APPENDIX A

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Appendix A-1

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BIOMASS AND DISTRIBUTION OF FORAGE SPECIES IN PRINCE WILLIAM SOUND

Lewis Haldorson and Thomas C. Shirley
Juneau Center, School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

and

Kenneth C. Coyle
Institute of Marine Sciences
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
Fairbanks, Alaska 99775

INTRODUCTION

Prince William Sound (PWS) is one of the largest areas of protected waters bordering the Gulf of Alaska (GOA), and provides a foraging area for large populations of apex predators including piscivorous seabirds. These avian predators were severely impacted by the *Exxon Valdez* oil spill (EVOS); and many -- especially common murres, marbled murrelets, pigeon guillemots -- suffered population declines that have not recovered to pre-EVOS levels (Agler *et al.* 1994). Piscivorous seabirds in PWS are near the apex of food webs based on pelagic production. They feed on an assemblage of forage species that include several fishes and may also prey on invertebrates such as euphausiids, shrimps and squid. Recovery of apex predator populations in PWS depends on restoration of important habitats and the availability of a suitable forage base. Since the 1970's there apparently has been a decline in populations of apex predators in the pelagic plankton production system, and it is not clear if failure to recover from EVOS-related reductions is due to long-term changes in forage species abundance or to EVOS effects.

Forage species include planktivorous fishes and pelagic invertebrates. Planktivorous fish species that occur in PWS and are known or likely prey of apex predators include Pacific herring *Clupea pallasi* ; Pacific sand lance *Ammodytes hexapterus* (Drury et al. 1981, Springer et al. 1984, Wilson and Manuwal 1984), walleye pollock *Theragra chalcogramma* (Springer and Byrd 1989, Divoky 1981), capelin *Mallotus villosus* , and eulachon *Thaleichthys pacificus* (Warner and Shafford 1981, Baird and Gould 1985). Pelagic invertebrates; including euphausiids, shrimp, mysids, amphipods; are found in the diets of sand lance, capelin and pollock, as well as young salmon (Clausen 1983, Coyle and Paul 1992, Livingston et al. 1986, Straty 1972). When aggregated in sufficient densities, macrozooplankton are fed on directly by marine birds (Coyle et al. 1992, Hunt et al. 1981, Oji 1980).

The research described in this report was part of a program (APEX) designed to determine if prey availability is limiting the recovery of seabird populations that were impacted by the EVOS. The main tool for measuring the distribution and abundance of forage fishes is hydroacoustics. Hydroacoustics can measure horizontal and vertical abundance and biomass at scales not possible by traditional net sampling techniques, and has been used to quantify fish (Thorne et al. 1977, Thorne et al. 1982, Mathisen et al. 1978) and the spatial patterns of a variety of aquatic populations (Gerlotto 1993; Baussant et al. 1993; Simard et al. 1993). In Alaskan waters, acoustics have been used to measure biomass relative to tidally-generated frontal features (Coyle and Cooney 1993) and the relationship between murre foraging, tidal currents and water masses in the southeast Bering Sea (Coyle et al. 1992). Acoustic sampling cannot positively identify the species of targets; consequently, net sampling must be conducted concurrently with acoustics to identify species and to provide size distribution data necessary for biomass estimations.

OBJECTIVES

1. Provide an estimate of the abundance and distribution of forage species in three study areas of Prince William Sound.
2. Describe the species composition of the forage assemblage and size distributions of the most abundant forage species.
3. Provide samples of forage fishes to NMFS for food habits studies, and other samples of forage species to other APEX and EVOS funded researchers.
4. Describe oceanographic conditions in the study area.

FIELD METHODS

Field studies were conducted in the summer (July and August) and in the fall of 1995. Surveys were conducted in three areas designated as the north, central and south study sites (Figure 1). In summer, sampling began in the Central area and had the following sequence:

20 July -	Loaded gear on charter vessels in Cordova
21 - 25 July	Acoustic, bird and trawl sampling the Central study area
26 - 28 July	Acoustic, bird and trawl sampling in the North study area
29 July	In transit
30 - 31 July	Acoustic, bird and trawl sampling in the South study area
1 - 4 August	Acoustic, bird and trawl sampling in the Central area
5 - 7 August	Acoustic, bird and trawl sampling in the North study area
7 August	In transit
8 August	Acoustic, bird and trawl sampling in the South study area
9 - 11 August	Acoustic bird and trawl sampling in Montague Island area
11 August	Acoustic, bird and trawl sampling in Port Gravina
12 August	Off-load gear in Cordova

Within each study site, hydroacoustic data were collected along a series of offshore, parallel, east-west transects spaced at 2.0 nautical mile (nm) intervals; and a series of inshore, zig-zag transects that usually ran between the shoreward ends of the offshore parallel series (Figures 2, 3, 4). Inshore transects are identified by the inclusion of a z in the transect code.

The summer survey was conducted from two vessels, an acoustic/bird observation vessel and a mid-water trawl vessel. Surveys were conducted during daylight hours, typically between 0600 and 2000. The acoustic vessel would acoustically survey a series of transects. Meanwhile, the mid-water trawl vessel collected trawl samples of targets designated by the acoustic vessel and conducted CTD sampling on all transects and at all stations where biological samples were collected.

From 8 October - 15 October additional sampling was conducted in the three study areas, with the following itinerary:

Sept. 29	Equipment and supplies loaded on R/V MEDEIA at Juneau
Oct. 8	Personnel board vessel in Cordova
Oct. 9	Acoustic and net sampling in the Central study area
Oct. 10	Acoustic and net sampling in the Southern study area
Oct. 11	Acoustic and net sampling in the Central study area
Oct. 12	Acoustic and net sampling in the Central study area
Oct. 13	Acoustic and net sampling in the Central and North study areas
Oct. 14	Acoustic and net sampling in the North study area.
Oct. 15	Acoustic and net sampling in the North study area, personnel disembark at Cordova

The fall survey was conducted from a single research vessel equipped for both acoustic and mid-water trawl sampling. Limited time available for fall sampling precluded a complete survey of the three study areas; consequently, the objectives were to investigate the distributional patterns of forage species in selected areas offshore and in nearshore embayments and to collect specimens for food habits and condition studies. This report includes the methods but no results from the fall sampling, as those data are still being analyzed.

Acoustic methods
Data were collected with a 420 kHz Biosonics Model 120-121 echo-integration system. The data were integrated over 1 m depth intervals, corrected for calibration and stored to disk. Standard transects were run at 6 knots with the transducers towed beside the vessel. Both side-look and down-look data were collected. The effective range of the equipment was 65 m from the transducers. All data and analyses in this report are based on transect data using this equipment.

Data were also collected with a 120 kHz DT4000 digital echo-sounder. The echo-sounder failed to function during the first pass through the study area. After repairs, the machine functioned during portions of the second half of the cruise, however, the data contained spikes of around 30 dB in magnitude, data from the bottom of fish schools and below fish schools occasionally blanked out, and secondary bottom reflections occasionally contaminated the data. The digital data set will require extensive editing to remove defective segements; consequently, results from analyses of digital data are not included in this report.

In the July/August cruise, acoustic data were collected on 167 individual transects, most of which were transects in the three study sites that were visited twice each (Table 2).

In the October cruise, acoustic data were collected on the preselected transect lines and at a number of collection sites within bays where concentrations of forage fishes occurred (Table 3).

Net Sampling methods
A mid-water trawl was the primary sampling tool used to sample acoustic targets. This net is a research-scale version of a mid-water commercial trawl used in Canada to catch herring (an important forage fish). Although the absolute net mouth opening is about 100 m2, the effective opening is about 50 m2. This size net has proven effective on larger nektonic forage fishes such as herring (Mike Halstead, Research Nets Inc. Seattle, Personal communication). The mesh sizes diminish stepwise from about 2" in the wings to 3/8" in the codend. An additional cod end liner

with 1/8" mesh netting was sewn into the midwater trawl, this inner liner terminated in a plankton bucket with 0.5 mm nytex mesh that retained smaller macroplanktonic organisms.

In the July/August cruise, midwater trawl samples were collected at locations and depths specified by the researchers monitoring the acoustic sampling. Trawl samples were relatively evenly divided between shallow (< 25 m) and deep (> 25 m) depths with 31 and 29 samples from each, respectively (Table 4).

In the fall cruise the midwater trawl was again used, and, in addition, a 1 M2 NIO (Tucker) trawl was used to collect macrozooplankton. This net had a body and cod end of 0.5 mm mesh and was towed in a double oblique trajectory through depths with targets of interest. Twelve midwater trawl and six NIO net samples were collected in the fall cruise (Table 5).

SAMPLE PROCESSING

MacroInvertebrates.

Macroinvertebrates were preserved in 5 % buffered formalin.,

Fishes

Fish larger than about 50 mm were identified in the field and sorted to species. All fish were measured (fork length) unless net hauls contain large numbers of individuals of some species. Large catches were randomly subsampled by splitting the catch down to 100 - 200 individuals for measurement. Subsamples of all forage fish species were frozen and returned to the laboratory for future life history and energetics studies.

Hydrographic methods

A Seabird SEACAT CTD was used to sample the water column from the surface to 200 m depth, or to within 20 m of the bottom at shallower stations. This instrument has an internal data logger, and recorded conductivity, temperature and depth. In the summer cruise a total of 104 CTD profiles were collected at net collection stations and on each major transect line (Table 6). In the October cruise and additional six stations were sampled (Table 7).

ANALYTICAL AND STATISTICAL METHODS

Biomass estimates were developed by scaling acoustic data based on the length distributions of the dominant fish species collected by mid-water trawl in each study area. Estimates of the number of individual fish per cubic meter are determined by an equation relating acoustic target strength to fish length. The numbers of fish are then converted to an estimate of biomass per cubic meter using the length-weight relationship for the dominant species. Finally, biomass per cubic meter estimates are converted to biomass per square meter of surface by integrating the results over the depth of the sampled water column. Length to target strength relationships were taken from the literature, and the length-weight equations were from our unpublished data in PWS or from literature sources.

A randomization technique was used for statistical analyses. The data were integrated from 65 m depth to 25 m (deep) and from 25 m to the surface (shallow). The shallow and deep data sets from a given region during a survey were linked into a single data string. A random number generator was used to pick starting points in the string. A length of data equal to the average transect length was then extracted and a mean biomass computed. The procedure was repeated until a length equal to the total length of the data set was sampled once and a mean was computed.

The above procedure was repeated 1000 times in a boot-strapping technique. The average of the 1000 runs through the data set was computed, the values for each individual run were ranked; the 25th and 975th values indicate the 0.05 confidence intervals.

Geographic distributions of forage species were assessed by developing area plots of biomass density gradients determined through a kriging routine. The kriging method has a gridding algorithm (we used a minimum curvature algorithm) that estmates the data between transect lines based on estimates of spatial variation along the transect lines. Therefore, the most accurate point estimates are those occurring closest to the lines in regions where transect density is highest. Land masses were overlaid on the area plots after the gridding algorithm had been run.

RESULTS

JULY/AUGUST CRUISE

Hydroacoustic Biomass Estimates - Offshore Transects
Offshore biomass estimates of forage species in PWS varied temporally between surveys, vertically between shallow and deep depth strata, and geographically among the three study areas (Table 8, Figure 5). Biomass estimates increased in the second survey. This trend was most marked in the deep stratum of the North area, where the biomass estimate in the second survey was approximately three times higher than the first survey, although both the Central and South areas also had marked increases in deep strata biomass in the second survey. In the Central and South, biomass in the shallow stratum biomass changed relatively little between surveys, whereas in the North there was an increase in the second survey.

In the first survey there was no consistent variability between depths; as the North and South had higher biomass in shallow depths and the Central area had markedly lower biomass shallow. By the second survey, however, deep strata had the highest biomass in all three study areas, although in the South the difference was minimal.

Geographically, the Central area always had the lowest total biomass, especially in shallow depth stratum. The shallow depth stratum of the Central area was remarkable for the exceptionally low biomass estimate in both surveys. The North area in the second survey had the highest estimates of acoustic biomass in the two surveys.

North - offshore
In the first survey of the North, highest biomass estimates occurred in the Port Fidalgo area (Transects 01 and 02), apparently due to the presence of schools of 1+ age herring (about 150 mm long) in shallow depths, and in the southern end of Valdez Arm (Transect 03), where 1+ pollock occurred in the deep stratum (Table 9) The increase in biomass during the second survey may have been due to increased numbers of adult salmon in shallow depths and large, mature pollock (over 30 cm) that were caught in a midwater trawl sample on the second survey.

Central - offshore
In the Central offshore area there was very little sign of forage species in the shallow stratum, and biomass estimates were low (<0.1 g/m2) in both surveys. In the deep stratum the Central area had notable concentrations of 0+ age pollock in the southernmost transects (Transects 01, 02, 03), and the increase in the biomass estimate in the deep stratum on the second survey appears to have been due to increased size of those schools (Table 10).

South - offshore

In the South, biomass in shallow depths appeared to be comprised mainly of herring of several year classes. Maximum biomass tended to occur on transects crossing Knight Island Passage (Transect 05, Table 11). The biomass in the deep stratum was low, and probably was pollock; although limited catches preclude much certainty in assigning species identifications. Target strengths for the South deep stratum were based on data for pollock.

Hydroacoustic Biomass Estimates -Inshore Transects
The highest total biomass estimates in the summer surveys occurred on the nearshore transects, especially in the Central area on the first survey and the North area on the second survey (Table 12, Figure 6). In the North, high biomass estimates in the second survey were due to consistently high transect means in the Valdez Arm area south of the narrows (Transects VZ4, VZ5, and VZ6, Table 13). In the Central area the elevated biomass estimate in the first survey appears due mainly to a very strong acoustic signal that occurred on one transect (Transect NZ6, Table 14). In the South, nearshore biomass estimates were similar in the two surveys, and were influenced strongly by high mean biomass levels on transects in the Dangerous Passage area (Transects JZ1, JZ3m, Table 15).

HYDROACOUSTIC DISTRIBUTION PATTERNS

North Study Area - First Survey
The North area had highest biomass estimates above 25 m in Port Fidalgo and in parts of Valdez Arm (Figure 7). In the deep stratum there were also concentrations of acoustic targets in those general areas (Figure 8).

Above 25 m (Figure 7) the high biomass south of Bligh Island in Port Fidalgo is comprised of herring schools between km 5 and 12 on Transect V01A (Figure 9), while the less dense biomass on the east end of Port Fidalgo is due to a school of herring at 10 - 15 m depth on the east end of Transect V02A (Figure 10). The patchy occurrence of relatively high biomass areas in shallow depths Valdez Arm is due to the presence of many small but relatively intense acoustic returns from the upper 15 m such as those seen on the west end of V02A and the central part of V03A (Figures 10, 11). These targets could be small herring schools or groups of adult salmon.

From 25 to 65 m there were two areas of high biomass in the first survey of the North area, one in Port Fidalgo and in Valdez Arm west of Bligh Island. The first is due to three small but intense schools of unknown composition near the bottom on transect V01A (Figure 9), while the Valdez Arm concentration is due to a dense school of age 1+ pollock on transect V03A (Figure 11).

North Study Area - Second Survey
Biomass increased in the second survey of the North area in both depth strata. In shallow depths, acoustic biomass was concentrated around Bligh Island and in several locations in the south part of Valdez Arm (Figure 12). The deep biomass was concentrated in an area of Port Fidalgo just to the south of Bidarka Point (Figure 13).

The shallow biomass concentrations found in Valdez Arm were due to very strong acoustic signals from targets in the upper 20 m such as those that occurred on Transects V03A and V06A (Figures 14, 15). Attempts to sample these targets with the midwater trawl were generally futile, and signs of salmon in the area (many jumpers) suggest that many of those shallow targets may have been adult salmon migrating to spawning streams. However, small schools of herring may also have been in the area (a salmon caught in this area by angling had herring in its stomach).

The deep stratum had a notable dense school on Transect V02A in Port Fidalgo (Figure 16). This school was comprised of age 1+ pollock, indicating that, as in the first survey, deep biomass in the North region was mainly age 1+ walleye pollock.

Central Study Area - First Survey
In the Central area, biomass was generally low in the first survey (July 22 - 25), with higher biomass in the deep stratum. This pattern is apparent in an area map of shallow and deep biomass distribution (Figures 17, 18 - note the change in scale for the gray scale).

Above 25 m, most acoustic targets were found east of Knight Island on Transects N01A and N02A (Figures 19, 20) and to the west of Storey Island on the northern edge of the Central area (Transect N11W, Figure 21). Much of the shallow return on N01A and N02A appears to be vertical extensions of the dense schools of 0+ age pollock that are found deep in that area - this is obvious on transect N02A (Figure 20). The shallow returns around Storey Island (N11W, Figure 21) were not identified, but may have been migrating adult salmon.

Below 25 m the dominant forage fishes were 0+ walleye pollock (58 mm long). These fish were loosely concentrated to the east of Knight Island on the southernmost transects. These schools were densest in an area 5 - 10 km east of Knight Island (N02A, Figure 20), but there were notable concentrations further east. The main school to the east of Knight Island apparently was stretched over 10 km north to south (it appears on transect N01A, N02A and N03A, Figures 19, 20, 22) and was 1 - 3 km wide. It extended vertically for at least 30 - 40 m in the water column.

Central Study Area - Second Survey
Biomass levels in the Central area were higher in the second survey, due almost entirely to increases in the deep strata. The depths above 25 m had a distribution similar to the first survey (Figure 23, again note the biomass scale), while the deeper stratum again had schools of fish concentrated to the east of Knight Island (Figure 24).

As in the first survey, the shallow acoustic returns to the south were due vertical extensions of the dense schools of age 0+ pollock found deeper in the southern part of the Central Region (Transects N01A, N02A, Figures 25, 26); whereas shallow returns in the northern part of the Central area were due to small schools of fish near the surface (e.g. Transect N11E, Figure 27) - as in the first survey the identity of those shallow targets was not confirmed.

The increased biomass in the second survey was due largely to increased size and density of schools of age 0+ walleye pollock on transects N01A and N02A (Figures 25, 26), although other schools of 0+ pollock occurred elsewhere, as on Transect N11E where a dense school occurred just above the bottom to the east of Storey Island (Figure 27).

South Study Area - First Survey
On the first survey biomass was lower in the deep stratum, as indicated by the difference in the biomass scales between plots of the shallow and deep biomass distributions (Figures 28, 29). A notable concentration of fish occurs off Dual Head on transect J01A in both depth strata. In shallow depths this was a school of herring that actually occurred just off the fixed transect (J01A) and was recorded on transect J01ex (Figure 30). The scattering of weak targets typical of shallow depths in this area is apparent in the fixed transect J01A (Figure 31). Additional targets were present below the herring school but do not appear on the plot (Figure 30) because their biomass was too low to show up on this scale.

South Study Area - Second Survey
The surface plot of shallow returns in the second survey is dominated by several areas where small dense targets occurred (Figure 32), while the deep stratum had several areas of concentration near

the south end of Dangerous Passage near the shores of Chenega Island (Figure 33).

The shallow returns off the southwest corner of Knight Island were two discrete schools on transects J01E and J05E. Similarily, the strong acoustic signal in Icy Bay is due to a single large target that may have been a discrete school of small fish such as herring.

The deeper targets that were observed on the south end of Dangerous Passage were epibenthic schools of unknown composition that occurred above the bottom in the nearshore parts of the transects J02A and J03A and around a ridge near the center of J02A (Figure 34).

NET SAMPLING

Fishes
Schools of fishes identified on acoustic transects were predominantly walleye pollock and herring. In all areas, walleye pollock were the most abundant fishes in deep strata, while in shallow strata herring were the dominant species in the North and South areas (Tables 16, 17, 18). In the Central area pollock were the dominant species in both shallow and deep strata. Other species that were notable components of catches were capelin, which were found in shallow depths of the Central study area around Naked Island (Table 17); eulachon - found in the deep stratum of the North area (Table 16); and both prowfish and crested sculpin that were found occasionally in samples from all depths and areas (Tables 16, 17, 18).

Walleye pollock in midwater trawl samples had size distributions that clearly identified them as ages 0+ (less than 1 year old, hatched in the spring of 1995) or age 1+ (1 year old, year class 1994, Table 19). Age 0+ pollock are < 100 mm long, wheras age 1+ pollock are typically between 100 and 200 mm, with no overlap between length distributions of the two age classes. The mean size of age 0+ pollock ranged from 58 mm in the Central area to 66 mm in the South (Table 19).

Most herring collected in mid-water trawl samples in the North area were of a length (mean 153 mm) consistent with age 1+. Samples of herring collected in shallow, nearshore areas with dip nets appeared to be 0+ age fish (mean length 77 mm, Table 19). Herring collected in the South area had several length modes, with little overlap between distributions. Apparently several age classes were found in herring schools in the South study area.

Jellyfish
Gelatinous zooplankters (including hydrozoan medusae, scyphozoans and ctenophores) were visually conspicuous and common components of trawl samples in Prince William Sound. Net sampling often damages gelatinous zooplankters so that they are not identifiable, and their distensible form allows smaller specimens to pass through nets. However, because of their potential importance as both prey and predators of other forage species, data were collected on their abundance and distribution in trawl samples. Gelatinous zooplankters were not enumerated to species during the initial transects in each area because of identification problems, but in subsequent sampling were recorded as belonging to Cyanea capillata, Chrysaora melanaster, *Phacellophora camtschatica, Aequorea* sp., hydrozomedusae, ctenophores and unidentified jellyfish.

Gelatinous zooplankters (hereafter collectively referred to as jellyfish) were collected in 55 trawl samples during the summer sampling, with more being present in trawl samples (33 trawl samples) from the Central area than from the North (15 trawl samples) or the South area (7 trawl samples) . Few individual specimens were collected in the South area (69), but large numbers were present in trawls from both the Central (655) and North (492) areas.

Different distributional patterns were present for the species. *Cyanea capillata* was present in all areas but more numerically predominate in the North and South, representing 37%, 9% and 36% of the identified jellyfish in the North, Central and South areas, respectively (Table 20). *Chrysaora melanaster* was more uniformly distributed, constituting 18%, 17% and 27% of the jellyfish in the North, Central and South areas, respectively. *Phacellophora camtschatica* was uncommon to rare in all areas, representing 9%, 3% and 1% of all jellyfish in the North, Central and South areas, respectively. The hydromedusae *Aequorea* sp. perhaps had the most skewed distributional pattern, representing 59% of all jellyfish in the Central area, but only 10% in the North and <1% in the South area. Many small, unidentified hydromedusae were present in the North area but were absent in other areas. Ctenophores were rare in all areas, perhaps due to sampling bias related to their smaller sizes.

Euphausiids

Euphausiids (hereafter referred to as krill) are common macrozooplankton herbivores in Prince William Sound (PWS). Of the 24 krill species that have been reported from the Northeast Pacific Ocean, five were collected in both summer and fall 1995 sampling in PWS; the same five species were collected in the 1994 PWS sampling. *Euphausia pacifica* and four congeneric species, including *Thysanoessa inermis, T. longipes, T. raschii* and *T. spinifera* were collected.

The mid-water trawl used in our sampling did not have an optimum mesh size for efficient collection of krill. However, all species in our collections were of the same approximate size (15-25 mm total length) and we assume sampling biases to be similar for all species. Smaller species and early life history stages may not have been collected with our sampling gear. Also, krill are known to have robust diurnal migration patterns and generally are in the upper water column during the night hours. Most of our trawl sampling was conducted during the daylight hours to coincide with seabird observations, and krill were collected only in deep tows during the summer collections. The shallowest trawl in the summer which contained krill was to 60 m depth. Because our hydroacoustic gear sampled effectively only to 65 m depth, few hydoacoustic targets were identified as krill. All krill collected during the summer months were adults; early life history stages may have passed through the large mesh, but it is also reasonable to expect that krill hatching in April or May would be adults by late July/August.

The most striking pattern of krill distribution during the summer sampling was that no krill were collected in the Central area despite intensive sampling (33 trawl tows) to a variety of depths. The same sampling gear collected five krill species in both the North and South areas (Table 21). During the summer most krill species were present at all sampling sites where krill were collected, however *T. inermis* and *T. longipes* were collected at only two sites. A distribution gradient in abundance of the species appeared to be present: *T. rashii* was numerically abundant in the North area, while *T. spinifera* and *T. inermis* were most abundant in the South area (Table 21). Another impressive attribute of the krill collections in PWS was the variability in species composition between sites. Where multiple samples were collected at the same site, little variability was present.

Some indication of spatial variability in condition of krill was present. The length-weight relationship of *T. spinifera* varied greatly between collections in the North and South area (Figure 35), even though the length range of specimens from the two areas were similar.

The wet weight of the krill individuals varied between 0.112 g for the largest species (*T. spinifera*) and O.040 g for the smallest species (T. rashii); the average *T. rashii* specimen weighs 36% of the average wet weight of the average *T. spinifera* specimen. Despite its smaller size, *T. rashii* was the predominant species by biomass (49%) in the North, while *T. spinifera* was the predominant species by biomass (64%) in the Central and South (65%).

HYDROGRAPHY

Prince William Sound is a large estuary, with large amounts of freshwater input from rainwater and meltwater from glaciers and snowfields. The resultant salinity gradients are largely responsible for stratification of the water column in the Sound. In the summer of 1995 all three study areas had gradients in temperature and salinity in the upper 50 m, with surface temperatures ranging from 12 - 15^{o} C. and salinities from 17 - 30 o/oo (Figures 36, 37, 38). Below about 50 m temperatures were typically <5^{o} C. with salinities above 32 o/oo.

Physical conditions in the three study areas were generally similar, although conditions in the upper 30 m of the water column varied somewhat as the result of differences in the amount and type of fresh water runoff. The Central study area was least influenced by freshwater runoff, and consequently had the highest salinity in surface waters. Both the South and North study areas had lower surface salinity, with lowest salinity in the South, where large amounts of glacial meltwater produced a near-surface layer of very cold (<5^{o} C.) water that was not present in the North (Figures 36, 37, 38).

Over the time period of the two surveys in each study area conditions remained relatively stable. In both the North and Central areas there are indications that the upper 50 m was becoming somewhat fresher and warmer (Figures 36, 37). The South study area showed relatively little change between the surveys, and the upper water column had a marked lens of cold water on both surveys (Figure 38).

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Table 1. Locations of transects and transect lengths in three study areas.

Northeast Area - (East/West Boundaries - Variable)

Transect Number	Latitude	General Location	From/To	Length(NM)
FFV01A	60°46.2'	S Port Fidalgo	shore to 147°0'	13.20
FFV02A	60°8.2'	S Bligh Is.	146°0' to 147°5'	17.05
FFV03LLB	60°0.2'	Landlocked Bay	shore to shore	1.60
FFV03TT	60°0.2'	S Tatitlek Narrows	shore to shore	2.40
FFV03VA	60°0.2'	Bligh Reef	shore to 147°0'	10.30
FFV04BB	60°2.2'	Boulder Bay	shore to shore	1.00
FFV04VA	60°2.2'	E Glacier Is.	shore to shore	9.80
FFV05VA	60°4.2'	Valdez Arm	shore to shore	10.90
FFV05GIW	60°4.2'	W Glacier Is.	shore to 147°0'	2.55
FFV06GBE	60°6.2'	inner Galena Bay	shore to shore	1.50
FFV06GBW	60°6.2'	outer Galena Bay	shore to shore	1.40
FFV06VA	60°6.2'	Valdez Arm	shore to shore	5.50
FFV06CB*	60°56.2'	Columbia Bay ent.	shore to shore	5.25
FFV06LB	60°56.2	Long Bay ent.	shore to shore	1.90
FFV07VA	60°58.2'	Valdez Arm	shore to shore	4.35
FFV08VA	61°00.2'	Valdez Arm	shore to shore	4.10
FFV09VA	61°02.2'	Valdez Arm/Jack B.	shore to shore	5.15
FFV10VN	61°04.2'	Valdez Narrows	shore to shore	1.00
FFV11PV	61°06.2'	Port Valdez	shore to shore	11.30
			TOTAL	110.25

APPENDIX A-13

Table 1. Continued

Central Area - (East/West Boundaries - 147°12.0' to 147°42.0')

Transect Number	Latitude	General Location	From/To	Length(NM)
FFN01A	60°22.3'	N Montague St.	147°12.0' to shore	12.60
FFN02A	60°24.3'	Manning Rocks	147°12.0' to shore	14.45
FFN03A	60°26.3'	N Seal Is.	147°12.0' to shore	12.50
FFN04A	60°28.3'	N Knight Is.	147°12.0' to shore	12.60
FFN05A	60°0.3'	S Smith Is.	147°2.0' to shore	11.90
FFN06A	60°2.3'	N Smith Is.	147°2.0' to shore	10.45
FFN07E	60°34.3'	NE Eleanor Is.	147°2.0' to shore	10.25
FFN07W	60°4.3'	NW Eleanor Is.	shore to 147°2.0'	3.35
FFN08A	60°6.3'	Eleanor Pass.	147°12.0' to 147°42.0'	14.80
FFN09E	60°38.3'	SE Naked Is.	147°12.0' to shore	3.95
FFN09W	60°8.3'	SW Naked Is.	shore to 147°42.0'	7.00
FFN10E	60°0.3'	E Naked Is.	147°12.0' to shore	3.55
FFN10C	60°0.3'	McPherson Bay	shore to shore	1.80
FFN10W	60°0.3'	W Naked Is.	shore to 147°42.0'	7.35
FFN11E	60°2.3'	E Peak Is.	147°12.0' to shore	4.70
FFN11W	60°2.3'	W Peak Is.	shore to 147°42.0'	8.40
FFN12E	60°4.3'	E Storey Is.	147°12.0' to shore	5.35
FFN12W	60°4.3'	W Storey Is.	shore to 147°42.0'	7.80
			TOTAL	152.80

APPENDIX A-14

Table 1. Continued

Southwest Area - (East/West Boundaries - 148°05.0' / 148°16.0')

Transect Number	Latitude	General Location	From/To	Length(NM)
FFJ01E	59°5.0'	Whale Bay Entr.	148°5' to shore	2.96
FFJ01W	59°5.0'	Icy Bay	shore to shore	1.30
FFJ02A	59°7.0'	lower Dang. Pass.	shore to shore	3.66
FFJ03A	59°9.0'	S. Jackpot Is.	shore to shore	1.82
FFJ04A	59°21.0'	Dangerous Pass.	shore to shore	1.14
			TOTAL	10.88

Zigzags near shore — Northeast Area

Transect Number	Length
FFVZ1S	<1 fragments
FFVZ1N	1.1
FFVZ2S	runs through foul ground
FFVZ2N	1.5
FFVZ3S	2.1
FFVZ3N	<1
FFVZ4S	<1
FFVZ4N	1.0
FFVZ5S	1.0
FFVZ5N	<1
FFVZ6S	3.1
FFVZ6N	1.0
FFVZ7S	1.2
FFVZ7N	1.2
TOTAL	13.2

Table 1. Continued

Zigzags near shore

Central Area

Transect Number	Length
FFNZ1S	1.1
FFNZ1N	1.9
FFNZ2S	1.1
FFNZ2N	1.1
FFNZ3S	1.65
FFNZ3N	1.0
FFNZ4S	2.0
FFNZ4N	1.1
FFNZ5S	2.4
FFNZ5N	3.4
FFNZ6S	1.4
FFNZ6N	1.9
TOTAL	20.05

Southwest Area

Transect Number	Length
FFJZ1S	1.3
FFJZ1N	1.5
FFJZ2S	<1.0
FFJZ2N	<1.0
FFJZ3S	1.9
FFJZ3N	1.3
TOTAL	6.0

APPENDIX A-16

Table 2. Acoustic transects sampled on APEX cruise 95-1 in Prince William Sound.

TRANSECT	DATE	TIME START	LAT START	LONG START	TIME END	LAT END	LONG END
ffnz1s	21-Jul	11:39:40	60 25.62	147 45.31	11:50:44	60 26.03	147 39.92
ffnz2s	21-Jul	17:24:20	60 29.85	147 45.87	17:36:00	60 29.21	147 43.42
ffnz2e	21-Jul	17:51:16	60 30.75	147 40.70	18:02:26	60 30.29	147 38.89
ffn01a	22-Jul	9:13:16	60 26.27	147 14.01	11:38:24	60 25.21	147 45.21
ffn02a	22-Jul	12:26:07	60 27.10	147 41.56	14:50:26	60 26.68	147 13.93
ffnz3s	22-Jul	13:01:43	60 33.34	147 36.35	13:19:22	60 33.94	147 39.21
ffn03a	22-Jul	15:10:41	60 28.61	147 12.47	17:21:43	60 29.03	147 43.26
ffnz2n	22-Jul	17:37:09	60 30.04	147 43.62	17:49:52	60 30.05	147 39.70
ffn04a	23-Jul	8:08:22	60 30.79	147 38.34	10:31:18	60 31.45	147 13.03
ffn08a	23-Jul	8:19:03	60 38.61	147 44.02	11:33:00	60 39.70	147 13.83
ffn08e	23-Jul	9:38:33	60 41.00	147 36.40	10:08:25	60 39.11	147 29.12
ffn05a	23-Jul	10:52:27	60 32.18	147 13.07	12:59:32	60 33.19	147 42.42
ffn09e	23-Jul	11:57:44	60 40.39	147 12.98	12:42:53	60 40.65	147 23.71
ffnz3n	23-Jul	13:20:26	60 34.81	147 38.62	13:29:43	60 33.90	147 34.64
ffn06a	23-Jul	13:31:19	60 34.90	147 41.41	15:40:17	60 35.92	147 13.24
ffn06e	23-Jul	14:42:28	60 36.01	147 28.26	14:44:29	60 34.89	147 28.93
ffn07e	23-Jul	16:14:28	60 35.25	147 17.22	18:05:43	60 37.07	147 39.45
ffnz5s	23-Jul	17:26:34	60 43.24	147 31.04	17:48:53	60 42.96	147 31.76
ffn07w	23-Jul	19:08:42	60 37.16	147 39.91	19:42:31	60 36.76	147 49.08
ffn12e	24-Jul	9:55:47	60 46.78	147 28.97	10:52:54	60 46.25	147 14.21
ffn11e	24-Jul	11:12:54	60 45.22	147 13.90	11:55:34	60 44.82	147 27.14
ffn11x	24-Jul	11:57:19	60 45.95	147 29.10	12:08:55	60 45.31	147 24.80
ffn09w	24-Jul	13:44:15	60 40.07	147 29.27	14:54:09	60 41.32	147 49.32
ffnz6s	24-Jul	14:53:48	60 48.35	147 21.34	15:04:03	60 45.18	147 22.09
ffn11w	24-Jul	15:23:50	60 44.54	147 49.36	16:46:15	60 45.33	147 27.33
ffnz5n	24-Jul	17:07:31	60 50.99	147 29.24	17:24:55	60 44.27	147 32.64
ffn10w	24-Jul	17:51:25	60 42.70	147 32.34	19:03:20	60 42.47	147 49.28
ffv01a	25-Jul	7:55:21	60 47.29	146 37.24	10:33:28	60 47.99	146 67.63
ffn12w	25-Jul	8:05:59	60 46.51	147 49.55	9:25:43	60 47.05	147 31.35
ffv01x	25-Jul	8:09:14	60 48.45	146 36.43	8:27:44	60 47.61	146 43.96
ffv02a	25-Jul	11:02:46	60 49.59	147 12.99	15:30:23	60 50.86	146 31.63
ffv02x	25-Jul	12:36:00	60 49.98	146 52.77	12:43:49	60 50.56	146 51.85
ffnz6n	25-Jul	15:04:58	60 45.76	147 22.28	15:23:06	60 46.30	147 27.51
ffv03tt	25-Jul	17:51:18	60 51.74	146 44.09	18:09:58	60 52.33	146 49.23
ffvz2n	26-Jul	14:30:31	60 61.99	146 48.78	14:44:10	60 56.15	146 50.83
ffv02x2	26-Jul	15:33:52	60 51.59	146 35.44	15:52:54	60 54.34	146 35.17
ffv03llb	26-Jul	17:02:21	60 52.60	146 39.65	17:14:32	60 52.20	146 36.09
ffvz3s	27-Jul	8:03:29	60 58.03	146 38.91	8:20:48	60 63.87	146 48.20
ffv07va	27-Jul	9:03:07	60 59.95	146 46.81	9:44:57	60 59.55	146 59.53
ffv03va	27-Jul	9:08:01	60 52.21	146 54.39	10:47:34	60 52.13	147 16.51
ffv08va	27-Jul	10:22:51	61 01.07	146 50.83	11:08:04	61 02.35	146 43.71
ffvz5s	27-Jul	11:09:04	61 03.21	146 50.71	11:19:28	61 02.62	146 42.84
ffv04va	27-Jul	11:14:21	60 53.82	147 10.20	12:46:37	60 55.05	146 47.67

Table 2. Continued

TRANSECT	DATE	TIME START	LAT START	LONG START	TIME END	LAT END	LONG END
ffv09va	27-Jul	11:42:50	61 03.78	146 45.96	12:41:48	61 05.44	146 54.19
ffvz6s	27-Jul	13:36:00	61 05.03	146 47.97	14:03:48	61 04.45	146 46.75
ffvz7s	27-Jul	14:34:46	61 07.47	146 47.73	14:47:10	61 06.46	146 42.06
ffv05va	27-Jul	15:15:46	60 56.59	146 46.73	18:12:25	60 58.16	146 50.52
ffv06gbe	28-Jul	7:49:12	60 57.92	146 46.04	8:01:58	60 58.24	146 38.31
ffv06gbw	28-Jul	8:29:35	60 58.40	146 42.73	8:41:41	60 58.54	146 42.84
ffvz4nx	28-Jul	10:00:02	60 60.64	146 53.06	10:09:38	60 62.80	146 59.76
ffvz4n	28-Jul	10:10:24	60 63.15	146 59.08	10:21:47	61 00.89	146 51.87
ffv09vax	28-Jul	11:58:53	61 03.78	146 42.33	12:05:50	61 04.29	146 48.90
ffvz6n	28-Jul	14:04:41	61 04.73	146 45.84	14:16:29	61 05.01	146 49.46
ffv10vn	28-Jul	14:17:46	61 05.74	146 48.24	14:24:55	61 04.92	146 44.75
ffvz7n	28-Jul	14:48:17	61 07.38	146 41.62	14:59:45	61 07.47	146 46.45
ffv11pv	28-Jul	15:00:52	61 07.94	146 45.16	16:54:58	61 07.18	146 24.76
ffj04a	29-Jul	8:30:50	60 29.33	148 07.15	8:38:56	60 21.44	148 11.77
ffjz3s	29-Jul	8:56:09	60 20.16	148 17.54	9:13:15	60 19.86	148 17.50
ffj03a	29-Jul	9:14:11	60 19.15	148 17.52	9:30:33	60 27.40	148 13.75
ffj02a	29-Jul	9:58:49	60 17.25	148 15.45	10:32:34	60 25.84	148 17.29
ffjz1s	29-Jul	10:50:44	60 24.19	148 22.00	10:55:37	60 21.08	148 19.01
ffj01e	29-Jul	13:09:09	60 15.13	148 10.29	14:06:26	60 23.24	147 62.94
ffj05e	29-Jul	14:38:37	60 21.52	147 56.93	15:33:16	60 21.31	148 05.90
ffjz4s	29-Jul	16:39:49	60 12.22	148 09.02	16:50:44	60 11.75	148 15.08
ffj06a	29-Jul	16:57:49	60 19.69	148 07.09	17:07:51	60 11.55	148 07.16
ffjz5s	29-Jul	17:19:29	60 18.83	148 10.68	17:29:36	60 09.69	148 12.07
ffj07a	29-Jul	17:31:17	60 17.97	148 13.94	17:35:13	60 10.26	148 11.56
ffjz3n	30-Jul	8:40:07	60 29.97	148 13.25	8:55:19	60 20.78	148 16.51
ffjz1n	30-Jul	10:40:16	60 22.41	148 18.24	10:49:52	60 24.86	148 20.80
ffj01ex	30-Jul	11:35:45	60 22.74	148 17.72	11:49:08	60 20.45	148 18.95
ffj05ex	30-Jul	15:40:01	60 13.01	148 05.46	16:06:12	60 21.34	148 05.95
ffjz4n	30-Jul	16:28:19	60 21.10	148 05.70	16:38:56	60 12.94	148 08.02
ffjz5n	30-Jul	17:08:51	60 19.99	148 06.01	17:18:35	60 10.64	148 10.13
2fn01a	1-Aug	8:54:25	60 24.80	147 14.29	11:01:16	60 25.05	147 44.21
2fnz1s	1-Aug	11:01	60 22.38	147 36.86	11:12:00	60 23.37	147 36.41
2fn012a	1-Aug	11:46	60 24.21	147 40.74	14:30:00	60 24.40	147 12.00
2fn03a	1-Aug	14:48	60 26.27	147 11.98	16:53:00	60 26.35	147 36.90
2fnz2s	1-Aug	16:53	60 26.35	147 36.90	17:05:00	60 27.33	147 35.88
2fnz2n	1-Aug	17:05	60 27.33	147 35.88	17:17:00	60 28.27	147 37.19
2fn04a	2-Aug	8:07	60 28.29	147 36.97	10:09:00	60 28.19	147 12.86
2fn05a	2-Aug	10:35	60 30.35	147 11.97	12:26:00	60 30.36	147 35.99
2fnz3s	2-Aug	12:26	60 30.36	147 35.99	12:44:00	60 31.28	147 33.42
2fnz3n	2-Aug	12:44	60 31.28	147 33.42	12:55:00	60 32.25	147 32.86
2fn06a	2-Aug	12:55	60 32.25	147 32.86	17:54:00	60 32.45	147 12.03
2fn07e	2-Aug	18:14	60 34.26	147 11.94	19:54:00	60 34.35	147 32.88
2fn10c	3-Aug	8:09:36	60 43.25	147 31.52	8:20:50	60 46.37	147 28.10
2fn07w	3-Aug	8:13	60 34.24	147 35.66	8:46:00	60 34.31	147 41.87
2fn10e	3-Aug	8:35:38	60 42.79	147 27.81	9:16:35	60 42.36	147 13.50
2fn08a	3-Aug	9:09	60 36.21	147 41.97	14:20:00	60 36.30	147 12.00
2fn11e	3-Aug	9:40:35	60 44.55	147 13.65	10:26:17	60 45.74	147 22.81

Table 2. Continued

TRANSECT	DATE	TIME START	LAT START	LONG START	TIME END	LAT END	LONG END
2fnz6s	3-Aug	10:33:35	60 47.26	147 23.42	10:45:24	60 45.71	147 24.97
2fn08ax	3-Aug	10:43	60 36.96	147 26.71			
2fn12e	3-Aug	11:03:31	60 47.28	147 25.88	11:58:18	60 46.27	147 13.22
2fn09e	3-Aug	14:42	60 38.30	147 12.22	15:17:00	60 38.34	147 19.19
2fnz4n	3-Aug	15:17	60 39.29	147 19.19	15:36:00	60 39.29	147 16.49
2fnz4s	3-Aug	15:36	60 39.29	147 16.49	16:08:00	60 40.28	147 18.70
2fnz4nx	3-Aug	16:08	60 40.28	147 18.70			
2fnz5n	3-Aug	16:14:10	60 47.54	147 32.17	16:34:56	60 44.45	147 32.64
2fnz5s	3-Aug	16:35:48	60 43.64	147 33.12	16:56:21	60 42.84	147 30.95
2fn10ex	4-Aug	8:28:24	60 46.54	147 24.45	8:32:19	60 43.46	147 20.47
2fv01a	4-Aug	9:41:53	60 48.06	146 64.75	11:50:53	60 48.10	146 38.13
2fn11ex	4-Aug	10:27:07	60 45.99	147 23.62	10:31:09	60 46.87	147 23.71
2fnz6n	4-Aug	10:46:14	60 46.40	147 24.22	11:02:16	60 46.59	147 25.70
2fv02a	4-Aug	12:19:40	60 50.22	146 38.22	15:16:07	60 50.56	147 12.06
2fn12w	4-Aug	12:56:31	60 46.86	147 31.04	14:12:35	60 47.52	147 49.30
2fv02x	4-Aug	13:53:43	60 56.61	146 54.29	13:54:57	60 56.60	146 54.65
2fn11w	4-Aug	14:33:42	60 45.44	147 49.66	16:03:22	60 45.57	147 30.88
2fv03a	4-Aug	15:47:00	60 52.26	147 17.89	17:31:02	60 56.46	146 54.70
2fn10w	4-Aug	16:57:28	60 42.58	147 31.87	18:02:59	60 42.96	147 49.04
2fn09w	4-Aug	18:21:17	60 41.49	147 42.72	19:29:03	60 40.63	147 29.48
2fv03tt	4-Aug	18:31:02	60 51.98	146 47.79	18:45:49	60 51.95	146 45.00
2fvz2n	5-Aug	13:25:02	60 62.64	146 46.22	13:36:34	60 56.00	146 51.04
2fv06va	5-Aug	14:08:45	60 57.73	146 51.36	15:02:19	60 57.46	146 59.77
2fv07va	5-Aug	15:35:42	60 59.39	146 59.42	16:16:53	60 60.23	146 47.93
2fvz3s	5-Aug	17:02:18	60 63.30	146 41.01	17:26:19	60 57.31	146 38.42
2fv06gbe	5-Aug	17:27:28	60 56.92	146 38.49	17:39:12	60 57.61	146 44.74
2fv03ax	5-Aug	17:32:57	60 54.95	146 54.08	17:52:58	60 56.27	146 50.30
2fv03llb	5-Aug	19:12:16	60 51.36	146 38.36	19:26:12	60 52.85	146 37.82
2fv08va	6-Aug	7:59:59	61 01.65	146 57.81	8:38:27	61 02.57	146 45.65
2fvz5s	6-Aug	8:39:26	61 02.84	146 44.35	8:50:11	61 02.10	146 42.60
2fv04va	6-Aug	9:07:53	60 54.67	146 52.54	10:47:16	60 54.03	147 08.57
2fv05va	6-Aug	11:11:54	60 55.53	147 09.87	13:48:50	60 57.28	146 54.44
2fv05vax	6-Aug	12:47:16	60 62.42	146 49.15	13:18:05	60 62.53	146 46.97
2fvz7s	6-Aug	14:01:41	61 06.51	146 41.63	14:14:31	61 07.03	146 42.41
2fvz6s	6-Aug	14:44:37	61 04.40	146 42.34	15:15:55	61 04.50	146 55.69
2fv09va	6-Aug	15:17:01	61 04.55	146 54.60	16:06:33	61 04.19	146 38.75
2fv06gbw	6-Aug	16:38:33	60 58.54	146 44.53	16:47:36	60 57.85	146 44.96
2fvz4v	7-Aug	7:48:17	60 60.68	146 59.22	7:58:59	61 01.25	146 50.43
2fj04a	7-Aug	8:41:43	60 29.88	148 07.76	8:48:31	60 21.38	148 11.48
2fjz3n	7-Aug	8:49:22	60 21.09	148 12.90	9:03:03	60 20.91	148 11.75
2fjz3s	7-Aug	9:04:01	60 20.45	148 13.28	9:22:49	60 20.13	148 17.25
2fj03a	7-Aug	9:23:43	60 19.50	148 16.43	9:38:58	60 27.47	148 13.25
2fj02x	7-Aug	10:22:37	60 19.56	148 15.14	10:28:13	60 20.56	148 15.87
2fj02a	7-Aug	10:32:56	60 17.36	148 14.58	11:06:24	60 25.61	148 15.99
2fjz1n	7-Aug	11:07:21	60 25.40	148 17.22	11:25:10	60 24.90	148 23.56
2fjz1s	7-Aug	11:26:05	60 24.33	148 24.50	11:32:07	60 19.55	148 20.94
2fv11pv	7-Aug	11:53:39	61 07.56	146 24.78	13:47:18	61 08.83	146 44.96
2fj01e	7-Aug	12:15:40	60 23.49	148 14.42	13:15:05	60 23.81	147 63.74
2fj05e	7-Aug	13:46:39	60 21.85	147 56.38	14:37:28	60 21.98	148 06.01

Table 2. Continued

TRANSECT	DATE	TIME START	LAT START	LONG START	TIME END	LAT END	LONG END
2fvz7n	7-Aug	13:48:32	61 07.90	146 44.36	14:00:40	61 07.20	146 41.53
2fv10vn	7-Aug	14:15:39	61 06.47	146 44.24	14:22:01	61 05.43	146 48.02
2fvz6n	7-Aug	14:23:05	61 04.71	146 49.08	14:30:58	61 05.95	146 43.84
2fvz6sx	7-Aug	14:38:14	61 04.42	146 50.55	14:43:37	61 04.20	146 50.81
2fjz4s	7-Aug	14:51:23	60 21.98	148 06.25	15:03:06	60 21.98	148 06.25
2fj06a	7-Aug	15:04:26	60 21.98	148 06.25	15:13:56	60 19.68	148 06.90
2fjz5s	7-Aug	15:24:28	60 18.74	148 12.07	15:33:29	60 09.83	148 11.01
2fj07a	7-Aug	15:34:24	60 09.44	148 11.99	15:39:03	60 09.17	148 11.59
2fj05w	7-Aug	16:33:54	60 13.25	148 13.57	16:46:47	60 21.97	148 12.31
2fj04a	8-Aug	8:41:43	60 29.88	148 07.76	8:48:31	60 21.38	148 11.48
2fjz3n	8-Aug	8:49:22	60 21.09	148 12.90	9:03:03	60 20.91	148 11.75
2fjz3s	8-Aug	9:04:01	60 20.45	148 13.28	9:22:49	60 20.13	148 17.25
2fj03a	8-Aug	9:23:43	60 19.50	148 16.43	9:38:58	60 27.47	148 13.25
2fj02x	8-Aug	10:22:37	60 19.56	148 15.14	10:28:13	60 20.56	148 15.87
2fj02a	8-Aug	10:32:56	60 17.36	148 14.58	11:06:24	60 25.61	148 15.99
2fjz1n	8-Aug	11:07:21	60 25.40	148 17.22	11:25:10	60 24.90	148 23.56
2fjz1s	8-Aug	11:26:05	60 24.33	148 24.50	11:32:07	60 19.55	148 20.94
2fj01e	8-Aug	12:15:40	60 23.49	148 14.42	13:15:05	60 23.81	147 63.74
2fj05e	8-Aug	13:46:39	60 21.85	147 56.38	14:37:28	60 21.98	148 06.01
2fjz4n	8-Aug	14:39:02	60 21.98	148 06.25	14:50:28	60 21.98	148 06.25
2fjz4s	8-Aug	14:51:23	60 21.98	148 06.25	15:03:06	60 21.98	148 06.25
2fj06a	8-Aug	15:04:26	60 21.98	148 06.25	15:13:56	60 19.68	148 06.90
2fjz5n	8-Aug	15:14:49	60 19.37	148 06.13	15:23:38	60 10.14	148 11.63
2fjz5s	8-Aug	15:24:28	60 18.74	148 12.07	15:33:29	60 09.83	148 11.01
2fj07a	8-Aug	15:34:24	60 09.44	148 11.99	15:39:03	60 09.17	148 11.59
2fj05w	8-Aug	16:33:54	60 13.25	148 13.57	16:46:47	60 21.97	148 12.31
flock10	10-Aug	13:29:50	60 47.65	147 21.91	13:46:29	60 46.95	147 26.14
rocky1	10-Aug	17:34:44	60 27.99	147 09.60	19:22:59	60 28.53	147 10.58

APPENDIX A-19

Table 3. Locations and times of acoustic transects on APEX research cruise 95-2 in Prince William Sound.

DATE	TRANSECT	START TIME	START LAT.	START LONG.	END TIME	END LAT.	END LONG.
9-Oct	3FN01A	10:40	60 22.38	147 11.81			
9-Oct	3FN02A	16:56	60 24.2	147 11.9	18:05	60 24.19	147 26.66
10-Oct	3FJ05E	10:05	60 12.58	147 52.07	11:06	60 12.80	148 04.90
11-Oct	3FN03A	13:38	60 26.534	147 11.610	15:40	60 26.42	147 36.59
11-Oct	CENTRAL AREA	22:49	60 21.74	147 27.31	23:08	60 22.739	147 25.702
12-Oct	3FN06A	10:43	60 33.45	147 32.33			
12-Oct	CENTRAL AREA	11:47	60 32.41	147 19.48			
12-Oct	FORAGING FLOCK	12:01	60 32.16	147 20.19			
12-Oct	CENTRAL AREA	12:04	60 32.35	147 20.13	12:53	60 32.19	147 11.89
13-Oct	3FNZ45X	10:44	60 37.44	147 19.67	11:18	60 36.85	147 19.99
13-Oct	Galena Bay	20:48	60 55.93	146 36.58	21:31	60 57.22	146 43.04
14-Oct	3FVO2A	11:20	60 48.18	147 04.97			
14-Oct	FORAGING FLOCK	12:29	60 47.97	146 50.61	14:09	60 48.2	146 29.91
14-Oct	TWO MOON BAY	14:12	60 48.16	146 29.64	14:45	60 45.29	146 33.58
14-Oct	PORT FIDALGO	20:45	60 44.96	146 33.56	21:12	60 46.92	146 33.01
14-Oct	LANDLOCKED BAY	22:49	60 48.281	146 35.62	23:10	60 50.57	146 35.25
15-Oct	FORAGING FLOCK	10:40	60 44.746	146 44.134			
15-Oct	3FV14W	11:59	60 40.09	146 45.00			
15-Oct	FORAGING FLOCK	12:45	60 39.99	146 35.36			
15-Oct	FORAGING FLOCK	13:01	60 40.00	146 34.96			
15-Oct	3FV14W	13:21	60 40.02	146 34.71	13:34	60 40.03	146 32.20
15-Oct	3FV14E	14:05	60 40.14	146 25.66	15:07	60 40.22	146 13.43

APPENDIX A-20

Table 4. Midwater trawl samples collected on APEX cruise 95-1 in Prince William Sound.

DATE	START TIME	END TIME	STATION	TRANSECT/LOCATION	LATITUDE START	LONGITUDE START	LATITUDE END	LONGITUDE END	BOTTOM DEPTH	FISHING DEPTH
21-Jul	16:40	17:05	1	NE Montague	60 13.56	147 29.01			130	50-60
22-Jul	9:25	9:48	2	NW side of Montague	60 19.19	147 29.69	60 20.35??	147 28.49	120	16
22-Jul	12:23	13:09	3	Btw Applegate and Knight Is	60 22.31	147 29.66	60 22.11	147 34.08	162	60
22-Jul	14:35	15:12	4	Transect FFN02A	60 24.21	147 31.24	60 24.18	147 27.27	146	40-60
22-Jul	17:04	17:40	5	FFN03A; NW of Seal Is.	60 26.15	147 30.66	60 25.666	147 34.086	174	50-60
23-Jul	9:37	10:04	6	FFN04A	60 28.428	147 29.248	60 28.556	147 26.994	172	60
24-Jul	10:15	10:36	11	N. of FFNO8A; SW Naked Is.	60 36.771	147 27.516	60 36.941	147 29.474	20-50	6
24-Jul	10:53	11:14	11	N. of FFNO8A; SW Naked Is.	60 37.00	147 29.768	60 36.893	147 27.715	20-70	12
25-Jul	15:37	16:09	19	FFNZ6N; E. of Liljegren Pass	60 43.58	147 19.65	60 42.22	147 18.74	70-130	50
26-Jul	10:15	10:36	22	FFV01A; S. of Bligh Is.	60 46.40	146 45.58	60 46.23	146 47.45	185-200	20-30
26-Jul	11:07	11:26	22	FFV01A; S. of Bligh Is.	60 46.22	146 48.15	60 46.36	146 46.06	166-185	15-20
26-Jul	16:16	16:58	25	FFV02A; S. of Bligh Is.	60 47.80	146 43.98	60 47.88	146 44.99	65-90	10 - 20
26-Jul	18:10	18:24	26	FFV02A; S. of Graveyard Pt.	60 48.38	146 32.78	60 48.35	146 34.18	40	10
27-Jul	9:06	9:49	28	FFV02A, S.E. Bligh Is.	60 47.63	146 43.58	60 48.02	146 44.08	137-160	50
27-Jul	10:57	11:41	29	FFV03VA, W of Bligh Reef	60 50.94	146 56.29	60 50.78	146 56.77	120-160	80
28-Jul	8:45	9:10	35	Outer Galena Bay	60 56.278	146 41.399	60 57.710	146 43.666	200-220	90-110
30-Jul	12:37		43	Whale Bay near Dual Head	60 13.84	148 11.56	60 14.821	148 10.747	120-200	8 - 10
30-Jul	16:07	16:20	47	FFJ05E; Pt. Countess	60 12.914	148 04.986	60 12.321	148 05.423	80-120	10
31-Jul	9:04	9:29	50	NE. of Pt. Countess	60 14.504	148 07.708	60 14.28	148 09.76	288-380	50-60
31-Jul	11:15	11:49	50	NE. of Pt. Countess	60 15.898	148 09.913	60 14.564	148 07.555	240-320	50-60
31-Jul	13:04	13:17	52	E. of Bainbridge Pt.	60 11.072	148 02.209	60 11.76	148 02.135	80-130	20
1-Aug	9:17	9:37	53	FFN01A; E. end of transect	60 22.308	147 15.217	60 22.416	147 13.219	110	50-60
1-Aug	9:55	10:34	53	FFN01A	60 22.64	147 11.49	60 22.305	147 15.516	110	20
1-Aug	12:14	12:36	54	FFN01A; E. of Knight Is.	60 22.477	147 29.583	60 22.535	147 27.291	130-160	60
1-Aug	13:40	14:18	55	FFN02A	60 24.375	147 29.666	60 24.468	147 25.533	80-146	10
1-Aug	15:27	15:51	56	FFN03A	60 26.241	147 16.158	60 26.296	147 18.266	200	80
1-Aug	17:30	17:57	57	FFN03A	60 26.331	147 29.559	60 26.625	147 26.819	160	75-80
2-Aug	9:25	9:54	58	FFN04A	60 28.04	147 29.09	60 28.369	147 25.647	170	75-80
2-Aug	14:28	14:55	62	FFN07A	60 35.274	147 29.678	60 36.639	147 29.051	80-200	15-20
2-Aug	15:16	15:59	62	FFN07A	60 36.667	147 29.171	60 36.245	147 26.300	70-120	50-60
3-Aug	10:27	10:49	64	FFN08A	60 36.245	147 33.589	60 36.160	147 30.922	250-320	7
3-Aug	14:49	15:30	66	E. end of FFN08A	60 36.343	147 14.880	60 35.94	147 12.190	120-190	7
3-Aug	17:06	17:35	67	E. of Peak Is.	60 41.356	147 20.636	60 40.29	147 18.419	20-40	7
4-Aug	10:45	11:24	72	E.of Liljegren Passage	60 43.792	147 20.909	60 42.613	147 20.387	80-90	12
4-Aug	11:56	12:43	73	E.of Liljegren Passage	60 43.940	147 21.697	60 44.264	147 21.674	70-80	90-140
5-Aug	13:04	13:43	81	W. end of FFV01A	60 46.414	146 33.445	60 46.535	146 33.165	60-80	50-70
5-Aug	14:25	15:12	82	FFV02A; E. of Graveyard Pt.	60 48.287	146 35.539	60 48.052	146 40.199	100-140	80-100
5-Aug	17:29	18:02	84	S. of Bligh Is.	60 47.850	146 45.039	60 48.310	146 49.213	20-25	5 - 15
5-Aug	18:38	19:08	84	S. of Bligh Is.	60 48.28	146 49.438	60 48.672	146 50.059	40-60	15-20
6-Aug	12:51	13:17	87	off of SW tip of Bligh Is.	60 48.277	146 49.656	60 48.138	146 48.778	20-50	15-20
6-Aug	15:52	17:06	87	off of SW tip of Bligh Is.	60 48.011	146 49.823	60 47.927	146 49.460	30-50	20-30
7-Aug	8:33	9:03	93	Galena Bay	60 56.338	146 40.871	60 57.278	146 43.097	200-220	100-110
7-Aug	9:32	10:17	93	Galena Bay	60 56.334	146 41.600	60 58.024	146 44.061	200-240	160-180
7-Aug	14:08	14:37	94	E. of Storey Is.	60 41.531	147 21.085	60 42.112	146 20.657	40-100	12
7-Aug	15:58	16:30	94	E. of Storey Is.	60 41.057	147 21.800	60 42.331	147 20.399	30-50	15-20
8-Aug	13:20	13:53	100	Dual Head, Whale Bay	60 15.085	148 09.583	60 15.09	148 10.626	320-340	8
8-Aug	17:21	17:46	104	Bainbridge Passage	60 09.098	148 06.366	60 10.302	148 05.937	140	85-90
8-Aug	20:16	20:33	107	S. of Pt. Helen (Knight I.)	60 09.342	147 45.055	60 08.613	147 45.619	50-70	15-20
8-Aug	21:57	22:22	108	N. of Hogan Bay	60 11.574	147 43.306	60 12.802	147 42.094	25-50	15
9-Aug	8:59	9:42	109	E. of Discovery Pt.	60 14.159	147 41.429	60 12.205	147 42.696	50-70	30-50
10-Aug	10:09	10:34	111	off of SW tip of Naked Is.	60 36.956	147 29.751	60 36.790	147 27.982	50-100	15
10-Aug	11:44	12:27	111	off of SW tip of Naked Is.	60 36.648	147 28.172	60 36.680	147 27.421	30-80	15-60
10-Aug	13:13	13:44	112	S. of Naked Is.	60 36.538	147 19.616	60 35.943	147 22.413	80-140	80
10-Aug	15:11	15:40	113	E. of Naked Is.	60 40.597	147 18.564	60 39.377	147 17.121	40-70	12
10-Aug	16:10	16:50	113	E. of Naked Is.	60 39.708	147 17.718	60 39.780	147 17.077	20-40	5
10-Aug	19:00	19:14	114	Montague Pt.	60 22.998	147 004.031	60 22.300	147 03.145	20-30	20
10-Aug	19:34	19:40	114	Montague Pt.	60 22.324	147 02.572	60 22.643	147 02.875	30	surface
10-Aug	19:59	20:10	114	Montague Pt.	60 22.996	147 03.622	60 22.769	147 03.995	30-40	10
10-Aug	20:38	21:05	114	Montague Pt.	60 23.220	147 05.712	60 22.764	147 03.622	30	12
11-Aug	12:10	13:02	116	Port Gravina	60 40.236	146 24.248	60 40.398	146 23.819	40-50	20-30

APPENDIX A-21

Table 5. Midwater trawl and NIO net sampling locations during APEX October cruise in Prince William Sound.

DATE	TIME	STATION	HAUL #	GEAR	LOCATION	LATITUDE	LONGITUDE	BOTTOM DEPTH (M)	GEAR DEPTH (M)
9-Oct	12:32	1	1	NIO	FFN01A	60 22.51	147 27.61	129	2-Jan
9-Oct	12:57	1	2	NIO	FFN01A	60 22.78	147 27.52	75-125	2-Jan
9-Oct	15:12	1	3	Mid Water	FFN01A	60 22.05	147 26.29	67-85	30-50
9-Oct	18:32	1	4	Mid Water	FFN01A	60 21.99	147 26.57	63-100	50-60
10-Oct	19:37	2	1	Mid Water	E. arm of Whale Bay	60 09.102	148 12.47	52-108	30-60
10-Oct	21:40	2	2	NIO	E. arm of Whale Bay	60 09.31	148 12.28	80	50
11-Oct	21:00	3	1	Mid Water	Applegate Rocks	60 22.029	147 26.601	60-90	40-56
11-Oct	21:53	3	2	Mid Water	Applegate Rocks	60 22.75	147 24.30	60-90	50-60
11-Oct	23:13	3	3	NIO	Applegate Rocks	60 22.716	147 25.667	110	80
12-Oct	13:03	4	1	Mid Water	E. of Smith Island	60 32.236	147 12.556	90	40-60
12-Oct	20:28	4	2	Mid Water	E. of Smith Island	60 32.410	147 13.654	55-70	30-50
12-Oct	21:50	4	3	Mid Water	E. of Smith Island	60 33.03	147 19.622	80-100	20-60
13-Oct	11:31	5	1	Mid Water	SE corner of Naked Is.	60 32.482	147 20.450	50-90	45-65
13-Oct	21:43	6	1	Mid Water	Galena Bay	60 57.062	146 43.035	220	15-Oct
13-Oct	22:40	6	2	CTD	Galena Bay	60 56.438	146 42.050	180	150
13-Oct	23:00	6	3	Ring Net	Galena Bay	60 56.438	146 42.050	180	50
14-Oct	21:58	7	1	Mid Water	Landlocked Bay	60 50.550	146 35.210	95-106	20-Oct
14-Oct	23:19	7	2	Mid Water	Landlocked Bay	60 50.316	146 35.397	97	67-90
15-Oct	10:42	8	1	NIO	NW of Goose Is.	60 44.783	146 44.179	40-45	2
15-Oct	13:02	9	1	NIO	off Knowles Bay	60 39.96	146 35.036	32	2

Table 6. CTD stations sampled during APEX cruise 95-1 in Prince William Sound.

DATE	TIME	STATION	TRANSECT #, LOCATION	LATITUDE	LONGITUDE	DEPTH	GEAR DEPTH
22-Jul	10:50	2	FFN01A	60 22.80	147 15.60	210	100
22-Jul	13:45	3	Btw Ap'gate and Knight Is	60 22.12	147 30.42	148	140
22-Jul	15:35	4	FFN02A;E of Manning Rks	60 24.22	147 30.00	169	140
22-Jul	16:46	5	FFN03A; NW of Seal Is.	60 26.18	147 30.29	164	140
23-Jul	9:10	6	FFN04A	60 28.337	147 30.183	197	200
23-Jul	10:39	7	FFN05A	60 30.288	147 30.090	197	200
23-Jul	12:25	8	FFN06A	60 32.341	147 30.144	194	180
23-Jul	13:20	9	FFN07A.	60 34.226	147 29.875	197	200
24-Jul	8:20	10	FFN08A	60 36.166	147 35.246	362	200
25-Jul	8:02	14	FFN10W	60 40.34	147 34.72	503	200
25-Jul	8:35	15	FFN11W	60 42.29	147 35.15	500	200
25-Jul	9:20	16	FFN12W	60 44.29	147 35.08	580	200
25-Jul	9:35	16	FFN12W	60 44.08	147 35.16	580	200
25-Jul	11:25	17	FFN12E	60 44.32	147 15.10	273	200
25-Jul	11:57	18	FFN11E	60 42.27	147 15.08	176	160
26-Jul	9:06	20	FFV01A	60 46.21	146 40.02	110	100
26-Jul	9:36	21	FFV02A	60 48.24	146 40.00	72	60
26-Jul	12:19	22	FFV01A	60 46.8	146 44.80	173	160
26-Jul	14:00	23	FFV01A; W. end of line	60 46.25	146 59.5	438	200
26-Jul	14:34	24	FFV02A; end of line	60 48.27	146 59.69	322	200
27-Jul	12:30	29	FFV03VA	60 51.88	146 57.33	118	100
27-Jul	13:00	30	FFV04VA	60 52.38	146 58.60	373	200
27-Jul	13:20	30	FFV04VA	60 52.41	146 59.26	370	200
27-Jul	13:40	30	FFV04VA	60 52.37	147 00.34	380	200
27-Jul	14:12	31	FFV03VA	60 50.34	147 00.29	372	200
27-Jul	15:00	32	FFV05VA	60 54.16	147 56.92	348	200
27-Jul	16:11	33	FFV06VA	60 56.26	146 53.23	330	200
28-Jul	8:06	34	Inner Galena Bay	60 56.34	146 37.75	105	100
28-Jul	10:25	35	Outer Galena Bay	60 57.3	146 43.30	220	200
28-Jul	11:05	36	FFV07A	60 58.22	146 50.27	332	200
28-Jul	11:49	37	FFV08A	61 00.27	146 48.29	305	200
28-Jul	13:30	38	FFV09VA	61 02.35	146 43.95	318	200
28-Jul	15:30	39	FFV11VA	61 06.29	146 30.41	243	200
30-Jul	9:45	40	FFJ03A	60 19.07	148 09.90	236	200
30-Jul	10:23	41	FFJ02A	60 17.01	148 09.98	287	200
30-Jul	11:19	42	FFJ01W	60 15.54	148 16.66	151	140
30-Jul	13:20	44	FFJ01E	60 15.093	148 09.989	318	200
30-Jul	14:30	45	FFJ01E	60 15.01	148 00.01	596	200
30-Jul	15:15	46	FFJ05E	60 12.94	147 59.40	502	200
30-Jul	17:15	48	Bainbridge	60 10.96	148 06.34	117	100
30-Jul	18:50	49	FFJ05W; Whale Bay	60 13.06	148 10.00	106	100
1-Aug	10:50	53	FFN01A	60 22.305	147 15.516	117	100
1-Aug	12:00	54	FFN01A; E. of Knight Is.	60 22.32	147 30.01	154	140
1-Aug	13:16	55	FFN02A	60 24.38	147 29.99	166	160
1-Aug	16:05	56	FFN03A	60 26.296	147 18.266	152	140
1-Aug	17:15	57	FFN03A; reg. stat.	60 26.32	147 29.98	162	140
2-Aug	9:01	58	FFN04A	60 28.046	147 29.803	175	160
2-Aug	11:05	59	FFN05A	60 30.29	147 30.21	198	180
2-Aug	12:15	60	FFN06A	60 32.12	147 30.65	204	200
2-Aug	14:08	61	FFN07A	60 34.28	147 30.15	190	180
3-Aug	10:00	64	FFN08A	60 36.274	147 35.270	342	200
3-Aug	14:35	66	E. end of FFN08A	60 36.34	147 15.15	199	180
4-Aug	8:40	68	FFN09E	60 36.36	147 15.28	161	140
4-Aug	9:10	69	FFN10E	60 40.33	147 15.27	116	100
4-Aug	9:35	70	FFN11E	60 42.36	147 15.27	176	160
4-Aug	10:05	71	FFN12E	60 44.45	147 15.35	264	200
4-Aug	14:05	74	FFN12W	60 44.27	147 35.04	566	200
4-Aug	14:52	75	FFN11W	60 42.229	147 35.099	488	200
4-Aug	15:20	76	FFN10W	60 40.280	147 35.454	528	200
4-Aug	15:51	77	FFN09W	60 38.251	147 35.359	370	200

Table 6. Continued

DATE	TIME	STATION	TRANSECT #, LOCATION	LATITUDE	LONGITUDE	DEPTH	GEAR DEPTH
4-Aug	16:22	78	E. side of FFN08A	60 36.170	147 35.120	338	200
5-Aug	10:17	79	E.end of FFV01A	60 46.279	147 00.01	452	200
5-Aug	11:05	80	E. end of FFV02A	60 48.18	146 59.92	320	200
5-Aug	15:22	82	FFV02A	60 48.128	146 39.992	88	80
5-Aug	16:06	83	West end of FFV01A	60 46.323	146 39.945	139	120
6-Aug	9:36	85	FFV03VA	60 50.327	147 00.03	372	200
6-Aug	10:06	86	FFV04VA	60 52.215	146 59.705	375	200
6-Aug	18:10	88	FFV05VA	60 54.194	146 57.949	334	200
6-Aug	18:49	89	FFV06VA	60 56.215	146 53.526	327	200
6-Aug	19:21	90	FFV07VA	60 58.249	146 50.509	203	180
7-Aug	7:26	91	Galena Bay	60 57.96	146 44.033	211	200
7-Aug	7:50	92	Galena Bay	60 56.981	146 42.699	213	200
7-Aug	8:13	93	Galena Bay	60 56.389	146 41.545	182	160
7-Aug	15:02	94	E. of Storey Is.	60 42.063	147 20.803	30	20
7-Aug	15:10	94	E. of Storey Is.	60 41.897	147 20.147	118	100
7-Aug	15:24	94	E. of Storey Is.	60 42.054	147 19.012	126	120
8-Aug	8:55	95	Ewan Bay	60 23.902	148 09.071	34.6	20
8-Aug	9:06	95	Ewan Bay	60 23.40	148 08.36	36	20
8-Aug	9:15	95	Ewan Bay	60 22.93	148 07.91	85	80
8-Aug	9:28	95	Ewan Bay	60 22.58	148 07.51	93	80
8-Aug	9:43	95	Ewan Bay	60 21.89	148 06.56	97	80
8-Aug	10:41	96	FFJ03A; E. of Chenega I.	60 19.019	148 10.056	280	200
8-Aug	11:15	97	FFJ02A	60 17.032	148 09.986	290	200
8-Aug	11:47	98	Icy Bay	60 17.079	148 14.120	118	100
8-Aug	12:17	99	FFJ01W	60 15.096	148 17.296	153	140
8-Aug	13:03	100	FFJ01E	60 15.059	148 10.045	320	200
8-Aug	14:26	101	FFJ05W	60 1.93	148 09.950	91	80
8-Aug	15:31	102	FFJ01E	60 14.995	147 59.924	594	200
8-Aug	16:01	103	FFJ05E	60 12.949	147 59.967	379	200
8-Aug	18:04	105	Bainbridge Passage	60 11.004	148 05.959	116	100
8-Aug	19:17	106	Btw Fleming and Knight Is	60 10.903	147 54.074	394	200
8-Aug	20:47	107	S. of Pt. Helen (Knight I.)	60 09.037	147 45.346	46	40
9-Aug	12:14	109	E. of Discovery Pt	60 12.704	147 42.404	22	20
9-Aug	12:21	109	E. of Discovery Pt	60 12.686	147 42.277	55	40
9-Aug	12:27	109	E. of Discovery Pt	60 12.721	147 42.135	124	120
10-Aug	13:57	112	S. of Naked Is.	60 36.035	147 21.680	78	60
10-Aug	15:58	113	E. of Naked Is.	60 39.633	147 17.332	35	20
10-Aug	20:17	114	Montague Pt.	60 22.800	147 03.578	34	20
11-Aug	8:33	115	E. of Montague Pt.	60 22.506	147 03.453	24.5	20
11-Aug	8:46	115	E. of Montague Pt.	60 22.849	147 02.367	44.5	40
11-Aug	8:59	115	E. of Montague Pt.	60 23.143	147 01.260	90	80
11-Aug	13:20	116	Port Gravina	60 40.504	146 23.755	42	40

APPENDIX A-24

TABLE 7. CTD stations sampled during APEX October cruise in PWS.

DATE	TIME	STATION	HAUL #	GEAR	LOCATION	LAT. IN	LONG. IN	BOTTOM DEPTH (M)	GEAR DEPTH (M)
9-Oct	19:47	1	5	CTD	FN02A	60 22.80	147 20.91	93	80
10-Oct	22:06	2	3	CTD	FJ05E	60 10.38	148 11.57	80	75
11-Oct	23:52	3	6	CTD	APPLEGATE ROCKS	60 22.420	147 26.299	101	80
12-Oct	23:57	4	4	CTD	E. OF SMITH IS.	60 32.71	147 17.593	90	80
13-Oct	13:22	5	2	CTD	S.E. OF NAKED IS.	60 38.010	147 17.820	88	80
14-Oct	0:19	7	3	CTD	LANDLOCKED BAY	60 49.480	146 35.873	120	100

Table 8. Offshore biomass estimates (grams/square meter of surface) of forage fishes from acoustic data for the first and second surveys in the North, Central and South study areas of PWS from APEX cruise 95-1 in July and August 1995. Data are from two depth strata, shallow (S, 0 - 25 m) and deep (D, 26 - 65 m).

SURVEY	DEPTH (m)	BIOMASS ESTIMATE (g/m^2)		
		NORTH	CENTRAL	SOUTH
	0 - 25	0.241	0.032	0.158
FIRST	26 - 65	0.115	0.093	0.143
	TOTAL	0.365	0.125	0.301
	0 -25	0.257	0.052	0.120
SECOND	26 - 65	0.330	0.202	0.165
	TOTAL	0.587	0.254	0.285

Table 9. Mean biomass estimates for individual transects in the North offshore area.

TRANSECT	MEAN (G/M2)	MAX	TRANSECT LENGTH (nm)
FIRST SURVEY			
ffv01a	0.295	2.463	23.9
ffv01x	0.347	2.068	0.3
ffv02a	0.446	5.168	31.4
ffv02x	0.007	0.119	0.2
ffv02x2	0.245	0.848	0.5
ffv03llb	0.378	3.347	2.2
ffv03tt	0.328	2.268	3.0
ffv03va	0.243	13.663	18.3
ffv04va	0.138	2.378	17.4
ffv05va	0.176	4.012	3.8
ffv06gbe	0.359	0.749	2.3
ffv06gbw	0.244	2.625	1.6
ffv07va	0.229	4.011	7.6
ffv08va	0.131	1.826	7.1
ffv09va	0.086	0.673	8.8
ffv09vax	0.050	0.143	0.3
ffv10vn	0.026	0.064	1.1
ffv11pv	0.095	1.789	17.6
		total length	147.5
SECOND SURVEY			
2fv01a	0.213	1.377	23.5
2fv02a	0.303	4.136	31.5
2fv02x	0.097	0.107	0.1
2fv03a	0.877	7.952	18.4
2fv03ax	0.128	0.295	3.3
2fv03llb	0.284	6.137	2.5
2fv03tt	0.225	2.874	2.7
2fv04va	0.240	2.018	16.9
2fv05va	0.218	3.638	16.0
2fv05vax	0.105	2.454	0.2
2fv06gbe	1.145	2.202	2.2
2fv06gbw	0.382	0.781	1.6
2fv06va	0.822	10.119	9.7
2fv07va	1.131	7.112	7.5
2fv08va	1.265	5.068	6.7
2fv09va	0.840	3.255	8.7
2fv10vn	0.180	0.978	1.2
2fv11pv	0.377	5.184	17.5
		total length	170.2

Table 10. Mean biomass estimates for individual transects in the Central offshore area.

TRANSECT	MEAN (g/m2)	MAX	TRANSECT LENGTH (nm)
FIRST SURVEY			
ffn01a	0.264	12.645	22.6
ffn02a	0.197	15.141	25.6
ffn03a	0.068	5.034	22.6
ffn04a	0.243	119.001	22.9
ffn05a	0.046	2.587	21.6
ffn06a	0.034	2.196	19.0
ffn06e	0.027	0.055	0.2
ffn07e	0.058	6.109	19.2
ffn07w	0.020	0.167	5.7
ffn08a	0.110	44.306	27.3
ffn08e	0.157	14.637	0.4
ffn09e	0.034	1.575	6.7
ffn09w	0.027	0.762	12.5
ffn10w	0.024	0.742	13.0
ffn11e	0.022	0.109	7.7
ffn11w	0.354	42.450	15.1
ffn11x	0.053	1.235	0.5
ffn12e	0.277	19.817	9.5
ffn12w	0.155	6.573	13.9
		Total Length	266.0
SECOND SURVEY			
2fn01a	0.816	19.827	22.5
2fn02a	0.842	93.933	26.2
2fn03a	0.216	45.919	22.7
2fn04a	0.092	8.239	21.9
2fn05a	0.057	2.095	21.7
2fn06a	0.156	46.187	18.9
2fn07e	0.091	1.428	19.0
2fn07w	0.072	2.329	5.7
2fn08a	0.084	4.603	27.1
2fn08ax	0.459	22.897	0.4
2fn09e	0.119	1.173	6.5
2fn09w	0.121	7.352	12.7
2fn10c	0.017	0.328	2.0
2fn10e	0.118	3.198	6.2
2fn10ex	0.101	0.155	0.7
2fn10w	0.077	1.669	12.9
2fn11e	0.372	19.746	8.2
2fn11ex	0.072	0.127	0.2
2fn11w	0.083	1.814	14.8
2fn12e	0.159	3.152	9.3
		Total Length	259.5

Table 11. Mean biomass estimates for individual transects in the South offshore area.

TRANSECT	MEAN (g/m2)	MAX	TRANSECT LENGTH (nm)
FIRST SURVEY			
ffj01e	0.286	7.212	10.6
ffj01ex	0.759	20.305	0.5
ffj02a	0.248	2.423	6.0
ffj03a	0.140	0.880	2.8
ffj04a	0.069	0.210	1.3
ffj05e	0.357	4.867	9.1
ffj05ex	0.842	4.256	0.2
ffj06a	0.154	0.746	1.6
ffj07a	0.275	0.467	0.7
		Total Length	32.7
SECOND SURVEY			
2fj01e	0.301	8.328	10.9
2fj02a	0.799	6.312	5.9
2fj02x	0.692	1.962	0.2
2fj03a	0.108	0.227	2.8
2fj04a	0.161	0.771	1.2
2fj05e	0.819	33.706	9.2
2fj05w	0.062	0.223	2.4
2fj06a	0.150	0.360	3.8
2fj07a	0.144	0.839	0.8
		Total Length	37.2

Table 12. Nearshore biomass estimates (grams/square meter of surface) of forage fishes from acoustic data for the first and second surveys in the North, Central and South study areas of PWS from APEX cruise 95-1 in July and August 1995. Data are from two depth strata, shallow (S, 0 - 25 m) and deep (D, 26 - 65 m).

SURVEY	DEPTH (m)	BIOMASS ESTIMATE (g/m^2)		
		NORTH	CENTRAL	SOUTH
	0 - 25	0.163	0.428	0.439
FIRST	26 - 65	0.071	0.613	0.081
	TOTAL	0.234	1.041	0.520
	0 -25	0.687	0.106	0.363
SECOND	26 - 65	1.075	0.169	0.161
	TOTAL	1.762	0.275	0.524

Table 13. Nearshore mean biomass estimates for individual transects in the North area, with maximum estimate (MAX) for a 15 second data record

TRANSECT	MEAN (g/m2)	MAX	TRANSECT LENGTH (nm)
FIRST SURVEY			
ffvz2n	0.278	5.641	2.3
ffvz3s	0.593	3.904	3.4
ffvz4n	0.062	0.418	1.4
ffvz4nx	0.084	0.242	0.5
ffvz5s	0.044	0.109	1.7
ffvz6n	0.194	3.800	1.8
ffvz6s	0.057	0.210	5.2
ffvz7n	0.049	0.297	2.1
ffvz7s	0.110	1.967	2.0
			20.3
SECOND SURVEY			
2fvz2n	0.084	0.242	2.0
2fvz3s	1.224	4.356	3.6
2fvz4v	1.137	3.862	1.9
2fvz5s	0.670	3.452	1.8
2fvz6n	0.258	1.413	1.5
2fvz6s	1.177	4.125	4.7
2fvz6sx	0.546	1.202	0.1
2fvz7n	0.136	0.801	2.1
2fvz7s	0.173	1.123	2.3
			20.1

Table 14. Nearshore mean biomass estimates for individual transects in the Central area, with maximum estimate (MAX) for a 15 second data record

TRANSECT	MEAN (g/m2)	MAX	TRANSECT LENGTH (nm)
FIRST SURVEY			
ffnz1s	0.438	14.914	1.8
ffnz2e	0.022	0.146	0.2
ffnz2n	0.020	0.120	2.1
ffnz2s	0.012	0.029	1.9
ffnz3n	0.021	0.029	1.6
ffnz3s	0.019	0.042	2.8
ffnz5n	0.030	0.326	3.0
ffnz5s	0.024	0.119	3.7
ffnz6n	4.349	122.167	3.4
ffnz6s	0.038	0.133	1.9
			22.4
SECOND SURVEY			
2fn12w	0.036	0.422	13.9
2fnz1s	0.013	0.024	1.8
2fnz2n	0.662	28.606	2.0
2fnz2s	0.019	0.171	2.0
2fnz3n	0.287	8.459	1.8
2fnz3s	0.134	2.249	2.8
2fnz4n	0.116	0.553	2.5
2fnz4nx	0.407	1.403	0.2
2fnz4s	0.077	0.239	2.9
2fnz5n	0.089	0.420	4.0
2fnz5s	0.103	1.905	3.9
2fnz6n	0.168	1.224	3.1
2fnz6s	0.120	0.529	2.0
			43.0

Table 15. Nearshore mean biomass estimates for individual transects in the South area, with maximum estimate (MAX) for a 15 second data record

TRANSECT	MEAN (g/m2)	MAX		TRANSECT LENGTH (nm)
FIRST SURVEY				
ffjz1n	1.146	15.256		1.6
ffjz1s	1.326	14.562		0.8
ffjz3n	0.288	2.308		2.6
ffjz3s	0.267	0.603		3.0
ffjz4n	0.566	1.644		1.8
ffjz4s	0.126	0.546		1.8
ffjz5n	0.243	0.812		1.8
ffjz5s	0.249	0.636		1.7
			Total Length	15.2
SECOND SURVEY				
2fjz1n	0.150	0.925		2.9
2fjz1s	1.657	29.589		1.0
2fjz3n	0.405	13.352		2.3
2fjz3s	0.134	1.153		3.3
2fjz4n	0.689	6.705		0.0
2fjz4s	0.421	0.895		0.0
2fjz5n	0.192	0.513		1.7
2fjz5s	0.199	1.047		1.6
			Total Length	12.8

Table 16. Proportional composition of midwater trawl hauls in shallow (< 26 m) and deep (>25 m) depths of the North study area in PWS from APEX cruise 95-1 in summer 1995.

SPECIES		ALL DEPTHS	SHALLOW	DEEP
	N	5708	5150	558
POLLOCK	524	0.09		0.94
HERRING	5131	0.90	0.99	
SALMON	2			
CAPELIN	1			
EULACHON	32	0.01		0.06
PROWFISH	6			
CRESTED SCULPIN	11		0.01	
WOLFFISH	1			

Table 17. Proportional composition of midwater trawl hauls in shallow (< 26 m) and deep (>25 m) depths of the central study area of PWS from APEX cruise 95-1 in summer 1995.

SPECIES		ALL DEPTHS	SHALLOW	DEEP
	N	11008	815	10193
POLLOCK	10873	0.99	0.89	1.00
HERRING	4		0.01	
SALMON	28		0.03	
CAPELIN	60	0.01	0.07	
PROWFISH	7			
CRESTED SCULPIN	34			
SANDLANCE	1			
SANDFISH	1			

Table 18. Proportional composition of midwater trawl hauls in shallow (< 26 m) and deep (>25 m) depths of the south study area of PWS from APEX cruise 95-1 in summer 1995.

SPECIES		ALL DEPTHS	SHALLOW	DEEP
	N	1324	1314	10
POLLOCK	8	0.01		0.80
HERRING	1314	0.99	1.0	0.10
PROWFISH	1			
CRESTED SCULPIN	1			0.10

Table 19. Mean lengths of forage fishes collected in PWS during APEX cruise in summer 1995.

SPECIES (AGE)		STUDY AREA	HABITAT	N	LENGTH (mm)	STD. ERR
Herring	(1+)	North	Offshore	413	153	0.94
Herring	(0+)	North	Inshore	281	77	0.53
Herring	(1+)	South	Offshore	212	151	1.43
Herring	(0+)	South	Inshore	7	53	0.67
Pollock	(1+)	North	Deep	228	183	0.82
Pollock	(0+)	Central	Peak/Osprey Is	568	58	0.24
Pollock	(0+)	Central	Kn. Is. Inside	713	58	0.17
Pollock	(0+)	Central	Kn. Is. Outside	987	63	0.20
Pollock	(0+)	South	Deep	30	66	1.76
Pollock	(1+)	South	Deep	12	150	5.67

Table 20. Composition (percentage of total number identified) of jellyfish in mid-water trawl samples in North, Central and South sampling areas of PWS during summer sampling.

TAXA	NORTH	CENTRAL	SOUTH
Cyanea capillata	37	9	36
Chrysaora melanaster	18	17	27
Phacellophora camtschatica	9	3	3
Aequorea sp.	10	59	3
Hydromedusae	23	0	30
Ctenophores	0	2	0
Other/Unidentified	2	11	0

Table 21. Composition (percentage of total number identified) of krill in mid-water trawl samples in North, Central and South sampling areas of PWS during summer sampling.

TAXA	NORTH	CENTRAL	SOUTH
Euphausia pacifica	41	0	< 1
Thysanoessa inermis	0	0	38
T. longipes	5	0	0
T. raschii	51	0	5
T. spinifera	3	0	57

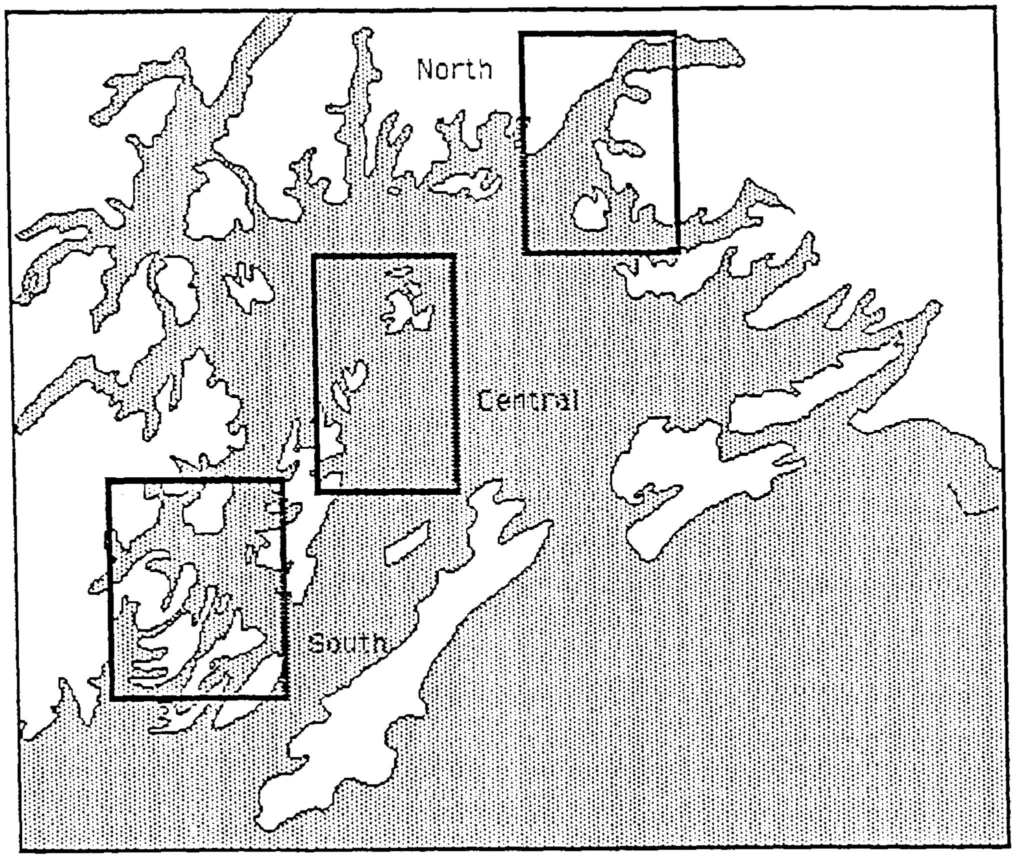


Figure 1. Locations of North, Central and South study areas within Prince William Sound.

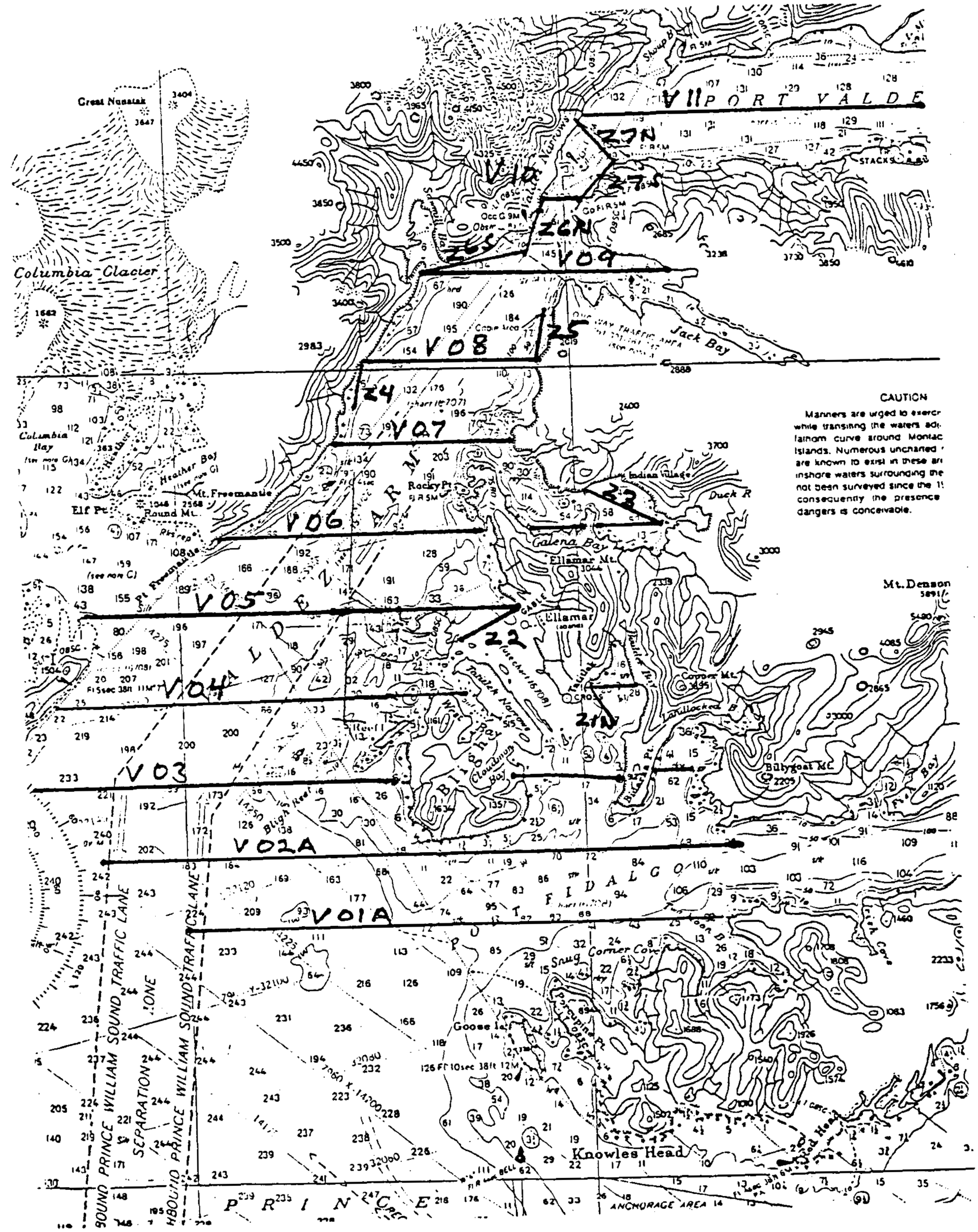


Figure 2. Hydroacoustic transect locations in the North study area of Prince William Sound

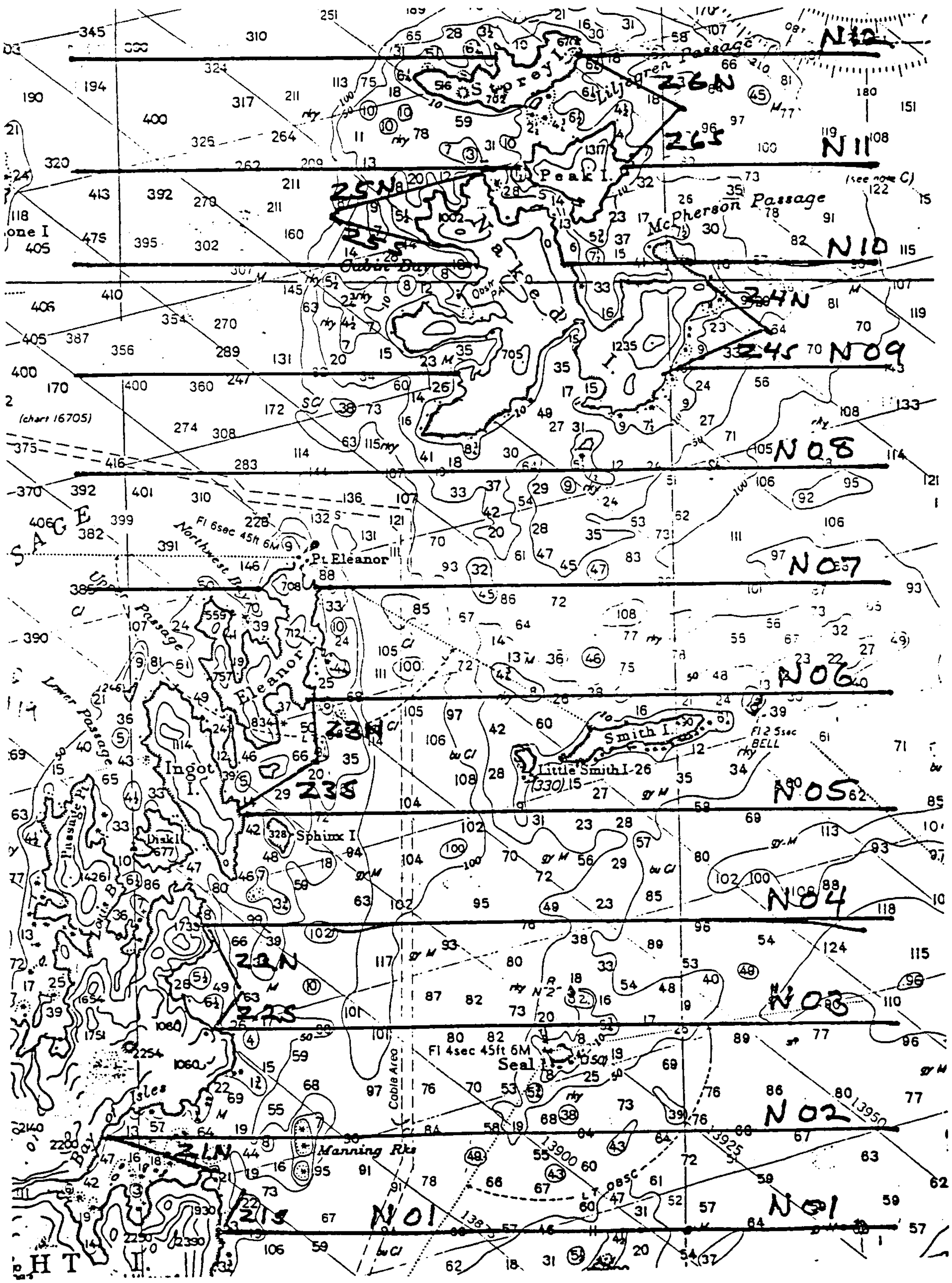


Figure 3. Hydroacoustic transect locations in the Central study area of Prince William Sound.

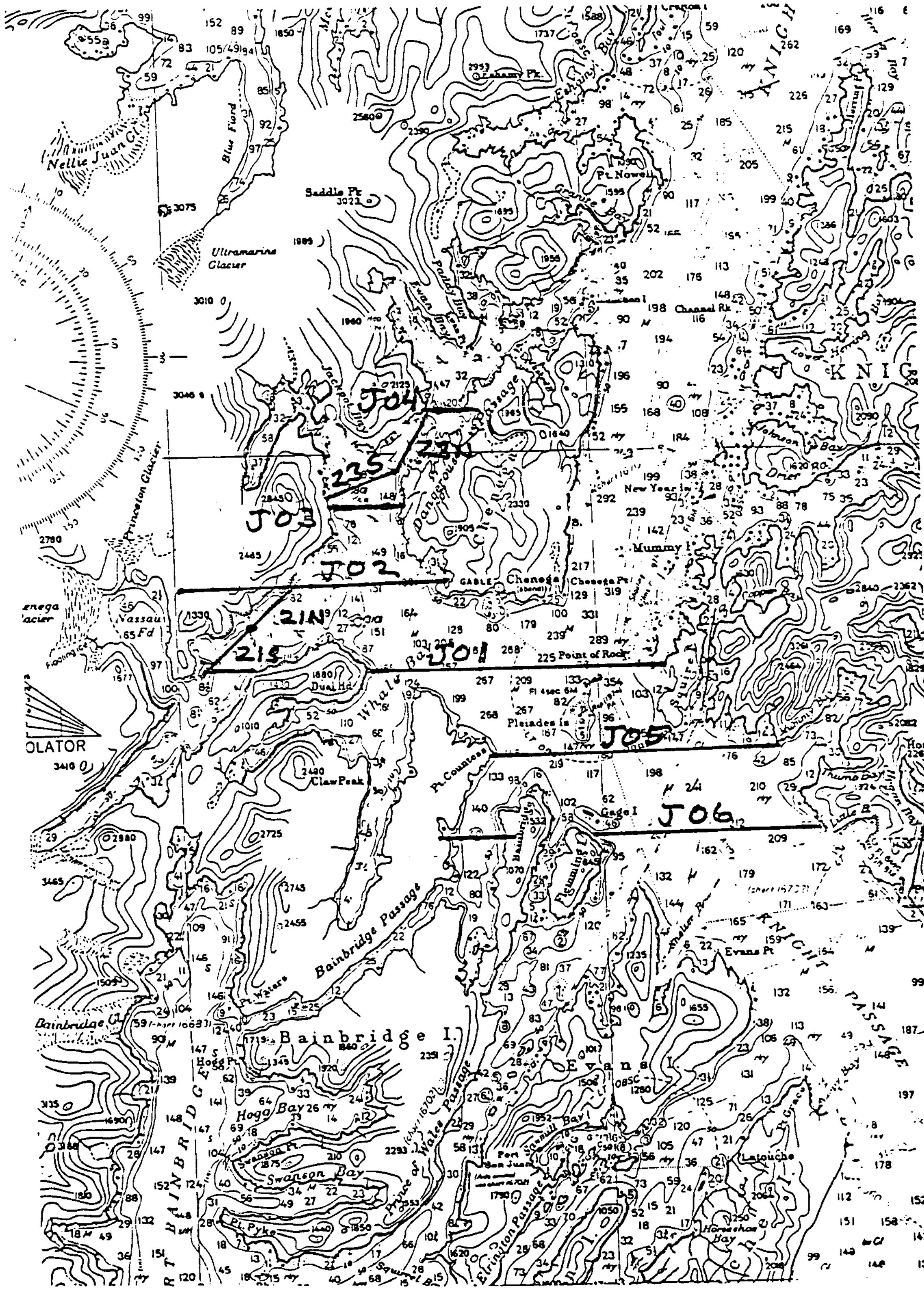


Figure 4. Hydroacoustic transect locations in the South study area of Prince William Sound.

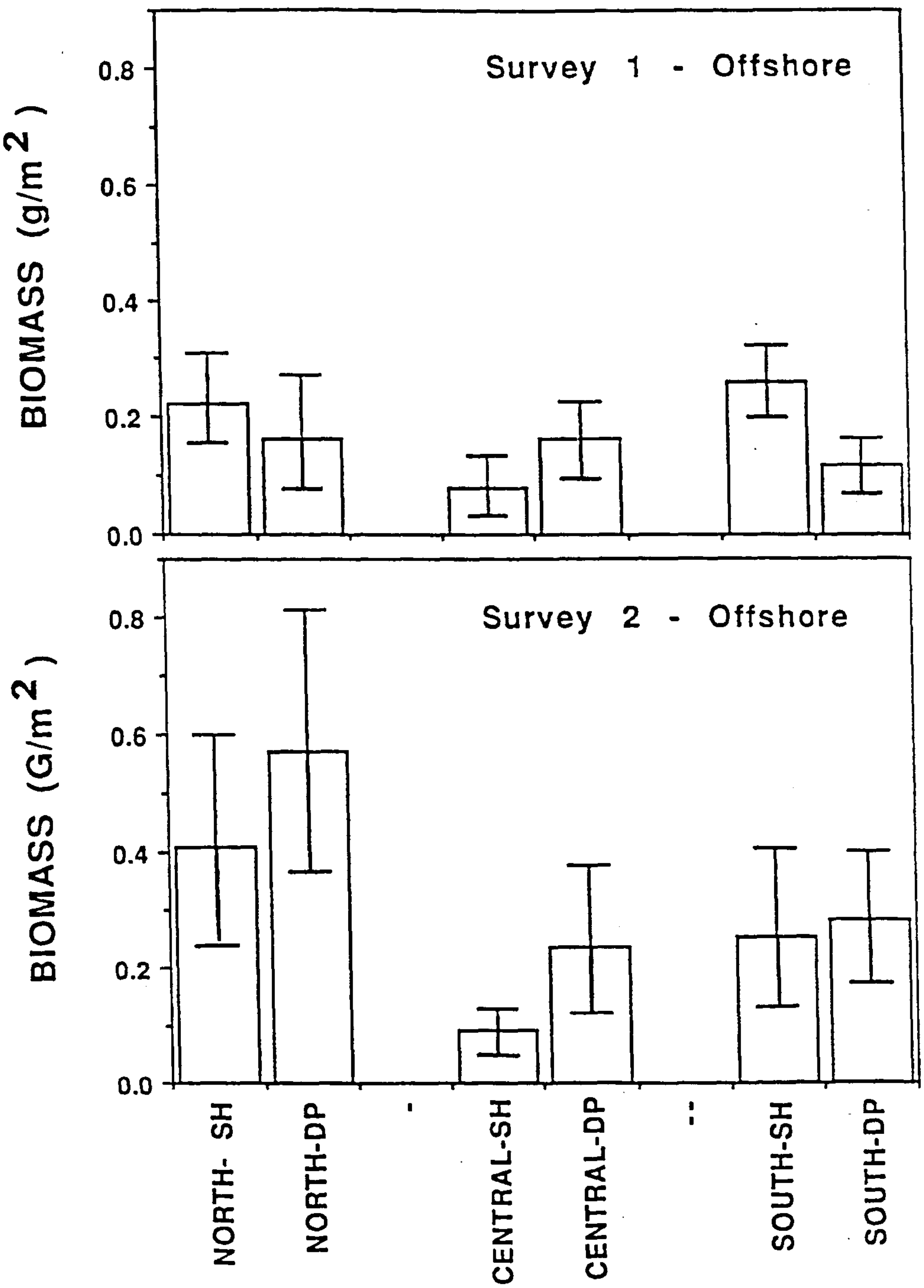


Figure 5. Mean offshore biomass estimates for shallow and deep strata in three study areas of Prince William Sound on the first and second surveys in July and August 1995. Error bars are the upper and lower 95 % confidence limits determined by bootstrapping.

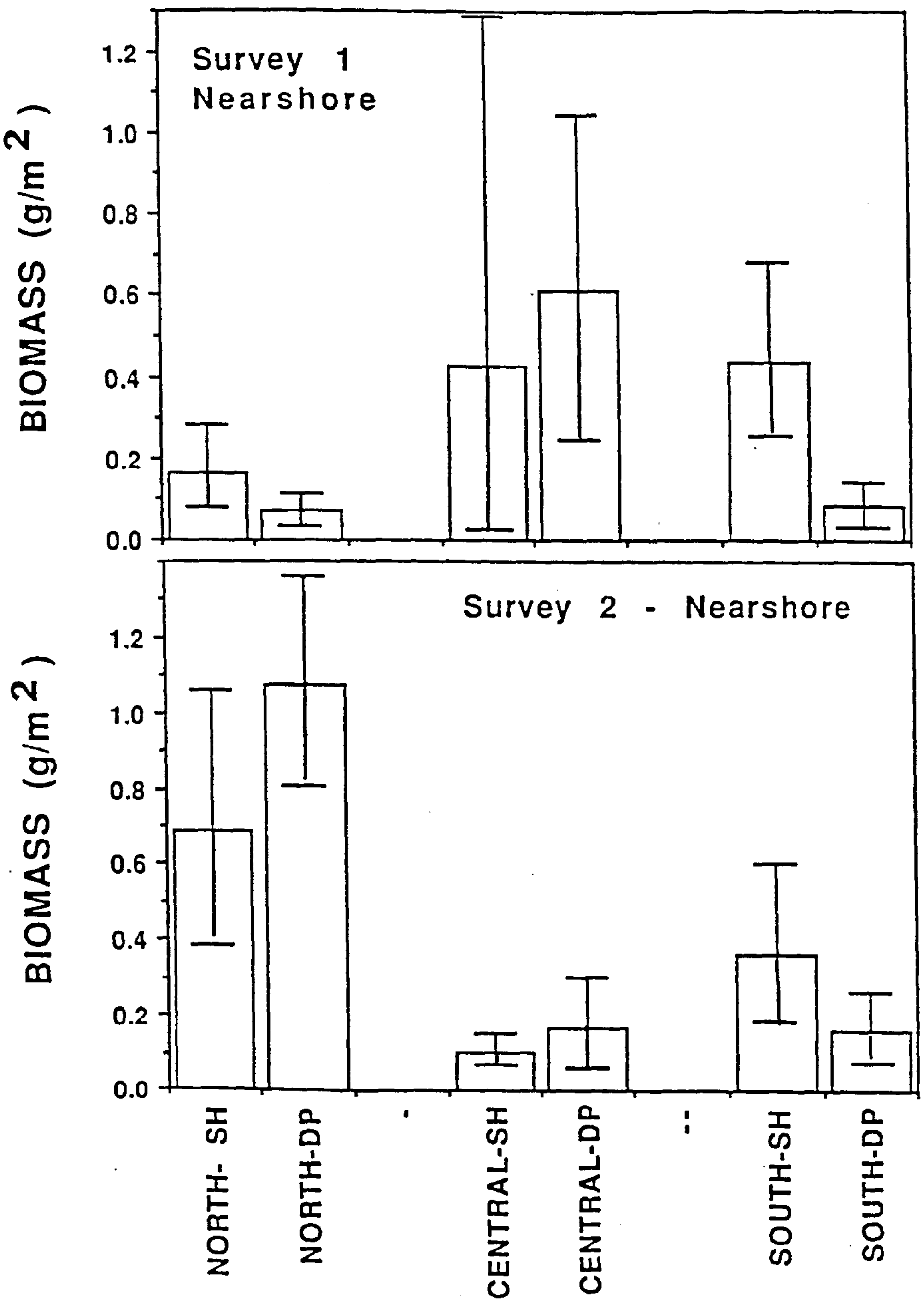


Figure 6. Mean nearshore biomass estimates for shallow and deep strata in three study areas of Prince William Sound on the first and second surveys in July and August 1995. Error bars are the upper and lower 95 % confidence limits determined by bootstrapping.

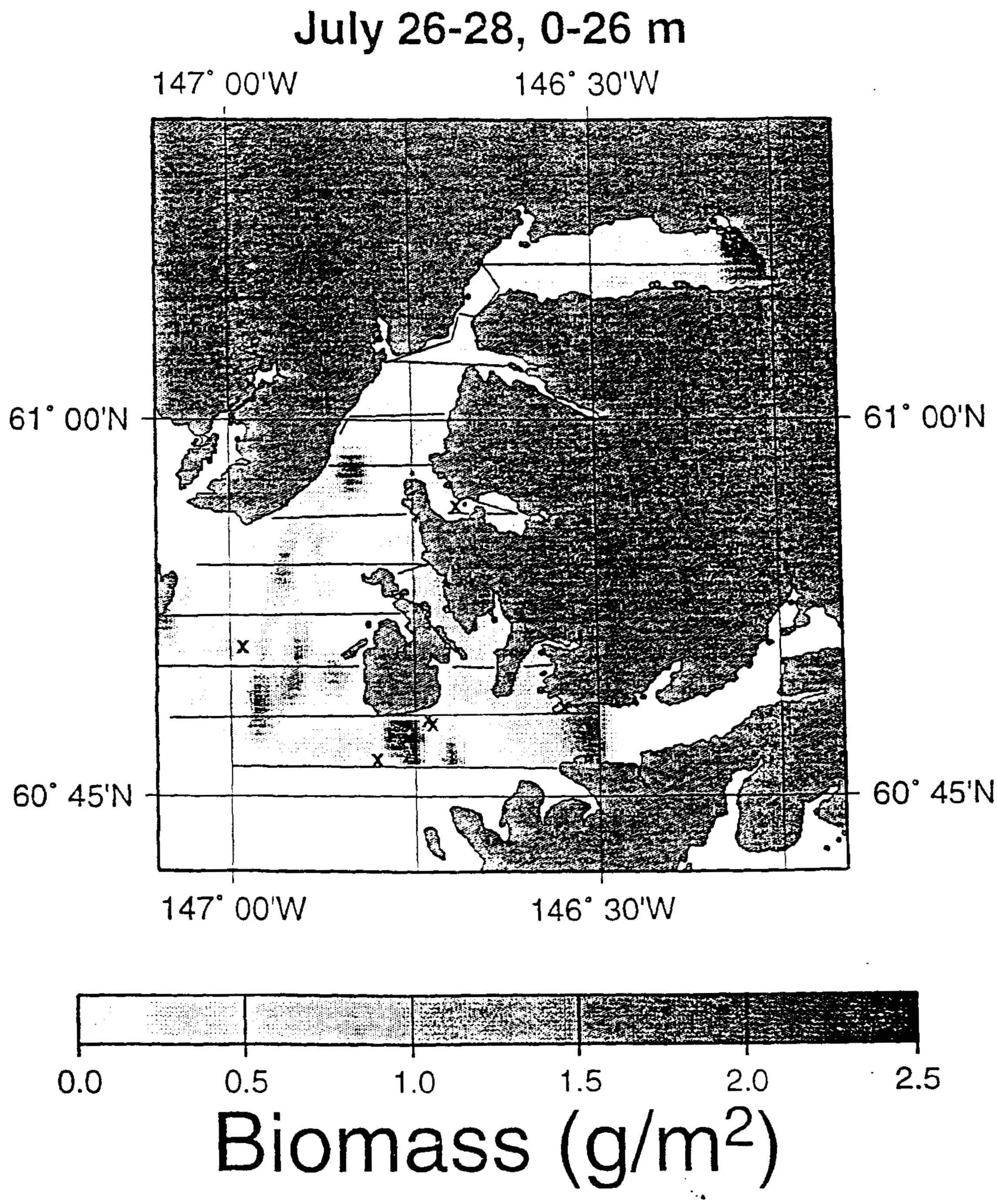


Figure 7. Geographic distribution of biomass in the shallow (<26 m) depth stratum of the North study area during the first acoustic survey.

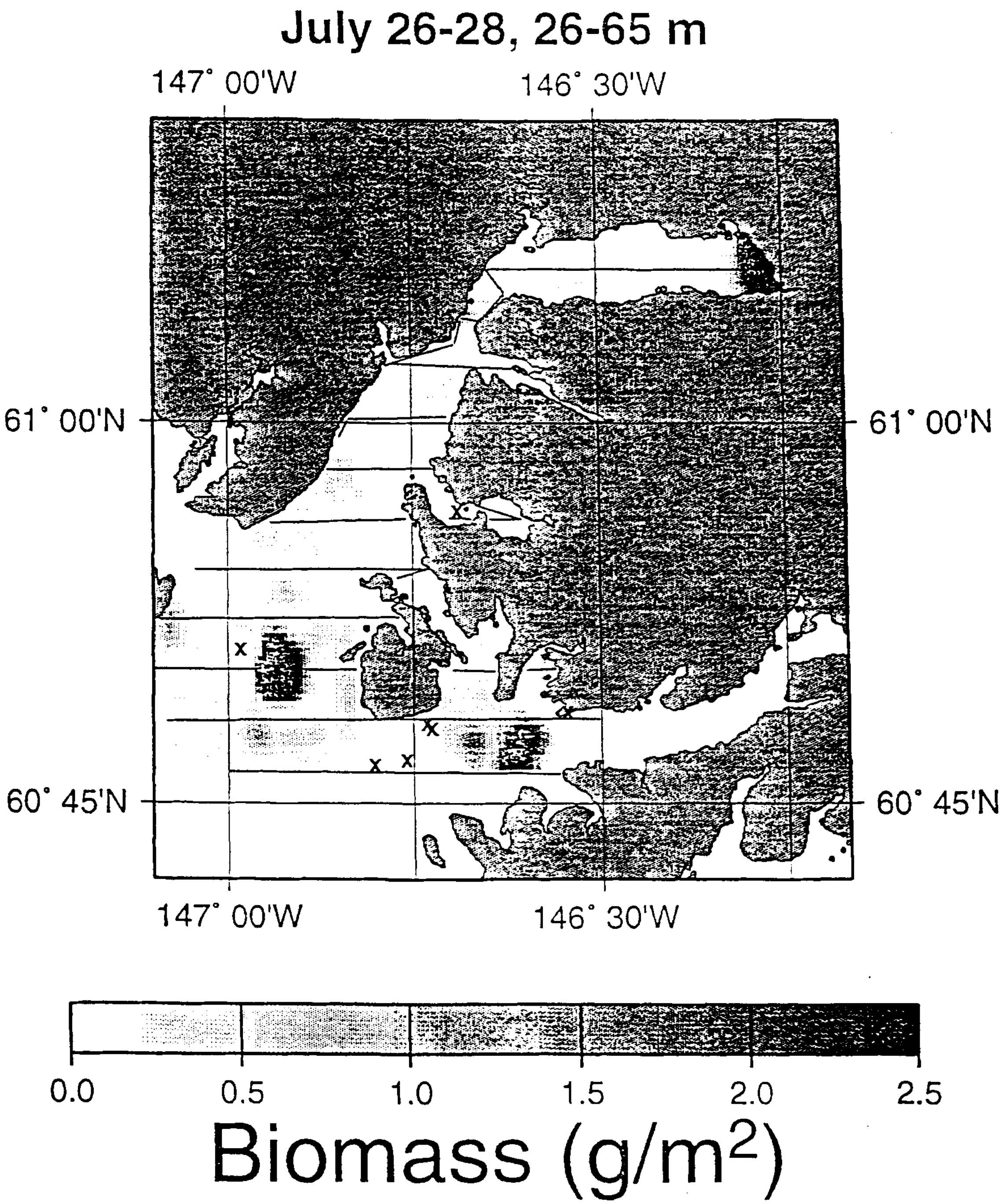


Figure 8. Geographic distribution of biomass in the deep (26 - 65 m) depth stratum of the North study area during the first acoustic survey.

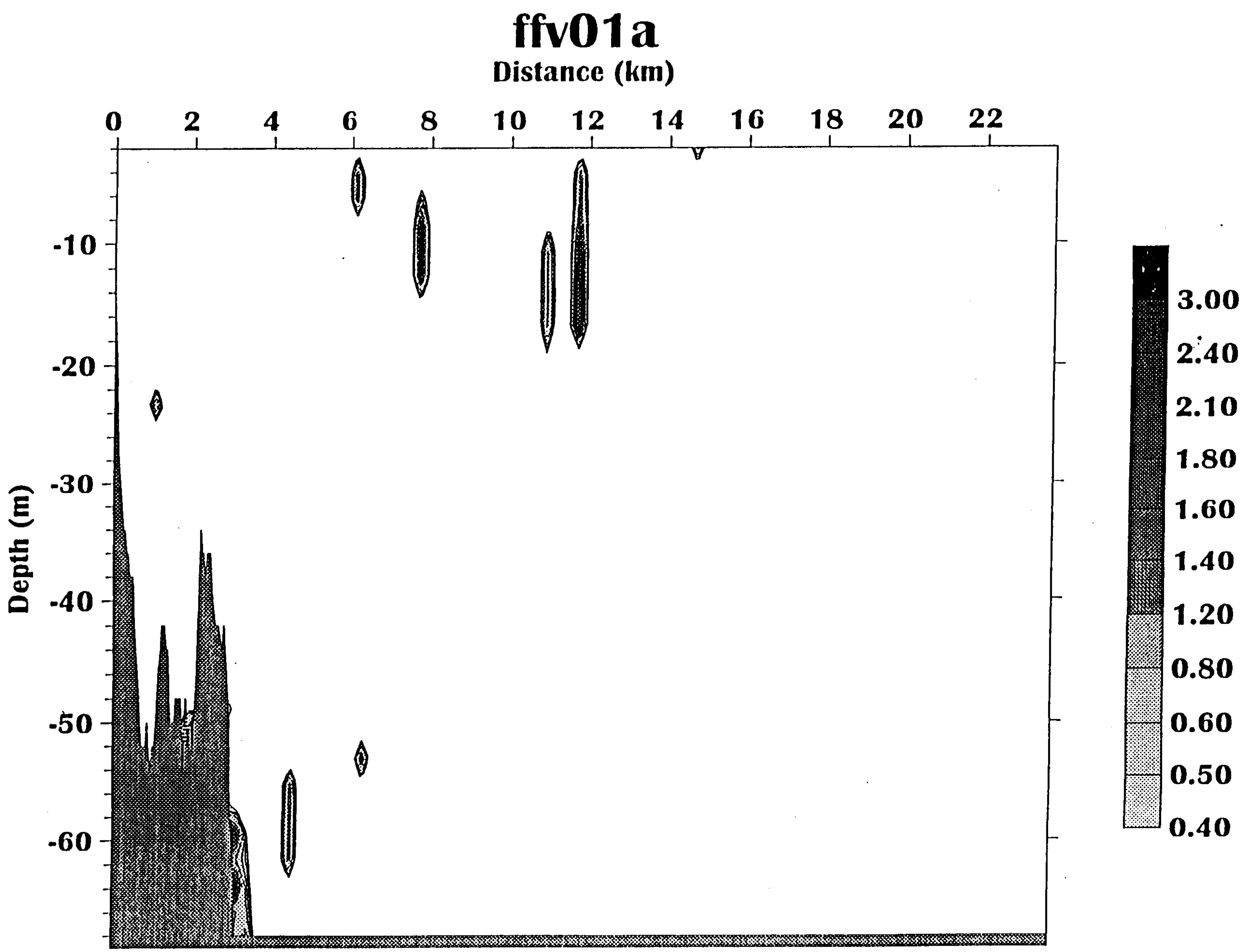


Figure 9. Distribution of biomass on transect V01A in Port Fidalgo (North area) during the first acoustic survey.

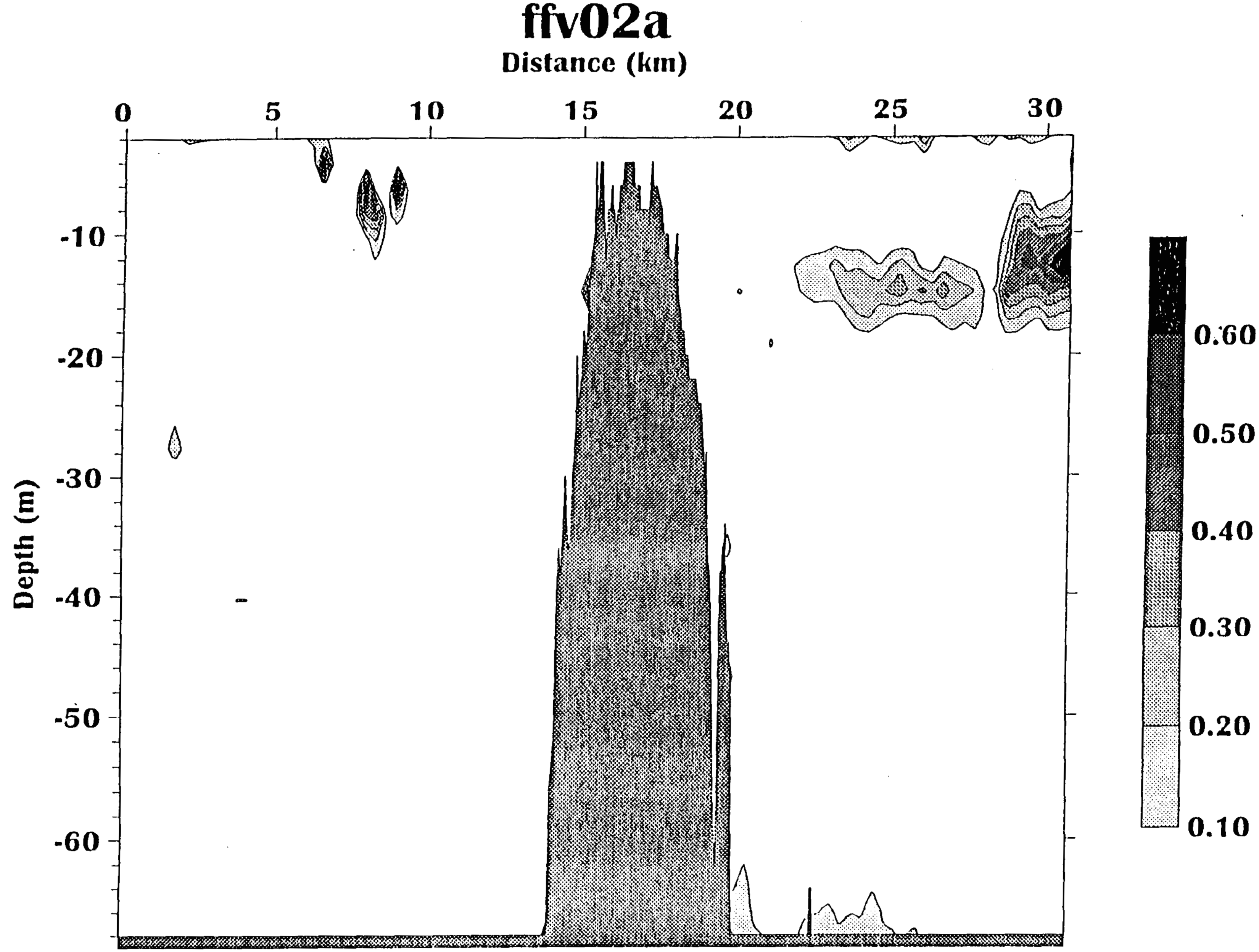


Figure 10. Distribution of biomass on transect V02A in Port Fidalgo (North area) during the first acoustic survey.

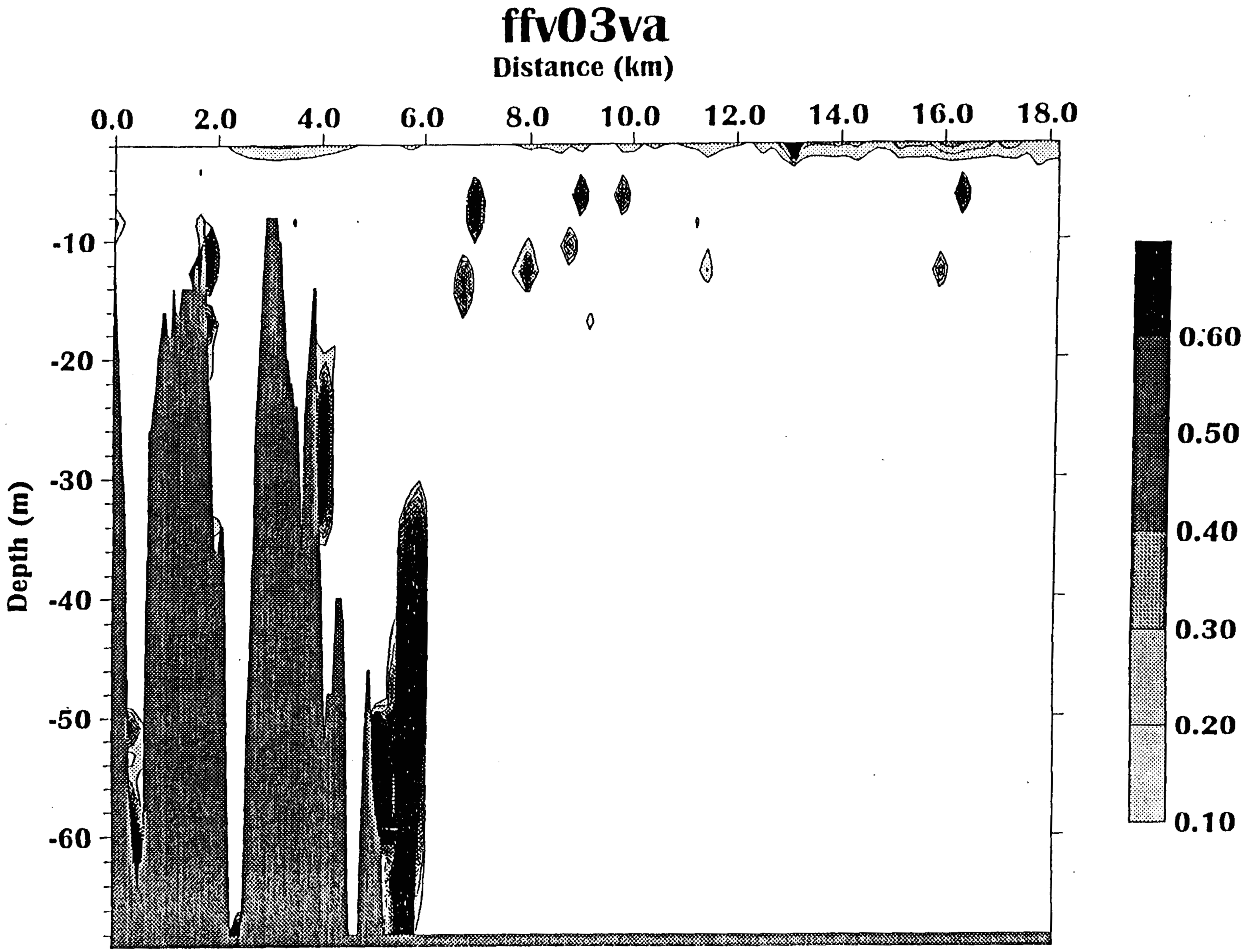


Figure 11. Distribution of biomass on Transect V03A in Valdez Arm (North area) during the first acoustic survey.

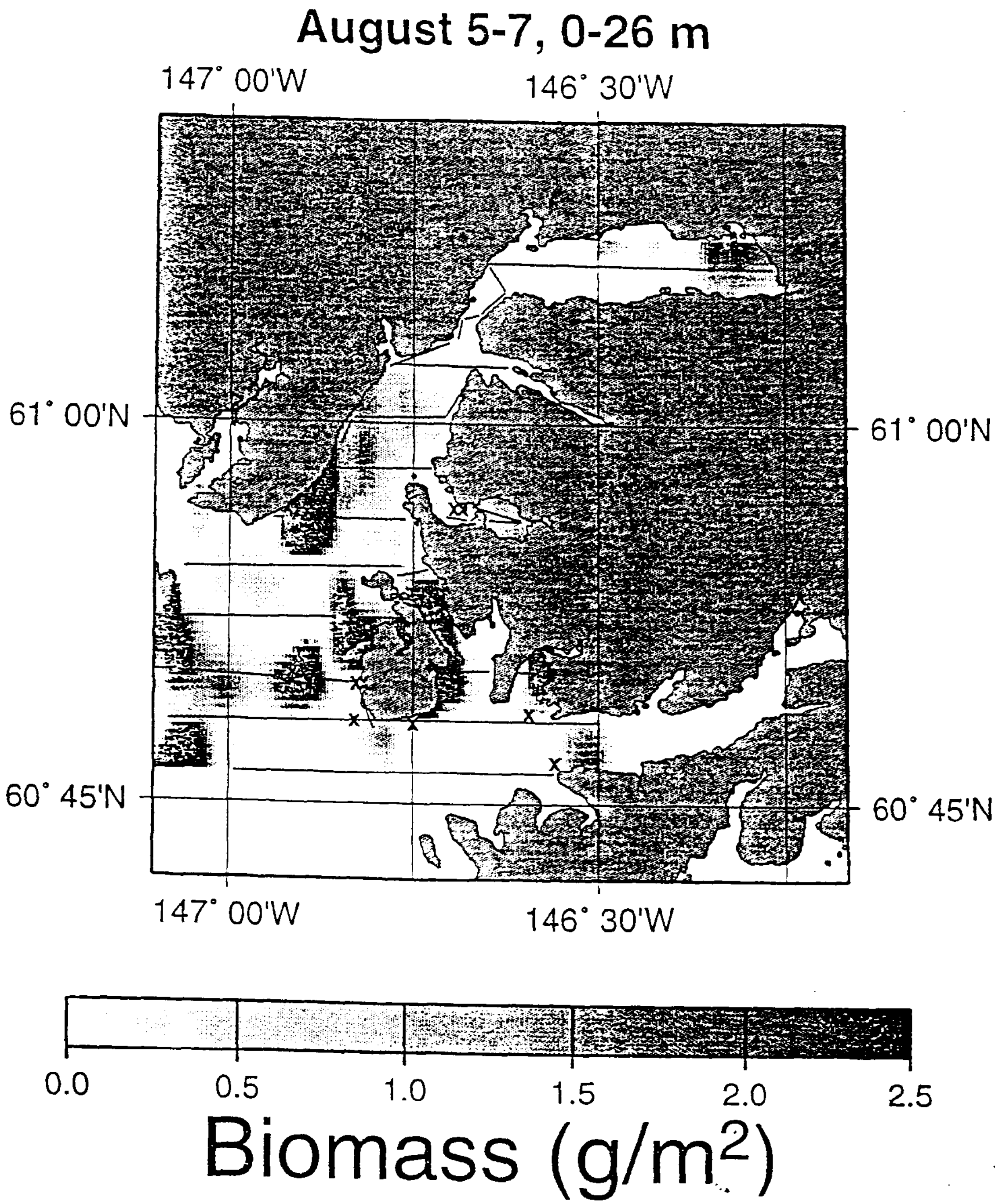


Figure 12. Geographic distribution of biomass in the shallow (<26 m) depth stratum of the North study area during the second acoustic survey.

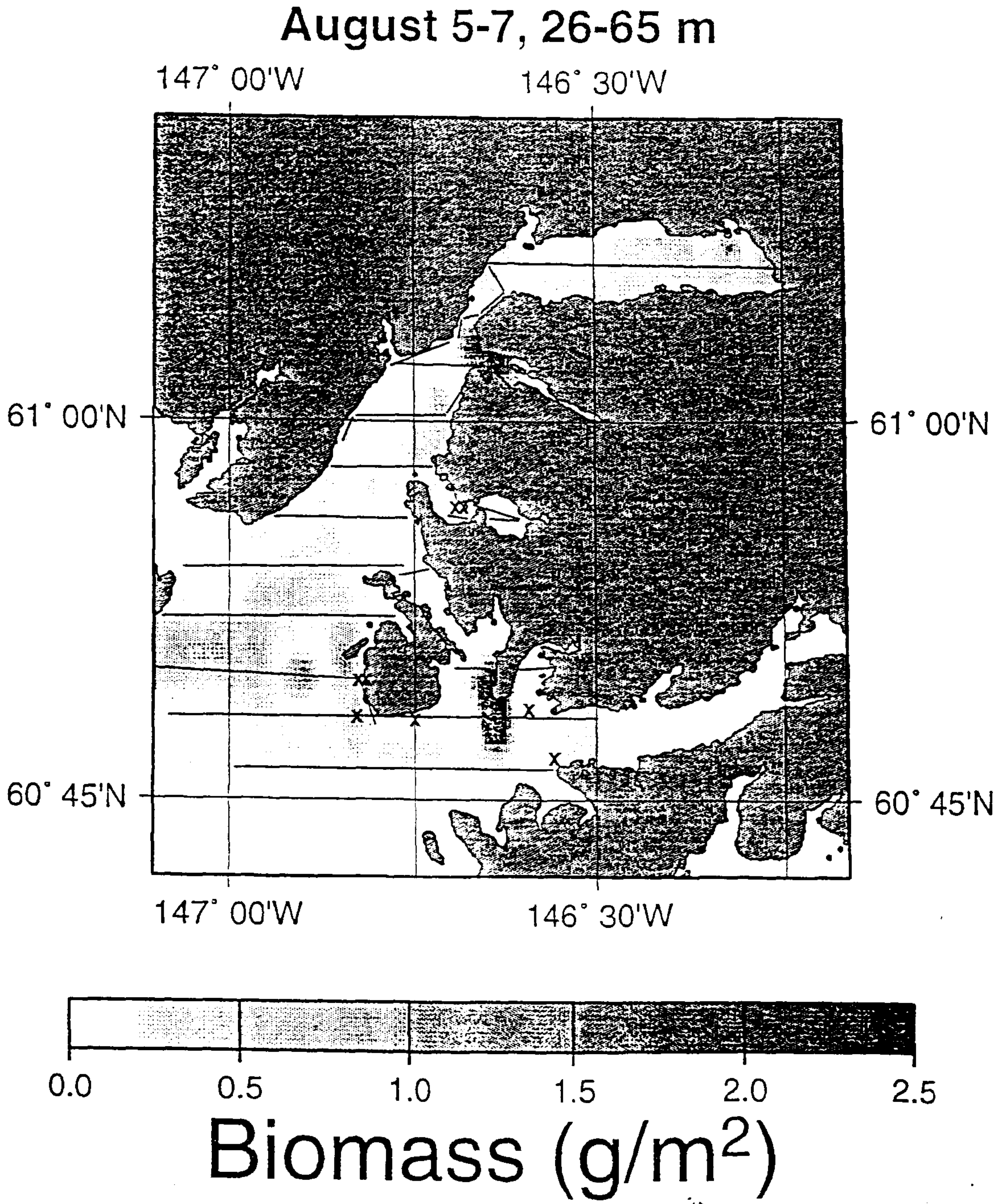


Figure 13. Geographic distribution of biomass in the deep (26 - 65 m) depth stratum of the North study area during the second acoustic survey.

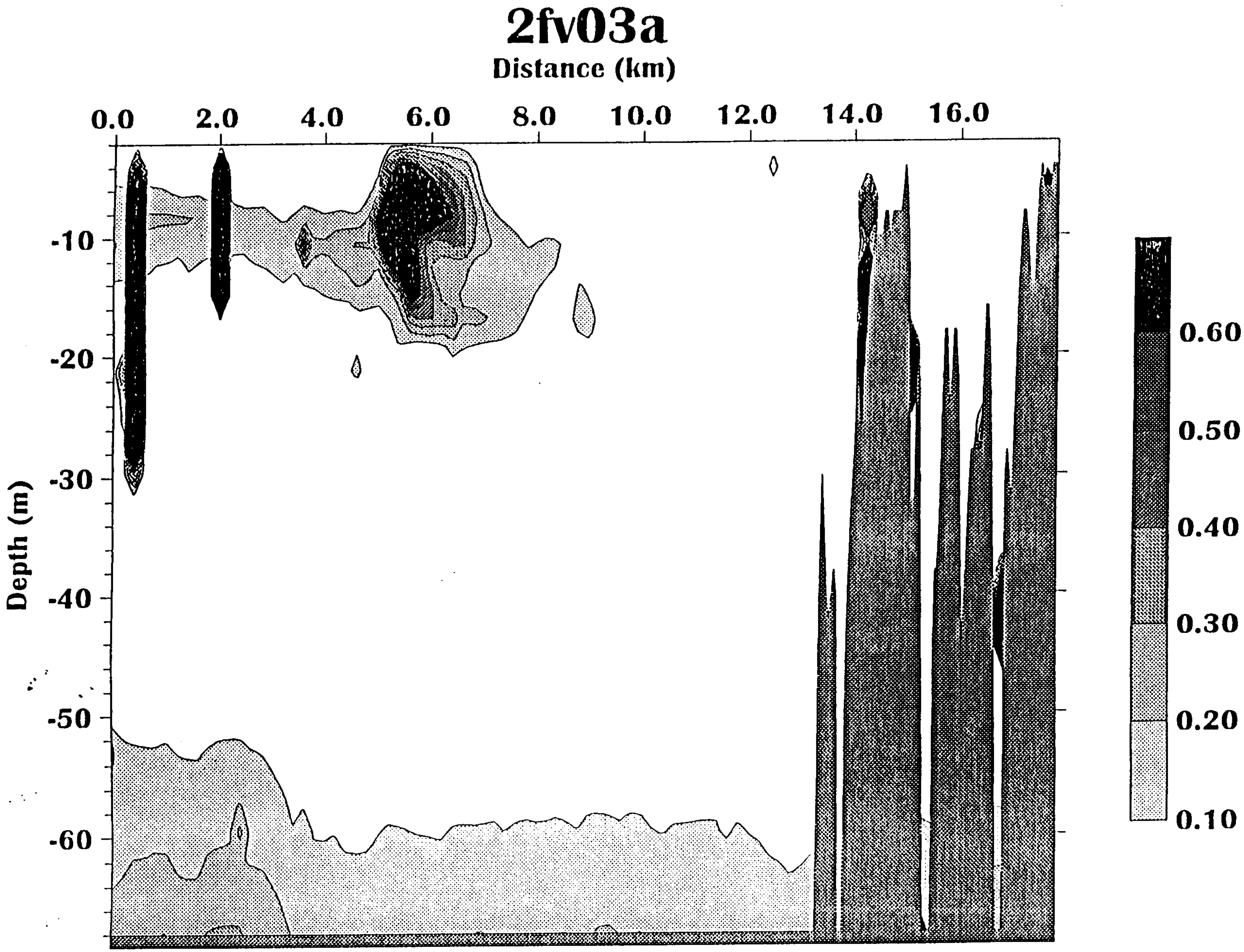


Figure 14. Distribution of biomass on Transect V03A in Valdez Arm (North area) during the second acoustic survey.

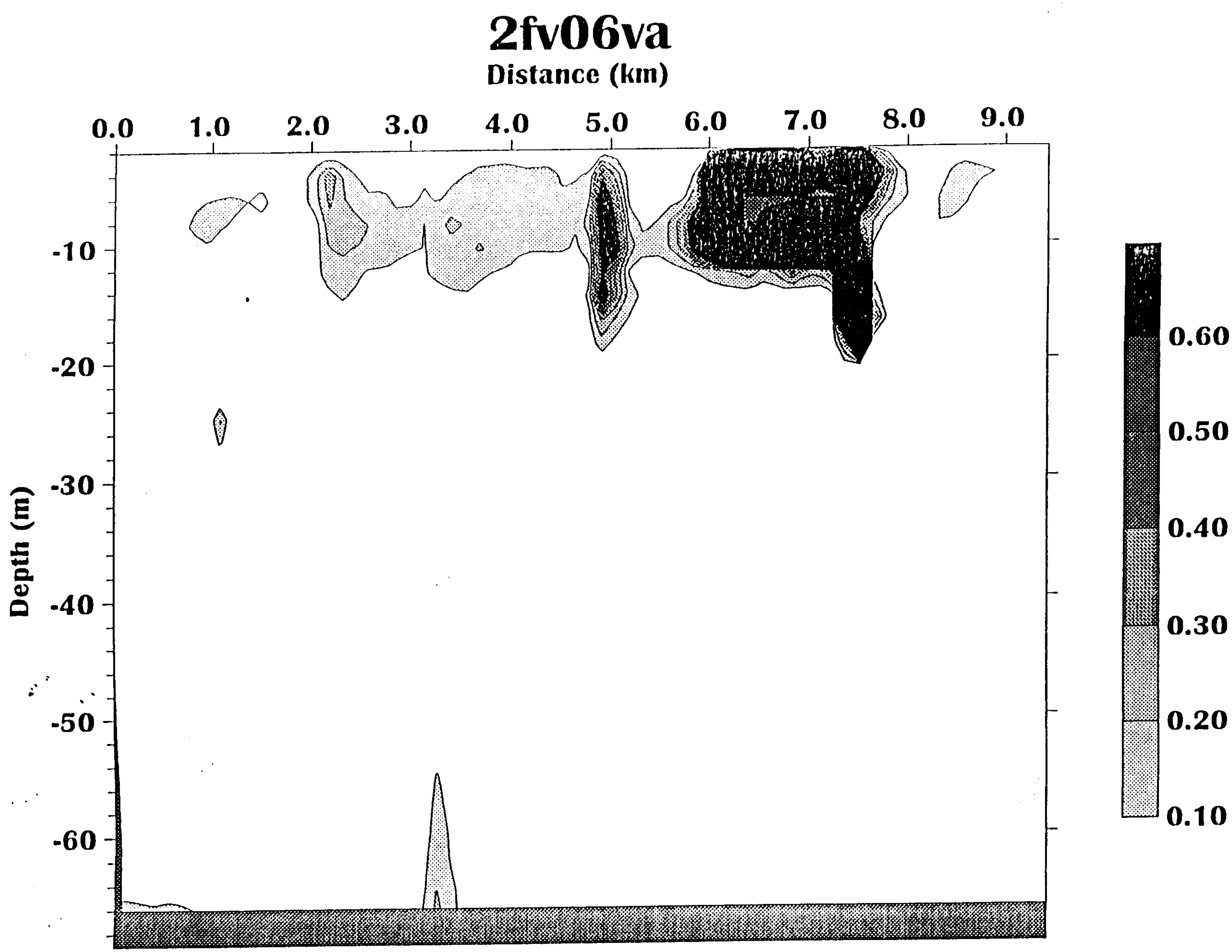


Figure 15. Distribution of biomass on Transect V06A in Valdez Arm (North area) during the second acoustic survey.

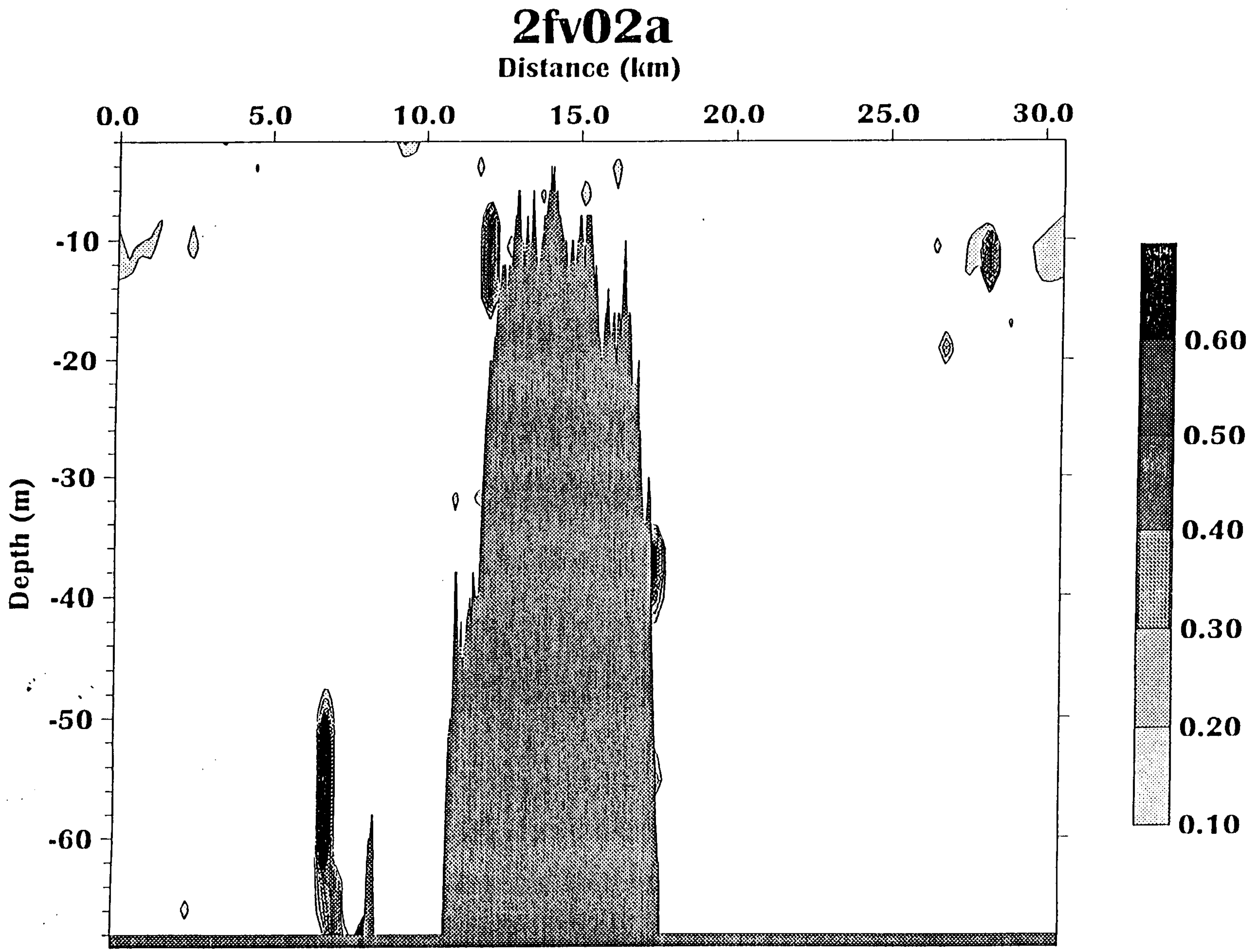


Figure 16. Distribution of biomass on Transect V02A in Port Fidalgo (North area) during the second acoustic survey.

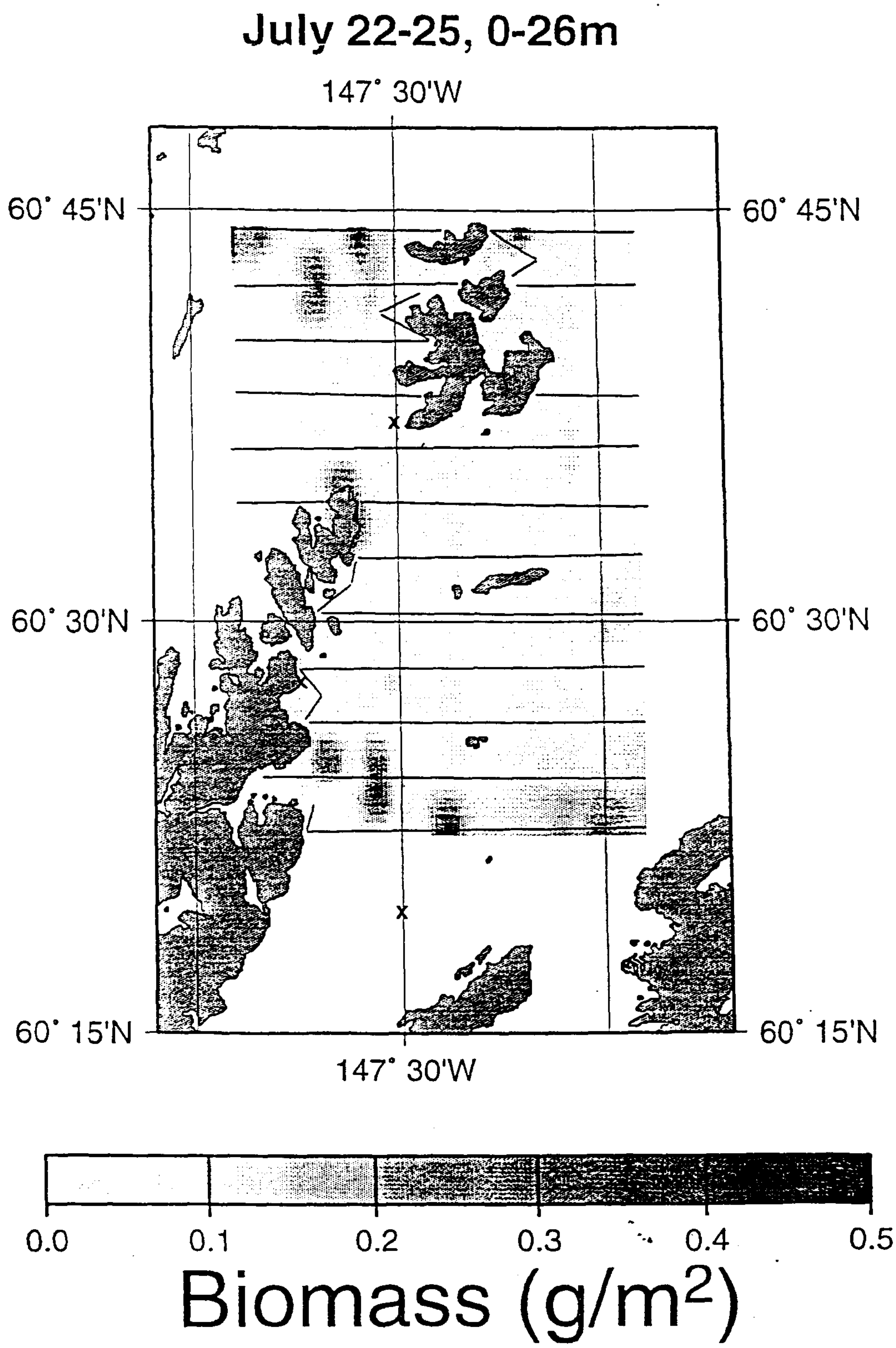


Figure 17. Geographic distribution of biomass in the shallow (<26 m) depth stratum of the Central study area during the first acoustic survey.

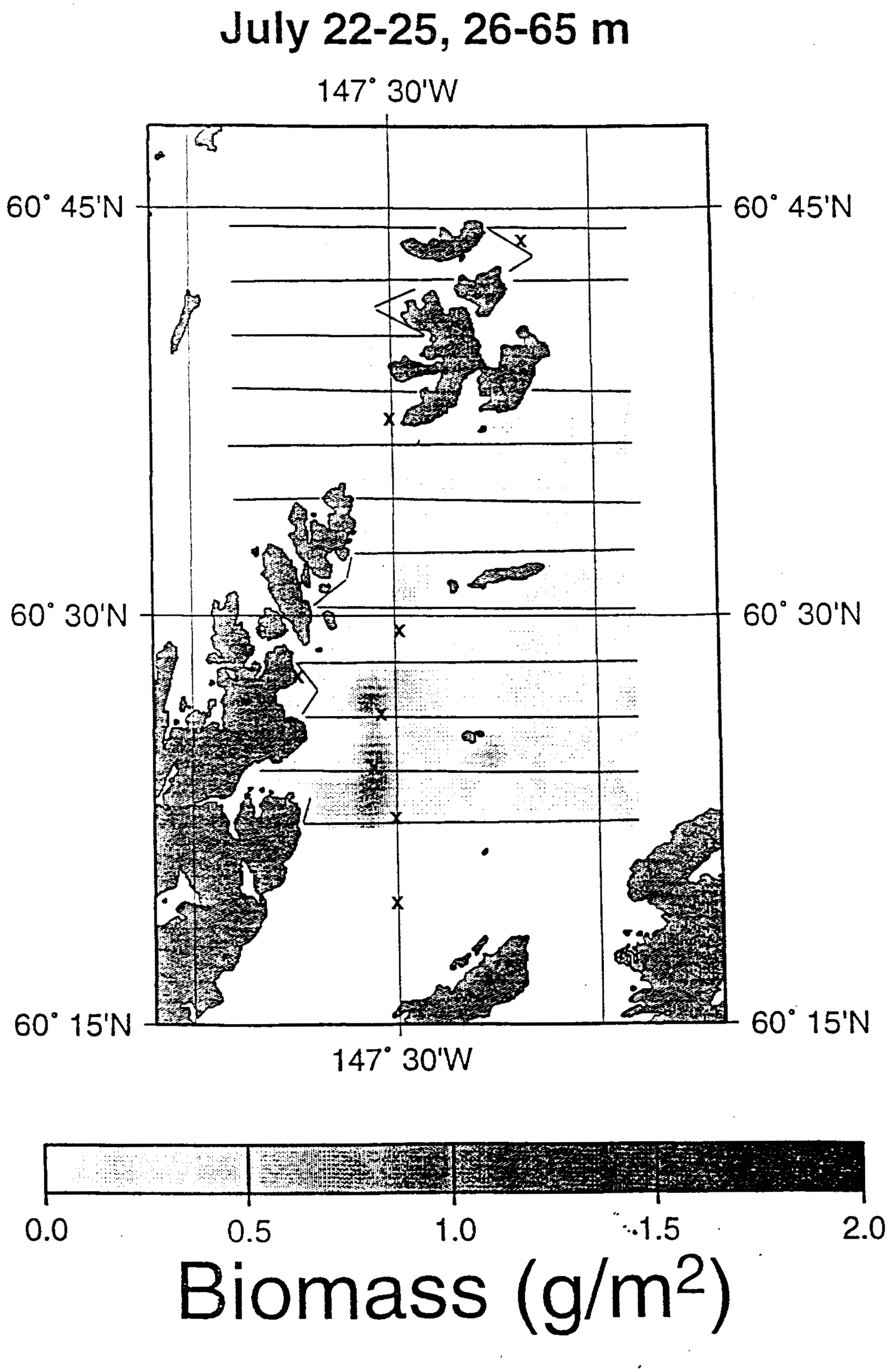


Figure 18. Geographic distribution of biomass in the deep (26 - 65 m) depth stratum of the Central study area during the first acoustic survey.

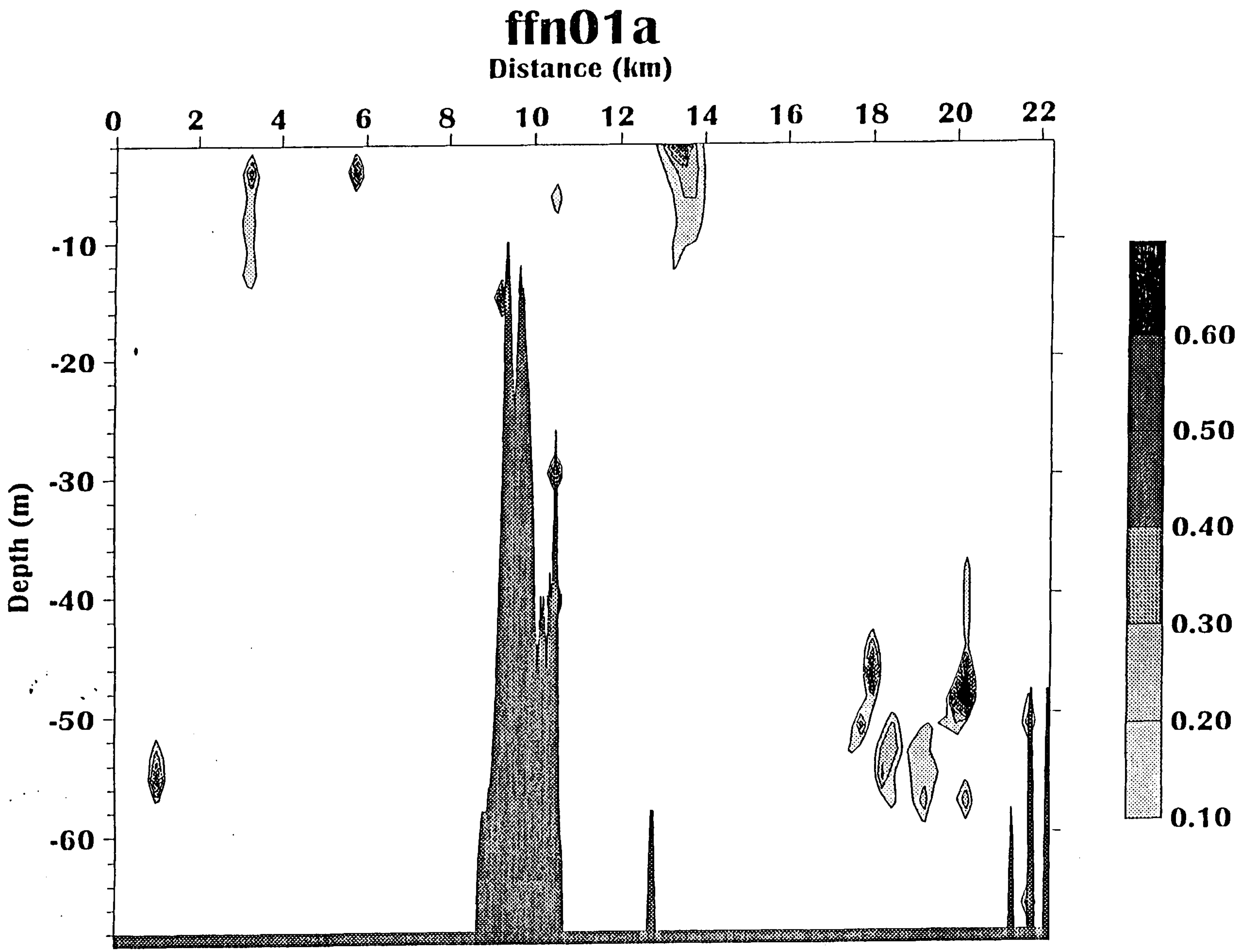


Figure 19. Distribution of biomass on Transect N01A east of Knight Island (Central area) during the first acoustic survey.

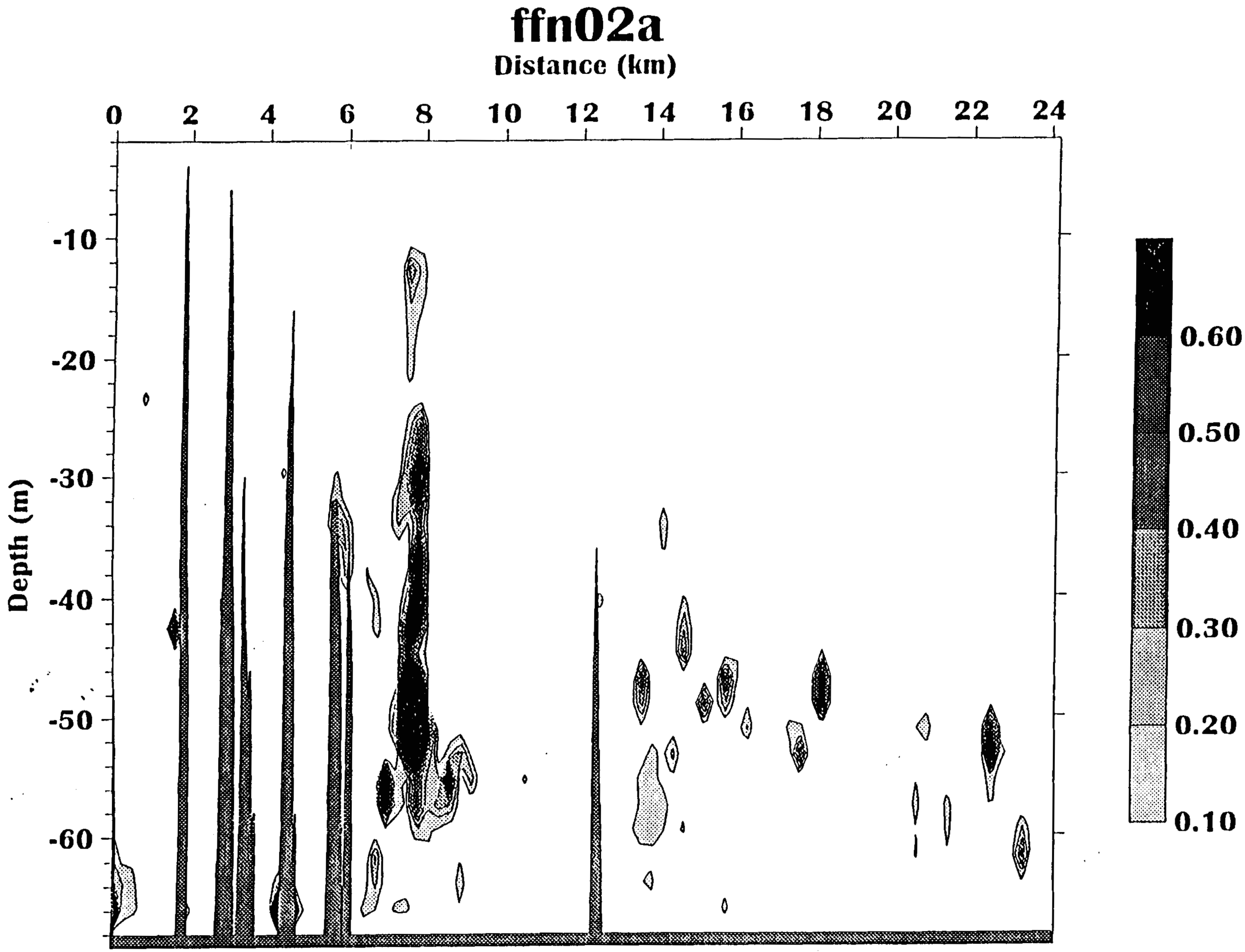


Figure 20. Distribution of biomass on Transect N02A east of Knight Island (Central area) during the first acoustic survey.

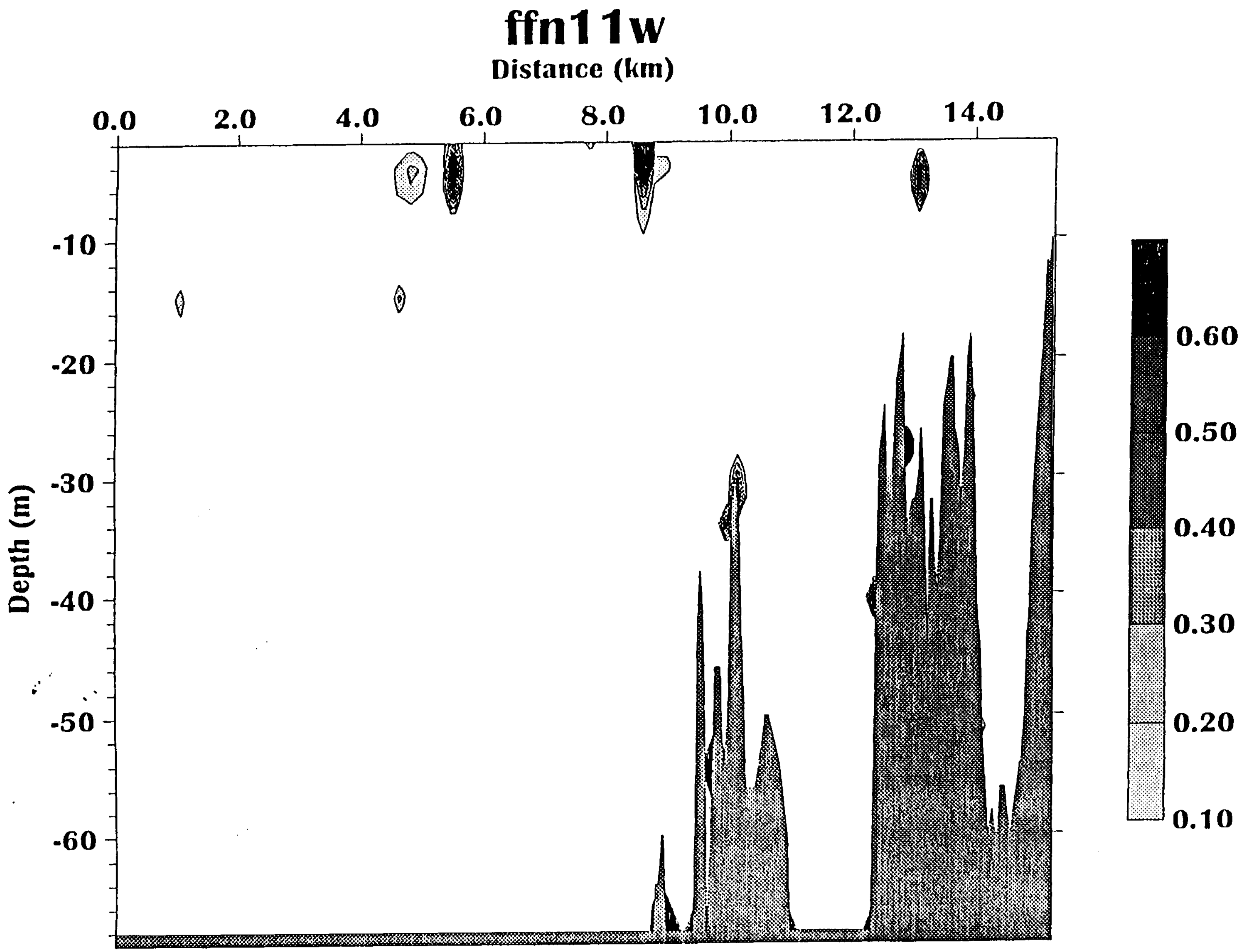


Figure 21. Distribution of biomass on Transect N11W west of Storey Island (Central area) during the first acoustic survey.

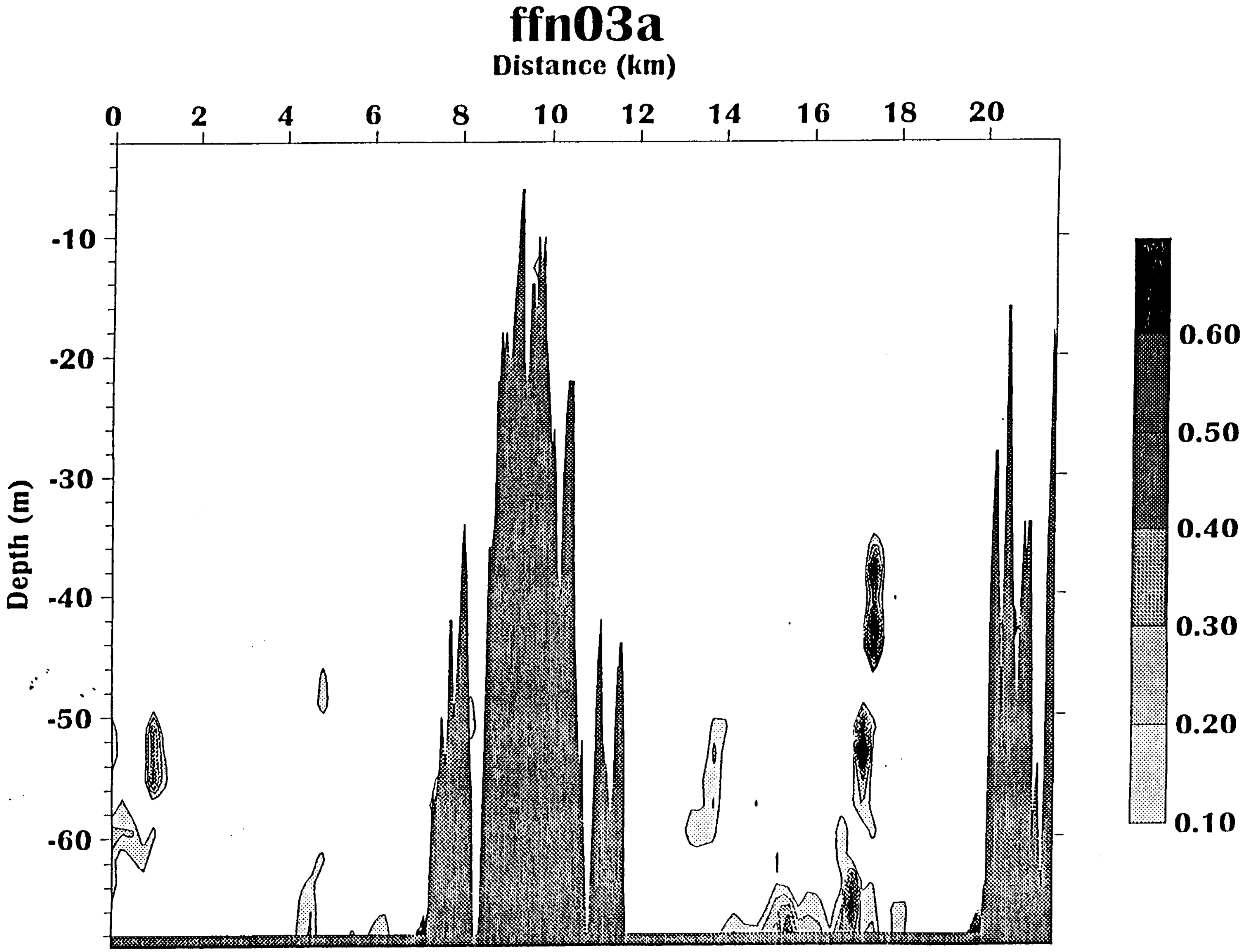


Figure 22. Distribution of biomass on Transect N03A east of Knight Island (Central area) during the first acoustic survey.

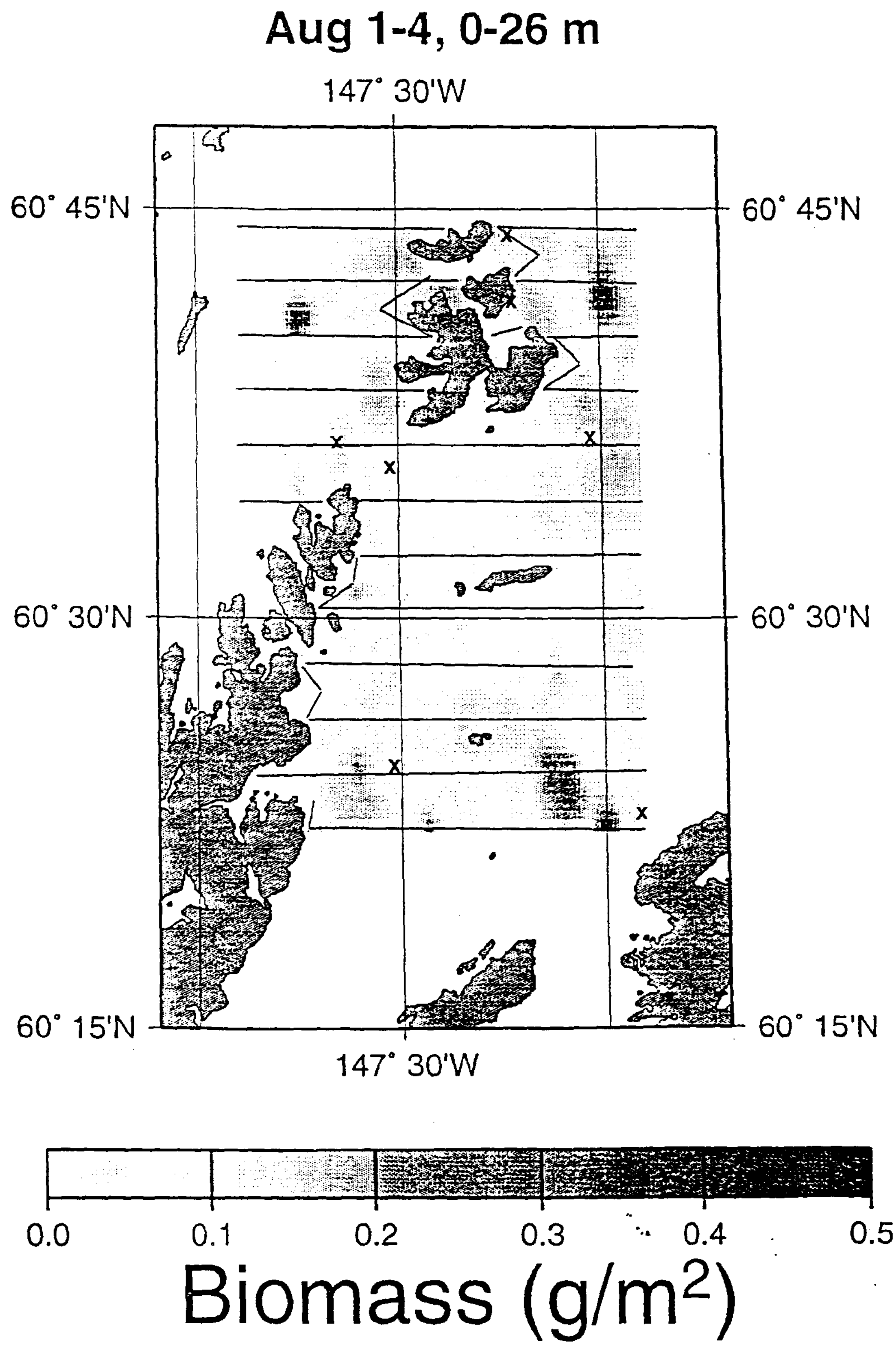


Figure 23. Geographic distribution of biomass in the shallow (<26 m) depth stratum of the Central study area during the second acoustic survey.

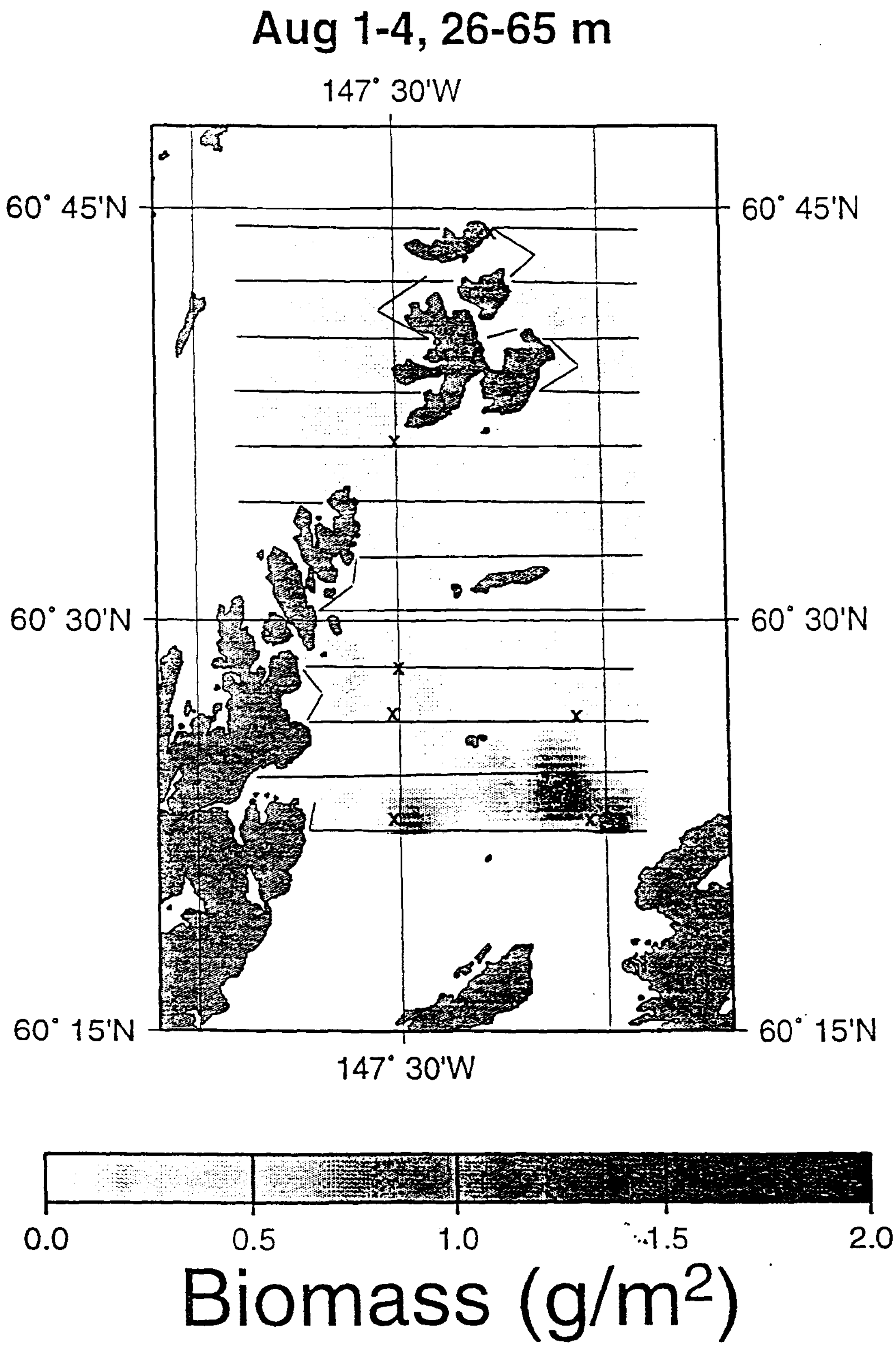


Figure 24. Geographic distribution of biomass in the deep (26 - 65 m) depth stratum of the Central study area during the second acoustic survey.

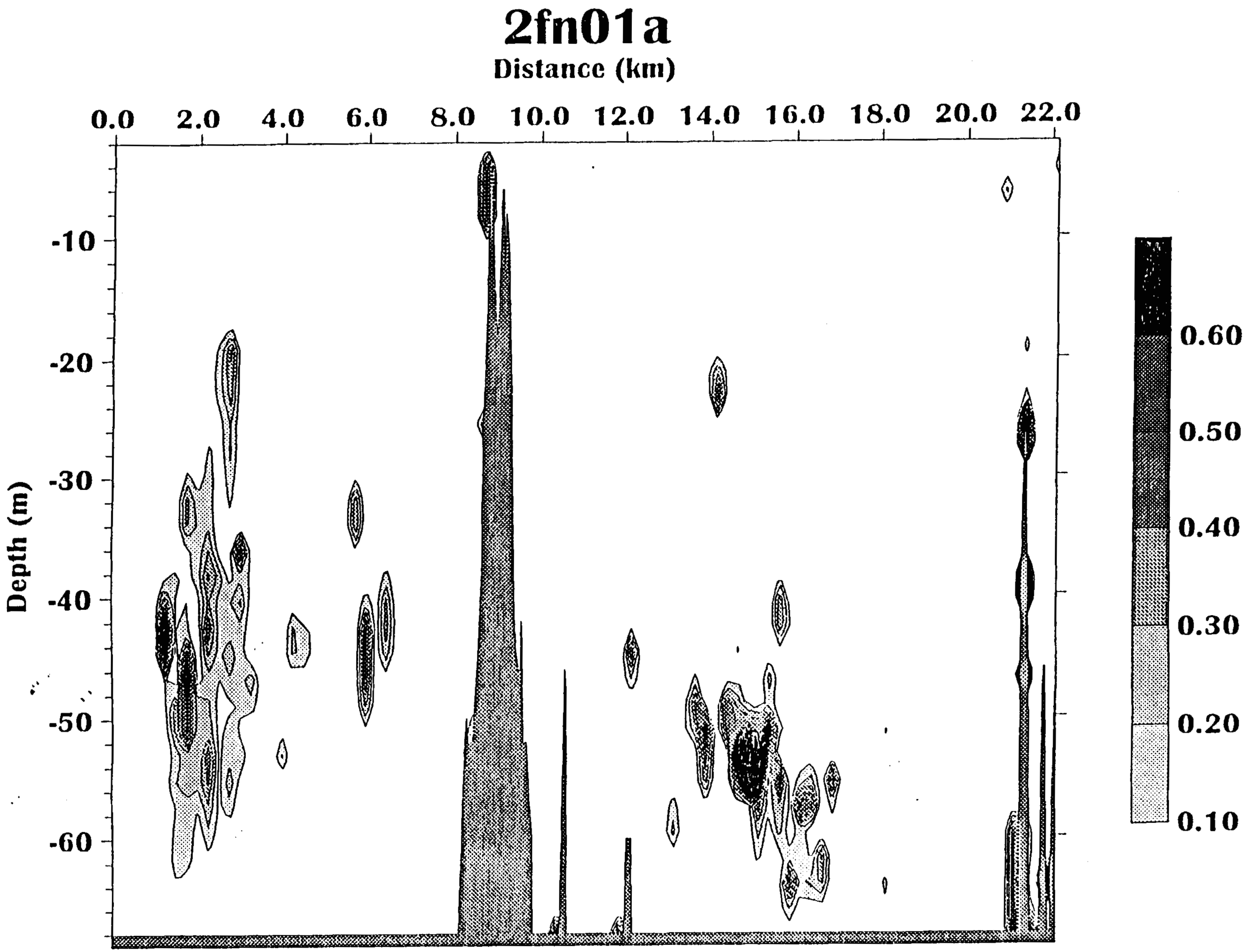


Figure 25. Distribution of biomass on Transect N01A east of Knight Island (Central area) during the second acoustic survey.

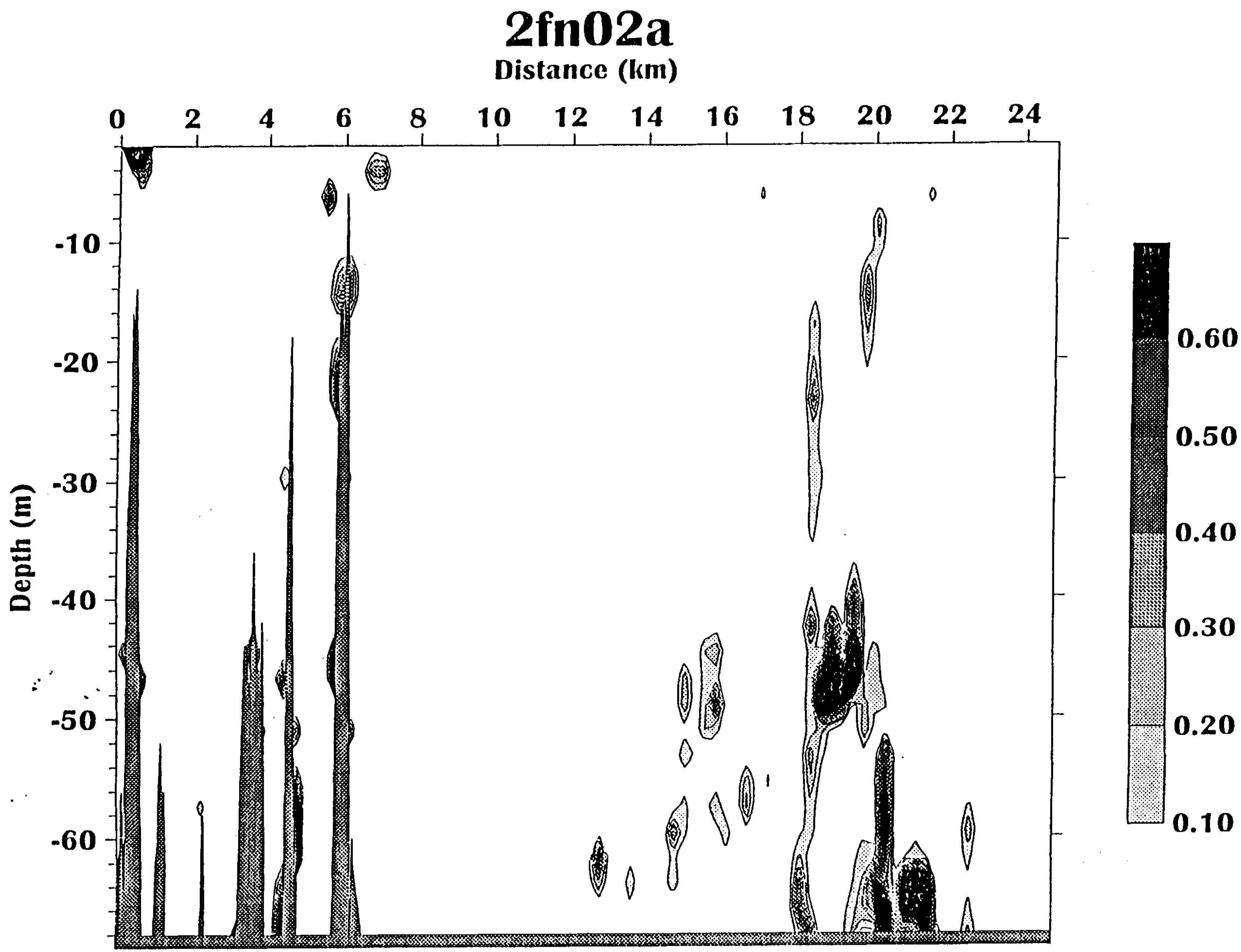


Figure 26. Distribution of biomass on Transect N02A east of Knight Island (Central area) during the second acoustic survey.

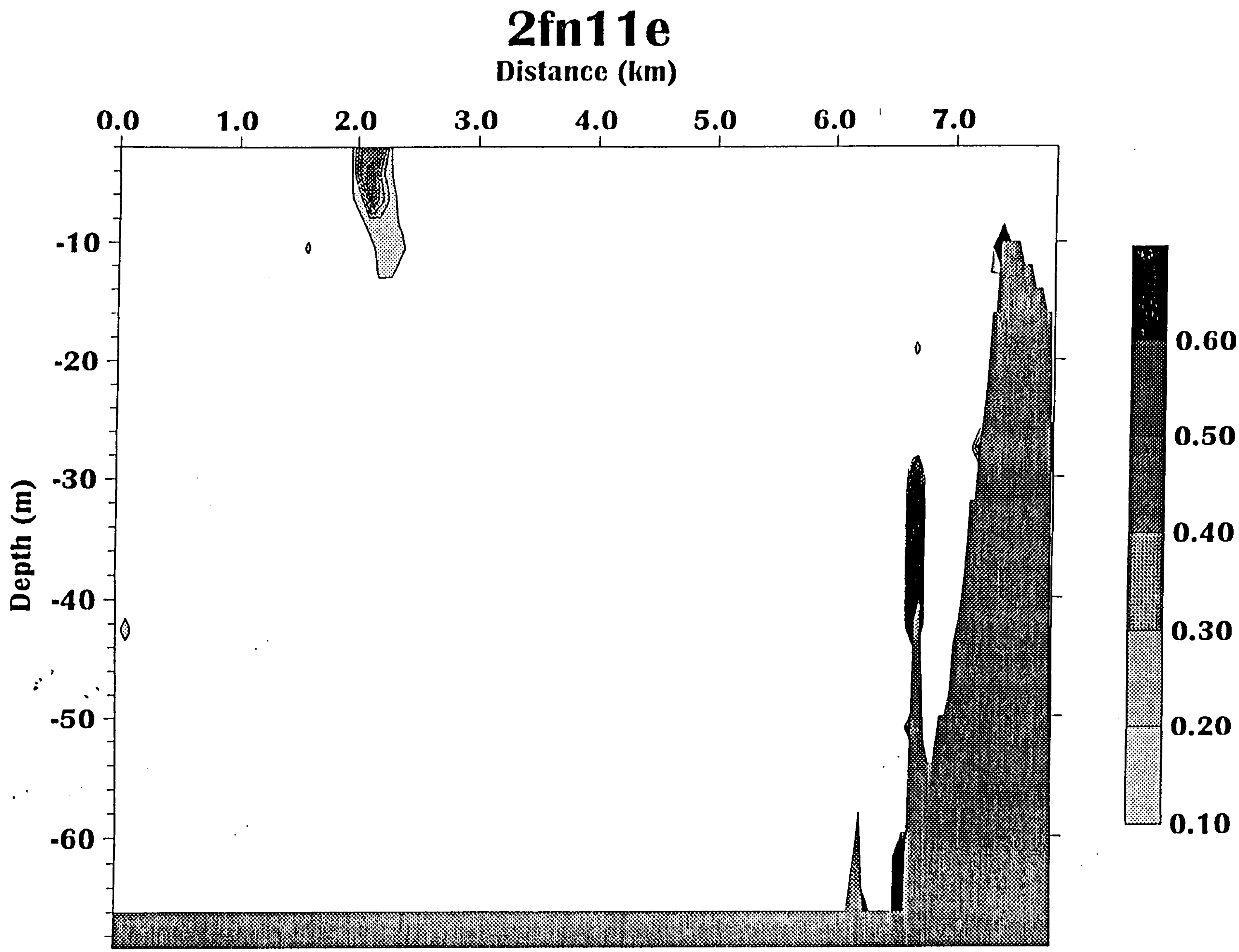


Figure 27. Distribution of biomass on Transect N11E east of Storey Island (Central area) during the second acoustic survey.

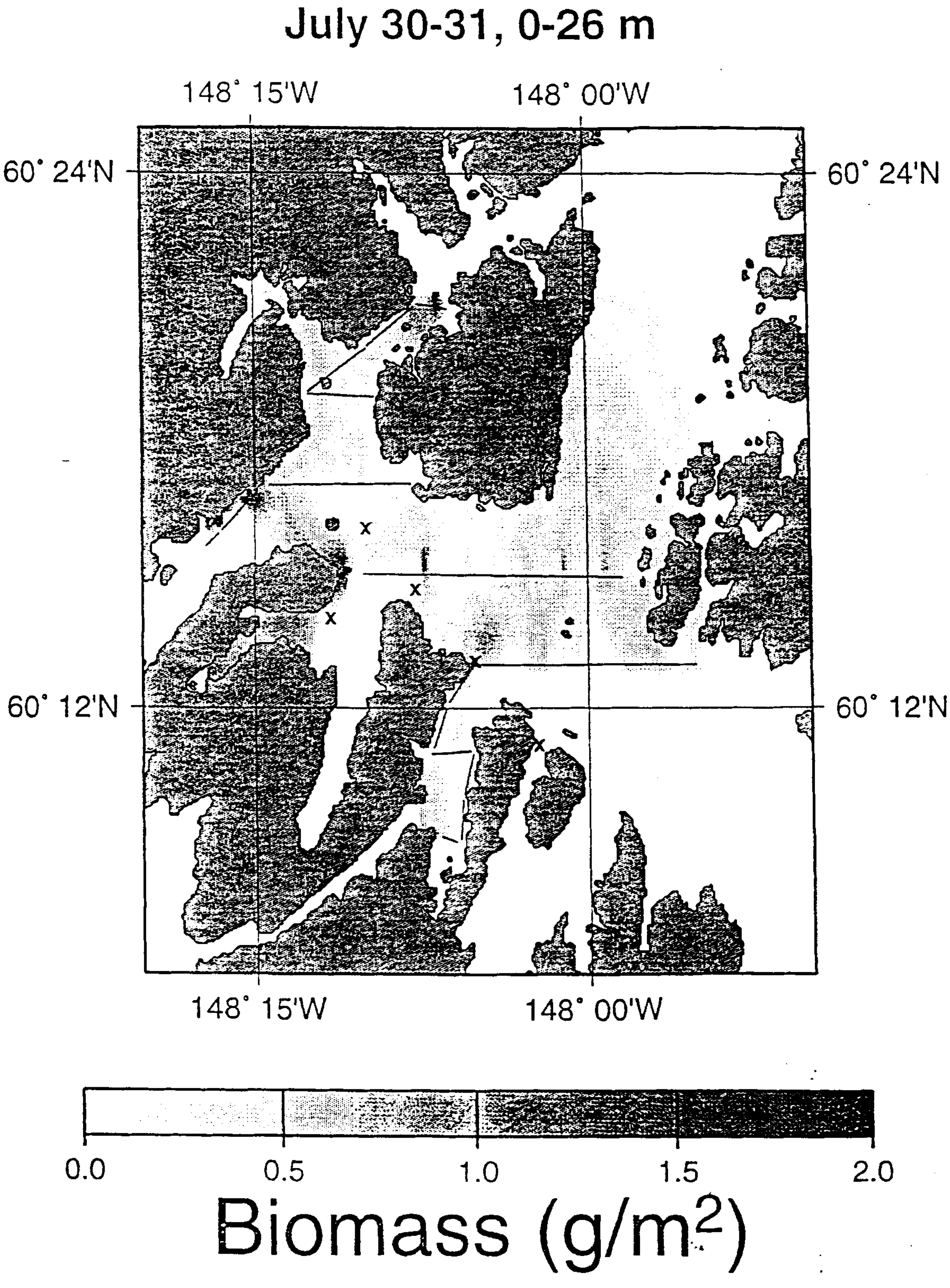


Figure 28. Geographic distribution of biomass in the shallow (<26 m) depth stratum of the South study area during the first acoustic survey.

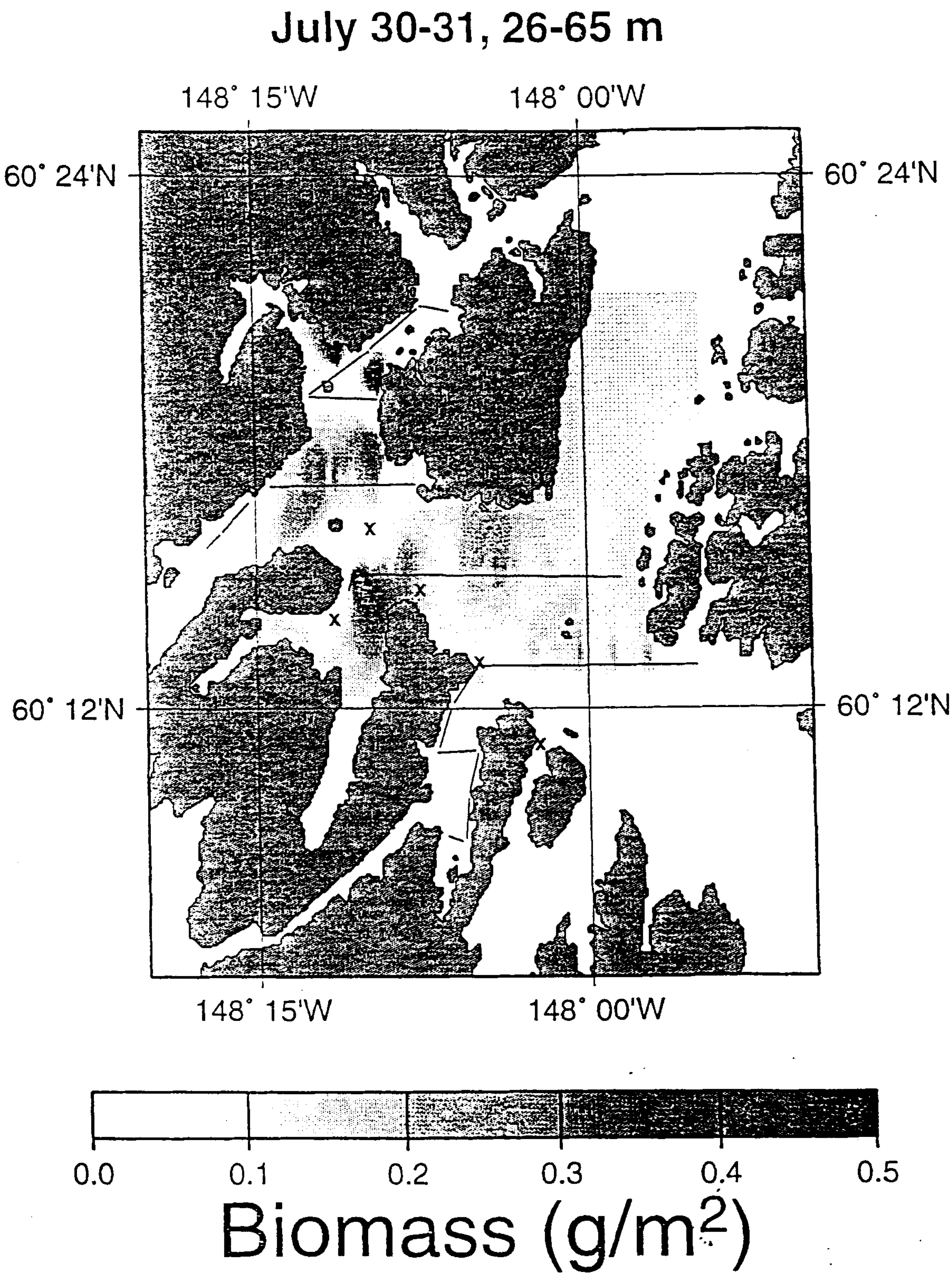


Figure 29. Geographic distribution of biomass in the deep (26 - 65 m) depth stratum of the South study area during the first acoustic survey.

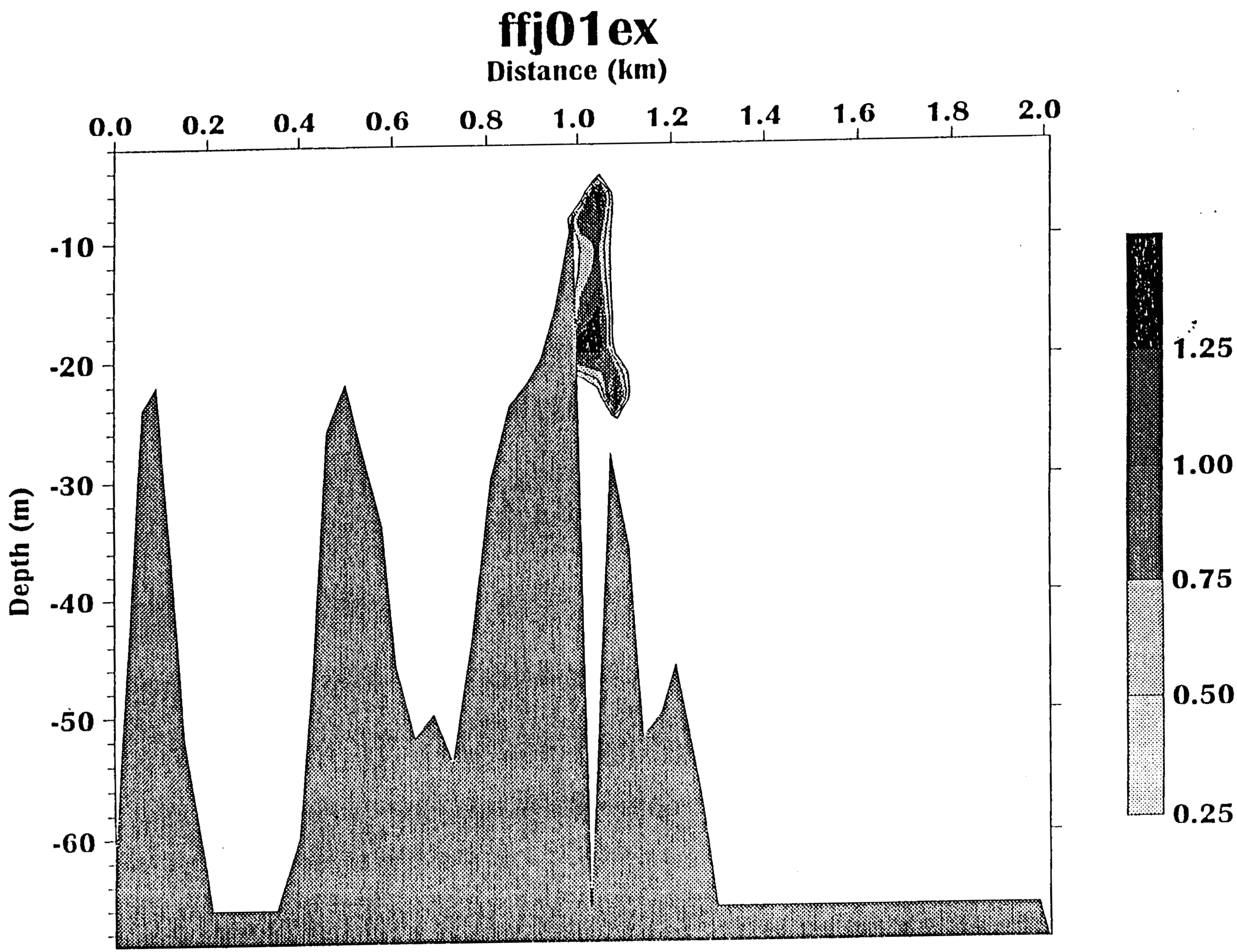


Figure 30. Distribution of biomass on Transect J01ex off Dual Head (South area) during the first acoustic survey.

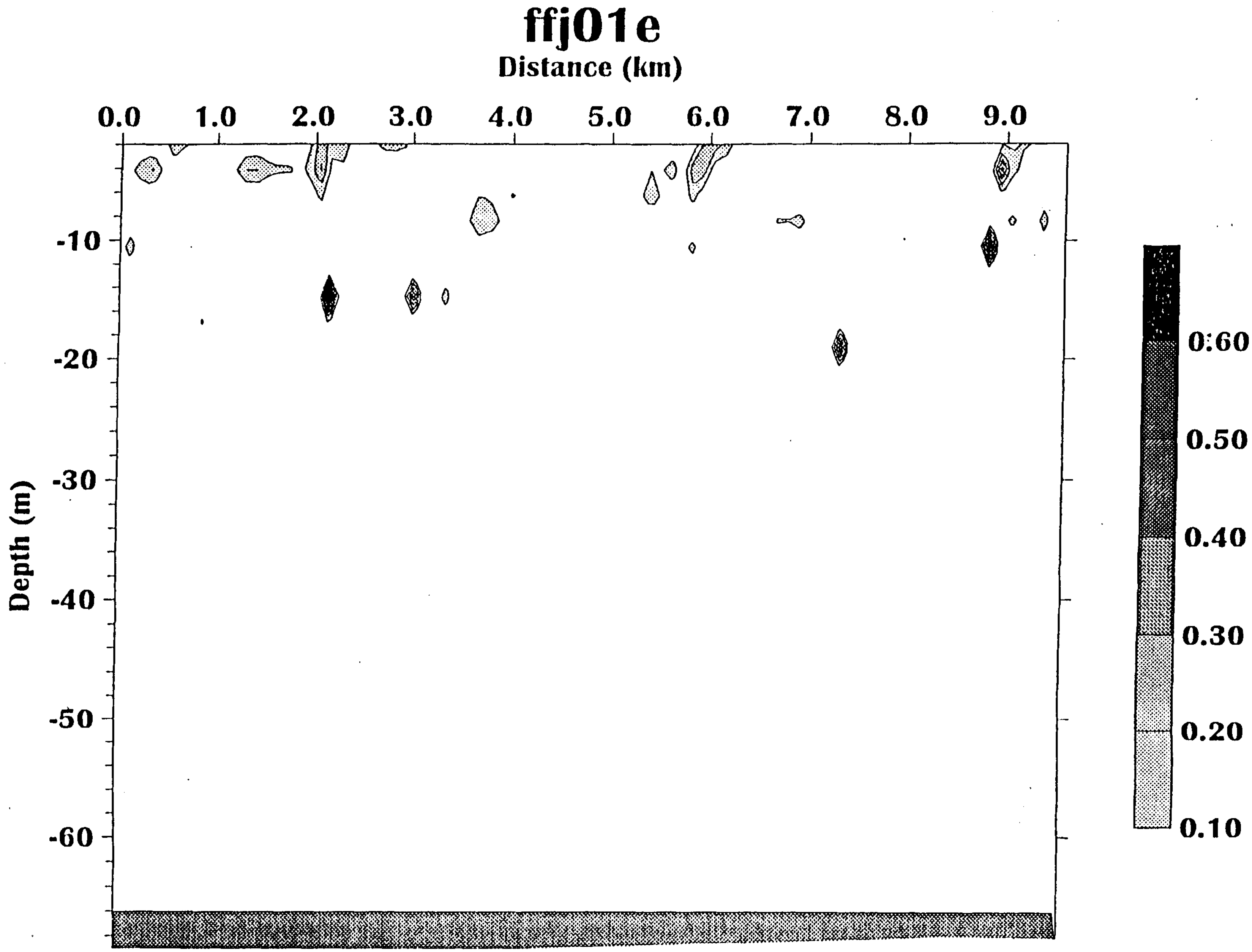


Figure 31. Distribution of biomass on Transect J01A in Knight Island Passage (South area) during the first acoustic survey.

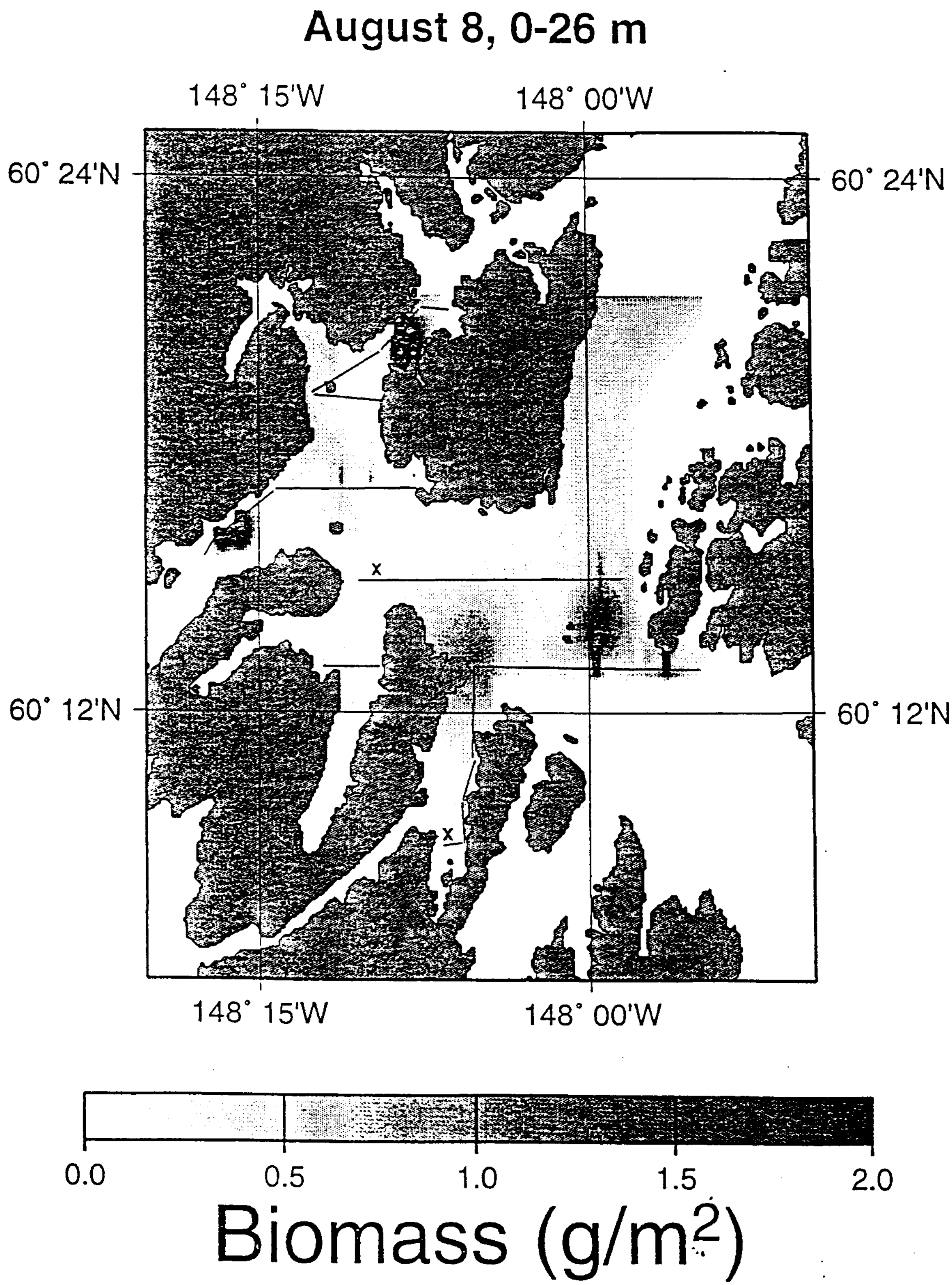


Figure 32. Geographic distribution of biomass in the shallow (<26 m) depth stratum of the South study area during the second acoustic survey.

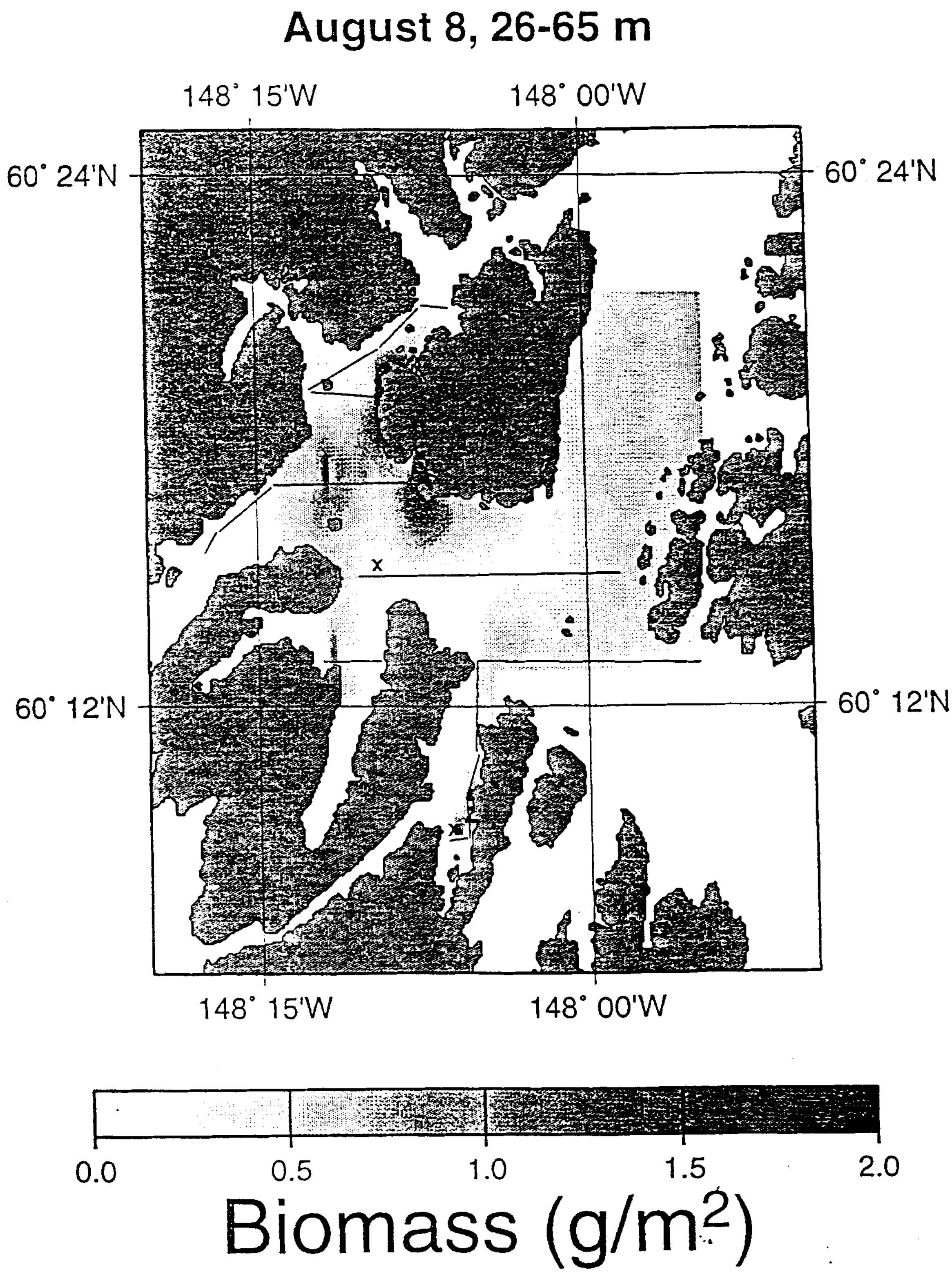


Figure 33. Geographic distribution of biomass in the deep (26 - 65 m) depth stratum of the South study area during the second acoustic survey.

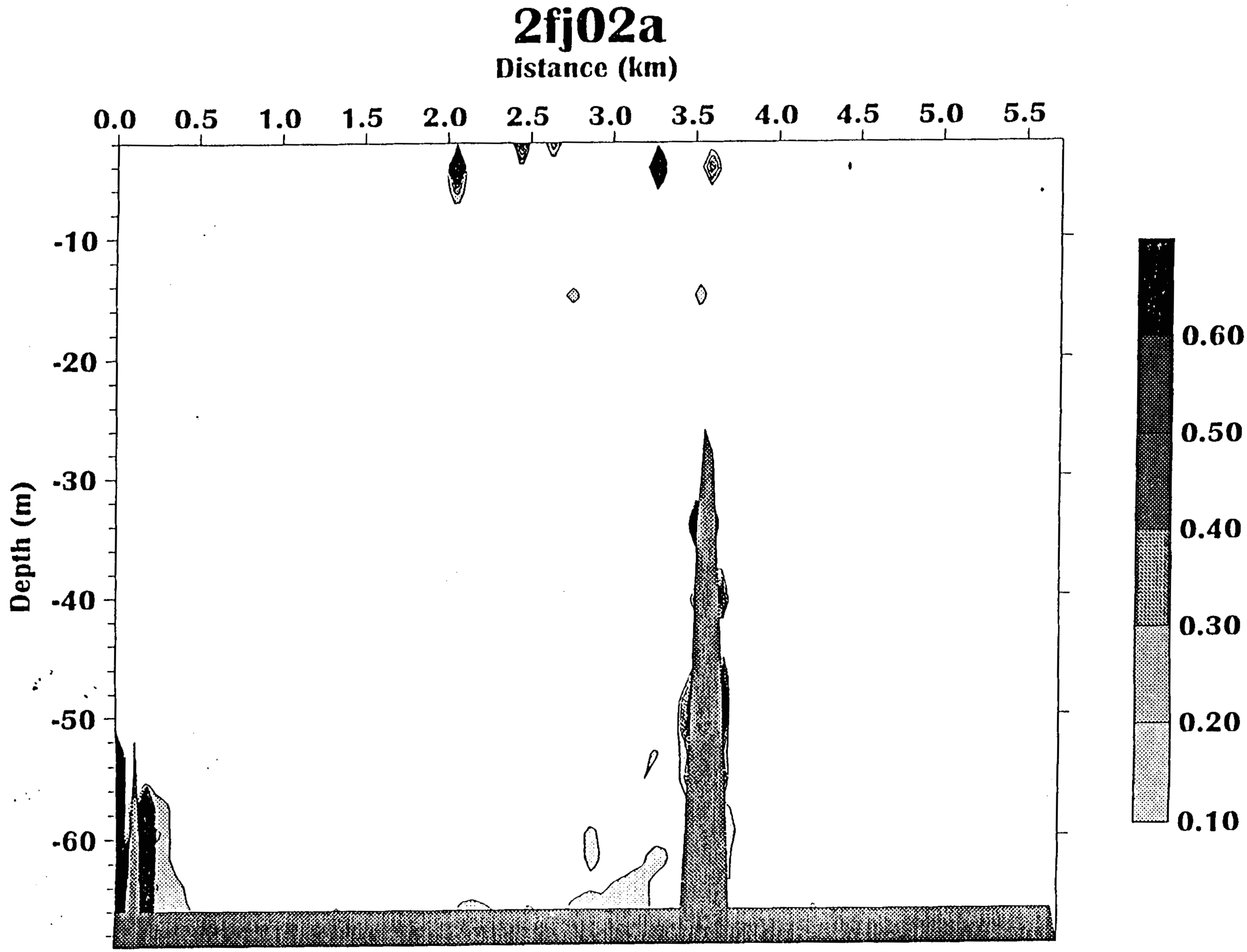


Figure 34. Distribution of biomass on Transect J02A in Dangerous Passage (South area) during the second acoustic survey.

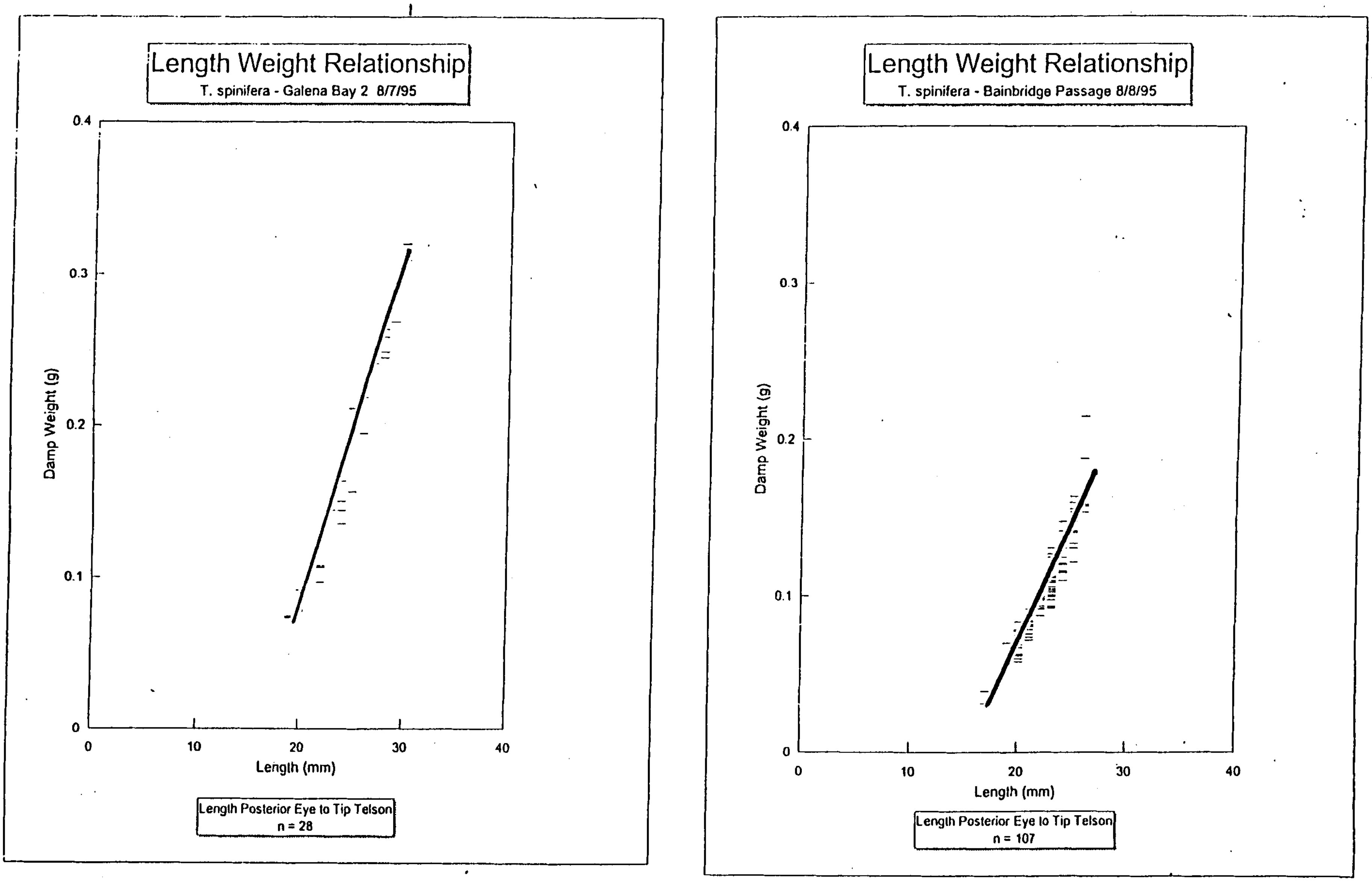


Figure 35. Length (mm)/weight (wet wt. in g) relationships of T. Spinifera from: A. Galena Bay collectod on August 7, 1995 and, B. Bainbridge Passage on August 8, 1995.

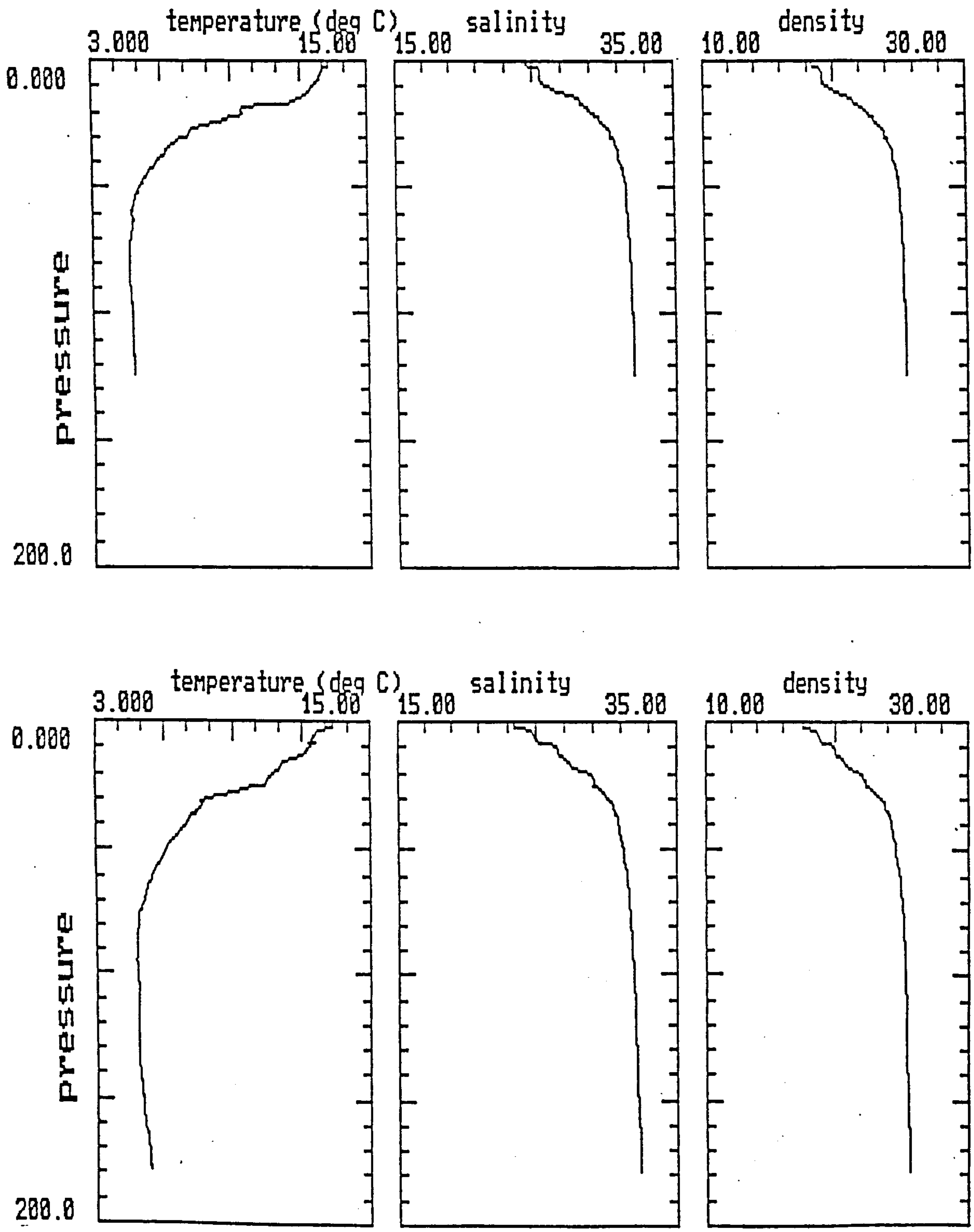


Figure 36. Vertical profiles of temperature, salinity and density (sigma-t) on transect V01A in the North area during the first (26 July) and second (5 August) surveys.

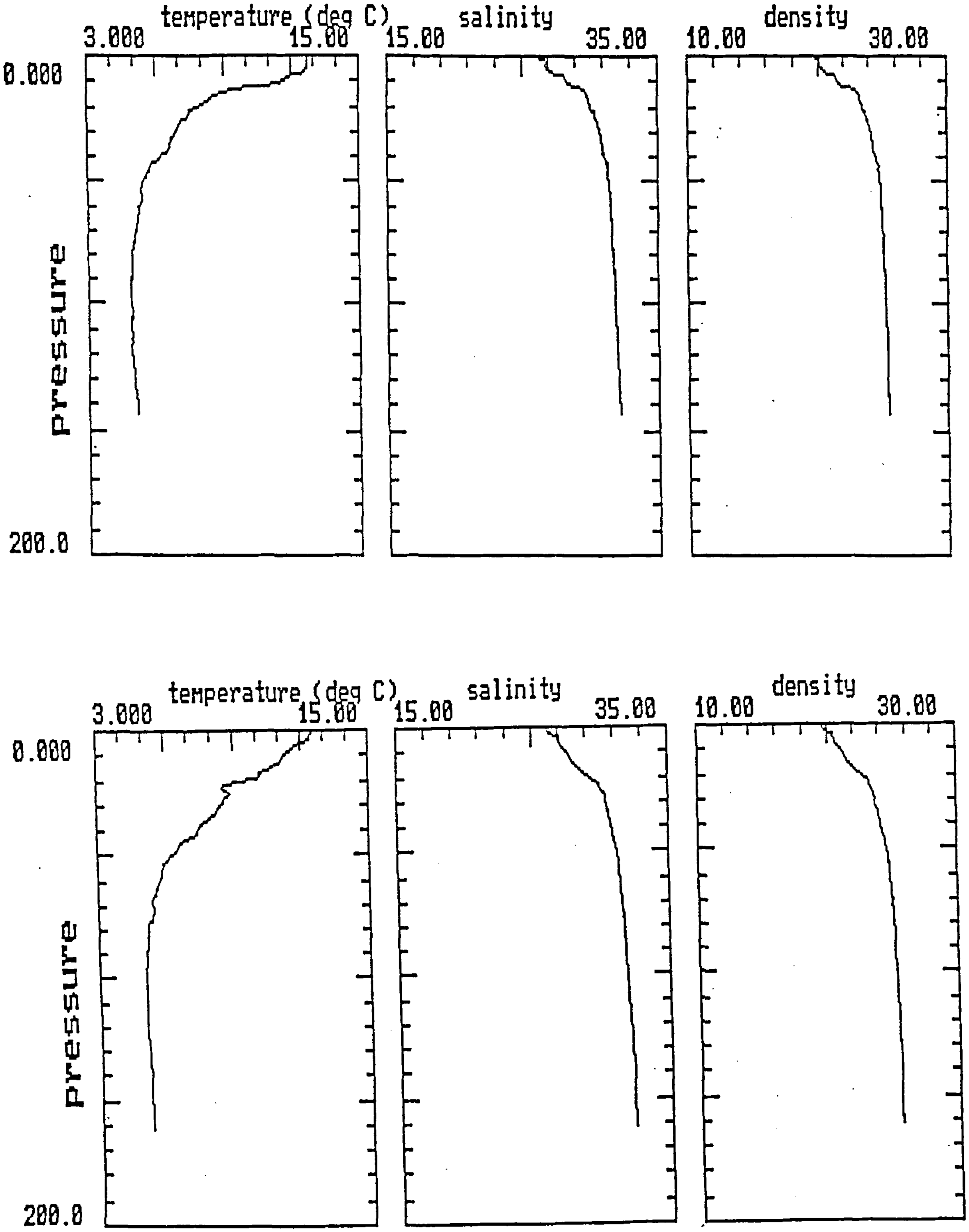
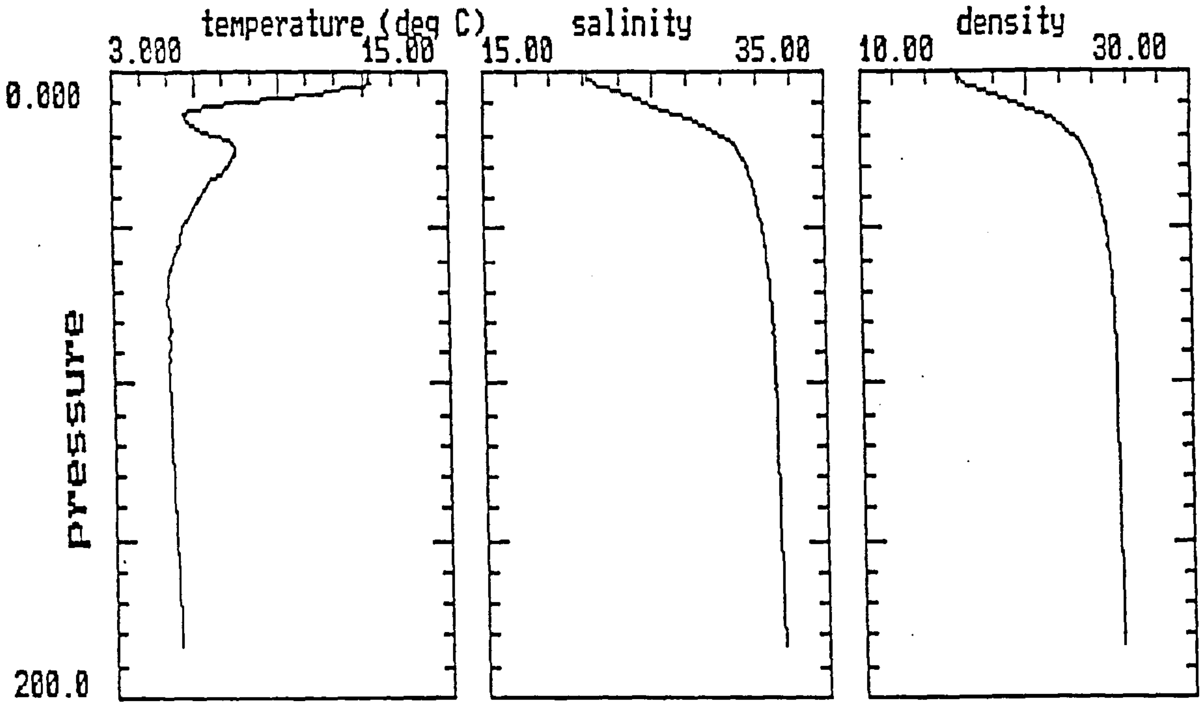


Figure 37. Vertical profiles of temperature, salinity and density (sigma-t) on transect N07A in the Central area during the first (23 July) and second (2 August) surveys.



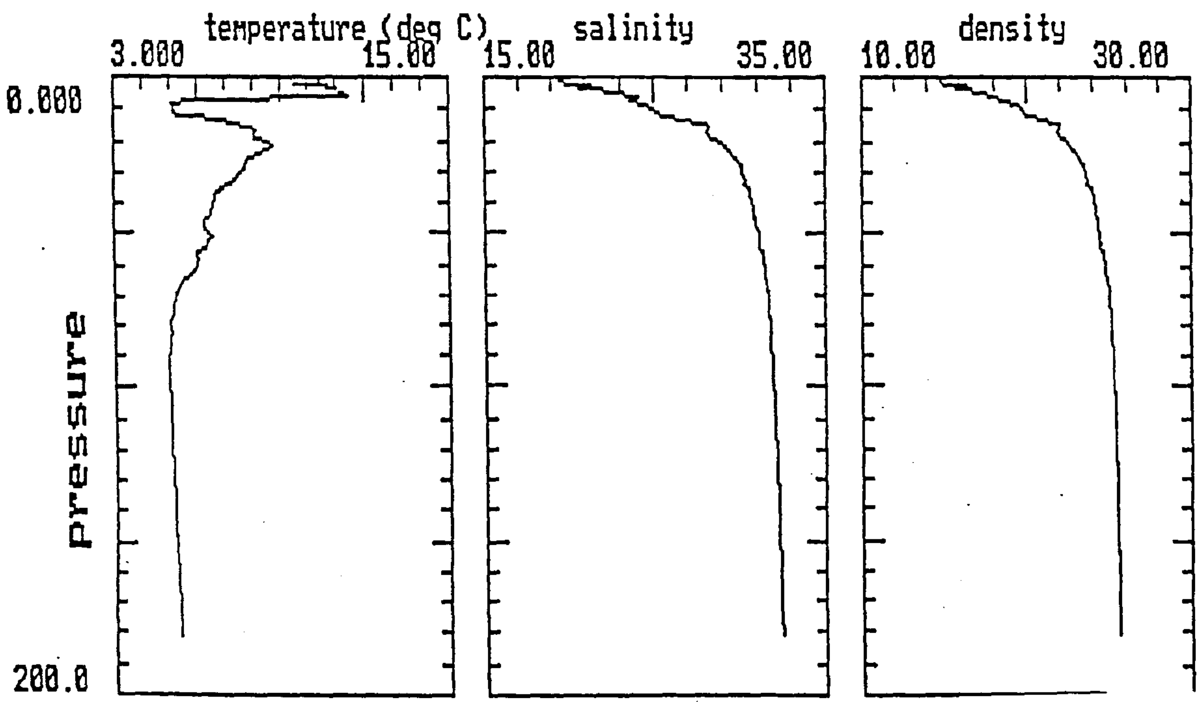


Figure 38. Vertical profiles of temperature, salinity and density (sigma-t) on transect J02A in the South area during the first (30 July) and second (8 August) surveys.