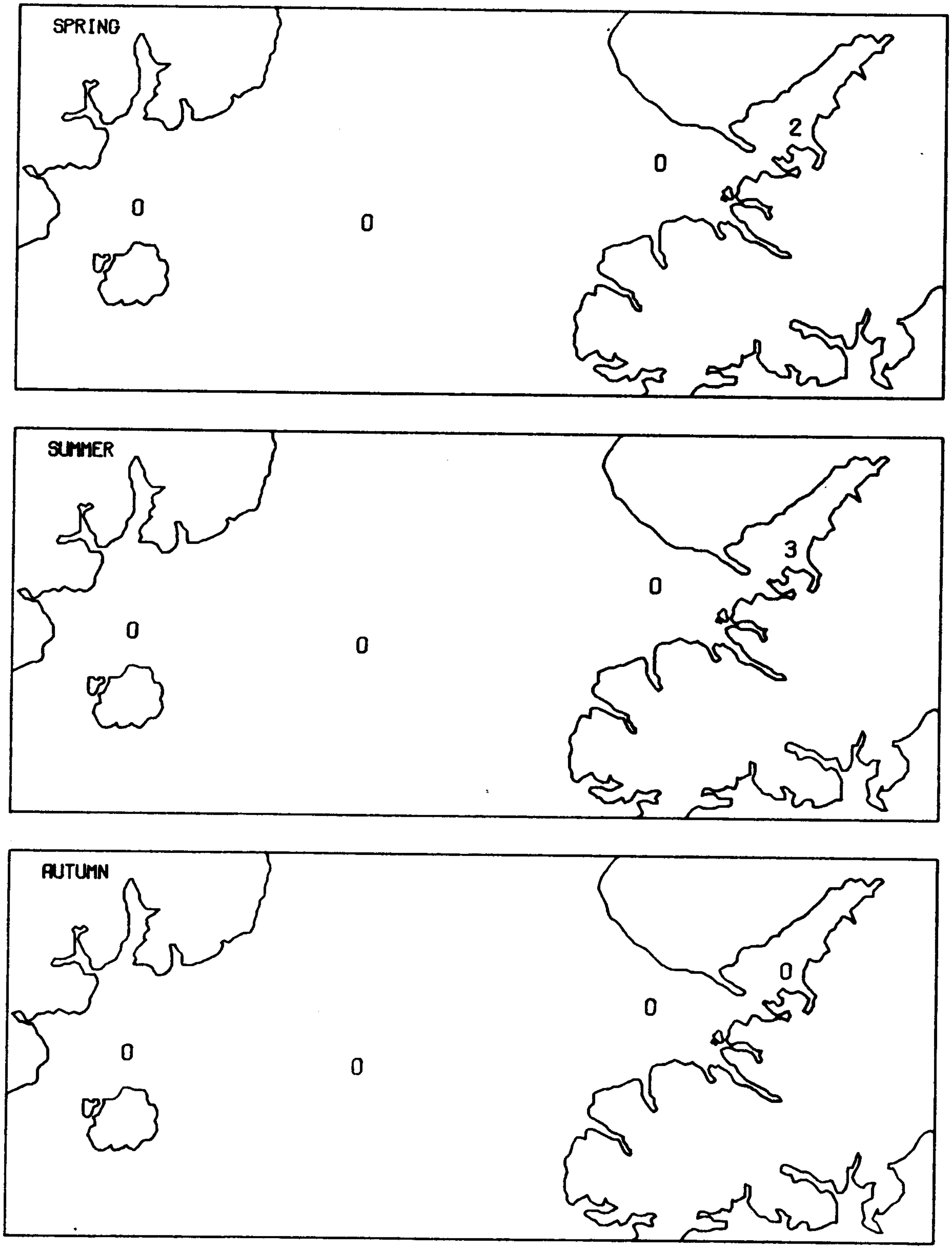
PANDALUS BOREALIS
STAGE I/10 SQ M



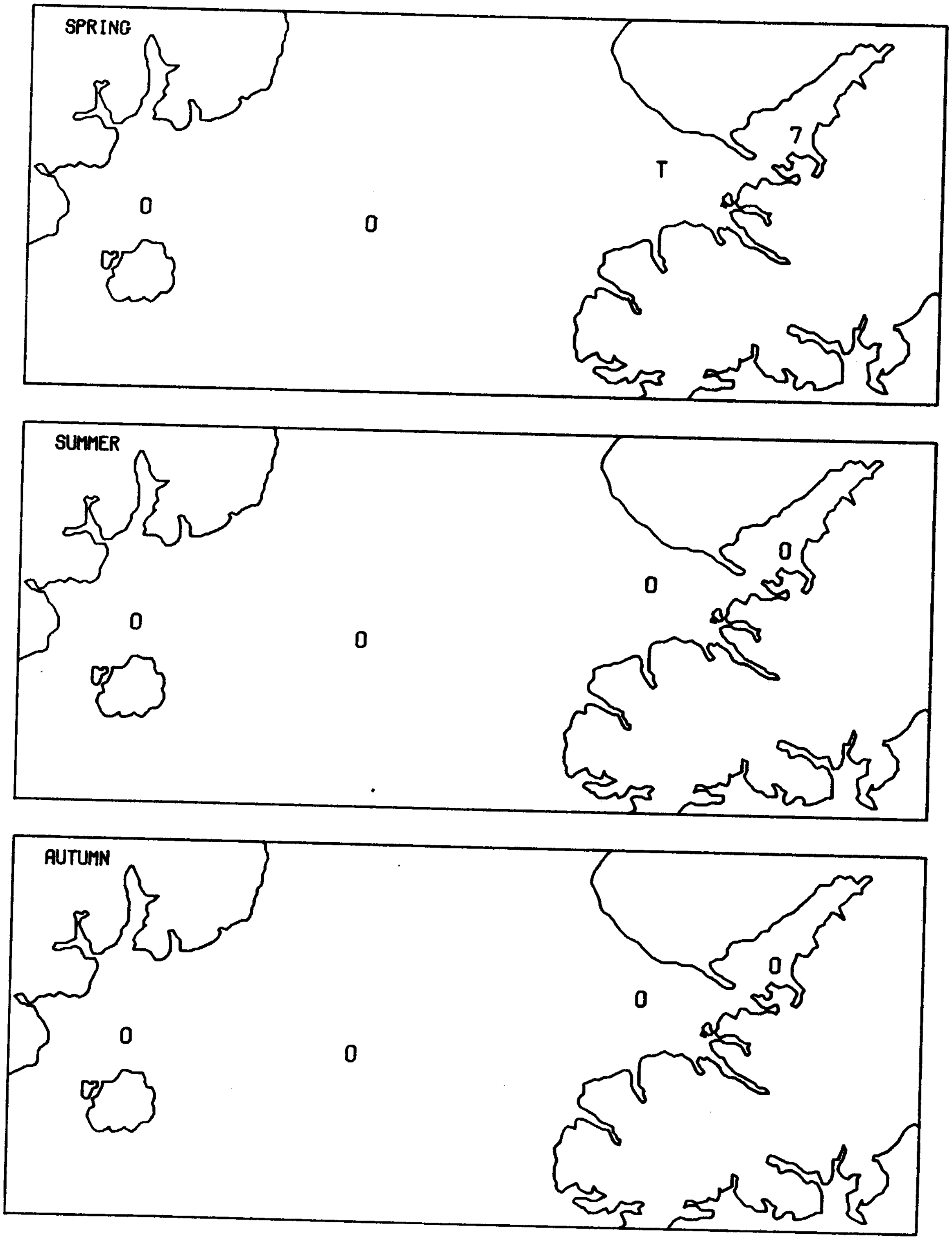




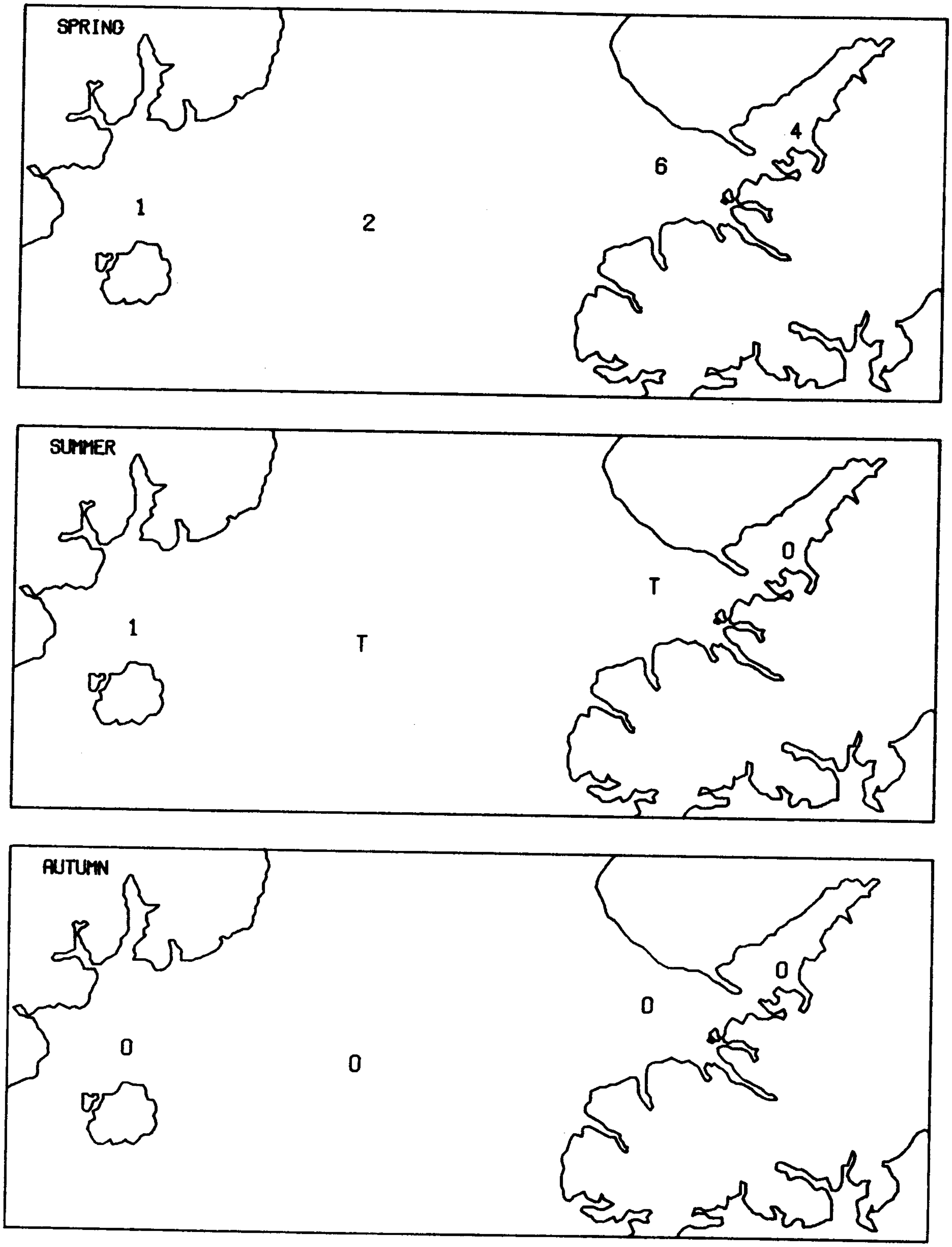
PANDALUS BOREALIS
STAGE II/10 SQ M



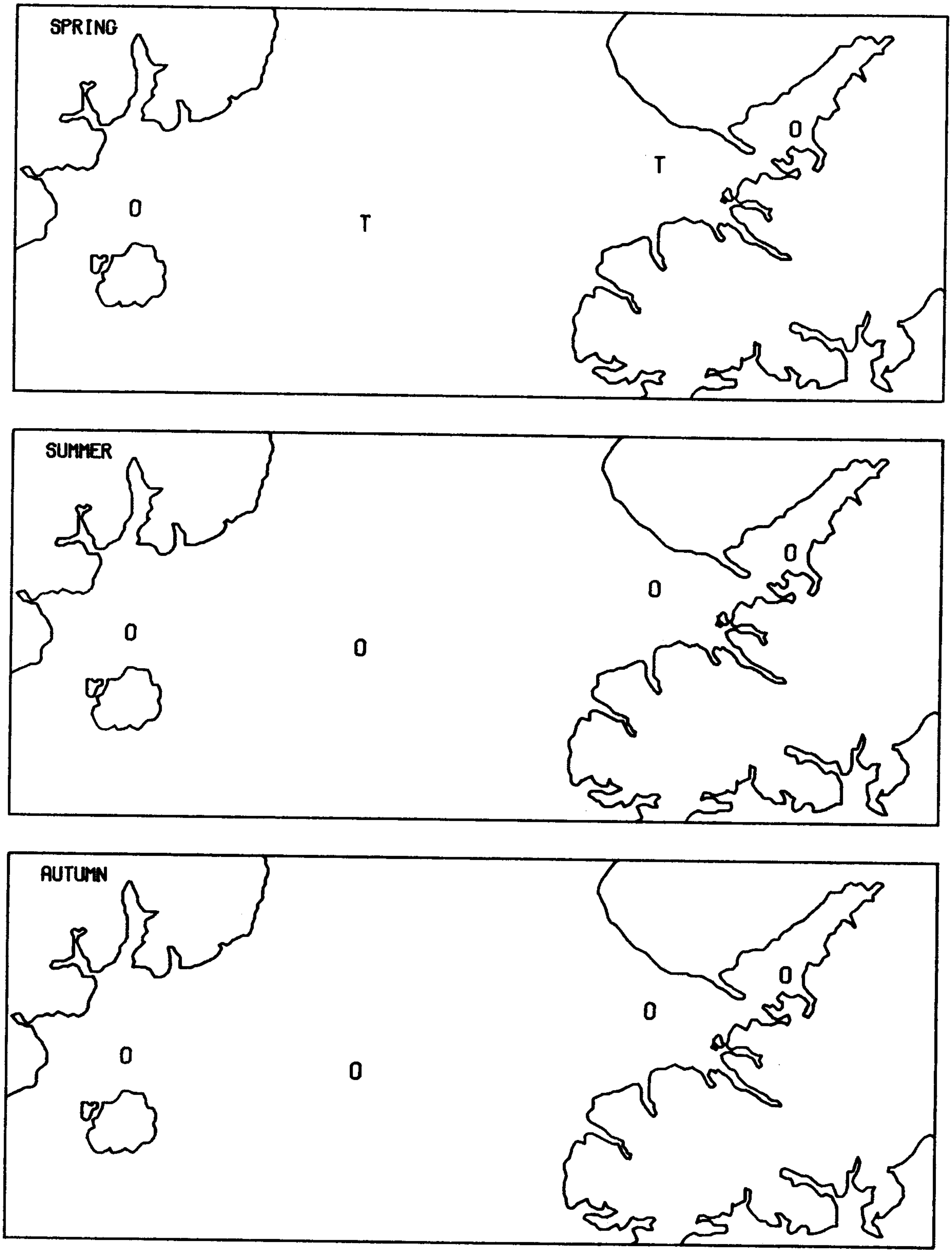
PANDALUS BOREALIS
STAGE III/10 SQ M



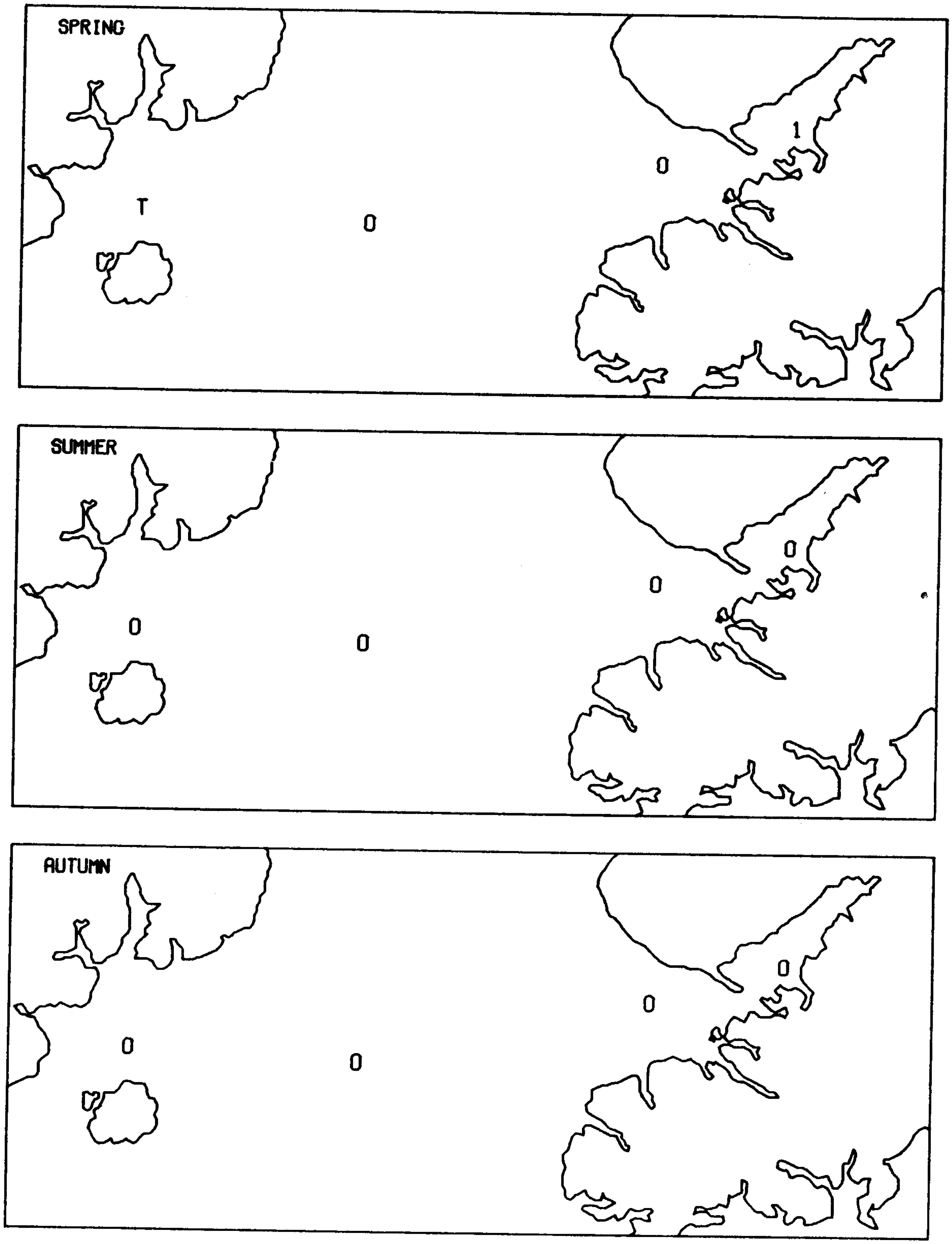
PANDALUS BOREALIS
STAGE IV/10 SQ M



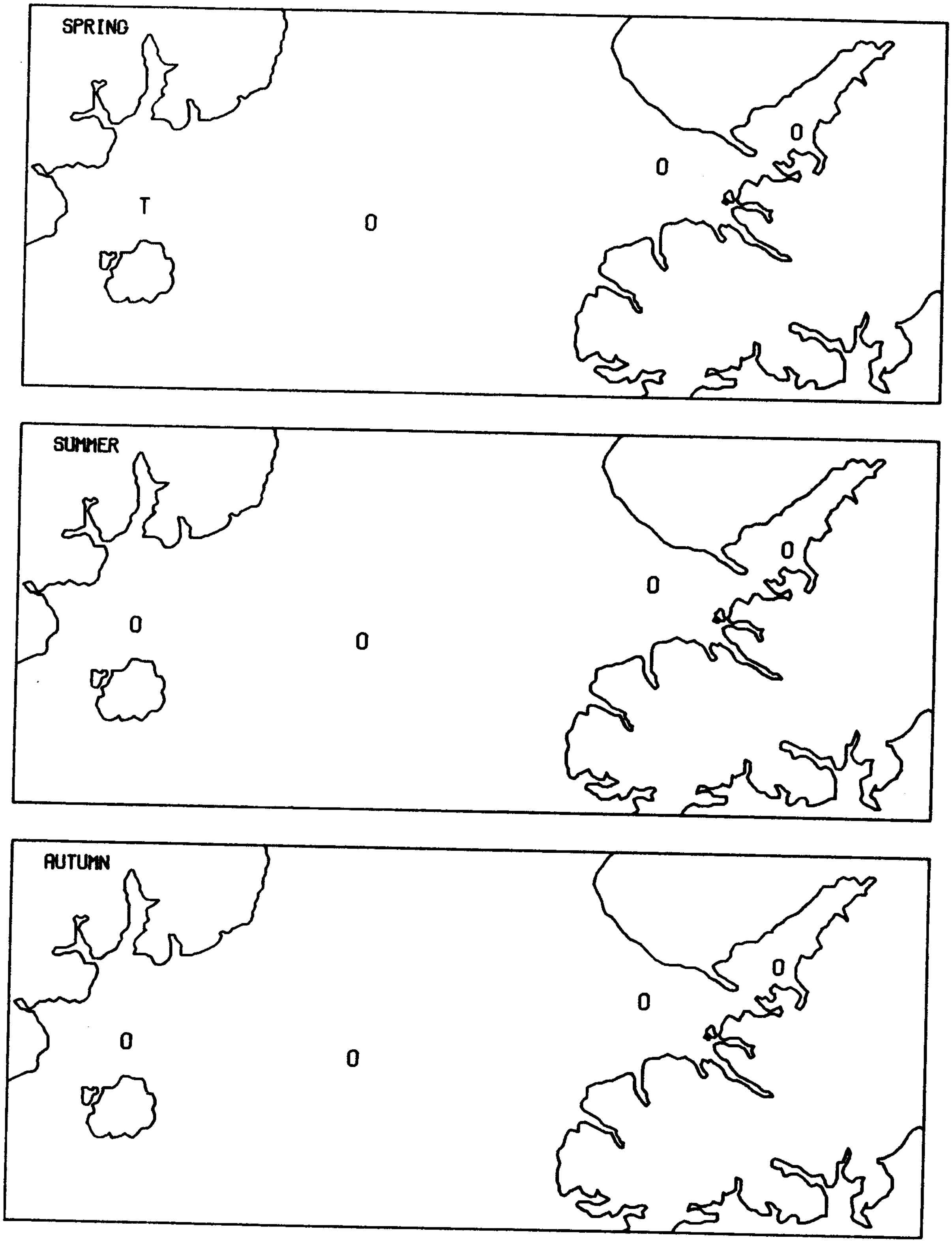
PANDALUS BOREALIS
STAGE V/10 SQ M



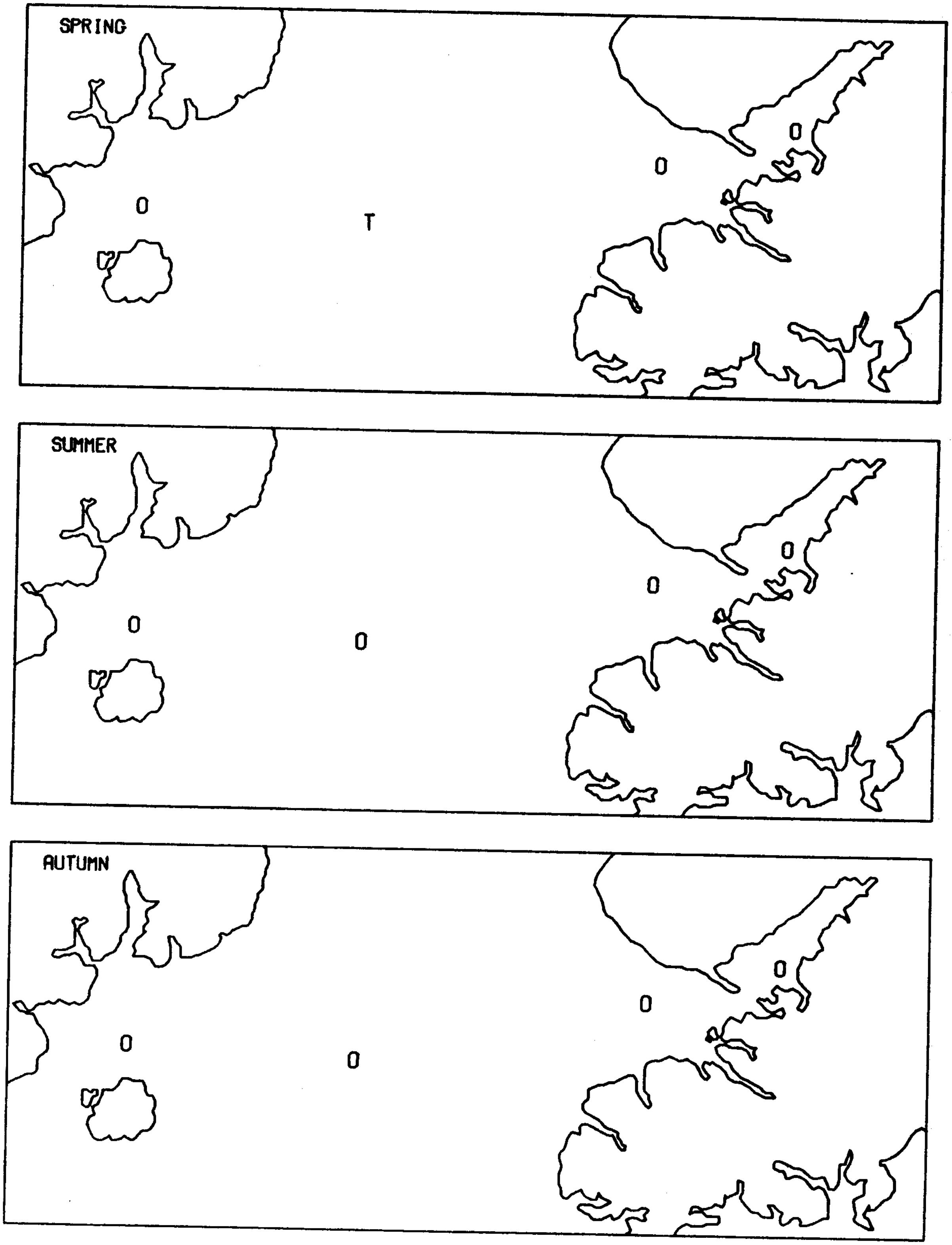
PANDALUS DANAE
STAGE II/10 SQ M



PANDALUS DANAE
STAGE III/10 SQ M

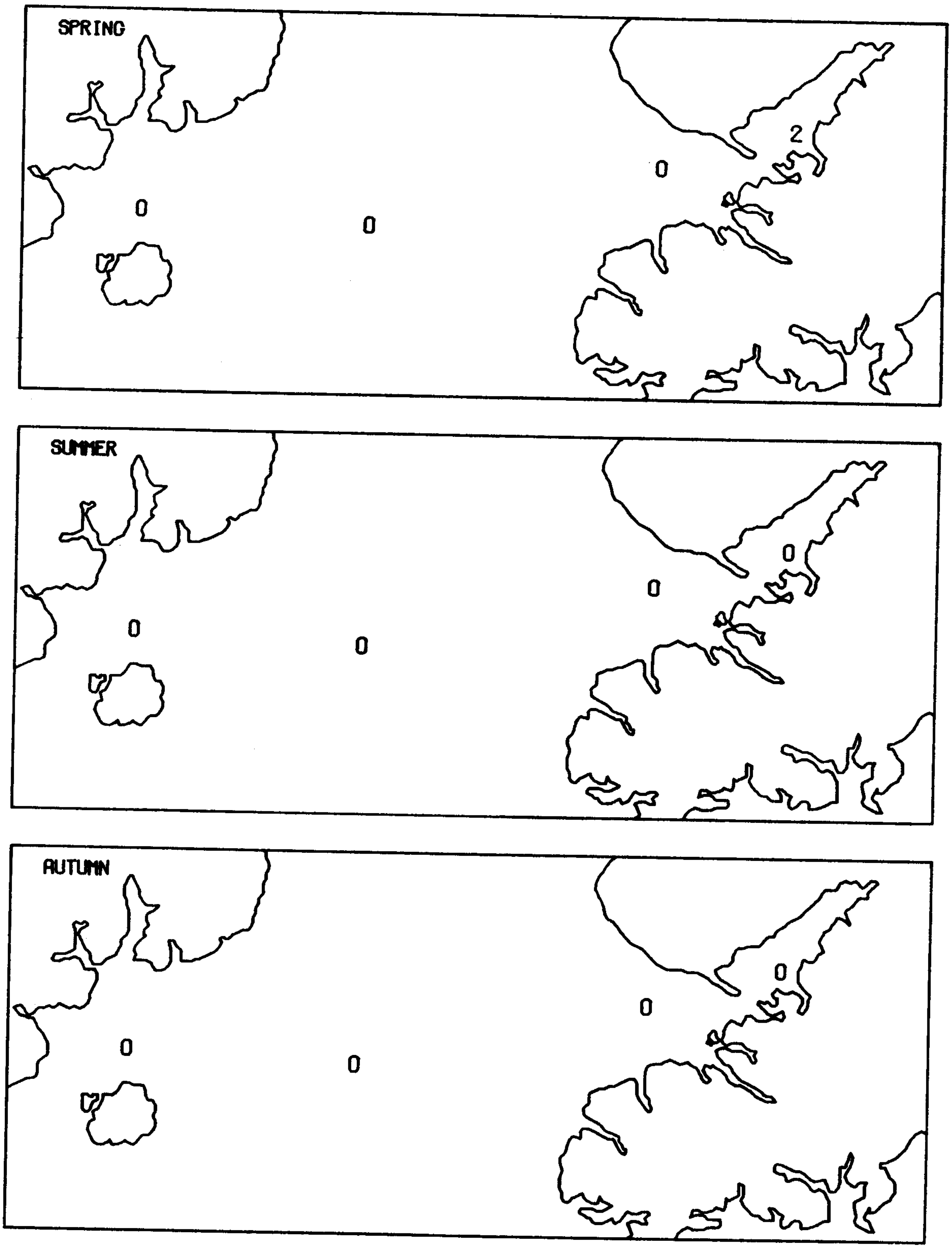


PANDALUS DANAE
STAGE V/10 SQ M

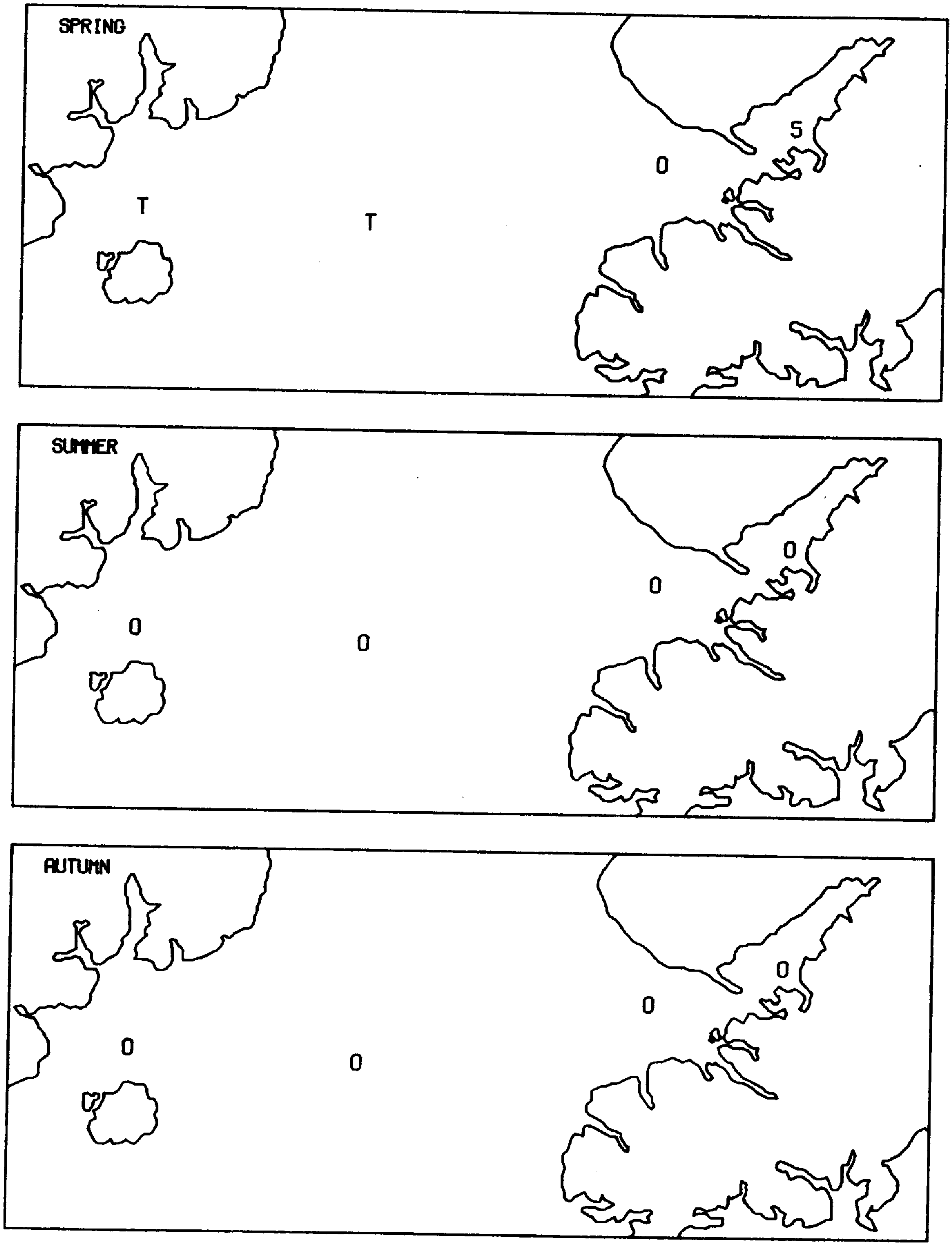


PANDALUS GONIURUS

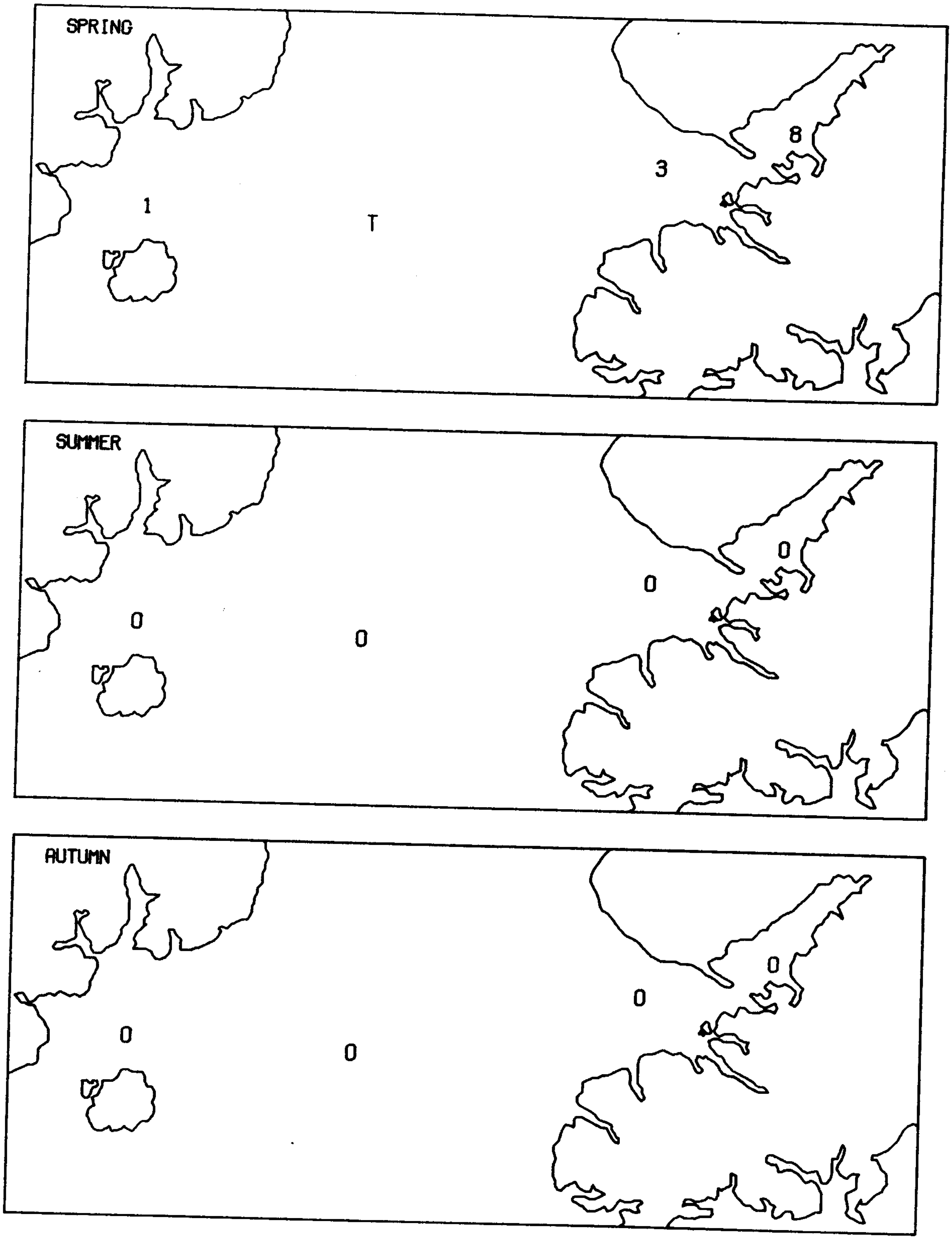
STAGE I/10 SQ M



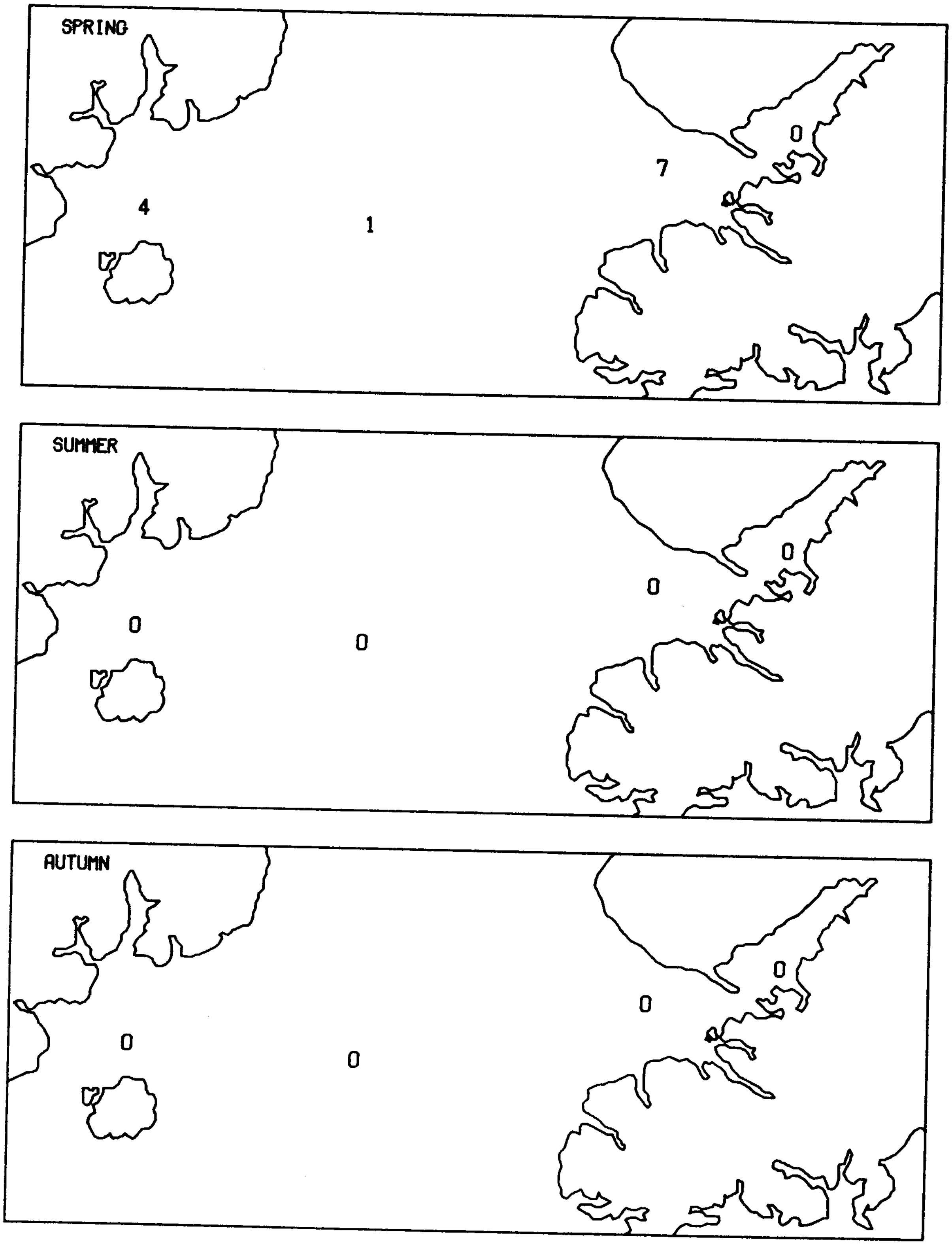
PANDALUS GONIURUS
STAGE II/10 SQ M



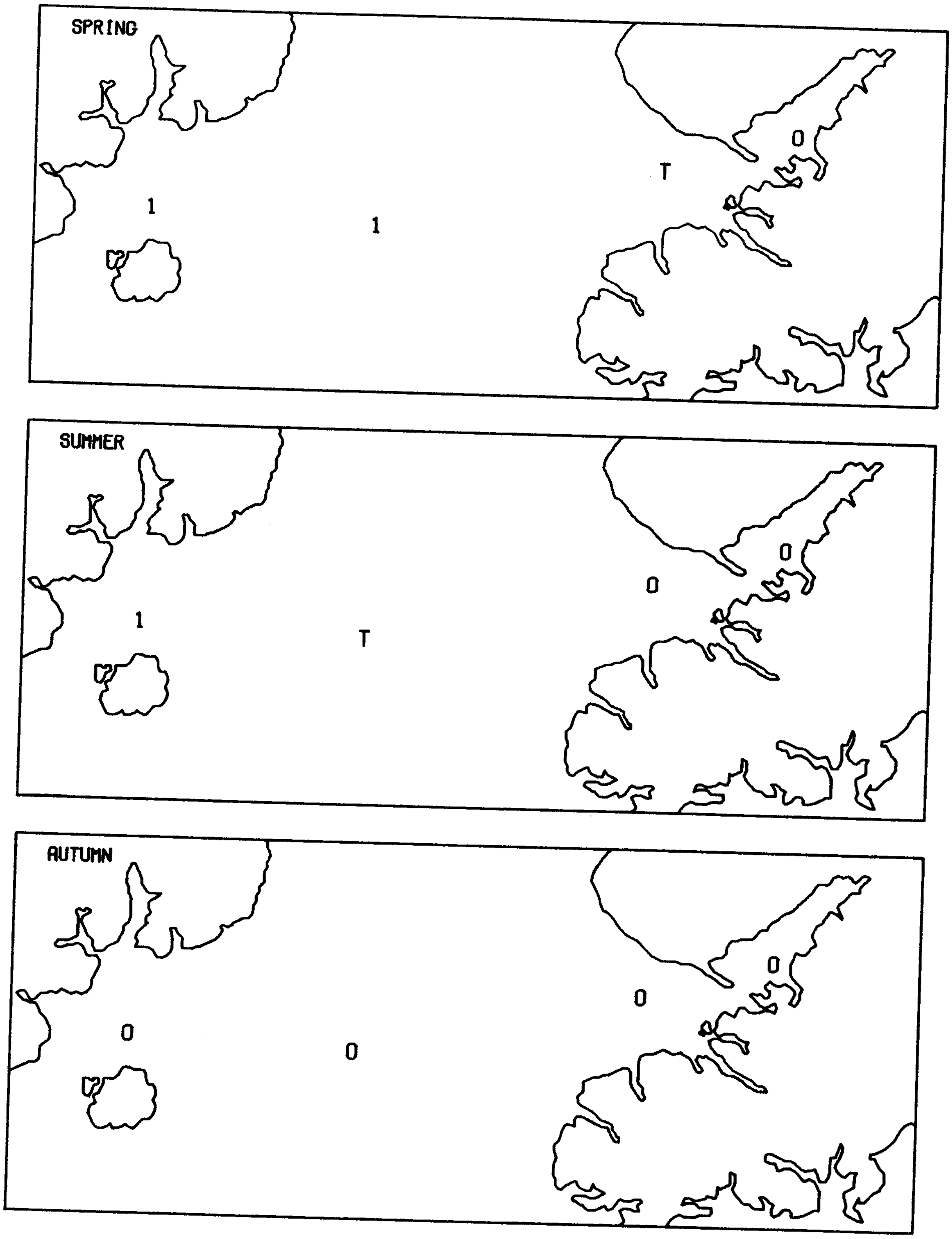
PANDALUS GONIURUS
STAGE III/10 SQ M



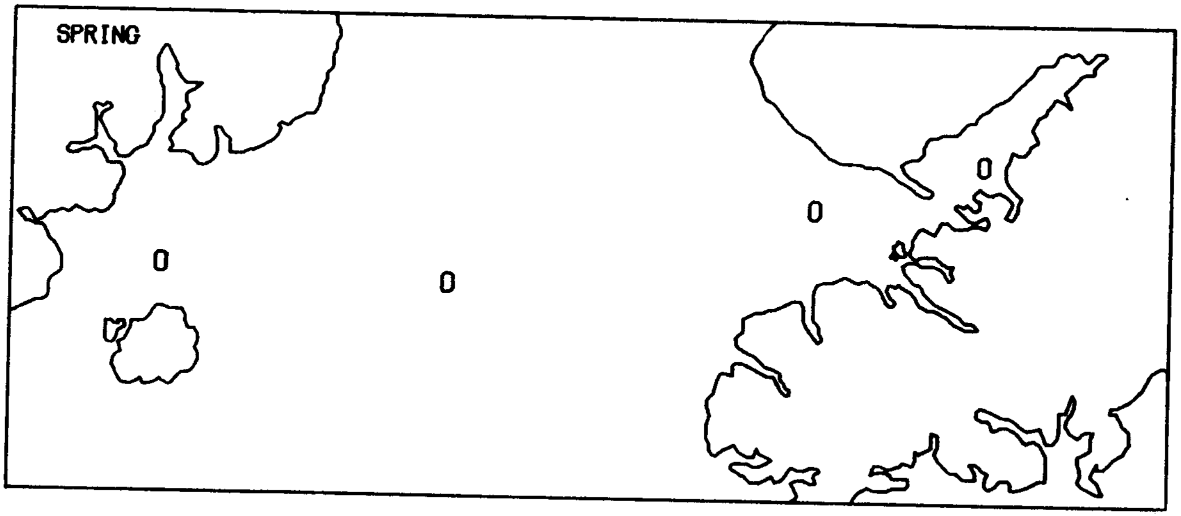
PANDALUS GONIURUS
STAGE IV/10 SQ M

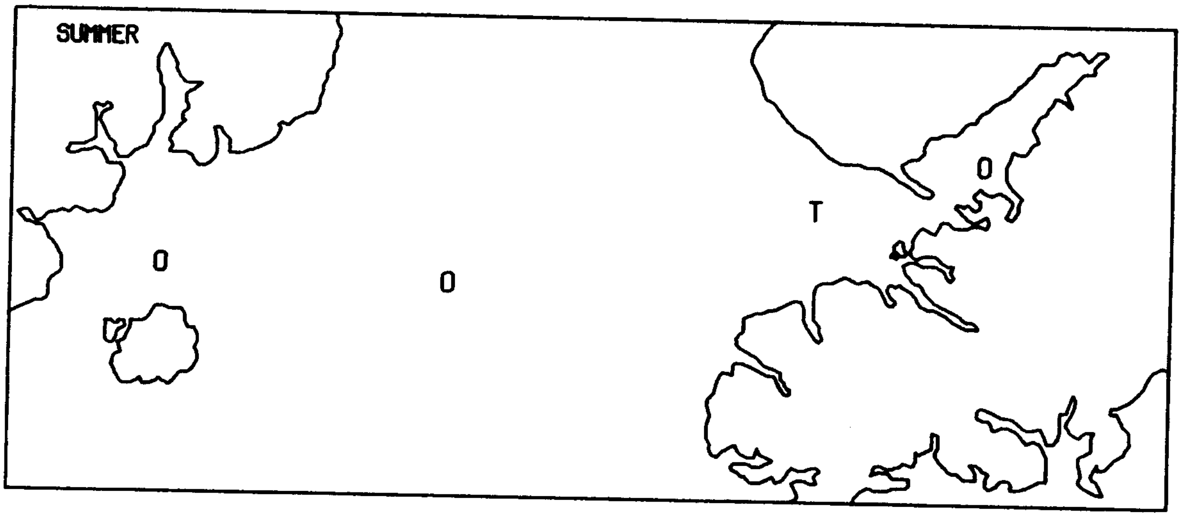


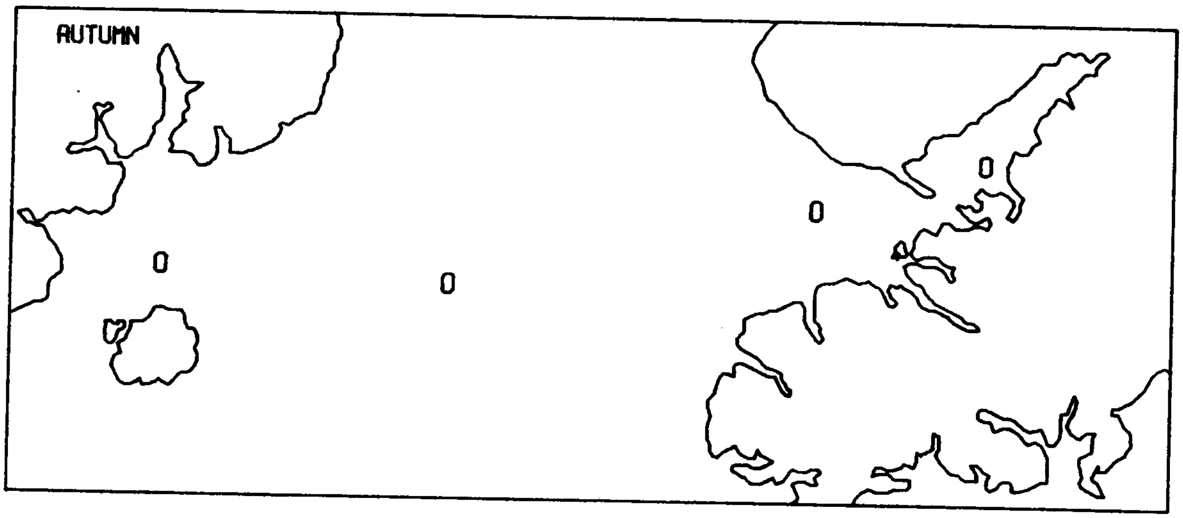
PANDALUS GONIURUS
STAGE V/10 SQ M



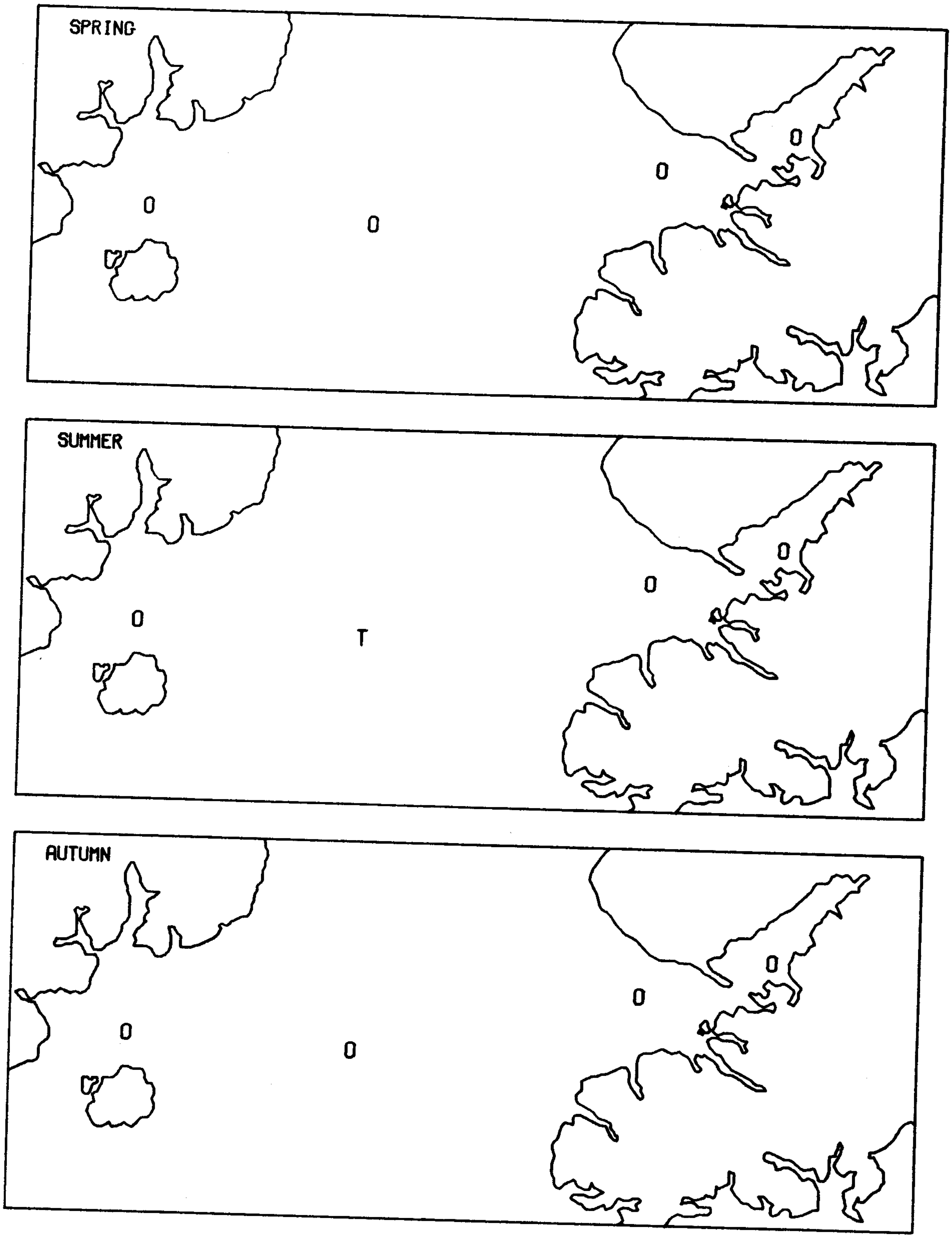
PANDALUS HYPSINOTUS
STAGE II/10 SQ M



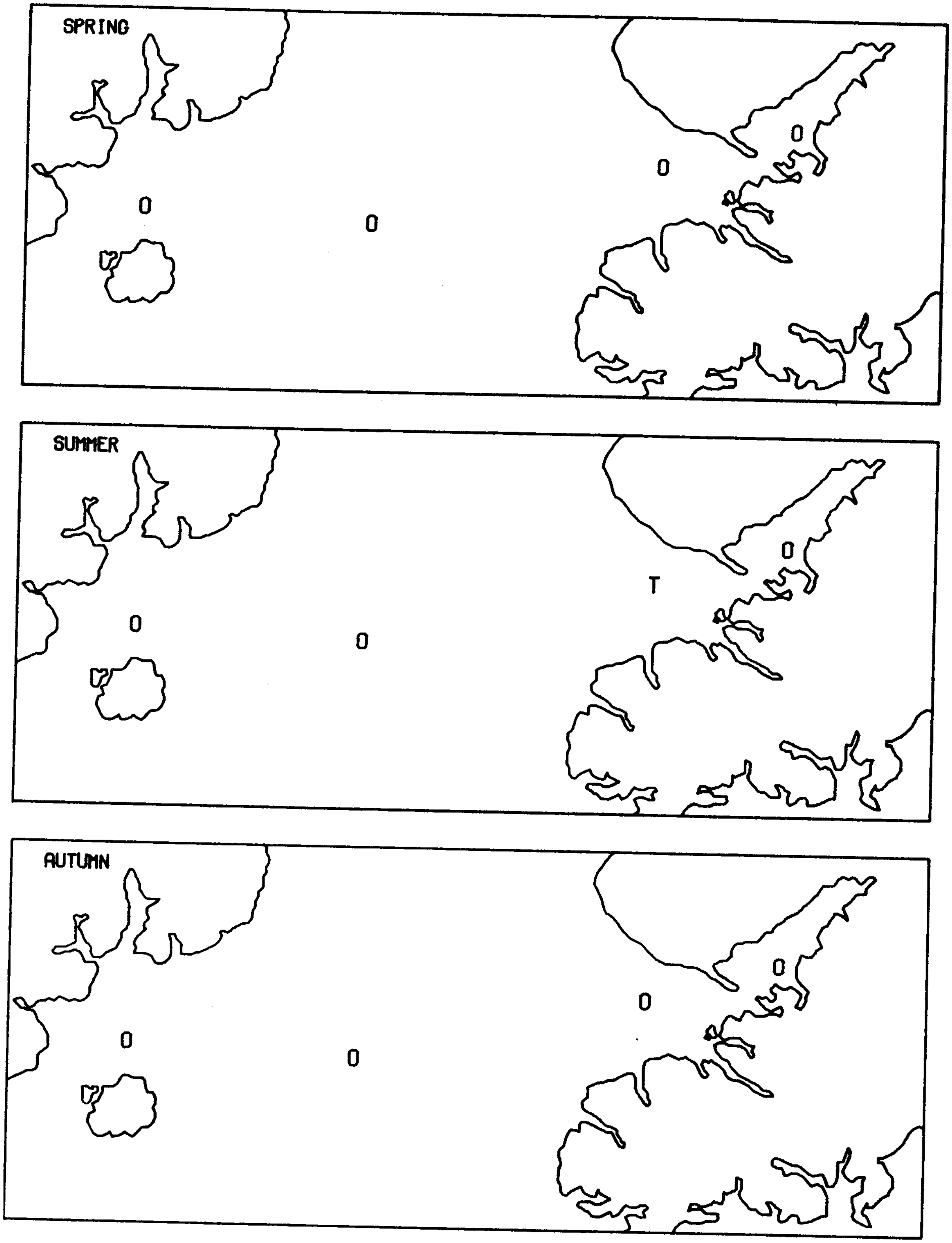




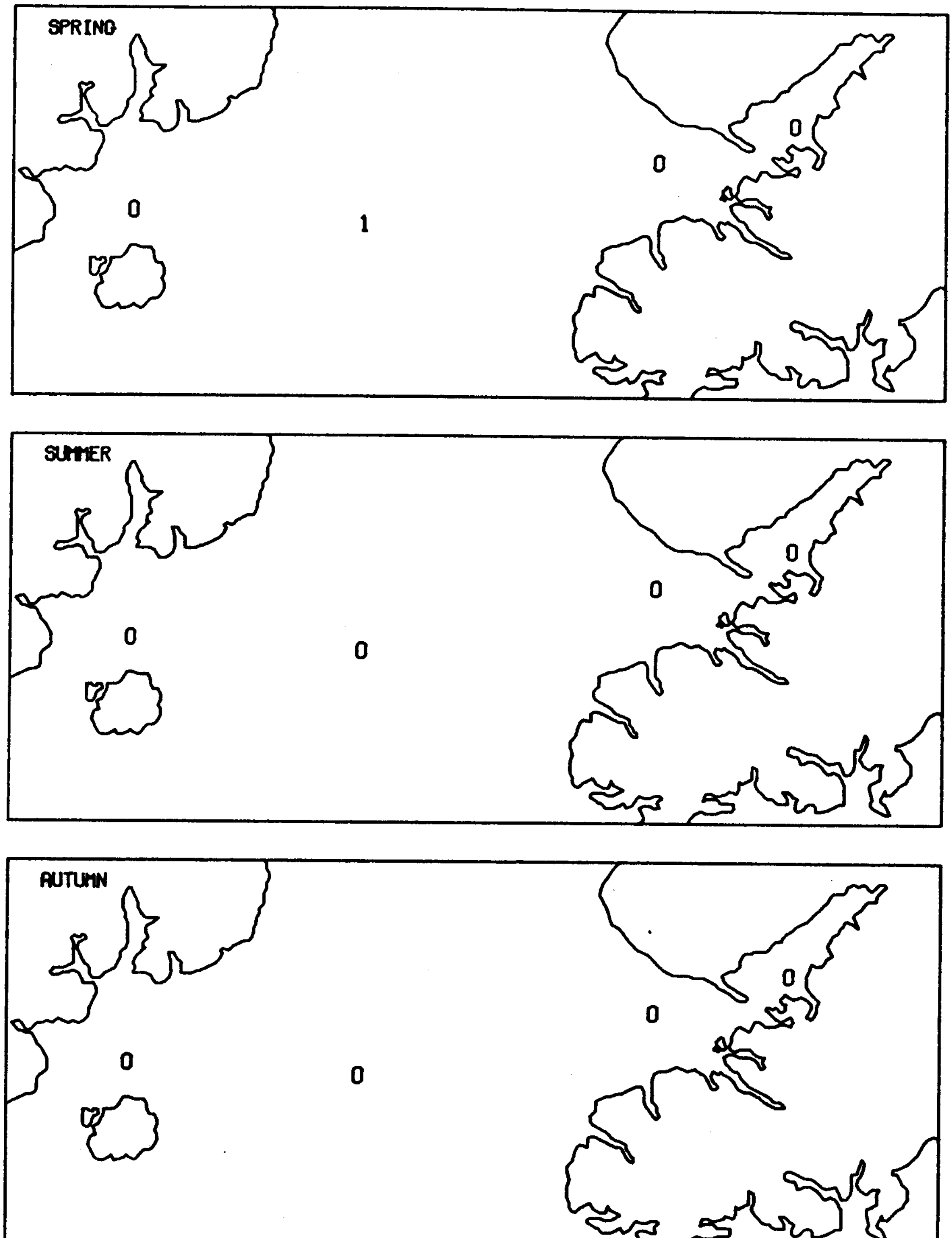
PANDALUS HYPSINOTUS
STAGE III/10 SQ M



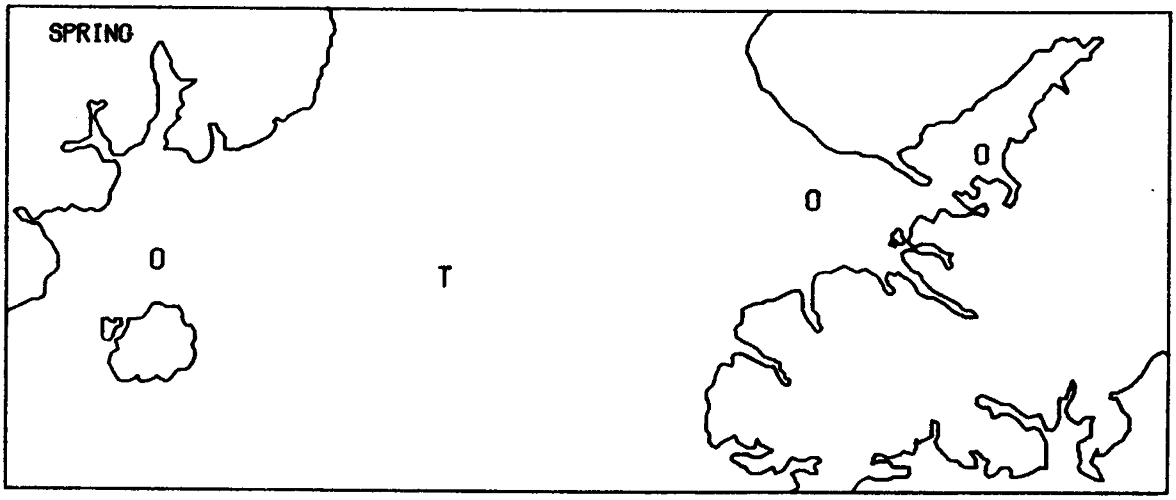
PANDALUS HYPSINOTUS
STAGE VI/10 SQ M

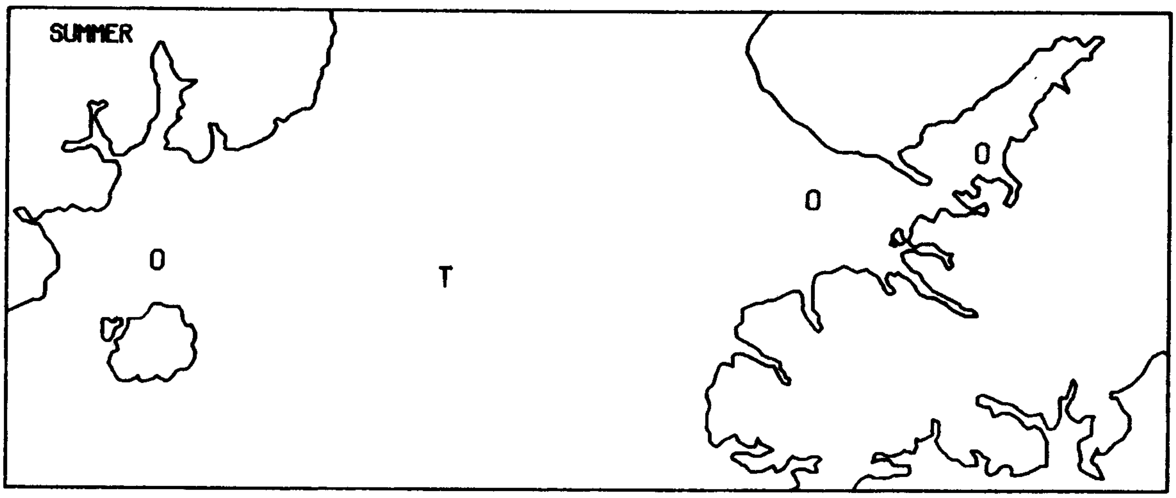


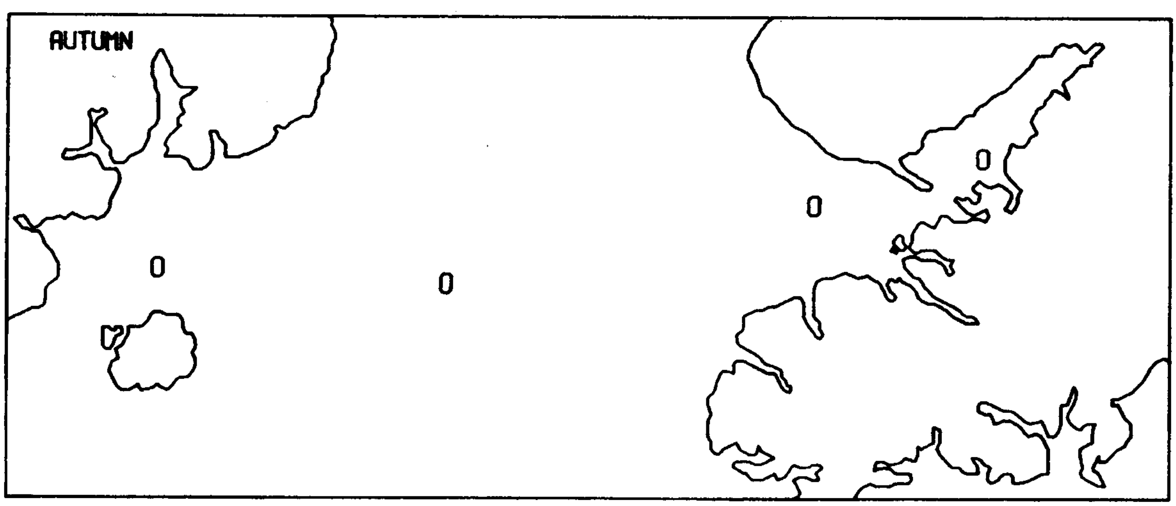
PANDALUS STENOLEPIS
STAGE I/10 SQ M



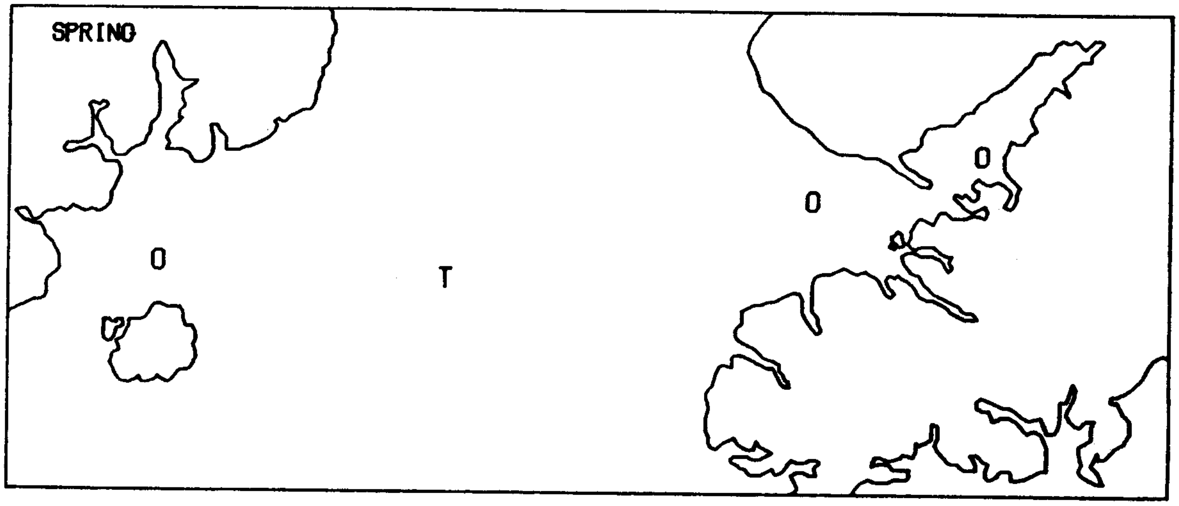
PANDALUS STENOLEPIS
STAGE II/10 SQ M

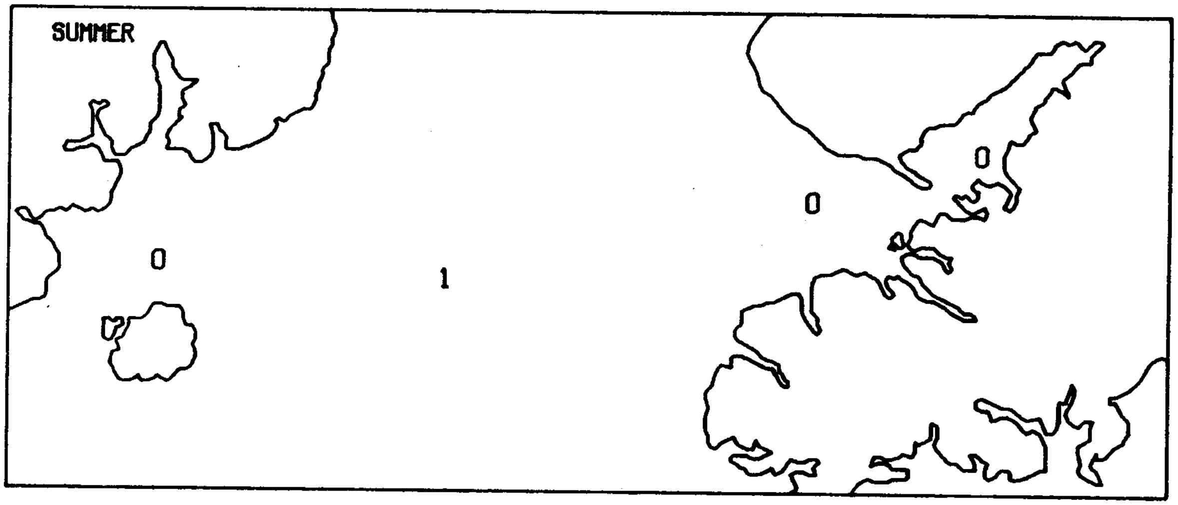


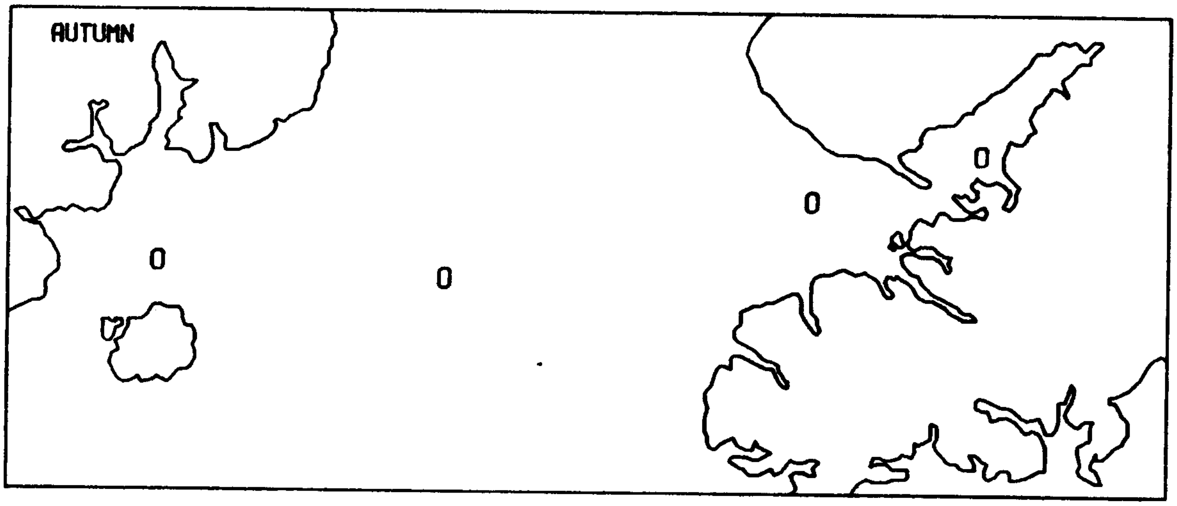




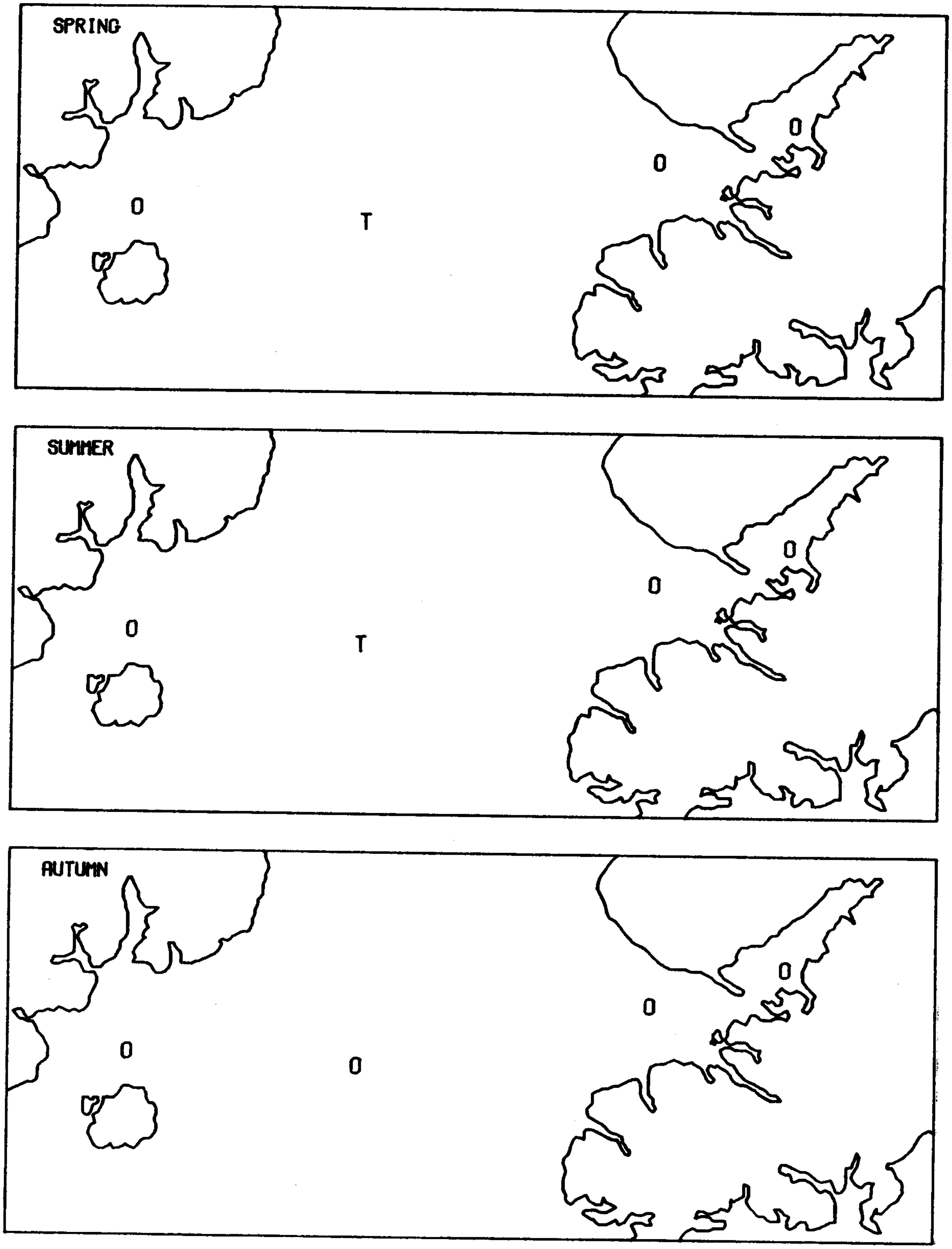
PANDALUS STENOLEPIS
STAGE III/10 SQ M



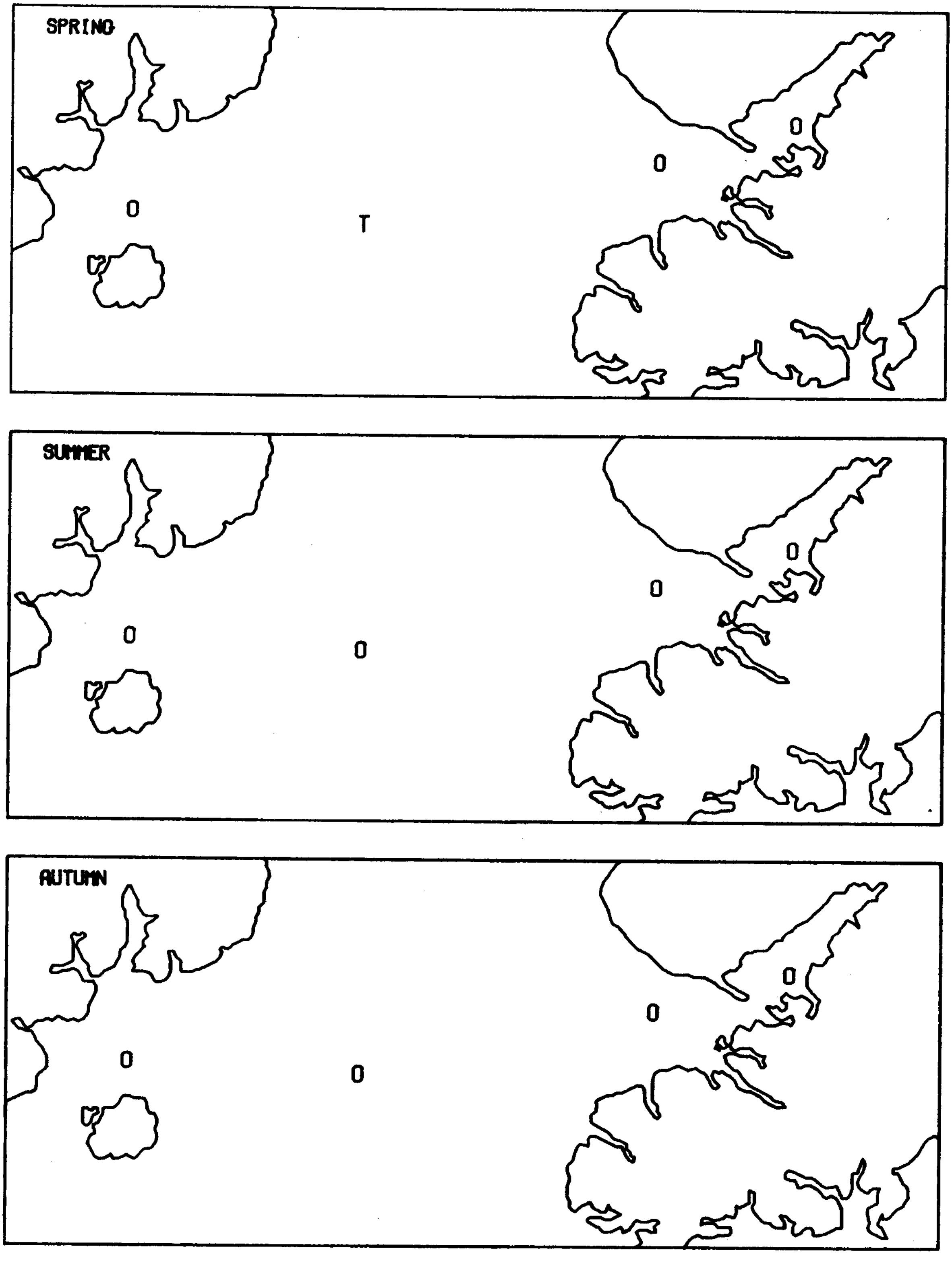




PANDALUS STENOLEPIS
STAGE IV/10 SQ M

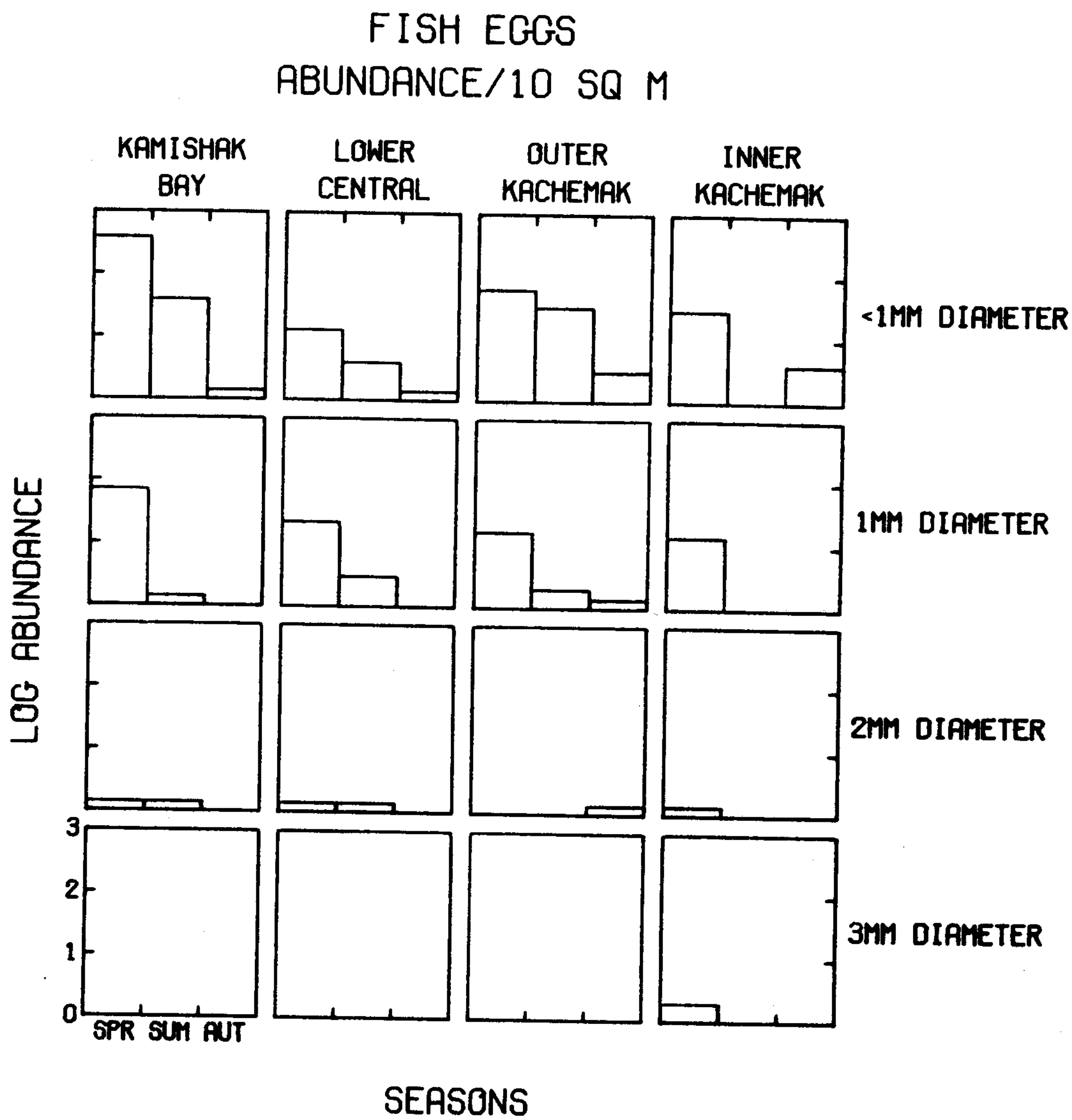


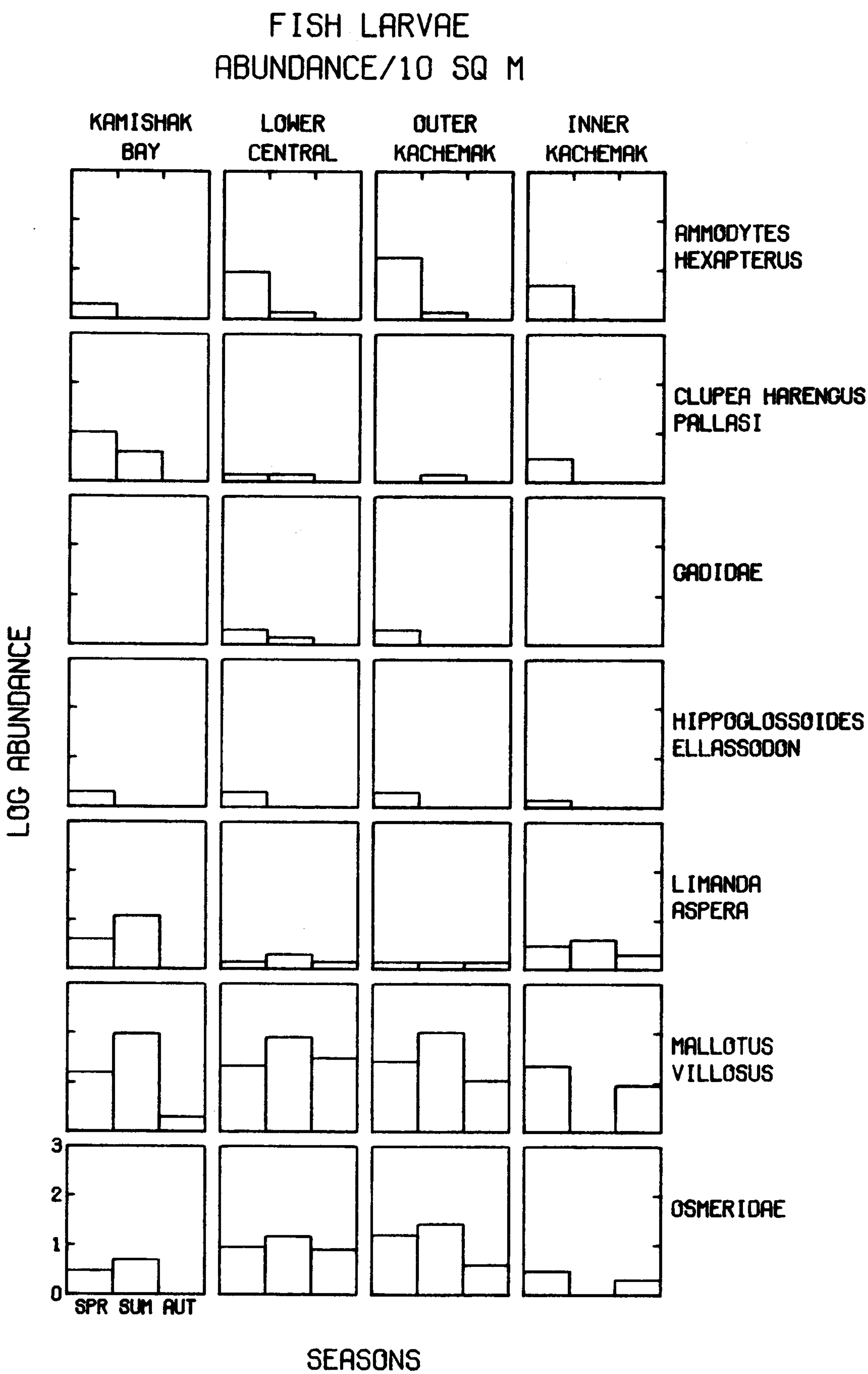
PANDALUS MONTAGUI TRIDENS
STAGE III/10 SQ M

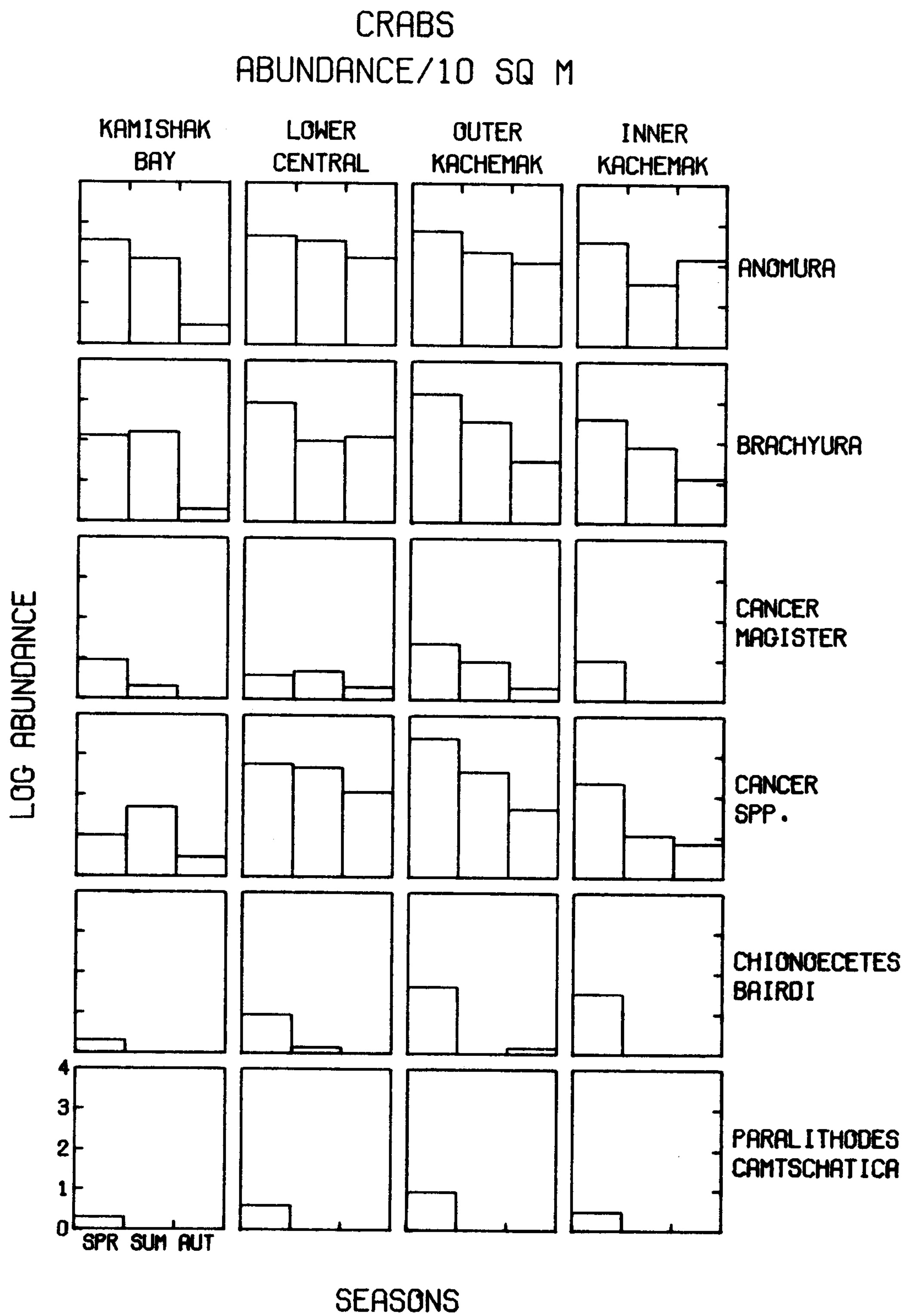


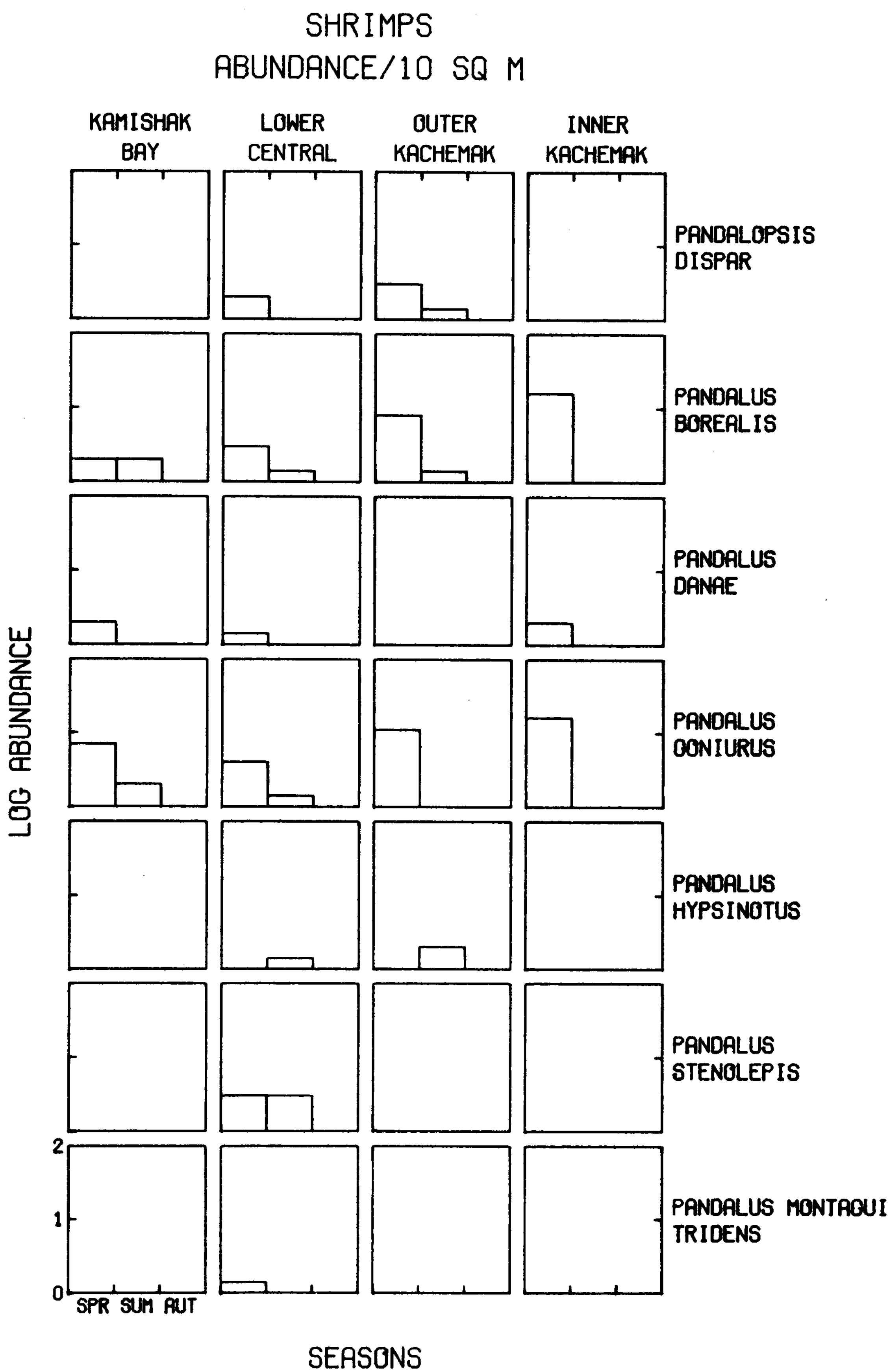
APPENDIX J

Temporal changes over three seasons in species composition and density in four areas, 1978.


FISH EGGS
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
<1MM DIAMETER
1MM DIAMETER
2MM DIAMETER
3MM DIAMETER
LOG ABUNDANCE
3
2
1
0
SPR SUM AUT
SEASONS


FISH LARVAE
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
AMMODYTES HEXAPTERUS
CLUPEA HARENGUS PALLASI
GADIDAE
HIPPOGLOSSOIDES ELLASSODON
LIMANDA ASPERA
MALLOTUS VILLOSUS
OSMERIDAE
LOG ABUNDANCE
3
2
1
0
SPR SUM AUT
SEASONS

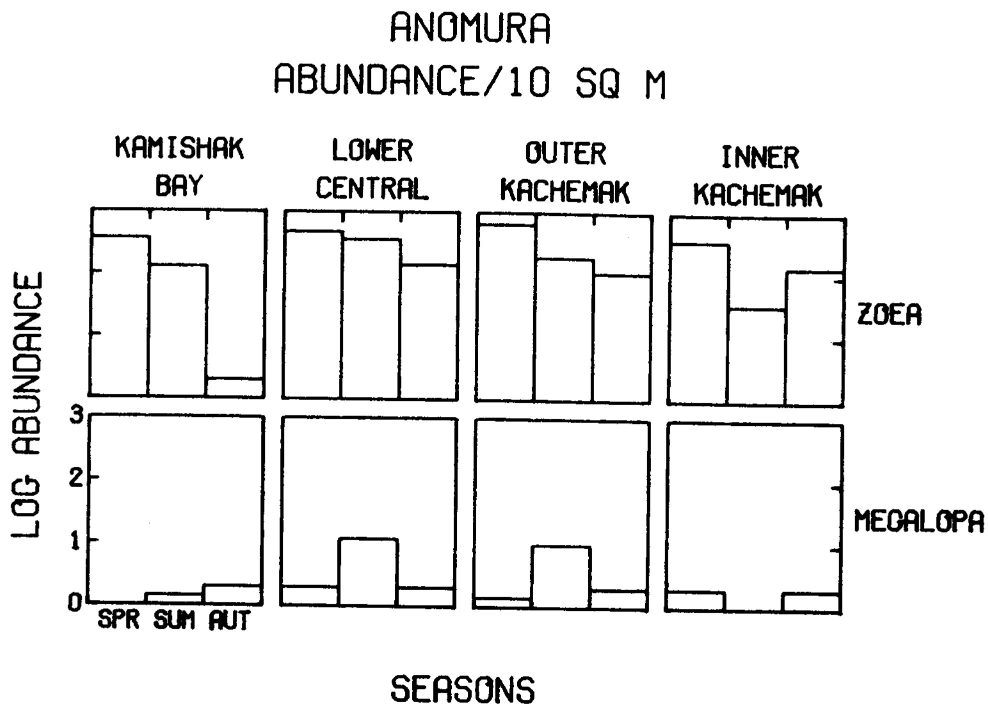

CRABS
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
ANOMURA
BRACHYURA
CANCER MAGISTER
CANCER SPP.
CHIONOECETES BAIRDI
PARALITHODES CAMTSCHATICA
LOG ABUNDANCE
0
1
2
3
4
SPR SUM AUT
SEASONS

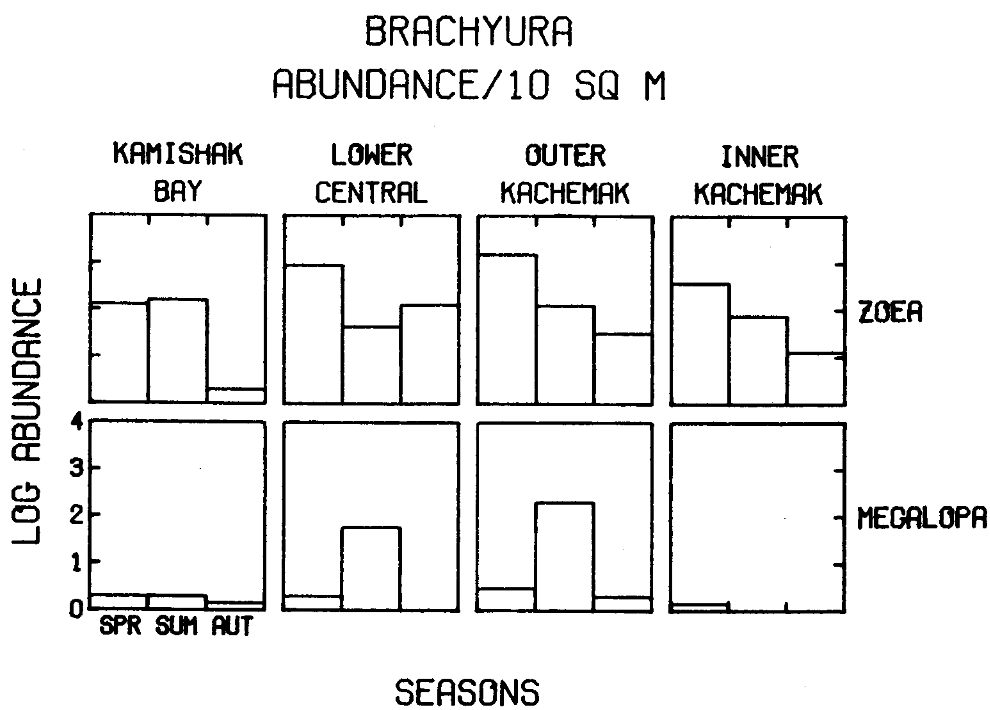


SHRIMPS
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
PANDALOPSIS DISPAR
PANDALUS BOREALIS
PANDALUS DANAE
PANDALUS GONIURUS
PANDALUS HYPSINOTUS
PANDALUS STENOLEPIS
PANDALUS MONTAGUI TRIDENS
LOG ABUNDANCE
2
1
0
SPR SUM AUT
SEASONS

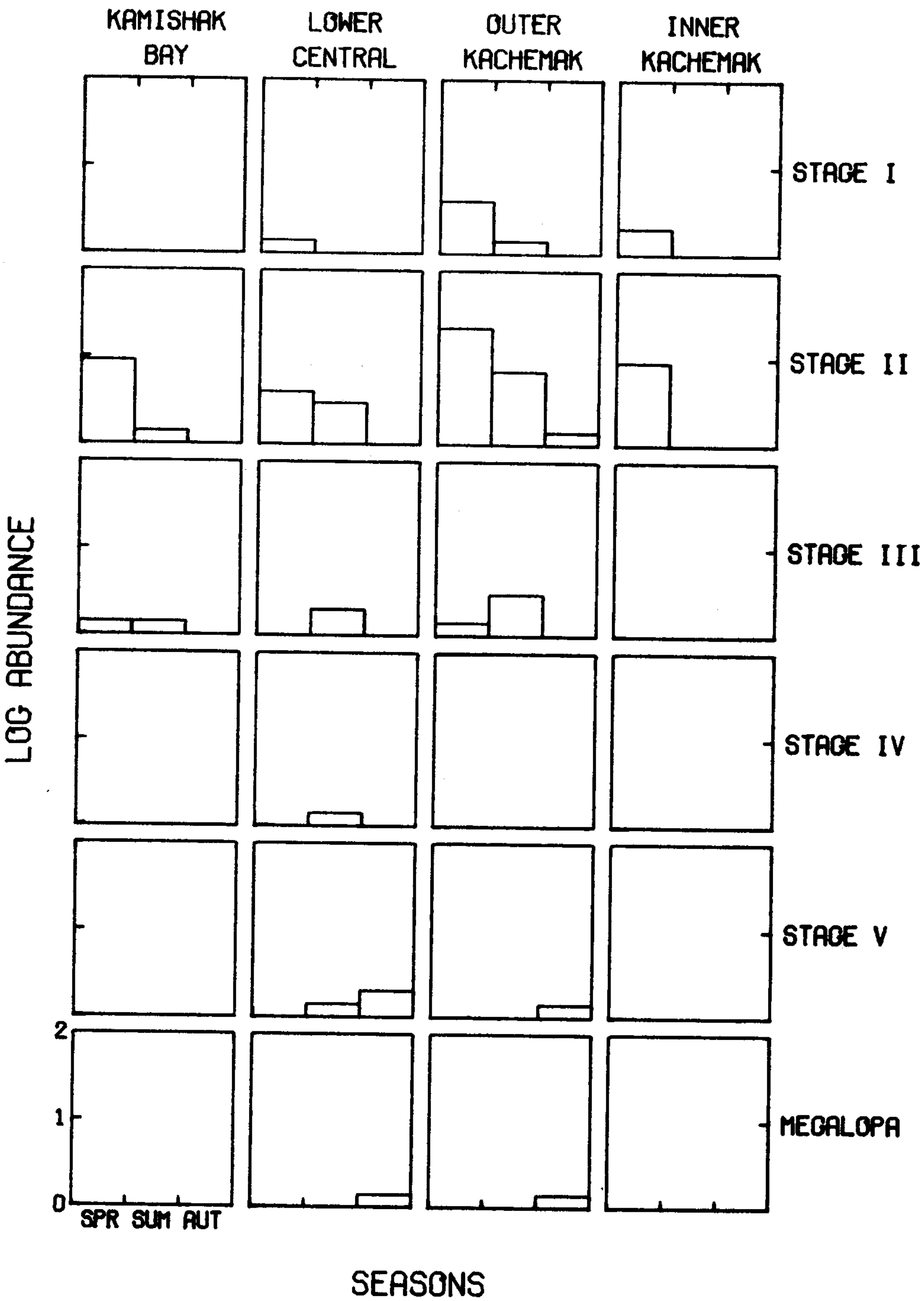
APPENDIX K

Temporal changes over three seasons
of relative abundance of life history stages
in four areas, 1978.

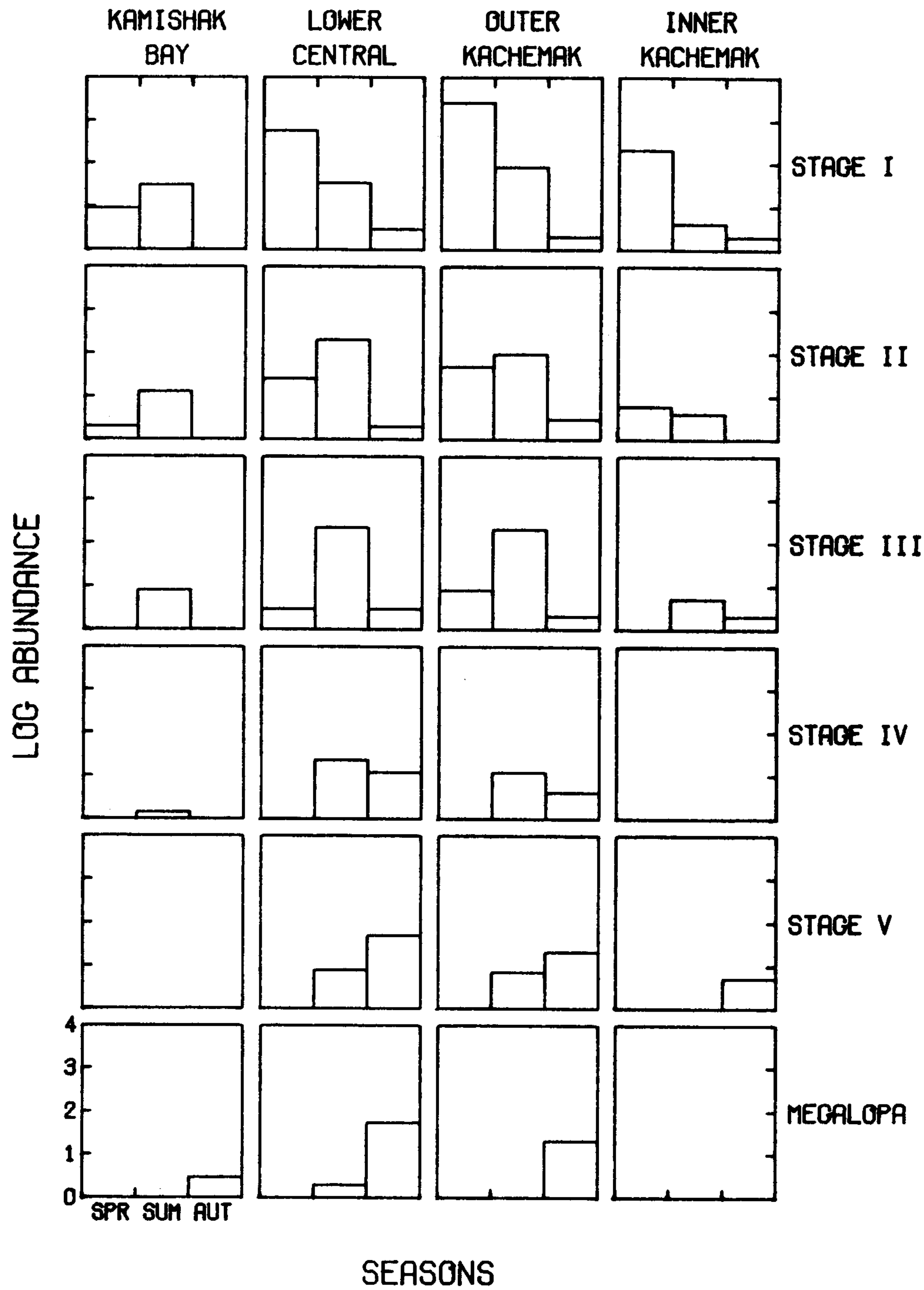

ANOMURA
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
ZOEA
MEGALOPA
LOG ABUNDANCE
3
2
1
0
SPR SUM AUT
SEASONS

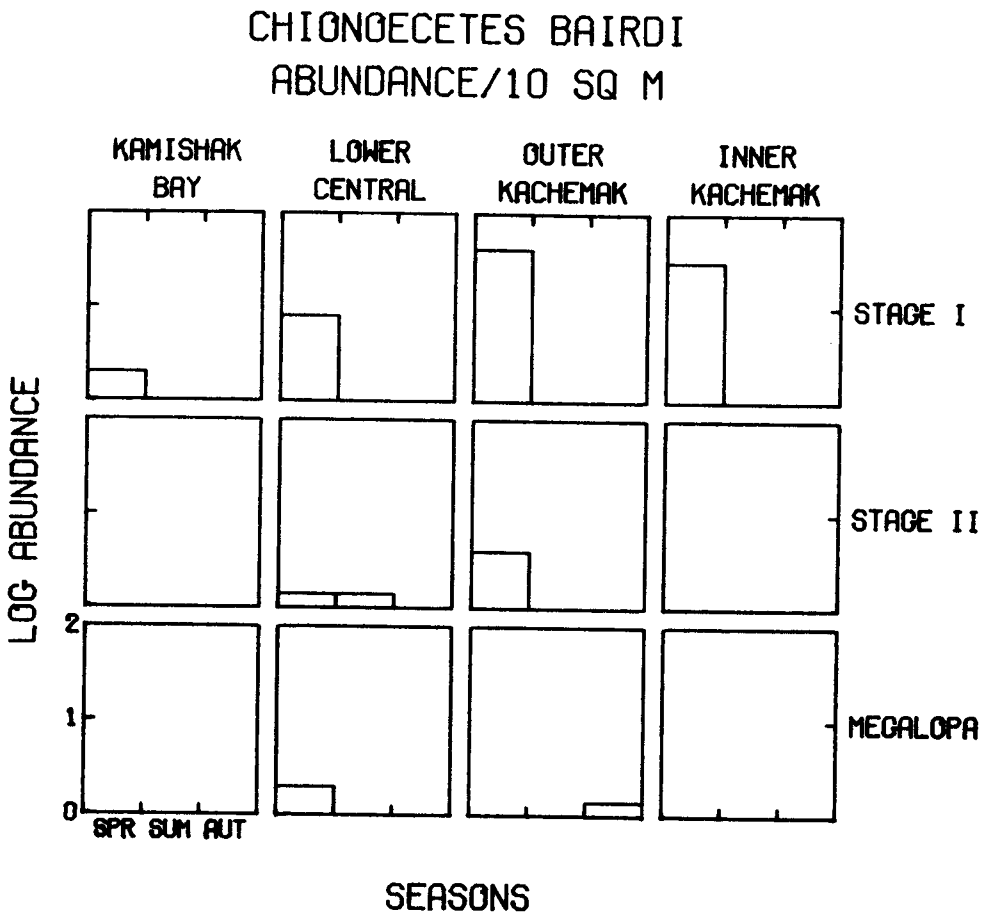

BRACHYURA
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
ZOEA
MEGALOPA
LOG ABUNDANCE
4
3
2
1
0
SPR SUM AUT
SEASONS

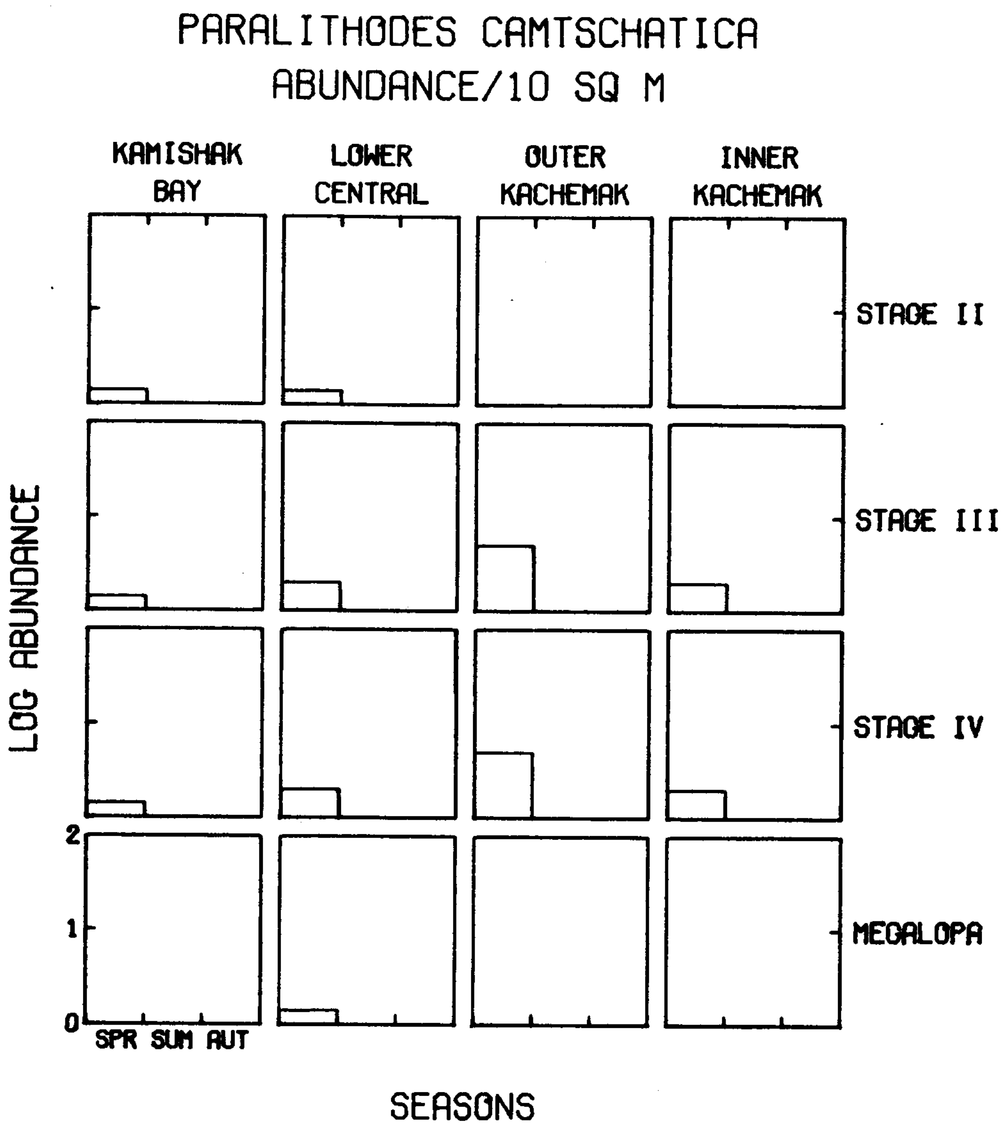
CANCER MAGISTER
ABUNDANCE/10 SQ M

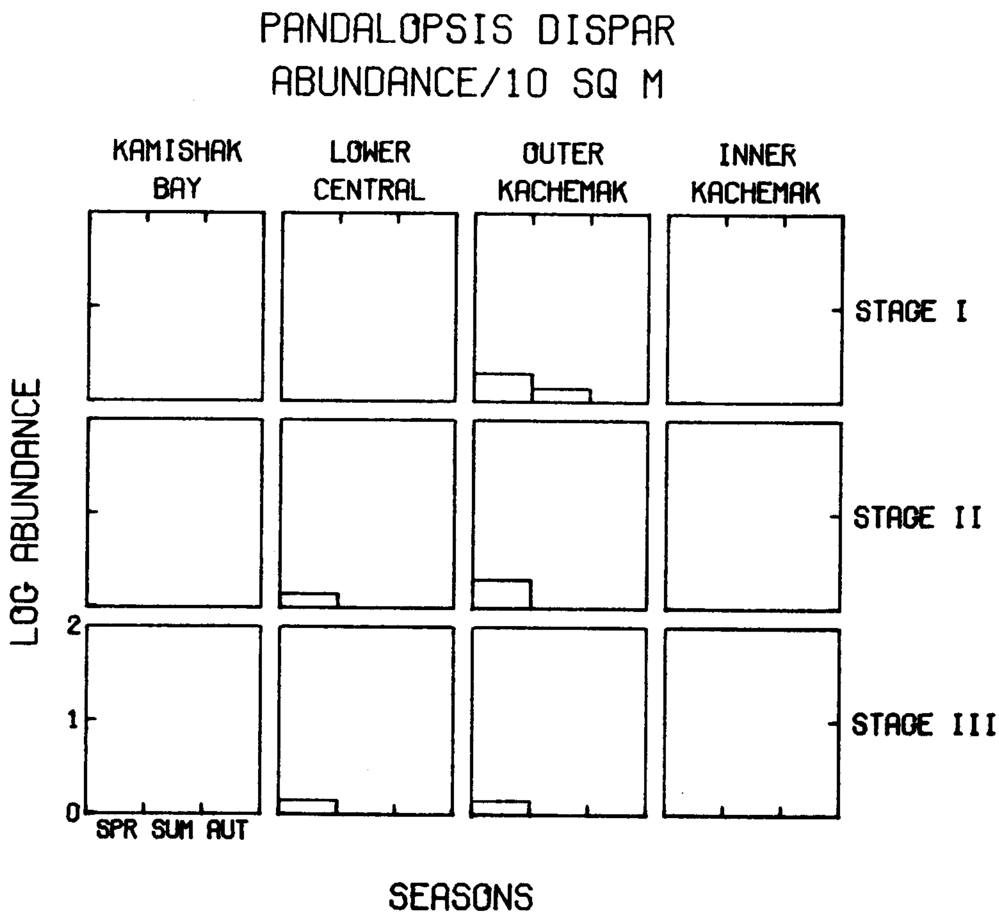


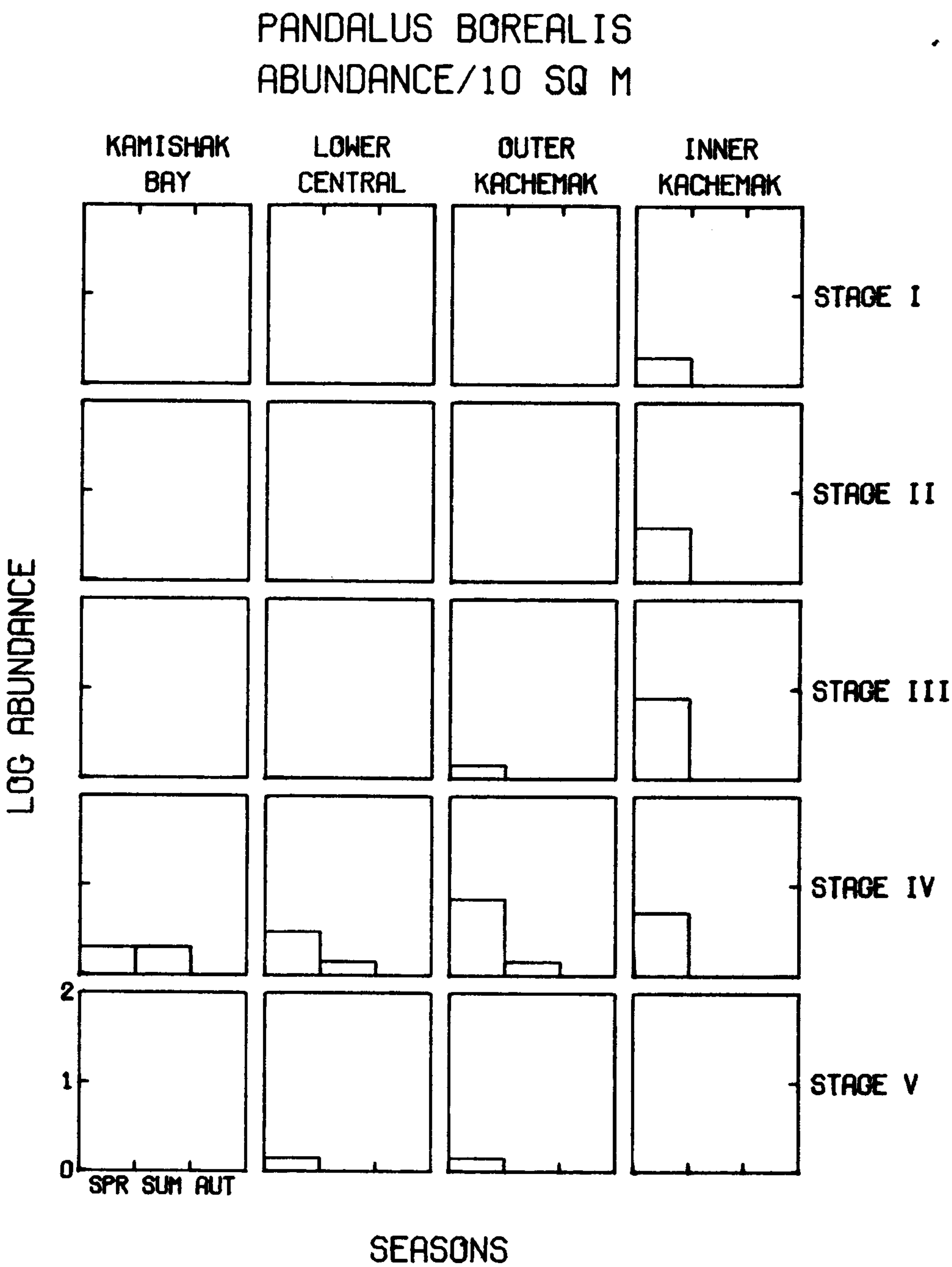
CANCER SPP.
ABUNDANCE/10 SQ M

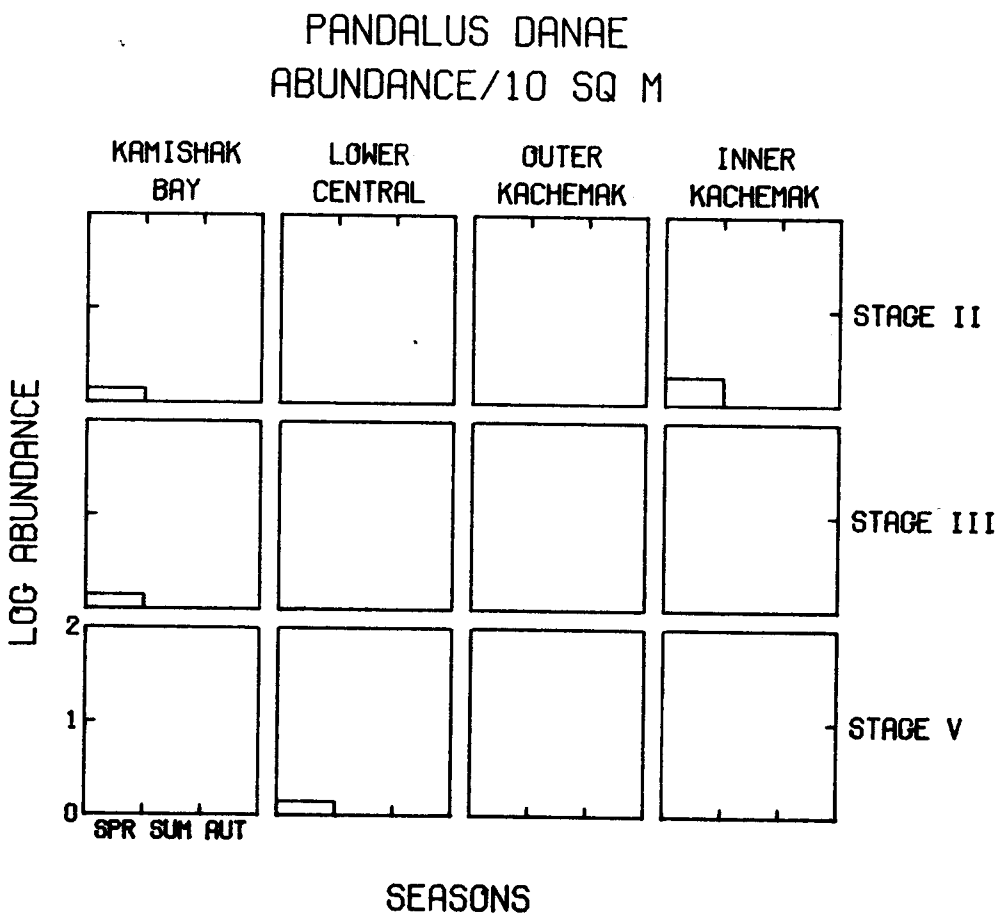



CHIONOECETES BAIRDI
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
STAGE I
STAGE II
MEGALOPA
LOG ABUNDANCE
2
1
0
SPR SUM AUT
SEASONS


PARALITHODES CAMTSCHATICA
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
STAGE II
STAGE III
STAGE IV
MEGALOPA
LOG ABUNDANCE
2
1
0
SPR SUM AUT
SEASONS


PANDALOPSIS DISPAR
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
STAGE I
STAGE II
STAGE III
LOG ABUNDANCE
2
1
0
SPR SUM AUT
SEASONS


PANDALUS BOREALIS
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
INNER KACHEMAK
STAGE I
STAGE II
STAGE III
STAGE IV
STAGE V
LOG ABUNDANCE
2
1
0
SPR SUM AUT
SEASONS


PANDALUS DANAE
ABUNDANCE/10 SQ M
KAMISHAK BAY
LOWER CENTRAL
OUTER KACHEMAK
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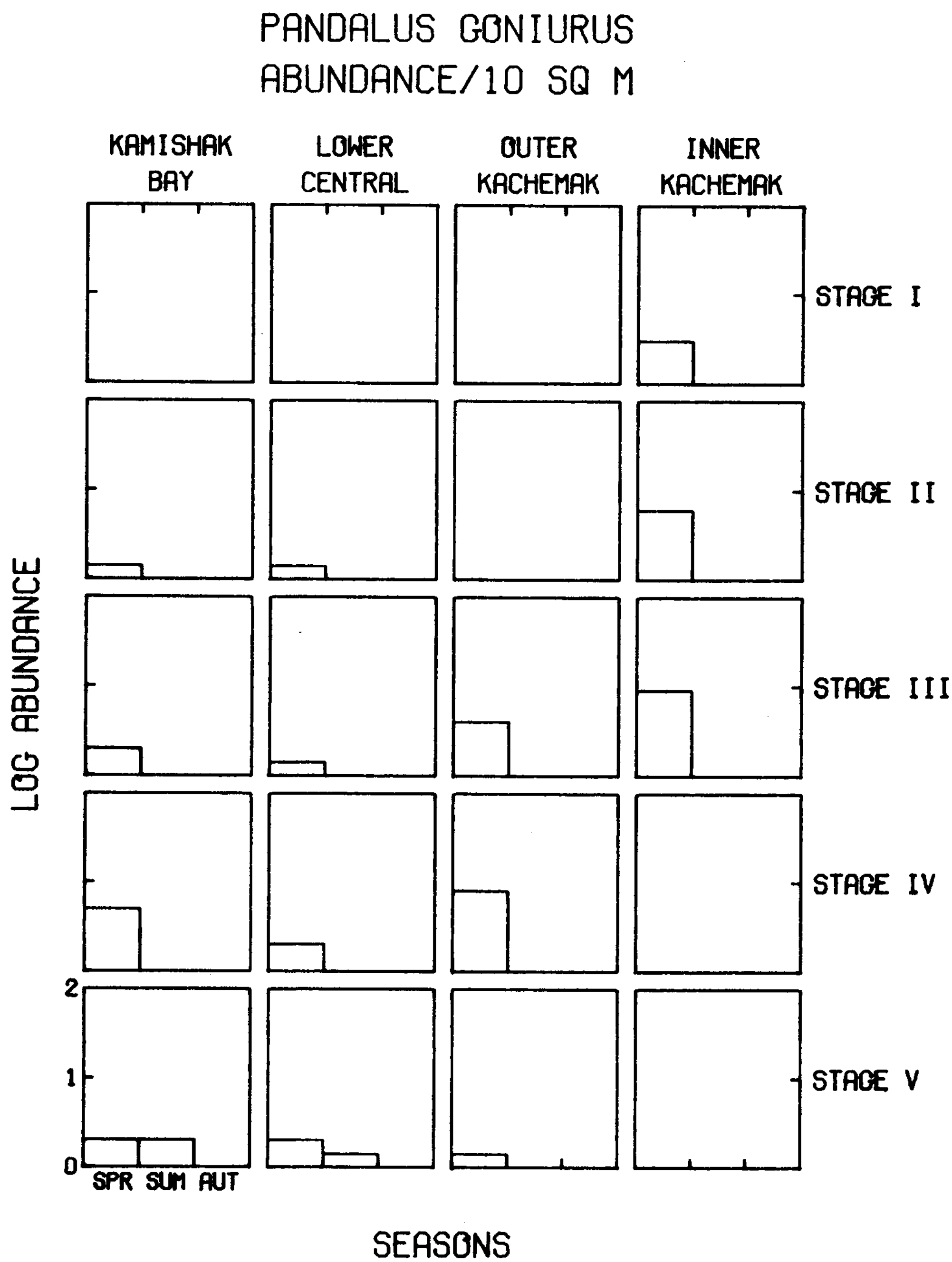
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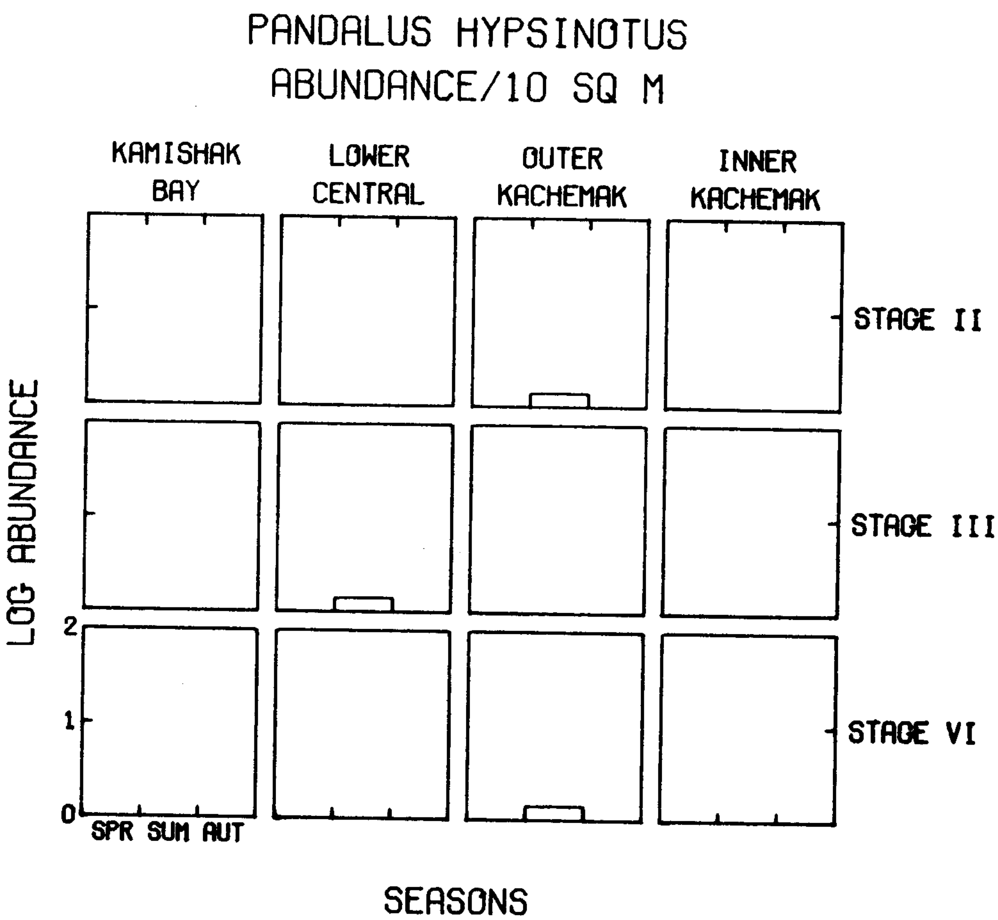
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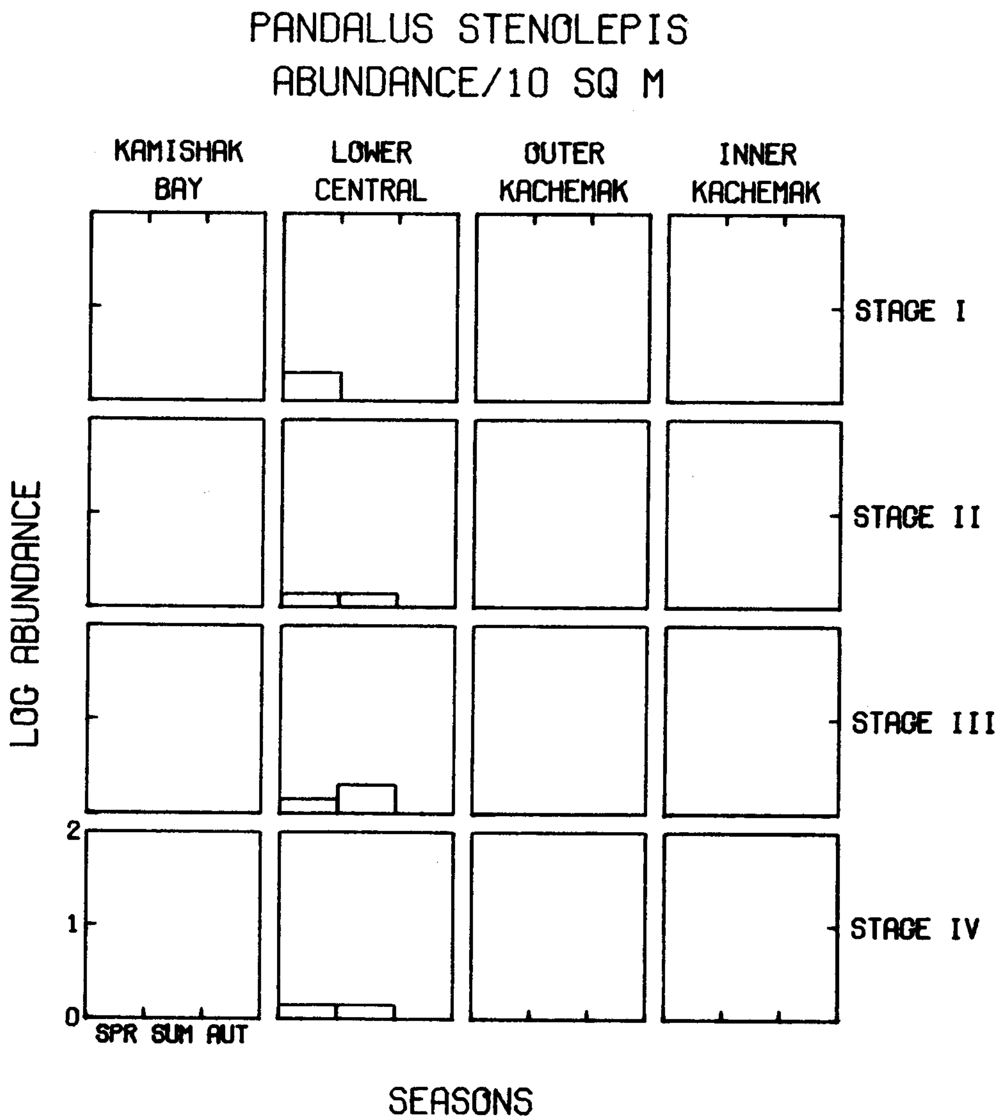
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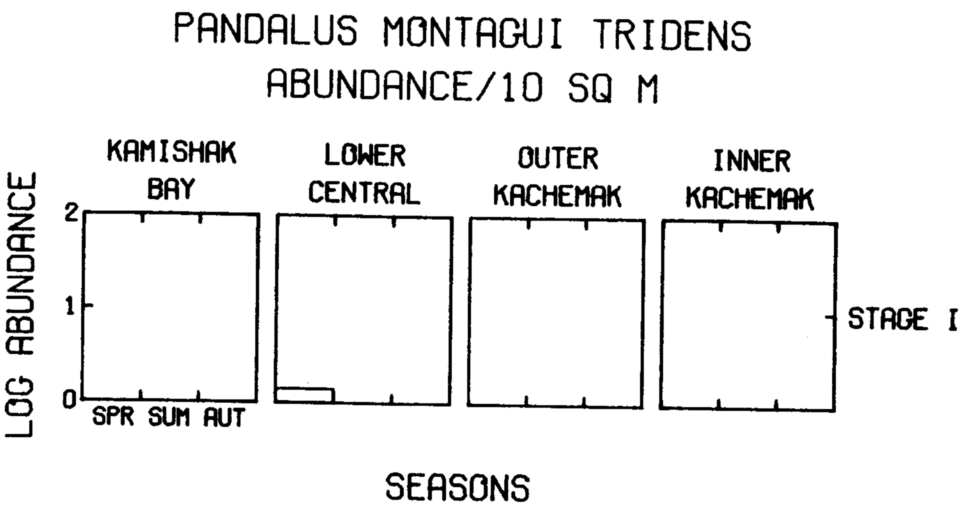
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SEASONAL POPULATION DENSITY DISTRIBUTION OF COPEPODS, EUPHAUSIIDS, AMPHIPODS AND OTHER HOLOPLANKTON ON THE KODIAK SHELF

by

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VTN Oregon, Inc.

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Abstract

Over 800 zooplankton samples collected from four bays and the continental shelf off the Kodiak archipelago, Alaska, U.S. A. were analyzed for holoplankton species composition, distribution and abundance. The results of this analysis were compared to the distribution of marine animals belonging to higher trophic levels in an effort to assess the significance of selected holozooplankters to the pelagic food chain.

One hundred forty-six taxa were identified from these samples. Nine major taxonomic groups comprised over 90% of the taxa and 99% of the individuals found. Copepods were the most abundant group, including 53 of the taxa and 85% of the individuals collected. The predominant copepods were *Pseudocalanus* spp., *Metridia pacifica*, *Acartia longiremis*, *Calanus* spp. and *Oithona* spp. Euphausiids were numerically the second most abundant group and cnidarians had the second largest number of taxa. Common euphausiids included *Euphausia pacifica* and four species of *Thysanoessa*. Larvaceans and chaetognaths were the most abundant non-crustaceans. Other abundant zooplankton were the amphipod, *Parathemisto pacifica*, the cladoceran *Podon leuckarti*, the larvaceans *Oikopleura* spp., the chaetognaths, *Sagitta* spp. and the pteropod, *Limacina helicina*.

Four seasonal distribution patterns were observed. Characterized by period of greatest abundance, they were spring, summer, fall, and non-seasonal. The summer seasonal pattern was the most common. Spatial distribution patterns were weaker than seasonal ones. There were no important within-bay differences and the only obvious between-bay trend was towards increased densities of zooplankton in the southern bays. Offshore, the highest densities occurred in the nearshore area off the southern bays and over Kiliuda Trough. The lowest observed densities were usually over North Albatross Bank. The most distinct offshore zone was the continental slope.

Comparison of the distribution of larger pelagic animals to that of holozooplankton suggested a relationship between copepods, euphausiids and cladocerans with ichthyoplankton, capelin, herring, Atka mackerel, shearwaters, and the humpback and minke whales. Predation by the capelin and Atka mackerel appeared strong enough to cause a decrease in zooplankton densities.

1.0 INTRODUCTION

The oil embargo of 1973-74 brought home graphically to many Americans their dependency upon foreign oil. Out of this realization came the resolve, expressed in Project Independence and similar official pronouncements, to once again obtain energy self-sufficiency. One of the programs initiated as a consequence was an increased rate of exploration for oil and natural gas deposits on the outer continental shelf areas of this country.

In response to this exploration program and the legal mandate of the National Environment Policy Act of 1969, the Outer Continental Shelf Environmental Assessment Program (OCSEAP) was developed. Its purpose is to provide a comprehensive study program for the protection of the marine and coastal environments which might be endangered or damaged during the proposed oil and gas exploration and extraction. The primary objectives of the Alaskan OCS environmental studies have been to provide background information to enable managers to adequately protect the environment and to characterize the ecological systems under potential impact. Much of the effort expended has been oriented towards the identification of key species and determination of their ecological requirements, including habitat needs, trophic status, and critical lifecycle periods.

1.1 Specific Task Orientation

The Kodiak Continental Shelf area is biologically highly productive, supporting commercial fisheries and shellfisheries, the sea otter, small populations of six rare and endangered species of cetaceans, and high densities of marine birds. This region has one of the three largest salmon fisheries in Alaska. It is also potentially an important oil and natural gas area. The lease areas are in zones of high geological hazard with earthquakes, tsunamis, vulcanism and submarine landslides all likely factors. It has been estimated that over the 25 year lifespan of the extraction of oil and natural gas from sale area #46 there will be 1.1 major accidents (BLM, 1980). Natural gas is considered much more likely to be discovered than oil. Its natural volatility is higher than that of crude oil and the region impacted might be much smaller. But microcrustaceans, the predominant taxa of zooplankton, are very sensitive to these hydrocarbons (Mironov 1968, 1970; Nelson-Smith 1972) as are some larval fishes (BLM, 1980; SAI, 1978). As a consequence, the potential for conflict between fossil fuel extraction and commercial fisheries is great.

The potential for conflict between the productive environment and possible fossil fuel extraction has resulted in a number of OSCEAP studies in the Kodiak area. Previous studies have dealt with: the distribution, abundance and catch statistics of the commercially important species of fish, decapod crustaceans and mollusks; distribution and abundance of larval and juvenile stages of commercially important fish; and the distribution of forage fish, pelagic larvae of crab and shrimp, and ichthyoplankton. Similar data analysis on the holoplanktonic crustaceans and other zooplankters is the substance of this report.

1.2 Study Objectives

The purpose of the present study is to provide data on the seasonal distribution and abundance of major zooplankton species/taxa that are principal food items for fish and bird species of commercial, ecological or aesthetic significance.

Specific task objectives for this study are to:

a. Determine the taxonomic composition and seasonal abundance of pelagic copepods, copepodite stages, and other holoplankters, such as euphausiids and amphipods, which are important as food for fish, birds and mammals;

b. Describe the numerical abundance and frequency of occurrence of selected plankton taxa considered important as food sources to the commerically harvested fish species and the numerically dominant bird and mammal species; and

c. Provide input toward synthesis of data on the trophic structure and food relations in the nearshore areas of the Kodiak Shelf.

These objectives were met utilizing two general methods of approach. The major method was the direct identification and enumeration of holoplankton samples. The second method was through comparison of the stomach contents analysis with the results of these direct counts. The latter approach was especially important in identifying the key zooplankton taxa. The bulk of this report is devoted to a discussion of the zooplankton samples.

1.3 Description of Study Area

1.3.1 Geomorphology (Bathymetry and Geography)

The Kodiak Archipelago is located on the northwestern edge of the Gulf of Alaska, south of Cook Inlet and the Kenai Peninsula. The largest islands in the archipelago are Kodiak (9,293 km^2) and Afognak (1,813 km^2). The topography of the area, both above and below sea level, is extremely rugged and its composition varied. Numerous deep-mouthed bays and rocky headlands characterize the highly irregular coastline of the islands. There are mountains over 1,200 m arising adjacent to bays with depths of over 150 m. Offshore, the mid-shelf region is composed of a series of troughs and banks varying 200 m or more in depth between nearby locations. Substrates vary from hard rock to soft mud and include unconsolidated sands and gravels throughout the area, both on land and under water. The region has considerable seismic activity and changes in topography are not uncommon. The climate is cold maritime with cloudy skies, moderately heavy precipitation (140 cm/year) and mild temperatures for the latitude (56 to 59°N). Air temperatures average 15°C in the summer and -5° in the winter (AEIDC 1974). Terrestrial vegetation grades from heavy coniferous forest in the northeast to moist tundra in the extreme southwest (Viereck and Little 1972). Sitka spruce is predominant around Izhut Bay on Afognak, while Sitka alder, willow and tundra plants, e.g., sedges and other annuals, are the main vegetation surrounding Chiniak, Kiugnak and Kiliuda Bays on Kodiak.

The offshore study area extended seaward from the east side of the archipelago to the 2,000 m depth contour and included a small area southwest of Kodiak Island and northwest of the Trinity Islands in Shelikof Strait (Figure 1.3-1). The main portion was divided into three regions: 1) nearshore, extending outward from land approximately five km and having stations with depths usually less than 100 m; 2) mid-shelf, a 65 to 90 km wide band of troughs and banks (four each in the study area); and 3) the continental slope, a zone beyond the mid-shelf gradually increasing in depth from 200 to 2,000 m. Nearshore stations frequently overlapped or were located nearby the outer bay stations. Bank stations were similar in depth to the nearshore while trough station depths varied between 110 and 250 m. The troughs and banks of the mid-shelf were hydrographically different and were separated in the analyses of Dunn et al. (1979) and Kendall et al. (1980), producing the five distinct offshore hydrographic regions considered in this study (nearshore, mid-shelf banks, mid-shelf troughs, continental slope and the Shelikof Strait area). The total offshore area studied was 68,000 km^2.

The onshore program examined three bays on Kodiak Island and one on Afognak Island (Figures 1.3-1 and 1.3-2). Chiniak Bay is a large, open bay on the northeast corner of Kodiak Island. The sampling stations began in Kalsin Bay, an 11 km long arm of Chiniak Bay, and swept out in a clock-wise fashion south of a number of islands into the main bay and then the open ocean. This sampling pattern was different from the other three bays where sampling stations were placed in the mid-channel, in side bays and off headlands. The depths observed for the Chiniak stations averaged 39 m for C 1 and between 130 and 165 m for the others. Kiliuda Bay was the longest sampled (24 km) and had a sill present off Coxcomb Point, indicating its glacial origin. Station depths averaged 70 m deep and varied between 32 and 131 m. Kaiugnak Bay, the furthest south, was 15 km long and characterized by an irregular bathymetry and shoreline. Station depths varied between 41 and 137 m. Both Kiliuda and Kaiugnak Bays had several side arms and lagoons. Izhut Bay was also highly irregular in its morphology. The inner portion of Izhut Bay had at least seven distinct side bays, lagoons or coves. It was 15 km long, averaged 135 m deep (mean station depths were 31 to 164 m) and exceeded 200 m in depth at the entrance. The inner stations in Kiliuda Bay were probably the most protected ones while the inner Izhut Bay stations, except Z8 in Kitoi Bay, were the least sheltered from the Gulf's storms.

1.3.2 Current Knowledge of Hydrography

The Alaska Current flows southwest along the continental slope off Kodiak at rates of up to 100 cm/s (Dunn et al. 1979). It is believed to extend to the bottom of the slope, though slowing with increasing depth. A smaller branch flows west through Kennedy Entrance, then southwest through Shelikof Strait at 30-40 cm/s (SAI 1980). The main portion of the Alaska Current is overlaid with a band of low salinity water, the Copper River plume.

There is a net southwest flow over the mid-shelf region of 2-3 cm/s, though surface eddying and turbulence with speeds to 30 cm/s has more impact on the area. A small surface inshore drift of 1-3 cm/s occurs in Kiliuda Trough, through the speed and duration are quite variable (SAI 1980). An inwardly-directed bottom current of 3-10 cm/s is also present there and similar bottom currents have been hypothesized for Chiniak and Stevenson Troughs (SAI 1980).

Vertical mixing of offshore waters is due to tides, winds and thermal convection. Tides over the Kodiak Shelf are mixed, semi-diurnals with a mean range of 2 m at Kodiak. The variability in range extends from 0.4 to 4.2 m. The winds in the lease area average 5 to 6.5 m/s in the summer and 9.5 to 10.5 during the winter. Wind direction is predominantly from the southwest May through September and from the north and west-northwest otherwise. There is weak upwelling June to August and very strong downwelling throughout the remainder of the year (SAI 1980). The upwelling index varies between +10 in July and August to -120 in January (Ingraham et al. 1976). Complete vertical mixing over the banks is observed, while the water column in the troughs is stratified throughout the year below 150 m (Dunn et al. 1979; SAI 1980). Four vertical layers (surface, thermocline, temperature-minimum and temperature-maximum) were observed during periods of stratification by Dunn et al. (1979).

The distribution of surface salinity indicates high runoff diluting coastal waters to as low as 29^{o}/oo off the Kenai Peninsula. The Copper River plume also produces low surface salinities along the slope while the mid-shelf region has typical values of 32.3^{o}/oo. Oceanic surface salinities beyond the plume are in excess of 32.6^{o}/oo (Dunn et al. 1979; SAI 1980). Bottom salinities decrease from 33.8^{o}/oo on the slope to 32.5^{o}/oo nearshore. This decrease is depth related as the troughs maintain bottom salinities greater than 32.6^{o}/oo while the adjacent banks have values between 32.3 and 32.4^{o}/oo. The complete and frequent mixing over the banks contributes to the lower bottom salinities observed.

Offshore surface temperatures are a function of seasonality and no consistent horizontal pattern is apparent. The recorded range is 4.5° to 14°C. Inshore surface water temperatures in the winter of 1°C and ice formation in the more protected inlets are common. Summer surface temperatures can exceed 14°C at the heads of some inlets, though maxima of 10° to 12°C are more common (Rogers et al. unpublished NODC data). Bottom temperatures below 2°C are found in the nearshore on the east side of the Kodiak Archipelago. The bottom water warms to over 5°C in the outer parts of the troughs and along the 200 m contour of the slope (SAI 1980). The temperature at the 2,000 m contour is 3°C. The low bottom temperatures of the nearshore are anomalous as these values are not reached in the bays and fjords off Shelikof Strait or Kennedy Entrance.

Light hydrocarbons, principally methane, vary seasonally between 150 and 2,000 nl/l (Cline et al. 1978). Surface concentrations of methane south of Chiniak Trough are 200 to 300 nl/l. Bottom concentrations have a similar distributions, though with higher values (Cline et al. 1978). Portlock Bank, the northern most one, has the lowest values. Ethane and propane are similarly distributed while ethene and propene concentrations have a different distribution. Cline et al. (1978) hypothesize that ethene concentrations may be controlled by primary productivity or by the same processes controlling primary production.

Heavy metals (cadmium, copper, lead, mercury, nickel, silver and zinc) measured in the water column over the Kodiak Shelf were evenly distributed and lower than oceanic means (SAI 1980).

1.4 Current Knowledge of Kodiak Plankton Ecology

This literature review of plankton ecology from the Kodiak Shelf area covers the distribution and abundance of zooplankton in the region and what has been learned concerning the lower trophic level dynamics of the pelagic community in that part of the Pacific.

1.4.1 Review of Zooplankton Distribution and Abundance Near Kodiak Island

No zooplankton measurements were made in the continental shelf area directly east of the Kodiak Island prior to the OCSEAP investigations with the exception of a pair of biomass estimates from the Central and South Albatross Banks (AEIDC 1974). The nearest location sampled for zooplankton species enumeration was east of Kennedy Passage in the Gulf of Alaska (northeast of Kodiak, Damkaer 1977). Thus, information about the distribution, abundance and trophic interactions of the zooplankton of the Kodiak Continental Shelf has been largely gained by inference from nearby or similar areas. The three relevant regions studied were Cook Inlet, Prince William Sound and the northeast Gulf of Alaska (AEIDC 1974; Cooney 1975, 1976; Cooney et al., 1973, 1978; Damkaer 1976, 1977). Less important data sources included studies of the east Bering Sea (Motoda and Minoda 1974), around Amchitka Island in the Aleutians (McAlister and Favorite 1977), the central gyre of the Gulf of Alaska (Gulland, 1972; Johnson and Brinton 1963; LeBrasseur, 1965; Marlowe and Miller 1975; NORPAC Committee, 1960), and northern southeast Alaskan waters (Wing and Reid, 1972).

Mean settled volumes of zooplankton from Cook Inlet collected in 1976 varied between one and 31 ml m^{-3} (Damkaer 1977). Values from the open waters of the Inlet and outside in the Gulf of Alaska peaked at 11 ml m^{-3} during the summer. In Prince William Sound, Damkaer (1976) found that settled volume varied between 0.1 and 7.4 ml m^{-3} depending upon season and time of day. NORPAC (1960) biomass values for zooplankton collected northeast of Kodiak Island were about 2.0 ml m^{-3} while north of Afognak Island this value increased to 0.4 ml m^{-3}. It should be noted that these values are based upon very few samples. The biomass estimate from South Albatross Bank (Hokkaido University data cited in AEIDC, 1974) was over 500 mg wet weight m^{-3} while the estimate from the Central Bank was considerably less. Biomass tended to decrease offshore.

Species composition of the zooplankton east of Kodiak island is presumed to represent populations intermediate to those of the northeast Gulf of Alaska (from which most of the population seedstocks originate) and those of the open waters of lower Cook Inlet (which is adjacent to the study area and has a similar population source and proximity to land). In Kachemak Bay, Cook Inlet (Damkaer 1977), Prince William Sound (Cooney et al. 1978) and the neritic areas of the northeast Gulf of Alaska (Cooney 1975; Damkaer 1976), the predominant zooplankters are the copepods Pseudocalanus spp., Acartia longiremis, Oithona spp., larvaceans, cladocerans and the larval stages of various crustaceans. This pattern has also been noted in southeastern Alaska (Bailey et al. 1975; Wing and Reid 1972). The four bays under consideration on Kodiak and Afognak Islands probably are similarly characterized.

Offshore more species of zooplankton were found in both areas. However, this may be partly due to the greater opportunity for vertical segregation as noted by Motoda and Minoda (1974). The composition in the northeast Gulf of Alaska seems to favor the larger calanoid copepods, euphausiids, amphipods, and chaetognaths rather than the small (less than 3 mm long) copepods. In the central gyre (Gulland 1972; LeBrasseur 1965;), and off Amchitka (McAlister and Favorite 1977) the predominant forms were the larger calanoid copepods (70-85%). Besides the copepods, only chaetognaths, amphipods, cnidarians, larvaceans, and euphausiids composed over one percent of the total volume. A similar species composition was expected in the offshore regions east of Kodiak and Afognak Islands.

The Northwest and Alaska Fisheries Center of the National Marine Fisheries Service (NWAFC) has been investigating waters over the Kodiak Shelf for fisheries stock assessment and recruitment since 1945. Several taxonomic and ecological papers concerned with copepods (Heron and Damkaer 1969; Threlkeld 1973a, b) resulted from these studies.

Reports of the number of species found in the area vary greatly. Damkaer (1977) reported only 35 zooplankton species from Cook Inlet. This is probably a sampling artifact due to mesh size of the nets used, since University of Alaska, Institute of Marine Sciences studies have shown at least 65 taxa of zooplankters to be present there (Hood, et al. 1968; Rosenberg, et al. 1969). Cooney (1976) collected nearly 200 species of zooplankton from the northeastern Gulf of Alaska using 333 um mesh size nets. A similar number of species is anticipated from the Kodiak continental shelf samples.

Two OCSEAP-supported studies (Dunn et al. 1979; Kendall et al. 1980; Rogers et al. 1979a,b), analyzing the larval stocks of commercial fisheries off Kodiak, also provided a general overview of the samples being examined in this study.

Offshore, eight groups of zooplankton comprised 99.9% of all holozooplankton collected (Kendall et al. 1980). These were copepods (84.4%; seasonal range = 79.2-90.1% by numbers) euphausiids (5.5%; 2.6-10.2%), chaetognaths (2.8%), larvaceans (2.3%), cnidarians, ostracods, pteropods, and amphipods. Isopods, cladocerans, mysids and cumaceans were also collected on occasion. Broad patterns of seasonal and regional abundances for these groups were briefly discussed.

Euphausiids were an exception to the brief data analysis accorded to the other holozooplankton. Identification to species, length-weight frequencies, and horizontal, diel vertical, and seasonal distribution patterns of adults and developmental stages were analyzed for these important crustaceans. Eight species were found; *Thysanoessa inermis*, *T. longipes*, *T. spinifera*, *T. raschii*, *T. inspinata*, *Euphausia pacfica*, *Tessarabrachion oculatus*, and *Stylocheiron* sp. (*maximum*?). *Thysanoessa* spp. and *Euphausia pacifica* represented 99.3% of all euphausiids collected offshore. *T. inermis* was the dominant species. All, except *Stylocheiron* sp., are subarctic or arctic-boreal species (Brinton 1962). *T. inermis*, *T. raschii* and *T. spinifera* predominated in the nearshore region, becoming common farther offshore in the fall and having their highest densities over the entire study area during the late winter. T. longipes, T. inspinata and E. pacifica were primarily found in the slope with a similar seasonal pattern. The distribution over the study area of both T. longipes and E. pacifica was closely related to the apparent distribution on the shelf of deep (>200 m) oceanic waters with temperatures $\leq$5.0°C and salinities $\geq$32.6^{o}/oo. The remaining two species, T. oculatus and Stylocheiron sp., were found infrequently year-round along the slope. The latter species was apparently brought into the area by the Alaska Current. Diel vertical migration was observed for adult T. inermis and T. spinifera while larval stages remained on the upper 50 m throughout the day.

Euphausiid length-weight frequencies were presented in Table 10 and Figures 48 through 50 in Kendall et al. (1980). The five most abundant species, T. inermis, T. longipes, E. pacifica, T. spinifera and T. raschii, were measured. The data supported Ponomareva's (1963) contention that boreal euphausiids have a biennial life cycle. The large reproductive individuals were 25-27 mm long for T. inermis, 25-29 mm for T. longipes, 21-25 mm for E. pacifica, 25-31 mm for T. spinifera and 19-20 mm long for T. raschii. Mean lengths were between 16.1 and 16.8 mm for all species except T. raschii which averaged 14.0 mm. Mean weights varied more; T. inermis, T. raschii and E. pacifica averaged between 14 and 18 mg, while T. longipes and T. spinifera were 26 and 23 mg, respectively. Mean values were strongly biased toward non-sexually reproductive individuals because members of the first year class far outnumbered the second year group for all species measured.

The analysis of inshore Kodiak invertebrate holozooplankton reported by Roger, et al. (1979a,b) was even shorter than that provided by Kendall et al. (1980) and Dunn et al. (1979). Copepods, euphausiids and the larval stages of barnacles and decapods predominated in all bays sampled. Larvaceans, gastropods and cladocerans were also common on occasion.

Copepods averaged 87% by number of the total holozooplankton in Izhut and Kiliuda Bays. The predominant species found by Rogers et al. (1979a,b) at station 2 in these two bays from R/V Commando cruises 78-1, 3, 5, 7 and 9 were Pseudocalanus spp. (77.6% of the total numbers of copepods), Acartia longiremis (10.7%), Calanus marshallae (4.3%), Acartia tumida (2.0%), Metridia pacifica (1.5%), and Centropages abdominalis (1.3%). Other common species included Calanus plumchrus, C. cristatus, Oithona spp., Microcalanus sp., Eucalanus bungii, Epilabidocera longipedata and Monstrilla spp.

Rogers et al. (1979a,b) examined euphausiids from eight stations in the four bays (stations 1 and 3 in each bay). The same set of species as found by Dunn et al. (1979) and Kendall et al. (1980) offshore, except for Stylocheiron sp., was found in the four bays. The dominant species were T. inermis (50%), and T. raschii (46.5%). T. spinifera and E. pacifica comprised an additional 3.2%. Mean adult euphausiid densities in Izhut Bay were significantly higher (95% level of confidence) than in the other three bays. Densities of larval stages were lowest in Izhut. The average density of T. raschii decreased southward from Izhut to Kaiugnak Bays, going from 284 to 41 per 1000 m^3. No other horizontal patterns were noted. T. raschii was collected in greater numbers during the spring and summer than in fall and winter; no other seasonal patterns were found. Diel vertical patterns for the four common euphausiids were similar to those found offshore by Dunn et al. (1979) and Kendall et al. (1980).

1.4.2 Plankton Trophic Dynamics of South Central Alaska and the Kodiak Shelf Area

While studies of the trophic dynamics of marine zooplankton are in their early stages, a wide array of marine animals have been found which feed upon various components of this assemblage. A partial list of planktivores by food organism is present in Table 1.4-1 (Sources:

Raymont 1963; Russell-Hunter 1970; SAI 1979 a,b). The principal planktivores in the northeast Pacific are juvenile salmonids, pollock and Pacific Ocean perch; adult capelin, herring, Pacific sand lance and smelt; shearwaters; and baleen whales. The major food organisms are copepods; euphausiids; fish, barnacle and decapod larvae; amphipods; larvaceans; cladocerans and mysids.

Juvenile salmonids in the 0-150 mm size range are mainly planktivorous. Juvenile Oncorhynchus gorbuscha (pink salmon) off Kodiak feed upon copepods, amphipods, euphausiids, cladocerans, barnacle cyprids and larvaceans (Gosho 1977; Harris and Hartt 1977; Rogers et al. 1979a,b). High electivities are exhibited for larvaceans, copepods, cladocerans and barnacle cyprids (Bailey et al. 1975; Cooney et al. 1978). These zooplankton comprise 53.4% by weight of the diet of O. gorbuscha juveniles (Rogers et al. 1979b). O. keta (chum salmon) juveniles consume less zooplankton than young O. gorbuscha. Specimens from the Kodiak bays had a diet which was 27.6% zooplankton by weight (Rogers et al. 1979b). Harris and Hartt (1977), however, suggest that pelagic chum juveniles near Kodiak eat mostly calanoid copepods. Higher percentages and stronger electivities for zooplankton consumption also have been demonstrated for this salmonid by Bailey et al. (1975) and Cooney et al. (1978). The diet of juvenile O. kisutch (coho salmon) collected by Rogers et al. (1979b) was 26.7% euphausiids by weight, indicating a very high selectivity for that group of zooplankton. Feeding habits of juvenile O. nerka (sockeye salmon) and O. tshawytscha (chinook salmon) in the Kodiak Shelf area have not been studied. The former species is known to be predominantly planktivorous when in freshwater though (Hart 1973).

Pelagic forage fish, fed upon by subadult salmonids, other commercial fisheries species, marine birds, some toothed whales and pinnipeds, consume enormous quantities of the larger holozooplankton. Nearly 100% of the diet of Mallotus villosus (capelin) from the Kodiak area was calanoid copepods and euphausiids (Harris and Hartt 1977; Rogers et al. 1979b). The remainder was an occasional decapod or fish larva. Food habits of osmerids, other than the capelin, from off Kodiak have not been examined. Hart (1973) indicates that all Pacific species of this family studied to date are exclusively planktivorous, with copepods, euphausiids, diatoms, crustacean eggs and ichthyoplankton as major foods. The other osmerids are much less numerous than the capelin, however. Young Clupea harengus pallasi (Pacific herring) feed exclusively upon copepods. Harris and Hartt (1977) found that 99% by weight of the gut contents of young Pacific herring collected in Kodiak bays were calanoids. The remaining 1% were harpacticoids. Wespestad and Barton (1979) found that larval and juvenile Pacific herring fed on copepods, diatoms, cladocerans, amphipods and decapod, barnacle and pelecypod larvae. Hardy (1965) reported that the Atlantic subspecies initially feed on Pseudocalanus, then included the larger calanoids and other zooplankton as it grew. Adults fed upon large zooplankton, such as the large Calanus species, Sagitta, Limacina and larval fish, e.g. young ammodytids. Ammodytes hexaptarus (Pacific sand lance) was essentially planktivorous throughout its lifecycle off Kodiak, feeding mainly on calanoid copepods (40.1% by weight, Rogers et al. 1979b; 75%, Harris and Hartt 1977) and planktonic crustacean larvae. This preference occurred even in specimens collected in bottom trawls (Harris and Hartt 1977; Rogers et al. 1979b; Simenstad et al. 1978).

Juvenile demersal species of fish, particularly walleye pollock, eat sizable numbers of holoplankton. Theragra chalcogramma (walleye pollock) under 150 mm long from the Kodiak area eat 32.4% euphausiids, 22.4% mysids, 12.9% calanoids and 1.8% other zooplankton (Rogers et al. 1979b). In the 150 to 300 mm long size group, these organisms made up 29.7% of the gut contents by weight. Dependence upon zooplankton dropped to 2.9% in the adult pollock collected off Kodiak. Gadus macrocephalus (Pacific cod) and Microgadus proximus (Pacific tomcod) ate less zooplankton as juveniles in the 0-150 mm size class than did pollock, 9.6% and 37.9% by weight, respectively. The juvenile tomcod ate mainly mysids and euphausiids while juvenile cods were less specialized. The diet of pleuronectids in the 0-150 mm size range averaged 6.4% zooplankton by weight (Rogers et al. 1979b). Euphausiids, calanoid copepods and mysids were the main food items. Sebastes alutus (Pacific Ocean perch) of Kodiak feed mainly upon large calanoid copepods and euphausiids seasonally just before spawning; however, quantitative studies have not been published (SAI 1980). It may be inferred from the depths at which the larvae occurred (offshore surface waters, about 0-50 m) and at which juvenile stages occurred (125-150 m), that they are mainly planktivorous, but this is unproven. The depth distribution by age for Anoplopoma fimbria (sablefish or blackcod) suggests that the larvae are planktivorous and the juveniles may be (SAI 1980). Zooplankton comprised 1.7% by weight of the diet of subadult (length >151 mm) sablefish. Gut contents of juvenile (0-150 mm) greenlings averaged 12.2% zooplankton (Rogers et al. 1979b).

The short-tailed shearwater and the small alcid species, among the marine avifauna, are essentially planktivorous. Euphausiids comprise 45% of the annual diet of the short-tailed shearwater and 75% in the spring (Sanger et al. 1978). This shearwater is the most abundant species of marine bird off Kodiak, 56.3% by numbers and 48.2% of the biomass (Sanger et al. 1979). An additional 30% of its diet by weight and the bulk (65%) of the sooty shearwater's is the planktivorous capelin. This implies that at least 59% of the biomass of marine avifauna east of Kodiak Island is, or only one step removed from being, directly dependent upon the zooplankton. The diet of the next three most common pelagic birds, the Common Murre, the Tufted Puffin and the Black-legged Kittiwake, are 55-65% capelin and 8-12% sand lance (another planktivore), and the latter two species of birds also consume 5-10% euphausiids. The exclusively planktivorous small alcids, Cassin's, Parakeet, Crested, Least and Whiskered Auklets, are also among the 20 most common species of birds offshore. As a result over 95% of the offshore Kodiak avian biomass and most of the common species are dependent upon zooplankton, either directly upon euphausiids or through planktivorous forage fish.

Six of the seven species of baleen whales known to occur off Kodiak live on euphausiids and copepods (Pike 1960; Nemato 1970; Nishiwaki 1972). Sei, blue and right whales live entirely on these zooplankters, while minke, fin and humpback whales add small, gregarious fish to their diet as well. Recent estimates suggest there are about 57,500 baleen whales of these species in the North Pacific at this time, consuming about 700 kilograms of food per day apiece (SAI 1980). The concentration of these whales off Kodiak is not presently known. Distribution of sightings, however, reveal a distinct pattern of occurrences related to bottom depths between 100 and 200 m with some out to the 2000 m contour, so a seasonal census should be possible to obtain and dependence upon Kodiak zooplankton calculated.

Ichthyoplankton past the yolk-sac stage and decapod zoea also graze upon zooplankton, though direct studies from the Kodiak area are not extant. Atlantic herring are known to eat diatoms, copepod nauplii, and small copepods, e.g. Pseudocalanus, Acartia and Oithona, initially (Hardy 1965). Unpublished gut content analyses of Pacific herring from southeast Alaska added small cladocerans and barnacle nauplii to this list. Cancer magister zoea have been found to eat diatoms, copepod eggs and copepod and barnacle nauplii (Lough 1975). It may be assumed that other ichthyoplankton and decapod zoeae feed upon similar types of plankton.

Zooplankton of the Kodiak Shelf are the only link between primary productivity there and almost all offshore organisms of higher trophic levels. The predominant commercial fisheries off Kodiak are for salmon, halibut, decapod crustaceans, herring, pollock, Pacific Ocean perch and sablefish. These fish, with the exceptions of halibut and sablefish, feed mainly on zooplankton as juveniles or throughout their life cycle, and/or are part of the zooplankton early in their life-cycle. Over 95% of the biomass of offshore marine birds is dependent upon euphausiids or planktivorous forage fish. The six rare and endangered species of baleen whales present feed mainly upon copepods and euphausiids. Therefore, over the Kodiak Shelf area, the bulk of all energy fixed by the phytoplankton and utilized by the trophic levels containing the species of commercial, ecological and/or aesthetic significance and importance is funnelled through the marine zooplankton of that area. Consequently, the population dynamics and sensitivity to pollution of zooplankton represent a potentially limiting factor for the entire pelagic ecosystem of the Outer Kodiak Continental Shelf.

2.0 METHODS AND MATERIALS

2.1 Field Methods

2.1.1 Field Gear and Sampling Procedures

Four types of sampling gear were used to collect the zooplankton analyzed in this study: 1) a Sameoto neuston sampler (Sameoto and Jaroszynski 1969) with a mouth opening of 0.3 m high by 0.5 m wide; 2) paired aluminum MARMAP bongo nets (Smith and Richardson 1977) with an interior diameter of 0.6 m; 3) a mechanical opening-closing Tucker trawl (Clark 1969), with an aperture of 1.0 m^2 containing three or five nets; and 4) an epibenthic sled (a Tucker trawl mounted on skis). Net mesh pore size was 505 micrometers for all samplers except one bongo net where 333 micrometer mesh was used. All gear types were metered so the length of haul and volume of water filtered could be measured.

Sampling procedures followed MARMAP survey guidelines (Smith and Richardson 1977; Rogers et al. 1979; Kendall et al. 1980). At each station sampled a neuston tow was taken first, followed by an STD cast and an oblique bongo tow. Tucker trawls and epibenthic sled samples completed the sampling series at selected stations. Samplers were towed for about 10 minutes at a speed of 1 m per second. The rate of net retrieval for bongo and offshore Tucker trawls was 20 m per minute. The depths sampled were 0 to 1 m for the neuston sampler; 0 to 5-10 m above the bottom in shallow waters (< 200 m) and 0 to 200 m in deeper waters for the bongo nets; 10, 30, 50, 70 and 90 m for the inshore Tucker trawls; two or three oblique sampling depth zones related to the thermocline depth for the offshore Tuckers; and 0 to 1 m above the ocean floor for the epibenthic sleds.

For the diel studies, Tucker and neuston samples were collected every four hours for 24 hours on three offshore cruises and twice daily during all inshore cruises. Tows were made every four hours offshore and twice daily inshore. Ancillary physical-chemical data (mainly salinity, or conductivity, and temperature) was also collected for the diel series.

Samples were preserved in the field with a 5% formalin solution, buffered with sodium tetraborate at saturation. The samples were then shipped to a commercial sorting center where plankton displacement volumes were determined and various components removed for identification. Fish larvae and eggs were removed from the 505 um samples and 500 invertebrate zooplankters were taken from the 333 um bongo samples for major category identification. Two hundred adult euphausiids were also removed from each offshore 333 bongo sample, then identified, counted, and measured for length and wet weights. A like number was processed from the 505 bongo samples collected at stations 1 and 3 in each inshore bay. Five hundred decapod larvae were also removed from the 333 bongo samples. The remaining organisms were stored in buffered formalin at the Northwest and Alaska Fisheries Center.

2.1.2 Timing and Location of Sampling Effort

Samples from four offshore and 12 inshore cruises were analyzed. A summary of cruise dates and identifications is listed in Table 2.1-1. The offshore cruises were from 28 March to 20 April 1978, 19 June to 9 July 1978, 25 October to 17 November 1978 and 13 February to 11 March 1979. The inshore cruises were every two weeks from late March through August 1978 and once in November 1978 and in March 1979. There were five cruises each in spring and summer. Station locations are presented in Figures 2.1-1 through 2.1-5.

The offshore stations ranged from the nearshore over the bank and trough region of the midshelf and out to the continental slope (Figures 2.1-1 through 2.1-4). Most of the offshore stations were located to the southeast of Kodiak and Afognak Islands over the proposed lease area. However, six stations were southwest of Kodiak Island and Kennedy and Stevenson Entrances, between Afognak Island and the Kenai Peninsula, were also investigated. Offshore stations varied in number between 85 and 98 per cruise.

Initially five stations were established in Izhut, Chiniak, Kiliuda and Kaiugnak Bays (Figure 1.3-2). These were linearly arranged along the main axis of each bay and in front of the adjacent headlands. The outer three bay stations and the nearshore stations of the offshore cruises were placed in close proximity to each other. Three additional stations were added to both Izhut and Kiliuda Bays in May 1978 and station Chiniak 5 was deleted after August 1978. Twenty-six stations per cruise were sampled during the peak of the inshore program.

2.2 Laboratory Procedures

2.2.1 Sample Selection

Over 2800 zooplankton samples from 124 stations were collected off Kodiak Island during 1978 and in March 1979. A reduction of the number of samples and stations for zooplankton enumeration was necessary. Eight hundred eighteen were finally counted. The sample selection design had to meet the following criteria:

a. Spatial distribution covered the entire study area and maximized resolution in the areas of interest; Kiliuda Bay, Izhut Bay and the adjoining shelf waters.

b. Seasonal data was as complete as possible.

c. Information about key selected species was maximized.

The sampling program, which used four different gear types, and sampled at different times of the year, locations and depths, was approached as a stratified, nested-ANOVA sampling design (Sokal & Rohlf 1969), which enabled relative ease of sample selection.

The listed criteria suggested that an optimal selection of samples was one that included analysis of the entire sample set collected by one gear type, in order to maximize seasonal and horizontal distributional data and analysis of samples collected by all gear-types, at selected stations to maximize vertical distributional data and resolution within the areas of interest. The alternative approach of selecting a large number of stations for analysis of samples collected by all gear-types, but not examining all possible stations collected, would weaken horizontal resolution in favor of vertical resolution. Since much of the area is relatively shallow compared to the known vertical migration range of zooplankton, most of the potentially observed vertical differences would be more a diel function (a lower priority topic) rather than actual vertical separation of species. The neuston sampler, Tucker trawl and epibenthic sled all were used to measure vertical patterns, depth localized populations, or diel migration.

Bongo nets, however, were used to collect samples for biomass and horizontal spatial distribution of organisms. Thus, the highest priority for enumeration was awarded the bongo samples, with less effort on the other gear types. The 333 um Bongo samples were preferred to the 505 um Bongo samples because of the lower escapement rates for immature and smaller forms (Jacobs and Grant 1978).

Final selection of stations where the collections by all gear types were analyzed was dependent upon the distribution of samples between stations as taken by the limiting gear type. Although the epibenthic sled was used the least number of times inshore, Tucker trawls were taken only at two stations; Kiliuda 2 and Izhut 2. Consequently, the bulk of the remaining samples analyzed came from these two bay stations. The Tucker trawls were limited to the Kiliuda 2 day series while night neuston and epibenthic sled samples series came from Izhut 2 to balance emphasis on the two bays. Inshore 505 bongos were analyzed from only these two stations. The inshore day neuston samples were selected to include Izhut 3, Kiliuda 1 and Kiliuda 3. Samples from all cruises were enumerated in each gear set, since seasonality was also an important topic.

Offshore eight neuston and eight bongo 505 samples, two from each cruise, and three Tucker trawl samples were also enumerated. The purpose of these samples was to obtain comparative information for sampling efficiency with the 333 Bongo data. A total of 818 samples was analyzed.

2.2.2 Selection of Key Species

Besides the predominant species, selected key zooplankters were enumerated. These key species included organisms: a) for which important commercial species exhibit high electivities (Ivlev 1961); b) that are major competitors for zooplankton with the commercial fish and shellfish species; c) that are predators of the planktonic lifestages of the commercially important species; d) that are possible keystone predators; or e) that have been shown to be particularly sensitive to pollution, especially hydrocarbons and trace metals in the water column.

The key species were selected by analyzing direct stomach content data, and by an extensive literature review on pelagic food web trophic dynamics, competition in the marine zooplankton, and marine pollution indicators. Key food species are arbitrarily defined here as those which make up more than two percent of the zooplankton component from the stomach contents analysis or comprise greater than two percent of the total volume of food.

The predominant species of copepods included Pseudocalanus spp., Acartia longiremis, Acartia tumida, Centropages abdominalis, Scolecithrella minor and Oithona spp. High electivity organisms included the three larger Calanus spp. (C. cristatus, C. marshallae and C. plumchrus), Metridia spp., probably Eucalanus bungi and Epilabidocera longipedata, Limacina helicina, the euphausiids, the larvaceans,and the cladocerans. Other high electivity organisms not analyzed here were mainly benthic, e.g. harpacticoid copepods, gammarid amphipods, mysids and meroplankton. Predators included the amphipods, cnidarians and chaetognaths. Species of Conchoecia, an ostracod, were also abundant compared to some of these groups, and were thus included.

2.2.3 Counting Methodology

Zooplankton samples went through six basic processing stages after receipt; inventory, biomass estimation, rough sorting, taxonomic identification, enumeration of important species, and conversion of the raw data into population density estimates. At the same time the samples were inventoried, they were checked for an adequate preservative concentration [following the recommended levels from the UNESCO (1968) Study], then stored in a safe location until processing. Biomass was estimated using the settled sample volume. The unsorted samples were poured into 500 ml pharmaceutical graduated cylinders and allowed to settle for several hours. The rarer forms were removed during rough sorting and placed in preservative-filled, sealed glass vials. These rarer zooplankters were subsequently identified and counted under a binocular dissecting microscope at 32X magnification.

Samples were sequentially divided with a Folsom plankton splitter until 400-600 copepods were obtained. All questionable identifications were placed in separate vials for later identification. Reference specimens were stored. The zooplankton in the split fraction were counted according to the following procedures:

1) A minimum of 400 (± <5%) copepods were identified to species and tallied as adults or copepodites; Calanus spp. copepodites were further separated into developmental stages.

2) Amphipods were enumerated in five groups; Parathemisto sp., Cyphocaris sp., Primno sp., gammarids and others. Specimens of Parathemisto sp. and Cyphocaris sp. were saved for species identi-

fication. The majority of the specimens in these two genera were Parathemisto pacifica and Cyphocaris challengeri. Identification of all gammarids was verified to sub-order and the specimens saved for future species identification. The remaining amphipods were identified to species, except where taxonomic problems existed (e.g. the genus Hyperoche).

3) Larval euphausiids from all inshore stations were counted by stage. Two hundred adult and late juvenile (length $\geq$ 11.0 mm) euphausiids were identified to species from stations Izhut 2, 5 and 6 and Kiliuda 2 and 5 from each cruise to supplement previous data from these bays.

4) Chaetognaths were routinely identified to genus. The first 25 specimens from each sample were further identified to species.

5) Larvaceans were enumerated as Oikopleura spp., Fritillaria borealis or unidentifiable due to physical condition of the specimen.

6) Other routinue counting categories were Conchoecia spp., Evadne spp., Podon spp., and Limacina helicina. Species identification of each was attempted on a cruise-by-cruise basis. Other ostracods, cladocerans and pelagic mollusks were saved for later identification as were cnidarians, mysids and pelagic polychaetes.

Assurance of quality was obtained through periodic, random audits of the extent of adherence to standard procedures and the reproducibility of the data. These audits consisted of independent re-analysis or reprocessing of the sample or data by two researchers, one a senior level scientist. The acceptable level of error between the original and rework results for identification and enumeration of samples was $\pm$10%. Five percent of all samples were audited and the results logged. An additional five percent were counted in triplicate to verify the calculated level of confidence of the enumerations. Internal, blind verification of difficult identifications was routinuely done, and all questionable identifications were submitted to outside recognized authorities on the appropriate taxonomic group.

2.2.4 Verification of Subsampling Procedures

2.2.4.1 General Considerations

Two analytical problems must be solved to provide the optimal sample aliquot size. These are finding the number of individuals which must be counted in order to tally all of the species present, and making an accurate determination of the percent contribution of each species to the total sample. The most accurate way to answer these questions is to count the entire sample, or secondarily, to take replicated subsamples. However, time considerations make these methods unfeasible; hence the need to count a single, large sample.

Calculation of the contribution of any one species to the total sample population is considerably less difficult and susceptible to error than determination of the number of species in a sample from an aliquot. Once the level of variation is chosen for the former calculation, determination of the number of individuals to be counted is easily obtained. Since the organisms have been randomly distributed by the plankton splitter (Jacobs & Grant 1978), the counts of each subsample should obey the Poisson distribution (Elliott 1971). Under these conditions the sample variance equals the sample mean (Snedecor & Cochran 1967) and the optimal number to be counted equals the reciprocal of the square of the desired confidence level (Cassie 1971; Watt 1968). For the 0.95 level of confidence it is 400 organisms. With only 300 organisms the resulting confidence level is 94.3%. Subsample size of 300-600 organisms has been frequently used in zooplankton studies (e.g., Peterson & Miller 1976; McAlister & Favorite 1977). Repeated splitting until each common organism has numbers in a given subaliquot between 100 and 200 (Jacobs & Grant 1978) is a common alternative.

Various methods of determining the number of species in a sample from an aliquot or in a population from a sample have been used in diversity studies (Pielou 1969, 1975). For a large sample (number of individuals is greater than 1,000) and for an association of species which obeys the discrete lognormal distribution, Preston's (1948) canonical index or the modification of Patrick, et al. (1954) provide a simple and relatively accurate means to obtain the theoretical total number of species present (Pielou 1969). Pielou (1975) has also demonstrated that the assemblage does not have to obey a discrete lognormal distribution of numbers and species to have an estimate made of the theoretical total number of species; it is merely more mathematically complicated to obtain.

Sanders (1969 as reviewed in MacArthur 1972) demonstrated for benthic invertebrates that a subsample of 400 individuals randomly drawn from a sample of over 2,000 will tend to include at least 75 to 80% of the total number of species present and that the rate of addition of new species is drastically reduced beyond that subsample size. Dennison and Hay (1967, as reported in Douglas et al. 1978), using binomial sampling theory, estimated that a minimum of 300 specimens must be counted in order to detect a species that constitutes 1% of the total population with a 95% level of confidence. Although direct verification through use of zooplankton counts has not been reported, other types of organisms with similar sized species assemblages tend toward a consistent pattern which can be utilized in counting zooplankton.

2.2.4.2 Level of Accuracy Obtained

The subsampling technique was verified through statistical analysis of the samples recounted in triplicate. The results from the 40 samples indicated that the Folsom plankton splitters used had an average coefficient of variation equaling 7.5% for total numbers subsampled. This variation was randomly distributed between the splitters used and among the counters. A comparison was made between the observed and expected (according to the Poisson distribution) relative abundance of the numbers of copepod species tallied in each subsample. Agreement between observed and expected values was excellent. The average number counted in the subsamples was 534 copepods. The calculated level of confidence that all species with an abundance greater than 1% of the total had been tallied in any given subsample was 95.67%. The observed value from the 40 recounted samples was 95.71%.

Individual audits for identification verification yielded an average variation between counters of 5.5% with a 1.8% coefficient of variation. Much of the variation observed was due to differences in the identification of *Calanus* copepodite stages to species.

The small size of the subsamples indicated that, as suggested by Sanders, a large percentage of the total number of species present in each sample would not be observed by the counters, thus biasing the counts toward the more abundant species. Preliminary analysis of some of the recounted samples strongly supported this hypothesis. The densities of the missed species were so low, however, that to increase the individual sample size to include the bulk of them would have reduced the number of samples counted to an eighth or less the amount actually enumerated. Counting a large number of samples increased the probability of observing rare species, counteracting this problem for the data set as a whole.

2.3 Data Reduction and Management

Counts were tallied on pre-coded data sheets designed to be keypunching forms (see Appendix 2 for an example of each type of data sheet). The coding format followed the November 1978 edition of NODC File Type 124-Zooplankton, except where a modification in Record Type E was required to handle the enumeration of *Calanus* spp. copepodite stages.

This expansion, and the parallel separation of all copepods into adults by sex and copepodites, was deleted in the final digital data tape submitted to NOAA/OMPA. The original data set with copepodite counts is on disc file at VTN and on the data sheets submitted to NOAA/OMPA.

The keypunched counts were sorted by cruise, gear and station. Verification of the keypunched cards was performed as was an initial editing of the data. The sorted cards were then stored on a magnetic tape. The magnetic tape was used to create a disc file on which a second edit of the data was made. Densities as numbers per m^3 were calculated, then added to the final tape. This tape was then submitted to NOAA/OMPA for a third edit and was used to generate contour maps of zooplankton densities.

The density data was transferred to $\log_{10}$ (numbers m^{-3} + 0.0001) with zeros set to equal -4.0000. This was done because zooplankton densities are very patchy, thus a diffèrence in the transformed data was more likely to be an actual difference, not the biasing effect of a patch. A second reason for this transformation was to partially standardize the graphics with those of Dunn et al. (1979) and Kendall et al. (1980) so enabling easier comparisons and providing a more consistent Kodiak Shelf data base for other scientists.

2.4 Data Analysis

2.4.1 Statistical Computations

The sampling program, as noted earlier, is an example of a stratified, nested-ANOVA sampling design. This design enables numerous statistical tests to be performed on the data (Hicks 1964). A brief selection of potential tests (from Draper and Smith 1966; Pielou 1969; Snedecor and Cochran 1967; and Sokal and Rohlf 1969) includes: nested and two-way analyses of variance between treatments; correlation and multiple linear regression analyses between species and between species, numbers and physical-chemical parameters; residual analysis; canonical variate analysis; and species-abundance relations.

The statistical tests selected were:

1) Multiple correlation on 20 key groups with physical-chemical parameters and holoplanktonic predators (5 independent variables);

2) Establishment of mean densities, rank order by abundance for each location, and rank order by abundance and frequency of occurrence by season for each of the key species in each of the bays of interest;

The statistical tests were primarily run on the 333 um Bongo data set (636 samples). Some statistical comparisons were performed on the neuston and Tucker trawl data sets. These analyses were limited to t-tests comparing means of different subsets of data.

The statistical analyses were performed on the Statistical Analysis System's (SAS) set of programs on an IBM 370 computer at Mellonics Information Center in Canoga Park, California. Contour maps of all zooplankton except Calanus spp. stages were generated from this study's data by the National Oceanographic Data Center, the EDIS Data Center of NOAA in Washington, D.C. Other visual graphics and maps were produced by VTN's environmental drafting department.

Locations compared included stations within bays, bays with other bays and different areas offshore. These offshore areas included the "nearshore", the mid-shelf banks and troughs, and the continental slope previously compared by Dunn, et al. (1979) and Kendall, et al. (1980), plus a fifth area southwest of Kodiak Island. The offshore areas are delineated in Figure 2.4-1.

2.4.2 Data Limitations

Reliability of species density values decrease with decreasing count size. This problem is especially acute for the predaceous non-copepods, particularly the amphipods. The small size of the subsample also increases the probability that not all of the rarer species were observed. This was demonstrated for inshore euphausiids and Sagitta, where one and two species, respectively, known to occur off Kodiak Island were not tallied.

Identification limitations occurred due to the condition of some of the samples caused by length of time in storage, length of time out of the preservative and failure on occasion to buffer the preservative in the field. The sampling procedures used also tended to damage certain taxa, e.g. cnidarians, larvaceans and salps, more than organisms with hard exoskeletons. A second type of limitation for accurate identification was the confused taxonomic state of some of the groups. Examples of this category included the genera Pseudocalanus, Metridia, and Hyperoche. Separation by species of young Calanus copepodites (I-III) was a third limitation. While stages were easy to distinguish, species separation within a stage is largely based upon size. The larger three species overlap in the early stages and the C. marshallae accessory photoreceptor, an important character for separation of species, is very difficult to see in CI and CII stages. Total length of copepodite stages in the Kodiak populations differed from populations found elsewhere in the northeast Pacific, thus compounding the identification problem. Separation of all stages and species, except C. marshallae I and C. plumchrus I, was eventually attained; but the reliability of the other separations done earlier is not perfect.

Euphausiid data was excluded from computer analysis except for samples collected in Izhut and Kiliuda Bays. This action was taken to avoid redundancy in data analysis, since Rogers et al. (1979a, b) had previously analyzed some of the inshore samples for euphausiids and Dunn et al. (1979) had likewise analyzed all the offshore samples. Further, euphausiids had been removed from many of the samples being processed in this study (Kendall, personal comm.).

There were several minor limitations to the data or its analysis. Missing information and information not obtainable limited certain types of data analysis. Trophic dynamics were the main example of this problem. A few samples were also missing or improperly collected, i.e. several times the bongo nets hit the bottom, collecting mud and benthic organisms, but were not retaken, and the resultant samples could not be analyzed.

3.0 RESULTS AND DISCUSSION

3.1 Species Composition

A total of 146 zooplankton taxa was identified from the Kodiak Shelf and Izhut, Chiniak, Kiliuda and Kaiugnak Bays. A taxonomic listing of all zooplankton identified is presented in Table 3.1-1. The predominant group was the Crustacea, represented by 95 taxa and comprising over 90% of the numbers collected. Copepods, followed by euphausiids, were the most abundant crustacean holoplankters. Amphipods were abundant, as were cladocerans in the bays and ostracods over the shelf. Important non-crustacean holoplankters were larvaceans, pteropods, chaetognaths, and cnidarians. These nine major taxonomic groups comprised over 90% of the taxa and 99% of the individuals found.

Copepods were the most abundant taxonomic group, including 53 of the taxa and 85% of the individuals collected. Eighteen species of calanoid copepods were present over the shelf and 16 species were present in the bays throughout the year. *Pseudocalanus* spp., *Metridia* spp. (primarily *M. pacifica*) and *Acartia longiremis* were the most abundant calanoid copepods found in both the shelf and bay plankton. *Scolecithricella minor* was common offshore, while *Acartia tumida* and *Centropages abdominalis* were numerous in the bays. Five species of the genus *Calanus* were observed. *Calanus plumchrus* was the most common species offshore and *C. marshallae* was most common in the bays. *Oithona* spp. (primarily *O. spinirostris*) were the only common cyclopoid copepods in the samples. All other cyclopoid copepods observed belonged to the family Oncaeidae and were either deep-water forms (Heron and Damkaer 1969) or small species of the genus *Oncaea*. This genus was probably undersampled due to the mesh size of the gear used. Harpacticoid and monstrilloid copepods were present in small numbers. *Harpacticus* sp. (inshore) and *Microsetella* sp. (offshore) were the most common harpacticoid copepods found. This copepod assemblage is similar to that found by Threlkeld (1973a, b) in the northeast Pacific using similar sampling gear and mesh size and to that reported by Damkaer (1977) from Prince William Sound and the Gulf of Alaska.

The second most common group was the euphausiids. Six species of euphausiids were identified in samples taken from nine stations in Kiliuda and Izhut Bay. Thysanoessa inermis was the most common, followed by T. raschii. Euphausia pacifica, Thysanoessa longipes, T. spinifera and T. inspinata occurred infrequently. Rogers, et al. (1979) also found that T. inermis and T. raschii were the most common euphausiids in these bays. They likewise identified the same less common euphausiids reported here.

Amphipods were the third largest group of crustaceans collected. The most abundant species were Parathemisto pacifica and Cyphocaris challengeri. Other common hyperiid amphipods were Primno macropa, Hyperia medusarum hystrix, Phronima sedentaria and Scina spp. Sanger (1972) observed a similar pelagic amphipod assemblage in the southeastern Bering Sea with the same relative densities of these species. Another species of Parathemisto, P. gracilipes, was observed in the current study. This species has not been previously reported from this area; its North Pacific range had been limited to the East China and Yellow Seas (Bowman 1960).

Other crustacean holoplankton included five species of cladocerans and four species of ostracods. The most common species were the cladoceran, Podon leuckarti, and the ostracod, Conchoecia alata minor.

Common non-crustacean holoplankters were the chaetognaths, cnidarians, larvaceans, and pteropods. The most common chaetognaths were Sagitta elegans, S. scrippsae and Eukrohnia hamata. Eukrohnia bathypelagica also was observed in some offshore samples. These specimens represent a small range extension northward for this species. Thirty-four species of cnidarians were identified. The most abundant of these were Aglantha digitale and Rathkea octopunctata. The genera Eutonina, Sarsia and Phialidium were also common. All of the larvaceans found belonged to the three species: Oikopleura labradoriensis, O. dioica and Fritillaria borealis. The only common pteropod was Limacina helicina. Other pelagic molluscs collected included <u>Clione limacina</u>, <u>Clio</u> sp. and squids.

Other animals observed in the plankton included: holoplanktonic salps, polychaetes and ctenophores; meroplanktonic barnacle, decapod, polychaete and fish larvae; and epibenthic mysids and cumaceans. All pelagic polychaetes found belonged to either the genus <u>Tomopteris</u> or the species <u>Pelagobia longicirrata</u>. The most common mysids were <u>Acanthomysis</u> spp., collected in the bays. Cumaceans were represented by <u>Cumella</u> sp.

3.2 Patterns of Holozooplankton Abundance and Distribution

3.2.1 Spatial Distribution

3.2.1.1 Inshore

No statistically significant ($p < 0.05$) horizontal within-bay differences in abundance were found in the nine zooplankton groups examined. One general trend was apparent in the entire data set: a gradient existed from the innermost bay stations to those outside and subject to more oceanic conditions. This gradient was expressed in two ways. First, zooplankton numbers tended to increase earlier in the spring at the inner-bay stations than at the other stations. Second, zooplankton numbers tended to reach a lower maximum density at the inner-bay stations than at the other stations. This fact may be explained by hypothesizing that copepod nauplii and early copepodite stages were probably more common in the inner bay and, as they are small, passed through the 333 um mesh net.

One statistically significant ($p < 0.05$) horizontal between-bay difference was found; the cnidarians had a greater mean density in Kaiugnak Bay (0.151 m^{-3}) than in Izhut Bay (0.010 m^{-3}). A generally north-south trend in density gradient between bays seemed to be present. Densities of copepods, cladocerans, larvaceans, cnidarians and pteropods were greater in the southern bays than farther north, while euphausiids, ostracods and chaetognaths exhibited the opposite pattern. Amphipods lacked a north-south trend. The increase in numbers of copepods, cladocerans, larvaceans and pteropods in the southern bays may be due to more phytoplankton being present, if primary productivity in Kodiak bays is light-limited and consequently would be less light-limited further south. Ostracods may be brought inshore out of the Gulf by a branch of the Alaska current which comes from the northeast off Kodiak. There is no apparent explanation for the distribution of the other four groups.

Diel vertical distribution of zooplankton collected in neuston samples and with the Tucker trawl was examined at Kiliuda Bay Station L2. During the period between May and July 1978, the mean density of copepods at 0, 10 and 30 m was an order of magnitude less than their mean density at 70 and 90 m. The mean density at the 50 m depth stratum during this period fluctuated between those of the other strata. No other statistically significant patterns were found.

3.2.1.2 Offshore

For statistical analysis, the shelf was divided into the four areas defined by Dunn, et al. (1979) and Kendall, et al. (1980) plus a fifth area southwest of Kodiak Island (Figure 2.4-1). Statistically significant ($p < 0.05$) density differences for all cruises combined occurred between the slope and the other four shelf areas in four taxa: Eukrohnia hamata, Conchoecia spp. and the aetideid and euchaetid copepods. Analysis by individual cruise resulted in 47 statistically significant ($p < 0.05$) differences; 40 of these separated the slope from the other shelf areas. Four of the remaining significant differences separated the southwest stations from the nearshore, bank and trough stations. These 47 differences are further discussed separately under their appropriate taxon heading in Section 3.2.3.

3.2.1.3 Neuston Population Trends

Diel neuston populations differed greatly from those collected by either the bongo nets or Tucker trawls. Densities were much lower at the surface than in the water column and there was a predominance of males in the neuston samples, mostly Acartia longiremis, A. tumida and Epilabidocera longipedata. The low densities observed in these samples were due to the near absence of Acartia spp. females, Pseudocalanus spp., Metridia spp., Calanus spp., and Oithona spp. which were the predominant taxa collected by the bongo nets and Tucker trawls. Both the pelagic hyperiid and epibenthic gammarid amphipods maintained the same densities throughout the water column and thus comprised a greater percentage of the surface zooplankton compared to deeper populations. Chaetognaths were absent from diel neuston samples. There was an increase of all zooplankton in the night neuston samples over the diel populations although not to the same densities as lower in the water column. Numbers of female Acartia spp. and Epilabidocera longipedata greatly increased at night. No other differences between the holozooplankton collected with neuston samplers and in bongo nets or Tucker trawls were clearly present.

3.2.2 Seasonality

Seasonality was the dominant factor exhibited in the abundance of zooplankton on the Kodiak Shelf and in the bays studied. Four general seasonal patterns were observed in Tables 3.2-1 to 3.2-57. (A density of zero is assigned a value of -4.0 in Tables 3.2-7 through 3.2-57.) The most common pattern found was an increase in population density throughout the spring into summer, a maximum sometime between mid-June and August, and a decline in November. The second most common pattern was characterized by high densities in March and April, and a decrease to no individuals in August and November. The least common seasonal pattern exhibited minimum densities in March and maximum densities in November. The fourth pattern found was the lack of seasonal change in density. These patterns will be referenced in subsequent discussion as summer, spring, fall and non-seasonal patterns, respectively.

The copepods, with few exceptions, followed a summer seasonal pattern of peak density as did the cladocerans and the larvaceans. The euphausiids tended to have a summer density peak although this pattern was not as distinct as that of the preceeding groups. Ostracods and pteropods from the shelf were non-seasonal, but ostracods collected inshore occurred mainly from March through early June, and pteropods tended to have a summer density peak. Amphipods and cnidarians were non-seasonal. Chaetognaths exhibited a fall pattern of maximum density.

An interesting seasonal pattern for Calanus spp. appeared when the inshore data was divided into adult, late copepodite (IV and V) and early copepodite (I to III) stages (Tables 3.2-15 to 3.2-18). Adult Calanus plumchrus occurred earlier in the southern bays than in the northern bays, but there were no differences in timing for Calanus marshallae adults or C. cristatus late copepodites. The peak density of C. plumchrus late copepodites was a brief, large and well-defined pulse early in the year in all bays, while late copepodites of C. marshallae exhibited a less well defined peak. The early copepodites of C. plumchrus and C. marshallae had a bi-modal seasonal pattern, suggesting that two separate cohorts developed.

The seasonal dominance tables ranked by density (Tables 3.2-1 and 3.2-2) demonstrated relative changes in abundance by season. There were three patterns observed: species which were always relatively common, e.g., Pseudocalanus spp. and Metridia spp; species which were always present, though relatively uncommon, e.g., aetideids; and species which changed seasonally in relative abundance, e.g., Centropages abdominalis and Conchoecia spp. Examination of the seasonal dominance tables ranked by frequency of occurrence (Tables 3.2-3 and 3.2-4) revealed less variability in species rank order than did those ranked by density. The three patterns were much less apparent.

3.2.3 Distribution of Selected Taxa

3.2.3.1 Total Copepods (Tables 3.2-7 and 3.2-8; Figures 3.3-1 to 3.3-4)

Total copepods inshore averaged 183.1 individuals m^{-3} with a maximum density of 3,281.9 m^{-3} in Chiniak Bay during July 1979. Over the shelf the geometric mean for all samples was 37.9 copepods m^{-3}. The highest mean densities occurred in early July (872.2 and 271.1 m^{-3} inshore and offshore, respectively). The lowest mean densities were likewise collected simultaneously in early March 1979 (1.5 and 3.8 m^3, respectively).

The horizontal distribution patterns observed were a composite of the five to ten most common species found. These usually included *Pseudocalanus* spp., *Metridia* spp., *Acartia* spp., *Calanus* spp. and *Oithona* spp. The most notable offshore patterns were high densities over Kiliuda Trough and the adjacent areas, particularly the nearshore, and low densities over North Albatross Bank during spring and summer.

3.2.2.2 *Calanus cristatus* (Tables 3.2-9, 3.2-10, 3.2-15 to 3.2-19; Figure 3.3-5)

Calanus cristatus Stages IV-V were present in small numbers throughout most inshore cruises. The largest numbers (mean densities of 9.41 and 8.20 m^{-3}) were found at Kaiugnak Bay during April and May 1978. A similar but smaller peak (3.33) occurred during March (2CM) at Kiliuda Bay. For all other cruises in the inshore study area, the mean density ranged between 0.0 and 1.8 m^{-3}. Early copepodites of this species followed a similar pattern, but preceeded Stages IV and V by two to four weeks. *C cristatus* adults were not present in the bay zooplankton samples.

The largest numbers of adults and late copoodites of C. cristatus occurred offshore during the summer (2.17 m^{-3}) while early copopodites were most numerous during the spring (5.36 m^{-3}). Offshore this was the tenth most abundant species. The distribution of Stages IV and V during the summer was concentrated over the troughs and the earlier copepodites were similarly distributed.

3.2.2.3 Calanus plumchrus (Tables 3.2-11, 3.2-12, 3.2-15 to 3.2-19)

The population of Calanus plumchrus Stages IV-V followed a similar pattern of occurrence to C. cristatus at Chiniak, Kaiugnak and Kiliuda Bays, but with larger population peaks. Smaller numbers generally were present in Izhut Bay with the exception that during June (6CM) the mean density of 18.47 m^{-3} was highest of the four bays. The greatest densities (197.6 and 202.9 m^{-3}) were present during mid-April (2 CM) and late April to early May (3 CM) at Kaiugnak Bay. Smaller population peaks occurred in Kiliuda Bay during April (54.76 m^{-3}) and in Chiniak Bay (35.97 m^{-3}) during the next cruise (3CM). Kaiugnak Bay showed a rapid decline in numbers after late April. Adults were present in very small numbers on 21 occasions throughout mid-May to August (cruises 4CM-19CM). Largest numbers were found during mid-July (8CM) when Chiniak C5 had 8.37 m^{-3} and Izhut Z2 had 6.09 m^{-3}.

Adults were absent from March to May (cruises 1CM-3CM) in all bays and were absent in Kaiugnak and Kiliuda Bays from early July (7CM) through the remainder of the sampling. No pattern of abundance by station location in any of the bays was apparent for this species. C. plumchrus Stages IV, V, and adults combined in Table 3.2-2 (seasonal dominance) ranked third in abundance during April and early May (2CM and 3CM).

Calanus plumchrus adults and late copepodites averaged 7.55 m^{-3} over the four offshore cruises. They were collected in their greatest numbers (11.85 m^{-3}) during spring and were least abundant in the fall (0.12 m^{-3}). This species was the third most abundant holoplankter collected over the shelf. Calanus plumchrus was uniformly distributed offshore.

3.2.2.4 Calanus marshallae (Tables 3.2-13 to 3.2-19)

Calanus marshallae Stages IV and V followed a later cycle of abundance than did C. cristatus and C plumchrus. The peak population density was reached between late June and August (7CM-9CM) in all four bays. Largest mean densities were recorded during June (7CM) at Kaiugnak Bay (37.72 m^3) and Kiliuda Bay (20.3). Stations with the highest population densities were Kaiugnak G2 with 121.6 m^3 and Kiliuda L4 with 113.47 m^{-3}. Numbers remained high during July (8CM) and early August (9CM) in Kaiugnak Bay. Population peaks at Chiniak Bay occurred during July (23.89 m^{-3}) and November (22.82 m^{-3}). Lower numbers were found at Izhut Bay throughout the sampling period with the highest mean density of 4.30 m^{-3} recorded in late July. A smaller population peak for Stages IV-V which occurred during April (3CM-4CM) led into an adult population peak during May (5CM-6CM) in all bays. The highest mean adult densities were seen during late May (6CM) in Chiniak Bay (6.06 m^{-3}) and Izhut Bay (5.24 m^{-3}). Similar numbers were recorded at Kiliuda Bay during May (5.67 and 4.46 m^{-3}). No adult population peak was evident following the larger population peaks of Stages IV-V during July and early August (7CM-9CM). No pattern of abundance by station location in any of the bays was apparent for this species. Stages IV-V and adults were combined in one category (Table 3.2-2) for a rank order of seventh or above for seasonal dominance on all inshore cruises except the first two.

Calanus marshallae was the sixth most abundant species collected offshore. It had an average density of 1.88 individuals m^{-3}. The highest observed density by cruise was 3.62 m^{-3} during the summer and the lowest by cruise occurred in spring (0.26 m^{-3}). The troughs had the greatest mean density during the summer (4.05 m^{-3}) and had the lowest during the spring (0.004 m^{-3}) among the different areas. There were no patterns of horizontal distribution found offshore.

3.2.2.5 Calanus copepodites I-III (Tables 3.2-15 and 3.2-16)

Copepodite stages I-III of C. plumchrus, C. marshallae and C. spp. (other than C. cristatus) were combined in this study. Two peaks were evident, (March-April) 1CM-3CM, and June (7CM). These peaks led into the Stages IV-V peaks of the three species of Calanus. Highest mean densities were recorded in Kaiugnak Bay during late March (167.9 m^{-3}) and remained high during April. The second population peak occurred during June (7CM) with highest numbers at Kiliuda Bay (210.9 m^{-3}). This peak may have been largely comprised of C. marshallae as there was no corresponding increase in C. plumchrus IV-V during July and August (Cruises 8CM-10CM). As shown in Table 3.2-2, this category was the most abundant group in late March and second during April and early May.

The early copepodites of Calanus spp. averaged 18.04 m^{-3} offshore with their greatest collected density in spring (53.41 m^{-3}) and with the lowest during the fall (0.82 m^{-3}). This group followed the same offshore horizontal pattern as its most common species did as adults and late copepodites, i.e., none were found.

3.2.3.6 Pseudocalanus spp. (Tables 3.2-20 and 3.2-21; Figure 3.3-6 to 3.3-9)

Pseudocalanus spp. was the most common taxon found in the study area. Three forms occurred, but species identification was not assigned pending expected publication of a revision of the genus (B. Frost, personal communication). The geometric mean densities were 42.4 individuals m^{-3} in the bays and 8.7 m^{-3} over the shelf. The highest densities were found in Chiniak Bay during July and August (446.3 to 525.2 m^{-3}). Kaiugnak Bay had higher densities in March and April 1978 (91.7 to 181.7 m^{-3}) than the other bays, while Kiliuda Bay had relatively high densities in November 1978 and March 1979 (4.2 and 3.0 m^{-3}, respectively). The lowest monthly densities were found in March 1979 (0.4 m^{-3}). Chiniak Bay had the lowest average density (22.4 m^{-3}), though none of the four bays were significantly different.

Offshore there were significantly more Pseudocalanus spp. during the summer (205.5 m^{-3}) than the other sampling periods. The geometric mean density during February-March 1979 was 0.8 m^{-3}, the lowest observed. The only statistically significant ($p < 0.05$) areal difference found was between the continental slope and the southwest area during the spring 1978 cruise. Higher densities characterized Kiliuda Trough, the southern nearshore area and North Albatross Bank during the spring, fall and winter cruises. There were minimal changes throughout the year over the shelf except during the summer.

3.2.3.7 Metridia spp.(Tables 3.2-22 and 3.2.23; Figures 3.3-10 to 3.3-13)

Metridia spp. was the third most abundant taxon inshore, with a geometric mean of 1.6 individuals m^{-3}, and the second most common offshore with a mean density of 5.1 m^{-3}. The principal species was M. pacifica. The highest densities occurred during April (8.7 m^{-3} for all bays, 35.4 m^{-3} in Kaiugnak Bay). The lowest monthly density inshore was 0.08 m^{-3} during March 1979. Chiniak Bay had both the single lowest monthly value (0.01 m^{-3}), and the highest bay average (3.1 m^{-3}). Izhut Bay was the least densely populated with a geometric mean of 0.67 m^{-3}.

There were no significant differences between offshore cruises for Metridia spp. The greatest observed mean density was attained during the summer (10.38 m^{-3}) and the least in winter (0.78 m^{-3}). The only significant areal difference was between the continental slope (15.78 m^{-3}) and the troughs (3.02 m^{-3}) and nearshore (2.40 m^{-3}) during the winter. High densities of Metridia spp. were found over South Albatross Bank and nearshore to Kiliuda and Kaiugnak Bays in June and July, while lower densities occurred over North Albatross Bank.

3.2.3.8 Acartia longiremis (Tables 3.2-24 and 3.2-25; Figures 3.3-14 to 3.3-17)

Acartia longiremis was the second most abundant species inshore with a geometric mean of 10.07 individuals m^{-3} and fourth most abundant over the shelf averaging 0.40 m^{-3}. The highest mean density inshore occurred during August (163.98 m^{-3}) and the lowest was 0.05 m^{-3} in March 1979. The single highest density by cruise and bay was 249.34 m^{-3} during early August in Kaiugnak Bay and the lowest density was 0.003 m^{-3} in Izhut Bay during April. There were no significant differences found between bays though the densities tended to increase from north to south.

Acartia longiremis was significantly more abundant during the summer and fall offshore cruises (11.28 m^{-3}) than in either the spring (0.02 m^{-3}) or late winter (0.01 m^{-3}). The species was significantly less common over the slope than elsewhere during the fall cruise. No other areal differences by cruise were found. The offshore distribution maps for this species indicated high densities in the nearshore, adjacent to Kiliuda and Kaiugnak Bays, which extended over Middle Albatross Bank and arts of Kiliuda Trough.

3.2.3.9 Acartia tumida (Tables 3.2-26 and 3.2-27; Figures 3.3-18 to 3.3-19)

This species was eighth most abundant on the average inshore and eighteenth most abundant offshore, with the mean densities of 0.105

and 0.003 m^{-3} respectively. The highest densities inshore occurred in April and early June, earlier than A. longiremis. The highest inshore density was 104.21 m^{-3} in Kaiugnak Bay during April. None was found inshore during November.

Offshore, Acartia tumida had a similar horizontal distribution to A. longiremis; however, it was absent in November and too scarce in February-March 1979 for a contour plot to be made. A. tumida attained its offshore maximum observed density during the June-July 1978 cruise (1.06 m^{-3}).

3.2.3.10 Acartia clausi (Table 3.2-28)

This species of Acartia occurred mainly at the inner bay stations. Its frequency of occurrence was 67% at Izhut Bay Stations Z6 and Z8 and 56% at Kiliuda Bay Station L6. Kaiugnak Bay lacked stations close to the shore or freshwater inputs, so the appearance of this species was limited to the innermost station, G1. A. clausi reached its maximum density during August. The highest density observed was 234.1 m^{-3} at Station Z8.

3.2.3.11 Eucalanus bungii (Tables 3.2-29 and 3.2-30, Figures 3.3-20 to 3.3-23)

Eucalanus bungii was most abundant between late June and November throughout the study area. It attained maximum densities of 8.0 m^{-3} in Kaiugnak Bay during late August and 23.7 m^{-3} in the trough stations during the summer cruise. During this cruise E. bungii was significantly less abundant in the southwest area than over the troughs and continental slope. No other patterns in the data were noted for this species.

3.2.3.12 Epilabidocera longipedata (Tables 3.2-31 and 3.2-32; Figure 3.3-24)

This large calanoid copepod had an interesting vertical distribution pattern (Section 3.2.1); males were predominant in the day neuston samples. Females appeared in night neuston samples and were found deeper in the water column during the day.

E. longipedata was absent during March and April and attained its maximum density collected with bongo nets during November (3.7 individuals per 1000 m^3 inshore and 6.5 per 1000 m^3 offshore). The August and November inshore cruises were the only cruises to average densities significantly different from zero. The areas of greatest abundance were Izhut Bay and North Albatross Bank.

3.2.3.13 Centropages abdominalis (Table 3.2-33 and 3.2-34; Figures 3.3-25 and 3.3-26)

Mean densities of Centropages abdominalis were 0.25 individuals m^{-3} inshore and 0.004 m^{-3} offshore. However, this difference was not statistically significant as the data were highly variable and this species is strongly seasonal.

C. abdominalis exhibited a summer predominance pattern with a maximum mean density inshore during August of 23.78 m^{-3} and during the offshore summer cruise of 9.05 m^{-3}. It was more common in the southern than northern bays during 11 of the 12 inshore cruises. Offshore the only significant difference found was between the slope and nearshore zones during November. Relatively high densities occurred over North Albatross Bank during the summer cruise. During summer and fall C. abdominalis was relatively dense in the nearshore zone off the southern bays.

3.2.3.14 *Scolecithricella minor* (Tables 3.2-35 and 3.2-36; Figures 3.3-27 to 3.3-30)

Scolecithricella minor reached its maximum density during March and April inshore, then declined to very low densities by late July. A similar, though less obvious, seasonal pattern prevailed offshore. Mean observed densities were 0.01 m^{-3} and 0.10 m^{-3} for bay and shelf samples, respectively. The maximum densities were 1.37 m^{-3} and 2.72 m^{-3}, respectively. The same pattern of offshore areal differences observed in *Centropages abdominalis* in November held for *S. minor*.

3.2.3.15 *Oithona* spp. (Tables 3.2-37 and 3.2-38; Figures 3.3-31 to 3.3-34)

Oithona spinirostris and *O. helgolandica* together were the seventh most common taxon in the bays with a geometric mean density of 0.16 m^{-3}, and were the fifth most common over the shelf (0.13 m^{-3}). The period of greatest average abundance inshore was in August when the mean density for all bays was 2.83 m^{-3}. Kaiugnak Bay had the highest single abundance (8.4 m^{-3}) during late August. The southern bays had higher mean densities than the northern ones, although the highest single abundance observed in any bay was in Izhut Bay during late April (34.2 m^{-3}). The lowest mean monthly density (0.06 m^{-3} in 1978, 0.05 m^{-3} in 1979) of *Oithona* spp. inshore occurred in March.

Offshore, there were more *Oithona* spp. individuals m^{-3} during November than during the other cruises. This density (1.47 m^{-3}) was close to the inshore value (1.53 m^{-3}) during November. The only significant offshore areal difference observed was between the nearshore (0.13 m^{-3}) and slope zones (1.28 m^{-3}) during the winter cruise. There was also a consistently high density in the area south of Kaiugnak and

Kiliuda Bays during the spring, summer, and fall cruises. No other differences were apparent.

3.2.3.16 Total Euphausiids (Table 3.2-39)

Euphausiids were enumerated in Kiliuda and Izhut Bays. There was a higher density of both adult euphausiids and larval stages in Izhut Bay than in Kiliuda Bay. When all stages were combined, the euphausiids were the second most abundant major taxonomic group in both the inshore and offshore areas (Rogers et al. 1979b, Dunn et al. 1979, Kendall et al. 1980). The highest densities found offshore were over the inner midshelf where the nearshore species and the ones characteristic of the slope and outer midshelf, overlapped in distribution (Dunn et al. 1979, Figures 30 to 47).

3.2.3.17 Total Amphipods (Tables 3.2-40 and 3.2-41; Figures 3.3-35 to 3.3-38)

The only common amphipod collected in most of the study area was *Parathemisto pacifica*. Over the slope zone, however, *Cyphocaris challengeri* and *Primno macropa* comprised ten to twenty percent of the total numbers collected. Few benthic gammarid amphipods were observed in any samples. The patterns observed, consequently, were largely those of *P. pacifica*.

The mean densities observed were 0.04 m^{-3} and 0.09 m^{-3} inshore and offshore respectively. *Parathemisto pacifica* was significantly more common inshore between July and November than between March and June.

3.2.3.18 Total Ostracods (Tables 3.2-42 and 3.2-43; Figures 3.3-39 to 3.3-42)

Ostracods, like amphipods, were predominantly one species, Conchoecia alata minor. C. alata minor was most common during March over the entire study area. It was absent from mid-July through August in the bays and was rare during the summer offshore cruise. The geometric mean densities were 0.4 and 5.2 individuals per 1000 m^3 inshore and offshore, respectively. Ostracods were significantly more abundant over the continental slope than elsewhere over the shelf during the summer and fall cruises. They tended to be less common southeast of Kiliuda and Kaiugnak Bays.

3.2.3.19 Total Cladocerans (Tables 3.2-44 and 3.2-45)

Cladocerans were absent offshore, except for a few specimens collected at nearshore and bank stations during the summer and fall cruises. Inshore this taxonomic group was third most abundant after copopods and euphausiids; however, during their increase in July and August, Podon spp. and Evadne spp. became more abundant than the copepods and euphausiids combined at seven of the inner bay stations. The maximum density (2,438 m^{-3} was found at Izhut Bay Station Z8 during early August.

3.2.3.20 Larvaceans (Tables 3.2-46 to 3.2-49; Figures 3.3-43 to 3.3.46)

Three species of larvaceans were identified from the Kodiak samples. The genus Oikopleura was the ninth most abundant taxon inshore and twelfth most abundant offshore. Larvaceans were the fourth most common major taxonomic group throughout the study area. Numbers of larvaceans averaged 0.08 m^{-3} in the bays and 0.03 m^{-3} over the shelf. The largest mean inshore Oikopleura density was 68.82 individuals m^{-3} in Kiliuda Bay during early August. A second, smaller density maximum of Oikopleura spp. was observed in April. These two population maxima reflected the presence of two species of Oikopleura in the samples. O.

labradorensis was the only species found off of Kodiak during April, while O. dioica was more common during the summer and was primarily responsible for the early August peak. The third larvacean species, Fritillaria borealis, was two orders of magnitude less numerous inshore than Oikopleura spp.

The largest geometric mean density of larvaceans collected offshore was 0.24 m^{-3} during the June-July 1978 cruise. There were no significant differences in offshore density between either cruises or areas. Larvaceans tended to be more abundant in the southwest area during the summer cruise and over the Kiluda Trough and Southern Middle Albatross Bank throughout the year than elsewhere offshore.

3.2.3.21 Limacina helicina (Tables 3.2-50 and 3.2-51; Figures 3.3-47 to 3.3-50)

This species was the only pelagic mollusc commonly found. It had a geometric mean density of 0.05 m^{-3} inshore and 0.10 m^{-3} over the shelf. This was high enough to make the major taxonomic group of pteropods the sixth most common group inshore and seventh offshore. Limacina helicina attained its largest observed density during late August inshore and during November offshore. There were no significant seasonal or areal differences, nor were there any consistent spatial patterns offshore.

3.2.3.22 Chaetognaths (Tables 3.2-52 to 3.2-55; Figures 3.3-51 to 3.3-54)

Chaetognaths were the third most abundant major taxonomic group offshore and seventh most abundant inshore. The highest densities found were in the November samples. The November inshore densities were significantly higher than the inshore densities at other times of the year. Kiliuda Bay and the southwest area offshore had the highest mean densities in November (2.11 and 1.83 m^{-3}, respectively). The highest mean density by cruise moved southward through each bay from March through July for all chaetognaths. After July the highest mean density returned northward for Eukrohnia hamata. There was no clear pattern for Sagitta spp. during this period. The sampling frequency offshore was insufficient to detect any similar trends. The most consistent off-shore spatial features were density depressions over the slopeside edges of North and South Albatross Banks.

3.2.3.23 Cnidarians (Tables 3.2-56 and 3.2-57; Figures 3.3-55 to 3.3-58)

Differences in the density of cnidarians tended to be small and statistically insignificant. The mean density of this taxonomic group throughout the study area was 0.03m^{-3}. Cnidarians were slightly more common in the bays and the nearshore than over the midshelf and continental slope; however, the only significant difference found was a higher density in February-March 1979 over the slope (0.41m^{-3}) than in the nearshore area (0.06m^{-3}). The highest geometric mean density observed inshore was 4.73m^{-3} during mid-June in Kiliuda Bay.

3.3 Relationships Between Holozooplankton Patterns, Bathymetry and Hydrography

The abundance of 20 important taxa of holozooplankton, as measured by $\log_{10}$ (numbers per m^3 + 0.0001), was correlated with salinity and temperature at 25 m and depth of the water column at the sampling location. Correlations were considered significant when $p \leq 0.05$.

Two broad contrasts were observed: increasing abundance with high temperatures and low salinities or with low temperatures and high salinities (probably a seasonality response); and a deep-water versus shallow water/inshore response. Some groups (discussed below) responded to only one set of contrasts and others to both; five groups, cnidarians, euphausiids, Limacina helicina, Epilabidocera longipedata and Oithona spp., exhibited no significant correlations with the selected factors.

Increased abundance occurred with high temperatures and low salinities for Calanus marshallae, Pseudocalanus spp., the larvaceans and total copepods. Taxa increasing in abundance with these factors along with a shallow water station location were Acartia longiremis, Centropages abdominalis and the cladocerans, while taxa significantly associated with high temperatures, low salinities and a deep station location were Eucalanus bungii and the amphipods. All of these organisms can be considered late spring-summer dominants with variable depth responses.

The alternative pattern of an increase in abundance with decreasing temperature and increasing salinity may be due either to cross-correlation with increasing station depth or a winter predominance pattern. These factors were not separable for Calanus cristatus or the ostracods. The increase of Calanus plumchrus, however, was related only to decreasing temperature and increasing salinity, while Acartia tumida is correlated to these two trends and decreasing station depth. These last two species may be true winter-early spring predominants. The abundance of the remaining two taxa, *Metridia* spp. and the chaetognaths, were correlated only with increasing depth.

Analysis of these correlations suggest that seasonality of hydrographic characteristics is more important than bathmetry for the holozooplankton though there were station depth relationships in selected groups. These are not strong correlations as the water temperature and salinity measurements came from a single depth and were not available for offshore. No apparent correlation between the abundance of any of the groups and water column hydrocarbon (primarily methane) concentrations was found; however, the latter data were sparse, so a strong correlation would have had to be present for it to be detected.

3.4 Relationships Between Holozooplankton Patterns and the Distribution of Higher Trophic Levels

3.4.1 Holozooplankton Predators

Extensive investigations of the relative impact of different types of planktivores upon zooplankton have been performed in freshwater ecosystems (Zaret 1980). Comparable marine examples were almost nonexistent. Marine studies have been more oriented toward plankton consumption rates and electivities by fisheries stocks as fry or forage species (Cushing 1968). Relative impacts of and competition by invertebrate predators, marine birds and baleen whales have been less documented. Cnidarians in inshore locations, e.g., Saanich Inlet (Huntley and Hobson 1978), however, have been found to control zooplankton numbers rather than fish. *Centropages abdominalis* and *Metridia* spp. were the only important holozooplankton negatively correlated with cnidarians in this study. More taxa were significantly positively correlated with cnidarian densities, suggesting that cnidarians may be relatively unimportant to the groups they covary with off Kodiak. A similar relationship prevailed with chaetognaths, another important invertebrate planktivore, with Acartia tumida being the only common copepod negatively correlated with chaetognath density. The lack of negative correlations between invertebrate planktivores and their prey off Kodiak Island suggests that these predators may comprise a relatively minor foodweb component in the study area.

3.4.2 Ichthyoplankton and Decapod Larvae

Rogers et al. (1979a) reported total ichthyoplankton densities in excess of 1 m^{-3} from early July (Cruise 7CM) through August (10 CM) at many of the bay stations. The innermost stations in Izhut (Z1, Z6, Z7, and Z8) and Chiniak (C1) during July reached densities over 10 per m^3. Density contrasts were greatest within Izhut and Chiniak Bays as the outer stations there had the smallest numbers of fish larvae collected. Osmerids, including capelin, comprised 90% of the ichthyoplankton collected inshore.

Dunn et al. (1979) reported that offshore ichthyoplankton was most abundant in the summer, and that marked seasonal predominance of different taxa occurred. Fall and winter samples were dominated by larval capelin and Irish lords, spring by sandlance and pollock fry and summer by larval rockfish and bathymasterids (ronquils and searchers). Kiliuda Trough had the highest concentrations of total ichthyoplankton throughout the year, though capelin were commonest over North Albatross Bank and substantial numbers of several species were collected in the nearshore zone.

The inshore zooplankton were most abundant during mid-summer, the period of greatest total ichthyoplankton abundance within the bays. Changes in zooplankton densities between bay stations (i.e., spatial or horizontal variability) seemed to be inversely related to the changes in density of ichthyoplankton at those stations. Offshore zooplankton were abundant over Kiliuda Trough and positively related to total ichthyoplankton. This pattern was not apparent for copepods over North Albatross Bank. The variable relationship between total ichthyoplankton and the major zooplankton taxa may be due to feeding by larval capelin upon zooplankton as well as the distribution and abundance of this species in the ichthyoplankton.

Dunn et al. (1979) analyzed the decapod larvae from both sections of the Kodiak Shelf area. All decapod larvae had either a spring, summer, or intermediate seasonal distribution pattern, similar to that of most of the zooplankton groups. No horizontal distributional relationships were apparent between decapod larvae and any major group of zooplankton.

The lack of any strong relationship in horizontal distribution, either positive or negative, implied that any predation by decapod larvae probably had a minor impact upon zooplankton populations and that probably no major zooplankton taxon was particularly important to the decapod larvae off Kodiak.

3.4.3 Juvenile Fish

Insufficient data was available for direct comparisons of Kodiak Shelf zooplankton densities and juvenile fish populations. There appeared to be a weak relationship offshore between the described distribution of juvenile pollock and catch rates of adult pollock (SAI 1980) and the distribution of copepods and euphausiids, particularly Euphausia pacifica and Thysanoessa spinifera. These species are food items of juvenile pollock (Rogers, et al. 1979b).

3.4.4 Planktivorous Forage Fish

Herring were concentrated in the bays and nearshore area of the Kodiak archipelago (SAI 1980). High densities were found in all four bays studied (Harris and Hartt 1977; Rogers et al. 1979a; SAI 1980). This distribution was strongly related to the high densities of copepods and cladocerans found in the bays. Copepods and cladocerans are important food items of the herring (Wespestad and Barton 1979).

Capelin were the most common fish collected in the pelagic zone of the Kodiak bays studied by Harris and Hartt (1977) and were one of the most abundant pelagic species found offshore, except over the slope (SAI 1980). Smelt larvae, probably capelin, predominated in the ichthyoplankton of the four bays studied (Rogers, et al. 1979a). The highest density of larval capelin in the bays was June through August (Rogers, et al. 1979a). The adults moved into the bays in May (Harris and Hartt 1977), coinciding with a drop in bay zooplankton density in May and then a subsequent increase June through August when the adults were spawning, but not eating.

Offshore, the greatest density of larval capelin was from September onward over North Albatross Bank (Kendall, et al. 1980). Little density information was available on the seasonal distribution of the post-larval stages offshore (SAI 1980). There appeared to be a positive relationship between capelin and the zooplankton horizontal distribution inshore, and an inverse relationship seasonally. This relationship was not as well-defined, but appeared to exist offshore as well.

Atka Mackerel were found only in the epipelagic zone over the continental slope of the Kodiak Shelf (SAI 1980). Larval Atka mackerel were most abundant over the slope, Kiliuda Trough and the southern part of Middle Albatross Bank in the surface waters during the fall and winter (Dunn, et al. 1979; Kendall, et al. 1980). This is the same area where the euphausiids, Thysanoessa longipes and Euphausia pacifica, attained their greatest densities (mean densities of 137 and 59 per 1000 m^3, respectively, Dunn et al. 1979). Nothing is known about the food habits of the Atka mackerel; however it is believed to retain the food preferences of the pelagic juveniles of other species in its family (Kendall, et al. 1980). Pelagic specimens of this family in Kodiak bays ate mainly calanoid copepods, decapod zoea and euphausiids (Harris and Hartt 1977). There was an inverse relationship between the densities of copepods, Thysanoessa longipes and Euphausia pacifica and the density of larval Atka mackerel during the fall and winter.

Pacific sand lance were found throughout the study area (SAI 1980), though this species was more abundant as adults in the nearshore area (Macy, et al. 1978). This distribution was weakly related to the distribution of copepods, an important food item of sand lance (Harris and Hartt 1977; Rogers, et al. 1979b).

3.4.5 Marine Birds

The distribution and abundance of shearwaters in the spring and summer off Kodiak Island (SAI 1980) was positively related to the distribution and abundance of euphausiids (Kendall, et al. 1980) and less strongly, though positively, related to the density of total copepods. The bulk of the diet of shearwaters off Kodiak was composed of euphausiids and capelin (Sanger, et al. 1978). Since the capelin off Kodiak fed calanoid copepods and euphausiids (Harris and Hartt 1977; Rogers et al. 1979b), the relationships observed were probably casually-determined.

The distribution of flocks of two of the three next most common pelagic birds, the Tufted Puffin and the Black-legged Kittiwake, (SAI 1980) relate strongly to the described distribution of larval capelin off-shore of Kodiak (Kendall, et al. 1980) and weakly to the distribution of euphausiids and copepods. There was insufficient distributional data available for other birds (e.g., the small alcids) to compare distributions to zooplankton data.

3.4.6 Baleen Whales

Five species of baleen whales have been observed in the study area: the humpback, minke, fin, sei, and blue whales (NODC file data; SAI 1980). A total of 198 individuals were counted; humpback and minke whales were the most abundant species. The distribution of humpback and minke whale sightings were concentrated over the troughs, particularly Kiliuda, and the southern part of Middle Albatross Bank (SAI 1980). There was an apparent relationship between this distribution and spring-summer populations of euphausiids and copepods, especially late copepodites of Calanus cristatus. Euphausiids, copepods and planktivorous forage fish are the sole food items of humpback and minke whales (Nemato 1970; Nishiwaki 1972), suggesting a casual relationship.

3.5 Significance of Selected Holozooplankton to the Trophic Dynamics of the Kodiak Shelf

The copepods, euphausiids and cladocerans inshore appeared to be major prey for higher trophic levels. Chaetognaths, larvaceans and amphipods may also have some value as food. The distribution of cnidarians, pteropods and ostracods apparently had little relationship to the presence of higher predators, mainly because their biomass was relatively insignificant compared to the other groups.

The distribution of the larger copepods (Calanus spp., Metridia spp. and possibly Eucalanus bungi and Epilabidocera longipedata) along with that of the most abundant taxon of smaller copepod, Pseudocalanus spp., seemed to be related to the distribution of higher predators. The distribution of the smaller, less common copepods did not appear to be as closely related to the distribution of the higher predators. Relationships between euphausiids and higher predators were also apparent, e.g., Thysanoessa longipes, T. spinifera and Euphausia pacifica with the Atka mackerel and pollock.

The higher predators related to zooplankton distribution and abundance included holoplanktonic cnidarians and chaetognaths, ichthyoplankton, herring, capelin, Atka mackerel, shearwaters and two species of baleen whales (the humpback and minke). The spatial distribution of juvenile salmonids was also probably related to zooplankton distribution and abundance, given what the Kodiak stocks are known to eat. The capelin and Atka mackerel were the only predators related to obvious decreases in zooplankton densities. Since no information on feeding rates of planktivorous predators is available, we can not be certain at this time which predators have the greatest effect on Kodiak zooplankton population dynamics, despite these suggestive relationships.

3.6 Recommendations for Future Studies

Future studies concerning the zooplankton of the Kodiak shelf area should first address objectives which were not met by the present study. This would include both further analysis of the existing data sets and additional data collection. Hydrocarbon toxicity studies are lacking for the majority of the Kodiak shelf zooplankton. Future studies should also address the actual development of the oil and gas lease areas and should include an appropriate monitoring program.

The present study succeeded in describing the distribution and abundance of holozooplankton over the Kodiak shelf, but was largely unsuccessful in establishing the relationship of the holozooplankton to biotic and abiotic environmental factors. Future studies should specifically investigate and assess the importance of these relationships.

Our results suggested that the patterns of distribution and abundance of holozooplankton over the Kodiak shelf are mainly controlled by biotic environmental factors (disregarding seasonality). Food availability for the zooplankton should be better described, and should include information on both phytoplankton and microzooplankton. Even more important, though, is information concerning the predation selectivity of the predator species of interest in the study area. These include ichthyoplankton, capelin, herring and pelagic juvenile fish. The food habits of the Atka mackerel are completely unknown and may bear significantly on the Kodiak shelf zooplankton.

The present study has identified the key zooplankton species on the Kodiak shelf. These are the copepods, Calanus cristatus, C. plumchrus, C. marshallae, Pseudocalanus spp., Metridia pacifica, Acartia longiremis and Oithona spp.; the euphausiids, Euphausia pacifica, Thysanoessa inermis, T. raschii, T. spinifera and T. longipes; the amphipod, Parathemisto pacifica; the cladoceran, Podon leuckarti; the chaetognaths, Sagitta elegans and S. scrippsae; and the larvaceans, Oikopleura spp. Very little data exists on the toxicity of hydrocarbons to the 17 key taxa listed above. Laboratory toxicity studies are needed for the most important zooplankton species, and for larval fish and decapods and juvenile salmonids. Larval forms studied should include those of the herring, capelin, shrimp, and King, Tanner and Dungeness crabs.

Some of the remaining objectives of the present study could be met with a comparison of the existing but unavailable biological data sets with the zooplankton data generated here. Such a study would require a substantial amount of effort to get all of the existing data sets (e.g., birds, ichthyoplankton) into a single data base for statistical comparisons. The National Oceanic Data Center might be used since OCSEAP data are at least compatible to this system.

4.0 ACKNOWLEDGMENTS

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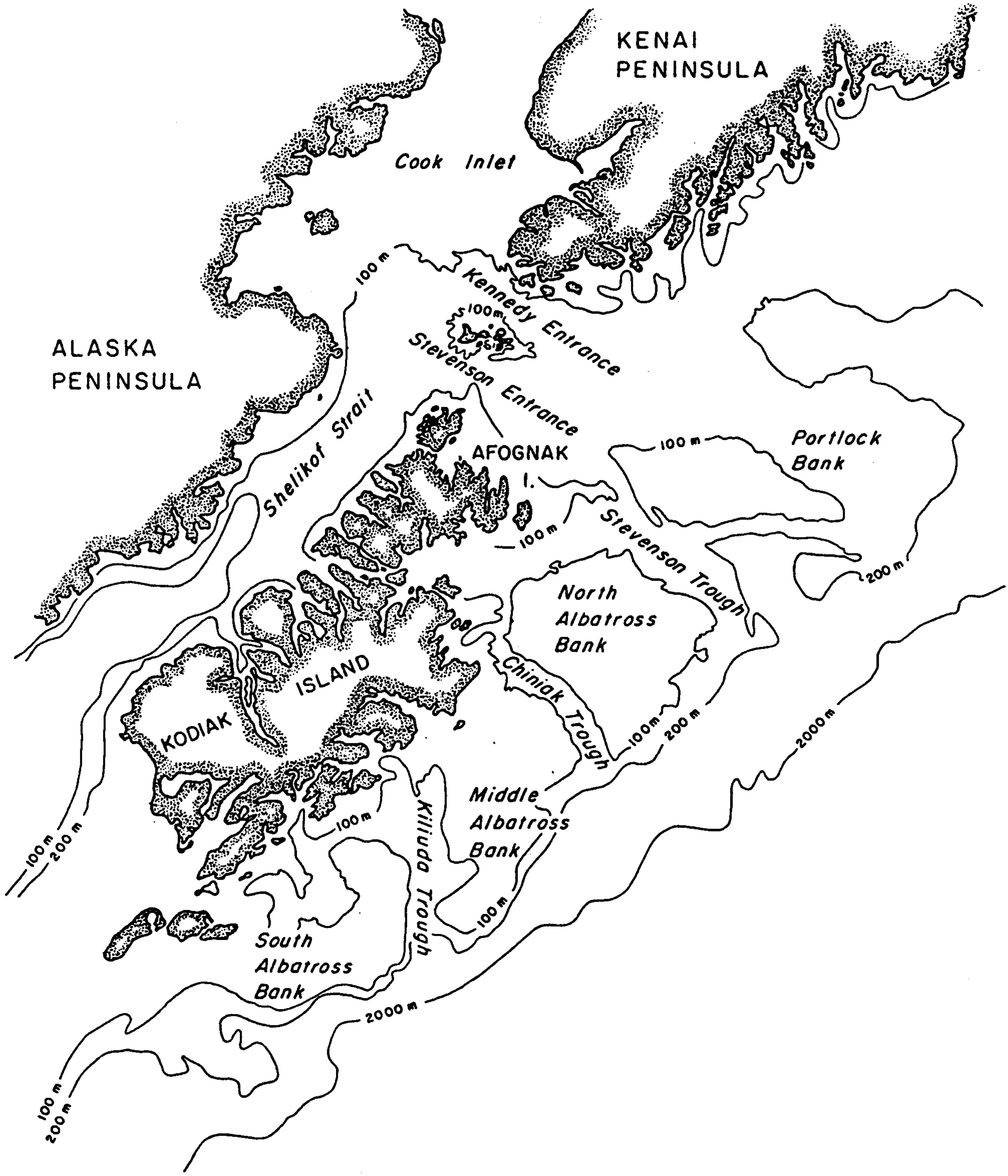
Thanks are in order to the following persons in our laboratory for their hard work and dedication in counting and identification of the samples: Harold B. Batchelder, Richard E. Conway, Joan D. Flynn, Judith L. Froggatt, Douglas A. Milward, Margaret C O'Brien, and Ronald A. Simmons. Data management and processing were handled internally by Margaret C. O'Brien and Williey D. Knox and by John J. Audet, Michael L. Crane, Dean Dale and Sid Halminski of NOAA. Assistance in data analysis was provided by Joan D. Flynn, Williey D. Knox, Margaret C. O'Brien, and Ronald A. Simmons. Barbara J. Priest prepared some of the graphs used in this report. Thanks are due to all of these people.

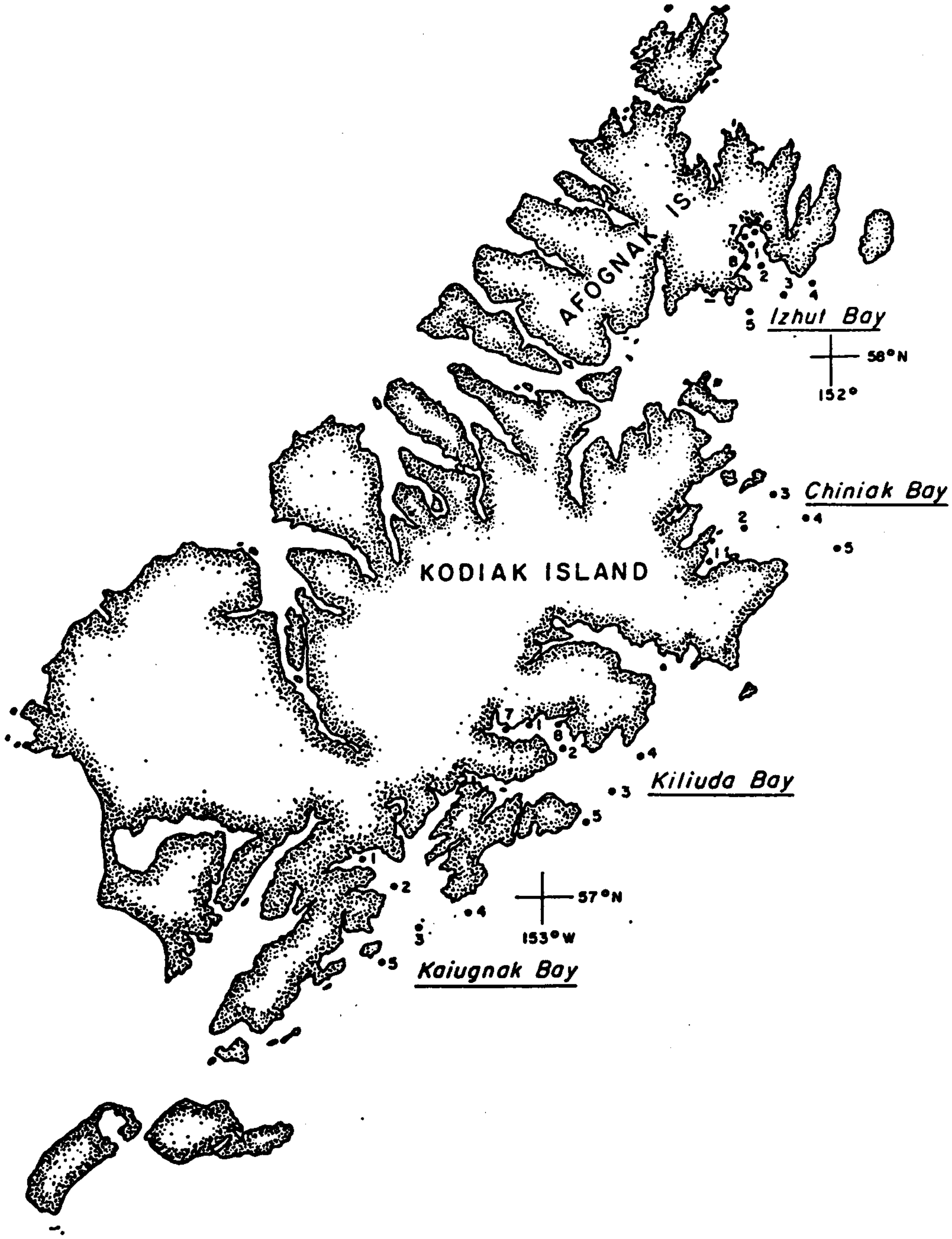
We thank Dr. William T. Petereson of SUNY-Stony Brook and Jeffrey Cordell of the University of Washington for taxonomic verification of *Calanus* spp. and identification of *Harpacticus* sp., respectively. Dr. Peterson also critically reviewed the manuscript.

We also wish to acknowledge the support received from Dr. Steven T. Zimmerman, our NOAA Technical Contact Officer in Juneau. Finally, a word of thanks is in order to our spouses and friends and the administrative staff of VTN Oregon who cheerfully supported us during the writing and editing of this report.



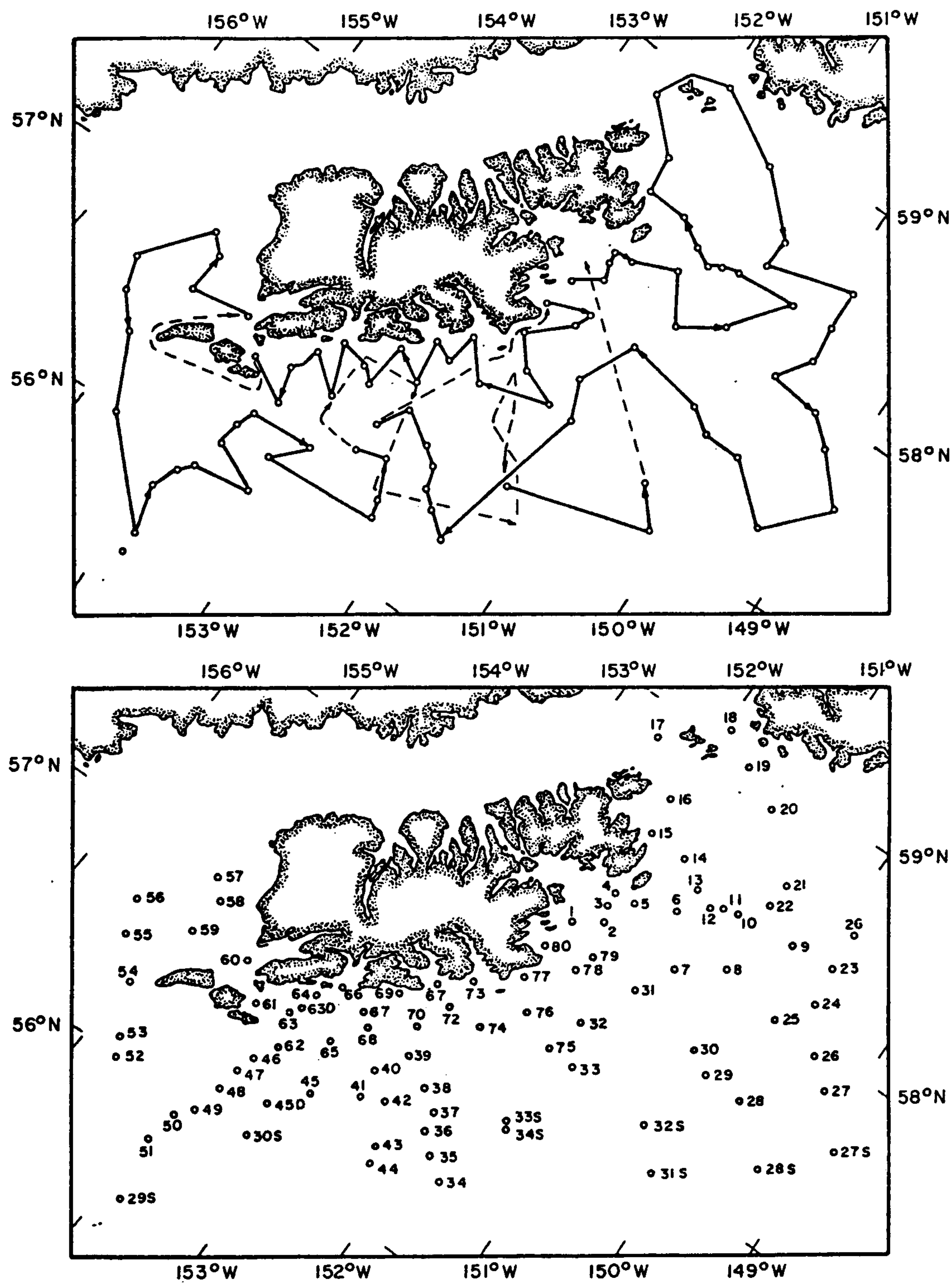
Kodiak Island study area depicting general bathymetry.

Figure 1.3-1



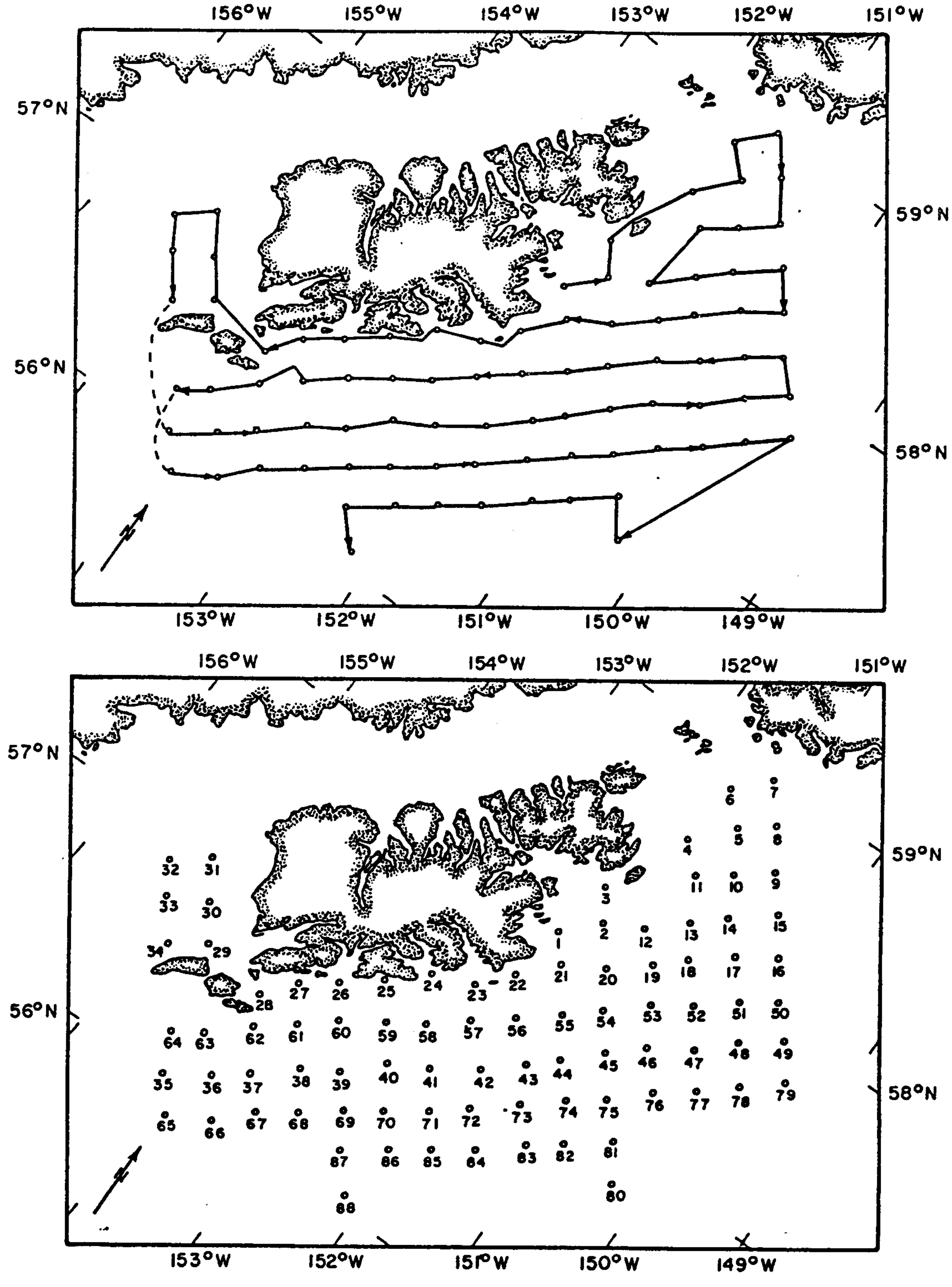
Bays and sampling locations of the inshore region of the Kodiak Island study area.

Figure 1.3-2



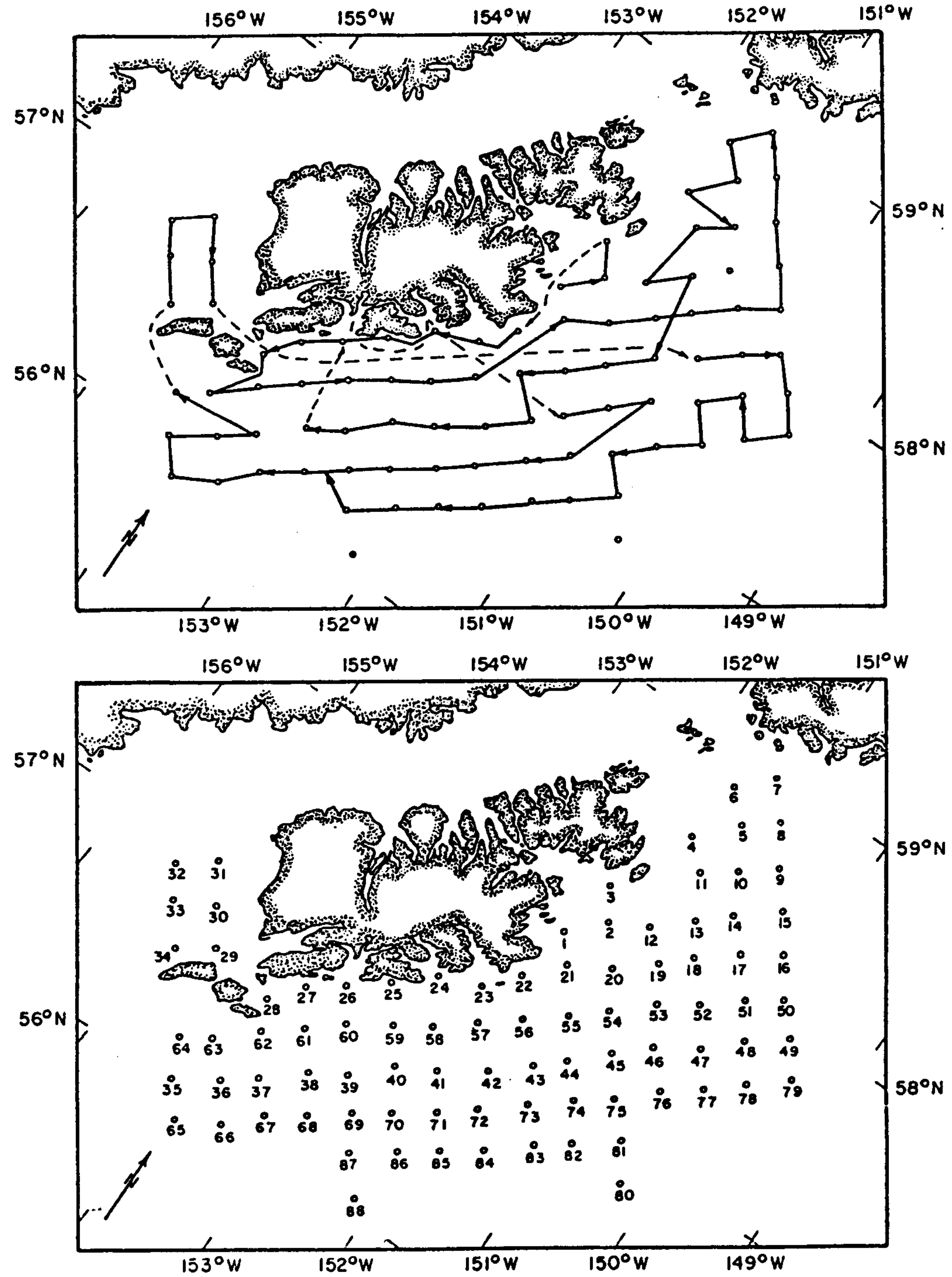
Cruise track (top) and station locations (bottom) for cruise 4DI78, spring 1978 (after Dunn et al. 1979).

Figure 2.1-1



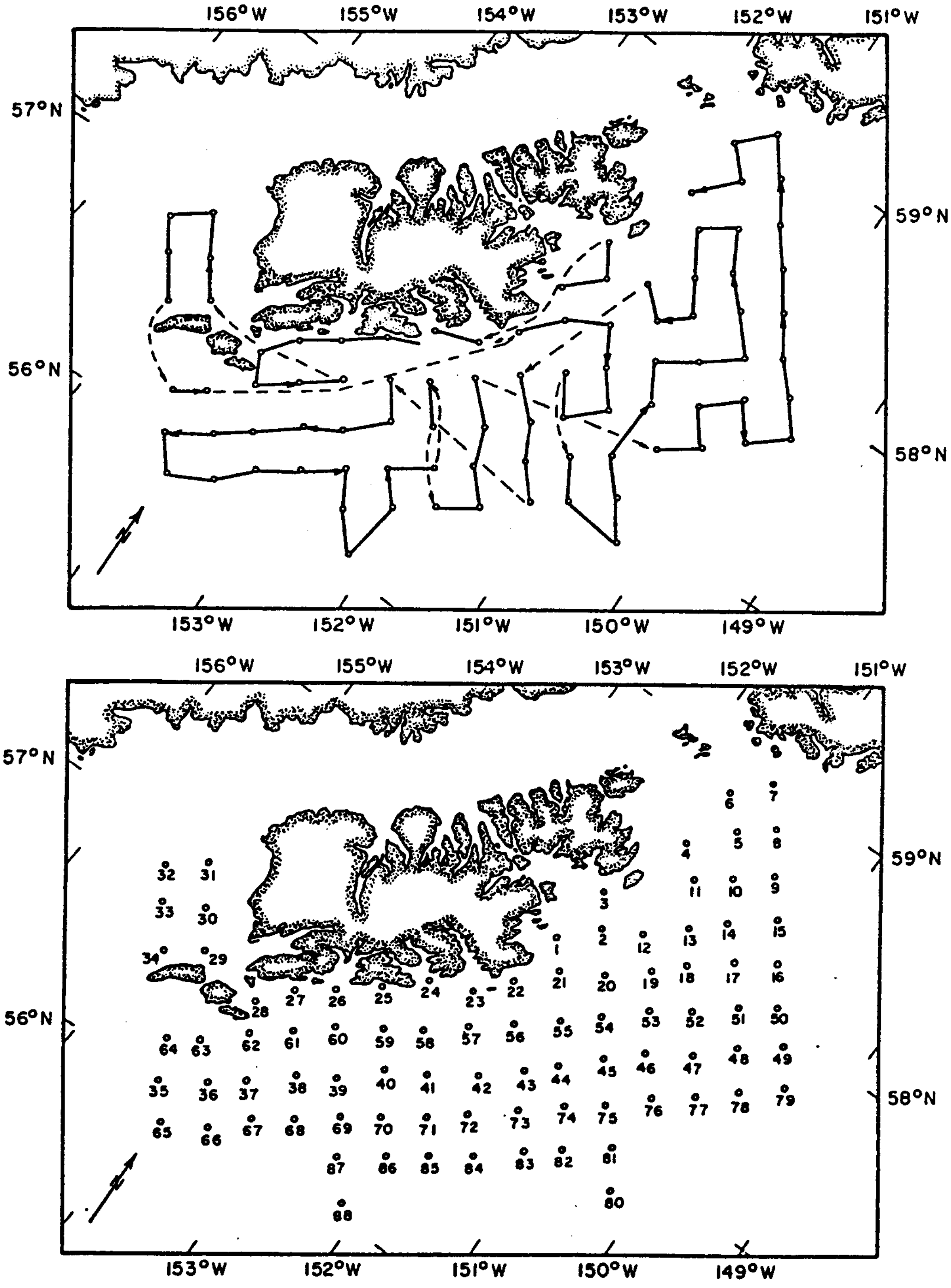
Cruise track (top) and station locations (bottom) for cruise 2MF78, summer 1978 (after Dunn et al. 1979).

Figure 2.1-2



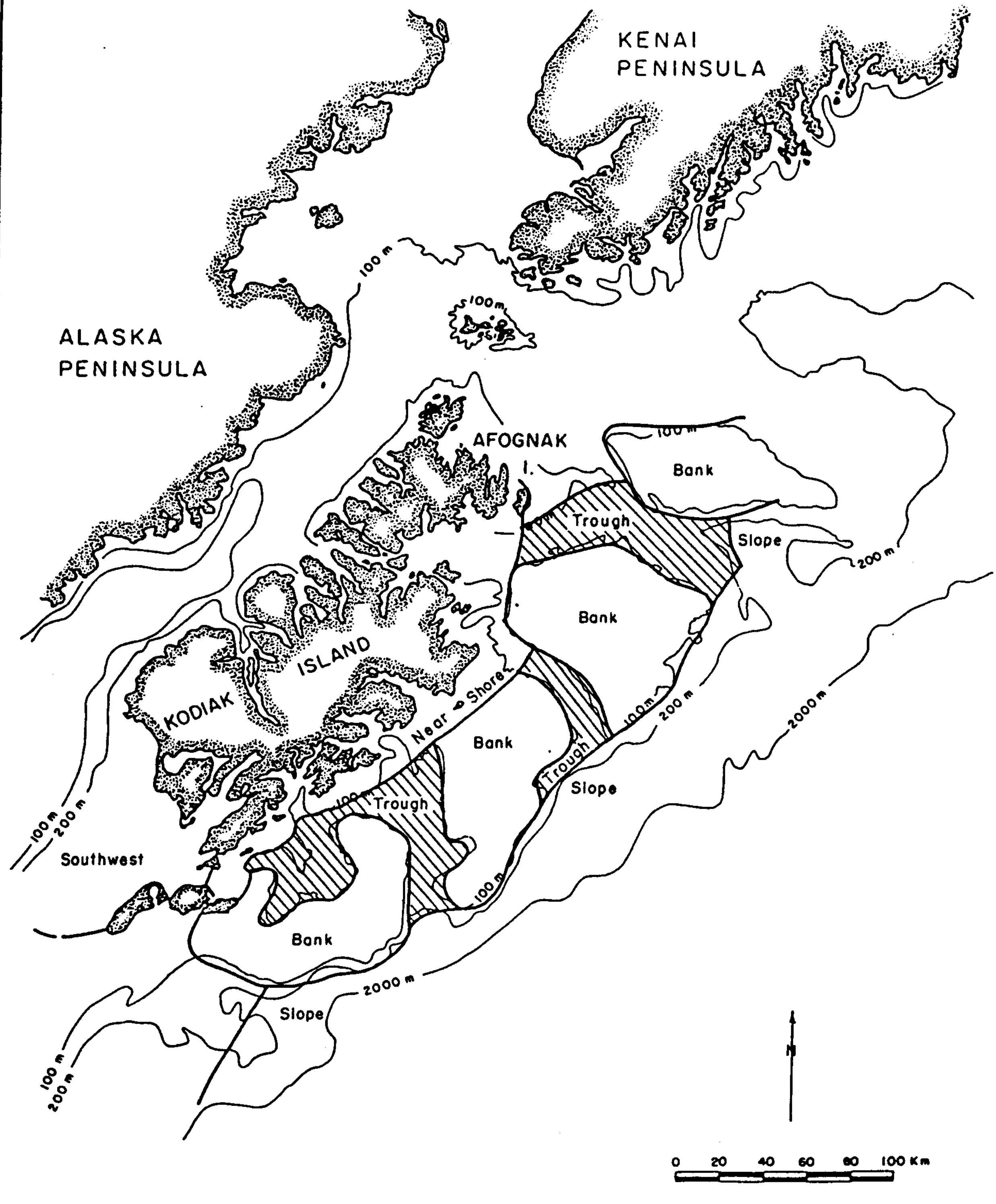
Cruise track (top) and station locations (bottom) for cruise 1WE78, fall 1978 (after Dunn et al. 1979).

Figure 2.1-3



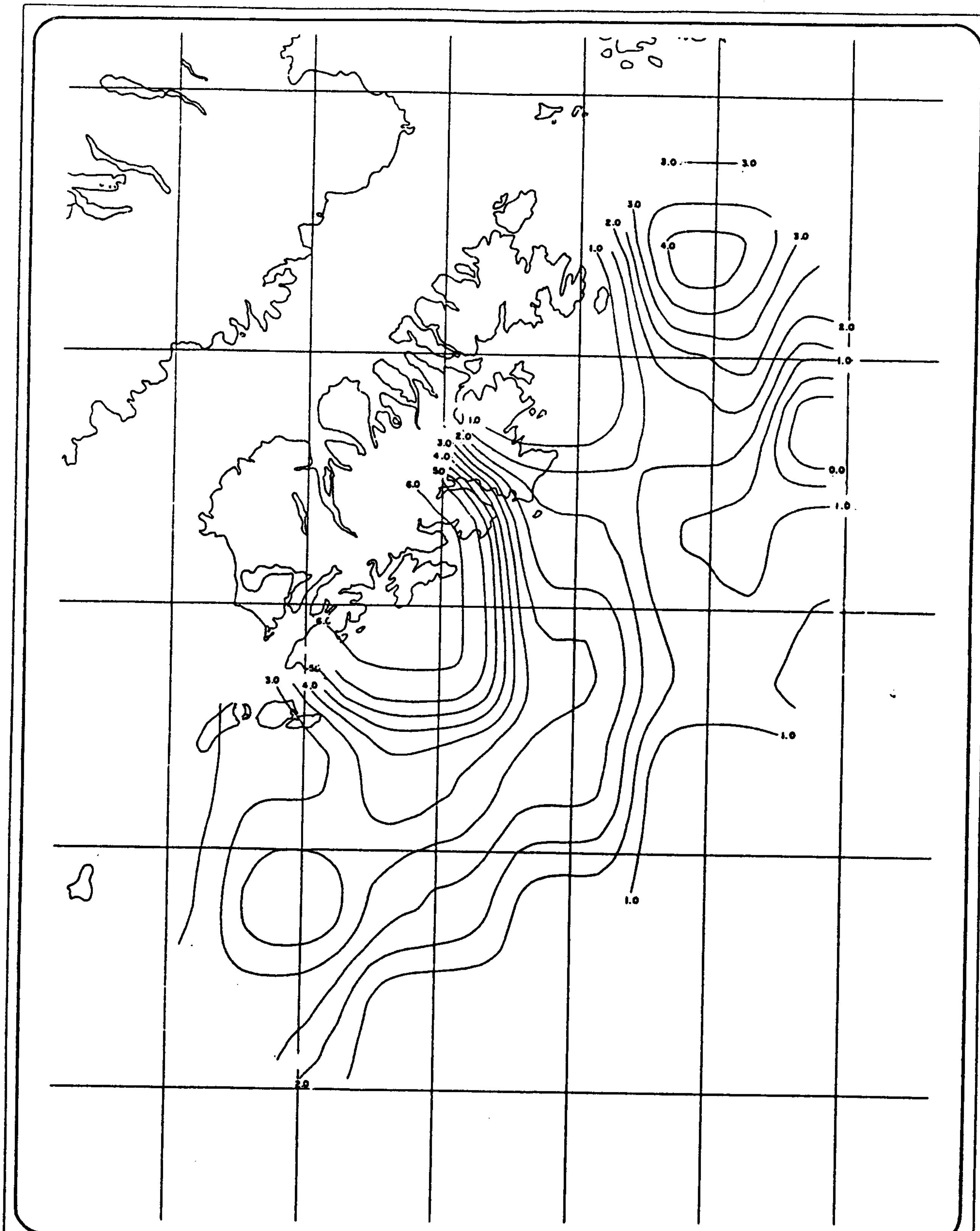
Cruise track (top) and station locations (bottom) for cruise 1MF79, winter 1979 (after Dunn et al. 1979).

Figure 2.1-4



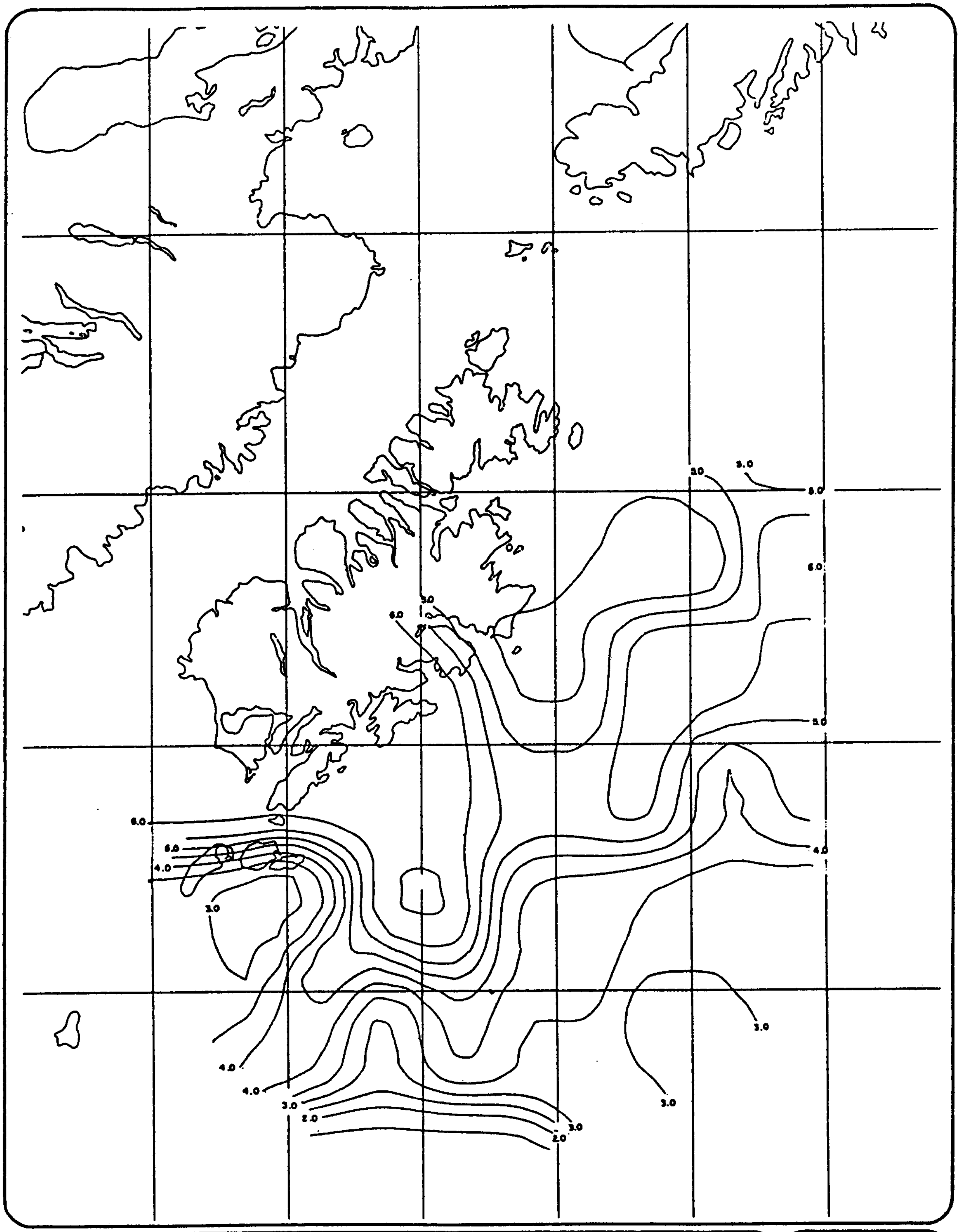
Offshore subareas of the Kodiak Island study area.

Figure 2.4-1



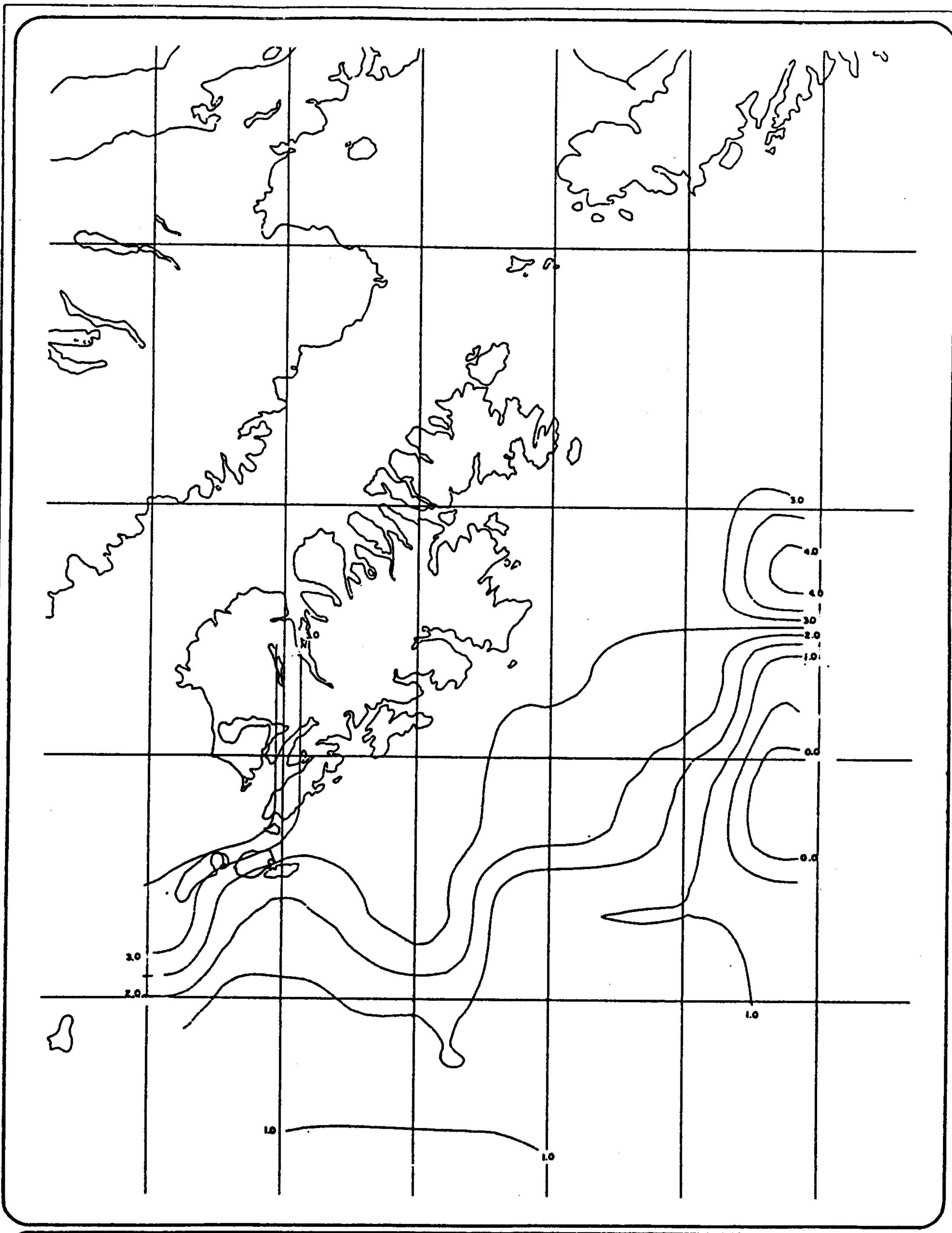
Distribution and abundance of total copepods in bongo tows from cruise 4DI78.

Figure 3.3-1



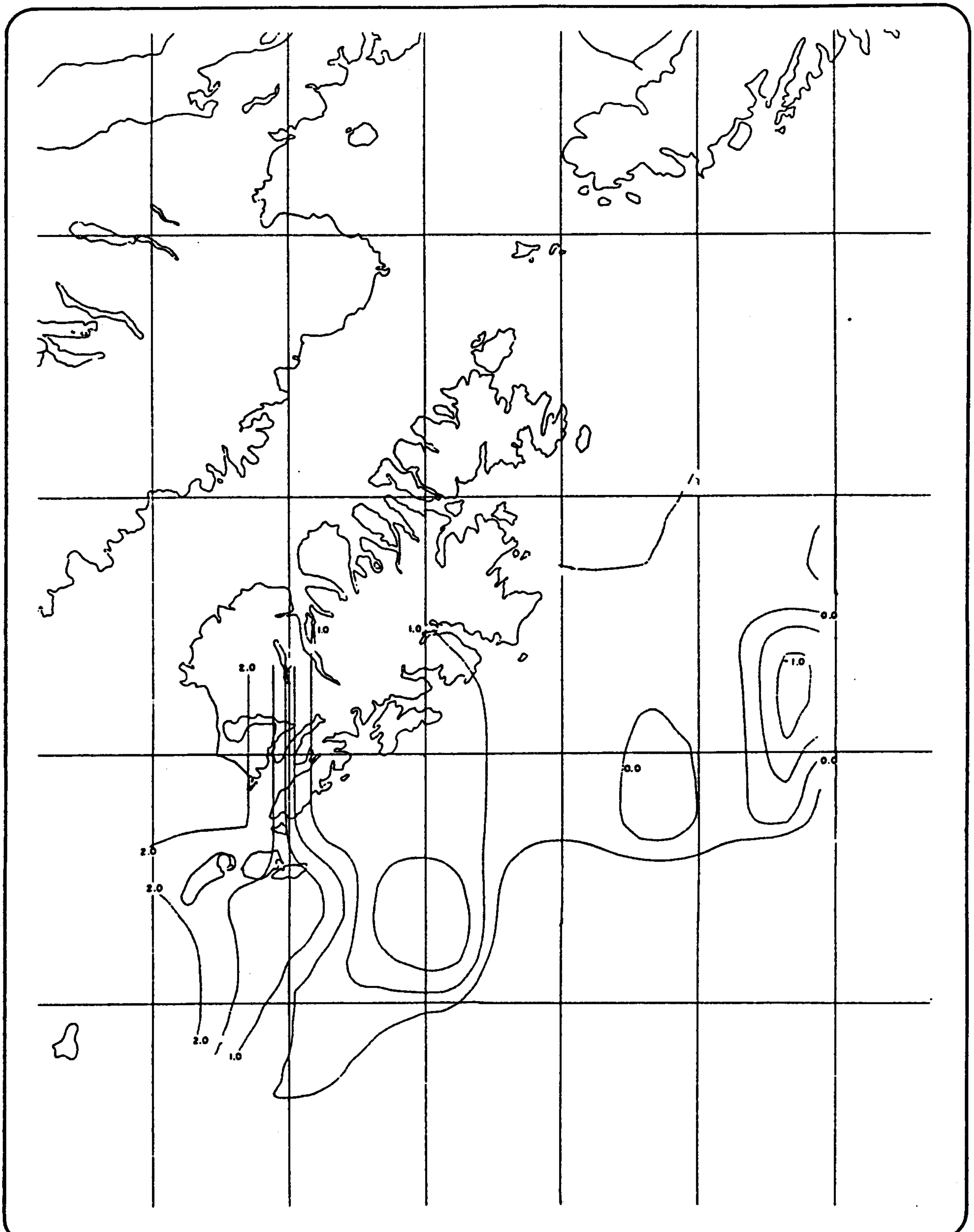
Distribution and abundance of total copepods in bongo tows from cruise 2MF78.

Figure 3.3-2



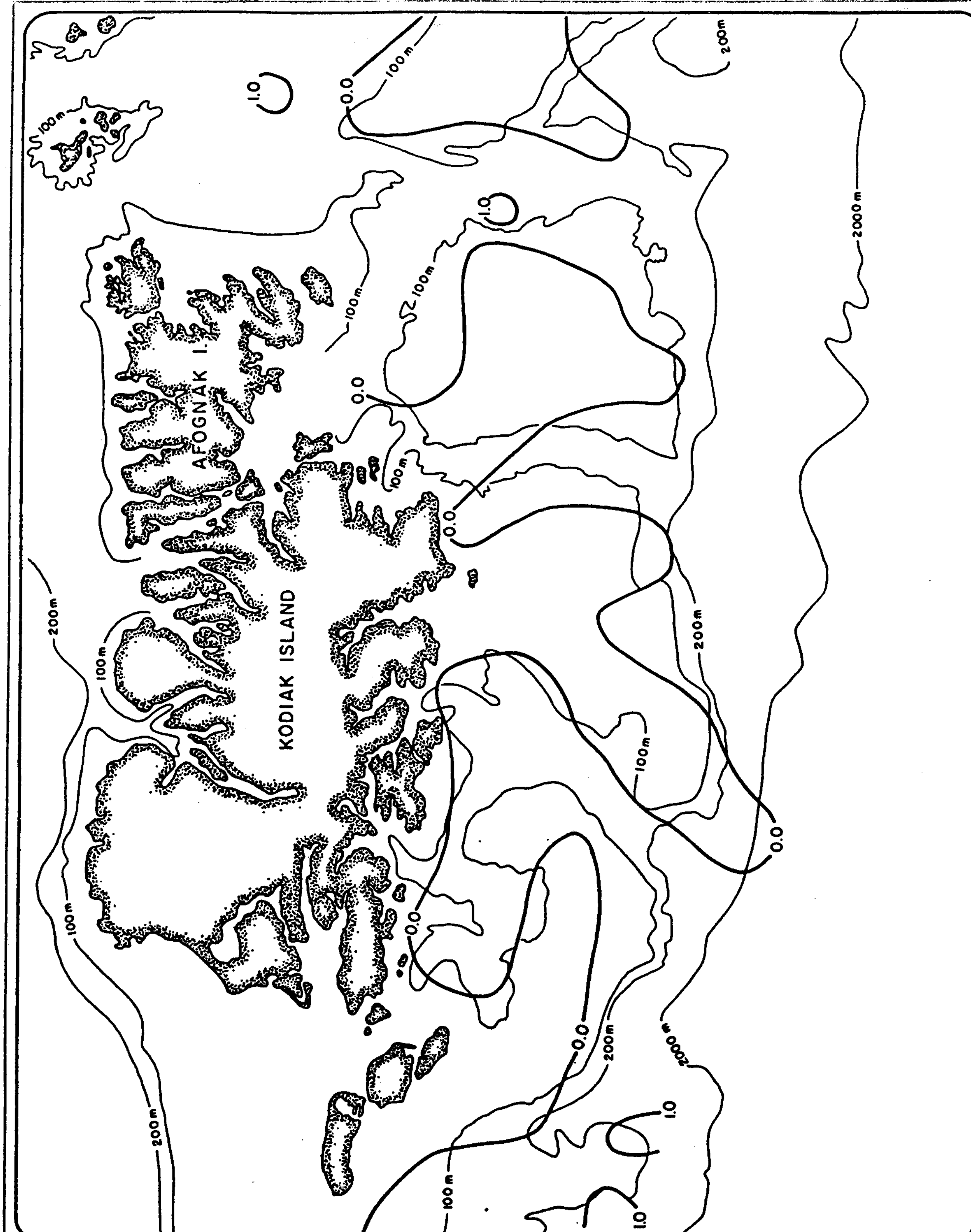
Distribution and abundance of total copepods in bongo tows from cruise 1WE78.

Figure 3.3-3

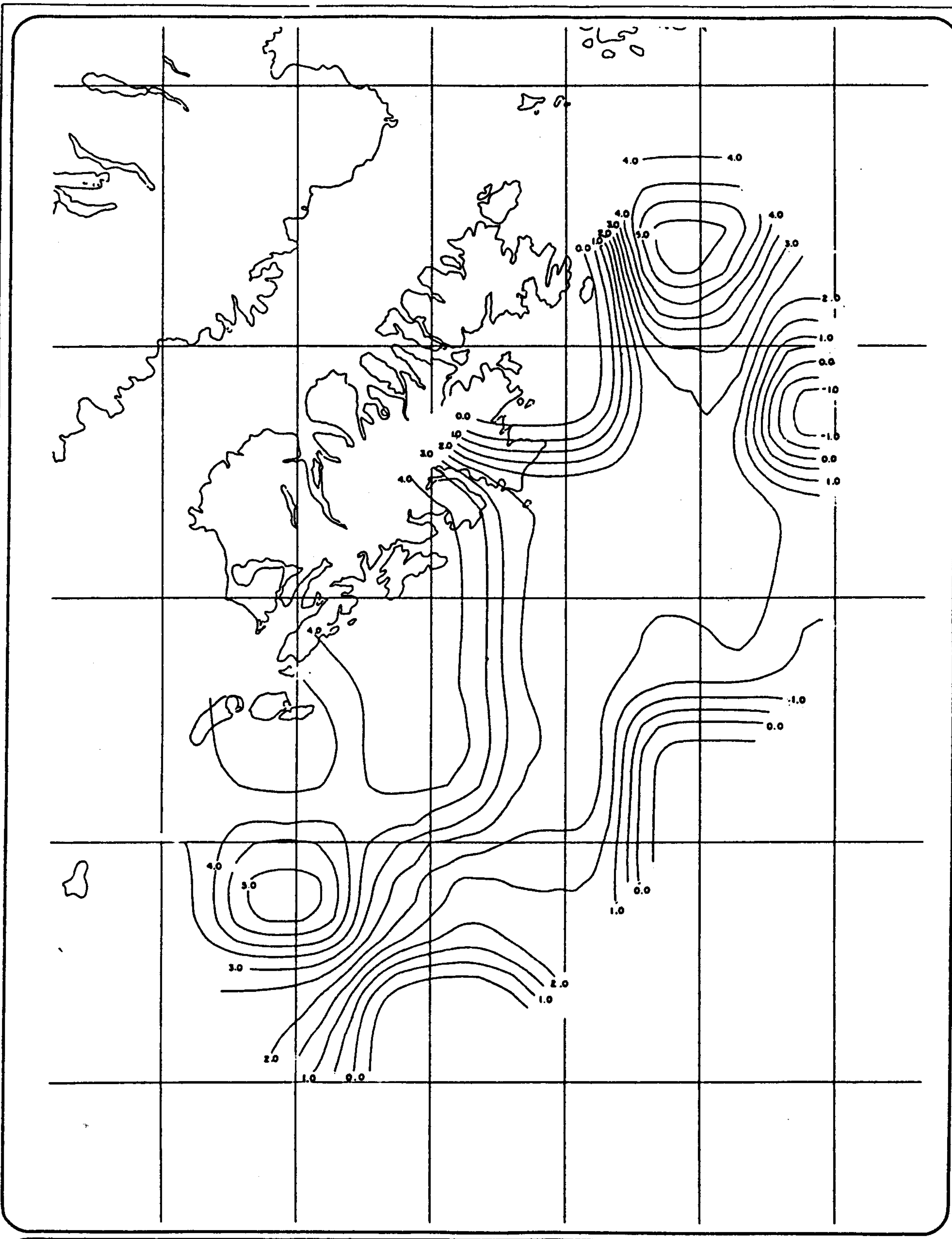


Distribution and abundance of total copepods in bongo tows from cruise 1MF79.

Figure 3.3-4

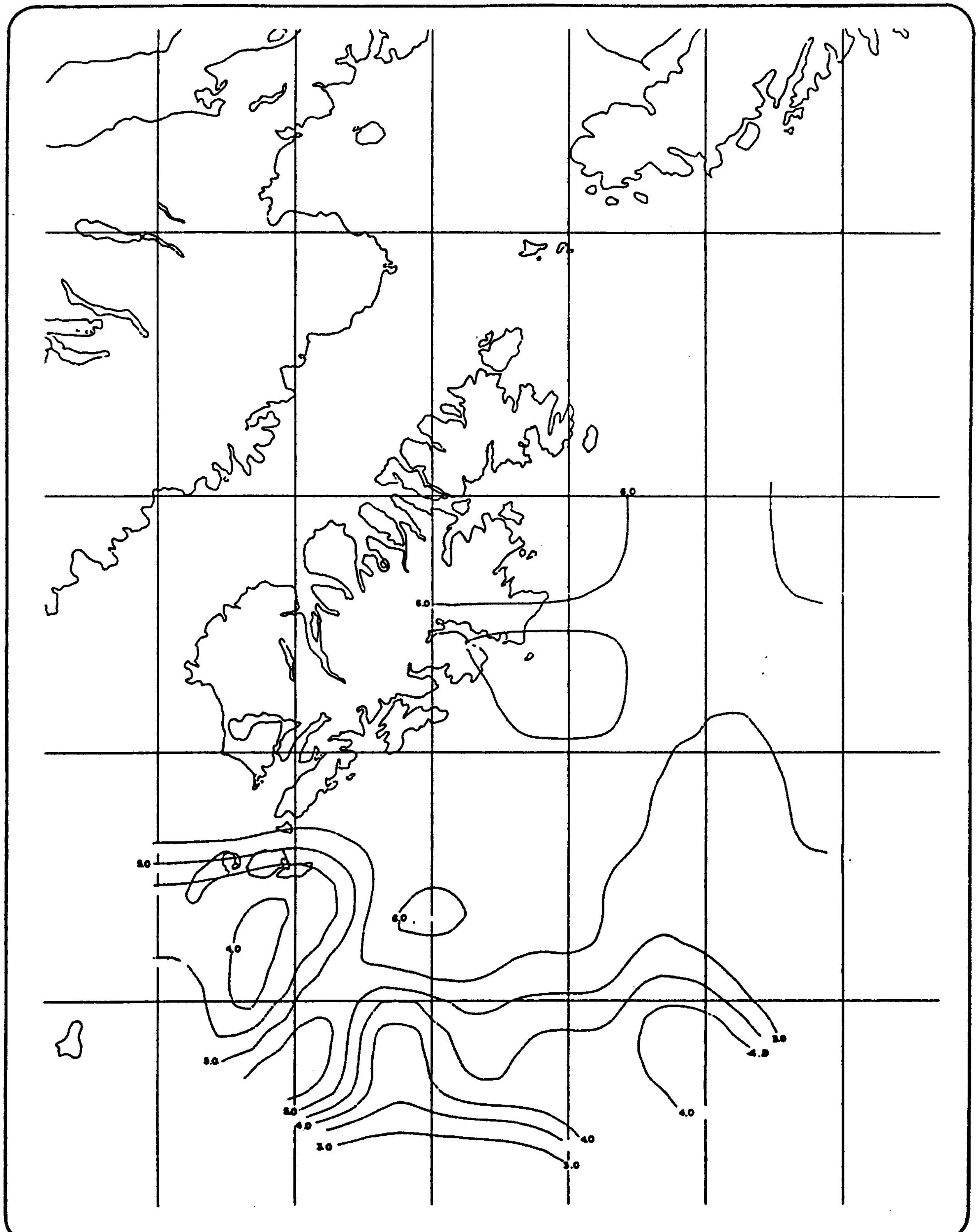


Distribution and abundance of <u>Calanus cristatus</u> copepodite stages IV and V in <u>bongo tows</u> from cruise 2MF78.	Figure 3.3-5



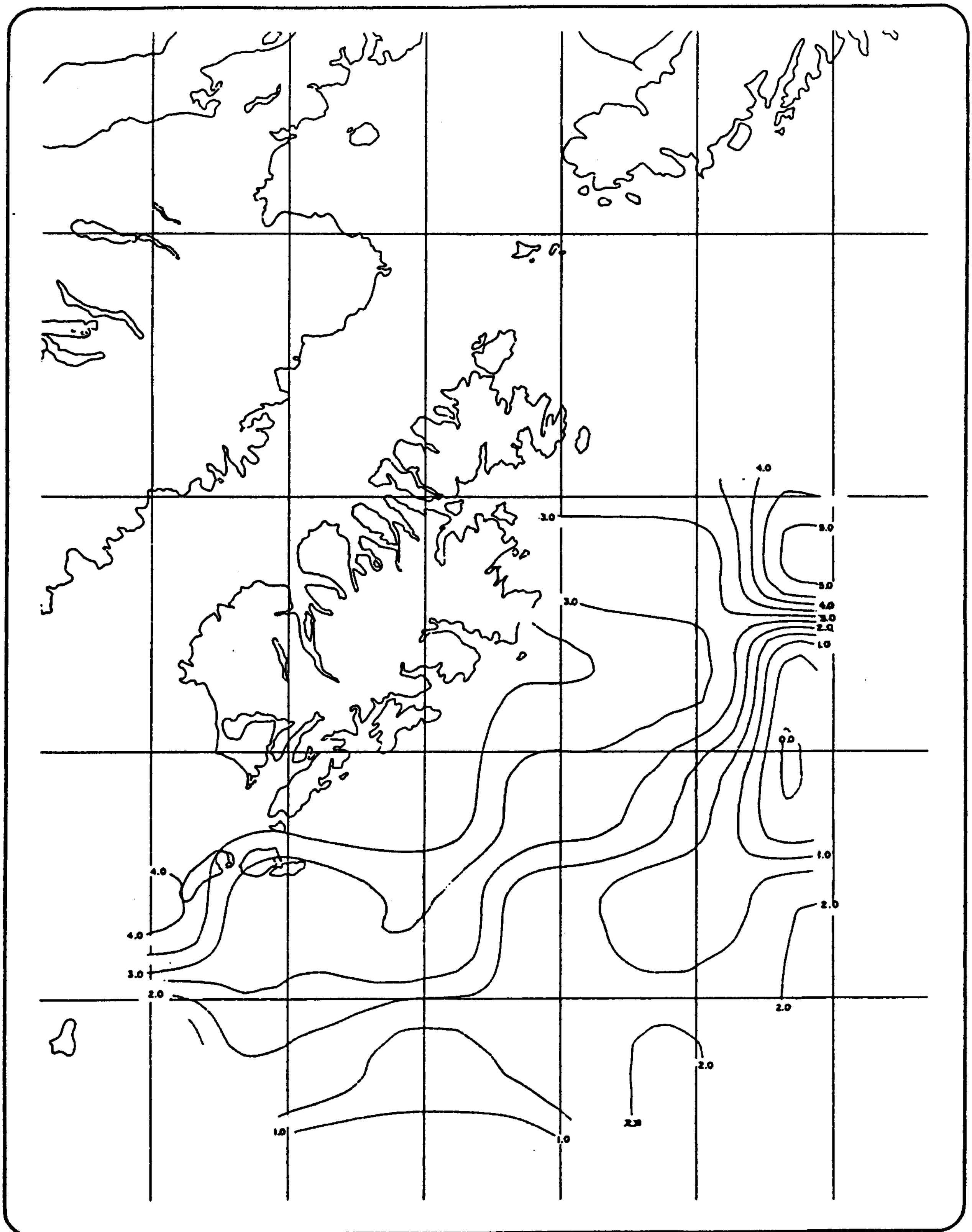
Distribution and abundance of Pseudocalanus spp. in bongo tows from cruise 4DI78.

Figure 3.3-6



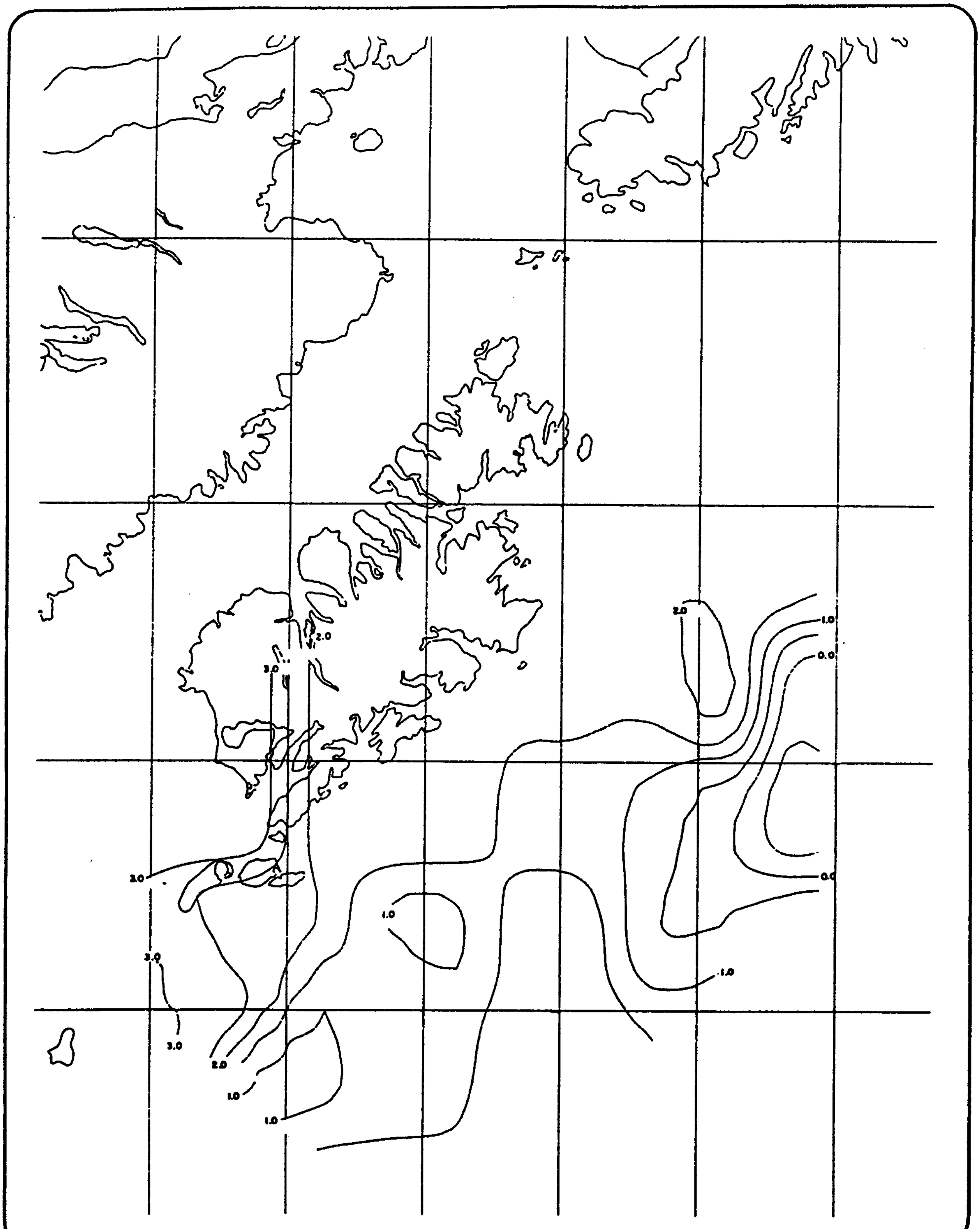
Distribution and abundance of Pseudocalanus spp. in bongo tows from cruise 2MF78.

Figure 3.3-7



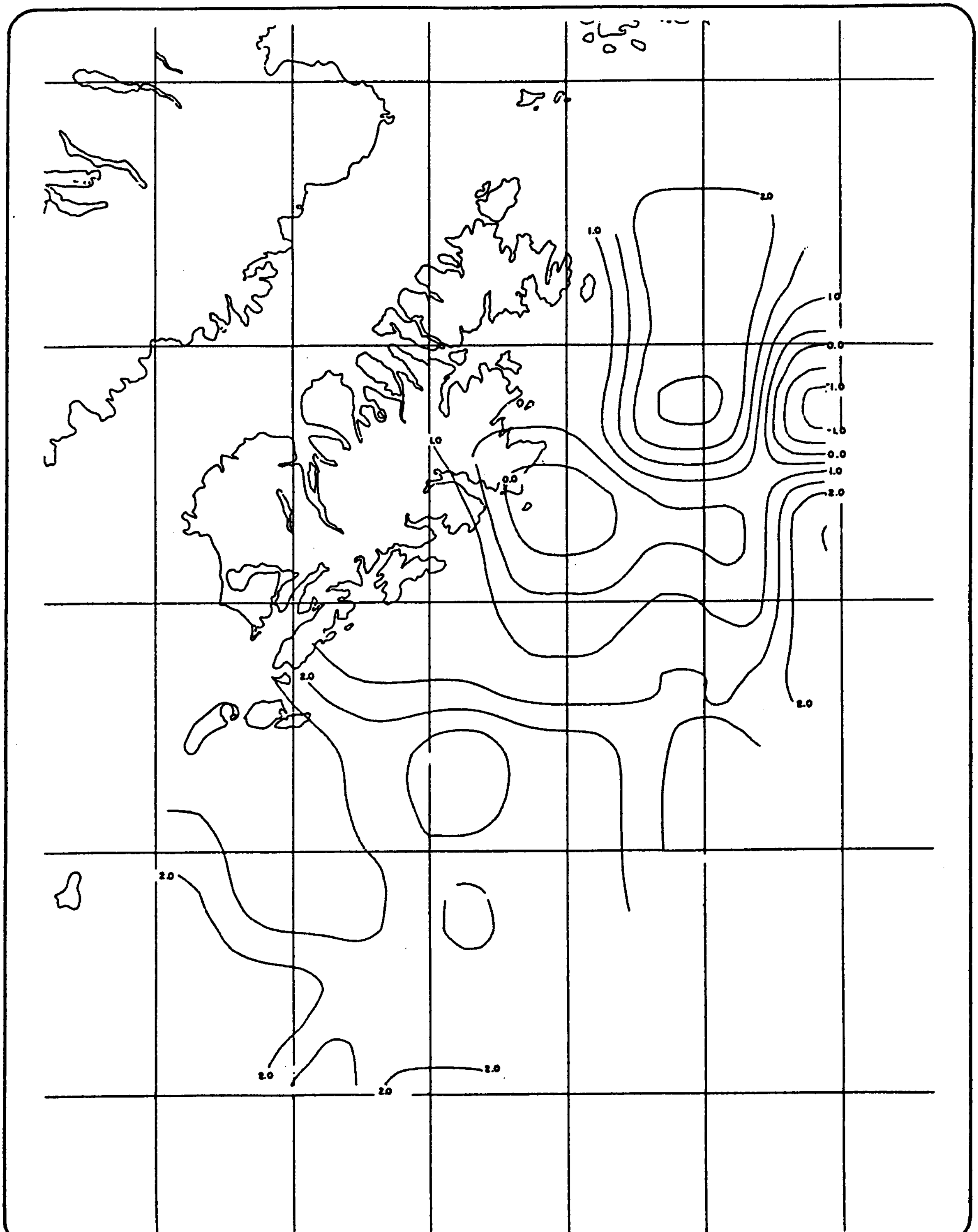
Distribution and abundance of Pseudocalanus spp. in bongo tows from cruise 1WE78.

Figure 3.3-8



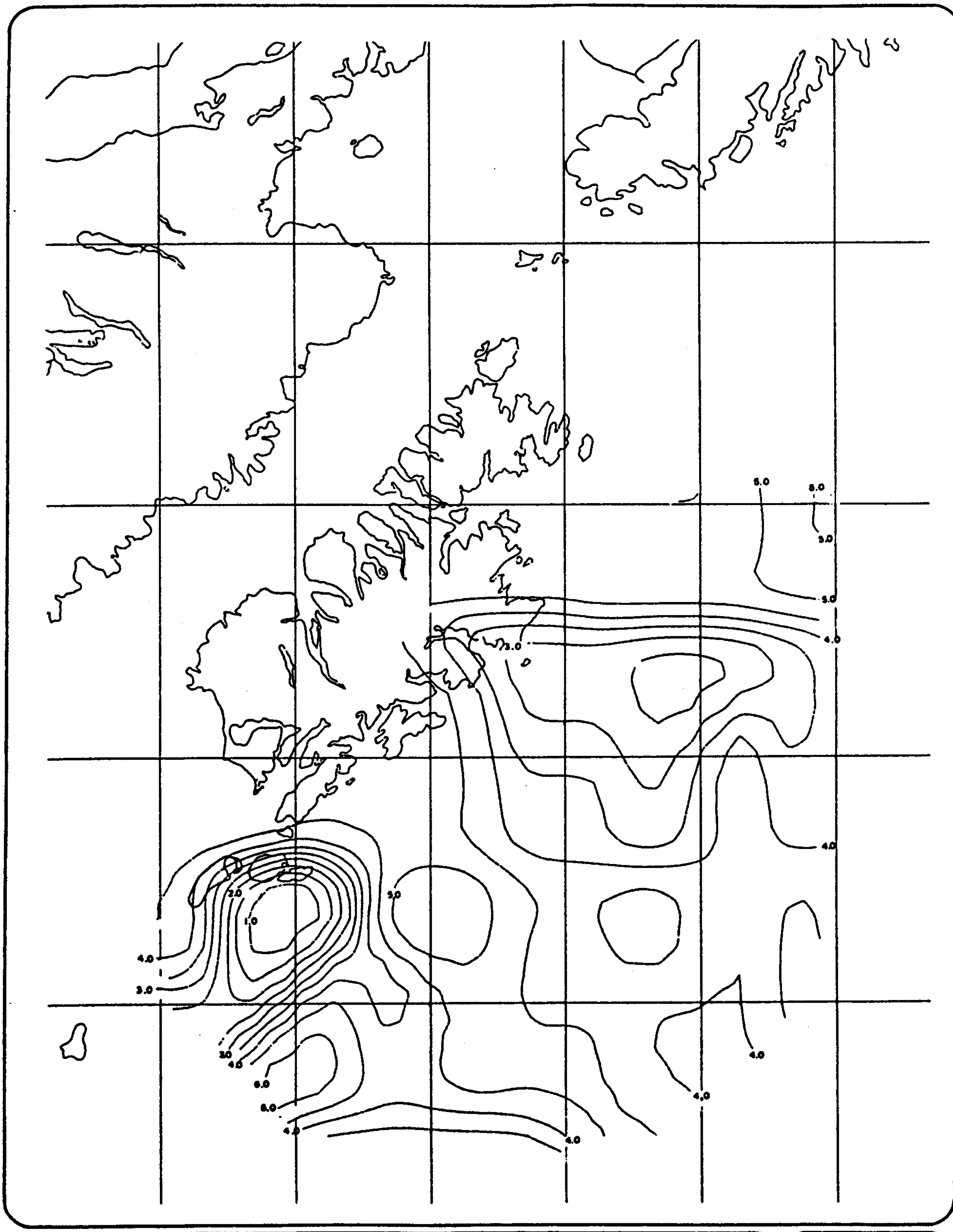
Distribution and abundance of Pseudocalanus spp. in bongo tows from cruise 1MF79.

Figure 3.3-9



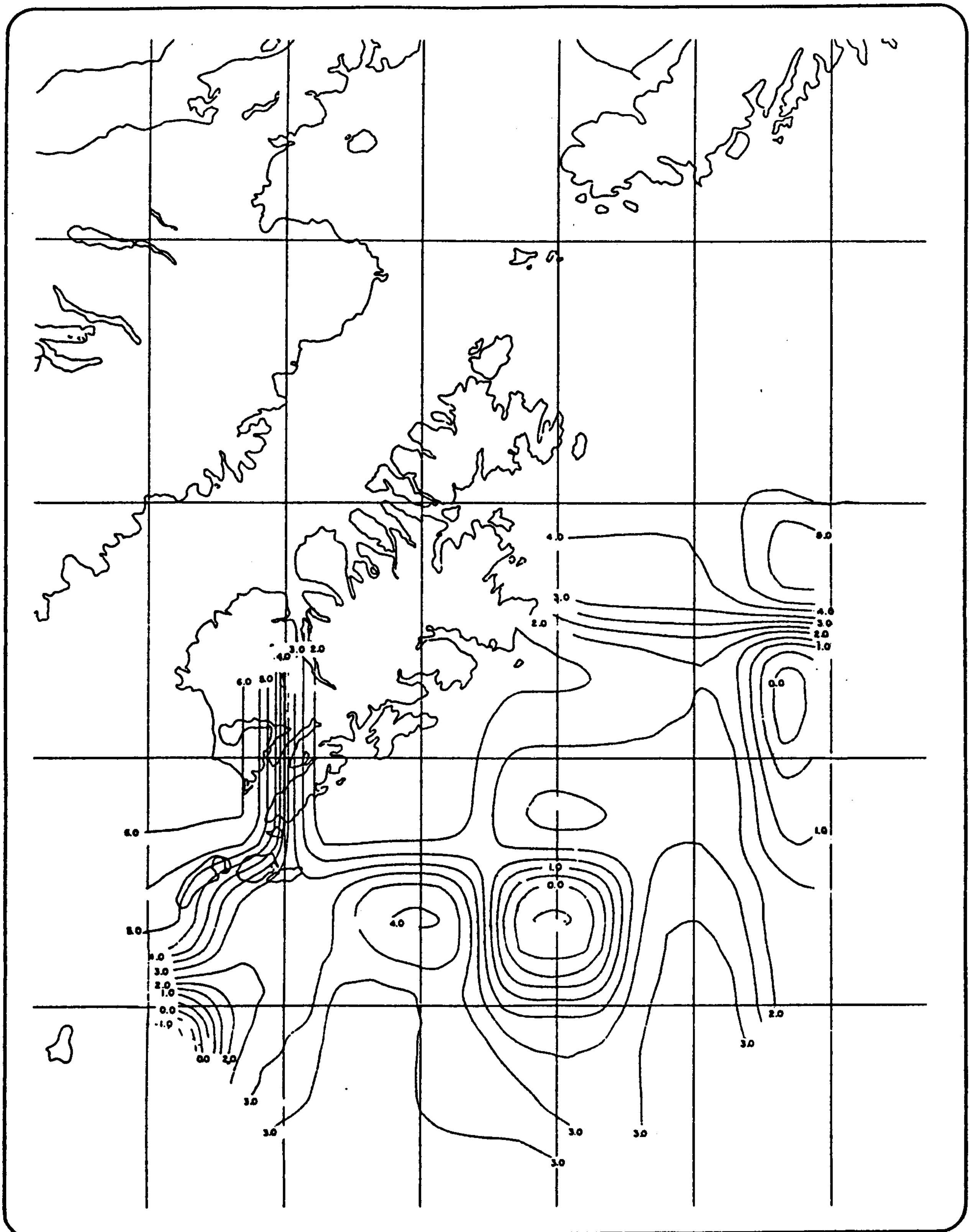
Distribution and abundance of Metridia spp. in bongo tows from cruise 4DI78.

Figure 3.3-10



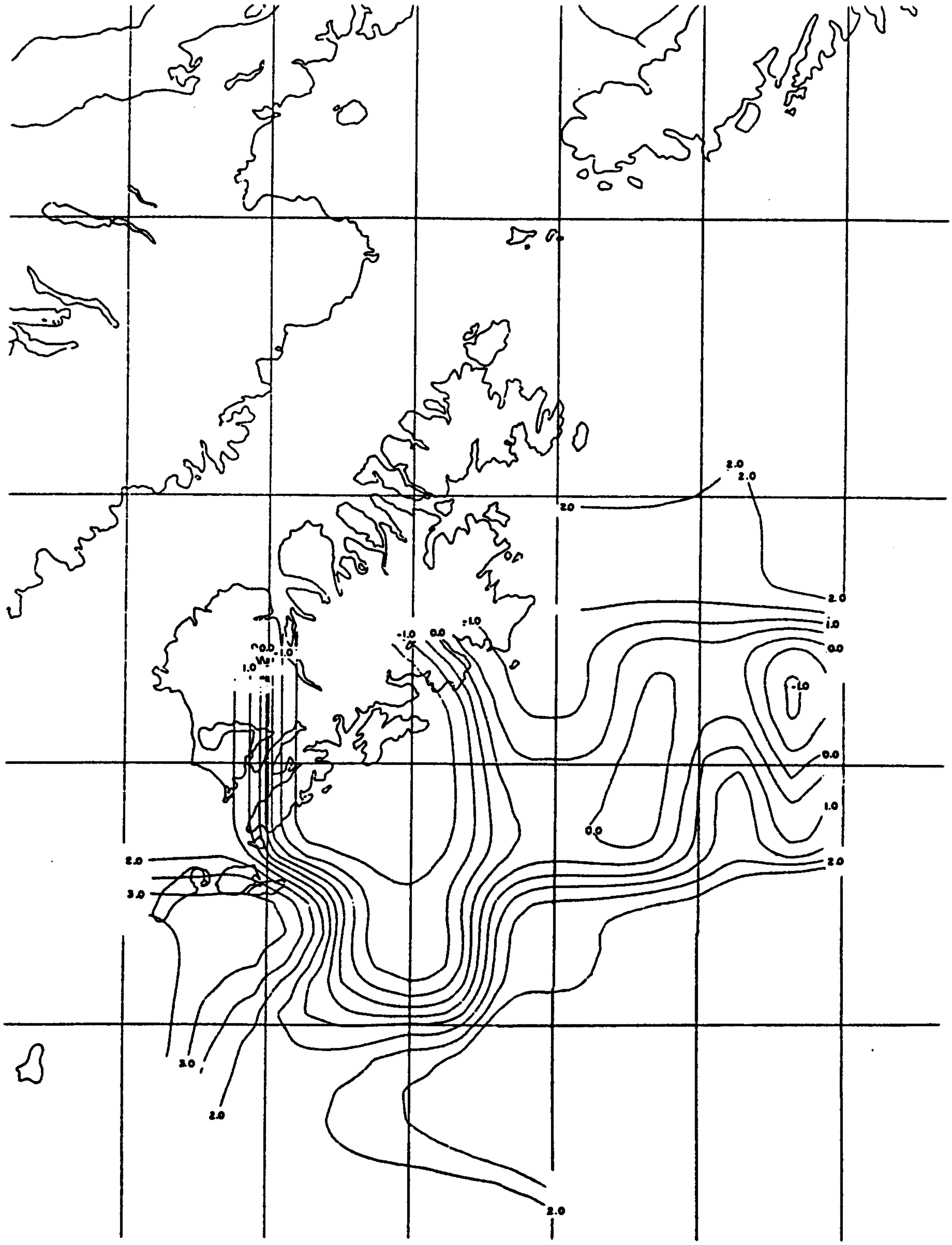
Distribution and abundance of Metridia spp. in bongo tows from cruise 2MF78.

Figure 3.3-11



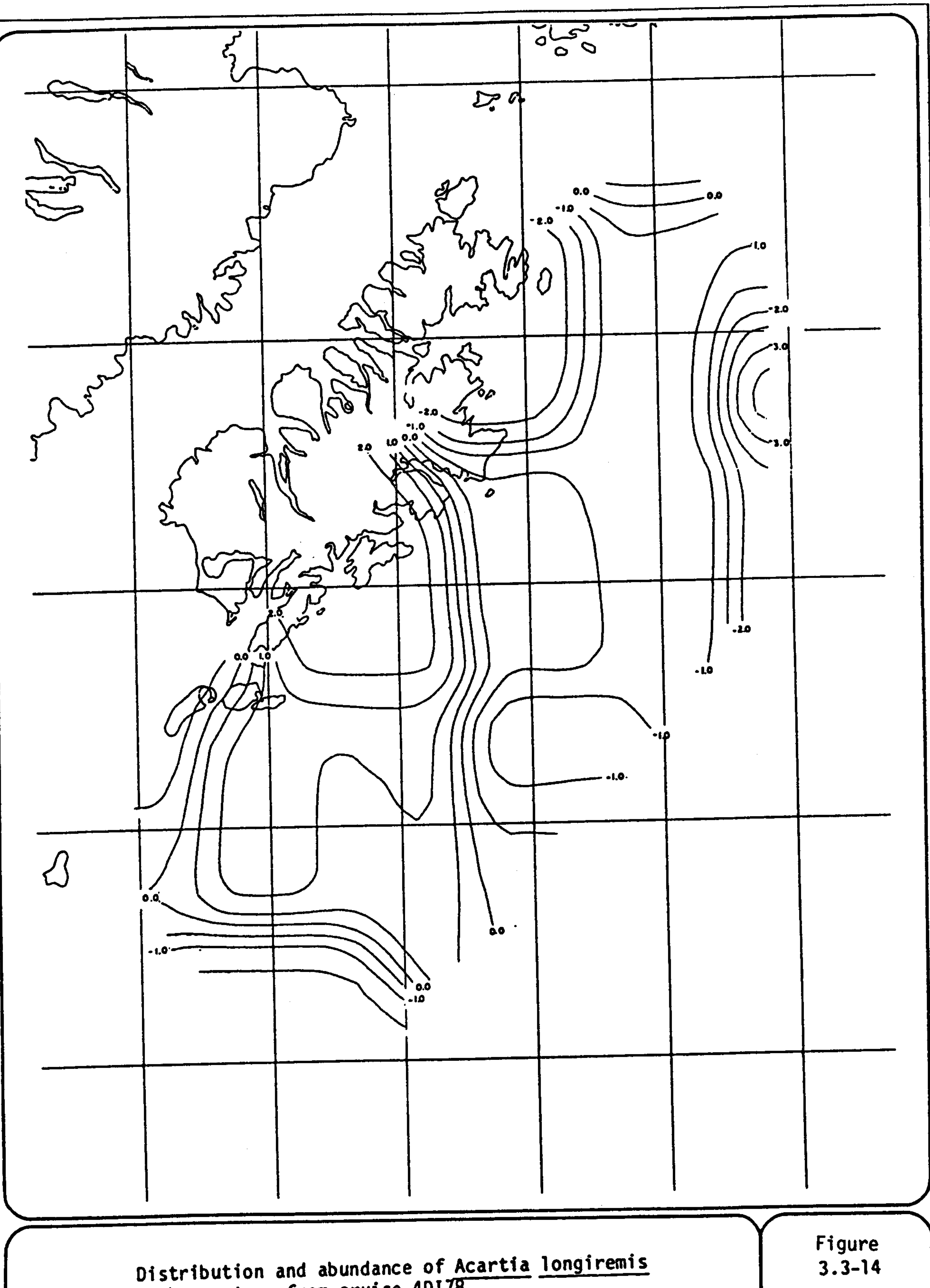
Distribution and abundance of Metridia spp. in bongo tows from cruise 1WE78.

Figure 3.3-12



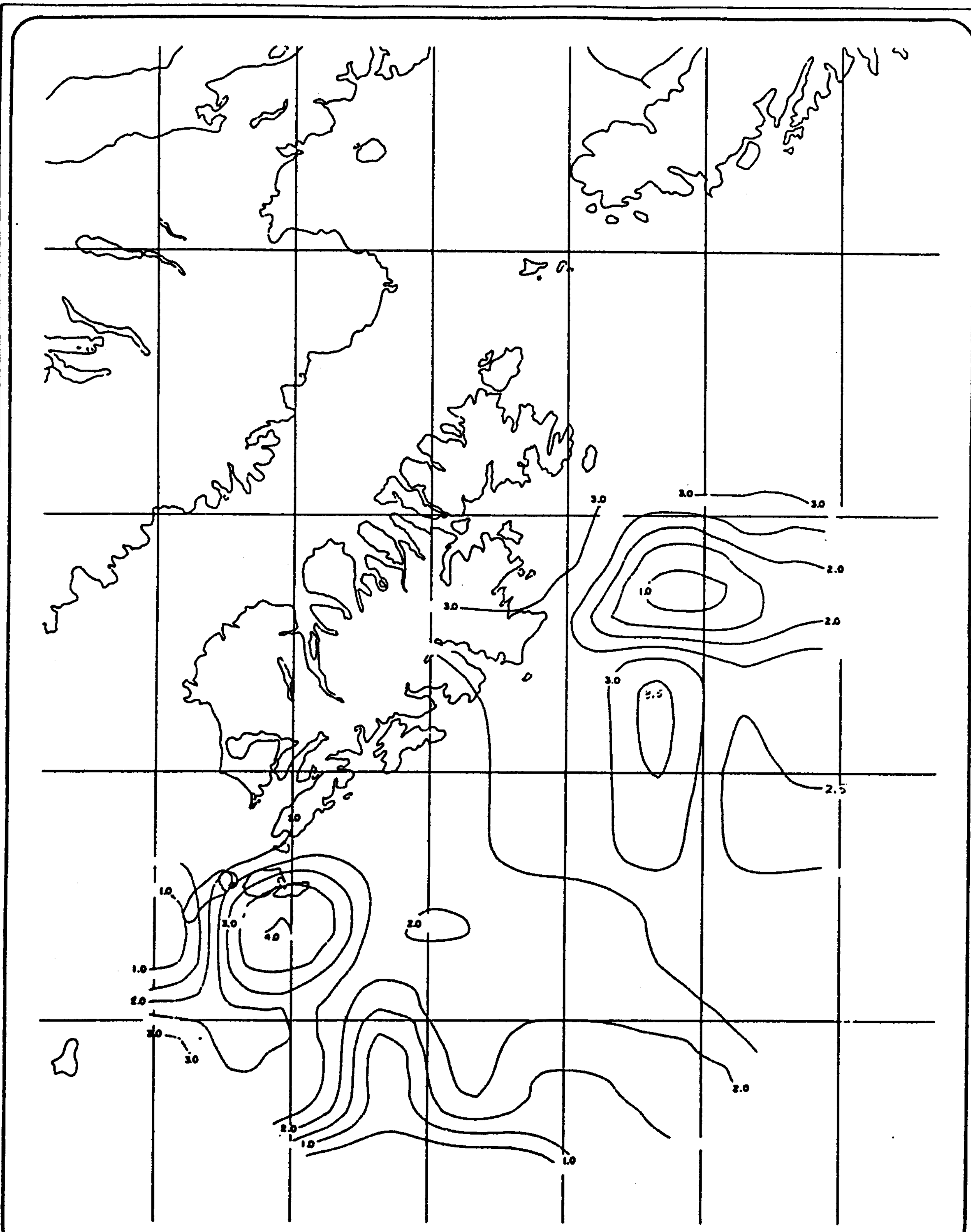
Distribution and abundance of Metridia spp. in bongo tows from cruise 1MF79.

Figure 3.3-13



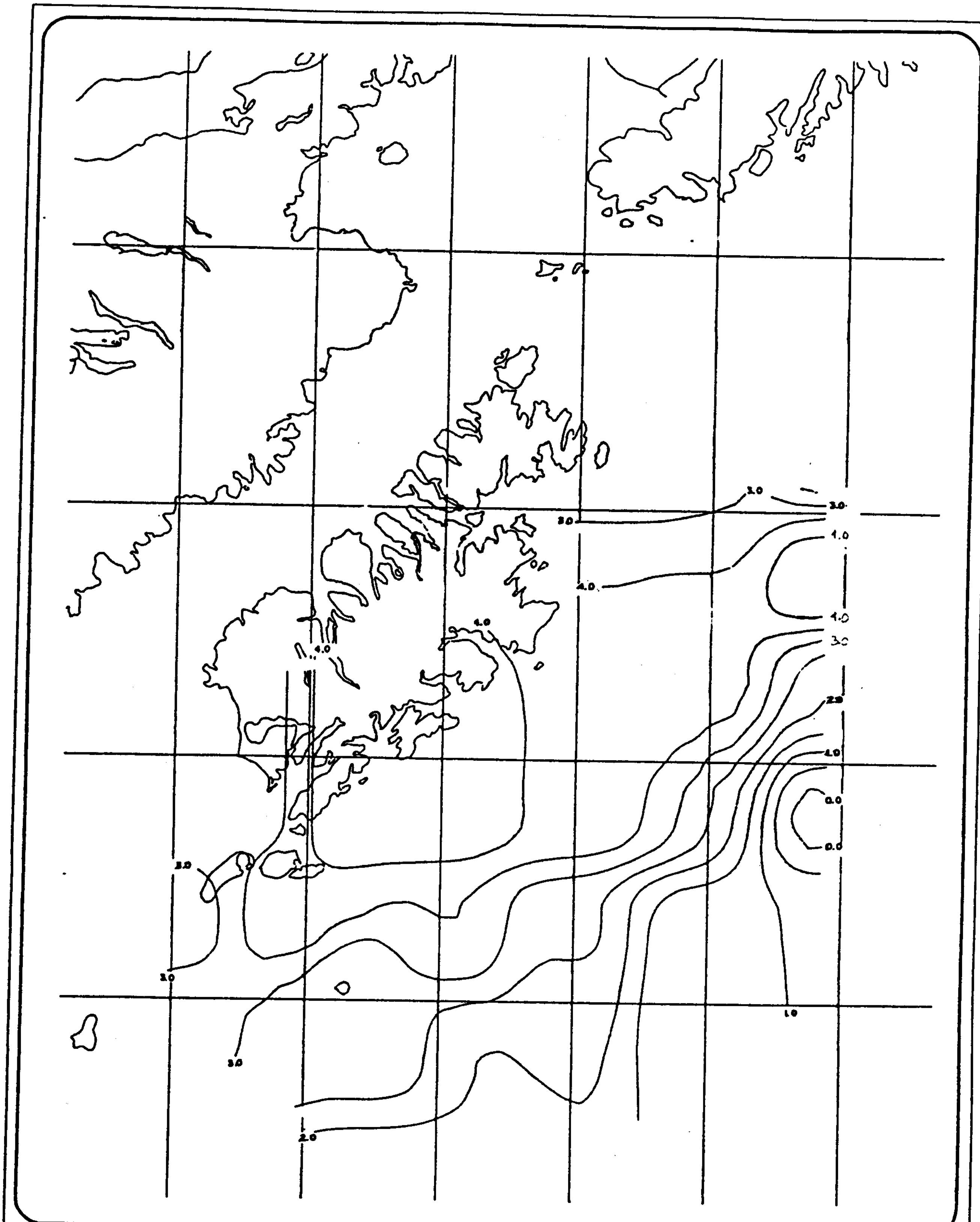
Distribution and abundance of Acartia longiremis in bongo tows from cruise 4DI78.

Figure 3.3-14



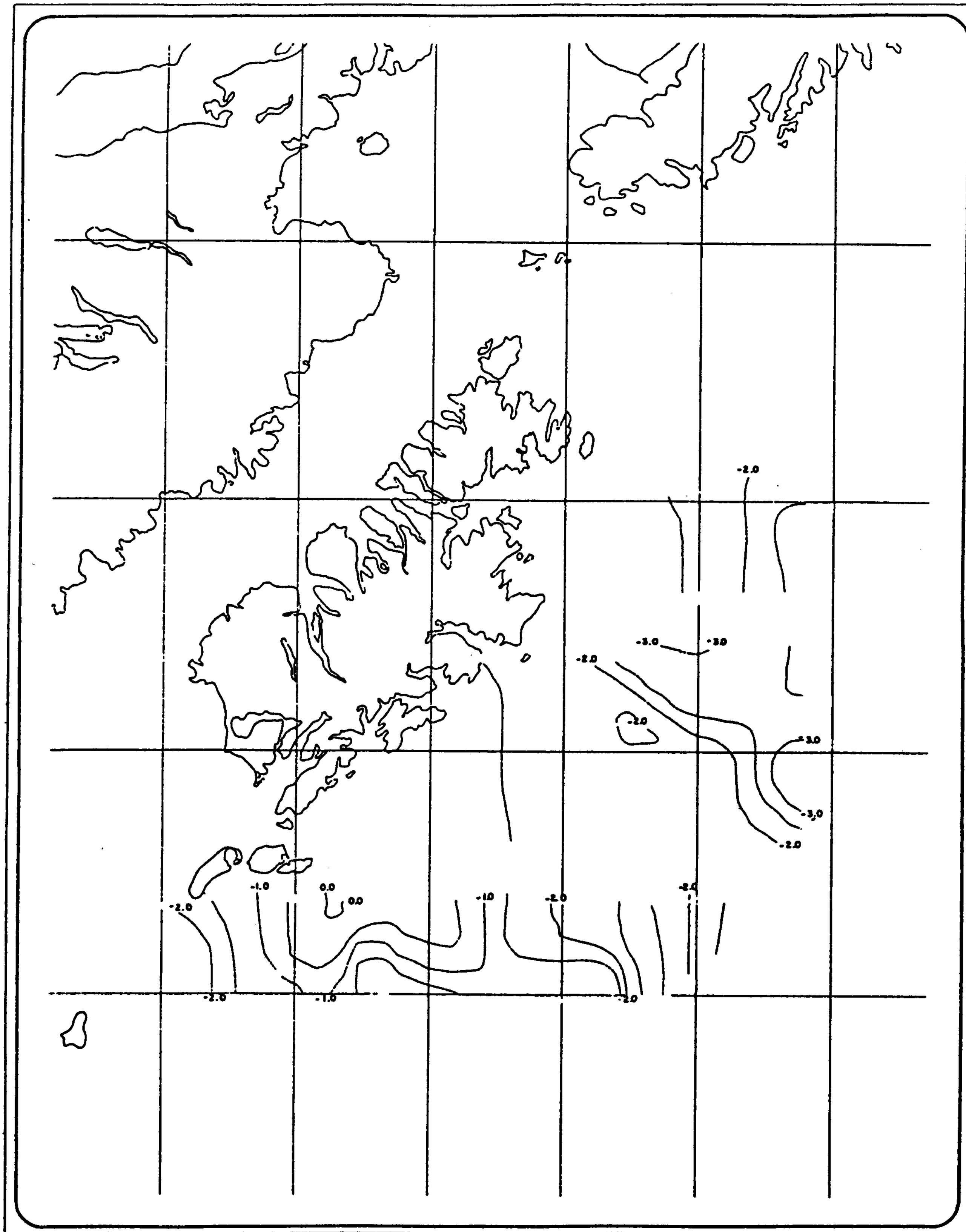
Distribution and abundance of Acartia longiremis in bongo tows from cruise 2MF78.

Figure 3.3-15

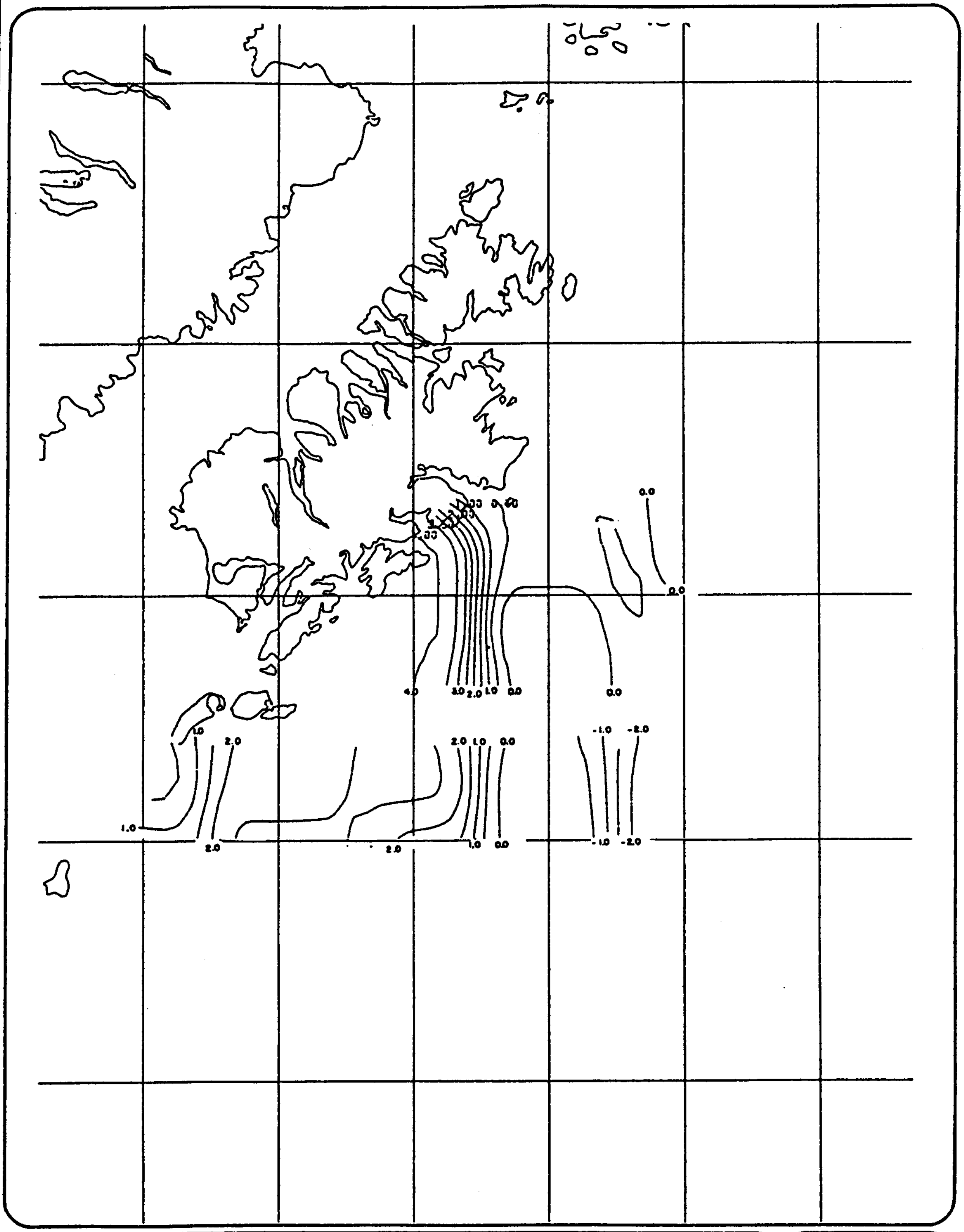


Distribution and abundance of Acartia longiremis in bongo tows from cruise 1WE78.

Figure 3.3-16

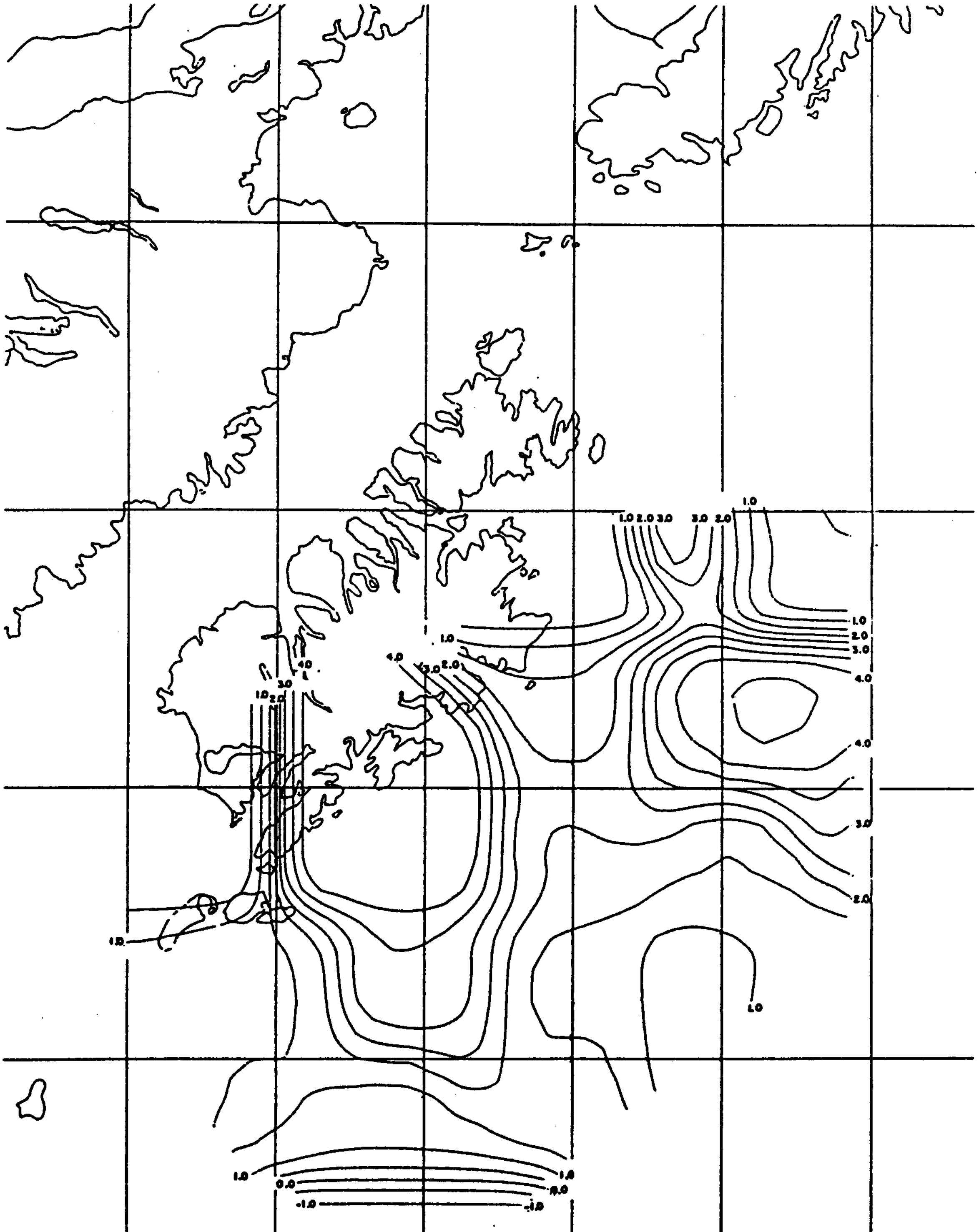


Distribution and abundance of *Acartia longiremis* in bongo tows from cruise 1MF79.	Figure 3.3-17



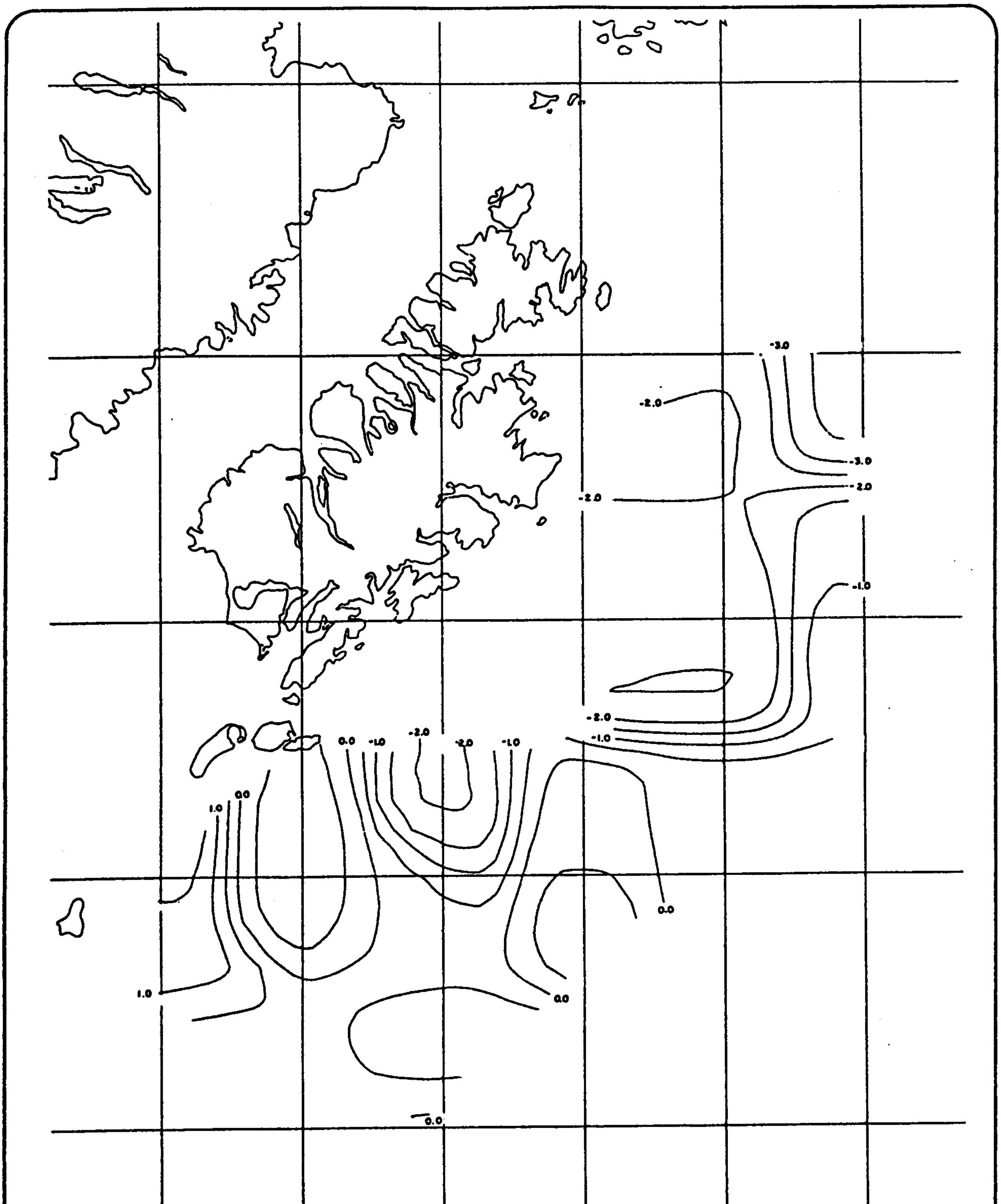
Distribution and abundance of Acartia tumida in bongo tows from cruise 4DI78.

Figure 3.3-18



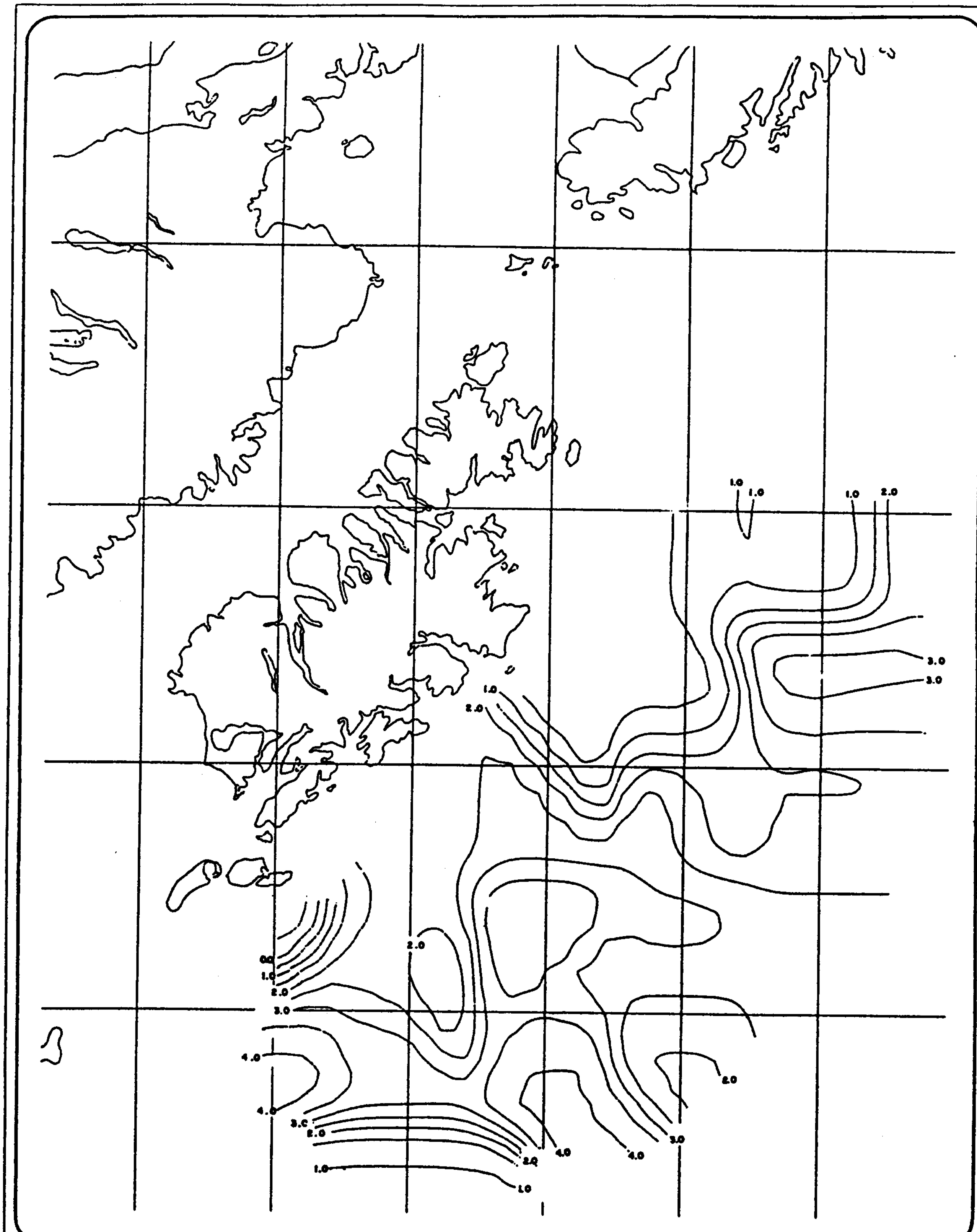
Distribution and abundance of Acartia tumida in bongo tows from cruise 2MF78.

Figure 3.3-19



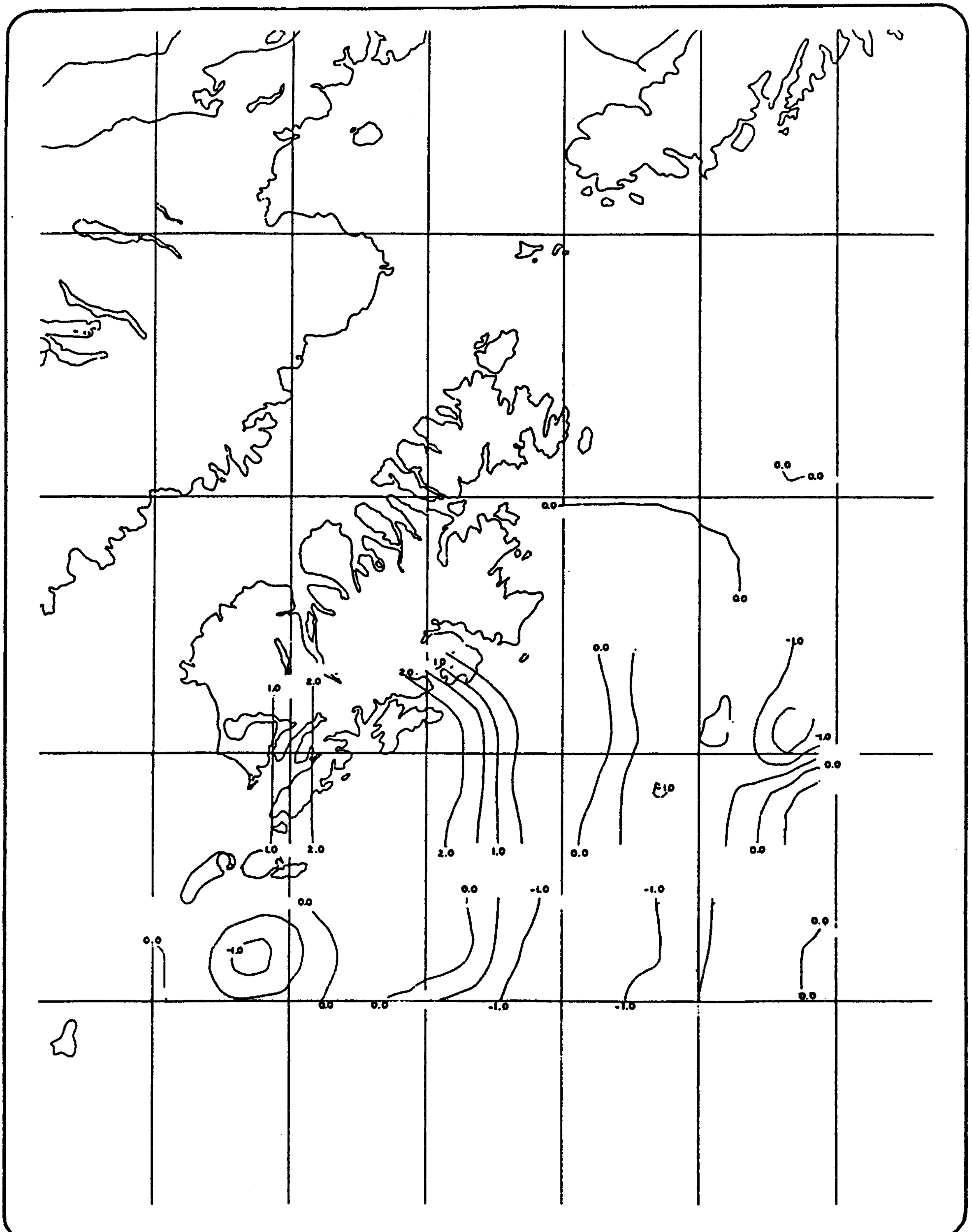
Distribution and abundance of Eucalanus bungii in bongo tows from cruise 4DI78.

Figure 3.3-20



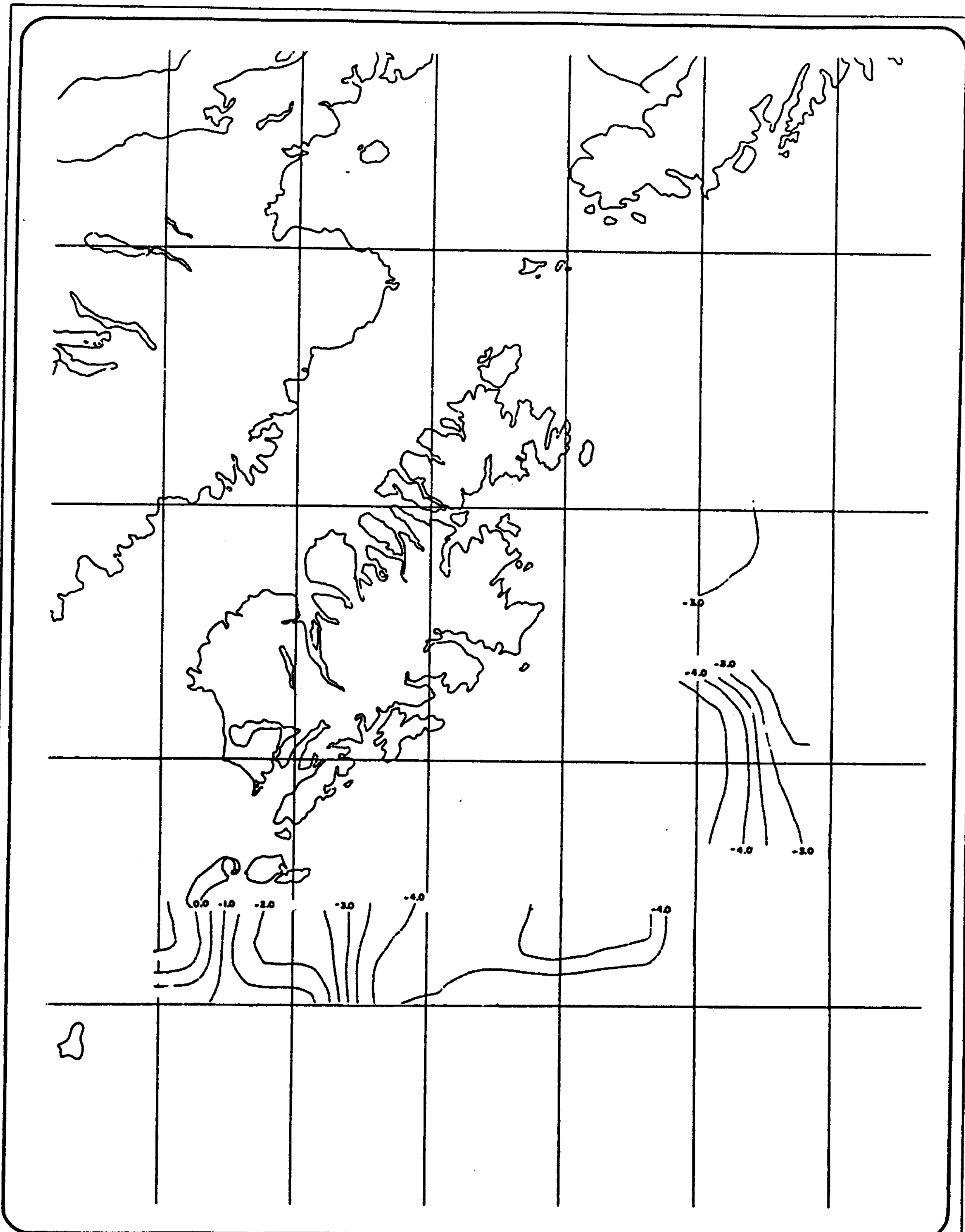
Distribution and abundance of Eucalanus bungii in bongo tows from cruise 2MF78.

Figure 3.3-21



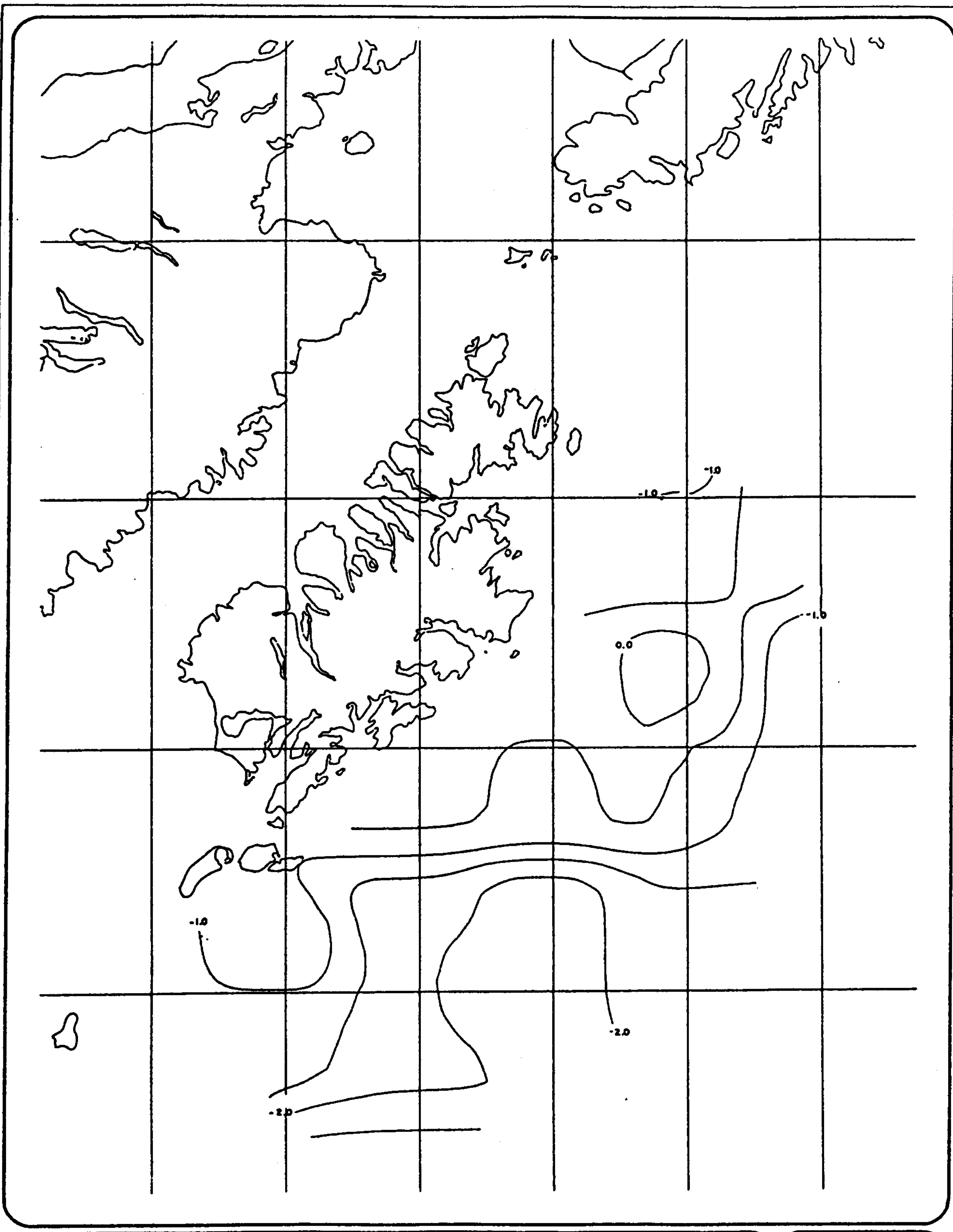
Distribution and abundance of Eucalanus bungii in bongo tows from cruise 1WE78.

Figure 3.3-22



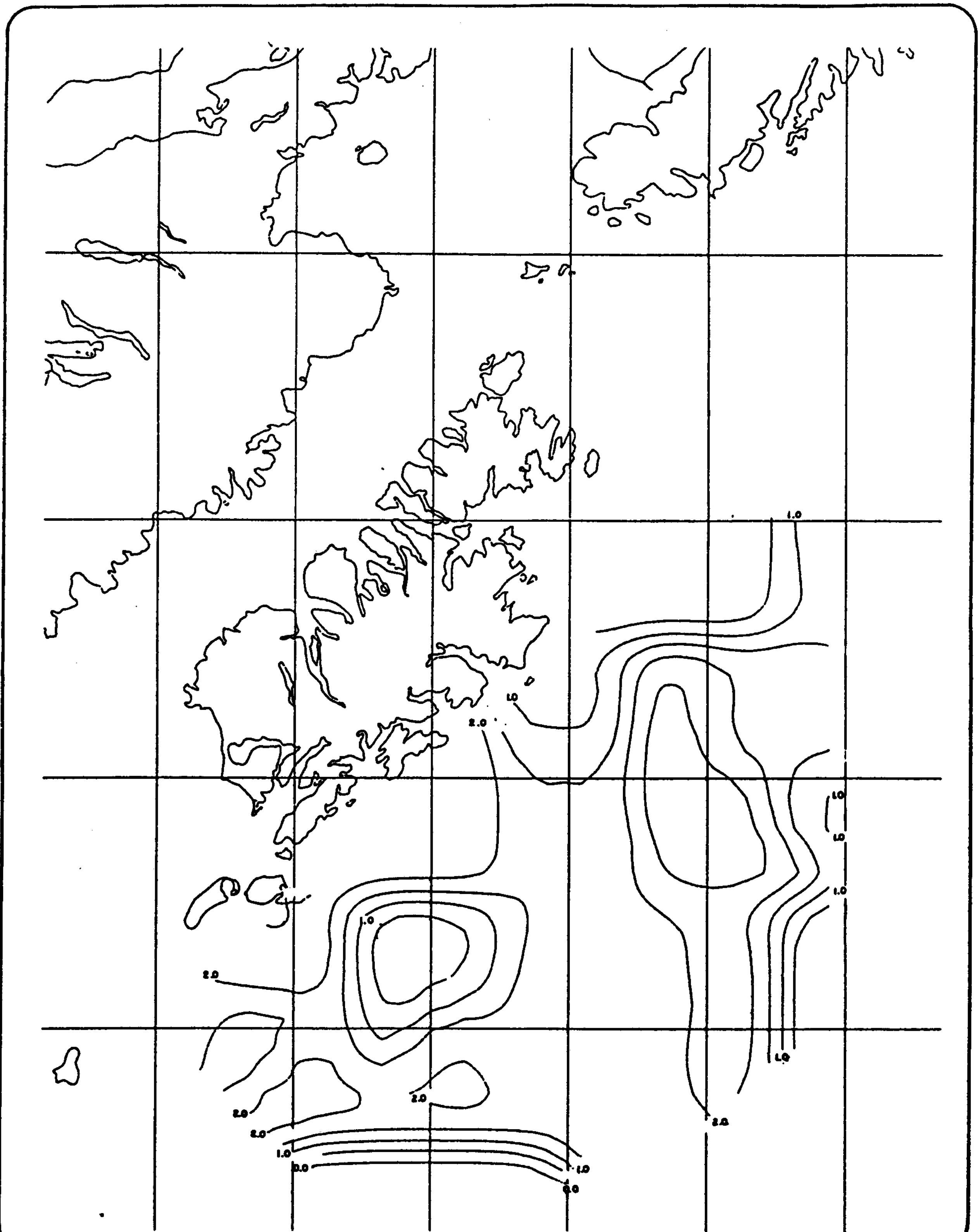
Distribution and abundance of Eucalanus bungii in bongo tows from cruise 1MF79.

Figure 3.3-23



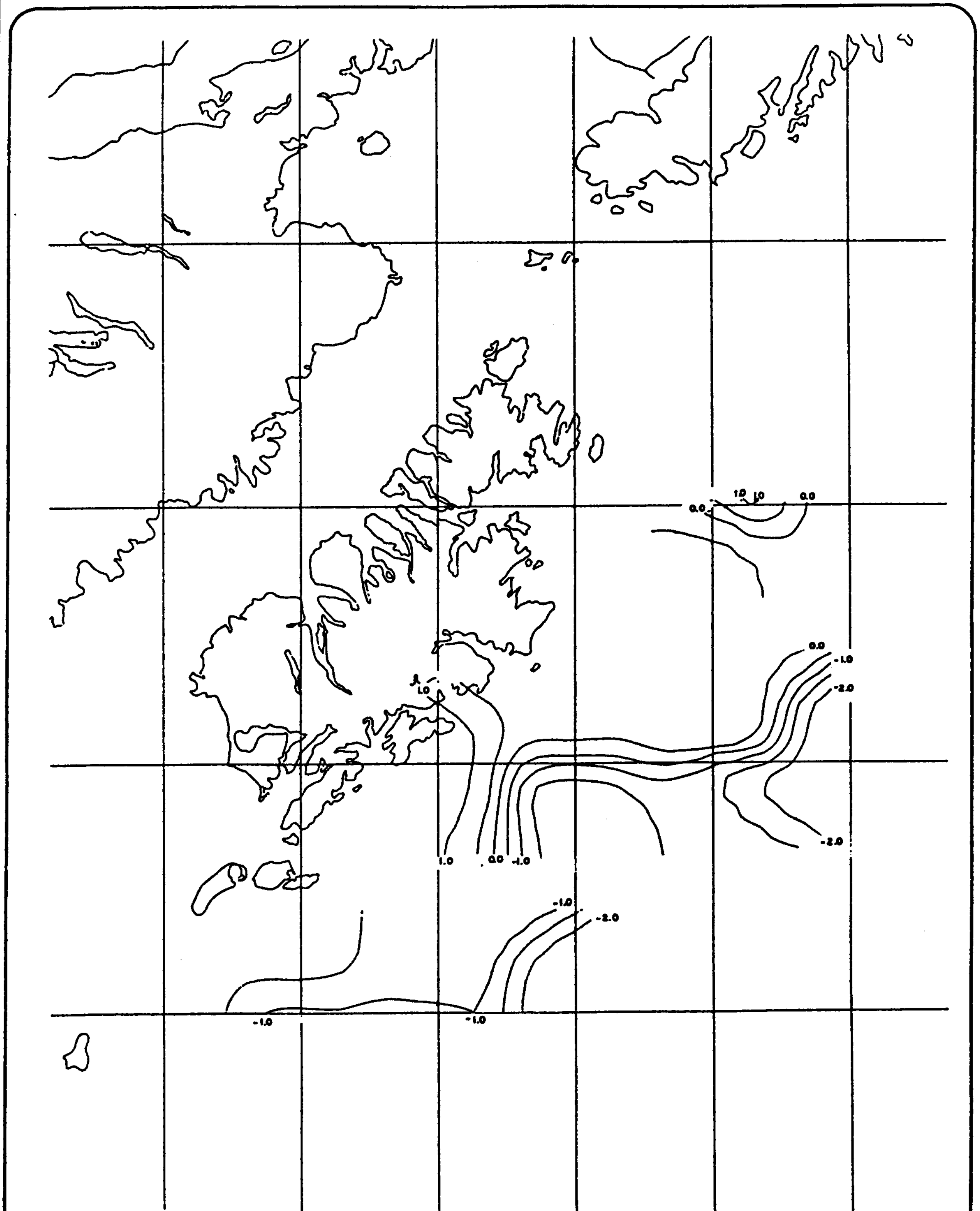
Distribution and abundance of Epilabidocera longipedata in bongo tows from cruise 4DI78.

Figure 3.3-24



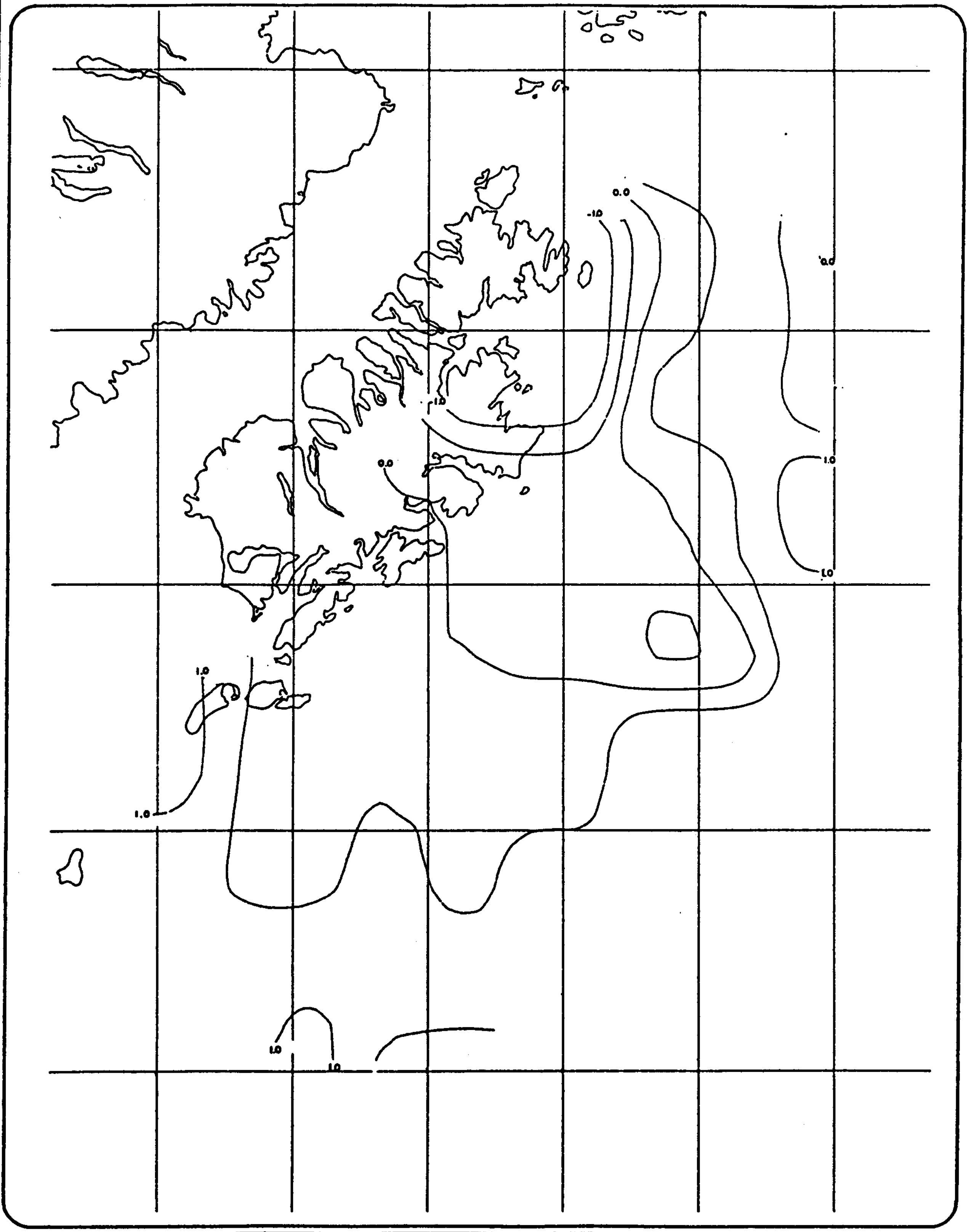
Distribution and abundance of _Centropages abdominalis_ in bongo tows from cruise 2MF78.

Figure 3.3-25



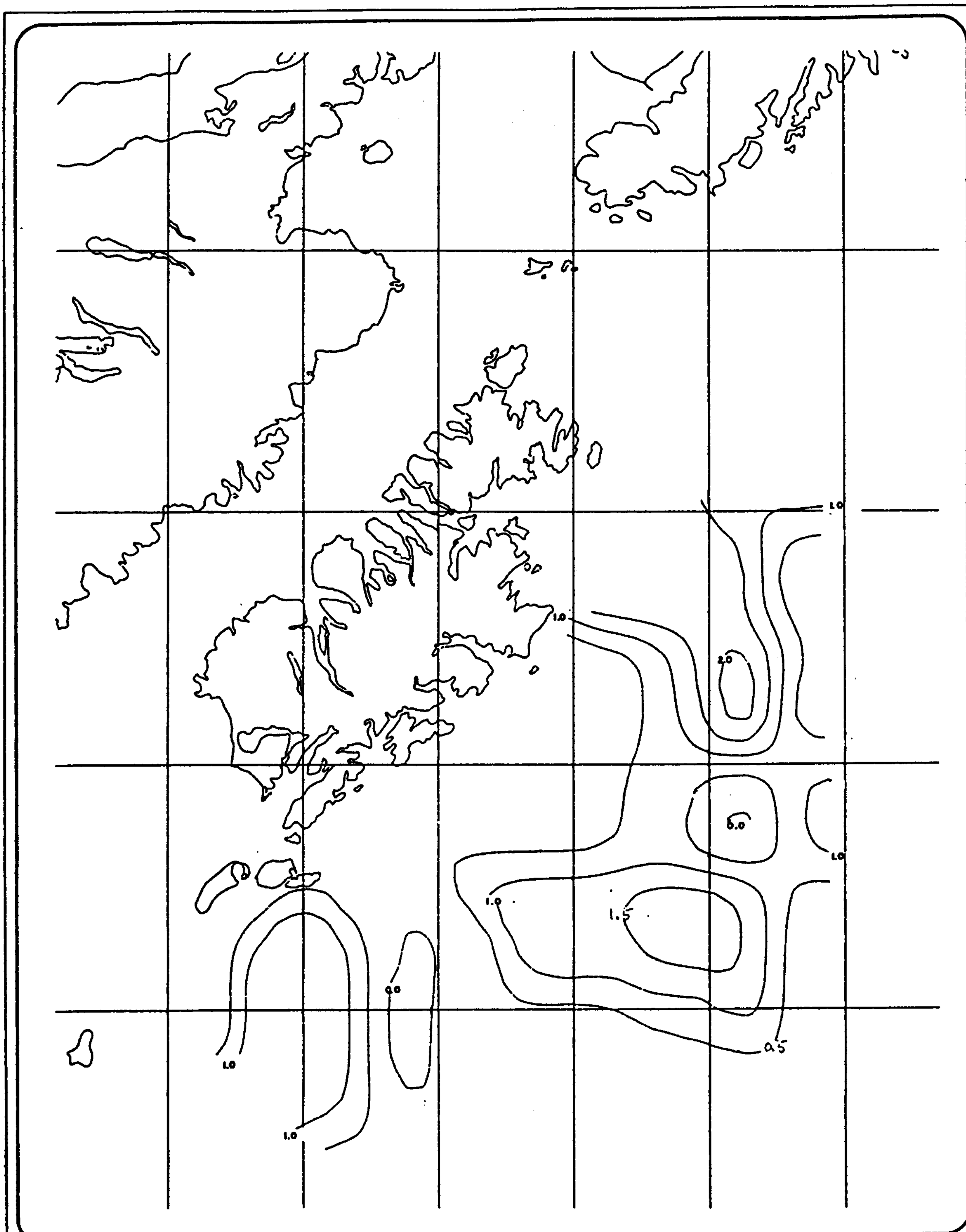
Distribution and abundance of Centropages abdominalis in bongo tows from cruise TWE78.

Figure 3.3-26



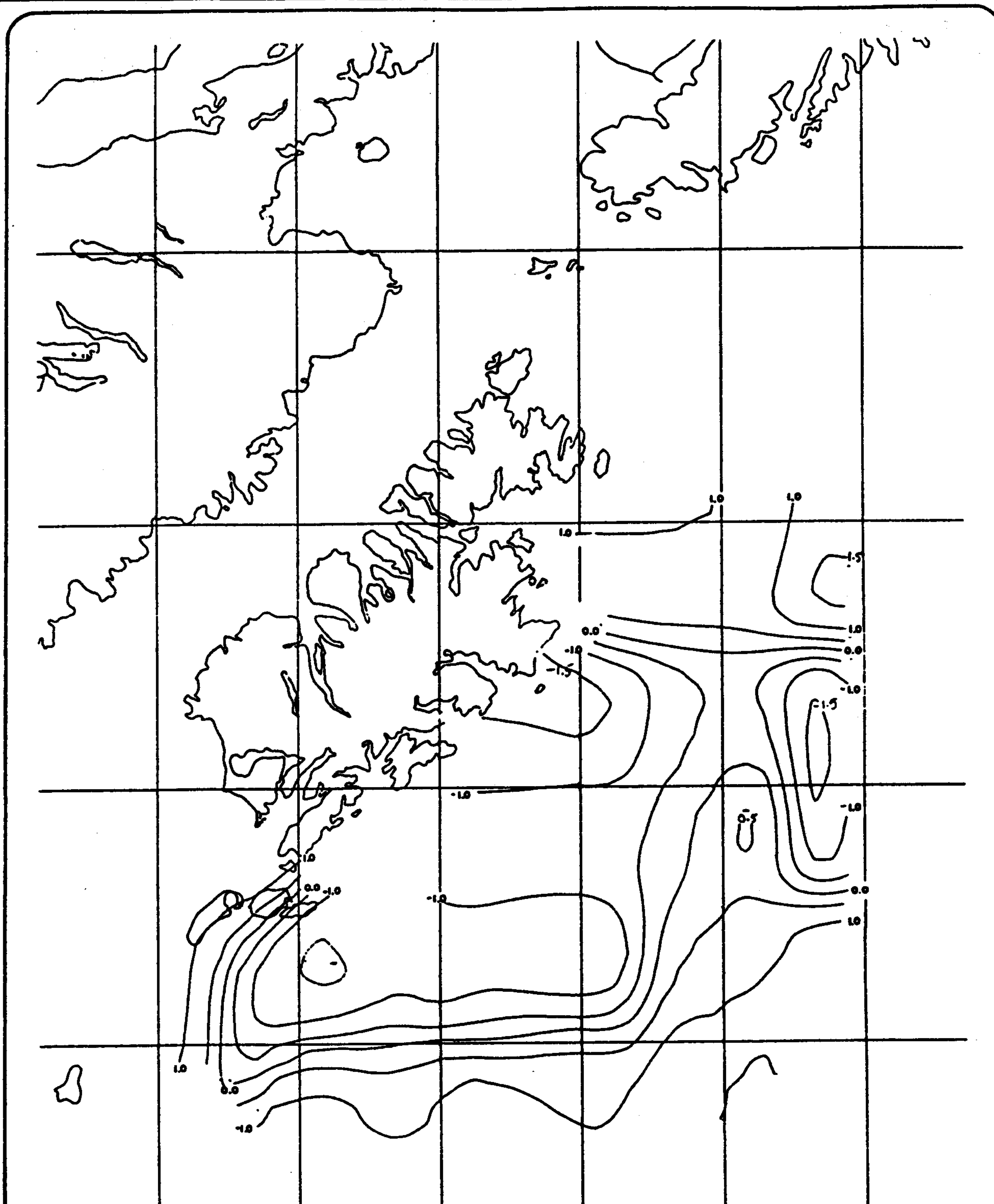
Distribution and abundance of Scolecithricella minor in bongo tows from cruise 4DI78.

Figure 3.3-27



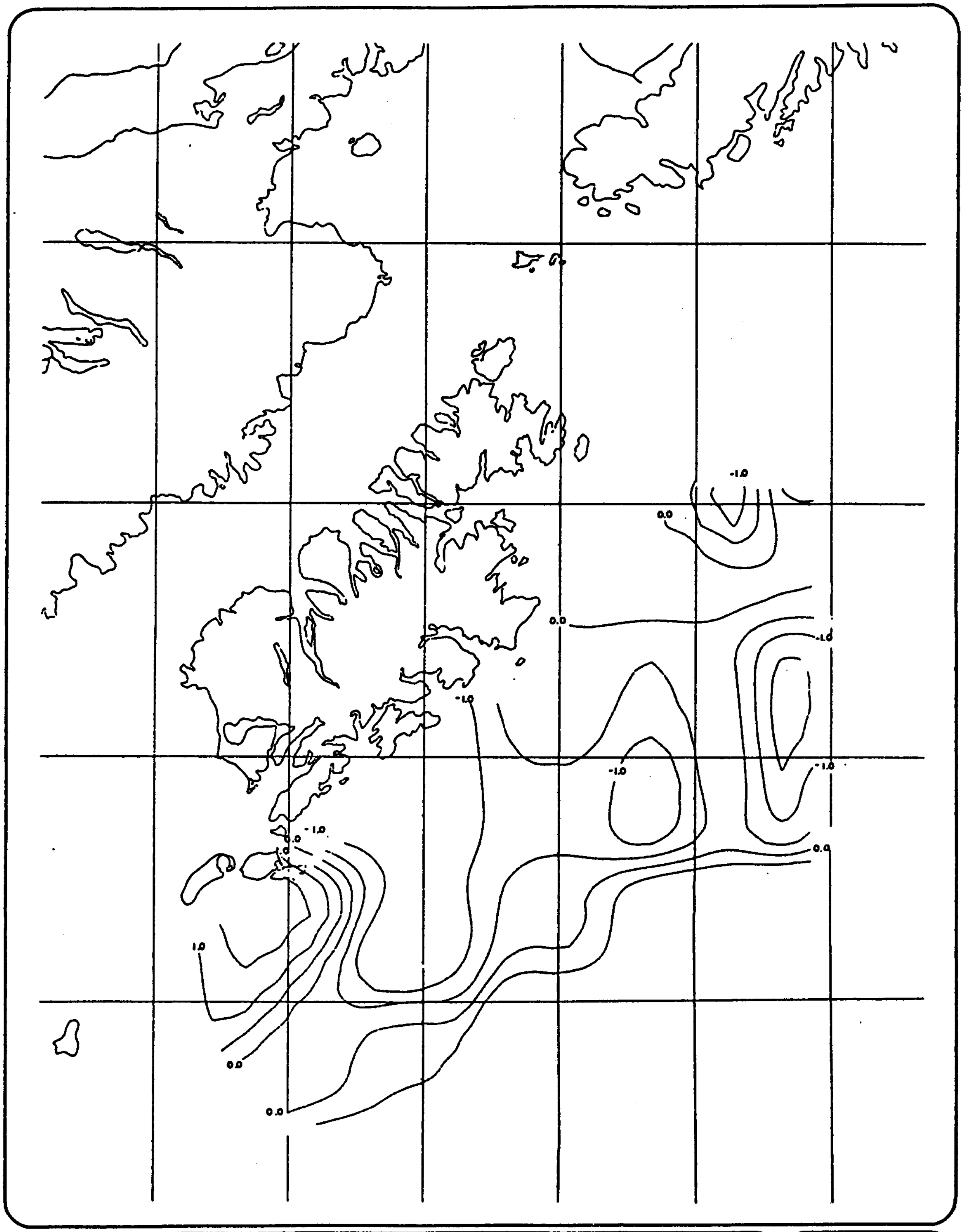
Distribution and abundance of Scolecithricella minor in bongo tows from cruise 2MF78.

Figure 3.3-28



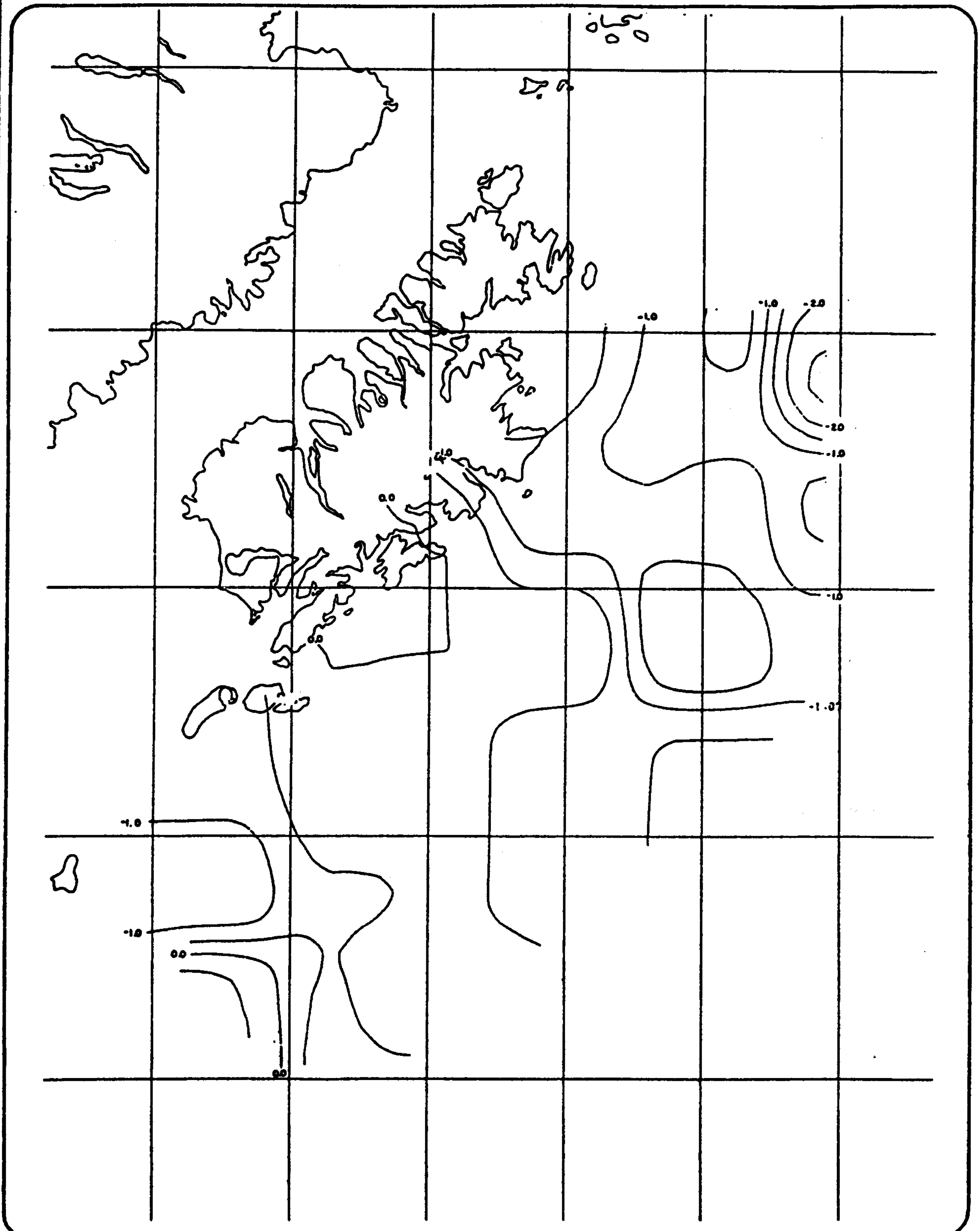
Distribution and abundance of Scolecithricella minor in bongo tows from cruise TWE78.

Figure 3.3-29



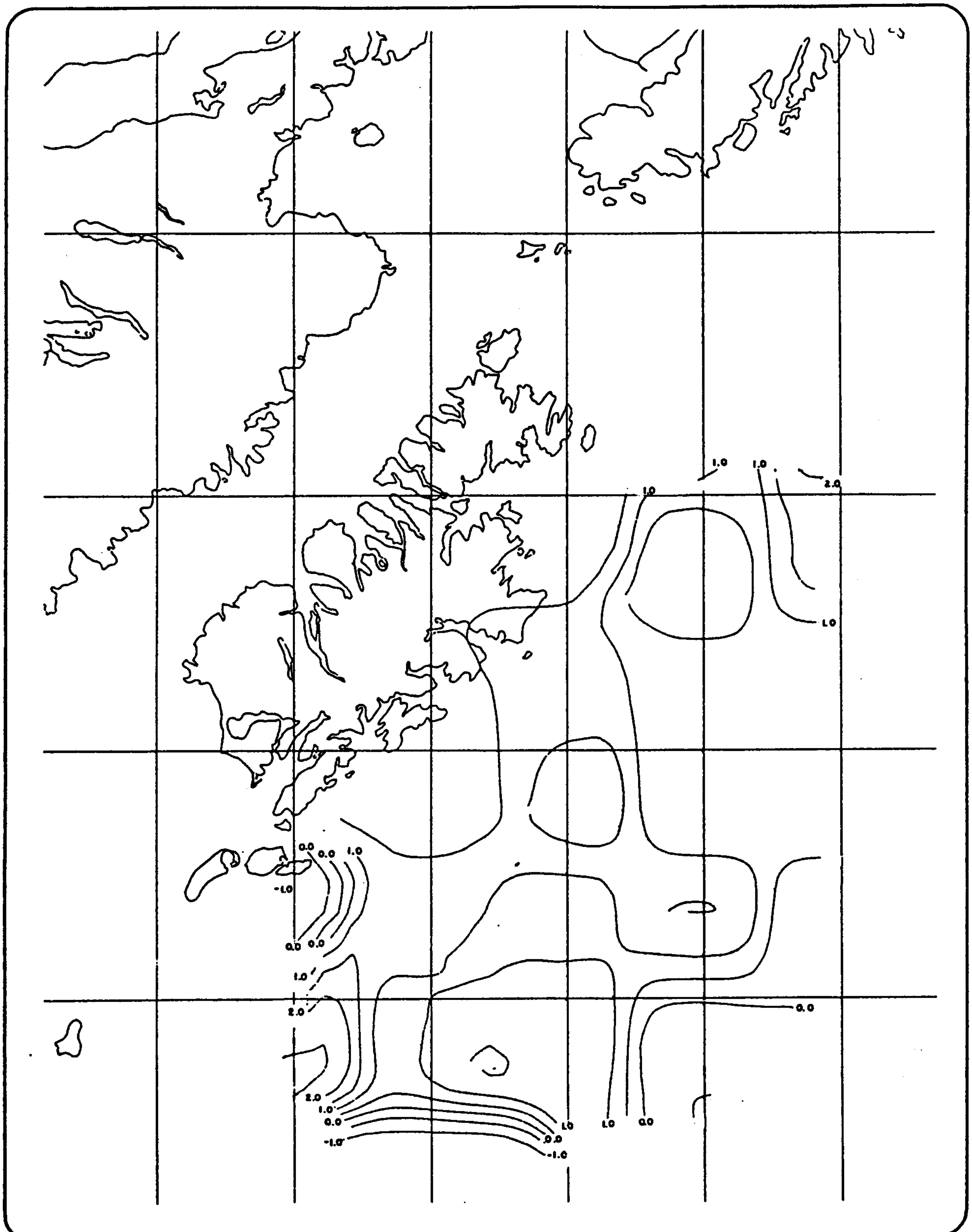
Distribution and abundance of Scolecithricella minor in bongo tows from cruise TMF79.

Figure 3.3-30



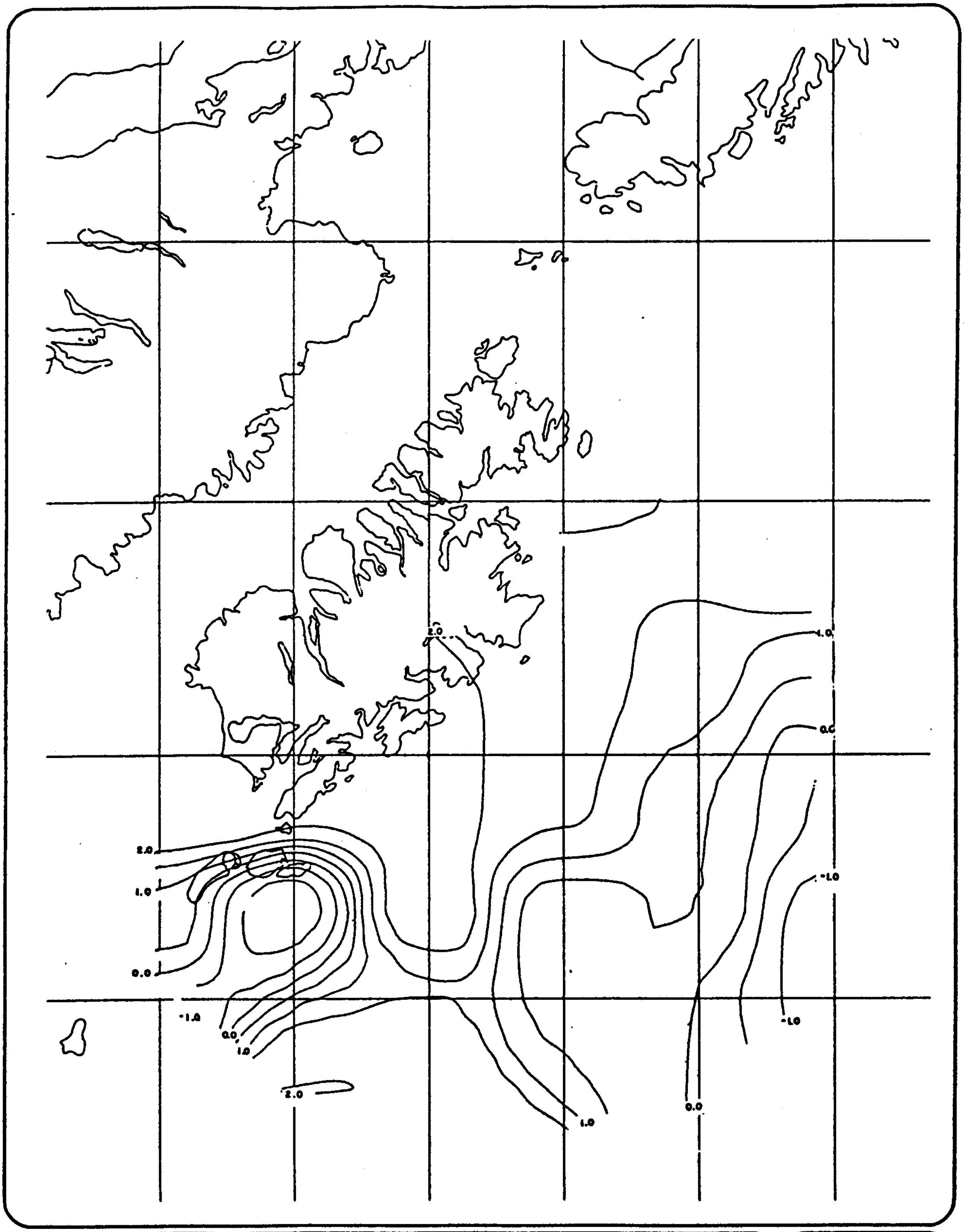
Distribution and abundance of <u>Oithona</u> spp. in bongo tows from cruise 4DI78.

Figure 3.3-31



Distribution and abundance of Oithona spp. in bongo tows from cruise 2MF78.

Figure 3.3-32



Distribution and abundance of *Oithona* spp. in bongo tows from cruise 1WE78.

Figure 3.3-33

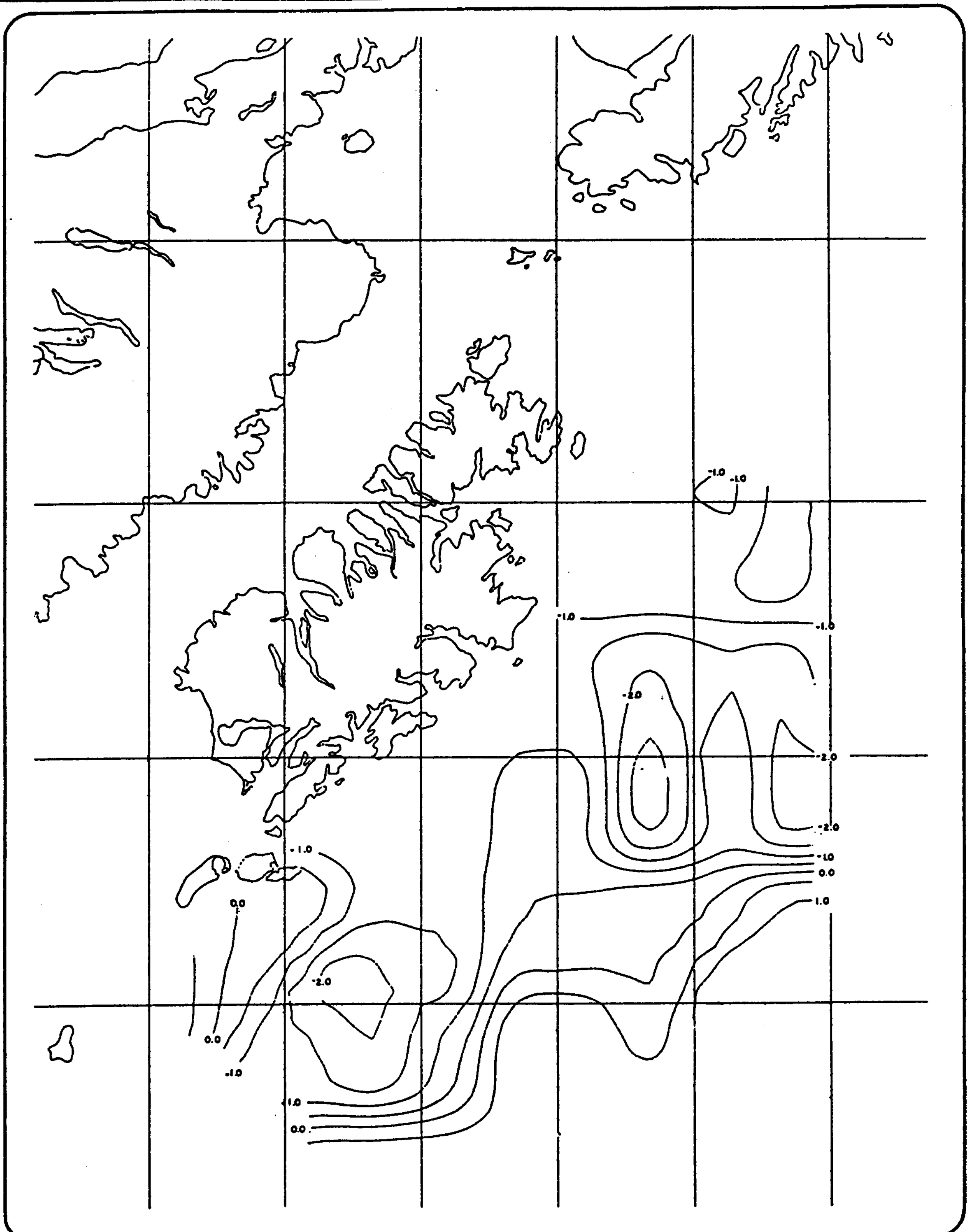
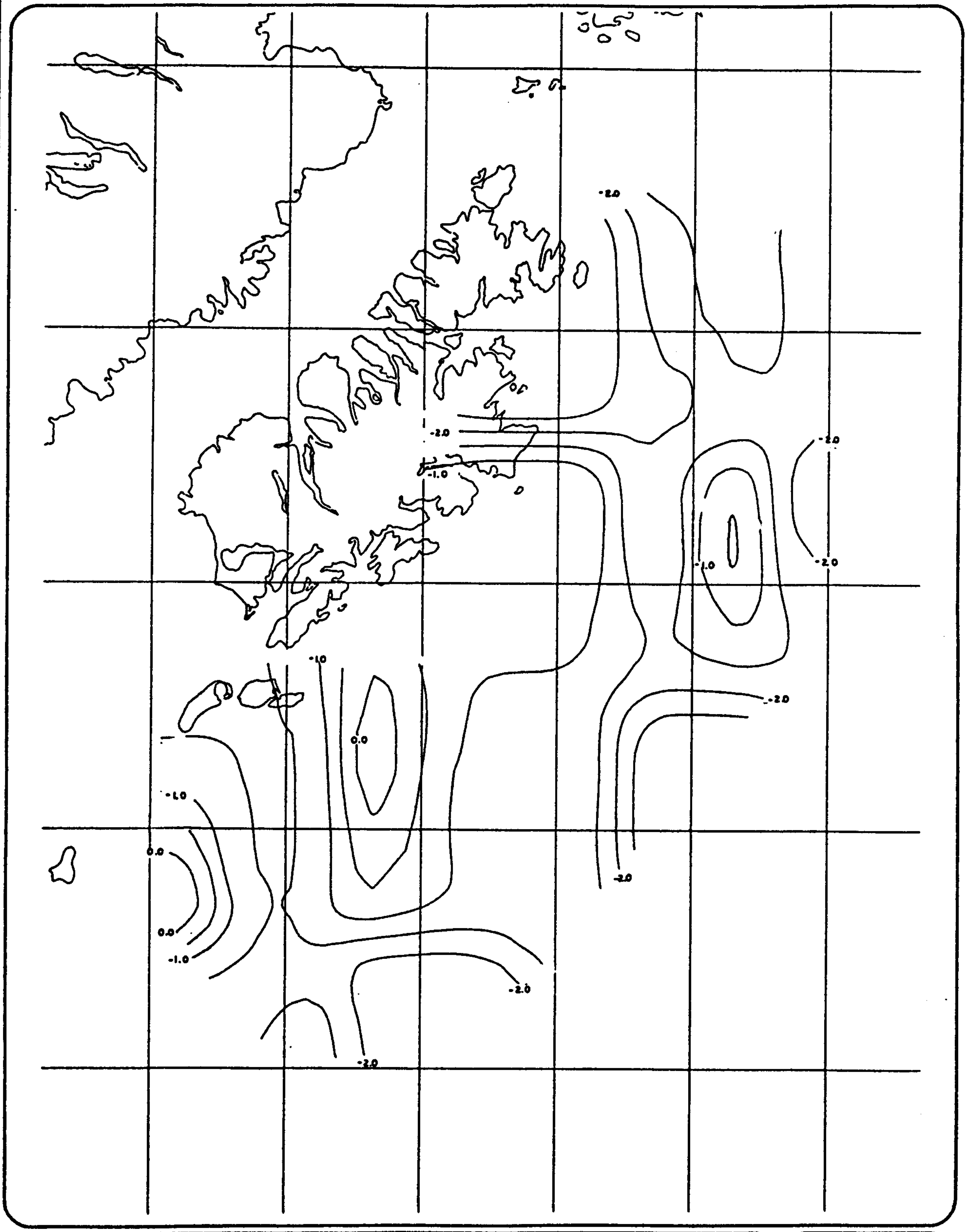


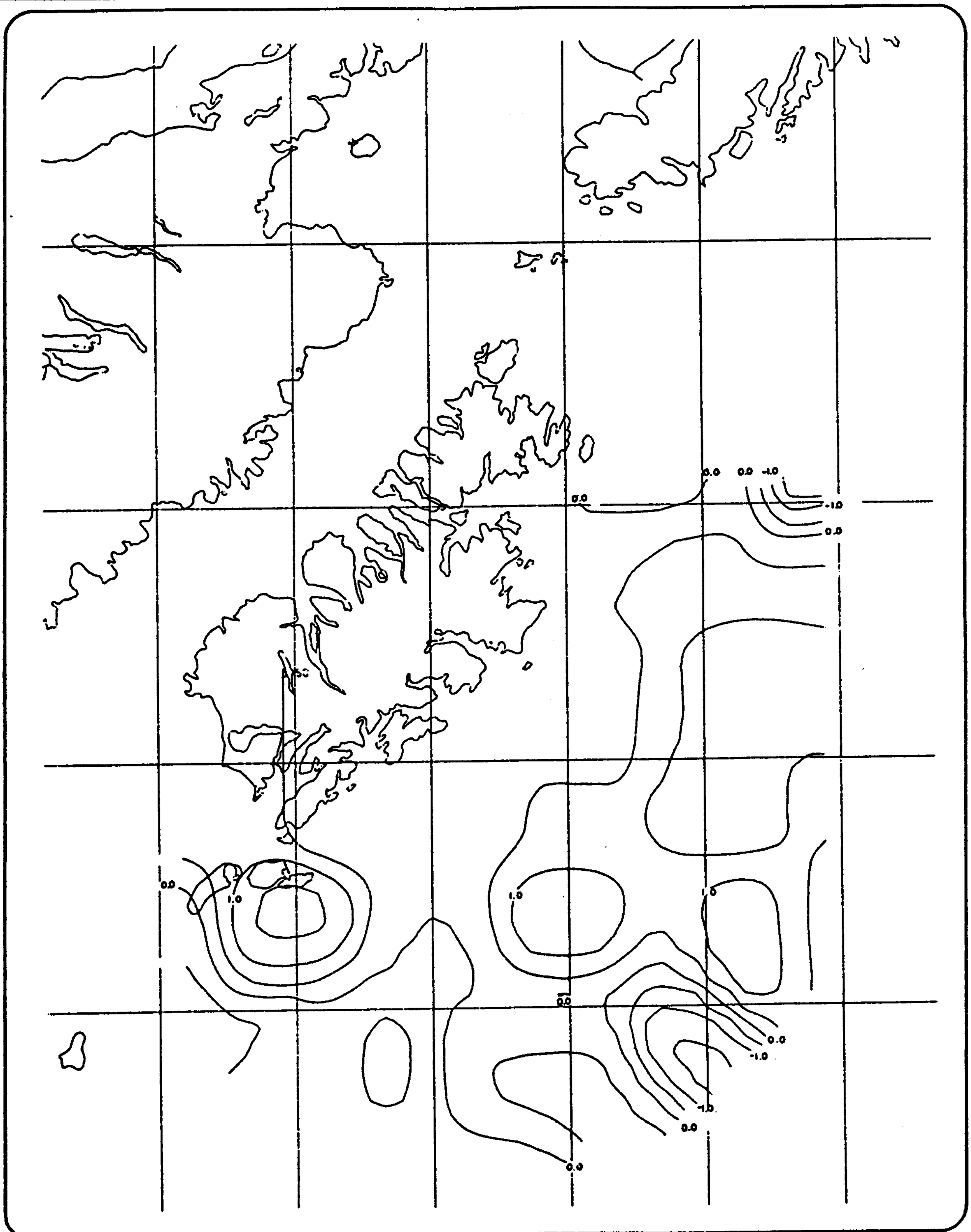
Figure 3.3-34

Distribution and abundance of _Oithona_ spp. in bongo tows from cruise 1MF79.



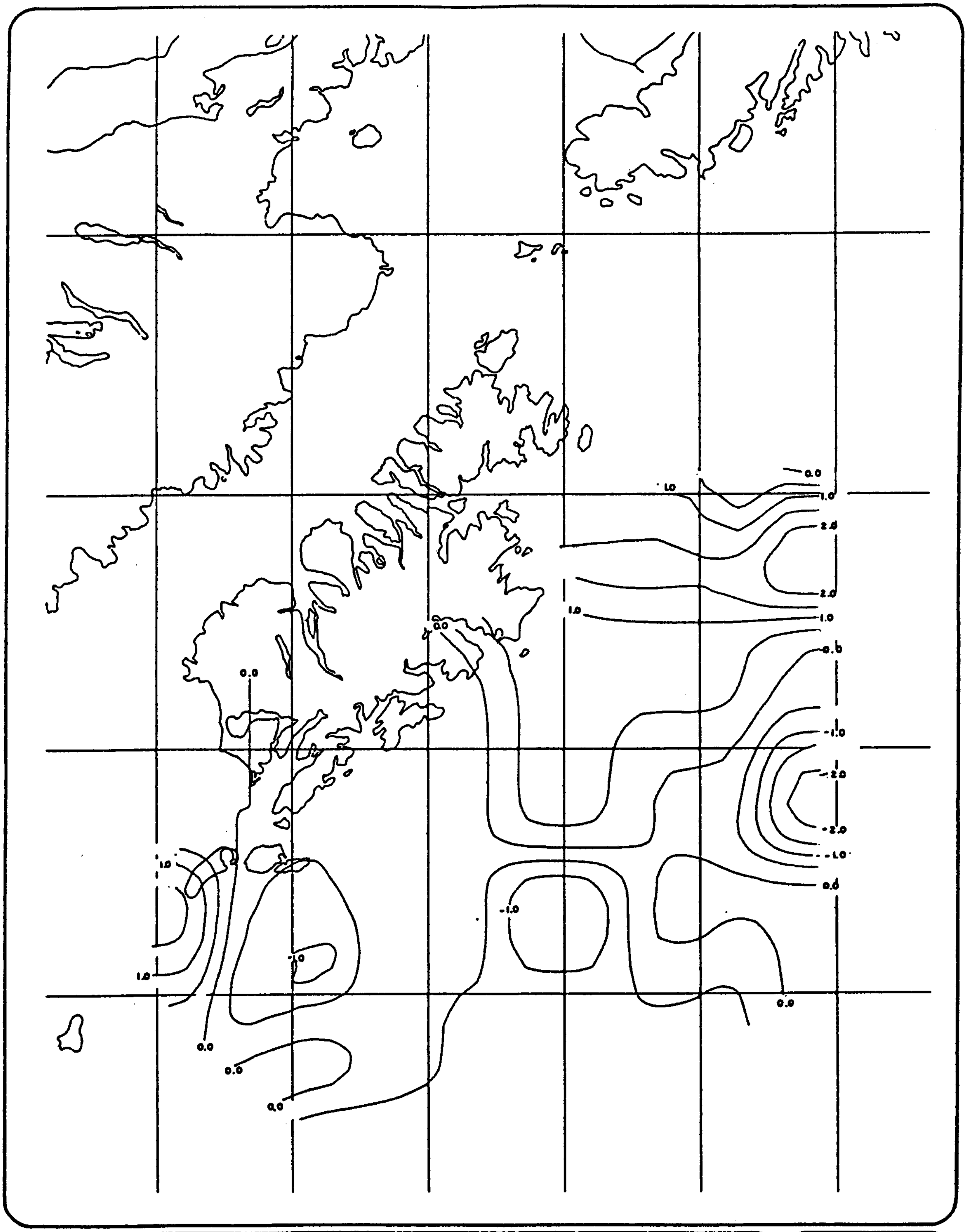
Distribution and abundance of total amphipods in bongo tows from cruise 4DI78.

Figure 3.3-35



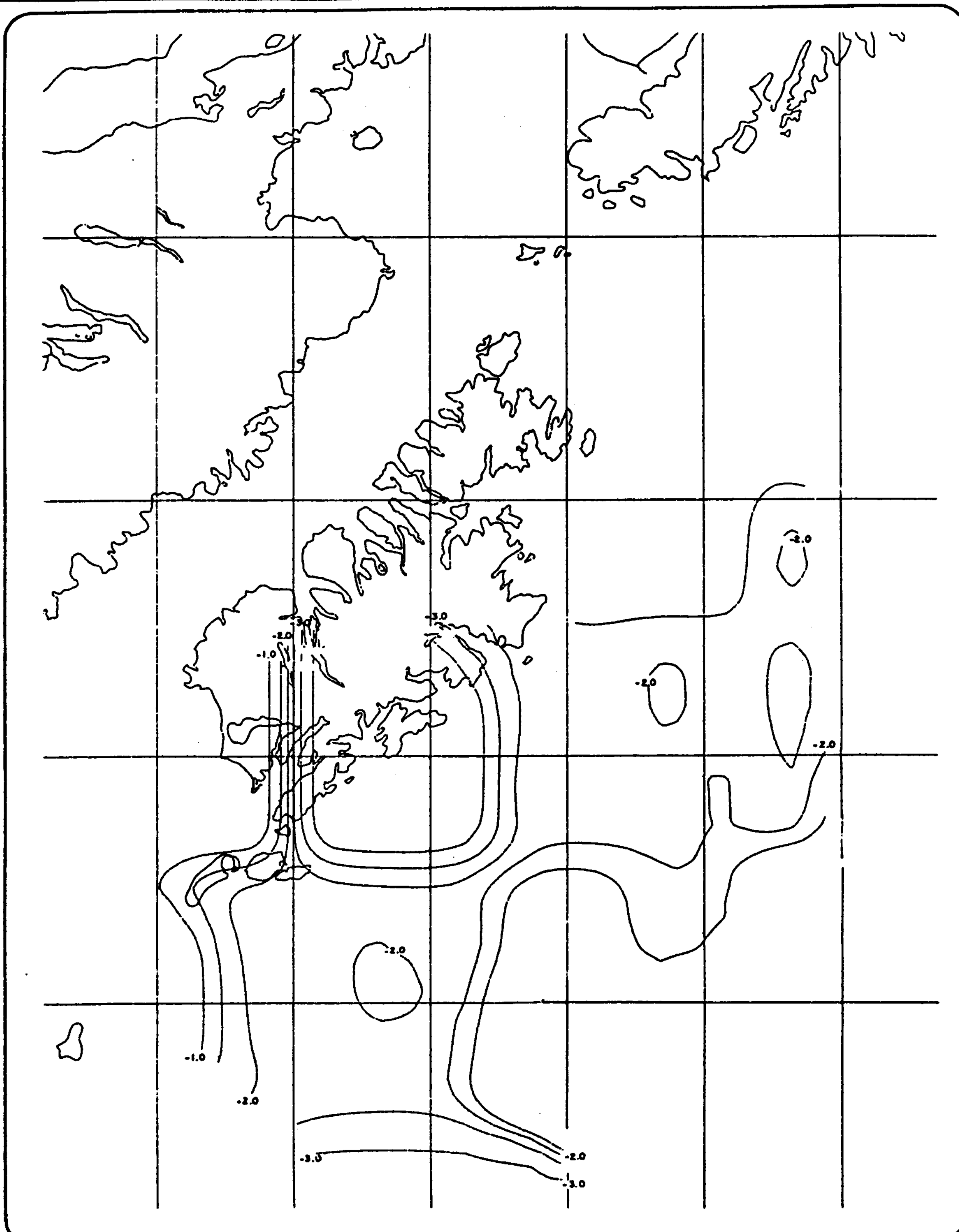
Distribution and abundance of total amphipods in bongo tows from cruise 2MF78.

Figure 3.3-36



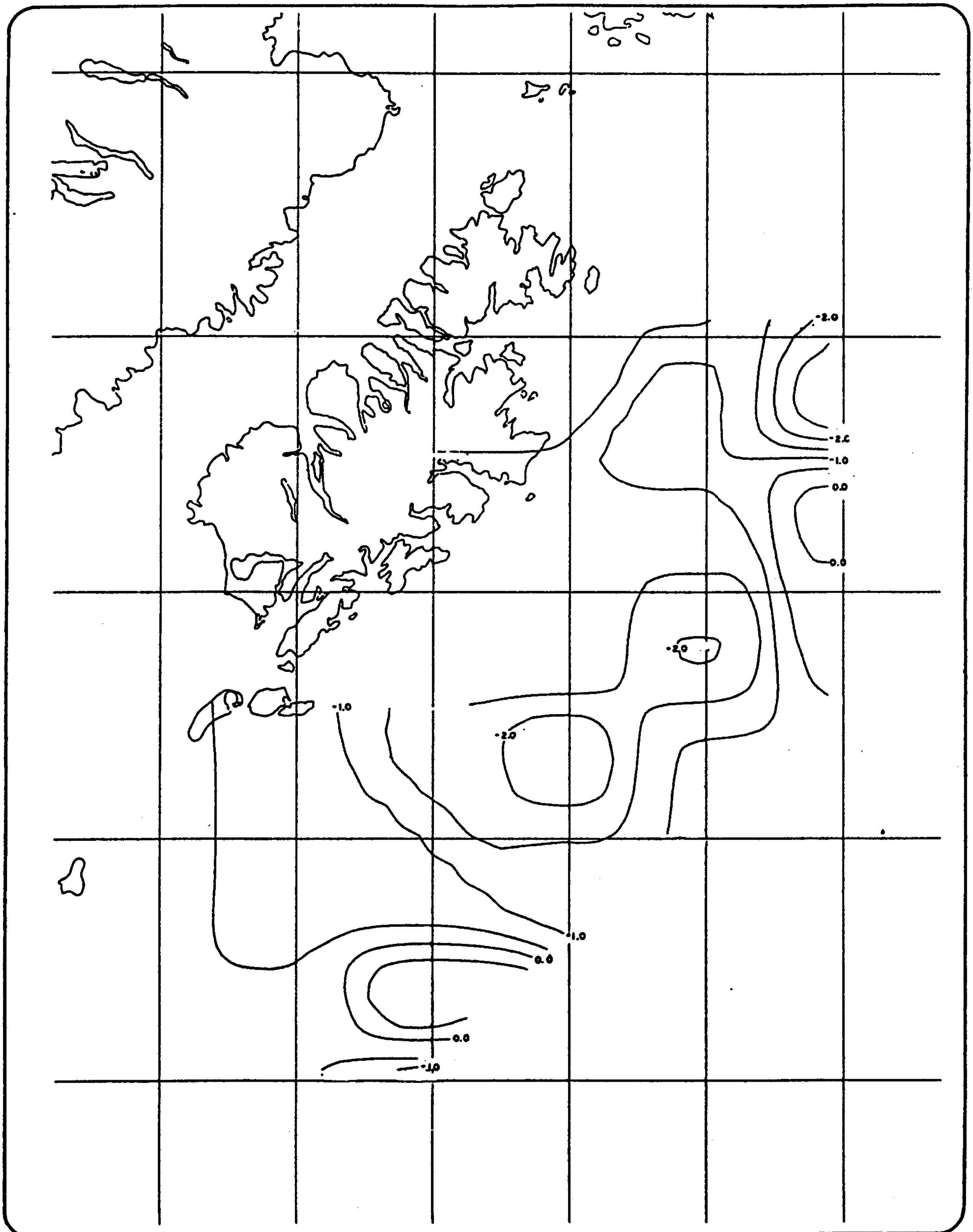
Distribution and abundance of total amphipods in bongo tows from cruise 1WE78.

Figure 3.3-37



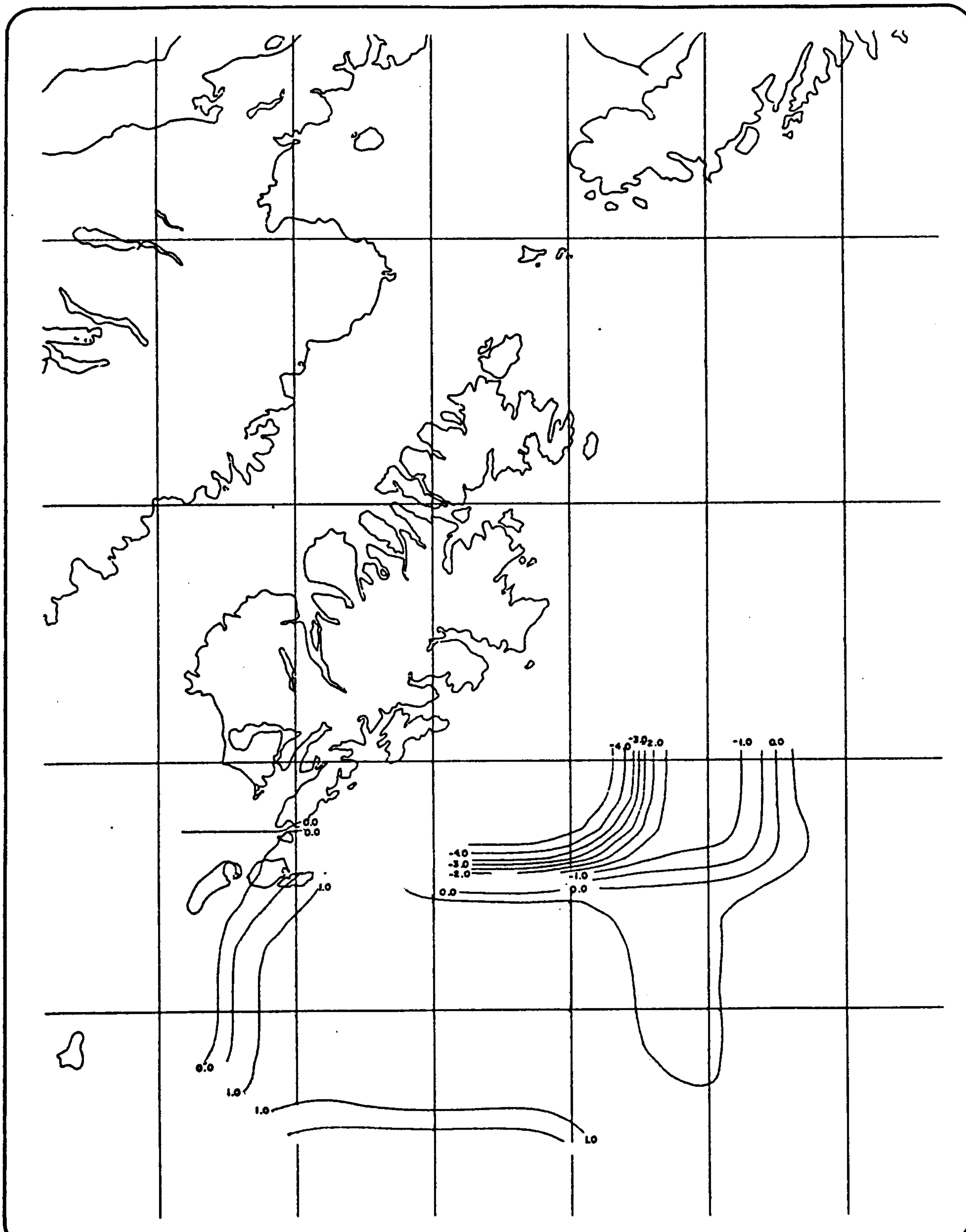
Distribution and abundance of total amphipods in bongo tows from cruise 1MF79.

Figure 3.3-38



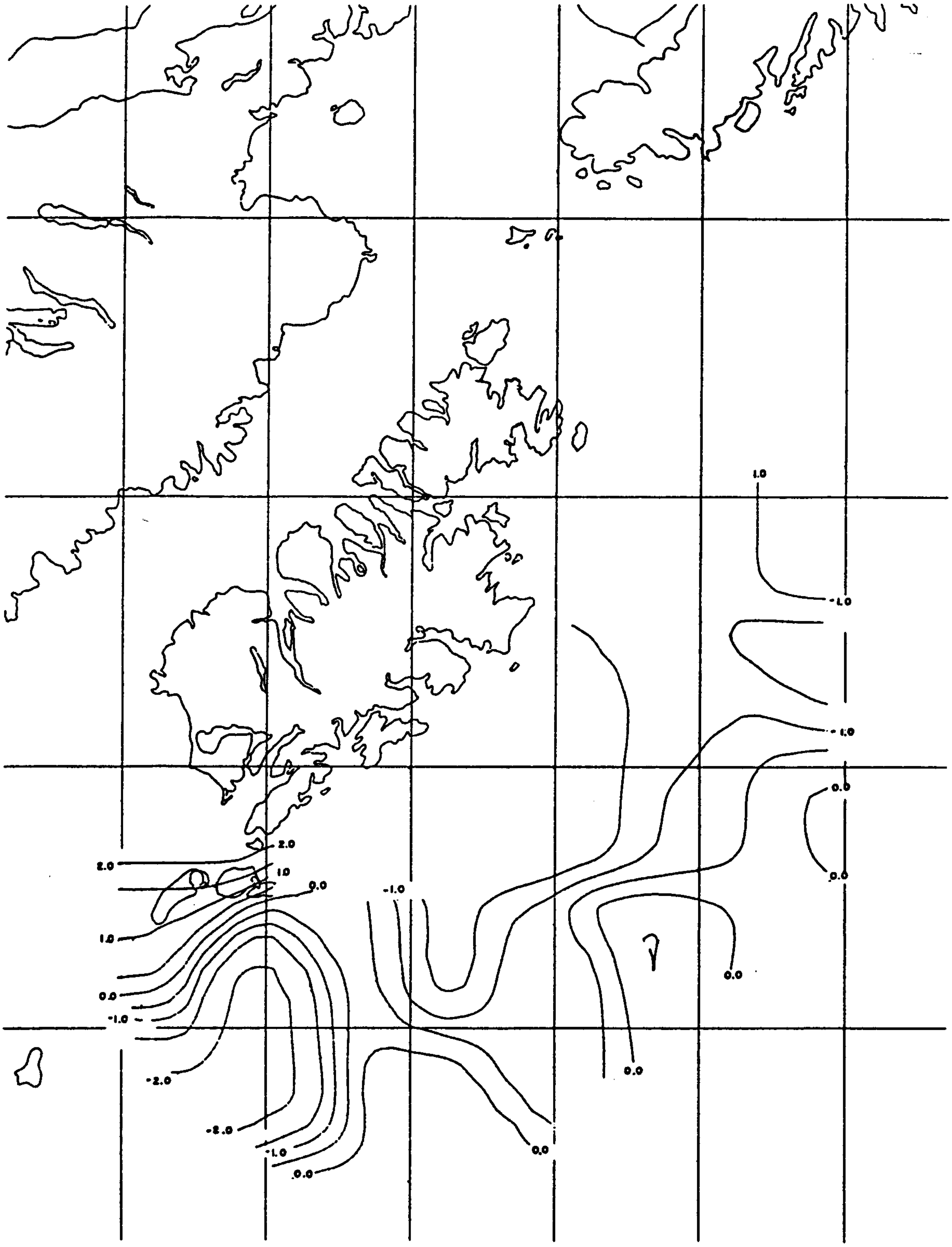
Distribution and abundance of total ostracods in bongo tows from cruise 4DI78.

Figure 3.3-39



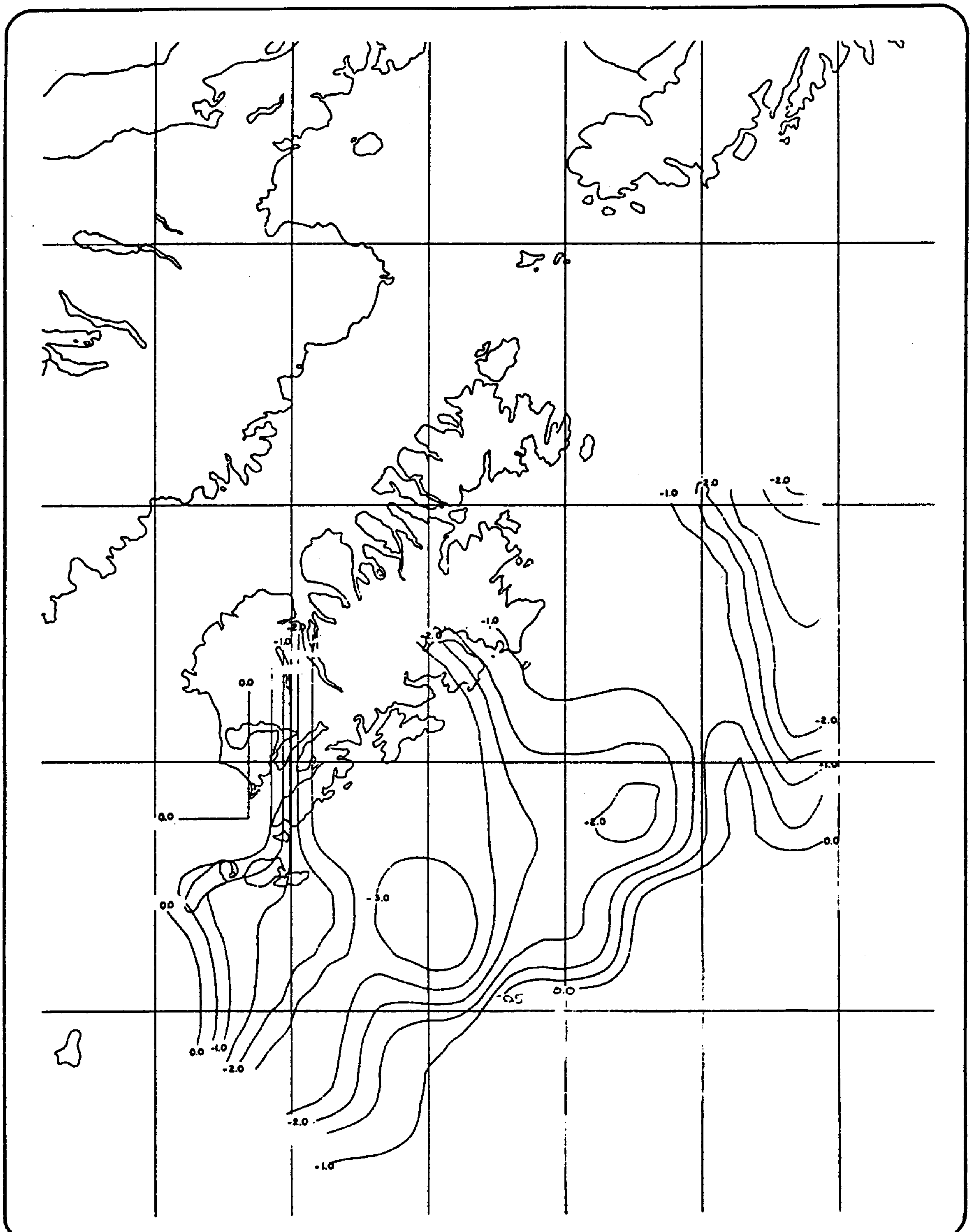
Distribution and abundance of total ostracods in bongo tows from cruise 2MF78.

Figure 3.3-40



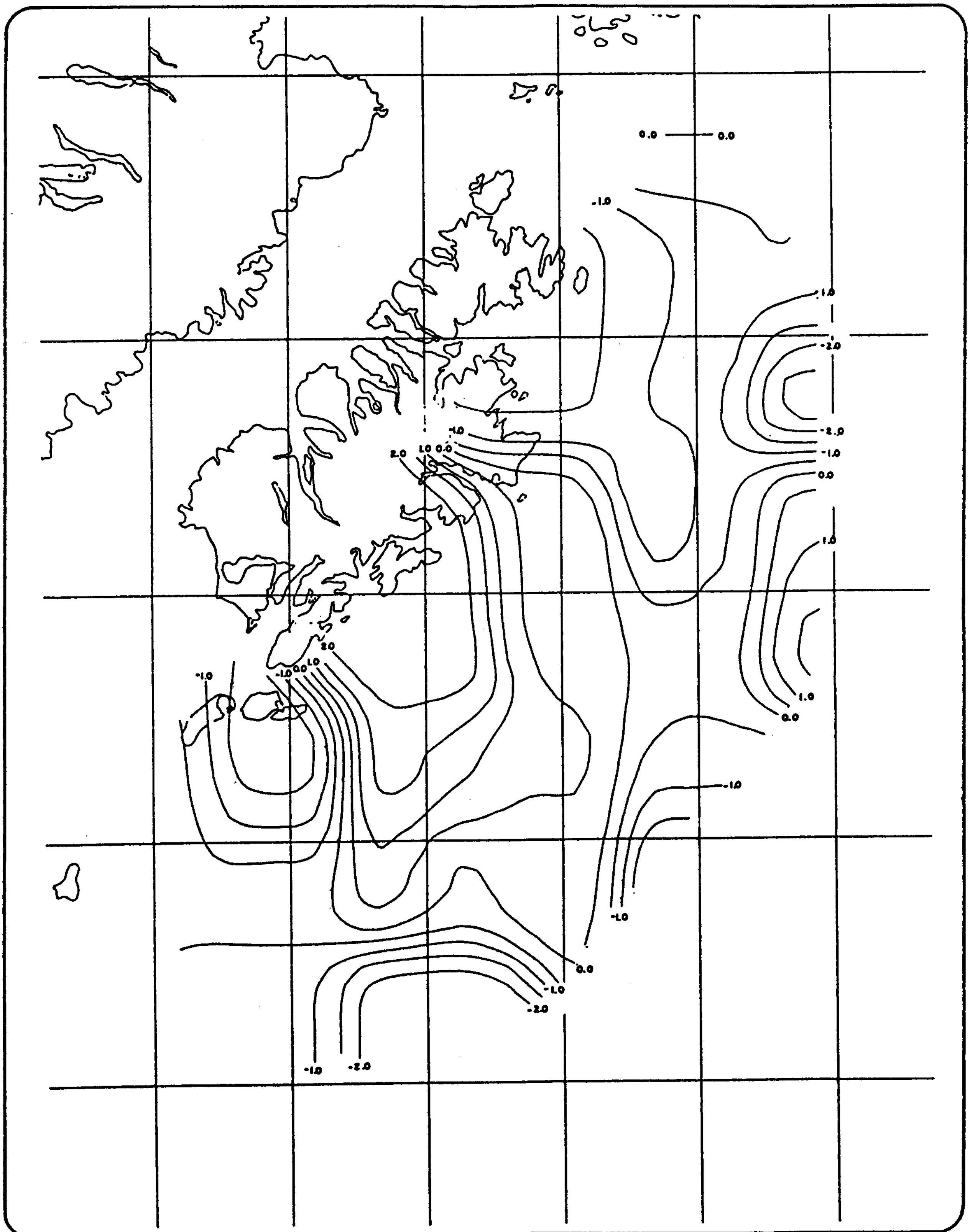
Distribution and abundance of total ostracods in bongo tows from cruise 1WE78.

Figure 3.3-41



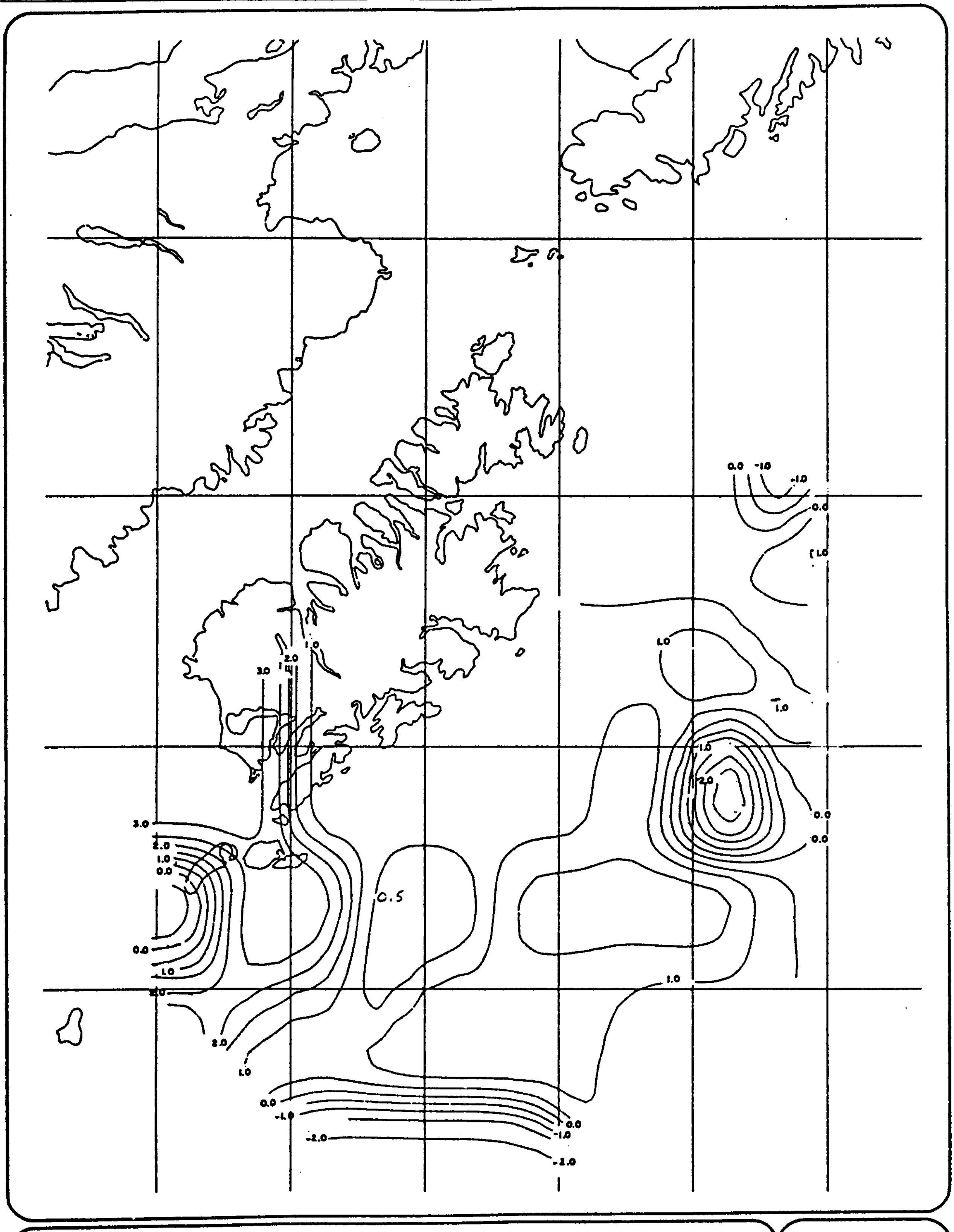
Distribution and abundance of total ostracods in bongo tows from cruise 1MF79.

Figure 3.3-42



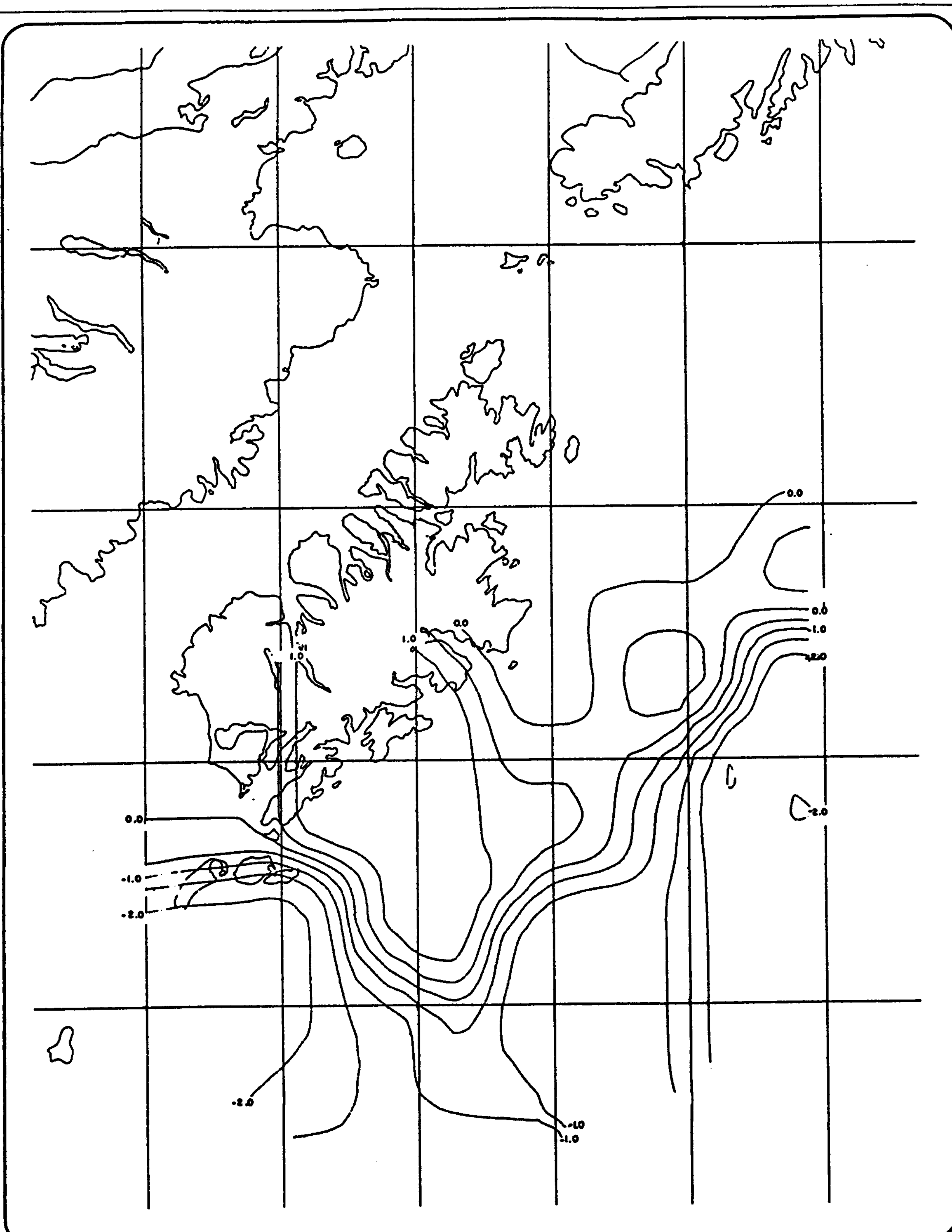
Distribution and abundance of total larvaceans in bongo tows from cruise 4DI78.

Figure 3.3-43



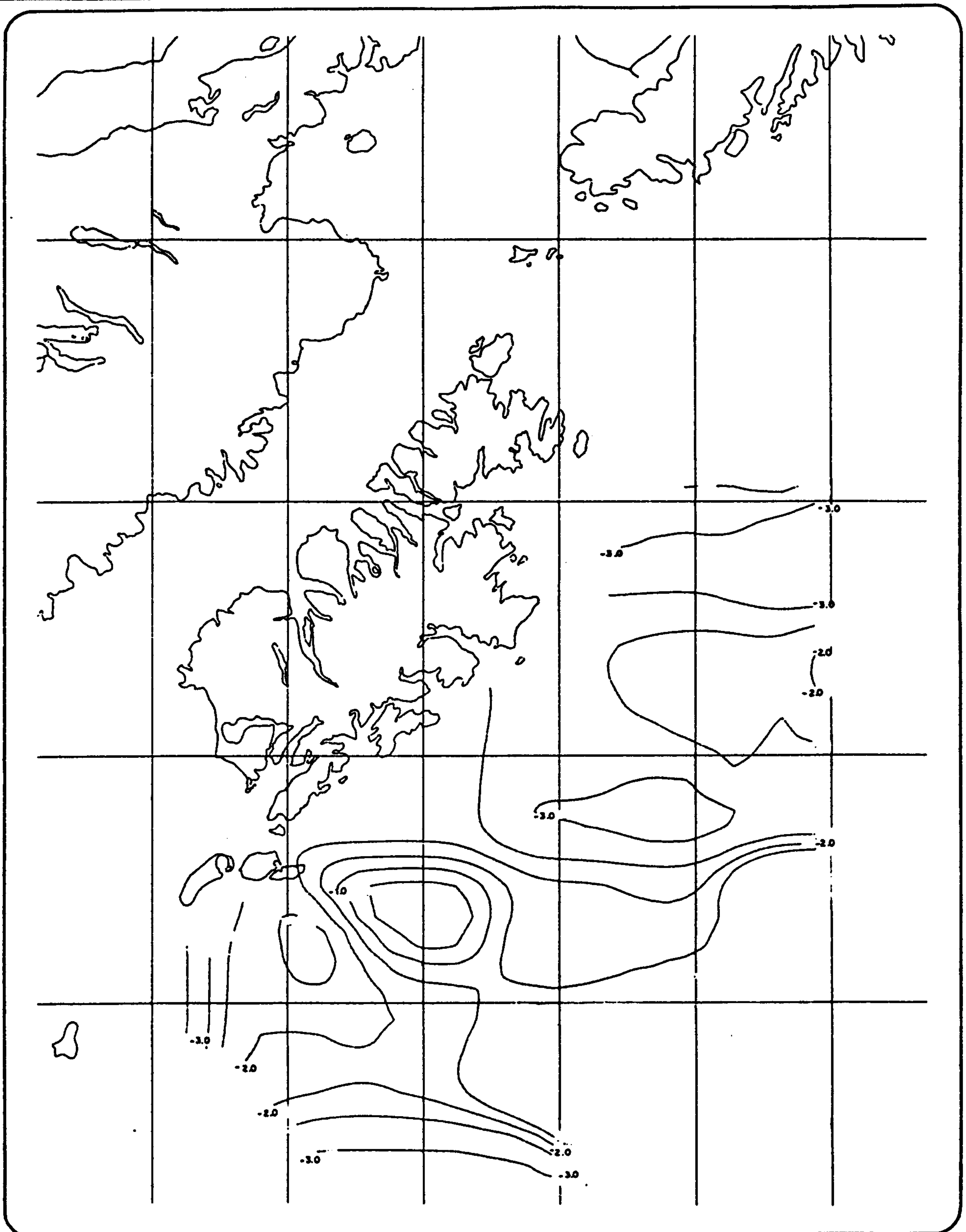
Distribution and abundance of total larvaceans in bongo tows from cruise 2MF78.

Figure 3.3-44



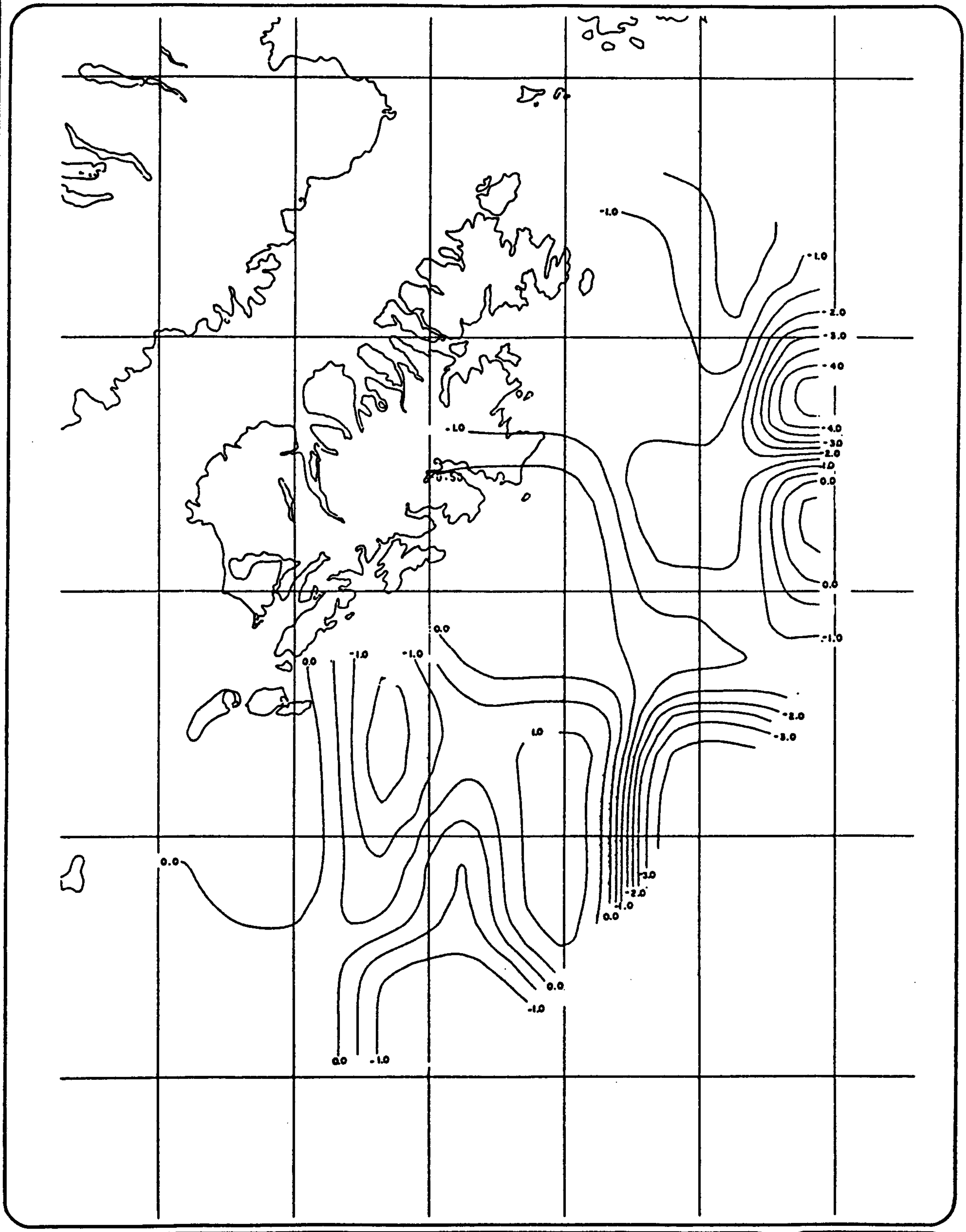
Distribution and abundance of total larvaceans in bongo tows from cruise 1WE78.

Figure 3.3-45



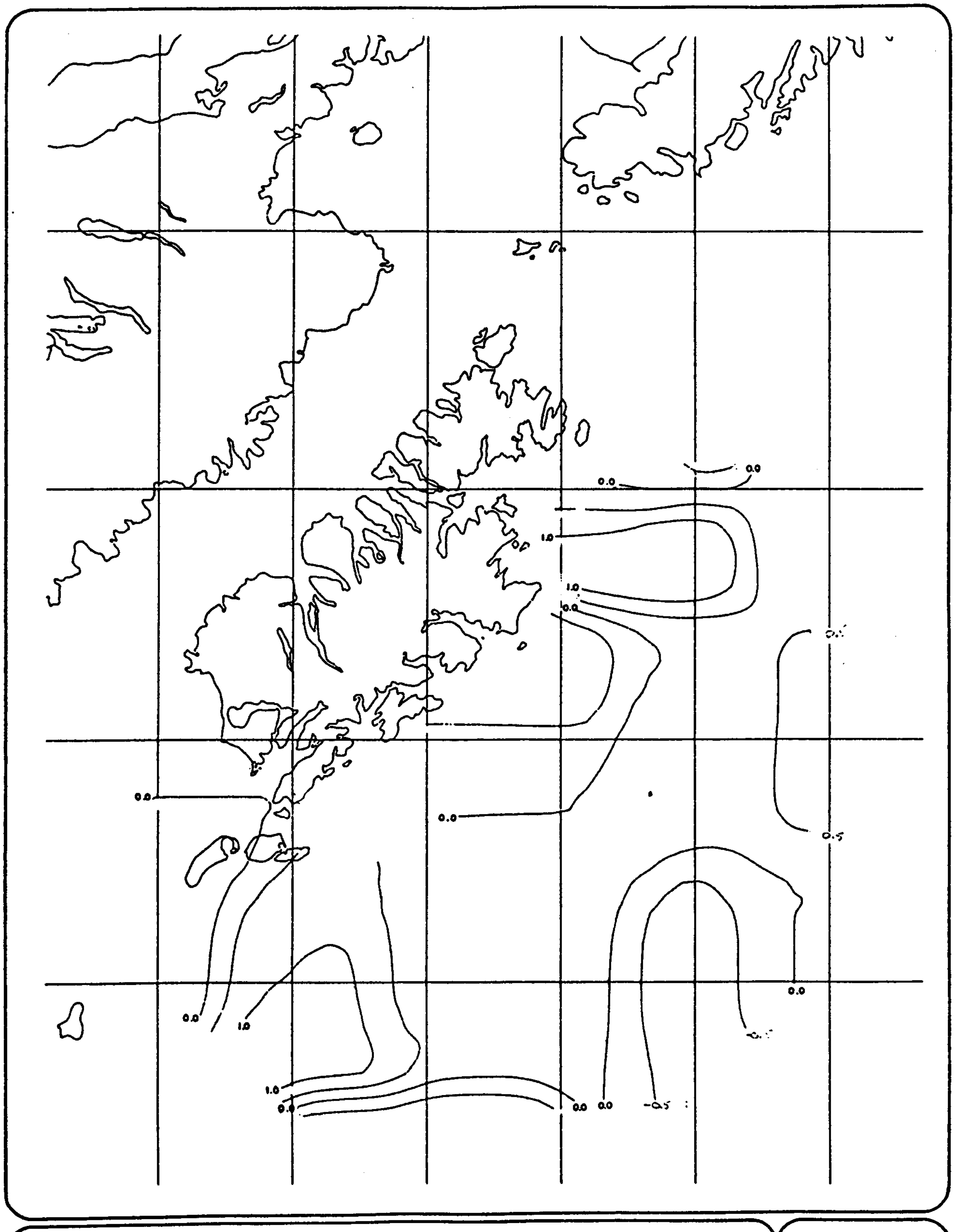
Distribution and abundance of total larvaceans in bongo tows from cruise 1MF79.

Figure 3.3-46



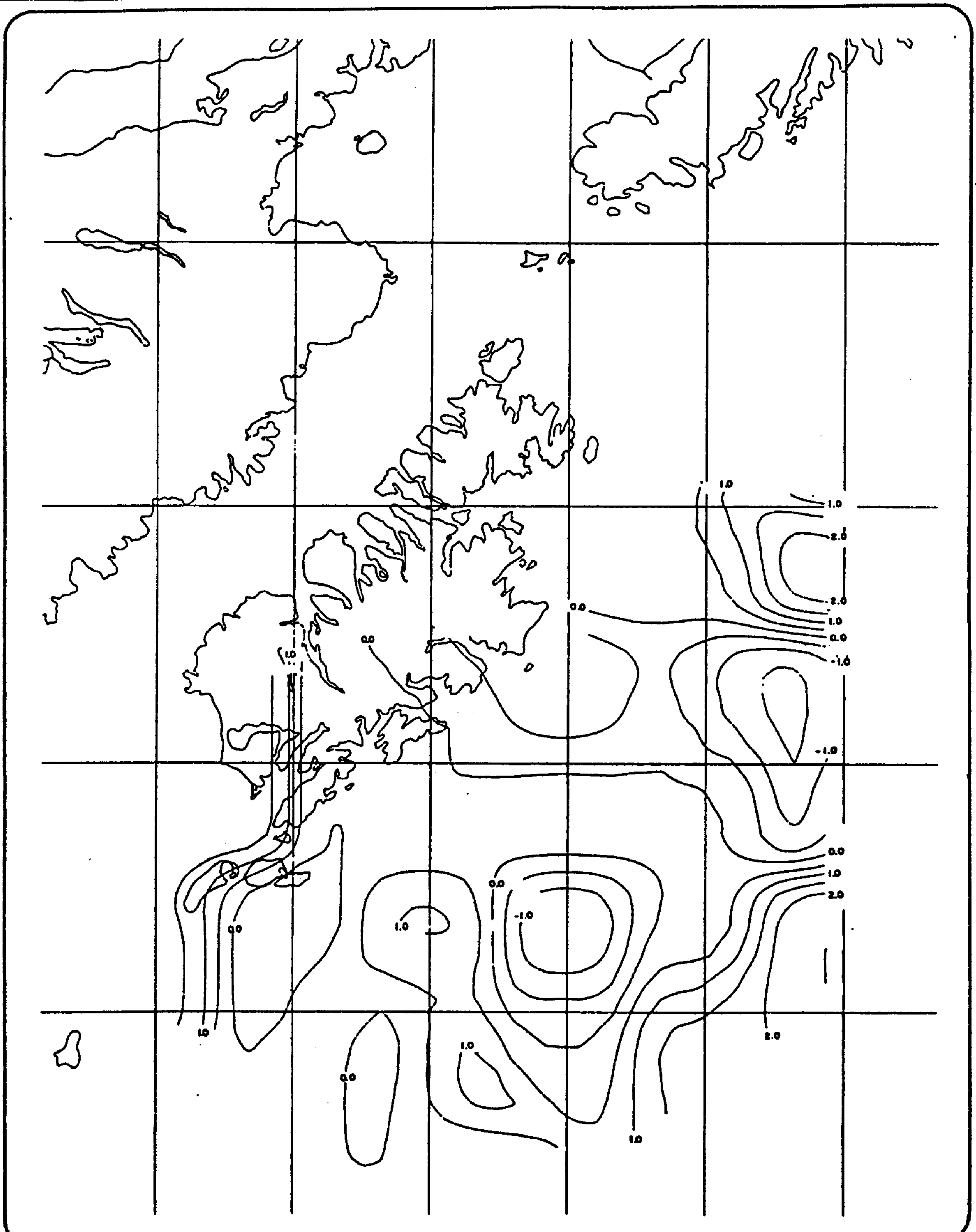
Distribution and abundance of Limacina helicina in bongo tows from cruise 4DI78.

Figure 3.3-47

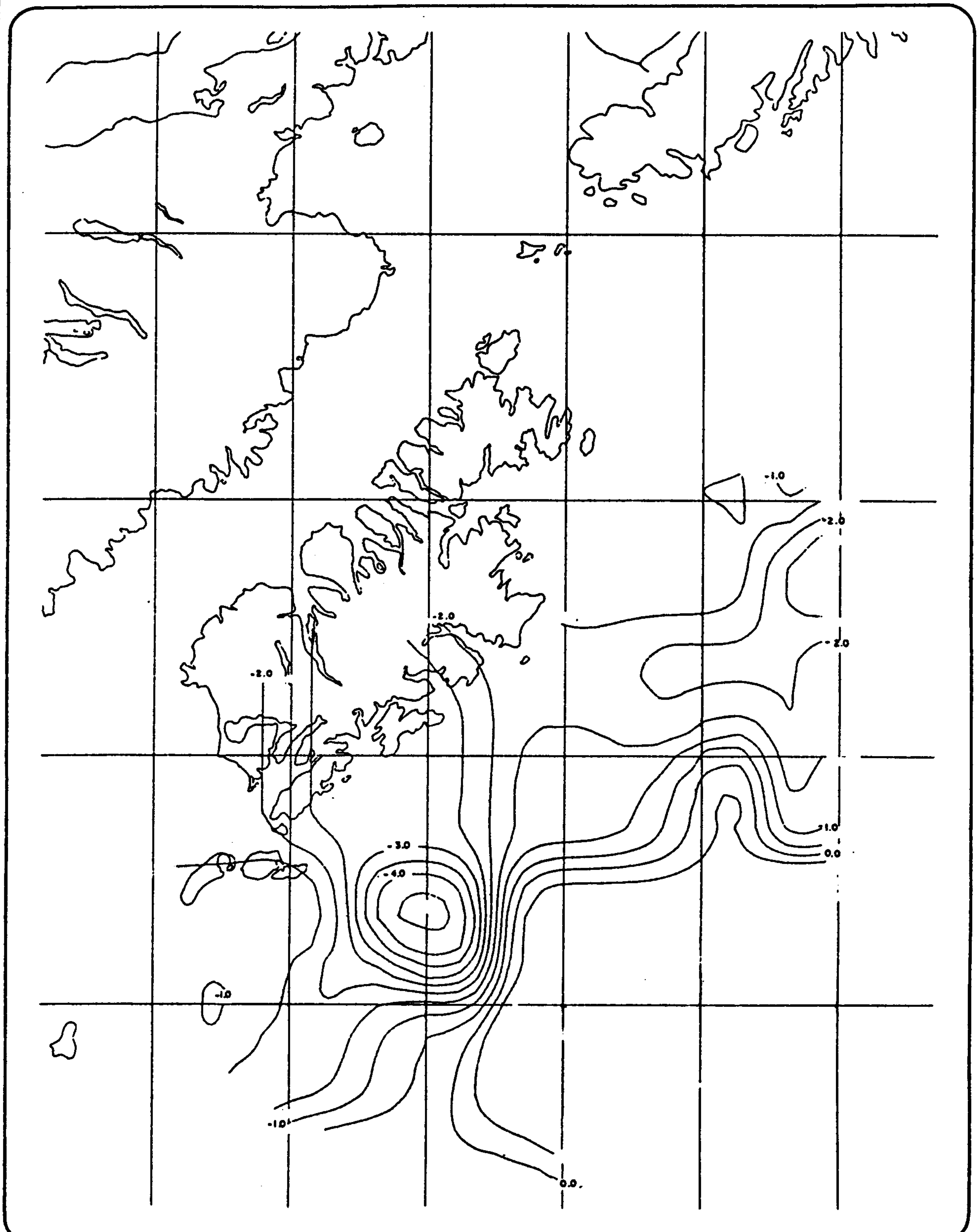


Distribution and abundance of *Limacina helicina* in bongo tows from cruise 2MF78.

Figure 3.3-48

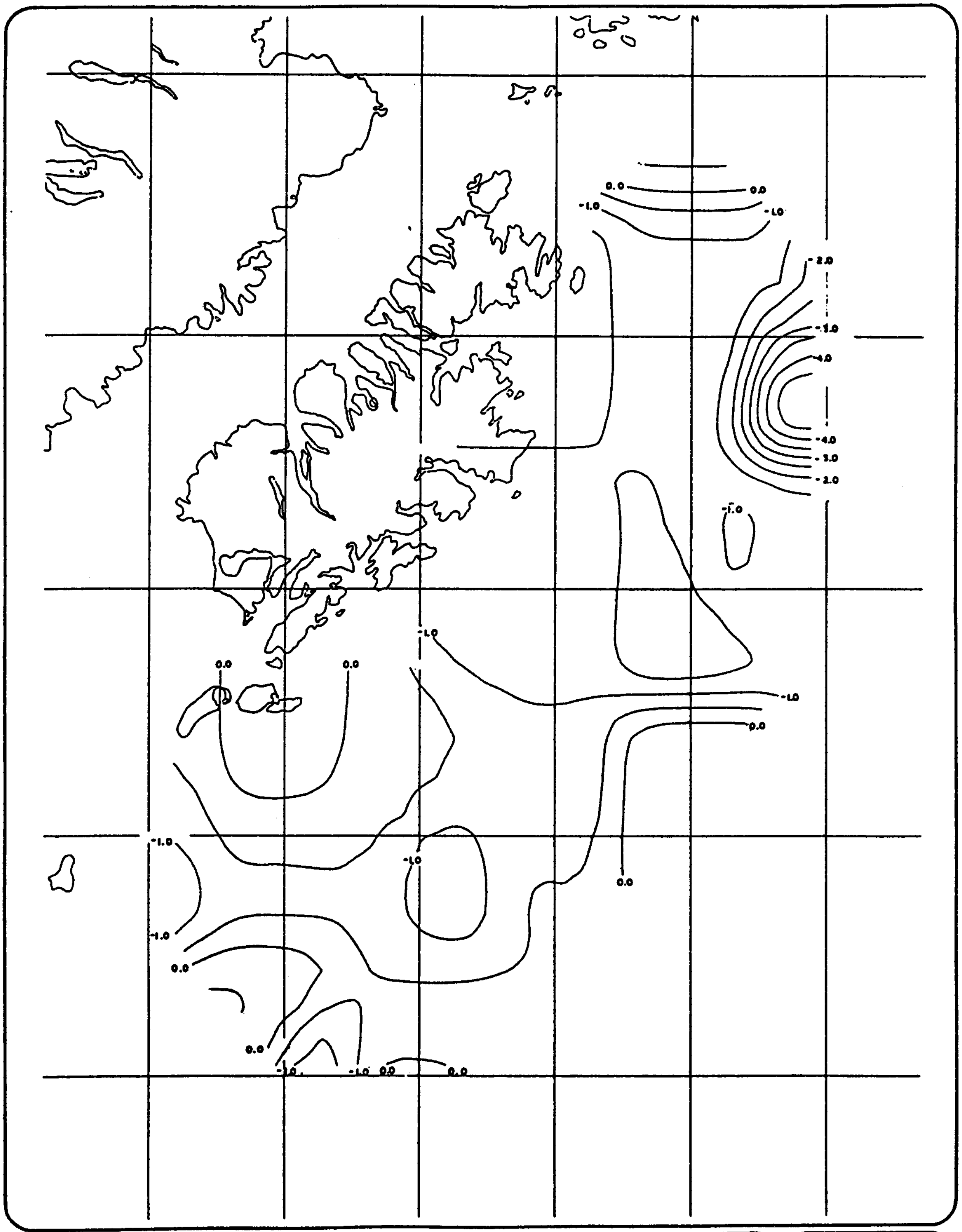


Distribution and abundance of <u>Limacina helicina</u> in bongo tows from cruise 1WE78.	Figure 3.3-49



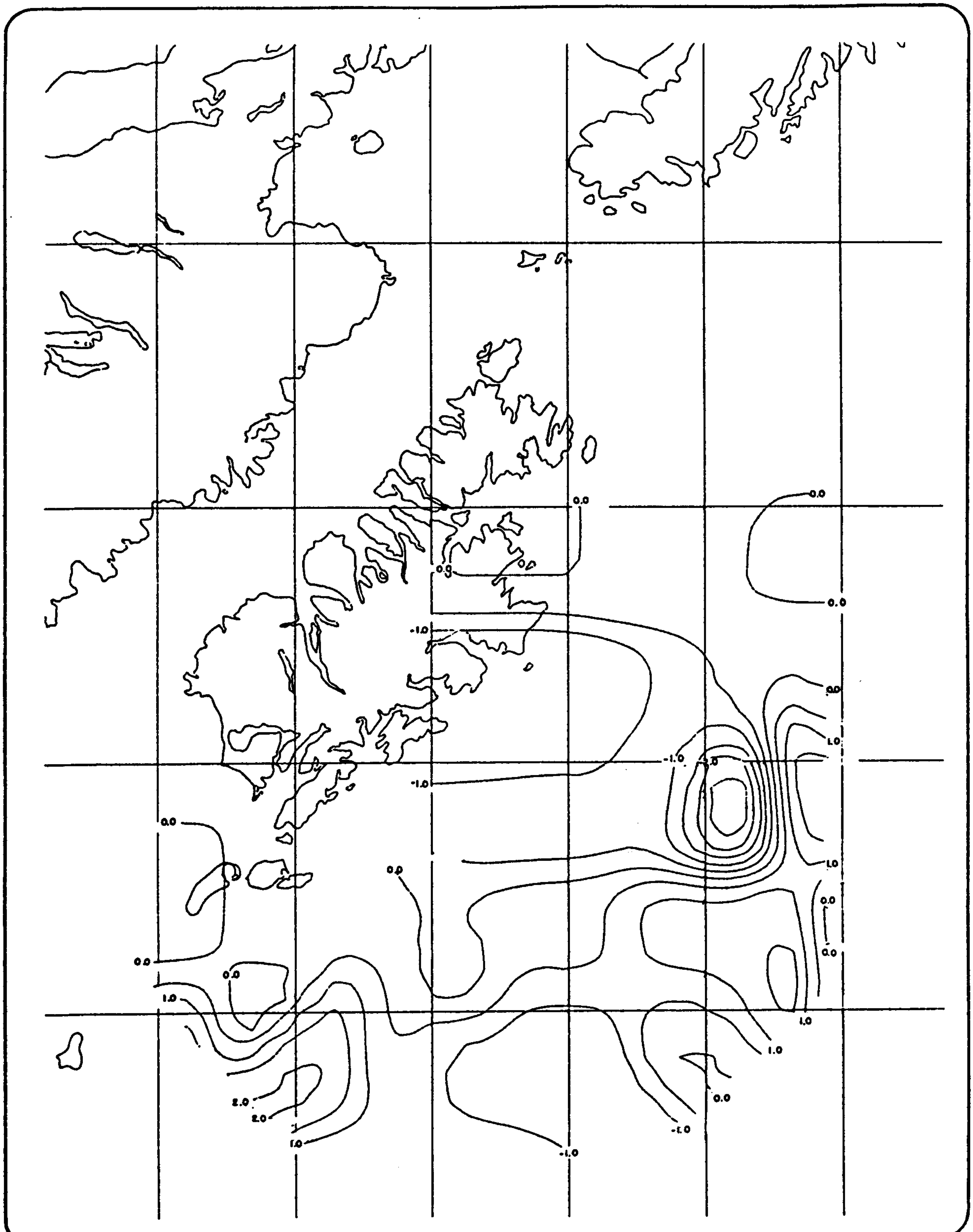
Distribution and abundance of Limacina helicina in bongo tows from cruise 1MF79.

Figure 3.3-50



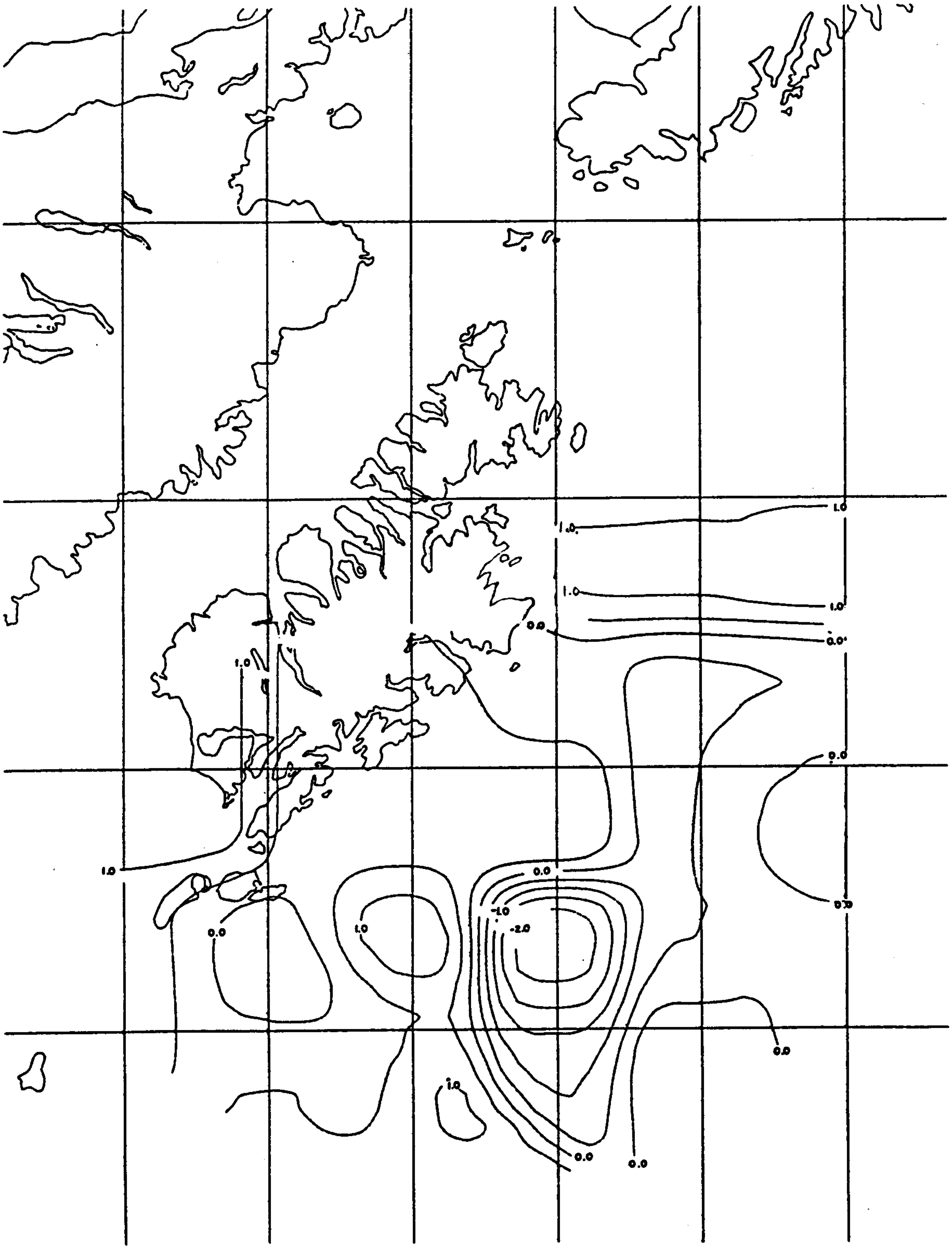
Distribution and abundance of total chaetognaths in bongo tows from cruise 4DI78.

Figure 3.3-51



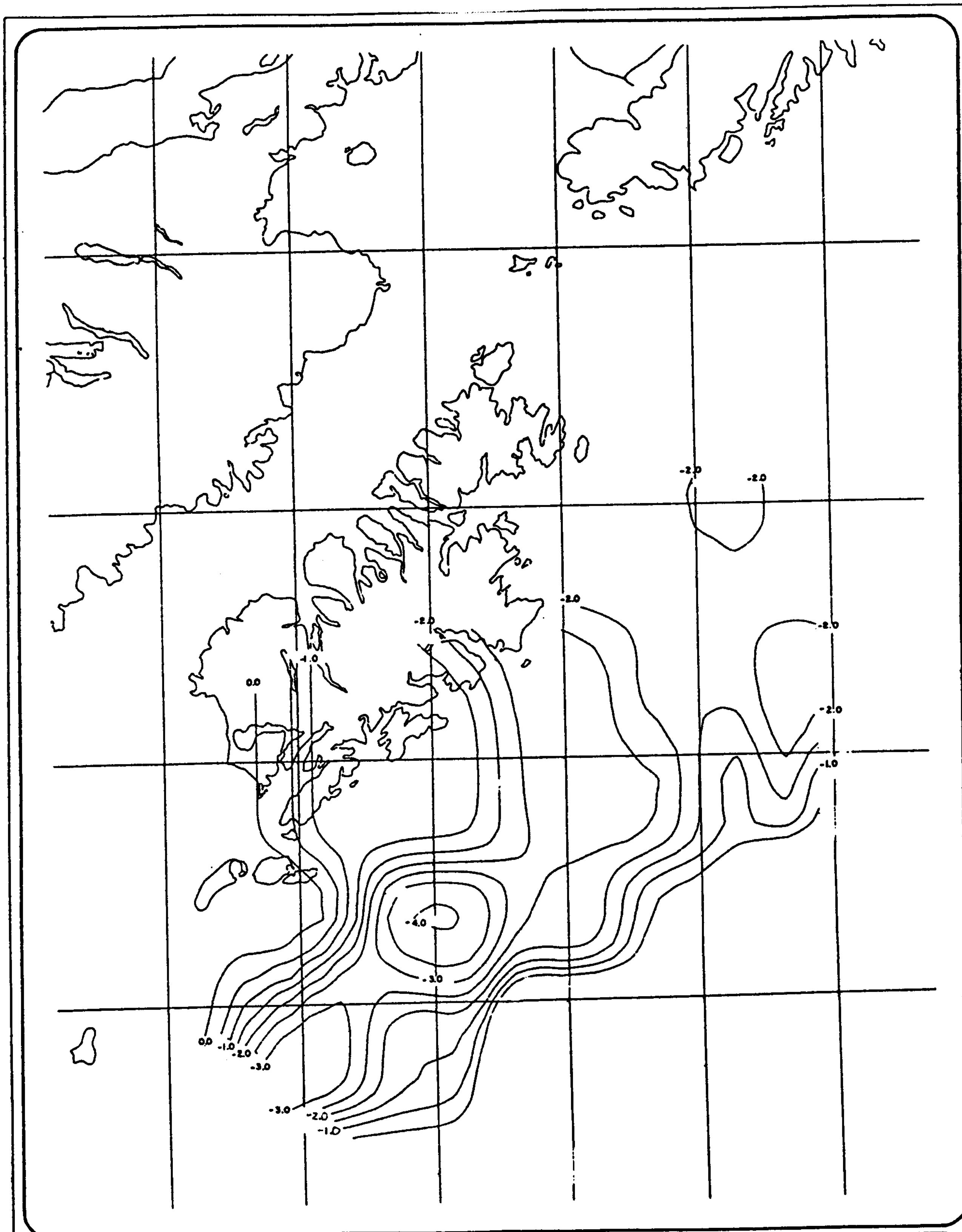
Distribution and abundance of total chaetognaths in bongo tows from cruise 2MF78.

Figure 3.3-52



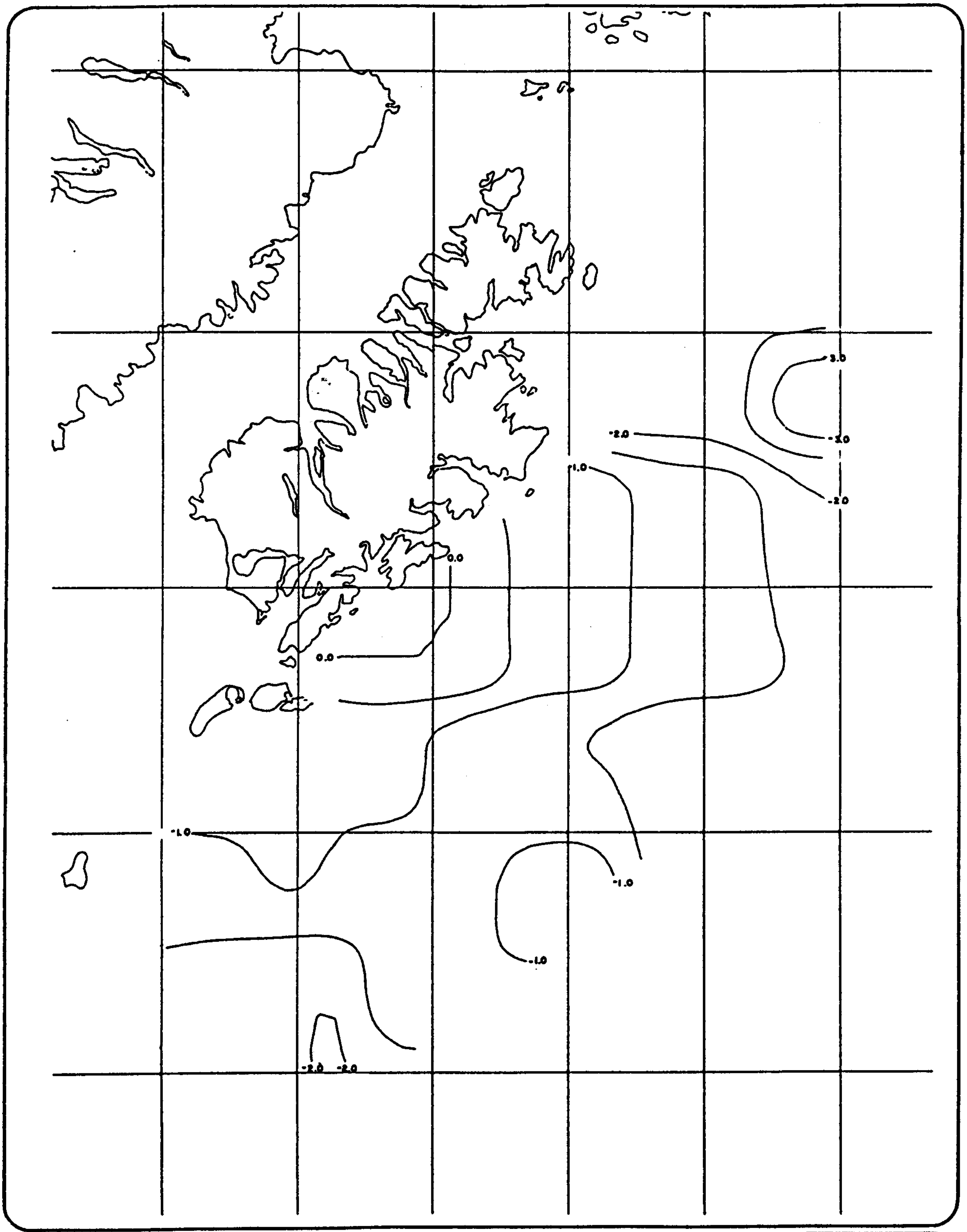
Distribution and abundance of total chaetognaths in bongo tows from cruise 1WE78.

Figure 3.3-53



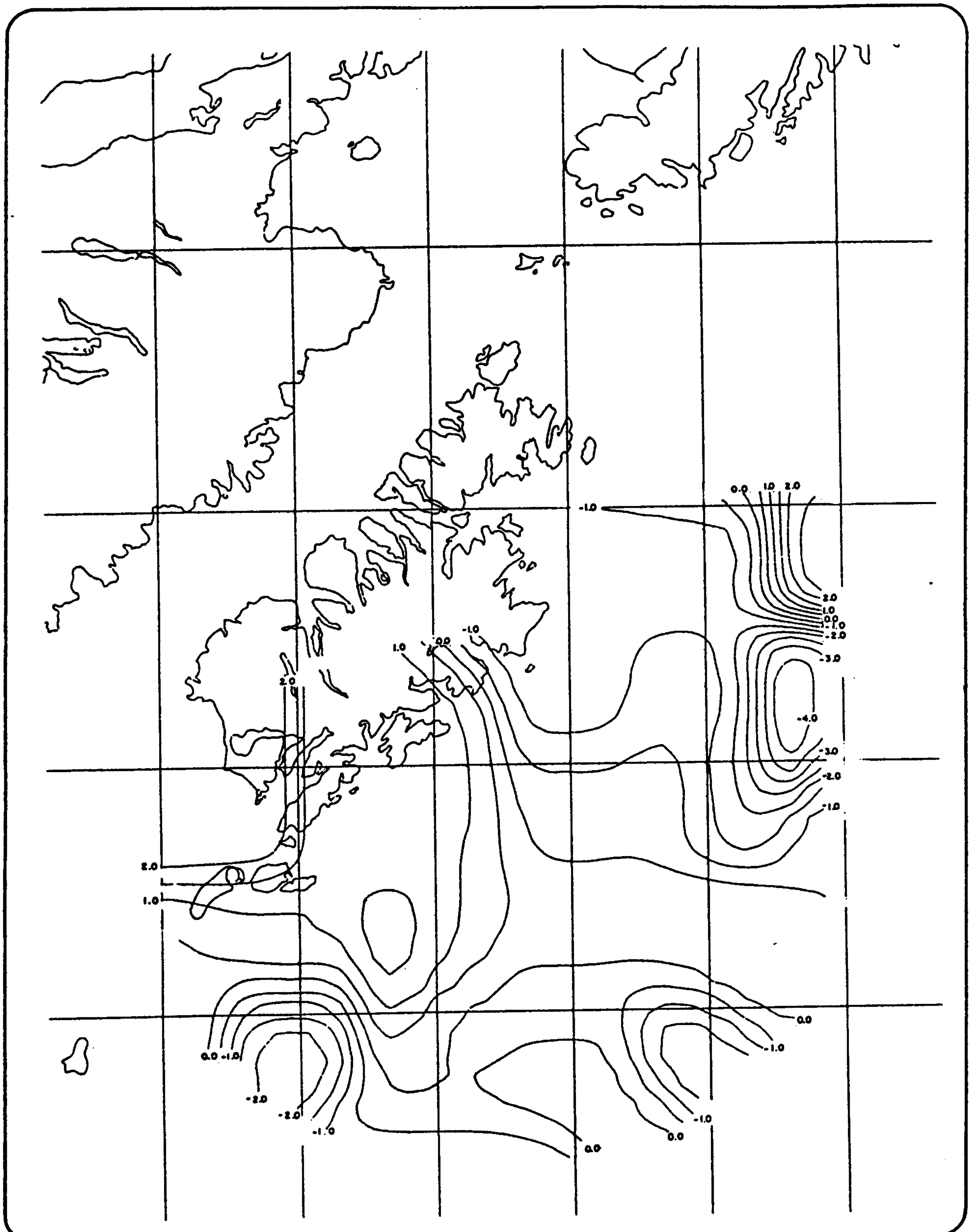
Distribution and abundance of total chaetognaths in bongo tows from cruise 1MF79.

Figure 3.3-54



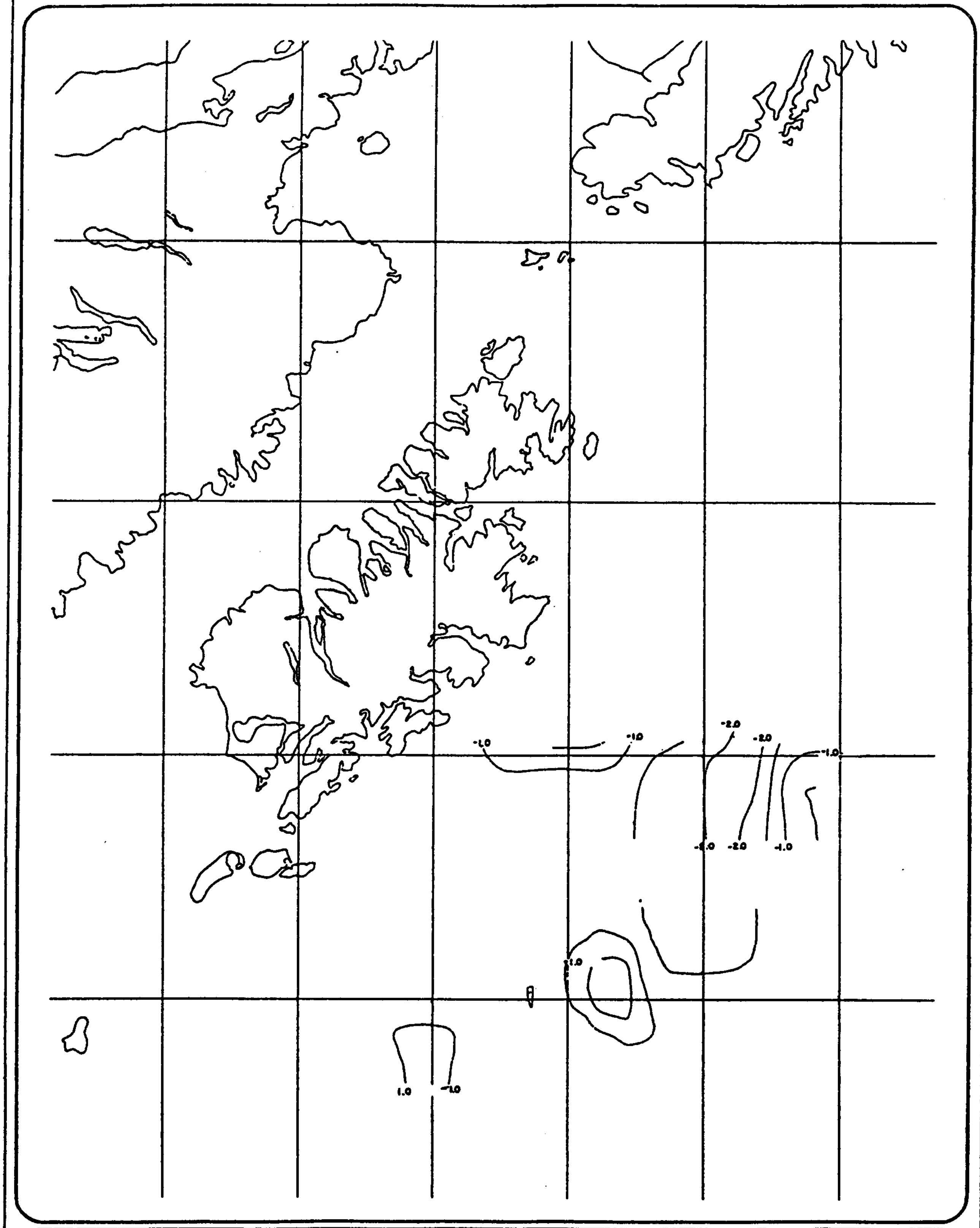
Distribution and abundance of total cnidarians in bongo tows from cruise 4DI78.

Figure 3.3-55



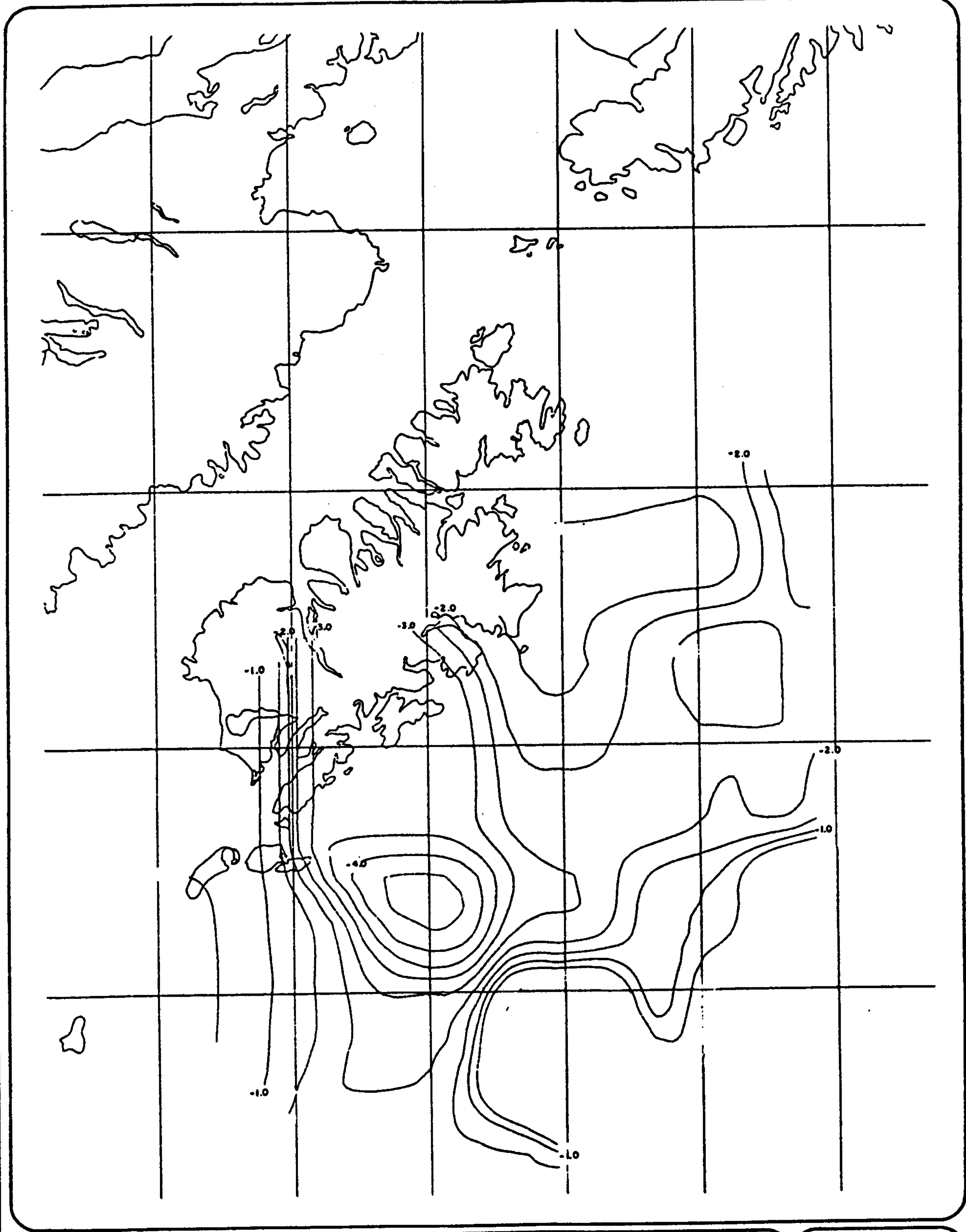
Distribution and abundance of total cnidarians in bongo tows from cruise 2MF78.

Figure 3.3-56



Distribution and abundance of total cnidarians in bongo tows from cruise 1WE78.

Figure 3.3-57



Distribution and abundance of total cnidarians in bongo tows from cruise 1MF79.

Figure 3.3-58

6.0 TABLES

Table 1.4-1 Planktivorous Organisms off Kodiak Island classified by known food sources.

Calanoid Copepods	Harpacticoid Copepods	Euphausiids	Decapod Larvae
juvenile salmonids	juvenile salmonids	pollock	Pacific Ocean perch
capelin	capelin	Pacific Ocean perch	herring
herring	Pacific sand lance	yellow Irish lord	smelt
Pacific sand lance	juv. whitespotted greenling	yellowfin sole	juvenile pink salmon
juv. whitespotted greenling	juv. masked greenling	rex sole	pandalid shrimp
juvenile pollock	juvenile pollock	flathead sole	
juvenile rock sole	Pacific cod	juvenile arrowtooth flounder	
juvenile yellowfin sole		short-tailed shearwater	
gray whale		tufted puffin	
sei whale		black-legged kittiwake	
fin whale		minke whale	
right whale		fin whale	
		blue whale	
		humpback whale	

Fish Larvae	Mysids	Pelagic Amphipods
juvenile salmonids	sand sole	juvenile chum salmon
Pacfic sand lance	pollock	herring
juv. whitespotted greenling		

Table 2.1-1 Summary of Kodiak shelf plankton cruise dates and identifications.

	Cruise Identification	VTN Number	Sampling Period
Offshore:	4DI78	02	28 Mar - 20 Apr 1978
	2MF78	03	18 Jun - 9 Jul 1978
	1WE78	04	25 Oct - 25 Nov 1978
	1MF79	05	13 Feb - 11 Mar 1979
Inshore:	1CM78	11	29 Mar - 8 Apr 1978
	2CM78	12	10 - 17 Apr 1978
	3CM78	13	21 Apr - 1 May 1978
	4CM78	14	3-28 May 1978
	5CM78	15	31 May - 6 Jun 1978
	6CM78	16	14-26 Jun 1978
	7CM78	17	28 Jun - 18 Jul 1978
	8CM78	18	21-29 Jul 1978
	9CM78	19	1-9 Aug 1978
	10CM78	20	15-21 Aug 1978
	11CM78	21	4-13 Nov 1978
	1CM79	22	4-16 Mar 1979

Vessel Key:
DI = Discoverer
MF = Miller Freeman
WE = Wecoma
CM = Commander

Table 3.1-1 Zooplankton species identified in samples from the Kodiak shelf.

CNIDARIA
- Rathkea octopunctata
- Bougainvilla sp.
- Euphysa flammea
- Hybocodon prolifer
- Sarsia tubulosa
- S. princeps
- S. rosaria
- Leuckartiara octona
- L. nobilis
- L. breviconis
- Halimedusa typus
- Stomotoca atra
- Polyorchis penicillatus
- Obelia sp.
- Phialidium gregarium
- Aequorea aequorea
- Melicertum octopunctata
- Halistaura cellularia
- Tiaropsidium sp.
- Staurophora mertensi
- Eutonina indicans
- Gonionemus vertens
- Proboscidactyla flavicirrata
- Aglantha digitale
- Aegina sp.
- Lensia sp.
- Muggiacea atlantica
- Dimophyes arctica
- Vogtia serrata
- Agalma elegans
- Nanomia sp.
- Periphylla periphylla
- Cyanea capillata
- Scyphozoan Type A

CTENOPHORA

POLYCHAETA
- Pelagobia longicirrata
- Tomopteris septrionalis
- T. pacifica
- T. planktonis

MOLLUSCA
- Limacina helicina
- Clio sp.
- Clione limacina

CLADOCERA
- Daphina schodleri
- Evadne nordmanni
- Evadne tergestina
- Podon leuckarti
- P. polyphemoides

OSTRACODA
- Philomedes sp.
- P. trituberculatus
- Conchoecia alata minor
- C. elegans

COPEPODA
- Calanus cristatus
- C. marshallae
- C. pacificus
- C. plumchrus
- C. tenuicornis
- Eucalanus bungii
- Clausocalanus arcuicornis
- Microcalanus spp.
- Pseudocalanus spp.
- Spinocalanus sp.
- Aetideids
- Aetideus armatus
- Bradyidius saanichi
- Gaetanus armiger
- Gaidius sp.
- G. variabilis
- Pseudochirella sp.
- Euchaetids
- Pareuchaeta elongata
- Lophothrix frontalis
- Racovitzanus antarcticus
- Scaphocalanus sp.
- Scolecithricella minor
- S. ovata

Table 3.1-1 (continued)

COPEPODA (continued)
- Undinella sp.
- Metridia curticauda
- M. okhotensis
- M. pacifica
- Pleuromamma scutullata
- Centropages abdominalis
- Limnocalanus macrurus
- Eurytemora americana
- E. pacifica
- Lucicutia flavicornis
- L. ovaliformis
- Heterorhabdus tanneri
- Heterostylites sp.
- Haloptilus pseudooxycephalus
- Candacia columbiae
- Pachyptilus pacificus
- Epilabidocera longipedata
- Acartia clausi
- A. longiremis
- A. tumida
- Tortanus discaudatus
- Microsetella sp.
- Harpacticus sp.
- Tisbe sp.
- Lubbockia sp.
- Oncaea conifera
- O. borealis
- Oithona helgolandica
- O. spinirostris
- Monstrilla helgolandica
- M. longiremis
- M. wandelii
- M. canadiensis
- Cymbasoma rigidum

CUMACEA
- Cumella sp.

MYSIDACEA
- Acanthomysis nephrophthalma
- A. pseudomacropa
- Neomysis kadiakensis
- Holmesiella anomala
- Pseudomma truncatum

ISOPODA
- Isopod sp. 1 (copepod parasite)
- Isopod sp. 2

AMPHIPODA
- Calliopius laeviuscula
- Cyphocaris challengeri
- Hyperia medusarum hystrix
- Hyperoche sp.
- Parathemisto gracilipes
- P. pacifica
- Phronima sedentaria
- Primmo macropa
- Scina stebbingi
- S. rattrayi
- Lanceola pacifica
- Vibilia australis
- Paraphronima sp.
- Caprella sp.

EUPHAUSIACEA
- Euphausia pacifica
- Thysanoessa inermis
- T. inspinata
- T. longipes
- T. raschii
- T. spinifera

CHAETOGNATHA
- Eukrohnia hamata
- E. bathypelagica
- Sagitta elegans
- S. scrippsae

LARVACEA
- Oikopleura dioica
- O. labradoriensis
- Fritillaria borealis

THALIACEA
- Salpa fusiformis

Table 3.2-1 Seasonal dominance of selected taxa expressed as rank order by cruise offshore.

Rank	4 DI 78	2 MF 78	1 WE 78	1 MF 79
1	Calanus plumchrus	Pseudocalanus spp.	Acartia longiremis	Pseudocalanus spp.
2	Pseudocalanus spp.	Metridia spp.	Metridia spp.	Metridia spp.
3	Metridia spp.	Calanus plumchrus	Pseudocalanus spp.	Scolecithricella minor
4	Calanus cristatus	Acartia longiremis	Oithona spp.	Calanus plumchrus
5	Limacina helicina	Eucalanus bungii	Calanus marshallae	Conchoecia spp.
6	Scolecithricella minor	Acartia tumida	Parathemisto pacifica	Calanus marshallae
7	Oikopleura spp.	Centropages abdominalis	Limacina helicina	Limacina helicina
8	Sagitta spp.	Calanus marshallae	Sagitta spp.	Sagitta spp.
9	Oithona spp.	Oikopleura spp.	Scolecithricella minor	Oithona spp.
10	Cnidarians	Parathemisto pacifica	Eucalanus bungii	Cnidarians
11	Acartia longiremis	Oithona spp.	Calanus pacificus	Parathemisto pacifica
12	Parathemisto pacifica	Cnidarians	Eukrohnia hamata	Calanus cristatus
13	Acartia tumida	Calanus cristatus	Centropages abdominalis	Acartia longiremis
14	Calanus marshallae	Limacina helicina	Oikopleura spp.	Eukrohnia hamata
15	Fritillaria borealis	Scolecithricella minor	Calanus cristatus	Calanus pacificus
16	Conchoecia spp.	Sagitta spp.	Epilabidocera longipedata	Aetideids
17	Eucalanus bungii	Eukrohnia hamata	Calanus tenuicornis	Oikopleura spp.
18	Calanus pacificus	Fritillaria borealis	Calanus plumchrus	Euchaetids
19	Eukrohonia hamata	Conchoecia spp.	Cnidarians	Fritillaria borealis
20	Aetideids	Aetideids	Conchoecia spp.	Eucalanus bungii
21	Euchaetids	Euchaetids	Aetideids	Gammarid amphipods
22	Calanus tenuicornis	Oncaea spp.	Tortanus discaudatus	Cyphocaris challengeri
23	Candacia columbiae	Calanus pacificus	Euchaetids	Candacia columbiae
24	Pleuromamma scutullata	Racovitzanus antarcticus	Racovitzanus antarcticus	Racovitzanus antarcticus
25	Gammarid amphipods	Pleuromamma scutullata	Clausocalanus arcuicornis	Pleuromamma scutullata
26	Racovitzanus antarcticus	Gammarid amphipods	Fritillaria borealis	Lucicutia flavicornis
27	Centropages abdominalis	Scolecithricella ovata	Cyphocaris challengeri	Calanus tenuicornis
28	Euphausiids	Monstrilla spp.	Scolecithricella ovata	Mysids
29	Oncaea spp.	Heterorhabdus tanneri	Gammerid amphipods	Scolecithricella ovata
30	Cyphocaris challengeri	Candacia columbiae	Heterorhabdus tanneri	Primno macropa

Table 3.2-2 Seasonal dominance of selected taxa expressed as rank order by cruise inshore.

Rank	1 CM 78	2 CM 78	3 CM 78	4 CM 78
1	Calanus copepodites I-III	Pseudocalanus spp.	Pseudocalanus spp.	Pseudocalanus spp.
2	Pseudocalanus spp.	Calanus copepodites I-III	Calanus copepodites I-III	Acartia longiremis
3	Metridia spp.	Calanus plumchrus	Calanus plumchrus	Calanus marshallae
4	Acartia longiremis	Acartia tumida	Acartia tumida	Acartia tumida
5	Acartia tumida	Metridia spp.	Metridia spp.	Metridia spp.
6	Oikopleura spp.	Calanus cristatus	Acartia longiremis	Centropages abdominalis
7	Calanus plumchrus	Oikoplerua spp.	Euphausiids	Calanus copepodites I-III
8	Calanus cristatus	Scolecithricella minor	Centropages abdominalis	Oithona spp.
9	Cnidarians	Acartia longiremis	Limacina helicina	Limacina helicina
10	Scolecithricella minor	Limacina helicina	Oithona spp.	Medusae
11	Limacina helicina	Euphausiids	Medusae	Scolecithricella minor
12	Oithona spp.	Sagitta spp.	Oikopleura spp.	Calanus plumchrus
13	Parathemisto pacifica	Oithona spp.	Calanus marshallae	Euphausiids
14	Sagitta spp.	Calanus marshallae	Scolecithricella minor	Oikopleura spp.
15	Calanus marshallae	Cnidarians	Calanus cristatus	Calanus cristatus
16	Euphausiids	Parathemisto pacifica	Parathemisto pacifica	Parathemisto pacifica
17	Conchoecia spp.	Centropages abdominalis	Sagitta spp.	Acartia clausi
18	Calanus pacificus	Conchoecia spp.	Fritillaria borealis	Fritillaria borealis
19	Fritillaria borealis	Mysids	Eukrohonia hamata	Calanus plumchrus
20	Centropages abdominalis	Calanus pacificus	Microcalanus spp.	Eucalanus bungii
21	Eukrohonia hamata	Polychaetes	Polychaetes	Eukrohonia hamata
22	Aetideids	Eukrohonia hamata	Conchoecia spp.	Sagitta spp.
23	Polychaetes	Podon spp.	Calanus pacificus	Tortanus discaudatus
24	Mysids	Harpacticoid copepods	Tortanus discaudatus	Epilabidocera longipedata
25	Tortanus discaudatus	Aetideids	Epilabidocera longipedata	Podon spp.
26	Eucalanus bungii	Euchaetids	Acartia clausi	Polychaetes
27	Microcalanus sp.	Fritillaria borealis	Mysids	Harpacticoid copepods
28	Acartia clausi	Acartia clausi	Podon spp.	Microcalanus spp.
29	Evadne spp.	Microcalanus spp.	Gammarid amphipods	
30	Harpacticoid copepods	Tortanus discaudatus	Eurytemora spp.	

Table 3.2-2 (continued)

	5 CM 78	6 CM 78	7 CM 78	8 CM 78
1	Pseudocalanus spp.	Pseudocalanus spp.	Pseudocalanus spp.	Pseudocalanus spp.
2	Acartia longiremis	Acartia tumida	Acartia longiremis	Acartia longiremis
3	Acartia tumida	Acartia longiremis	Centropages abdominalis	Calanus marshallae
4	Metridia spp.	Calanus marshallae	Acartia tumida	Centropages abdominalis
5	Calanus marshallae	Metridia spp.	Calanus marshallae	Metridia spp.
6	Centropages abdominalis	Calanus plumchrus	Euphausiids	Podon spp.
7	Calanus copepodites I-III	Cnidarians	Metridia spp.	Oikopleura spp.
8	Calanus plumchrus	Centropages abdominalis	Cnidarians	Parathemisto pacifica
9	Oikopleura spp.	Eucalanus bungii	Parathemisto pacifica	Eucalanus bungii
10	Oithona spp.	Scolecithricella minor	Podon spp.	Oithona spp.
11	Cnidarians	Oikopleura spp.	Eucalanus bungii	Limacina helicina
12	Parathemisto pacifica	Calanus cristatus	Oithona spp.	Sagitta spp.
13	Scolecithricella minor	Sagitta spp.	Calanus plumchrus	Euphausiids
14	Sagitta spp.	Oikopleura spp.	Calanus copepodites I-III	Acartia tumida
15	Euphausiids	Parathemisto pacifica	Oikopleura spp.	Acartia clausi
16	Calanus cristatus	Euphausiids	Limacina helicina	Calanus plumchrus
17	Fritillaria borealis	Podon sp.	Scolecithricella minor	Evadne spp.
18	Tortanus discaudatus	Fritillaria borealis	Sagitta spp.	Cnidarians
19	Podon spp.	Harpacticoids	Calanus cristatus	Eurytemora spp.
20	Eucalanus bungii	Tortanus discaudatus	Fritillaria borealis	Epilabidocera longipedata
21	Acartia clausi	Eukrohnia hamata	Tortanus discaudatus	Tortanus discaudatus
22	Harpacticoids	Polychaetes	Acartia clausi	Mysids
23	Cumaceans	Gammarid amphipods	Eukrohnia hamata	Aetideids
24	Limacina helicina	Cumaceans	Calanus pacificus	Oncaea spp.
25	Aetideids	Eurytemora spp.	Harpacticoids	Harpacticoids
26	Eurytemora spp.	Racovitzanus antarcticus	Evadne sp.	Calanus cristatus
27	Microcalanus sp.	Acartia clausi	Aetideids	Calanus copepodites I-III
28	Epilabidocera longipedata	Conchoecia spp.	Mysids	
29	Monstrilla spp.	Calanus pacificus	Eurytemora spp.	
30	Eukrohnia hamata	Limacina helicina	Euchaetids	

Table 3.2-2 (continued)

Rank	9 CM 78	10 CM 78	11 CM 78	1 CM 79
1	Acartia longiremis	Acartia tumida	Acartia longiremis	Pseudocalanus spp.
2	Pseudocalanus spp.	Pseudocalanus spp.	Metridia spp.	Metridia spp.
3	Podon spp.	Centropages abdominalis	Pseudocalanus spp.	Calanus marshallae
4	Centropages abdominalis	Podon spp.	Oithona spp.	Calanus copepodites I-III
5	Oikopleura spp.	Limacina helicina	Calanus marshallae	Acartia longiremis
6	Calanus marshallae	Oikopleura spp.	Sagitta spp.	Oithona spp.
7	Oithona spp.	Calanus marshallae	Parathemisto pacifica	Scolecithricella minor
8	Metridia spp.	Oithona spp.	Limacina helicina	Cnidarians
9	Limacina helicina	Metridia spp.	Calanus pacificus	Parathemisto pacifica
10	Parathemisto pacifica	Evadne spp.	Eucalanus bungii	Sagitta spp.
11	Evadne spp.	Parathemisto pacifica	Cnidarians	Calanus cristatus
12	Sagitta spp.	Sagitta spp.	Scolecithricella minor	Limacina helicina
13	Cnidarians	Eucalanus bungii	Tortanus discaudatus	Calanus pacificus
14	Eucalanus bungii	Acartia clausi	Centropages abdominalis	Conchoecia spp.
15	Calanus plumchrus	Cnidarians	Euphausiids	Acartia tumida
16	Acartia clausi	Euphausiids	Epilabidocera longipedata	Euphausiids
17	Euphausiids	Calanus plumchrus	Oikopleura spp.	Calanus plumchrus
18	Fritillaria borealis	Tortanus discaudatus	Eukrohnia hamata	Eukrohnia hamata
19	Tortanus discaudatus	Calanus copepodites I-III	Fritillaria borealis	Oikopleura spp.
20	Calanus copepodites I-III	Fritillaria borealis	Calanus cristatus	Harpacticoid copepods
21	Epilabidocera longipedata	Acartia tumida	Conchoecia spp.	Fritillaria borealis
22	Acartia tumida	Epilabidocera longipedata	Harpacticoid copepods	Tortanus discaudatus
23	Gammarid amphipods	Gammarid amphipods	Mysids	Gammarid amphipods
24	Eurytemora spp.	Eurytemora spp.	Calanus plumchrus	Mysids
25	Harpacticoid copepods	Aetideids	Aetideids	Centropages abdominalis
26	Mysids	Eukrohnia hamata	Gammarid amphipods	Eucalanus bungii
27	Oncaea spp.	Calanus cristatus	Monstrilla spp.	Cumaceans
28	Microcalanus sp.	Scolecithricella minor	Podon spp.	Euchaetids
29	Aetideids	Mysids	Evadne spp.	Aetideids
30	Scolecithricella minor		Racovitzanus antarcticus	Racovitzanus antarcticus

Table 3.2-3 Seasonal dominance of selected taxa expressed as rank order by frequency of occurrence offshore.

	4 DI 78		2 MF 78		1 WE 78		1 MF 79
1	Metridia spp.	1	Pseudocalanus spp.	1	Pseudocalanus spp.	1	Metridia spp.
2	Calanus cristatus	2	Metridia spp.	1	Metridia spp.	2	Pseudocalanus spp.
3	Pseudocalanus spp.	2	Acartia longiremis	1	Acartia longiremis	2	Scolecithricella minor
4	Calanus plumchrus	4	Calanus plumchrus	1	Parathemisto pacifica	4	Conchoecia spp.
5	Limacina helicina	5	Eucalanus bungii	5	Oithona spp.	5	Sagitta spp.
6	Scolecithricella minor	6	Centropages abdominalis	6	Calanus marshallae	6	Calanus plumchrus
7	Oikopleura spp.	7	Acartia tumida	7	Limacina helicina	7	Calanus marshallae
8	Sagitta spp.	8	Parathemisto pacifica	8	Sagitta spp.	7	Limacina helicina
9	Cnidarians	9	Calanus marshallae	9	Eucalanus bungii	9	Oithona spp.
10	Oithona spp.	10	Oikopleura spp.	10	Scolecithricella minor	10	Cnidarians
11	Parathemisto pacifica	11	Oithona spp.	11	Centropages abdominalis	11	Parathemisto pacifica
12	Acartia longiremis	12	Cnidarians	11	Oikopleura spp.	12	Calanus cristatus
13	Calanus marshallae	13	Calanus cristatus	13	Calanus pacificus	13	Acartia longiremis
14	Fritillaria borealis	14	Limacina helicina	14	Calanus cristatus	13	Eukrohnia hamata
15	Acartia tumida	15	Scolecithricella minor	14	Eukrohnia hamata	15	Calanus pacificus
16	Conchoecia spp.	16	Sagitta spp.	16	Epilabidocera longipedata	16	Aetideids
17	Eucalanus bungii	17	Eukrohnia hamata	17	Calanus tenuicornis	17	Oikopleura spp.
18	Calanus pacificus	18	Fritillaria borealis	18	Cnidarians	18	Euchaetids
18	Eukrohnia hamata	19	Conchoecia spp.	19	Calanus plumchrus	19	Fritillaria borealis
20	Aetideids	20	Aetideids	20	Conchoecia spp.	20	Eucalanus bungii
20	Euchaetids	21	Euchaetids	21	Aetideids	21	Gammarid amphipods
22	Calanus tenuicornis	22	Oncaea spp.	22	Tortanus discaudatus	22	Cyphocaris challengeri
23	Candacia columbiae	23	Calanus pacificus	23	Euchaetids	23	Racovitzanus antarcticus
24	Pleuromamma scutullata	24	Cyphocaris challengeri	24	Clausocalanus arcuicornis	24	Candacia columbiae
25	Gammarid amphipods	24	Racovitzanus antarcticus	25	Racovitzanus antarcticus	25	Pleuromamma scutullata
26	Centropages abdominalis	26	Gammarid amphipods	26	Fritillaria borealis	26	Lucicutia flavicornis
27	Racovitzanus antarcticus	26	Pleuromamma scutullata	27	Cyphocaris challengeri	27	Calanus tenuicornis
28	Cyphocaris challengeri	28	Scolecithricella ovata	28	Scolecithricella ovata	28	Primno macropa
28	Euphausiids	29	Monstrilla spp.	29	Gammarid amphipods	28	Scolecithricella ovata
28	Oncaea spp.	30	Primno macropa	30	Heterorhabdus tanneri	30	Mysids
			Heterorhabdus tanneri				
			Candacia columbiae				

Table 3.2-4 Seasonal dominance of selected taxa expressed as rank order by frequency of occurrence inshore.

1 CM 78		2 CM 78		3 CM 78		4 CM 78	
1	Pseudocalanus spp.	1	Pseudocalanus spp.	1	Pseudocalanus spp.	1	Pseudocalanus spp.
1	Metridia spp.	1	Acartia longiremis	1	Metridia spp.	1	Acartia longiremis
1	Calanus copepodites I-III	1	Calanus copepodites I-III	1	Acartia longiremis	3	Calanus marshallae
4	Acartia longiremis	1	Calanus plumchrus	1	Calanus copepodites I-III	4	Acartia tumida
5	Acartia tumida	5	Metridia spp.	1	Calanus plumchrus	5	Centropages abdominalis
6	Limacina helicina	6	Oikopleura spp.	6	Acartia tumida	5	Oithona spp.
6	Oikopleura spp.	7	Calanus cristatus	7	Centropages abdominalis	7	Metridia spp.
6	Cnidarians	7	Scolecithricella minor	7	Limacina helicina	7	Limacina helicina
6	Calanus plumchrus	9	Acartia tumida	9	Oithona spp.	7	Calanus plumchrus
10	Calanus cristatus	9	Euphausiids	10	Euphausiids	10	Cnidarians
10	Scolecithricella minor	9	Sagitta spp.	10	Cnidarians	10	Calanus copepodites I-III
10	Parathemisto pacifica	12	Limacina helicina	12	Oikopleura spp.	12	Scolecithricella minor
13	Oithona spp.	12	Oithona spp.	13	Calanus cristatus	13	Euphausiids
14	Sagitta spp.	14	Calanus marshallae	13	Calanus marshallae	14	Oikopleura spp.
15	Euphausiids	15	Parathemisto pacifica	13	Scolecithricella minor	15	Calanus cristatus
16	Calanus marshallae	15	Cnidarians	16	Parathemisto pacifica	16	Parathemisto pacifica
17	Conchoecia spp.	17	Centropages abdominalis	17	Sagitta spp.	17	Eukrohnia hamata
18	Calanus pacificus	18	Conchoecia spp.	18	Fritillaria borealis	18	Fritillaria borealis
19	Fritillaria borealis	18	Mysids	19	Eukrohnia hamata	18	Eucalanus bungii
20	Centropages abdominalis	20	Calanus pacificus	19	Microcalanus spp.	18	Calanus pacificus
20	Eukrohnia hamata	21	Eukrohnia hamata	21	Polychaetes	18	Tortanus discaudatus
22	Aetideids	21	Polychaetes	22	Conchoecia spp.	22	Epilabidocera longipedata
22	Polychaetes	23	Podon spp.	22	Calanus pacificus	23	Podon spp.
24	Eucalanus bungii	23	Harpacticoid copepods	24	Epilabidocera longipedata	24	Harpacticoid copepods
24	Microcalanus sp.	25	Aetideids	24	Tortanus discaudatus	24	Polychaetes
24	Tortanus discaudatus	26	Euchaetids	24	Mysids	26	Mysids
24	Mysids	27	Eucalanus bungii	27	Podon spp.	27	Eurytemora spp.
28	Evadne sp.	27	Cyphocaris challengeri	27	Gammarid amphipods	28	Evadne spp.
28	Harpacticoid copepods	27	Fritillaria borealis	27	Eurytemora spp.	28	Gammarid amphipods
28	Monstrilloid copepods	27	Microcalanus spp.	27	Aetideids	28	Monstrilloid copepods

Table 3.2-4 (continued)

5 CM 78		6 CM 78		7 CM 78		8 CM 78	
1	Pseudocalanus spp.	1	Pseudocalanus spp.	1	Pseudocalanus spp.	1	Pseudocalanus spp.
1	Acartia longiremis	1	Calanus marshallae	1	Acartia longiremis	1	Acartia longiremis
3	Centropages abdominalis	3	Acartia longiremis	3	Centropages abdominalis	3	Calanus marshallae
4	Acartia tumida	4	Acartia tumida	4	Acartia tumida	4	Centropages abdominalis
5	Calanus marshallae	5	Cnidarians	5	Parathemisto pacifica	5	Metridia spp.
5	Metridia spp.	6	Calanus plumchrus	5	Euphausiids	6	Podon spp.
7	Oithona spp.	7	Metridia spp.	5	Cnidarians	7	Oikopleura spp.
7	Oikopleura spp.	8	Centropages abdominalis	8	Calanus marshallae	8	Parathemisto pacifica
7	Cnidarians	9	Calanus copepodite I-III	9	Metridia spp.	9	Eucalanus bungii
7	Calanus plumchrus	10	Eucalanus bungii	10	Eucalanus bungii	10	Oithona spp.
11	Calanus copepodites I-III	11	Scolecithricella minor	11	Oithona spp.	11	Limacina helicina
12	Parathemisto pacifica	12	Oikopleura spp.	11	Podon spp.	12	Sagitta spp.
13	Sagitta spp.	13	Calanus cristatus	12	Calanus copepodites I-III	13	Euphausiids
14	Scolecithricella minor	14	Oithona spp.	14	Calanus plumchrus	14	Acartia tumida
15	Euphausiids	15	Sagitta spp.	15	Scolecithricella minor	15	Evadne spp.
16	Tortanus discaudatus	16	Euphausiids	15	Limacina helicina	16	Calanus plumchrus
16	Calanus cristatus	17	Parathemisto pacifica	17	Sagitta spp.	17	Mysids
18	Fritillaria borealis	18	Podon spp.	17	Oikopleura spp.	18	Epilabidocera longipedata
19	Podon spp.	19	Fritillaria borealis	19	Calanus cristatus	19	Eurytemora spp.
20	Eucalanus bungii	20	Harpacticoid copepods	20	Tortanus discaudatus	20	Cnidarians
20	Harpacticoid copepods	21	Tortanus discaudatus	21	Fritillaria borealis	20	Tortanus discaudatus
22	Limacina helicina	22	Polychaetes	21	Eukrohnia hamata	22	Calanus cristatus
23	Cumaceans	22	Gammarid amphipods	23	Evadne spp.	22	Calanus copepodites I-III
24	Epilabidocera longipedata	24	Eukrohnia hamata	24	Calanus pacificus	22	Gammarid amphipods
24	Aetideids	25	Eurytemora spp.	24	Gammarid amphipods	25	Aetideids
24	Eurytemora spp.	26	Cumaceans	25	Mysids	25	Oncaea spp.
27	Calanus pacificus	27	Epilabidocera longipedata	27	Epilabidocera longipedata		
27	Mysids	27	Conchoecia spp.	27	Eurytemora spp.		
29	Eukrohnia hamata	27	Limacina helicina	29	Aetideids		
29	Microcalanus spp.	27	Calanus pacificus	30	Conchoecia spp.		

Table 3.2-4 (continued)

Rank	9 CM 78	Rank	10 CM 78	Rank	11 CM 78	Rank	1 CM 79
1	Acartia longiremis	1	Pseudocalanus spp.	1	Acartia longiremis	1	Pseudocalanus spp.
1	Calanus marshallae	1	Acartia longiremis	2	Calanus marshallae	1	Metridia spp.
3	Pseudocalanus spp.	1	Centropages abdominalis	2	Metridia spp.	1	Acartia longiremis
4	Centropages abdominalis	4	Limacina helicina	2	Parathemisto pacifica	1	Oithona spp.
4	Oithona spp.	4	Podon spp.	2	Oithona spp.	5	Calanus marshallae
6	Podon spp.	4	Oikopleura spp.	2	Sagitta spp.	5	Scolecithricella minor
7	Oikopleura spp.	7	Oithona spp.	2	Calanus pacificus	5	Cnidarians
8	Parathemisto pacifica	8	Calanus marshallae	8	Pseudocalanus spp.	8	Calanus copepodites I-III
9	Limacina helicina	9	Parathemisto pacifica	8	Limacina helicina	8	Parathemisto pacifica
10	Metridia spp.	10	Evadne spp.	10	Eucalanus bungii	8	Sagitta spp.
11	Evadne spp.	11	Sagitta spp.	11	Cnidarians	11	Calanus cristatus
12	Sagitta spp.	11	Metridia spp.	12	Scolecithricella minor	12	Limacina helicina
13	Cnidarians	13	Eucalanus bungii	13	Centropages abdominalis	14	Conchoecia spp.
14	Eucalanus bungii	14	Euphausiids	14	Tortanus discaudatus	14	Calanus pacificus
15	Calanus plumchrus	15	Cnidarians	15	Euphausiids	15	Acartia tumida
15	Euphausiids	16	Calanus plumchrus	16	Epilabidocera longipedata	16	Calanus plumchrus
17	Calanus copepodites I-III	17	Tortanus discaudatus	17	Oikopleura spp.	16	Eukrohnia hamata
18	Epilabidocera longipedata	18	Calanus copepodites I-III	18	Calanus cristatus	16	Euphausiids
18	Fritillaria borealis	19	Epilabidocera longipedata	18	Fritillaria borealis	19	Oikopleura spp.
18	Tortanus discaudatus	20	Acartia tumida	20	Eukrohnia hamata	20	Fritillaria borealis
21	Acartia tumida	21	Eurytemora spp.	21	Conchoecia spp.	21	Eucalanus bungii
21	Gammarid amphipods	22	Gammarid amphipods	22	Harpacticoid copepods	21	Gammarid amphipods
23	Calanus cristatus	23	Calanus cristatus	23	Mysids	23	Tortanus discaudatus
23	Scolecithricella minor	23	Scolecithricella minor	24	Calanus plumchrus	24	Centropages abdominalis
25	Microcalanus spp.	23	Mysids	24	Podon spp.	24	Racovitzanus antarcticus
		24	Eukrohnia hamata	24	Gammarid amphipods	24	Aetideids
				24	Aetideids	27	Euchaetids
				24	Monstrilla spp.	28	Primno macropa
				29	Hyperia medusarum	28	Cyphocaris challengeri
				29	Racovitzanus antarcticus	28	Evadne spp.
				29	Oncaea spp.	28	Eurytemora spp.

Table 3.2-5 Mean rank order of selected taxa offshore.

1	Pseudocalanus spp.
2	Metridia spp.
3	Calanus plumchrus
4	Acartia longiremis
5	Oithona spp.
6	Calanus marshallae
7	Scolecithricella minor
8	Limacina helicina
9	Parathemisto pacifica
10	Calanus cristatus
11	Sagitta spp.
12	Oikopleura spp.
13	Eucalanus bungii
14	Cnidarians
15	Eukrohnia hamata
16	Conchoecia spp.
17	Centropages abdominalis
18	Acartia tumida
19	Calanus pacificus
20	Fritillaria borealis
21	Aetideids
22	Euchaetids
23	Calanus tenuicornis
24	Epilabidocera longipedata
25	Racovitzanus antarcticus
26	Gammarid amphipods
27	Cyphocaris challengeri
28	Candacia columbiae
29	Pleuromamma scutullata
30	Clausocalanus arcuicornis

Table 3.2-6 Location-specific rank order of selected taxa inshore.

Rank	Chiniak Bay	Kaiugnak Bay	Kiliuda Bay	Izhut Bay
1	Pseudocalanus spp.	Pseudocalanus spp.	Pseudocalanus spp.	Pseudocalanus spp.
2	Acartia longiremis	Acartia longiremis	Acartia longiremis	Acartia longiremis
3	Metridia spp.	Metridia spp.	Metridia spp.	Metridia spp.
4	Calanus marshallae	Calanus marshallae	Calanus marshallae	Calanus marshallae
5	Acartia tumida	Centropages abdominalis	Centropages abdominalis	Oithona spp.
6	Oikopleura spp.	Acartia tumida	Oithona spp.	Centropages abdominalis
7	Parathemisto pacifica	Oithona spp.	Oikopleura spp.	Euphausiids
8	Centropages abdominalis	Limacina helicina	Cnidarians	Parathemisto pacifica
9	Oithona spp.	Calanus copepodites I-III	Acartia tumida	Calanus copepodites I-III
10	Calanus plumchrus	Cnidarians	Euphausiids	Oikopleura spp.
11	Sagitta spp.	Calanus plumchrus	Calanus copepodites I-III	Acartia tumida
12	Calanus copepodites I-III	Oikopleura spp.	Limacina helicina	Calanus plumchrus
13	Limacina helicina	Parathemisto pacifica	Podon spp.	Limacina helicina
14	Scolecithricella minor	Eucalanus bungii	Calanus plumchrus	Scolecithricella minor
15	Cnidarians	Sagitta spp.	Sagitta spp.	Cnidarians
16	Podon spp.	Calanus cristatus	Scolecithricella minor	Sagitta spp.
17	Calanus cristatus	Podon spp.	Parathemisto pacifica	Calanus cristatus
18	Eucalanus bungii	Scolecithricella minor	Eucalanus bungii	Podon spp.
19	Calanus pacificus	Euphausiids	Calanus cristatus	Calanus pacificus
20	Euphausiids	Calanus pacificus	Tortanus discaudatus	Acartia clausi
21	Conchoecia spp.	Evadne spp.	Evadne spp.	Fritillaria borealis
22	Tortanus discaudatus	Fritillaria borealis	Fritillaria borealis	Eucalanus bungii
23	Eukrohnia hamata	Conchoecia spp.	Acartia clausi	Tortanus discaudatus
24	Aetideids	Epilabidocera longipedata	Eukrohnia hamata	Gammarid amphipods
25	Acartia clausi	Eukrohnia hamata	Calanus pacificus	Conchoecia spp.
26	Fritillaria borealis	Tortanus discaudatus	Mysids	Eukrohnia hamata
27	Harpacticoid copepods	Polychaetes	Polychaetes	Epilabidocera longipedata
28	Evadne spp.	Acartia clausi	Epilabidocera longipedata	Eurytemora spp.
29	Gammarid amphipods	Gammarid amphipods	Harpacticoid copepods	Evadne spp.
30	Mysids	Oncaea spp.	Conchoecia spp.	Mysids

Table 3.2-7 Geometric means and standard deviations of the $\log_{10}$ abundance of total Copepods by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	1.9655	2.6110	2.4185	2.4324
	0.0843	0.1782	0.2856	0.0968
KIAUGNAK BAY	2.8435	3.0129	2.6843	1.8917
	0.0622	0.1084	0.3238	0.0567
KILIUDA BAY	2.7680	2.6924	2.6288	2.0374
	0.2211	0.2117	0.1527	0.1403
IZHUT BAY	1.8916	2.0324	1.9924	1.2293
	0.0883	0.0890	0.0820	0.8754

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	2.3016	2.7002	2.9772	3.0875
	0.2084	0.0566	0.0461	0.1275
KIAUGNAK BAY	2.0348	2.6656	2.9084	2.5284
	0.1473	0.1262	0.1488	0.0601
KILIUDA BAY	1.9633	2.7418	2.8479	2.6507
	0.1041	0.2186	0.1981	0.1472
IZHUT BAY	2.3289	2.1489	3.0287	2.6028
	0.1197	0.2785	0.0671	0.2138

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	2.9188	3.0970	2.3630	-0.8148
	0.1568	0.0933	0.2047	1.0677
KIAUGNAK BAY	2.9189	2.4867	1.2732	0.1255
	0.0851	0.1084	0.0866	1.0354
KILIUDA BAY	2.4674	2.5623	1.6786	1.4564
	0.1597	0.1852	0.1053	0.2715
IZHUT BAY	2.7466	2.8654	1.8925	-0.0749
	0.0712	0.1556	0.2421	0.5732

Table 3.2-8 Geometric means of the $\log_{10}$ abundance of total Copepods by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	2.0623	0.5195	1.9584	0.9223
	STD	0.1473	2.8618	0.5291	2.4529
	STDERR	0.0557	1.0118	0.2160	1.0014
	NUMBER	7	8	6	6
BANK	MEAN	1.1161	2.7901	1.7652	0.0575
	STD	2.2434	0.2218	0.3077	1.9794
	STDERR	0.5016	0.0463	0.0656	0.4127
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	1.4955	2.6899	1.9892	0.9119
	STD	1.9801	0.2384	0.2034	0.2085
	STDERR	0.6262	0.0754	0.0643	0.0659
	NUMBER	10	10	10	10
SLOPE	MEAN	0.9988	2.4794	1.4746	1.4908
	STD	1.8409	0.3331	0.6226	0.3305
	STDERR	0.4339	0.0745	0.1392	0.0954
	NUMBER	18	20	20	12
TROUGH	MEAN	1.9484	2.6911	1.8508	0.2698
	STD	0.5744	0.2186	0.3268	1.8431
	STDERR	0.1436	0.0584	0.0873	0.4926
	NUMBER	16	14	14	14

Table 3.2-9 Geometric means and standard deviations of the $\log_{10}$ abundance of Calanus cristatus by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-1.7780	-1.4770	-1.7916	-2.3415
	0.9144	1.0630	0.9268	1.0158
KIAUGNAK BAY	-0.1833	1.0021	-1.5082	-1.7369
	0.9582	0.1326	1.0995	0.9320
KILIUDA BAY	0.2837	0.6979	0.0172	-2.2478
	0.0955	0.0845	0.1809	0.6637
IZHUT BAY	-1.3966	-0.6659	-2.7263	-3.3605
	1.0718	0.8479	0.7804	0.6395

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-2.5723	-1.6573	-1.4270	-4.0000
	0.8745	0.9565	1.0531	0.0000
KIAUGNAK BAY	-2.4985	-1.4604	-3.0685	-4.0000
	0.9233	1.0372	0.9315	0.0000
KILIUDA BAY	-3.5796	-2.9556	-2.9367	-4.0000
	0.4204	0.6848	0.6984	0.0000
IZHUT BAY	-2.5826	-1.8763	-2.9720	-3.4819
	0.6924	0.8161	0.6730	0.5181

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-4.0000	-3.3442	-2.7724
	0.0000	0.0000	0.6558	0.7119
KIAUGNAK BAY	-4.0000	-4.0000	-2.9177	-1.1215
	0.0000	0.0000	0.6628	0.7255
KILIUDA BAY	-3.5058	-3.5149	-3.5943	-1.0793
	0.4942	0.4851	0.4057	0.4540
IZHUT BAY	-4.0000	-4.0000	-2.3966	-2.4741
	0.0000	0.0000	0.6345	0.3435

Table 3.2-10 Geometric means of the $\log_{10}$ abundance of <u>Calanus</u> <u>cristatus</u> by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	0.5966	-3.4226	-2.7115	-2.5222
	STD	0.4989	1.4144	2.0204	1.6252
	STDERR	0.1886	0.5774	0.8248	0.6635
	NUMBER	7	6	6	6
BANK	MEAN	-0.1902	-2.5923	-2.3774	-2.5422
	STD	1.7531	2.1797	1.8360	1.8633
	STDERR	0.3920	0.4545	0.3914	0.3885
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	0.2640	-1.9349	-3.6893	-2.2526
	STD	1.5800	2.1896	0.9322	1.2427
	STDERR	0.4996	0.6924	0.3107	0.3930
	NUMBER	10	10	9	10
SLOPE	MEAN	0.2050	0.3085	-0.3638	-0.7679
	STD	1.5858	1.0456	1.3188	1.9693
	STDERR	0.3738	0.2338	0.2949	0.5462
	NUMBER	18	20	20	13
TROUGH	MEAN	0.2161	0.2205	-1.5623	-1.7450
	STD	1.3199	1.2403	1.6433	1.8359
	STDERR	0.3300	0.3315	0.4392	0.4907
	NUMBER	16	14	14	14

Table 3.2-11 Geometric means and standard deviations of the $\log_{10}$ abundance of Calanus plumchrus by cruise and location inshore.

CRUISE NO.

	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	0.9752	1.4940	1.4416	0.1583
	0.3292	0.2091	0.2451	1.0482
KIAUGNAK BAY	2.2134	2.1738	1.3396	0.6567
	0.0861	0.2433	0.6241	0.2026
KILIUDA BAY	1.9517	1.8685	1.6441	-0.8348
	0.0794	0.1100	0.0726	0.7264
IZHUT BAY	1.6570	1.5038	1.1100	0.1826
	0.1073	0.3883	0.1507	0.8544

CRUISE NO.

	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	0.5422	-0.0491	0.4208	-2.0541
	0.3487	0.9939	1.1099	1.2036
KIAUGNAK BAY	-0.9201	0.8069	-1.7585	-3.0665
	1.2859	0.1977	1.3778	0.9335
KILIUDA BAY	-1.7620	0.0925	-1.9211	-4.0000
	0.8504	0.6546	1.0178	0.0000
IZHUT BAY	0.8627	0.1162	-0.7982	-3.3715
	0.2229	0.7185	0.9388	0.6285

CRUISE NO.

	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-2.0499	-1.9737	-3.0609	-2.0986
	1.1970	1.2422	0.9391	0.6669
KIAUGNAK BAY	-3.0693	-1.6417	-4.0000	-0.3620
	0.9307	0.9872	0.0000	0.9175
KILIUDA BAY	-1.3621	-2.9597	-3.5714	-0.6163
	0.7871	0.6820	0.4286	0.2889
IZHUT BAY	-1.8378	-2.3827	-4.0000	-1.7819
	0.8190	0.7893	0.0000	0.3526

Table 3.2-12 Geometric means of the $\log_{10}$ abundance of *Calanus plumchrus* by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF78
SOUTH WEST	MEAN	1.5998	0.4298	-1.3285	-1.7136
	STD	0.1385	0.9522	2.1331	1.7880
	STDERR	0.0523	0.3887	0.8709	0.7300
	NUMBER	7	6	6	6
BANK	MEAN	0.7369	1.0222	-2.9372	-1.2923
	STD	2.1439	1.6221	1.6189	1.6200
	STDERR	0.4794	0.3382	0.3451	0.3378
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	0.6703	0.1751	-3.1748	-1.7985
	STD	2.5228	2.2421	1.6375	1.2562
	STDERR	0.7978	0.7090	0.5458	0.3972
	NUMBER	10	10	9	10
SLOPE	MEAN	0.5780	1.3366	-1.5488	0.5774
	STD	1.7530	0.3941	1.6678	0.6186
	STDERR	0.4132	0.0881	0.3729	0.1786
	NUMBER	18	20	20	12
TROUGH	MEAN	1.0193	1.4932	-2.9813	-1.2725
	STD	2.0687	0.2814	1.6817	1.5221
	STDERR	0.5172	0.0752	0.4495	0.4068
	NUMBER	16	14	14	14

Table 3.2-13 Geometric means and standard deviations of the $\log_{10}$ abundance of *Calanus marshallae* by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-1.2805	-1.4400	-2.1309	1.1079
	1.1401	1.0558	1.1510	0.1913
KIAUGNAK BAY	-3.1975	-1.3100	-0.7081	0.6595
	0.8025	1.1023	0.8262	0.2418
KILIUDA BAY	-1.3850	-0.7635	0.1295	0.0295
	1.0863	0.8153	0.2843	0.5851
IZHUT BAY	-1.0683	-1.6687	-2.5385	0.2664
	0.7436	1.0047	0.8951	0.3333

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-0.0379	0.9912	-1.6733	1.4586
	1.0126	0.1068	1.4248	0.2109
KIAUGNAK BAY	0.8909	0.7663	1.6765	1.6228
	0.0915	0.1514	0.2378	0.0813
KILIUDA BAY	-0.3232	0.7834	-0.8954	1.3547
	0.5493	0.3288	1.1848	0.2332
IZHUT BAY	-0.1869	0.0592	-0.4309	0.0984
	0.5815	0.4194	0.7817	0.6729

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	1.0927	1.3522	0.8409	-2.0310
	0.2462	0.1389	0.5375	0.6945
KIAUGNAK BAY	1.4121	1.0974	0.1492	-1.2125
	0.1627	0.1930	0.1611	0.7968
KILIUDA BAY	1.1246	0.5816	0.0818	-0.8683
	0.1914	0.6897	0.2265	0.4675
IZHUT BAY	0.6912	-1.0186	-0.4462	-0.9239
	0.1698	0.8828	0.5879	0.4440

Table 3.2-14 Geometric means of the $\log_{10}$ abundance of Calanus marshallae by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-1.1284	-2.2572	0.3009	-0.0292
	STD	1.9719	2.0085	0.9085	2.0570
	STDERR	0.7453	0.8200	0.3709	0.8398
	NUMBER	7	6	6	6
BANK	MEAN	-2.3134	-1.1932	0.2873	-1.4525
	STD	1.7457	2.3551	0.4788	1.6427
	STDERR	0.3903	0.4911	0.1021	0.3425
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-2.3416	-0.1715	0.6853	-0.5684
	STD	1.7858	1.3770	0.4142	0.7426
	STDERR	0.5647	0.4355	0.1310	0.2348
	NUMBER	10	10	10	10
SLOPE	MEAN	-1.9161	-0.3872	-1.1476	-1.9600
	STD	1.5583	1.6095	1.3701	1.7087
	STDERR	0.3673	0.3599	0.3064	0.4272
	NUMBER	18	20	20	16
TROUGH	MEAN	-2.4404	0.6078	0.5546	-1.0407
	STD	1.8951	0.4648	0.4305	1.4091
	STDERR	0.4738	0.1242	0.1151	0.3766
	NUMBER	16	14	14	14

Table 3.2-15. Mean density (no. m^{-3}) of stages of Calanus species from bongo (333um) samples, all stations, Chiniak Bay, 1978-79.

Species/Stage	1978											1979
Month	April		May		June		July		August		Nov	March
Cruise	1	2	3	4	5	6	7	8	9	10	11	1
Calanus cristatus												
Copepodite stages IV & V	-	0.04	0.65	0.41	0.06	0.32	0.27	-	-	-	-	0.01
Copepodite stages I, II, & III	0.37	2.12	-	0.16	0.09	0.16	1.02	-	-	-	0.01	0.01
Calanus plumchrus												
Adults	-	-	-	0.06	0.01	0.14	1.02	1.67	0.41	-	0.14	-
Copepodite stages IV & V	0.47	8.78	35.97	12.79	6.61	6.26	5.34	3.78	3.14	1.53	-	-
Calanus marshallae												
Adults	0.18	0.42	-	0.19	1.53	6.06	0.72	0.52	2.60	1.94	0.01	0.05
Copepodite stages IV & V	1.11	0.11	1.15	6.66	4.74	2.81	2.64	23.89	10.79	12.74	22.82	0.01
Unidentified *Calanus*[1]												
Copepodite stages I, II & III	23.33	47.57	17.42	17.96	5.12	4.01	65.57	24.05	5.31	15.76	0.35	0.07

(-) indicates no animals found at any station

[1] Predominantly *C. plumchrus* and *C. marshallae*

Table 3.2-16. Mean density (no. m^{-3}) of stages of *Calanus* species from bongo (333um) samples, all stations, Kaiugnak Bay, 1978-79.

Species/Stage	Year	1978											1979
	Month	April			May		June		July		August	Nov	March
	Cruise	1	2	3	4	5	6	7	8	9	10	11	1
Calanus cristatus													
Copepodite stages IV & V		1.47	9.41	8.20	0.26	0.27	0.91	0.91	-	-	-	0.01	0.02
Copepodite stages I, II, & III		3.79	2.67	1.20	0.20	-	0.13	-	-	-	-	0.01	0.33
Calanus plumchrus													
Adults		-	-	-	0.13	0.06	0.40	-	-	-	-	-	-
Copepodite stages IV & V		7.47	197.6	202.9	2.65	9.93	6.18	7.01	0.93	0.90	0.14	-	0.06
Calanus marshallae													
Adults		0.21	0.73	0.51	0.32	1.30	2.58	1.29	-	0.41	0.20	0.01	0.10
Copepodite stages IV & V		-	1.13	0.55	1.75	2.42	4.07	37.72	21.86	20.93	4.13	1.48	-
Unidentified *Calanus*[1]													
Copepodite stages I, II & III		167.9	68.26	89.50	11.06	14.44	3.38	71.40	23.06	11.33	14.75	0.32	6.08

(-) indicates no animals found at any station

1 Predominantly *C. plumchrus* and *C. marshallae*

Table 3.2-17. Mean density (no. m^{-3}) of stages of Calanus species from bongo (333um) samples, all stations, Kiliuda Bay, 1978-79.

Species/Stage	Year	1978											1979
	Month	April			May		June		July	August		Nov	March
	Cruise	1	2	3	4	5	6	7	8	9	10	11	1
Calanus cristatus													
Copepodite stages IV & V		0.06	3.33	1.02	0.17	0.03	0.30	0.44	-	0.11	0.10	0.02	0.02
Copepodite stages I, II, & III		2.03	2.03	0.35	-	-	0.12	0.11	-	-	-	-	0.31
Calanus plumchrus													
Adults		-	-	-	0.04	0.06	0.30	-	-	-	-	-	-
Copepodite stages IV & V		3.88	54.76	32.70	0.92	0.78	6.10	0.47	-	0.20	0.12	0.03	0.02
Calanus marshallae													
Adults		0.20	0.29	0.11	0.16	5.67	4.46	0.89	1.33	0.39	-	0.01	0.20
Copepodite stages IV & V		0.35	0.31	1.39	1.30	1.08	5.00	20.30	14.04	7.10	5.18	2.18	0.02
Unidentified Calanus[1]													
Copepodite stages I, II & III		93.61	39.63	15.26	4.61	1.47	10.42	210.9	30.77	15.20	19.77	0.31	1.66

(-) indicates no animals found at any station
[1] Predominantly C. plumchrus and C. marshallae

Table 3.2-18. Mean density (no. m^{-3}) of stages of Calanus species from bongo (333um) samples, all stations, Izhut Bay, 1978-79.

Species/Stage	Year	1978											1979
	Month	April		May		June		July		August		Nov	March
	Cruise	1	2	3	4	5	6	7	8	9	10	11	1
Calanus cristatus													
Copepodite stages IV & V		-	0.23	0.04	0.06	0.24	0.93	0.17	0.18	-	-	0.27	0.01
Copepodite stages I, II, & III		1.86	1.32	0.03	0.04	-	-	0.15	-	-	-	0.01	-
Calanus plumchrus													
Adults		-	-	-	-	0.83	0.26	1.20	0.76	0.11	0.25	-	-
Copepodite stages IV & V		0.47	1.01	5.54	9.88	7.50	18.47	5.61	0.38	0.40	0.48	-	0.01
Calanus marshallae													
Adults		0.26	0.06	0.03	0.07	1.14	5.24	0.87	1.22	-	0.25	0.06	0.23
Copepodite stages IV & V		-	0.14	0.08	2.31	2.70	1.97	1.07	2.31	4.30	2.24	2.63	0.07
Unidentified Calanus[1]													
Copepodite stages I, II & III		51.69	69.91	13.10	8.13	6.42	0.58	5.16	8.23	4.09	4.61	0.23	0.01

(-) Indicates no animals found at any station

[1] Predominantly C. plumchrus and C. marshallae

Table 3.2-19. Mean density (no. m^{-3}) of stages of Calanus species from bongo (333um) samples, all stations, offshore 1978-79.

Year / Month	1978 March-April 02 - 4DI678	1978 June-July 03 - 2MF78	1978 Oct.-Nov. 04 - 1WE78	1979 Feb.-March 05 - 1MF79
Calanus cristatus				
Adults	*	0.01	-	*
Copepodite stages IV & V	1.00	2.16	0.44	0.03
Copepodite stages I, II & III	5.36	0.60	0.16	1.27
Calanus plumchrus				
Adults	0.01	0.91	0.07	0.01
Copepodite stages IV & V	11.84	17.15	0.05	0.16
Calanus marshallae				
Adults	0.22	2.20	0.01	0.26
Copepodite stages IV & V	0.04	1.42	2.02	1.37
Unidentified Calanus[1]				
Copepodite stages I, II & III	53.41	16.05	0.82	1.86

(-) Indicates no animals found at any station

(*) Indicates mean density less than 0.01 m^{-3}

1 Predominantly C. plumchrus and C. marshallae

Table 3.2-20 Geometric means and standard deviation of the $\log_{10}$ abundance of Pseudocalanus spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	1.4206	1.8436	1.7798	2.1279
	0.1634	0.0625	0.1986	0.1258
KIAUGNAK BAY	1.9622	2.2593	2.2088	1.4080
	0.0622	0.0979	0.1693	0.1780
KILIUDA BAY	1.8135	1.9256	2.0587	1.4383
	0.1453	0.0928	0.1653	0.2732
IZHUT BAY	0.9713	1.1776	1.3184	1.3420
	0.1302	0.0828	0.1047	0.3269

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	2.0135	2.4801	2.7203	2.7081
	0.1884	0.0930	0.1022	0.3189
KIAUGNAK BAY	1.6537	2.4968	2.6108	2.1107
	0.1750	0.1201	0.1729	0.1275
KILIUDA BAY	1.2167	2.3456	2.3653	2.0441
	0.1791	0.3262	0.3412	0.3555
IZHUT BAY	1.8139	1.4540	2.5171	2.1464
	0.2258	0.5116	0.2323	0.4134

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	2.6496	2.7105	0.5389	-1.2387
	0.3130	0.3215	1.5151	0.9289
KIAUGNAK BAY	2.1142	1.9768	0.0423	-0.2994
	0.2653	0.0541	0.1773	0.9352
KILIUDA BAY	1.6831	1.6187	0.6234	0.4788
	0.3722	0.4409	0.2791	0.1442
IZHUT BAY	1.5497	2.0540	0.2551	-0.3940
	0.7982	0.2816	0.6676	0.5480

Table 3.2-21 Geometric means of the $\log_{10}$ abundance of *Pseudocalanus* spp. by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	1.3918	1.6423	1.1688	0.3895
	STD	0.6351	0.8155	0.5251	2.1823
	STDERR	0.2400	0.3329	0.2144	0.8909
	NUMBER	7	6	6	6
BANK	MEAN	0.1707	2.5387	1.0744	-0.3782
	STD	2.2373	0.2642	0.4443	1.7748
	STDERR	0.5003	0.0551	0.0947	0.3701
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	0.6612	2.5245	1.3909	0.6687
	STD	1.8186	0.2099	0.3750	0.1989
	STDERR	0.5751	0.0664	0.1186	0.0629
	NUMBER	10	10	10	10
SLOPE	MEAN	-0.3705	2.1116	0.5922	-0.3758
	STD	1.7652	0.5482	0.6223	1.6400
	STDERR	0.4161	0.1226	0.1392	0.4383
	NUMBER	18	20	20	14
TROUGH	MEAN	1.0939	2.3659	1.1446	-0.0889
	STD	0.6730	0.2573	0.4291	1.7048
	STDERR	0.1683	0.0688	0.1147	0.4556
	NUMBER	16	14	14	14

Table 3.2-22 Geometric means and standard deviations of the $\log_{10}$ abundance of Metridia spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	0.7139	0.2045	0.6480	0.9592
	0.2848	1.0618	0.3065	0.3440
KIAUGNAK BAY	1.2427	1.5489	0.6782	-0.3363
	0.2216	0.1075	0.4477	0.9315
KILIUDA BAY	1.0278	1.2824	1.4250	-1.5126
	0.2277	0.1868	0.1074	0.7531
IZHUT BAY	0.1386	0.8189	0.8913	0.5163
	0.3138	0.2192	0.1584	0.4428

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	1.1686	1.2868	-0.6224	0.4103
	0.4046	0.2917	1.3811	1.1283
KIAUGNAK BAY	-0.3722	0.6697	1.5303	1.0682
	0.9632	1.1707	0.2516	0.2807
KILIUDA BAY	-0.7952	0.8127	-1.1490	0.8158
	0.7286	0.7487	1.0801	0.3442
IZHUT BAY	0.8203	-1.2980	-1.2728	-0.0338
	0.3998	1.0271	1.0316	0.8832

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	1.3066	0.5849	1.2915	-2.0123
	0.4102	1.1513	0.5519	0.6960
KIAUGNAK BAY	-0.7474	-0.0732	0.0081	-0.8528
	1.3421	1.0212	0.2955	0.7965
KILIUDA BAY	-0.2387	-0.3936	0.1457	-0.4018
	0.8382	0.8321	0.3577	0.2704
IZHUT BAY	-0.3060	-1.3538	0.1404	-1.1431
	0.8127	1.0127	0.7348	0.4694

Table 3.2-23 Geometric means and of the log_{10} abundance of Metridia spp. by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	1.0443	0.1039	0.9554	0.5008
	STD	0.3883	2.2985	1.3270	2.2683
	STDERR	0.1467	0.9384	0.5418	0.9260
	NUMBER	7	6	6	6
BANK	MEAN	0.1231	0.9047	0.8723	-0.6636
	STD	1.8437	1.6786	0.5907	1.7727
	STDERR	0.4123	0.3500	0.1259	0.3696
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	0.0284	1.5198	0.9171	-0.1833
	STD	1.5400	0.6236	0.5636	0.6861
	STDERR	0.4870	0.1972	0.1782	0.2170
	NUMBER	10	10	10	10
SLOPE	MEAN	0.3296	1.8621	1.0796	1.0112
	STD	1.6210	0.2825	0.6322	0.4873
	STDERR	0.3821	0.0632	0.1414	0.1407
	NUMBER	18	20	20	12
TROUGH	MEAN	0.8610	2.0945	1.2741	-0.3693
	STD	0.7317	0.3084	0.7598	1.6626
	STDERR	0.1829	0.0824	0.2031	0.4443
	NUMBER	16	14	14	14

Table 3.2-24 Geometric means and standard deviations of the log_{10} abundance of Acartia longiremis by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	0.0919	-0.3281	-0.3054	1.0874
	0.3181	0.9565	0.9530	0.2341
KIAUGNAK BAY	0.5876	0.8607	1.1989	0.9659
	0.1801	0.2070	0.1339	0.0688
KILIUDA BAY	-0.1023	0.2627	0.7501	1.3363
	0.9882	0.2319	0.2486	0.1857
IZHUT BAY	-0.1070	-2.5569	0.7451	1.1330
	0.0865	0.8843	0.1072	0.1322

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	1.0487	1.1372	1.9701	2.2254
	0.2608	0.2196	0.1600	0.1964
KIAUGNAK BAY	1.1832	1.2348	1.7434	1.9163
	0.0903	0.0952	0.1917	0.1076
KILIUDA BAY	1.4018	0.8008	2.0207	2.2134
	0.0653	0.7138	0.1146	0.0740
IZHUT BAY	1.3663	1.3925	2.0783	1.7287
	0.1576	0.2366	0.2203	0.3096

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	2.1525	2.3446	2.0048	-1.4909
	0.1064	0.1343	0.1190	0.8510
KIAUGNAK BAY	2.3968	1.6765	0.7786	-1.5087
	0.1401	0.1316	0.1874	0.6346
KILIUDA BAY	2.0644	2.1152	1.3142	-0.2704
	0.1524	0.1957	0.1098	0.2362
IZHUT BAY	2.2453	2.2689	0.8702	-1.8963
	0.1714	0.1619	0.2289	0.3387

Table 3.2-25 Geometric means of the $\log_{10}$ abundance of Acartia longiremis by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-0.5849	0.8688	1.3230	-1.7030
	STD	1.5570	0.9444	0.3178	1.8089
	STDERR	0.5885	0.3856	0.1298	0.7385
	NUMBER	7	6	6	6
BANK	MEAN	-1.4859	1.6247	1.3513	-1.9916
	STD	1.9556	0.5213	0.3736	1.5720
	STDERR	0.4373	0.1087	0.0797	0.3278
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-0.5362	1.0616	1.5271	-0.8730
	STD	1.9364	0.4280	0.3269	1.1378
	STDERR	0.6123	0.1353	0.1034	0.3598
	NUMBER	10	10	10	10
SLOPE	MEAN	-3.2783	0.5684	0.4023	-3.2226
	STD	1.3991	1.6278	0.6634	1.4552
	STDERR	0.3298	0.3640	0.1483	0.3529
	NUMBER	18	20	20	17
TROUGH	MEAN	-1.3727	0.6880	1.2425	-1.9374
	STD	1.9084	1.4288	0.2513	1.6329
	STDERR	0.4771	0.3819	0.0672	0.4364
	NUMBER	16	14	14	14

Table 3.2-26 Geometric means and standard deviations of the $\log_{10}$ abundance of *Acartia tumida* by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-0.5192	0.8223	0.8022	0.9213
	0.9512	0.4851	0.3645	0.2481
KIAUGNAK BAY	1.2884	2.0179	1.6200	0.6596
	0.2086	0.1391	0.2799	0.2664
KILIUDA BAY	0.8889	0.9682	1.2266	-0.1691
	0.4969	0.3522	0.4340	0.8465
IZHUT BAY	-1.9469	0.4471	0.5017	0.5445
	0.8477	0.1927	0.1806	0.0974

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	1.3700	1.7718	0.6473	-1.2816
	0.2780	0.1370	1.1755	1.1189
KIAUGNAK BAY	0.6741	1.4426	0.6101	-4.0000
	0.2934	0.1734	0.1864	0.0000
KILIUDA BAY	-1.1204	0.4349	-0.6544	-2.8090
	0.8511	0.9736	0.9822	0.7823
IZHUT BAY	1.2218	0.9635	0.1897	-3.4533
	0.1887	0.3383	0.6266	0.5467

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-4.0000	-4.0000	-1.8405
	0.0000	0.0000	0.0000	0.8521
KIAUGNAK BAY	-2.2323	-3.2111	-4.0000	-2.6625
	1.0833	0.7889	0.0000	0.8269
KILIUDA BAY	-3.5317	-2.9868	-4.0000	-0.6296
	0.4683	0.6635	0.0000	0.2672
IZHUT BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000

Table 3.2-27 Geometric means of the log_{10} abundance of <u>Acartia tumida</u> by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-0.6610	-0.3542	-4.0000	-4.0000
	STD	2.3049	1.8092	0.0000	0.0000
	STDERR	0.8712	0.7386	0.0000	0.0000
	NUMBER	7	6	6	6
BANK	MEAN	-1.8391	1.4207	-4.0000	-4.0000
	STD	2.2519	0.7613	0.0000	0.0000
	STDERR	0.5035	0.1587	0.0000	0.0000
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-0.6242	1.3419	-4.0000	-3.8018
	STD	2.4501	0.7572	0.0000	0.6268
	STDERR	0.7748	0.2394	0.0000	0.1982
	NUMBER	10	10	9	10
SLOPE	MEAN	-3.4561	-1.8873	-4.0000	-4.0000
	STD	1.2644	2.1940	0.0000	0.0000
	STDERR	0.2980	0.4906	0.0000	0.0000
	NUMBER	18	20	20	20
TROUGH	MEAN	-2.2956	-0.3209	-4.0000	-3.8350
	STD	2.0394	2.0726	0.0000	0.6173
	STDERR	0.5098	0.5539	0.0000	0.1650
	NUMBER	16	14	14	14

Table 3.2-28 Geometric means and standard deviations of Acartia clausi by cruise and location inshore.

	Cruise No.			
	1 CM78	2 CM78	3 CM78	4CM78
Chiniak Bay	-4.0000 0	-4.0000 0	-3.1174 0.8826	-3.0650 0.9350
Kiaugnak Bay	-4.0000 0	-4.0000 0	-4.0000 0	-4.0000 0
Kiliuda Bay	-3.0575 0.9425	-3.2340 0.7660	-4.0000 0	-2.0409 0.7455
Izhut Bay	-4.0000 0	-4.0000 0	-3.3310 0.6690	-1.7252 1.0175

	Cruise No.			
	5 CM78	6 CM78	7 CM78	8 CM78
Chiniak Bay	-4.0000 0	-4.0000 0	-3.0086 0.9914	-3.0432 0.9568
Kiaugnak Bay	-3.3666 0.6334	-4.0000 0	-4.0000 0	-4.0000 0
Kiliuda Bay	-3.3337 0.4364	-4.0000 0	-2.5111 0.7294	-3.0658 0.6143
Izhut Bay	-2.2822 0.8667	-3.3772 0.6228	-2.7115 0.8476	-2.3787 0/7970

	Cruise No.			
	9 CM78	10CM78	11CM78	1 CM79
Chiniak Bay	-0.9680 1.2409	-2.9530 1.0470	-4.0000 0	-4.0000 0
Kiaugnak Bay	-4.0000 0	-4.0000 0	-3.5597 0.4403	-3.4148 0.5852
Kiliuda Bay	-3.5918 0.9492	-1.9760 0.9368	-4.0000 0	-4.0000 0
Izhut Bay	-2.5610 0.9492	-1.5780 0.9368	-4.0000 0	-4.0000 0

Table 3.2-29 Geometric means and standard deviations of the log abundance of <u>Eucalanus</u> <u>bungii</u> by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-3.3426	-3.3134	-3.2377	-3.2874
	0.6574	0.6866	0.7623	0.7126
KIAUGNAK BAY	-4.0000	-4.0000	-4.0000	-1.8766
	0.0000	0.0000	0.0000	0.8735
KILIUDA BAY	-3.2483	-4.0000	-4.0000	-3.5952
	0.7517	0.0000	0.0000	0.4048
IZHUT BAY	-4.0000	-4.0000	-4.0000	-3.4107
	0.0000	0.0000	0.0000	0.5893

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-4.0000	-2.2113	-1.1492	-1.2696
	0.0000	1.1125	1.1717	1.1248
KIAUGNAK BAY	-1.5681	0.8161	0.1716	-0.0762
	1.0042	0.4548	1.0595	0.9915
KILIUDA BAY	-3.1585	-0.2184	-0.2293	-0.6075
	0.5509	0.8453	0.8375	0.7532
IZHUT BAY	-4.0000	-2.6778	-2.9691	-1.2923
	0.0000	0.6511	0.6749	0.7972

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-2.1334	-0.1840	-4.0000
	0.0000	1.1434	0.0566	0.0000
KIAUGNAK BAY	-2.0121	0.9022	-0.4382	-4.0000
	1.2177	0.1215	0.1281	0.0000
KILIUDA BAY	-0.7431	-0.1446	-0.0191	-3.4052
	0.7203	0.5842	0.1204	0.3907
IZHUT BAY	-3.0224	-2.4748	-1.7365	-3.3309
	0.6400	0.7456	0.6844	0.3286

Table 3.2-30 Geometric means of the $\log_{10}$ abundance of Eucalanus bungii by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-2.4885	-3.4134	-2.1105	-1.1274
	STD	1.9155	1.4368	2.0937	1.4505
	STDERR	0.7240	0.5866	0.8547	0.5922
	NUMBER	7	6	6	6
BANK	MEAN	-3.5662	0.1750	-0.5028	-3.7309
	STD	1.0644	1.7425	0.8381	0.7108
	STDERR	0.2380	0.3633	0.1787	0.1482
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-3.6955	-0.6986	0.2137	-3.4101
	STD	0.9629	2.3784	0.3938	0.9502
	STDERR	0.3045	0.7521	0.1245	0.3005
	NUMBER	10	10	10	10
SLOPE	MEAN	-0.6065	0.9568	-0.8545	-3.1773
	STD	1.2911	0.3464	1.4076	1.3714
	STDERR	0.3043	0.0775	0.3147	0.3232
	NUMBER	18	20	20	18
TROUGH	MEAN	-3.2632	1.1252	-0.7908	-3.5108
	STD	1.3297	0.5677	1.4325	0.9898
	STDERR	0.3324	0.1517	0.3828	0.2645
	NUMBER	16	14	14	14

Table 3.2-31 Geometric means and standard deviations of the $\log_{10}$ abundance of Epilabidocera longipedata by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-4.0000	-4.0000	-3.3204	-4.0000
	0.0000	0.0000	0.6796	0.0000
KIAUGNAK BAY	-4.0000	-4.0000	-3.2919	-4.0000
	0.0000	0.0000	0.7081	0.0000
KILIUDA BAY	-4.0000	-4.0000	-3.3235	-3.2144
	0.0000	0.0000	0.6765	0.5150
IZHUT BAY	-4.0000	-4.0000	-4.0000	-2.2914
	0.0000	0.0000	0.0000	0.7787

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-3.4515	-4.0000	-4.0000	-4.0000
	0.5485	0.0000	0.0000	0.0000
KIAUGNAK BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
KILIUDA BAY	-3.1871	-4.0000	-3.6267	-3.5337
	0.5326	0.0000	0.3733	0.4663
IZHUT BAY	-4.0000	-3.6241	-3.5180	-2.9860
	0.0000	0.3759	0.4820	0.6646

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-3.2598	-4.0000	-3.1496	-4.0000
	0.7402	0.0000	0.8504	0.0000
KIAUGNAK BAY	-3.0894	-4.0000	-1.0325	-4.0000
	0.9106	0.0000	0.1550	0.0000
KILIUDA BAY	-3.5481	-4.0000	-2.7500	-4.0000
	0.4519	0.0000	0.6119	0.0000
IZHUT BAY	-3.0174	-2.5178	-2.7765	-4.0000
	0.6433	0.7268	0.5994	0.0000

Table 3.2-32 Geometric means of the $\log_{10}$ abundance of *Epilabidocera longipedata* by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-4.0000	-3.4472	-2.6963	-4.0000
	STD	0.0000	1.3542	2.0374	0.0000
	STDERR	0.0000	0.5528	0.8318	0.0000
	NUMBER	7	6	6	6
BANK	MEAN	-4.0000	-3.8169	-1.6498	-4.0000
	STD	0.0000	0.8779	1.6905	0.0000
	STDERR	0.0000	0.1831	0.3604	0.0000
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-4.0000	-4.0000	-0.9712	-4.0000
	STD	0.0000	0.0000	1.8019	0.0000
	STDERR	0.0000	0.0000	0.6006	0.0000
	NUMBER	10	10	9	10
SLOPE	MEAN	-4.0000	-4.0000	-3.0908	-4.0000
	STD	0.0000	0.0000	1.4435	0.0000
	STDERR	0.0000	0.0000	0.3228	0.0000
	NUMBER	18	20	20	20
TROUGH	MEAN	-4.0000	-4.0000	-2.3093	-4.0000
	STD	0.0000	0.0000	1.7743	0.0000
	STDERR	0.0000	0.0000	0.4742	0.0000
	NUMBER	16	14	14	14

Table 3.2-33 Geometric means of the $\log_{10}$ abundance of *Centropages abdominalis* by cruise and location inshore.

CRUISE NO.

	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-3.3426	-2.2737	-0.9548	-0.4173
	0.6574	1.0649	0.8126	0.9471
KIAUGNAK BAY	-3.1590	0.6121	1.0240	-1.1834
	0.8410	0.2184	0.1707	0.7402
KILIUDA BAY	-2.4914	-2.3675	-0.5794	0.4362
	0.9283	0.9999	0.8571	0.1982
IZHUT BAY	-4.0000	-4.0000	-1.2412	0.0203
	0.0000	0.0000	0.7022	0.8723

CRUISE NO.

	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-1.1365	-0.3332	1.4777	-0.0397
	1.1998	0.9624	0.2146	1.0324
KIAUGNAK BAY	0.1190	-0.4779	1.9790	1.3200
	0.1362	0.8831	0.1869	0.1075
KILIUDA BAY	0.3534	-0.9927	1.7635	1.1969
	0.0801	0.9135	0.1487	0.1204
IZHUT BAY	0.4972	-1.1802	0.6022	0.6867
	0.1560	0.8318	0.7040	0.2674

CRUISE NO.

	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	0.0509	1.2693	-3.3442	-4.0000
	1.0236	0.0951	0.6558	0.0000
KIAUGNAK BAY	2.3987	1.6724	-1.2449	-4.0000
	0.1209	0.2374	0.6982	0.0000
KILIUDA BAY	1.5235	1.8306	-0.8588	-2.8122
	0.1006	0.1245	0.4567	0.5799
IZHUT BAY	1.0779	1.1858	-1.7899	-3.7825
	0.1703	0.2134	0.6555	0.2175

Table 3.2-34 Geometric means of the $\log_{10}$ abundance of <u>Centropages abdominalis</u> by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-4.0000	-0.2347	-1.4943	-4.0000
	STD	0.0000	2.0939	2.0130	0.0000
	STDERR	0.0000	0.8548	0.8218	0.0000
	NUMBER	7	6	6	6
BANK	MEAN	-3.6348	0.7932	-1.1449	-4.0000
	STD	1.1240	1.1432	1.7002	0.0000
	STDERR	0.2513	0.2384	0.3625	0.0000
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-3.6820	-0.8725	0.1108	-4.0000
	STD	1.0057	2.1853	0.3406	0.0000
	STDERR	0.3180	0.6911	0.1077	0.0000
	NUMBER	10	10	10	10
SLOPE	MEAN	-3.8318	-0.6456	-3.2683	-3.8526
	STD	0.7136	2.0573	1.3037	0.6593
	STDERR	0.1682	0.4600	0.2915	0.1474
	NUMBER	18	20	20	20
TROUGH	MEAN	-3.6849	-0.0991	-2.1944	-3.8657
	STD	0.8846	1.7261	1.8933	0.5027
	STDERR	0.2212	0.4613	0.5060	0.1343
	NUMBER	16	14	14	14

Table 3.2-35 Geometric means and standard deviations of the $\log_{10}$ abundance of Scolecithricella minor by cruise and location inshore.

	CRUISE NO. 1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-0.5317	0.5034	-1.6795	0.0290
	0.9026	0.2775	0.9787	0.2053
KIAUGNAK BAY	-1.4831	-1.3634	-3.3499	-2.6110
	1.0278	1.0788	0.6501	0.8506
KILIUDA BAY	0.0911	-0.4389	0.0516	-2.3246
	0.1561	0.8996	0.1358	0.6422
IZHUT BAY	-1.7476	0.1081	-0.7614	-1.3731
	0.9218	0.2197	0.8309	0.8550

	CRUISE NO. 5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-3.2959	-0.8834	-2.2537	-4.0000
	0.7041	1.2759	1.0711	0.0000
KIAUGNAK BAY	-0.9204	-2.0358	-3.1287	-4.0000
	0.8164	1.2079	0.8713	0.0000
KILIUDA BAY	-2.5176	-1.3488	-1.7701	-4.0000
	0.7423	1.0072	0.8432	0.0000
IZHUT BAY	-1.6979	-0.5611	-2.3257	-4.0000
	0.8889	0.7932	0.8191	0.0000

	CRUISE NO. 9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-4.0000	0.0839	-2.0622
	0.0000	0.0000	0.4231	0.6590
KIAUGNAK BAY	-4.0000	-4.0000	-1.6665	-1.2367
	0.0000	0.0000	0.5955	0.6929
KILIUDA BAY	-4.0000	-4.0000	-1.6278	-0.7642
	0.0000	0.0000	0.7091	0.1392
IZHUT BAY	-3.4931	-3.5853	-1.2637	-1.2979
	0.5069	0.4147	0.6924	0.5998

Table 3.2-36 Geometric means of the log 10 abundance of Scolecithricella minor by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-0.3073	-2.6217	-2.0811	-0.8831
	STD	1.6505	2.1387	2.2054	2.4657
	STDERR	0.6238	0.8731	0.9004	1.0066
	NUMBER	7	6	6	6
BANK	MEAN	-1.2153	-2.6996	-0.7984	-1.3687
	STD	1.9383	2.0323	1.3520	1.5280
	STDERR	0.4334	0.4238	0.2882	0.3186
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-1.2697	-2.7405	-2.1227	-0.5658
	STD	1.9026	2.0315	1.7831	0.3969
	STDERR	0.6017	0.6424	0.5944	0.1255
	NUMBER	10	10	9	10
SLOPE	MEAN	-0.4271	-0.6602	0.3601	0.4333
	STD	1.6568	1.7341	0.6019	0.3475
	STDERR	0.3905	0.3878	0.1346	0.1003
	NUMBER	18	20	20	12
TROUGH	MEAN	-0.4127	-0.8412	-0.1548	-0.8013
	STD	1.4611	2.0978	1.1540	1.4335
	STDERR	0.3653	0.5607	0.3084	0.3831
	NUMBER	16	14	14	14

Table 3.2-37 Geometric means and standard deviations of the $\log_{10}$ abundance of <u>Oithona</u> spp. by cruise and location inshore.

CRUISE NO.

	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-0.5121	-1.6413	-2.0227	-0.4967
	0.2285	0.9645	0.8155	0.9011
KIAUGNAK BAY	-0.7720	-0.5688	-0.8013	0.1079
	0.8112	0.8610	0.8275	0.1295
KILIUDA BAY	-0.9418	-1.5681	-0.7310	-1.0136
	0.7726	1.0025	0.8220	0.6678
IZHUT BAY	-2.6343	-0.0025	1.5337	-0.2282
	0.8448	0.2055	0.0810	0.6594

CRUISE NO.

	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-1.0173	-3.2178	-1.9582	-2.9126
	1.2316	0.7822	1.2525	1.0874
KIAUGNAK BAY	0.4676	-2.9146	-3.1287	0.2800
	0.2881	1.0854	0.8713	0.1059
KILIUDA BAY	-2.1965	-0.5044	-0.6991	0.0132
	0.6940	0.7731	0.7355	0.6267
IZHUT BAY	-1.0664	-2.7761	-1.1886	-1.8927
	0.6500	0.6527	0.8251	0.8002

CRUISE NO.

	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	0.7429	0.6768	0.5860	-2.1571
	0.1477	0.0944	0.0561	0.6263
KIAUGNAK BAY	-0.3136	0.9246	0.0925	-1.3147
	0.9306	0.1629	0.2064	0.6788
KILIUDA BAY	0.5274	0.8508	0.6436	-0.4289
	0.2256	0.2361	0.1252	0.1179
IZHUT BAY	0.8450	-0.6383	-0.5831	-1.2795
	0.1794	0.7395	0.5558	0.4424

Table 3.2-38 Geometric means of the $\log_{10}$ abundance of Oithona spp. by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF79	1WE78	1MF79
SOUTH WEST	MEAN	-1.9580	-3.2716	-0.1549	-2.0285
	STD	1.9251	1.3870	0.7685	2.1734
	STDERR	0.7276	0.4904	0.3137	0.8873
	NUMBER	7	8	6	6
BANK	MEAN	-2.0717	-0.8952	0.2855	-1.7354
	STD	1.8247	2.1353	0.3992	1.4246
	STDERR	0.4080	0.4452	0.0851	0.2971
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-2.6035	0.1002	0.6704	-1.8233
	STD	1.8164	1.4959	0.4434	1.5494
	STDERR	0.5744	0.4730	0.1402	0.4900
	NUMBER	10	10	10	10
SLOPE	MEAN	-0.8551	-0.5513	-0.3478	-0.5596
	STD	1.4750	1.8225	1.3418	1.5630
	STDERR	0.3477	0.4075	0.3000	0.4335
	NUMBER	18	20	20	13
TROUGH	MEAN	-0.8483	-0.4567	0.4964	-1.1452
	STD	1.3717	1.9515	0.3815	1.3495
	STDERR	0.3429	0.5216	0.1020	0.3607
	NUMBER	16	14	14	14

Table 3.2-39 Geometric means and standard deviations of the $\log_{10}$ abundance of total Euphausiids by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
KILIUDA BAY	-0.3918	-0.4395	1.0908	-1.0146
	0.3096	0.5245	0.4242	0.7083
IZHUT BAY	-2.4502	-0.9985	0.6153	-0.5563
	0.6558	0.7931	0.2970	0.9321

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
KILIUDA BAY	-1.8824	-1.6264	0.5052	-1.3968
	0.8134	0.9017	0.9975	0.9919
IZHUT BAY	-1.3082	-1.6665	1.3325	-1.0056
	0.7930	0.6946	0.3942	0.8992

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
KILIUDA BAY	-2.0893	-1.2902	-1.9368	-2.7042
	0.9375	1.0303	0.6085	0.6601
IZHUT BAY	-1.3798	-1.8200	-1.5677	-2.1932
	0.9964	0.8590	0.7594	0.5966

Table 3.2-40 Geometric means and standard deviations of the $\log_{10}$ abundance of Parathemisto pacifica by cruise and location inshore.

CRUISE NO.

	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-1.3350	-1.4883	-1.0645	-2.5080
	0.6860	1.0287	0.7754	0.9152
KIAUGNAK BAY	0.0440	-3.1986	-2.6194	-1.9288
	0.1450	0.8014	0.8479	0.8595
KILIUDA BAY	-2.5718	-0.8590	-2.3832	-3.6328
	0.8750	0.7886	0.9965	0.3672
IZHUT BAY	-1.0299	-1.2585	-2.5898	-2.3068
	0.7499	0.6922	0.8644	0.7623

CRUISE NO.

	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-1.0671	-2.3183	-1.3170	0.6847
	0.7485	1.0299	1.1008	0.1706
KIAUGNAK BAY	-1.7974	-3.1391	0.4269	-0.5519
	0.9033	0.8609	0.1571	0.8632
KILIUDA BAY	-1.6533	-2.9092	-1.1864	-3.0415
	0.5155	0.7143	0.8264	0.6373
IZHUT BAY	-3.6165	-2.8965	-1.1683	0.1698
	0.3835	0.5670	0.8355	0.2720

CRUISE NO.

	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-0.4295	0.1647	-0.0226	-2.0804
	0.9174	1.0532	0.3186	0.6705
KIAUGNAK BAY	0.4882	-0.9525	-0.3451	-2.2244
	0.0557	0.7921	0.1535	0.7254
KILIUDA BAY	-1.0804	-1.2981	-0.7503	-1.3469
	0.6480	0.7951	0.4947	0.4188
IZHUT BAY	0.0705	0.1514	0.3951	-1.6025
	0.5859	0.6108	0.2044	0.3583

Table 3.2-41 Geometric means of the $\log_{10}$ abundance of <u>Parathemisto pacifica</u> by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-1.6751	-0.0168	-0.0610	-2.1327
	STD	1.5948	0.8364	0.4592	2.0456
	STDERR	0.6028	0.3415	0.1875	0.8351
	NUMBER	7	6	6	6
BANK	MEAN	-2.0096	-0.8490	-0.1550	-1.5396
	STD	1.7862	2.0097	0.4455	1.3535
	STDERR	0.3994	0.4285	0.0950	0.2822
	NUMBER	20	22	22	23
NEAR SHORE	MEAN	-1.7026	-1.2633	0.1890	-1.7708
	STD	2.0093	2.0604	0.5306	1.5931
	STDERR	0.6354	0.6868	0.1678	0.5038
	NUMBER	10	9	10	10
SLOPE	MEAN	-2.0614	-0.1487	-0.1407	-1.6757
	STD	1.6035	1.3634	0.6889	1.6572
	STDERR	0.3780	0.3049	0.1540	0.4596
	NUMBER	18	20	20	13
TROUGH	MEAN	-1.1491	-1.0848	0.0947	-1.9177
	STD	1.4402	2.0371	0.4472	1.3859
	STDERR	0.3601	0.5650	0.1195	0.3704
	NUMBER	16	13	14	14

Table 3.2-42 Geometric means and standard deviations of the log_{10} abundance of Conchoecia spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-0.8906	-1.5124	-3.2044	-4.0000
	0.8024	1.0244	0.7956	0.0000
KIAUGNAK BAY	-2.4280	-4.0000	-4.0000	-4.0000
	0.9632	0.0000	0.0000	0.0000
KILIUDA BAY	-3.2111	-2.5249	-4.0000	-4.0000
	0.7889	0.9033	0.0000	0.0000
IZHUT BAY	-2.6906	-2.6972	-1.7820	-3.5461
	0.8039	0.7992	0.9143	0.4539

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-3.1752	-4.0000	-3.1484	-4.0000
	0.8248	0.0000	0.8516	0.0000
KIAUGNAK BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
KILIUDA BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
IZHUT BAY	-4.0000	-3.4784	-4.0000	-4.0000
	0.0000	0.5216	0.0000	0.0000

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-4.0000	-4.0000	-2.1217
	0.0000	0.0000	0.0000	0.6467
KIAUGNAK BAY	-4.0000	-4.0000	-2.4551	-2.4844
	0.0000	0.0000	0.6322	0.6286
KILIUDA BAY	-4.0000	-4.0000	-4.0000	-2.1638
	0.0000	0.0000	0.0000	0.5518
IZHUT BAY	-4.0000	-4.0000	-3.6585	-1.5794
	0.0000	0.0000	0.3415	0.5424

Table 3.2-43 Geometric means of the $\log_{10}$ abundance of Conchoecia spp. by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-1.8922	-2.9883	-1.9573	-0.7956
	STD	2.0390	1.8793	2.3177	1.6308
	STDERR	0.7707	0.6644	0.9462	0.6658
	NUMBER	7	8	6	6
BANK	MEAN	-3.3408	-4.0000	-3.4170	-1.6662
	STD	1.3598	0.0000	1.2695	1.3631
	STDERR	0.3041	0.0000	0.2707	0.2842
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-2.9355	-3.7879	-4.0000	-1.4944
	STD	1.7179	0.6706	0.0000	1.3834
	STDERR	0.5432	0.2121	0.0000	0.4375
	NUMBER	10	10	10	10
SLOPE	MEAN	-1.4821	0.0990	-0.5391	-0.0586
	STD	1.8959	1.0180	1.5126	0.3855
	STDERR	0.4469	0.2276	0.3382	0.1113
	NUMBER	18	20	20	12
TROUGH	MEAN	-2.5205	-4.0000	-3.3166	-1.4575
	STD	1.7966	0.0000	1.3624	1.1431
	STDERR	0.4491	0.0000	0.3641	0.3055
	NUMBER	16	14	14	14

Table 3.2-44 Geometric means and standard deviations of the $\log_{10}$ abundance of Podon spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-4.0000	-3.3542	-3.1021	-3.2808
	0.0000	0.6458	0.8979	0.7192
KIAUGNAK BAY	-4.0000	-2.3623	-4.0000	-4.0000
	0.0000	1.0029	0.0000	0.0000
KILIUDA BAY	-4.0000	-3.2559	-4.0000	-2.7046
	0.0000	0.7441	0.0000	0.6385
IZHUT BAY	-4.0000	-4.0000	-4.0000	-3.5485
	0.0000	0.0000	0.0000	0.4515

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-3.1386	-2.3011	-1.9414	0.3489
	0.8614	1.0477	1.3008	1.1648
KIAUGNAK BAY	-4.0000	-4.0000	-0.8531	0.6980
	0.0000	0.0000	1.2848	0.1815
KILIUDA BAY	-2.5530	-1.7521	1.9131	1.2562
	0.7251	0.8565	0.1482	0.7585
IZHUT BAY	-2.9353	-3.4525	-3.2505	-1.0261
	0.6988	0.5475	0.7495	0.8945

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	1.5043	1.4120	-4.0000	-4.0000
	0.5245	0.3807	0.0000	0.0000
KIAUGNAK BAY	2.1242	1.2458	-4.0000	-4.0000
	0.1262	0.3711	0.0000	0.0000
KILIUDA BAY	2.0822	2.3145	-3.1105	-4.0000
	0.1764	0.1240	0.5879	0.0000
IZHUT BAY	0.1349	0.9728	-4.0000	-3.5964
	0.9745	0.8082	0.0000	0.4036

Table 3.2-45 Geometric means and standard deviations of the $\log_{10}$ abundance of Evadne spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
KIAUGNAK BAY	-3.2192	-4.0000	-4.0000	-4.0000
	0.7808	0.0000	0.0000	0.0000
KILIUDA BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
IZHUT BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
KIAUGNAK BAY	-4.0000	-4.0000	-4.0000	-4.0000
	0.0000	0.0000	0.0000	0.0000
KILIUDA BAY	-4.0000	-4.0000	-1.9519	-1.9448
	0.0000	0.0000	0.7754	0.7817
IZHUT BAY	-4.0000	-4.0000	-3.4207	-3.5285
	0.0000	0.0000	0.5793	0.4715

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-1.4487	-2.1385	-4.0000	-4.0000
	1.0449	1.1404	0.0000	0.0000
KIAUGNAK BAY	0.7392	0.4929	-4.0000	-4.0000
	0.2240	0.2451	0.0000	0.0000
KILIUDA BAY	-0.5565	0.4339	-3.1507	-4.0000
	0.7576	0.6509	0.5560	0.0000
IZHUT BAY	-1.9666	-0.6403	-4.0000	-4.0000
	1.0133	1.0247	0.0000	0.0000

Table 3.2-46 Geometric means and standard deviations of the $\log_{10}$ abundance of Oikopleura spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-2.4271	-1.1171	-3.3622	-0.6453
	0.9632	0.7240	0.6378	0.8790
KIAUGNAK BAY	-0.6642	0.7978	-0.1585	-3.3810
	0.8393	0.0633	0.9819	0.6190
KILIUDA BAY	0.1355	-0.6510	0.2674	-2.6900
	0.1488	0.8593	0.2117	0.6398
IZHUT BAY	0.1605	0.0087	-0.6554	-2.4339
	0.1905	0.1643	0.8810	0.7392

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-0.5850	-0.5491	-0.2206	-0.9185
	0.9656	0.8638	0.9724	1.2626
KIAUGNAK BAY	-0.2743	-0.6264	-4.0000	-0.1992
	0.9445	0.8504	0.0000	0.9612
KILIUDA BAY	-0.9640	-2.2344	-2.3415	1.3180
	0.6990	0.8692	0.8126	0.2272
IZHUT BAY	-1.9237	-3.0282	-2.8598	-0.8527
	0.7963	0.6384	0.7518	0.9270

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	1.7744	1.4067	-1.1595	-3.5820
	0.4249	0.2851	0.9481	0.4180
KIAUGNAK BAY	0.0025	0.2961	-2.7623	-3.2945
	1.0188	0.1635	0.7582	0.7055
KILIUDA BAY	1.8377	1.1159	-2.8214	-2.5173
	0.1645	0.2950	0.5847	0.5649
IZHUT BAY	1.0443	0.2542	-3.0643	-3.4993
	0.7843	0.6162	0.4707	0.3360

Table 3.2-47 Geometric means of the $\log_{10}$ abundance of Oikopleura spp. by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-1.3761	-0.9113	-2.8412	-3.6003
	STD	1.8264	2.6460	1.8135	0.9790
	STDERR	0.6903	0.9355	0.7403	0.3997
	NUMBER	7	8	6	6
BANK	MEAN	-0.6119	-0.1791	-1.5846	-2.9311
	STD	1.5944	1.8605	1.9331	1.3910
	STDERR	0.3565	0.3879	0.4121	0.2901
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-0.2242	-0.9217	-0.7208	-2.6214
	STD	1.4065	2.1322	1.7841	1.4712
	STDERR	0.4448	0.6743	0.5642	0.4652
	NUMBER	10	10	10	10
SLOPE	MEAN	-2.4117	-1.0759	-2.0153	-2.3333
	STD	1.8403	1.9828	1.7058	1.6513
	STDERR	0.4338	0.4434	0.3814	0.4264
	NUMBER	18	20	20	15
TROUGH	MEAN	-0.1001	-0.3886	-2.1938	-2.8908
	STD	1.2318	1.9833	1.9041	1.3342
	STDERR	0.3079	0.5301	0.5089	0.3566
	NUMBER	16	14	14	14

Table 3.2-48 Geometric means and standard deviations of the $\log_{10}$ abundance of Fritillaria borealis by cruise and station inshore.

CRUISE NO.

	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-3.4255	-4.0000	-4.0000	-2.3600
	0.5745	0.0000	0.0000	1.0169
KIAUGNAK BAY	-1.6002	-3.1295	-3.2919	-4.0000
	0.9804	0.8705	0.7081	0.0000
KILIUDA BAY	-2.5225	-4.0000	-2.3372	-3.1671
	0.9050	0.0000	1.0211	0.5469
IZHUT BAY	-4.0000	-4.0000	0.1872	-2.3404
	0.0000	0.0000	0.1867	1.0497

CRUISE NO.

	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-3.0650	-2.1299	-2.0424	-4.0000
	0.9350	1.1705	1.2228	0.0000
KIAUGNAK BAY	-2.3903	-4.0000	-4.0000	-4.0000
	1.0013	0.0000	0.0000	0.0000
KILIUDA BAY	-2.3890	-2.8665	-3.4571	-4.0000
	0.8208	0.7980	0.5429	0.0000
IZHUT BAY	-3.5036	-2.7376	-2.1547	-4.0000
	0.4964	0.8418	0.9088	0.0000

CRUISE NO.

	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-4.0000	-4.0000	-3.5820
	0.0000	0.0000	0.0000	0.4180
KIAUGNAK BAY	-2.9426	-2.5382	-2.1314	-4.0000
	1.0574	0.8973	0.7839	0.0000
KILIUDA BAY	-3.3624	-2.9390	-1.7406	-2.6897
	0.6376	0.6949	0.6905	0.4962
IZHUT BAY	-2.1435	-4.0000	-4.0000	-3.7009
	0.9263	0.0000	0.0000	0.2991

Table 3.2-49 Geometric means of the $\log_{10}$ abundance of *Fritillaria borealis* by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-3.0587	-2.4671	-4.0000	-4.0000
	STD	1.6134	2.3851	0.0000	0.0000
	STDERR	0.6098	0.9737	0.0000	0.0000
	NUMBER	7	6	6	6
BANK	MEAN	-1.8609	-1.0525	-2.7148	-2.5283
	STD	1.9413	2.2204	1.9573	1.6123
	STDERR	0.4341	0.4630	0.4173	0.3362
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-2.4575	-1.7667	-3.5708	-2.6294
	STD	2.0985	2.3678	1.2877	1.8237
	STDERR	0.6636	0.7488	0.4292	0.5767
	NUMBER	10	10	9	10
SLOPE	MEAN	-2.7300	-3.3724	-3.5629	-3.5073
	STD	1.8982	1.3964	1.0703	1.2500
	STDERR	0.4474	0.3122	0.2393	0.2795
	NUMBER	18	20	20	20
TROUGH	MEAN	-1.3371	-2.9399	-3.2729	-2.8511
	STD	1.9122	2.1187	1.4509	1.3828
	STDERR	0.4780	0.5662	0.3878	0.3696
	NUMBER	16	14	14	14

Table 3.2-50 Geometric means and standard deviations of the $\log_{10}$ abundance of <u>Limacina</u> <u>helicina</u> by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-1.9573	-0.7805	-0.8895	-0.8222
	0.8345	0.8107	0.8048	0.8356
KIAUGNAK BAY	-0.5817	-0.2995	0.6503	-0.3837
	0.8672	0.9336	0.2237	0.1618
KILIUDA BAY	-0.7358	-1.4125	-0.7053	-1.1610
	0.8219	1.0666	0.8330	0.6268
IZHUT BAY	-0.6023	-0.7749	-0.8133	-1.0008
	0.0744	0.8261	0.8028	0.6102

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-4.0000	-4.0000	-2.2916	-3.1034
	0.0000	0.0000	1.0462	0.8966
KIAUGNAK BAY	-2.6485	-4.0000	-2.3562	-0.8535
	0.8283	0.0000	1.0085	0.7890
KILIUDA BAY	-3.3172	-3.5113	-1.8623	-0.6732
	0.4490	0.4887	0.8176	0.7293
IZHUT BAY	-4.0000	-4.0000	-2.9268	-1.2493
	0.0000	0.0000	0.7036	0.8082

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	0.4668	1.2225	0.1521	-2.4621
	0.1066	0.1869	0.3391	0.5658
KIAUGNAK BAY	0.9336	1.6686	-0.1655	-1.5464
	0.2566	0.1723	0.2935	0.6522
KILIUDA BAY	-0.5775	0.5644	0.0418	-1.5500
	0.7532	0.6843	0.1705	0.5583
IZHUT BAY	-1.3948	1.4702	-1.0093	-2.3670
	0.7689	0.2060	0.6626	0.4924

Table 3.2-51 Geometric means of the $\log_{10}$ abundance of *Limacina helicina* cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-0.1227	-2.6511	-0.6907	-1.7507
	STD	0.6504	2.0973	1.7280	1.7596
	STDERR	0.2458	0.8562	0.7055	0.7184
	NUMBER	7	6	6	6
BANK	MEAN	-1.0295	-1.5488	-0.5899	-1.6664
	STD	1.7027	2.2154	1.4351	1.5245
	STDERR	0.3807	0.4619	0.3060	0.3179
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-0.8359	-2.8173	-0.0686	-1.7440
	STD	1.7810	1.9098	0.3047	1.2607
	STDERR	0.5632	0.6039	0.1016	0.3987
	NUMBER	10	10	9	10
SLOPE	MEAN	-1.3775	-1.9962	0.2819	-0.1097
	STD	1.7568	2.0727	0.6534	0.5604
	STDERR	0.4141	0.4635	0.1461	0.1618
	NUMBER	18	20	20	12
TROUGH	MEAN	0.0887	-0.4676	0.1126	-1.6582
	STD	0.8902	1.5193	0.5642	1.8221
	STDERR	0.2225	0.4060	0.1508	0.4870
	NUMBER	16	14	14	14

Table 3.2-52 Geometric means and standard deviations of the $\log_{10}$ abundance of Sagitta spp. by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-0.9570	-0.3455	-1.7020	-2.5829
	0.7947	0.1094	0.9748	0.8713
KIAUGNAK BAY	-3.1975	-0.5189	-3.2695	-3.2253
	0.8025	0.8764	0.7305	0.7747
KILIUDA BAY	-1.5120	-0.6878	-2.5636	-3.0898
	1.0172	0.8463	0.8855	0.5959
IZHUT BAY	-0.4625	-1.8850	-1.8698	-3.5485
	0.1434	0.8663	0.8712	0.4515

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-1.7789	-1.5911	-3.1484	-1.3252
	0.9472	0.9855	0.8516	1.1011
KIAUGNAK BAY	-2.4074	-2.3095	-2.1559	-0.5891
	0.9752	1.0564	1.1296	0.8909
KILIUDA BAY	-1.5897	-1.5851	-1.9073	-2.1323
	0.7501	0.9204	0.8206	0.9203
IZHUT BAY	-2.6941	-3.5787	-3.1414	-2.8920
	0.6479	0.4213	0.5872	0.7254

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-0.5417	-0.3248	0.2482	-2.1813
	0.8820	0.9190	0.1066	0.6082
KIAUGNAK BAY	-1.9760	-0.4651	0.0757	-2.3664
	1.2408	0.9326	0.3637	0.6849
KILIUDA BAY	-2.2051	-1.0887	0.3235	-0.8408
	0.8935	0.8633	0.1921	0.5493
IZHUT BAY	-0.4177	-1.2788	-0.8218	-1.9461
	0.5274	0.8056	0.4766	0.3289

Table 3.2-53 Geometric means of the $\log_{10}$ abunbdance of Sagitta spp. by cruise and location offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-0.7722	-1.0742	-0.5912	-0.6083
	STD	1.4568	1.9077	1.7627	1.7075
	STDERR	0.5506	0.6745	0.7196	0.6971
	NUMBER	7	8	6	6
BANK	MEAN	-1.6869	-2.8401	-0.7222	-2.0357
	STD	1.7733	1.7894	1.1693	1.3847
	STDERR	0.3965	0.3815	0.2493	0.2887
	NUMBER	20	22	22	23
NEAR SHORE	MEAN	-2.3266	-2.2012	-0.3290	-1.2713
	STD	1.8056	1.9668	1.3096	1.0317
	STDERR	0.5710	0.6219	0.4141	0.3263
	NUMBER	10	10	10	10
SLOPE	MEAN	-1.6779	-1.9867	-0.7612	-0.5361
	STD	1.5120	2.0760	1.4196	0.4555
	STDERR	0.3564	0.4642	0.3174	0.1315
	NUMBER	18	20	20	12
TROUGH	MEAN	-0.9538	-1.5123	-0.3140	-1.6026
	STD	1.3631	2.2093	1.1365	1.0730
	STDERR	0.3408	0.6378	0.3037	0.2868
	NUMBER	16	12	14	14

Table 3.2-54 Geometric means and standard deviations of the log_{10} abundance of <u>Eukrohnia hamata</u> by cruise and location inshore.

CRUISE NO.

	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-2.6955	-2.3633	-3.2044	-3.3021
	0.8082	1.0022	0.7956	0.6979
KIAUGNAK BAY	-3.2577	-4.0000	-3.3499	-4.0000
	0.7423	0.0000	0.6501	0.0000
KILIUDA BAY	-4.0000	-3.2669	-2.5126	-2.3431
	0.0000	0.7331	0.9109	0.6415
IZHUT BAY	-3.3214	-2.5569	-2.7263	-2.7066
	0.6786	0.8843	0.7804	0.8183

CRUISE NO.

	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-4.0000	-4.0000	-3.1652	-4.0000
	0.0000	0.0000	0.8348	0.0000
KIAUGNAK BAY	-3.4267	-3.2083	-4.0000	-4.0000
	0.5733	0.7917	0.0000	0.0000
KILIUDA BAY	-4.0000	-3.0147	-1.8570	-4.0000
	0.0000	0.6451	0.8195	0.0000
IZHUT BAY	-3.5488	-4.0000	-3.4207	-4.0000
	0.4512	0.0000	0.5793	0.0000

CRUISE NO.

	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-4.0000	-3.1439	-1.4428	-3.5079
	0.0000	0.8561	0.8979	0.4921
KIAUGNAK BAY	-4.0000	-4.0000	-3.4530	-3.4283
	0.0000	0.0000	0.5470	0.5717
KILIUDA BAY	-4.0000	-4.0000	-3.6118	-3.3623
	0.0000	0.0000	0.3882	0.4192
IZHUT BAY	-4.0000	-4.0000	-3.1041	-2.3907
	0.0000	0.0000	0.5868	0.5032

Table 3.2-55 Geometric means of the $\log_{10}$ abundance of Eukrohnia hamata by cruise and station offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-2.8073	-3.2672	-2.5973	-1.5897
	STD	2.0369	1.7949	2.1731	2.0090
	STDERR	0.7699	0.7328	0.8871	0.8202
	NUMBER	7	6	6	6
BANK	MEAN	-3.2118	-3.6174	-2.3166	-2.8194
	STD	1.4258	1.2682	1.7491	1.5464
	STDERR	0.3188	0.2644	0.3729	0.3224
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-3.0785	-2.9816	-3.6042	-2.4904
	STD	1.4989	1.7265	1.1874	1.3063
	STDERR	0.4740	0.5460	0.3958	0.4131
	NUMBER	10	10	9	10
SLOPE	MEAN	-1.6897	0.3068	0.0845	-0.5401
	STD	1.9314	1.0487	1.0289	1.6613
	STDERR	0.4552	0.2345	0.2301	0.4796
	NUMBER	18	20	20	12
TROUGH	MEAN	-2.9434	-2.2592	-1.9190	-2.5590
	STD	1.6339	2.0940	1.9598	1.5501
	STDERR	0.4085	0.5596	0.5238	0.4143
	NUMBER	16	14	14	14

Table 3.2-56 Geometric means and standard deviations of the $\log_{10}$ abundance of total Cnidarians by cruise and location inshore.

	CRUISE NO.			
	1CM78	2CM78	3CM78	4CM78
CHINIAK BAY	-1.7539	-0.2169	-0.7149	-1.6101
	0.9235	0.2229	0.8588	0.9850
KIAUGNAK BAY	0.1394	-1.3647	0.5487	-0.5588
	0.1530	1.0797	0.2701	0.1727
KILIUDA BAY	-1.2452	-1.5572	0.3242	0.1826
	1.1481	1.0059	0.2453	0.6307
IZHUT BAY	-0.3422	-3.3782	-3.4195	-1.6420
	0.0770	0.6218	0.5805	0.8412

	CRUISE NO.			
	5CM78	6CM78	7CM78	8CM78
CHINIAK BAY	-3.1386	0.4420	-0.7297	-4.0000
	0.8614	0.3087	1.3716	0.0000
KIAUGNAK BAY	-0.7954	-0.1718	-1.4813	-2.1334
	0.8029	0.9623	1.1243	1.1450
KILIUDA BAY	0.4039	0.6750	0.6252	-4.0000
	0.3622	0.2174	0.6850	0.0000
IZHUT BAY	-1.7350	-1.6634	-1.0013	-4.0000
	0.7033	0.8200	0.9439	0.0000

	CRUISE NO.			
	9CM78	10CM78	11CM78	1CM79
CHINIAK BAY	-3.0792	-3.1804	-2.8877	-3.2202
	0.9208	0.8196	1.1123	0.4526
KIAUGNAK BAY	-0.2383	-2.2054	0.0026	-1.5789
	0.9481	1.0992	0.2317	0.6307
KILIUDA BAY	-2.9481	-2.7484	0.7929	-0.1690
	0.6908	0.8358	0.2331	0.2628
IZHUT BAY	-1.0506	-2.6126	-1.8961	-1.3863
	0.8803	0.9130	0.6338	0.4033

Table 3.2-57 Geometric means of the $\log_{10}$ abundance of total Cnidarians by cruise and station offshore.

		CRUISE NO.			
		4DI78	2MF78	1WE78	1MF79
SOUTH WEST	MEAN	-0.8522	-1.0585	-2.8760	-2.1501
	STD	1.4349	2.4689	1.7438	2.0271
	STDERR	0.5423	0.8729	0.7119	0.8276
	NUMBER	7	8	6	6
BANK	MEAN	-2.0461	-0.6977	-3.1012	-1.6171
	STD	1.7894	2.2063	1.5067	1.3163
	STDERR	0.4001	0.4601	0.3212	0.2745
	NUMBER	20	23	22	23
NEAR SHORE	MEAN	-1.4630	-0.4757	-2.8723	-2.1258
	STD	1.7812	1.8603	1.8220	1.3681
	STDERR	0.5633	0.6577	0.5762	0.4326
	NUMBER	10	8	10	10
SLOPE	MEAN	-1.5659	-1.5539	-1.3820	-1.1560
	STD	1.5887	1.9084	1.5924	1.6288
	STDERR	0.3744	0.4267	0.3561	0.4517
	NUMBER	18	20	20	13
TROUGH	MEAN	-1.5691	-1.7726	-2.4911	-1.5434
	STD	1.7412	2.0942	1.8105	1.3788
	STDERR	0.4353	0.6045	0.4839	0.3685
	NUMBER	16	12	14	14

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8.0 APPENDIX

Sample Zooplankton Counting and Coding Sheets.

A. Cruise Header

1	2	3	4	5	6	7
1	2	4	T	R	K	Z

LAB CRUISE NO.

8	9

RECORD TYPE

10
A

VESSEL

11	12	13	14	15	16	17	18	19	20	21

FIELD CRUISE NUMBER

22	23	24	25	26	27

CRUISE BEGAN

28	29	30	31	32	33	34	35	36
7		/			/			-

CRUISE END

37	38	39	40	41	42	43	44
7		/			/		

PROJECT

45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
6	0	8		K	O	D	I	A	K		Z	P	L	A	N	K	T	N

INSTITUTION AND INVESTIGATORS

64	65	66	67	68	69	70	71	72	73	74	75	76	77
	V	T	N	-	O	R	E	.		G	M	A	V

B. Station Location and Date Collected

1	2	3	4	5	6	7
1	2	4	T	R	K	Z

LAB CRUISE NO. (8 9): [ ][ ]

RECORD TYPE (10): [B]

STATION NUMBER (11 12 13 14 15): [ ][ ][ ][ ][ ]

LATITUDE (16 17 18 19 20 21 22): [5][ ][ ][ ][ ][ ][N]

LONGITUDE (23 24 25 26 27 28 29 30): [1][ ][ ][ ][ ][ ][ ][W]

DATE COLL. (31 32 33 34 35 36): [ ][ ][ ][ ][ ][ ]

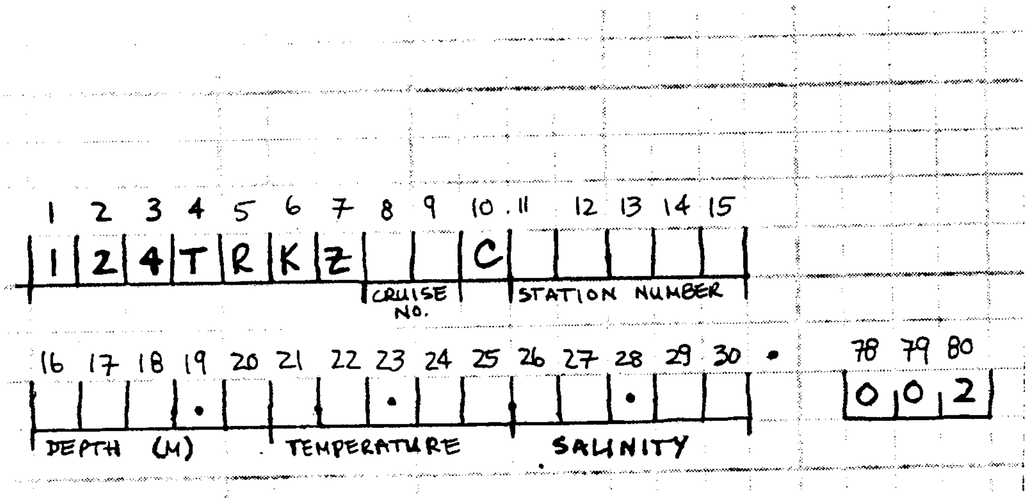
TIME COLL. (GMT) (37 38 39 40): [ ][ ][ ][ ]

STATION DEPTH (M) (41 42 43 44 45): [ ][ ][ ][ ][ ]

SAMPLE INTERVAL (UPPER, THEN LOWER IN M) (46 47 48 49 50 51 52 53): [ ][ ][ ][ ][ ][ ][ ][ ]
UPPER LOWER

CARD SEQUENCE NO IN SAMPLE (78 79 80): [0][0][1]

C. Water Chemistry



D. Gear and Haul Specifics

1	2	3	4	5	6	7
1	2	4	T	R	K	Z

LAB CRUISE NUMBER. 8 9 [ ][ ] RECORD TYPE 10 [D] STATION NUMBER 11 12 13 14 15 [ ][ ][ ][ ][ ] GEAR TYPE 16 17 [ ][ ]

MESH SIZE (IN UM) 18 19 20 21 [ ][ ][ ][ ] HAUL LENGTH (M) 22 23 24 25 [ ][ ][ ][ ] VOLUME OF WATER FILTERED (IN M^3) 26 27 28 29 30 31 [ ][ ][ ][ ][ ][ ]

ORIGINAL SETTLED VOLUME (IN ML) 32 33 34 35 [ ][ ][ ][ ] SETTLED VOLUME (IN ML) VTN 62 63 64 65 [ ][ ][ ][ ]

78	79	80
0	0	3

E-1. Non-copepod Species Counting/Coding Form

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	4	T	R	K	Z			E					

Cruise (8–9) Station (11–15)

Gear Used ________ Mesh Used _____

	NODC Taxonomic Code 20 21 22 23 24 25 26 27 28 29	Subsample 34 35 36 37	Total Count 39 40 41 42
CNIDARIANS			
______ Rathkea octopunctata	3 7 0 3 0 1 0 6 0 1		
______ Euphysa flammea	3 7 0 3 0 3 0 1 0 1		
______ Sarsia ______	3 7 0 3 0 6 0 9		
______ Leuckartiara ______	3 7 0 3 1 2 0 2		
______ Phialidium ______	3 7 0 4 0 1 0 4		
______ *Eutonina indicans	3 7 0 4 1 3 0 3 0 1		
______ Proboscidactyla flavicirrata	3 7 0 5 0 6 0 2 0 1		
______ Aglantha digitale	3 7 1 1 0 1 0 2 0 1		
______ Dimophyes arctica	3 7 1 6 0 1 0 5 0 1		
______ Nanomia ______	3 7 1 7 0 1 0 3		
______ ______			
______ ______			
______ CTENOPHORE- ______	3 8 0		
ANNELIDS			
______ Tomopteris ______	5 0 0 1 2 0 0 1		
MOLLUSCS			
______ Limacina helicina	5 1 1 3 0 1 0 1 0 2		
______ ______	5		
CHAETOGNATHS			
______ Sagitta elegans	8 3 0 0 0 0 0 3 0 3		
______ S. scrippsae	8 3 0 0 0 0 0 3 1 5		
______ S. ______	8 3 0 0 0 0 0 3		
______ Eukrohnia hamata	8 3 0 0 0 0 0 1 0 1		
TUNICATES			
______ Oikopleura ______	8 4 1 3 0 1 0 1		
______ Fritillaria borealis	8 4 1 3 0 2 0 1 0 1		
______ Unidentified larvacean	8 4 1 3		
______ Salpa ______	8 4 1 1 0 1		
CLADOCERANS			
______ Evadne nordmanni	6 1 0 9 0 5 0 1 0 1		
______ Podon ______	6 1 0 9 0 5 0 2		
______ ______	6 1 0		
OSTRACODS			
______ Conchoecia ______	6 1 1 1 0 5 0 1		
______ ISOPOD- ______	6 1 5 8		
______ CUMACEAN ______	6 1 5 4		
AMPHIPODS			
______ Parathemisto pacifica	6 1 7 0 0 1 1 0 0 3		
______ Hyperia ______	6 1 7 0 0 1 0 1		
______ Primno macropa	6 1 7 0 0 4 0 3 0 2		
______ Cyphocaris challengeri	6 1 6 9 3 4 1 1 0 1		
______ ______	6 1		
______ MYSID ______	6 1 5 3 0 1		
EUPHAUSIIDS			
______ Euphausia pacifica	6 1 7 4 0 2 0 1 0 1		
______ Thysanoessa ______	6 1 7 4 0 2 0 9		
______ ______	6 1 7 4		
______ larvae ______	6 1 7 4		
MEROPLANKTON			
______ cirriped ______	6 1 3 4		
______ ______			
______ Decapods ______	6 1		
______ ______	6 1		
______ Fish ______	8		

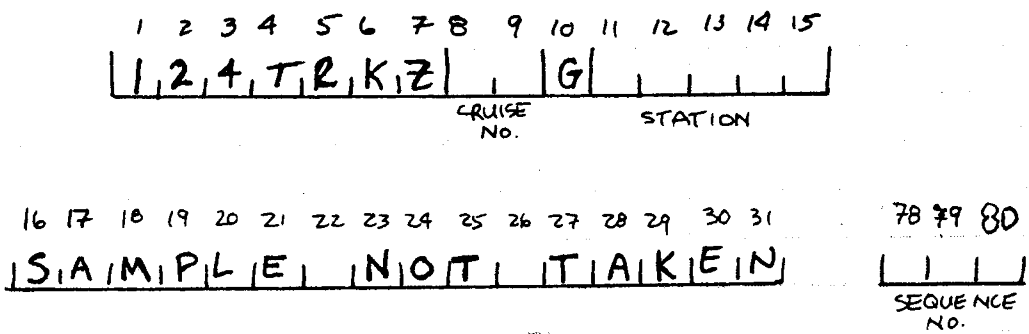
E-2. Expanded Euphausiid Coding Form

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	4	T	R	K	Z			E					
							CRUISE NO			STATION				

34	35	36	37
SUBSAMPLE SIZE			

	20	21	22	23	24	25	26	27	28	29	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
E. pac.	6	1	7	4	0	2	0	1	0	1																				
T. inermis	6	1	7	4	0	2	0	9	0	2																				
inspinata	6	1	7	4	0	2	0	9	0	3																				
longipes	6	1	7	4	0	2	0	9	0	5																				
raschii	6	1	7	4	0	2	0	9	0	6																				
spinifera	6	1	7	4	0	2	0	9	0	7																				
Larvae	6	1	7	4	0	2	0	0	0	0																				
											ADULTS					JUVENILES					LARVAE					EGGS				

F. Comment Cards



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	4	T	R	K	Z			G					

CRUISE NO. STATION NO.

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
S	A	M	P	L	E		N	O	T		C	O	U	N	T	E	D				

78	79	80
0	0	4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	4	T	R	K	E			G					

CRUISE NO. STATION NO.

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	78	79	80
N	O		Z	O	O	P	L	A	N	K	T	O	N		P	R	E	S	E	N	T	0	0	4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	4	T	R	K	Z			G					

CRUISE NO. STATION NO.

16–44: ANIMALS WITH DENSITY = 0 PRES

45–68: ENT BUT NOT QUANTITATIVE

G. Copepod Counting/Coding Form

ZOOPLANKTON COUNTING AND CODING SHEET
(each line = 1 card)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	4	T	R	K	Z			J					

Cruise Station

Gear Used ________ Mesh Used ______

Date Collected ______________ Date Examined ______________ Taxonomist ______________

♀	♂	C		NODC Taxonomic Code (20-29)	Split Size 34353637	Total Count 39404142	ADF 555 234	ADM 555 567	TCP 556 890
			Monstrilloids						
			M. ______	61220201					
			Harpacticoids						
			______	6119					
			______	6119					
			Cyclopoids						
			Oithona helgol.	6120090101					
			O. spinirostris	6120090104					
			Oncaea ______	6120010301					
			______	6120					
			Calanoids						
			Eucalanus bun.	6118030102					
			Pseudocalanus	6118050500					
			Aetideus	61180702					
			Gaetanus	61180710					
			Pareuch.elong.	6118080128					
			Racovitzanus	6118100301					
			Scolecit.minor	6118100504					
			Metridia	6118160200					
			Pleuromamma	61181603					
			C. abdom.	6118170101					
			Candacia col.	6118260102					
			Epilabid.long.	6118270102					
			Acartia clausi	6118290101					
			A. longiremis	6118290103					
			A. tumida	6118290105					
			Tortanus disc.	6118300101					
				6118					
				6118					
				6118					
				6118					
				6118					

♀	♂	5	4	3	2	1	Family Calanidae	NODC Taxonomic Code	Split Size	Total Count	ADF	ADM	5 666 123	4 666 456	3 666 789	2 777 012	1 777 345
							C. cristatus	6118010201									
							C. plumchrus	6118010206									
							C. marshallae	6118010204									
							C. pacificus	6118010205									
							C. tenuicornis	6118010207									
							C. ______	61180102									

(61 - 75)