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Distribution of Neustonic Sablefish Larvae and Associated Ichthyoplankton in the Eastern Gulf of Alaska, May 1990

by
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ABSTRACT

Ichthyoplankton were taken in neuston tows at 67 oceanographic stations in the eastern Gulf of Alaska (east of long. 140°W and between lat. 54°30'N and lat. 58°N) in-May 1990. Larvae of 25 taxa and eggs of 6 taxa were identified. Sablefish (Anoplopoma fimbria) were the most abundant species observed and most frequently captured larvae (57 stations). The highest catches of sablefish larvae (46 per 10 m^2) were observed during night sampling, 160 km offshore. Pacific sand lance (Ammodytes hexapterus) larvae ranked second in abundance and third in frequency of occurrence in our samples. Larvae of greenlings (Hexasrammos spp.) ranked third in abundance and second in frequency of occurrence. Irish lord larvae (Hemileoidotus spp.) ranked fourth in abundance and third in frequency of occurrence in our samples.

Abundant quantities of fish eggs for ragfish (Icosteus aenismaticus), Dover sole (Microstomus oacificus), and rex sole (Errex zachirus) were observed in our samples. Ragfish eggs were most numerous offshore in the southern half of the study area. Dover sole eggs were most numerous over the continental shelf and slope in the northern half of the study area. Rex sole eggs were most numerous at two offshore stations west of Sitka.

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INTRODUCTION

Sablefish (Anonlopoma fimbria (Pallas)), commonly sold as blackcod or butterfish, presently ranks fourth in value of Alaskan groundfish (Kinoshita et al.[1] in prep., P. Bearden, National Marine Fisheries Service (NMFS) Alaska Regional Office, Juneau AK 99802, pers. commun. 16 February 1995). Sablefish recruit to the fishery at age 4 or 5 years. Recruitment is characterized by large variations of year-class strength; consequently the catch may be strongly influenced by a single year class for 4 or more years (McFarlane and Beamish 1986, Saunders et al. 1987, Sigler and Fujioka 1988). Early forecasts of recruitment depend on an understanding of the ecology of the pre-recruits, particularly that of the eggs and larvae. A better understanding of the physical and biological determinants of growth and survival of larval sablefish may contribute to improved forecasts of recruitment 3-5 years before a year class enters the fishery (Kendall and Matarese 1987).

Anecdotal information from the commercial fishery suggests that the peak spawning period for sablefish in the eastern Gulf of Alaska occurs late February through March along the continental shelf slope. This is about 2 weeks to a month later than the spawning time reported for sablefish in British Columbia by Mason et al. (1983). Although some sablefish spawning may be as shallow as the shelf break (200 m), most spawning is below

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[1] Kinoshita, R. K., A. Greig, J. D. Hastie, and J. M. Terry. In Prep. Economic status of the groundfish fisheries off Alaska, 1994. U.S. Dep. Commer. NOAA Tech. Memo.

300 m (Mason et al. 1983). Investigations off Oregon and California indicate that some sablefish spawning may occur as deep as 3,000 m and 370 km offshore (H. G. Moser, NMFS, La Jolla, CA 92038, pers. commun., 1991). McFarlane and Beamish (1992) theorize that pelagic sablefish eggs take about 2 weeks to hatch at depths of 200-400 m and that the developing yolk-sac larvae sink to l,000-1,200 m before they start feeding. When the sablefish yolk-sac nears 50% absorption the larvae begin to feed, swim toward the surface, and become neustonic (McFarlane and Beamish 1986, 1992; Kendall and Matarese 1987). We have collected sablefish larvae and early juveniles in neustonic samples in the eastern Gulf of Alaska from April though July. During this neustonic period, young sablefish growth and survival could be strongly affected by oceanic conditions, especially temporal changes in ocean currents.

Coastal currents in the southeastern Gulf of Alaska have not been described in as much detail as the currents of the western Gulf of Alaska. There have been no consistent attempts to monitor annual and seasonal variation of the eastern Gulf of Alaska currents. Net transport along the coast of Southeast Alaska is northward from Dixon Entrance to the entrance of Prince William Sound. Several components of this northward flow are known to vary greatly from year to year and within a season, most notably the Haida Current (Thomson and Emery 1986) and the Sitka Eddy (Tabata 1982).

The objective of -the Auke Bay Laboratory's Marine Resource Ecology task is to provide an understanding of environmental variation and environmental effects on fisheries. In May 1990, when sablefish larvae were expected to be abundant, we examined ichthyoplankton distribution and temperature-salinity conditions in the eastern Gulf of Alaska. This report describes the distribution of neustonic fish larvae in the Gulf of Alaska east of 140°W and the potential relationship of this distribution to coastal currents. The results of oblique bongo net sampling conducted during the cruise will be published separately.

METHODS

Zooplankton samples were taken by the NOAA ship Townsend Cromwell, 7-22 May 1990, at 67 stations along 8 east-west transects from Dixon Entrance (54°30'N) to Cross Sound, Alaska (58°00'N). Transects extended across the continental shelf from nearshore to 136°00'W in the south and to 140°00'W in the north (Fig. 1, Appendix Table 1). Oceanographic profiles were taken at 95 stations. Nine oceanographic stations (87-95) were occupied twice because an unplanned 2-day break at the beginning of the cruise caused a change in the sequence in the sampling of stations. Because of the time constraints for completing the oceanographic survey, zooplankton samples were not collected at all oceanographic stations. Neustonic samples were collected at 66 stations either immediately before or after the oceanographic profiles were collected. On the last day of the cruise, we reoccupied Station 44 to collect 7 neuston samples during the day and 7 samples at night.

Neuston were sampled with a 50 cm by 30 cm Sameoto neuston net (Sameoto and Jaroszynski 1969) equipped with a 0.505 mm mesh net and plastic cod end. Flow meters were not installed in the net frame. To provide standardized catch data, all tows were made at 7.4 km h-l (4 knots) for 15 minutes. Duration of each tow was recorded to the nearest second. Nominally, a tow of 1 nautical mile sampled approximately 926 m^2. Assuming that the net samples the top 15 cm of the water, such a tow filtered 139 m^3. Immediately upon retrieval, the net was washed down carefully and the catch preserved in a 4% formaldehyde-seawater solution buffered with sodium tetraborate.

In the laboratory, all fish eggs and fish larvae were removed from each sample. Eggs and larvae in samples were identified by comparison with descriptions in Matarese et al. (1989) and reference specimens. Egg diameter-s and fish lengths were measured using an ocular micrometer. After processing, the eggs were stored in a 4% formaldehyde solution and the fish larvae in 40% isopropyl alcohol. The invertebrates collected during the sampling were stored in 40% isopropyl alcohol, and tar and plastic debris were stored in sterile water.

Oceanographic data were obtained using Sea-Bird Electronics, Inc. SEACAT SBE 19 Mini-CTDs (conductivity-temperature-depth recorders) and processed using SEASOFT 3.3H software. All CTD casts were to a depth of l,000-1,100 m or to within 10 m of bottom when over the continental shelf. Contour plots of temperature, salinity, density (sigma-t), and ichthyoplankton distributions were adapted from plots using the Golden Software, Inc. program SURFER V. 3.00.

RESULTS

Neuston Collections

A total of 86 neuston tows were made at 67 stations during the cruise. Sixty-six stations were sampled during the quasi-synoptic survey, of which 6 were sampled twice due to a change in sampling sequence. Fourteen of the samples were taken when Station 44 was reoccupied for the day-night comparisons.

Twenty-five taxa of fish larvae were identified in the neuston samples (Table 1). Sablefish was the most abundant and second most frequent species, occurring at 57 of the 67 neuston stations. More than 13,000 sablefish larvae were collected during the survey and an additional 811 were taken during the day and night replicate tows (190 and 621, respectively). The largest catches of larval sablefish were at stations located beyond the edge of the continental slope from 45 to 160 km offshore (Fig. 2). All samples yielding more than 100 sablefish larvae were taken during hours of darkness, except at Station 39 which was sampled near sunrise. Samples taken during full daylight generally had low (<lOj catches of sablefish larvae. The few daylight samples with greater than 10 sablefish larvae

were observed adjacent to areas with high nighttime catches and near or beyond the continental slope. Nearshore stations had zero or low sablefish catches during both daylight and darkness.

Although variances were high, comparison of the day-night replicate tows at Station 44 (Table 2) indicated that nighttime catches of sablefish larvae (i = 89+73) were significantly greater than daylight catches (i = 27+14) by threefold (p c 0.05, t-test for difference of means with unequal variances, Ostle 1963).

Other abundant species encountered in our samples were Pacific sand lance (*Ammodytes hexaoterus*), three species of greenlings (*Hexasrammos* spp.), and three species of Irish lords (*Hemileoidotus* spp.).

Pacific sand lance were present as larvae and early-stage juveniles, ranking second in abundance and tied for third -in frequency of occurrence (Table 1). Most (97%) of the 9,021 sand lance were collected at night (Table 1). Both nearshore and offshore areas of sand lance abundance were evident in the night catches. The largest night catch of Pacific sand lance (8,131 at Station 95, Fig. 3) consisted of early-stage juveniles that may have been schooling. The largest of the 14 daytime catches of sand lance (194 at Station 39) was taken near sunrise. Above-average catches of sablefish and greenlings were also observed at this station.

Greenlings (Hexagrammidae) were the most frequently occurring fish larvae in the neuston tows occurring at 62 of the

67 stations (Fig. 4). Rock greenling (Hexasrammos lasocephalus) were the most abundant and frequently encountered greenling (42 stations)', followed by whitespotted greenling (Hexasrammos stelleri) (23 stations). Kelp greenling (Hexasrammos decaarammus) ranked third in abundance of the hexagrammids, but was fourth in frequency of occurrence (9 stations). Lingcod (Ophiodon elonaatus) was the least abundant of the hexagrammids and was collected at 14 stations. Although we commonly found two species of greenling and lingcod co-occurring, at no time did we find all three species of greenlings together. The two centers of nearshore abundance (near Khaz Point and near Cape Ommaney) were dominated by whitespotted and rock greenlings, respectively. Offshore catches were predominately rock greenling, although whitespotted and kelp greenlings were also encountered. Day-night differences were not clearly evident in the hexagrammid catches. At station 44, the 24-hour station, mean catches of rock greenling and whitespotted greenling were lower at night than during the day (Table 2).

Sculpin larvae (Cottidae) were captured at 35 of the 67 stations. The red Irish lord (Hemilepidotus hemilepidotus) was the most abundant and most frequently encountered cottid, followed by the yellow Irish lord (H. jordani). Only one brown Irish lord (B. spinosus) was collected during the cruise. The Irish lord catches tended toward higher frequency and abundance at night (Table 1) and in the offshore tows (Fig. 5). One buffalo sculpin (*Enophrys bison*) and one cabezon (*Scorpaenichthys marmoratus*) were collected during our sampling.

Rockfish (*Sebastes* spp.) were captured in small numbers at only 13 stations, 8 of these stations were occupied during hours of darkness. Although at least two types of rockfish larvae were present in our samples, we were not able to assign them specific names. Most of the Arctic shanny (*Stichaeus ounctatus*), found at 12 stations, were also collected at night.

Blue lanternfish (*Tarletonbeania crenularis*) was the only myctophid and the only midwater pelagic spawning species whose larvae were observed in the neuston samples. These larvae were found at nine night stations. Adults, juveniles, and larvae of four other myctophids were captured in the oblique bongo net tows conducted during the cruise (Wing, unpublished data).

The larvae of 13 other species of fish captured by the neuston net were present in either low numbers or low frequency of occurrence and did not exhibit distinct spatial distribution patterns (Table 1). Within this group, the ronquils (*Bathvmaster* SPP.), snake pricklebacks (*Lumpenus saqitta*), giant wrymouth (*Cryptacanthodes sisanteus*), dwarf wrymouth (*Cryptacanthodes aleutensis*), arrowtooth flounder (*Atheresthes stomias*), Pacific halibut (*Hippoglossus stenolepis*), prowfish (*Zaorora silenus*), snailfish (Liparis spp.), and poachers (Agonidae) were present more frequently in the oblique bongo net tows than in neuston tows (Wing, unpublished data).

Juvenile pink salmon (*Oncorhynchus gorbuscha*) and threespine stickleback (*Gasterosteus aculeatus*) were taken at night. The occurrence of the juvenile pink salmon at Station 22 (<l km offshore) is consistent with their nearshore and intertidal distribution at this time of year (Heard 1991). The presence of juvenile threespine stickleback at Station 32 (160 km offshore) is not unusual, although this is primarily a freshwater and estuarine species (LeBrasseur 1964).

Fish eggs were collected at 56 stations. Eggs of ragfish (*Icosteus aenismaticus*), Dover sole (*Microstomus pacificus*), and rex sole (*Errex zachirus*) were abundant and widespread (Table 3, Figs. 6-8). Ragfish eggs were most numerous offshore in the southern half of the study area. Dover sole eggs were most numerous over the continental shelf and slope in the northern half of the study area and off Cape Ommaney. Rex sole eggs were most numerous at two offshore stations west of Sitka. Single eggs of the slender sole (*Eopsetta exilis*), curlfin sole (*Pleuronichthvs decurrens*), and a bathylagid were collected at Stations 6, 94, and 82, respectively.

Comparative tests for day-night differences in the abundance of eggs in the neuston tows at Station 44 exhibited no significant difference ($2 < 0.75$) for ragfish, Dover sole, or rex sole, and the distribution of high and low catches does not correspond to the distribution of day and night tows. No correlations of egg abundance or distribution were evident among the species (R^2s < 0.02)

Oceanographic Conditions

Surface temperatures were above 8.0°C only in the southern half of the survey area (Fig. 9a)., Surface salinities less than 32.00% were found over the continental shelf, whereas salinities greater than 32.50% were evident only at the western edge of the survey area (Fig. 9b). Surface density contours reflected salinity distributions with highest densities offshore except in a possible localized upwelling area near Cape Edgecumbe (Fig. 9c).

Contours of temperature, salinity, and density at 100 m and 200 m are believed generally to represent water mass movements above and below the permanent 120-150 m pycnocline in this area. The 100-m contours of salinity and sigma-L (Figs. 10 a-c) indicate weak northward transport along a broad front from lat. 54°30'N to lat. 56°00'N. Between 56°00'N and 57°30'N, small eddies of coastal water appear to have been entrained and carried west off the continental shelf, then northward near long. 139°00'W. Below the pycnocline, gradients of temperature, salinity, and density (Figs. 11 a-c) were weak, reflecting the northwesterly trend of the Alaska Gyre.

These oceanographic data suggest that neither the Haida Current nor the Sitka Eddy was present during the survey period. The Haida Current, when present in the winter and spring, is characterized at the surface by a narrow tongue of warm, low-salinity water over the continental slope extending from the Queen Charlotte Islands, British Columbia, to the southeastern

Alaska Panhandle (Thomson and Emery 1986). Surface water temperature, salinity, and density contours for May 1990 did not show a distinct surface current. Instead, the observed complex distribution of temperatures and salinities may reflect seasonal spring warming progressing northward and offshore transport of spring runoff.

The Sitka Eddy, when present in the spring and summer, is characterized by a warm, low-salinity core evidenced in vertical sections by depressed isotherms, isohalines, and isopycnals at the center of the eddy (Tabata 1982), or as concentric contours when plotted at constant depth. These features were not obvious in the vertical sections at the latitude of Sitka (Figs. 12 a-c) or in contours at constant depths, although examination of the dynamic heights (0-500 db) show a weak clockwise circulation (D. Musgrave, Univ. Alaska, Fairbanks, AK 99775-1080, pers. commun., 25 November 1991).

The absence of both the Haida Current and the Sitka Eddy during our May 1990 survey implicates upwelling and coastal dilution as possible mechanisms for transporting fish larvae and fish eggs offshore in the eastern Gulf of Alaska. In May 1990, upwelling indices for the Eastern Gulf of Alaska were weakly positive suggesting that some wind-driven upwelling and associated offshore transport was present. Ingraham (1979) describes offshore dilution at the surface extending from coastal Southeast Alaska westward beyond long. 140°W and between lat.

56°N and lat. -58% during the summer months. Whether this same type of transport occurs during late spring is not known.

The eastern Gulf of Alaska, especially the Southeast Alaska continental shelf, is regarded as a downwelling regime (Ingraham et al. 1976). Accordingly, in late winter and early spring our study area should be characterized by onshore transport with intensified counterclockwise flow near the coast. Mid-spring (May) is theoretically characterized by a weakening and spreading of the counterclockwise flow offshore. Although Ingraham (1979) described the offshore transport of low-salinity waters as an anomalous summer phenomenon, our data show that offshore transport may occur as early as May and it may be more frequently occurring than previously suspected. We believe that the distribution of sablefish larvae, Dover sole eggs, and rex sole eggs was the result of the offshore transport by upwelling and coastal dilution followed by northwesterly transport by the Alaska Gyre. In this case, the offshore transport needs only extend to, or slightly beyond, the shelf break to carry eggs and larvae into the Alaska Gyre. The impact, positive or negative, of such offshore transport on survival of larvae of continental shelf and slope fishes in the Eastern Gulf of Alaska is unknown.

SUMMARY

Sablefish larvae were the most abundant and second most frequently captured fish larvae (present, at 55 of 67 stations) taken by neuston tows -in the eastern Gulf of Alaska in May 1990. Peak catches of sablefish were encountered at night, 30-160 km offshore, west of the continental slope spawning areas. Replicated day and night tows at one station showed night. catches of sablefish to be three times greater than day catches.

Except for the blue lanternfish taken at a few night stations, all larval fish taken during the study were continental shelf or slope spawning species. Pacific sand lance were the second most abundant species collected and ranked fourth in frequency of occurrence. Greenlings (Hexagramos spp.) were the third most abundant and most frequently collected larvae. Irish lords (Hemileoidotus spp.) ranked fourth in frequency of occurrence and third in abundance. The remaining species were not abundant, occurring at less than 14 stations each. The oceanic distribution of these larval fish appears to be the result of the offshore movement of coastal waters and entrainment in the counterclockwise Alaska gyre.

Planktonic eggs of three species (Dover sole, rex sole, and ragfish) were common throughout the study area. Offshore concentrations of Dover sole and rex sole eggs are most easily explained by slope or shelf spawning with subsequent transport offshore by wind-driven upwelling and freshwater-driven surface circulation. The higher abundance of ragfish eggs in the southern offshore portions of the survey area suggests earlier pelagic spawning in the southern area than in the northern area.

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Table 1. -- Rank of abundance and frequency of occurrence of fish larvae collected by neuston tows at 67 stations in the Eastern Gulf of Alaska, May 1990. g = number of positive stations. X = mean number of organisms per positive tow.

SPECIES	Abundance Rank	Occurrence		Day		Night	
		f	%	f	$\bar{X}$	f	$\bar{X}$
Anoplopoma fimbria	1	57	85.1	34	35.45	21	402.02
Ammodytes hexapterus	2	25	37.3	14	13.74	13	584.07
Hexagrammos lagocephalus	3	41	61.2	26	12.22	15	14.48
Hemilepidotus hemilepidotus	4	25	37.3	9	9.56	17	12.27
Hexagrammos stelleri	5	23	34.3	2	9.69	10	15.90
Bathymaster sp.	6	6	9.0	2	2.00	5	36.00
Stichaeus punctatus	7	12	17.9	5	10.80	7	15.76
Hemilepidotus jordani	8	11	16.4	7	8.14	3	26.00
Hexagrammos decagrammus	9	9	13.4	6	12.00	3	3.67
Tarletonbeania crenularis	10	9	13.4	0	--	9	6.82
Ophiodon elongatus	11.5	13	19.4	5	2.20	8	4.67

Table 1.--(Continued)

SPECIES	Abundance	Occurrence		Day		Night	
	Rank	f	%	f	$\bar{X}$	f	$\bar{X}$
Sebastes spp.	11.5	13	19.4	5	1.80	8	3.39
Cryptacanthodes aleutensis	13	5	7.5	1	1.00	2	3.00
Liparis spp.	14	4	6.0	0	--	4	2.25
Hippoglossus stenolepis	15	1	1.5	0	--	1	2.67
Atheresthes stomias	16	1	1.5	1	4.00	0	--
Lumpenus sagitta	17.5	2	3.0	1	2.00	1	1.00
Oncorhynchus gorbuscha	17.5	1	1.5	0	--	1	3.00
Zaprora silenus	19	2	3.0	0	--	2	1.00
Gasterosteus aculeatus	22.5	1	1.5	0	--	1	1.00
Cryptacanthodes giganteus	22.5	1	1.5	0	--	1	1.00
Enophrys bison	22.5	1	1.5	0	--	1	1.00
Hemilepidotus spinosus	22.5	1	1.5	0	--	1	1.00
Scorpaenichthys marmoratus	22.5	1	1.5	0	--	1	1.00
Odontopyxis trispinosa	22.5	1	1.5	0	--	1	1.00

Table 2. -- Mean number (X) and standard deviation (s) of the numbers of fish larvae and fish eggs collected in 7 day and 7 night tows at Station 44, 22-23 May 1990. Abundance is expressed as the number of organisms per 15 minute tow.

Species	Day		Night	
	$\bar{X}$	*s*	$\bar{X}$	*s*
Anoplopoma fimbria	27.14	13.68	88.71	72.63
Hexagrammos lagocephalus	7.00	5.10	4.14	4.98
Hexagrammos stelleri	1.71	2.36	0.43	1.13
Ammodytes hexapterus	1.86	1.46	0.00	0.00
Sebastes spp.	0.43	1.13	2.00	1.15
Lumpenus sagitta	0.29	0.76	0.00	0.00
Icosteus aenigmaticus eggs	17.00	7.07	16.29	5.09
Microstomus pacificus eggs	25.14	7.71	27.57	7.37
Errex zachirus eggs	4.86	2.12	1.71	2.98
Hemilepidotus hemilepidotus			3.43	4.93
Ophiodon elongatus			0.86	0.90
Liparis spp.			0.43	0.79
Bathymaster spp.			6.86	11.32
Zaprora silenus			0.20	0.49
Hippoglossus stenolepis			0.86	1.46
Stichaeus punctatus			0.86	2.27
Tarletonbeania crenularis			0.29	2.56

Table 3. -- Rank of abundance and frequency of occurrence of fish eggs collected by neuston tows at 67 stations in the eastern Gulf of Alaska, May 1990.

Species	Abundance Rank	Occurrence F	Occurrence %
Microstomus pacificus	1.0	53	79.1
Errex zachirus	2.0	27	460.3
Icosteus aenismaticus	3.0	47	70.1
Bathylagidae	4.0	3	4.5
Eopsetta exilis	5.5	1	1.5
Pleuronichthys decurrens	5.5	1	1.5

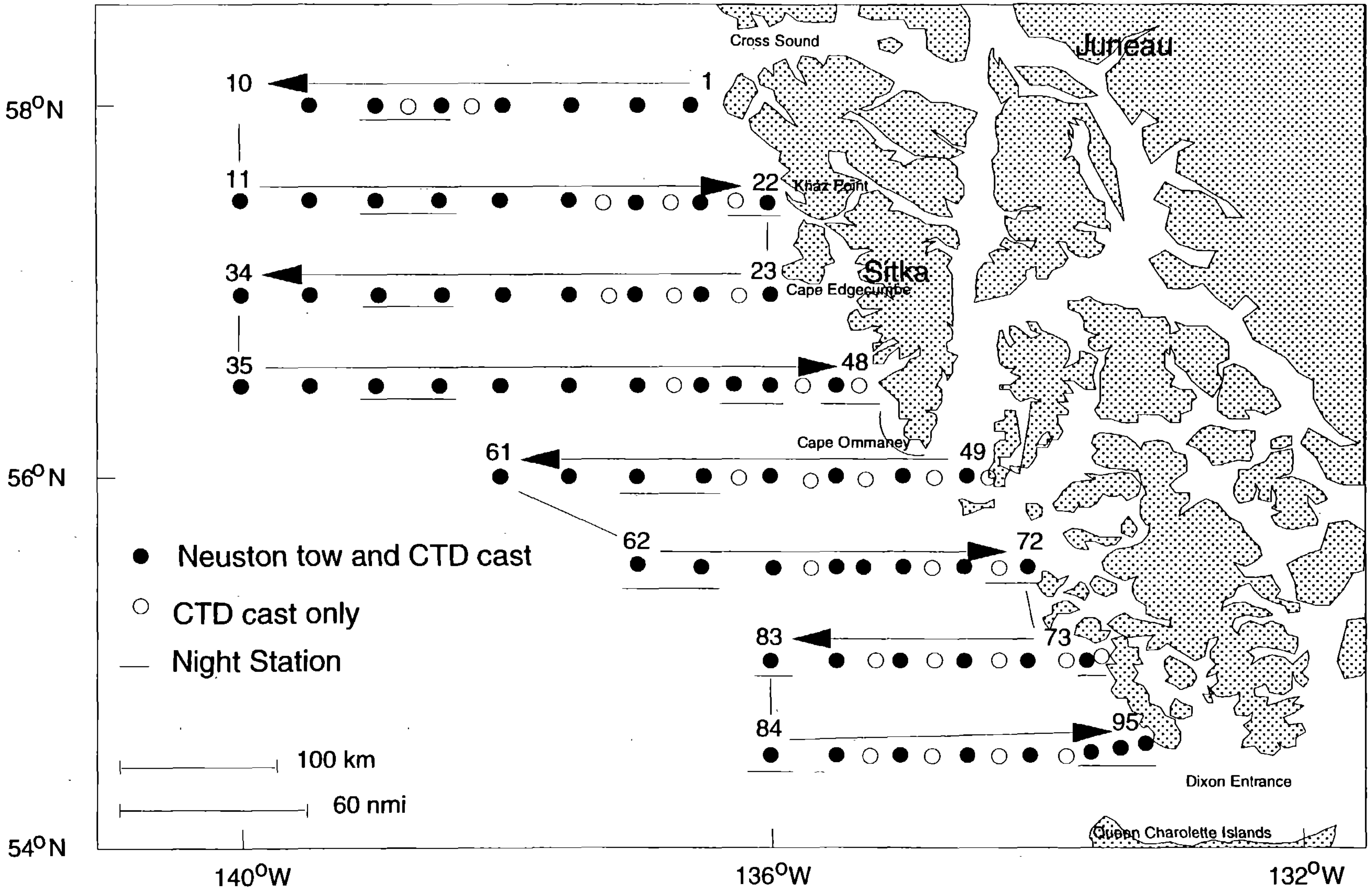

Figure 1. -- Location of oceanographic, neuston, and bongo net stations occupied by the RV Townsend Cromwell, 7-22 May 1990. Underlined stations were occupied at night.

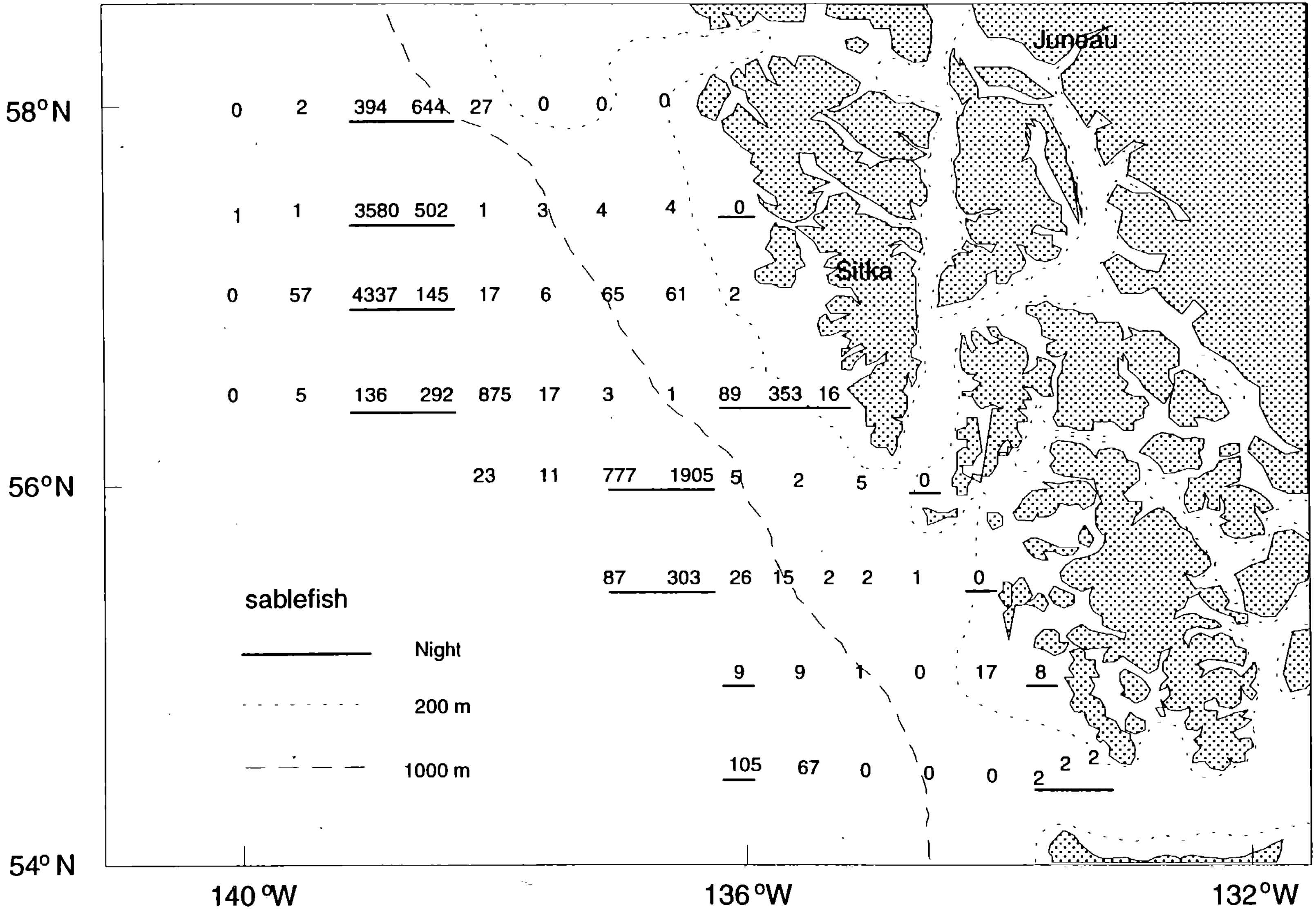

Figure 2. --Distribution of sablefish larvae in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of larvae per 15-minute tow. Underlined stations were occupied at night.

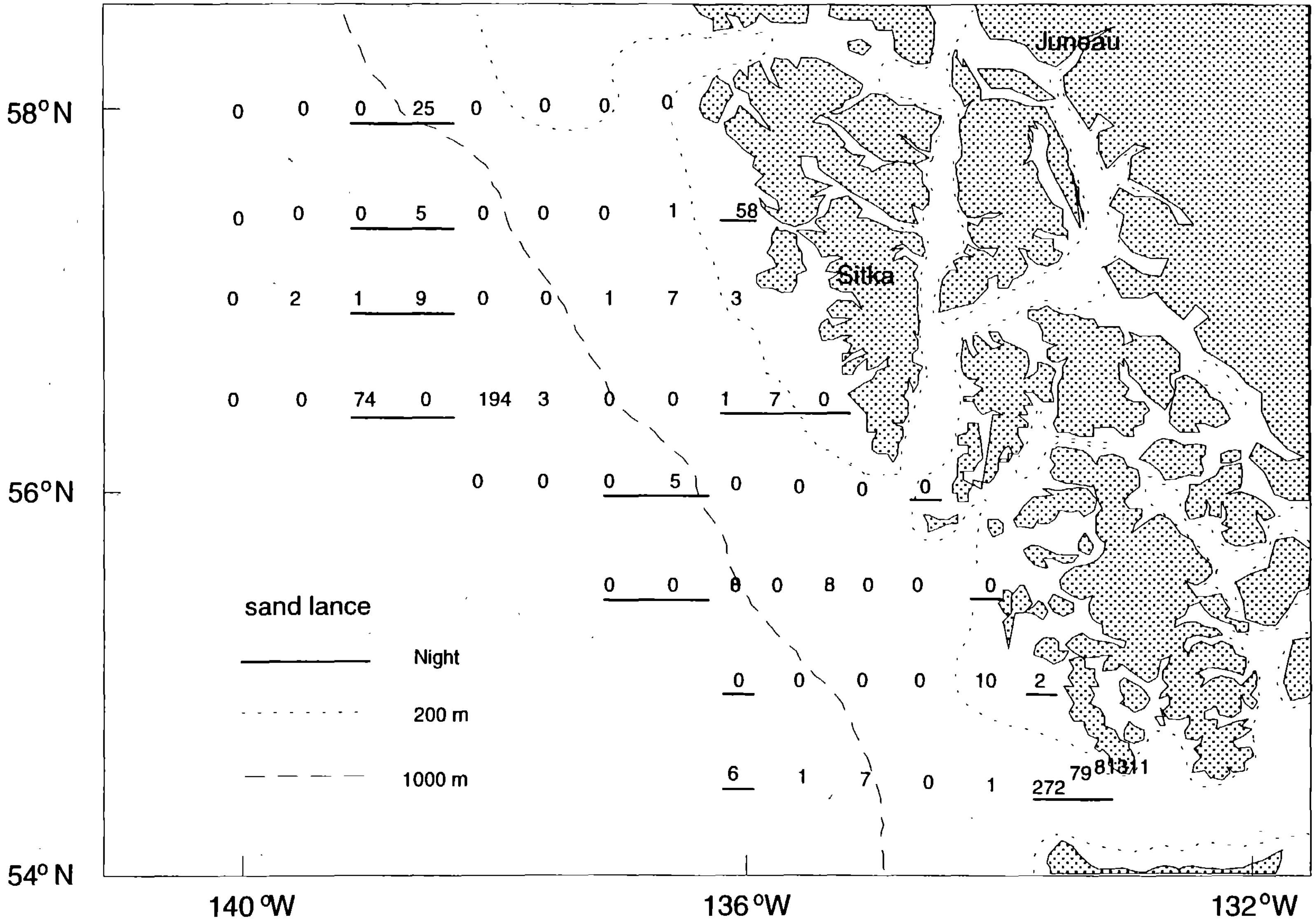

Figure 3. -- Distribution of Pacific sand lance larvae in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of larvae per 15-minute tow. Underlined stations were occupied at night.

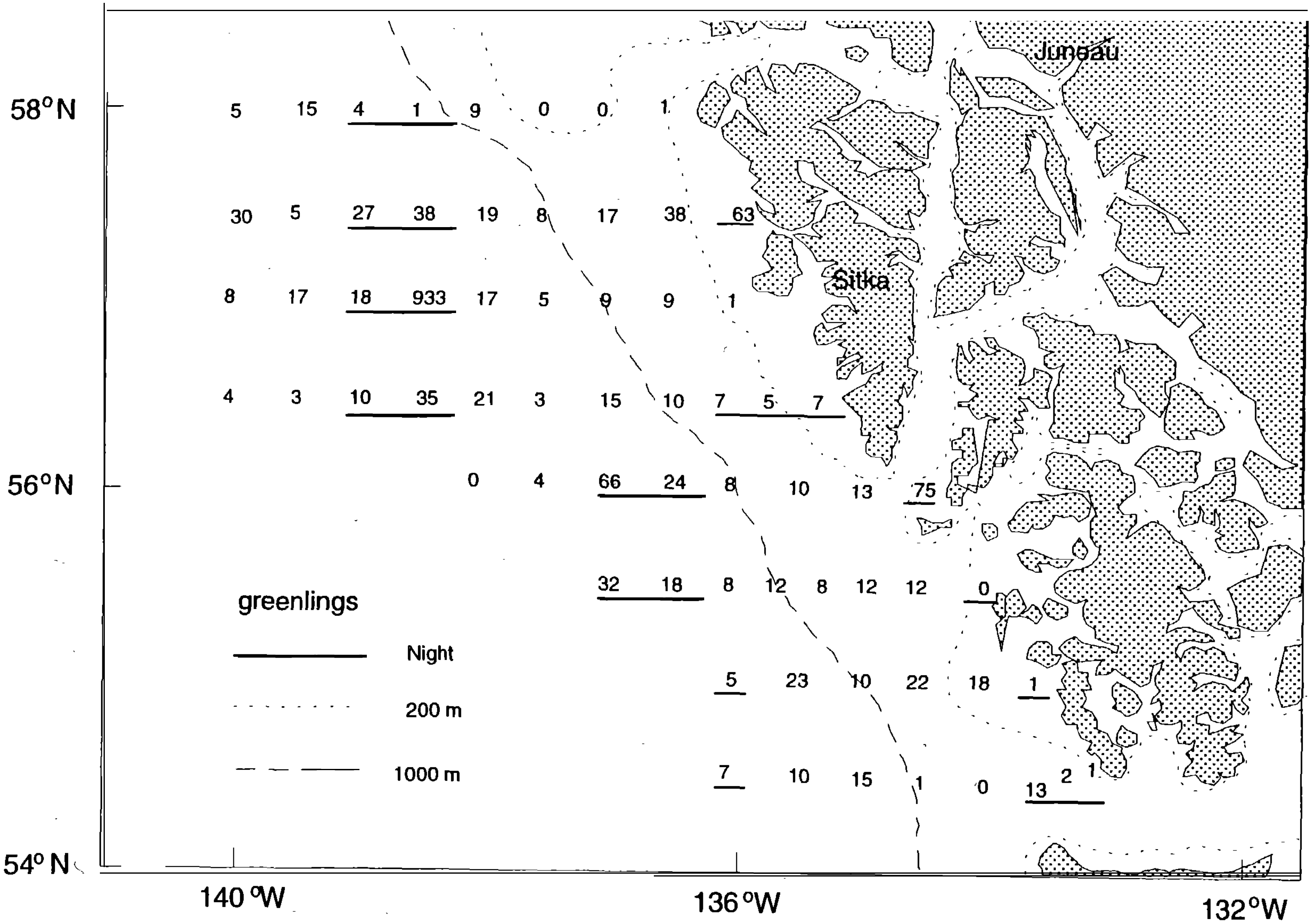

Figure 4 Distribution of greenling larvae (<u>Hexagrammos</u> spp.) in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of larvae per 15-minute tow. Underlined stations were occupied at night.

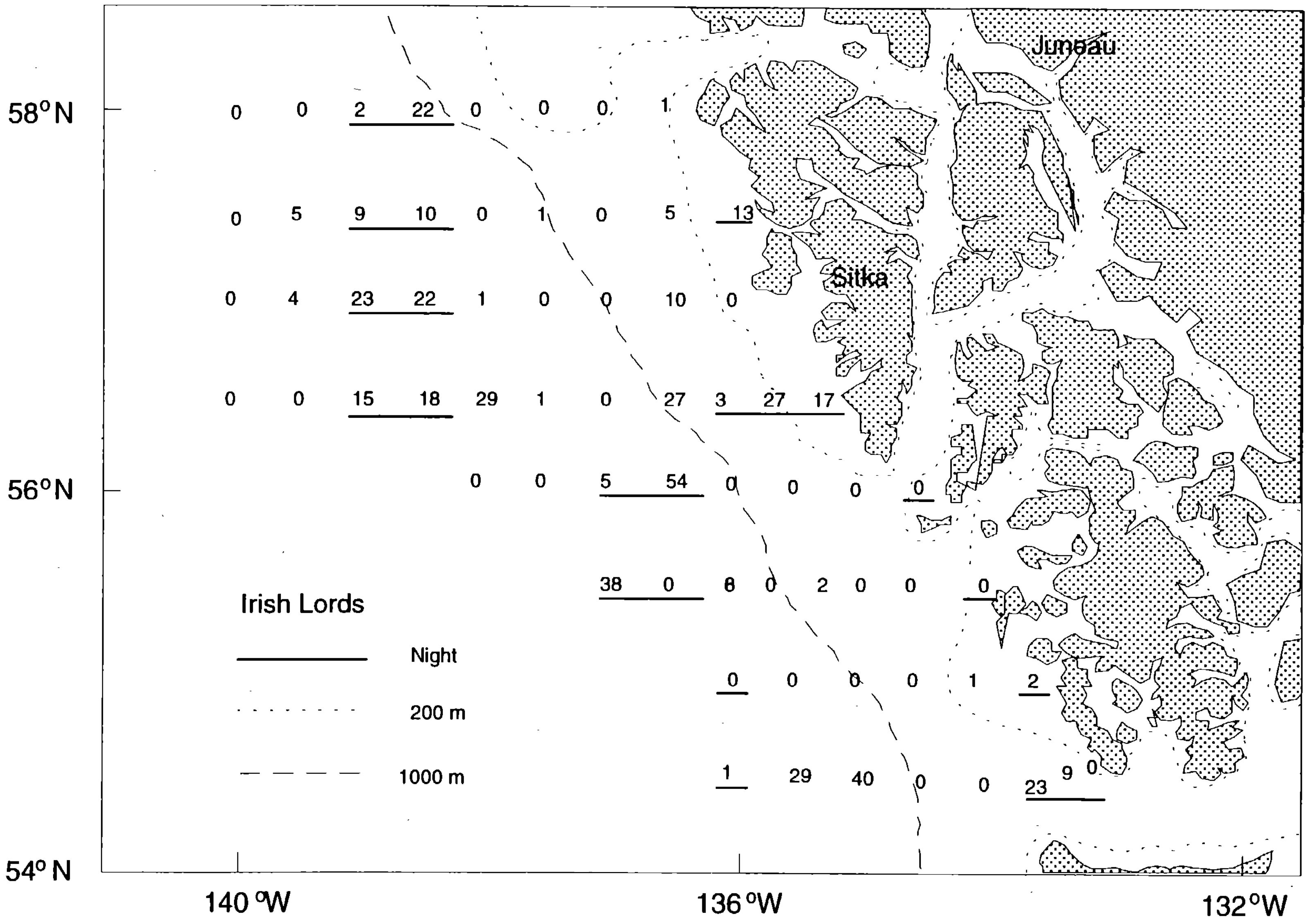

Figure 5. -- Distribution of Irish lord larvae (Hemilepidotus spp.) in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of larvae per 15-minute tow. Underlined stations were occupied at night.

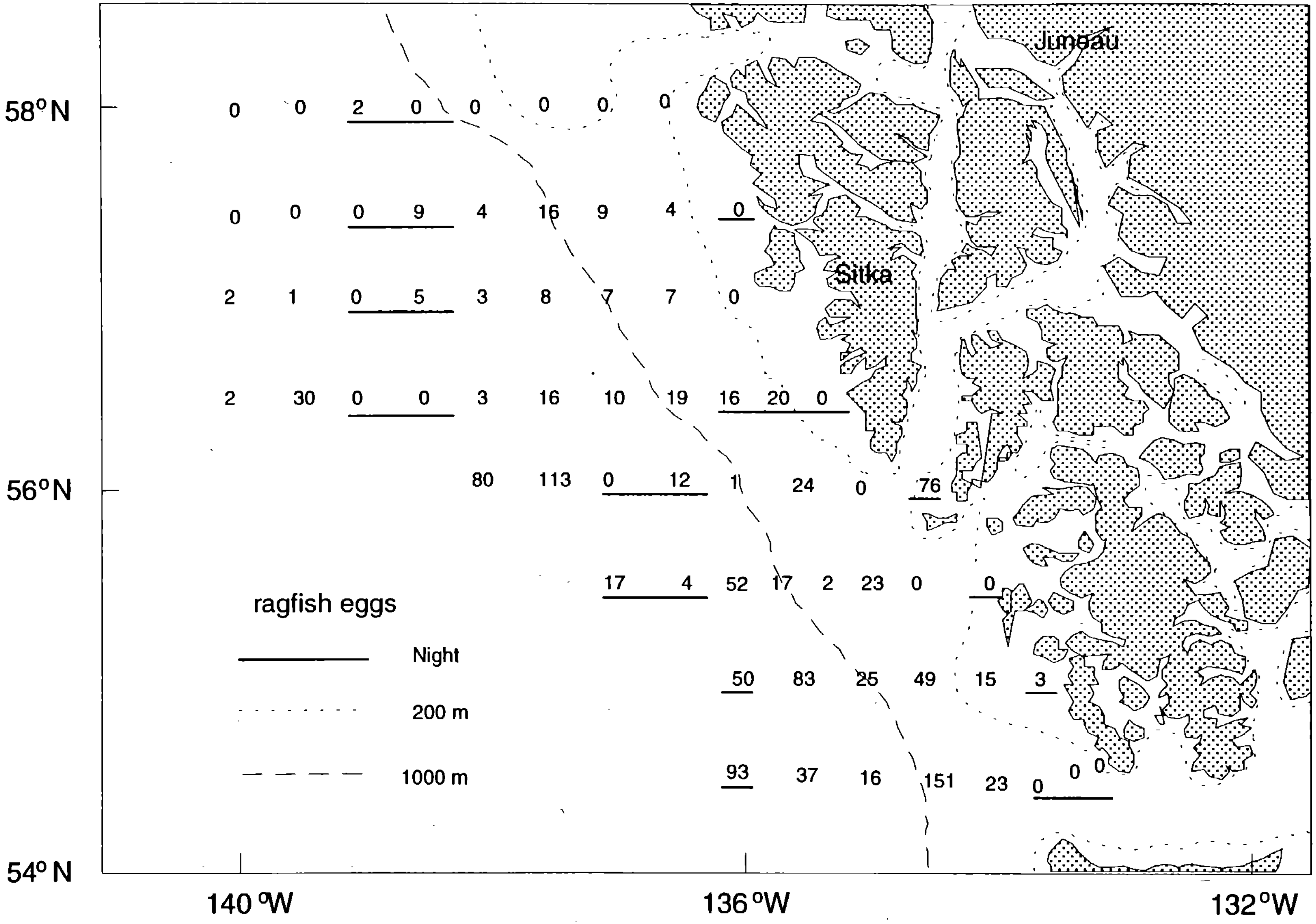

Figure 6. -- Distribution of ragfish eggs in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of eggs per 15-minute tow. Underlined stations were occupied at night.

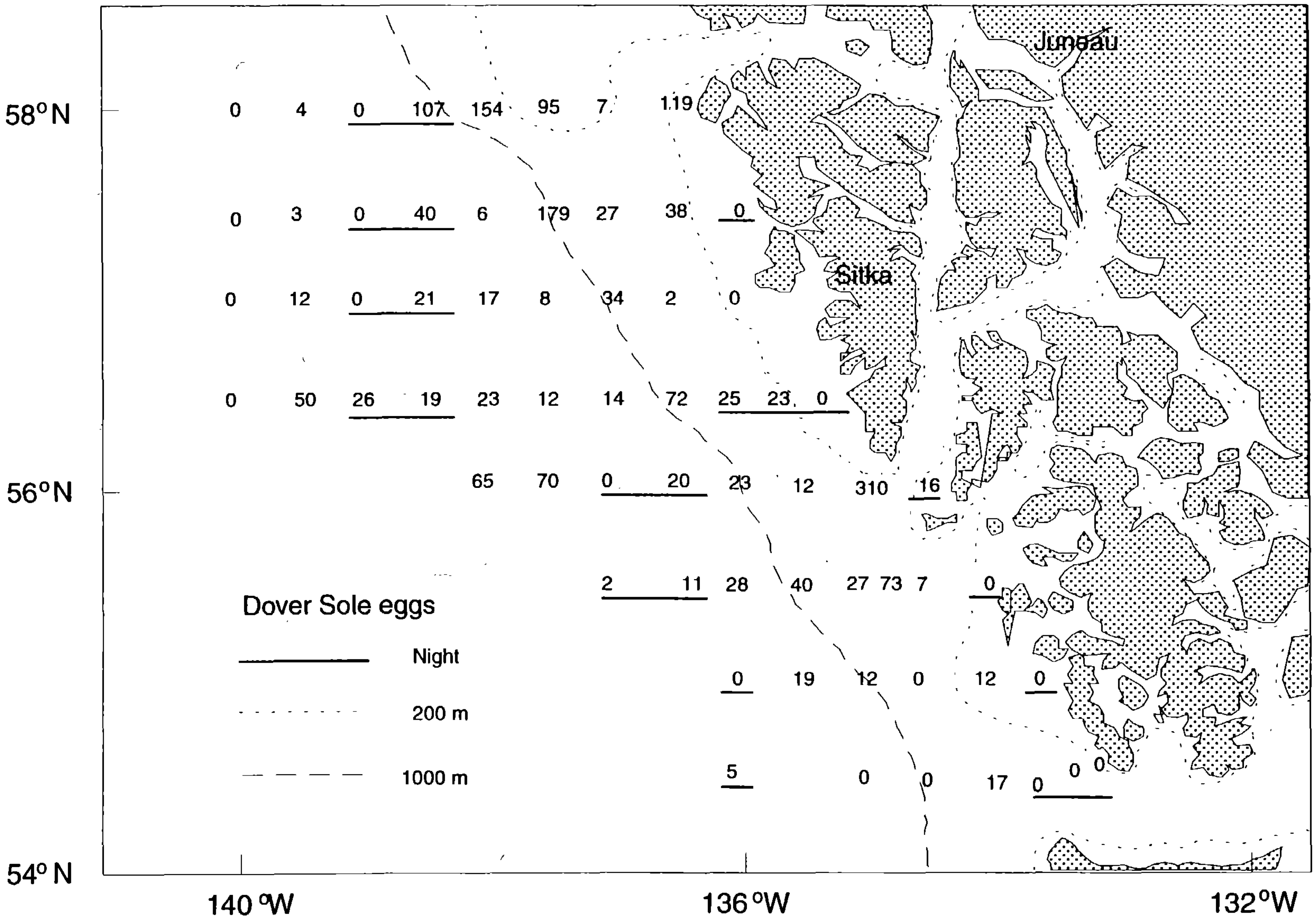

Figure 7. -- Distribution of Dover sole eggs in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of eggs per 15-minute tow. Underlined stations were occupied at night.

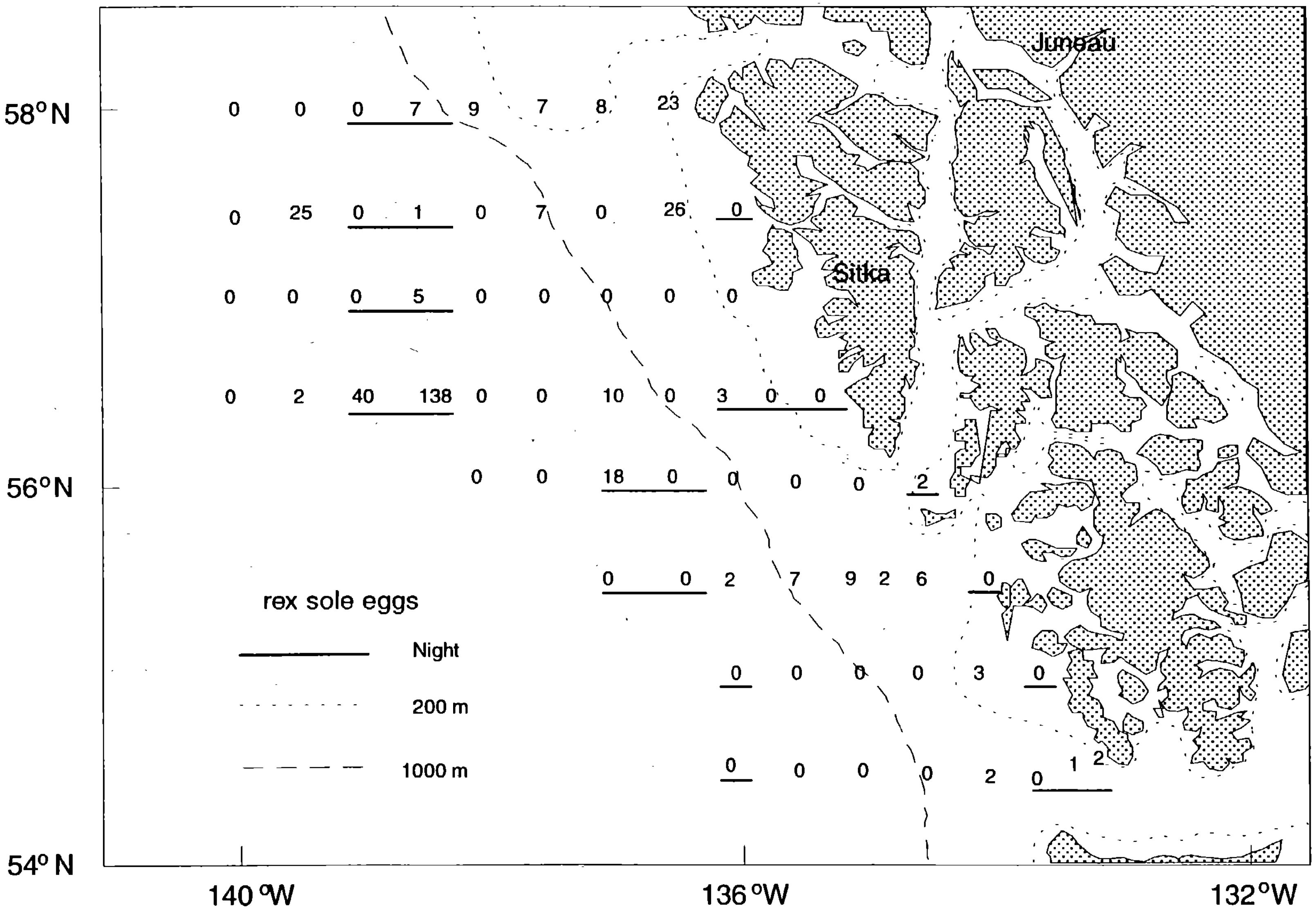

Figure 8. -- Distribution of rex sole eggs in the eastern Gulf of Alaska, as determined from neuston sampling from 10 to 22 May 1990. Abundance expressed as number of eggs per 15-minute tow. Underlined stations were occupied at night.

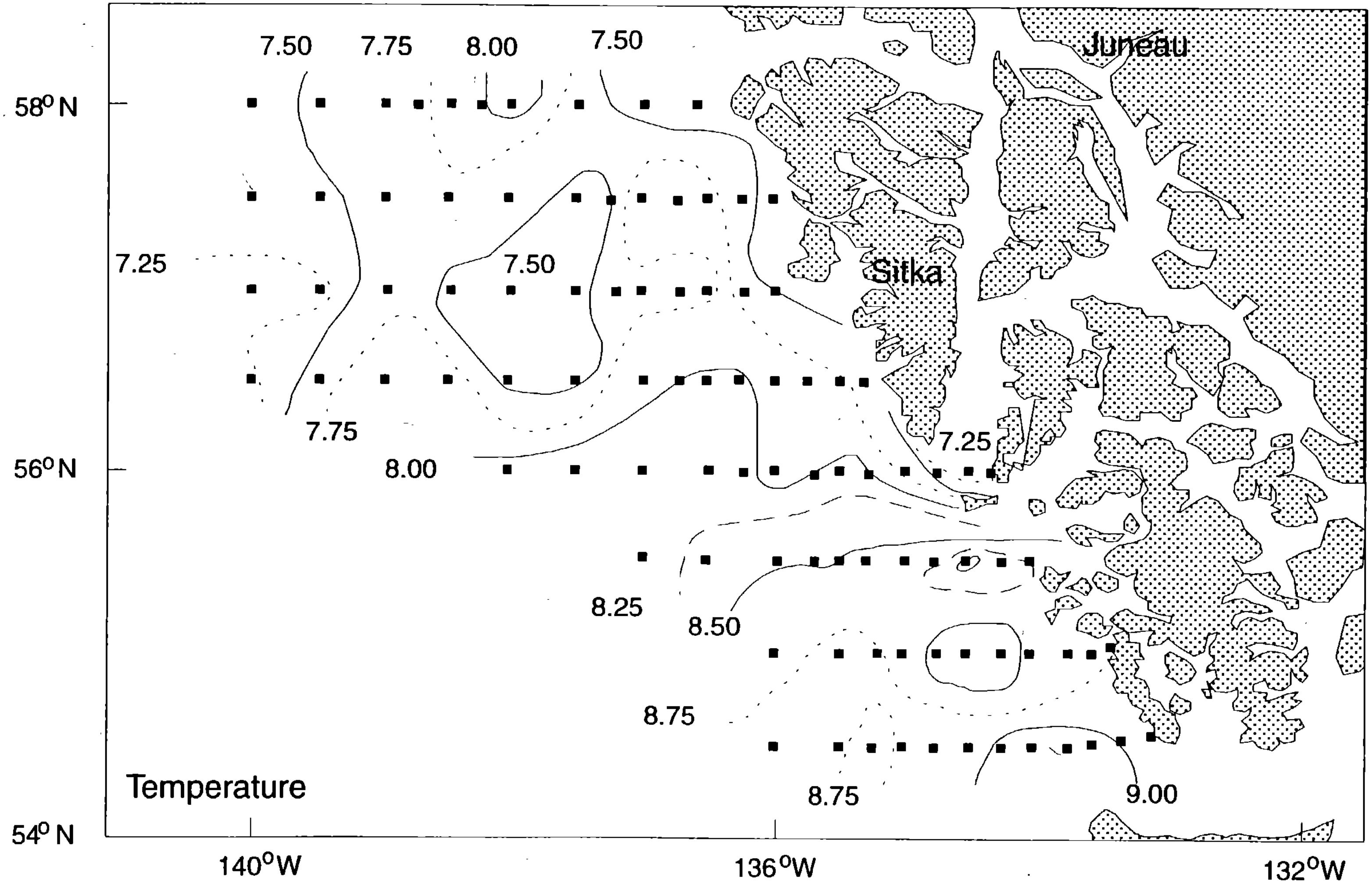

Figure 9a. -- Surface oceanographic properties in the eastern Gulf of Alaska, May 1990: temperature (°C).

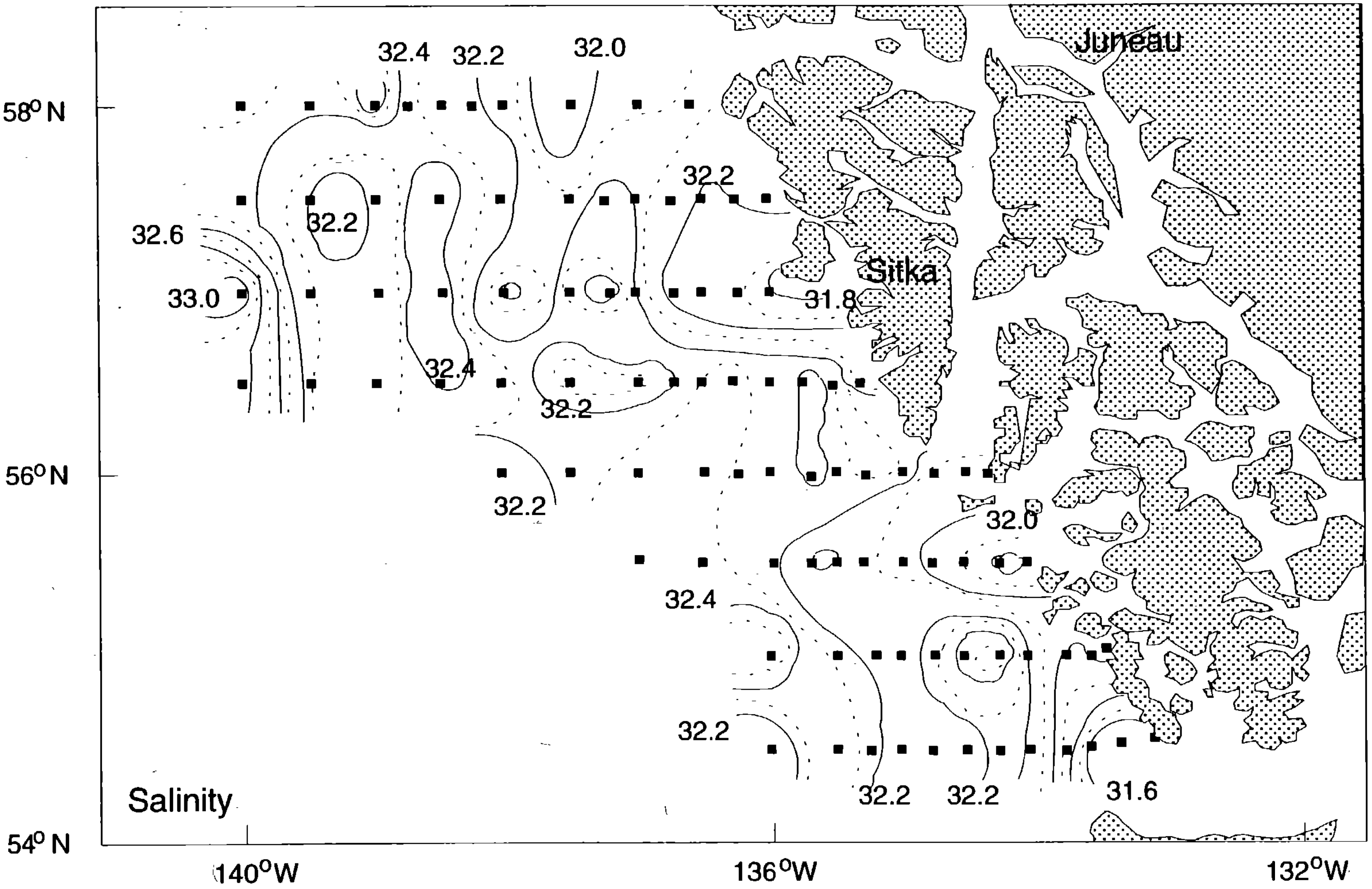

Figure 9b. -- Surface oceanographic properties in the eastern Gulf of Alaska, May 1990: salinity (‰).

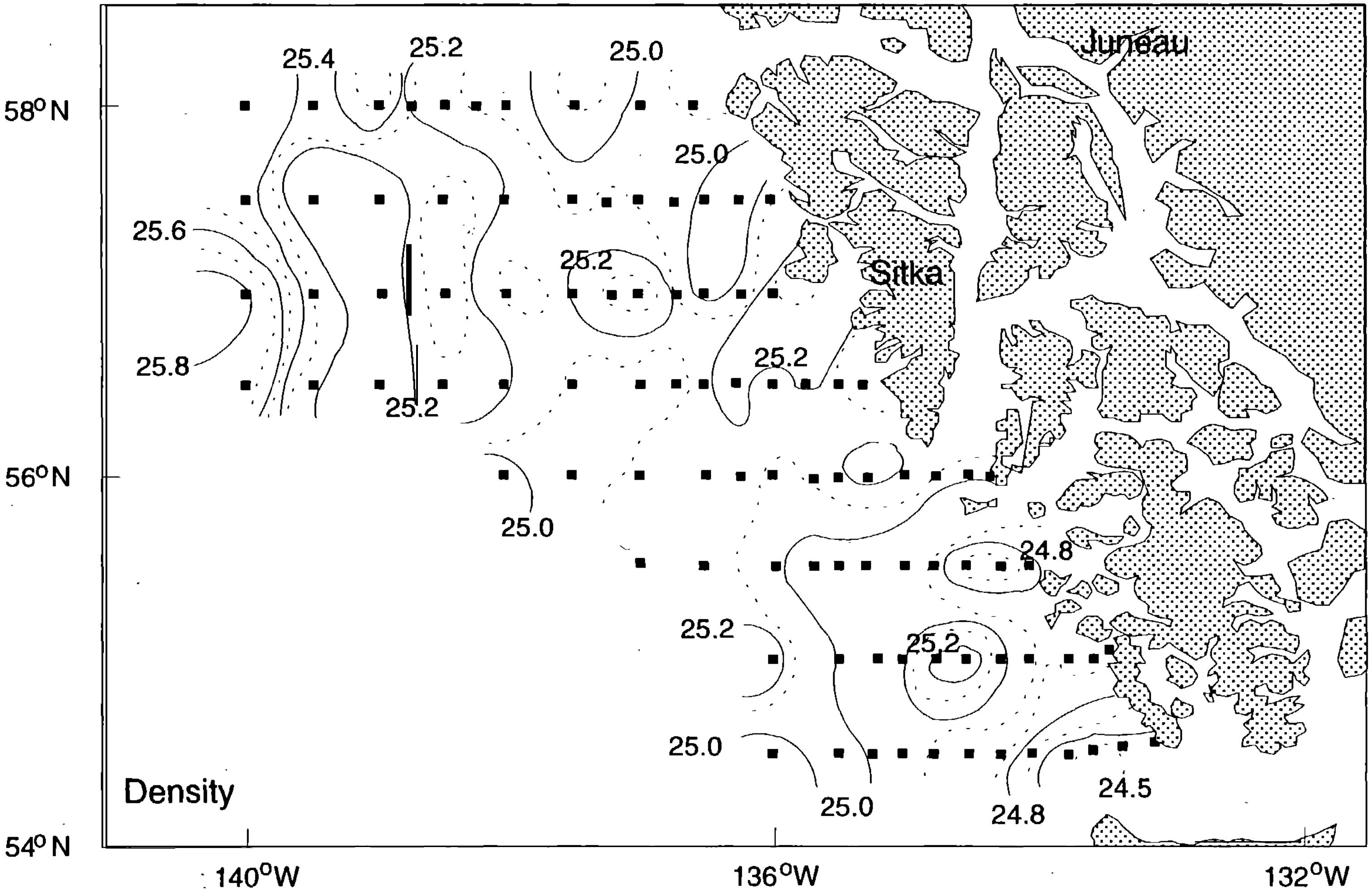

Figure 9c. -- Surface oceanographic properties in the eastern Gulf of Alaska, May 1990: density (sigma-t).

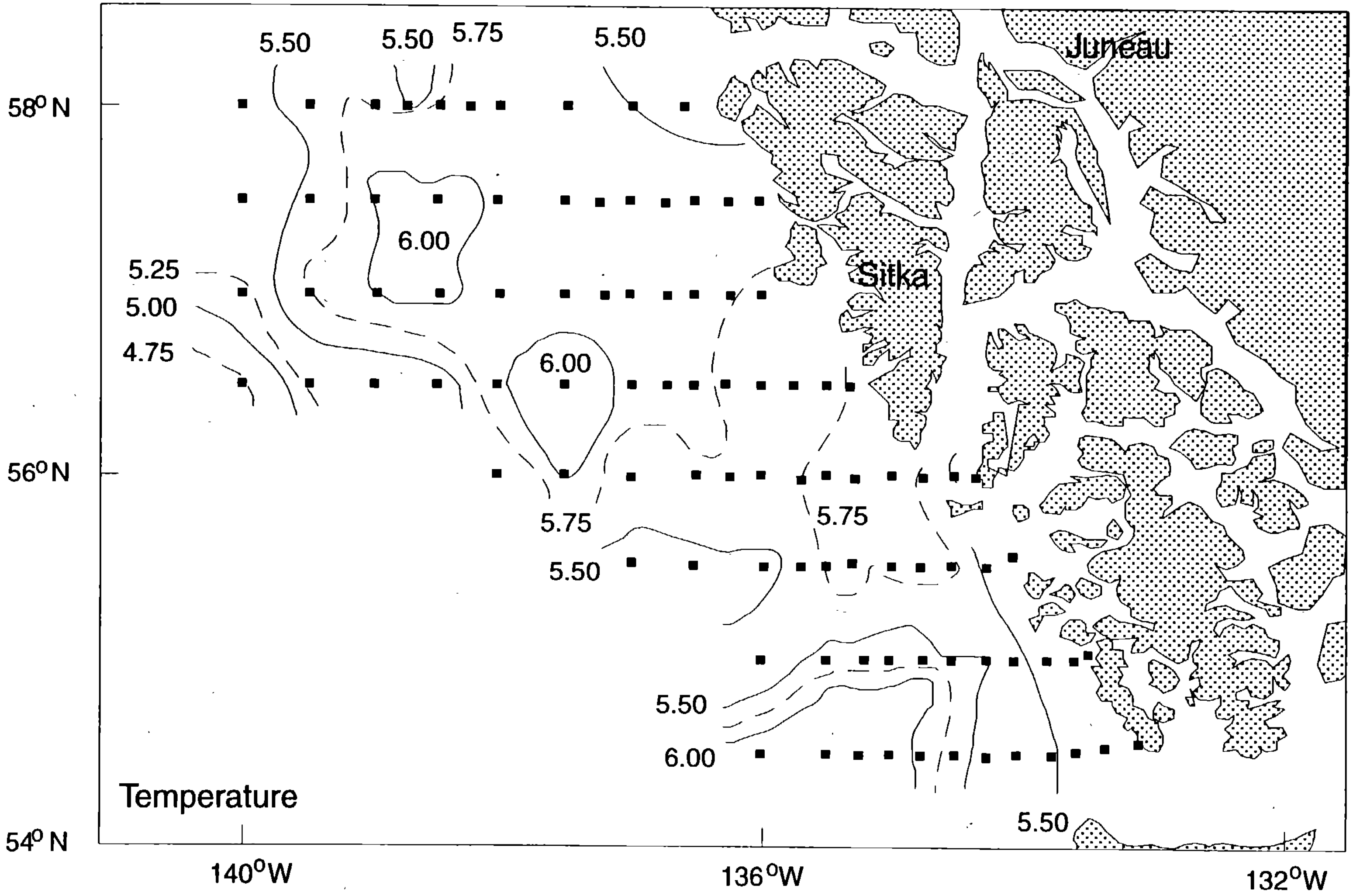

Figure 10a. -- Oceanographic properties at 100 m in the eastern Gulf of Alaska, May 1990: temperature (°C).

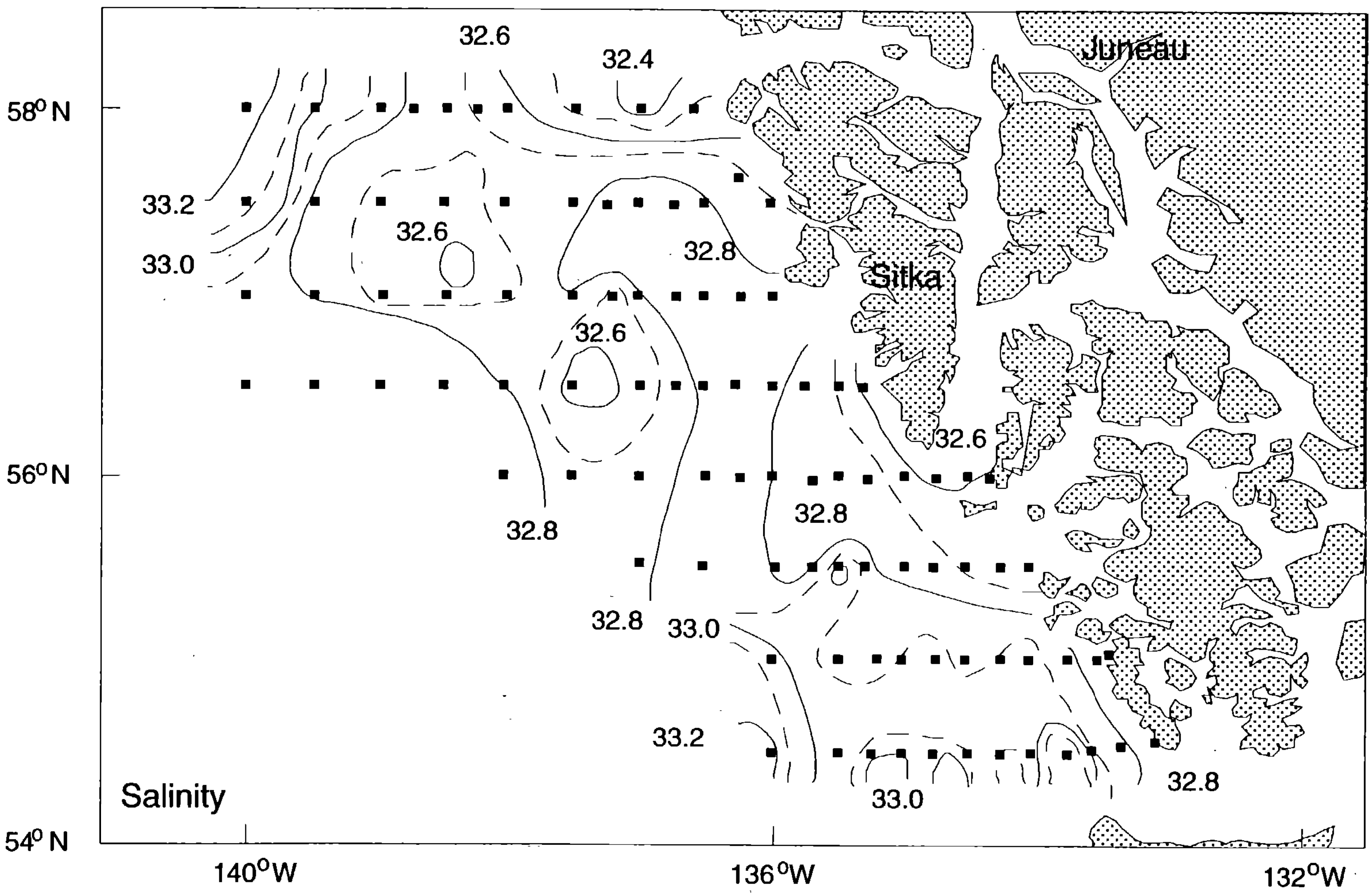

Figure 10b. -- Oceanographic properties at 100 m in the eastern Gulf of Alaska, May 1990: salinity (‰).

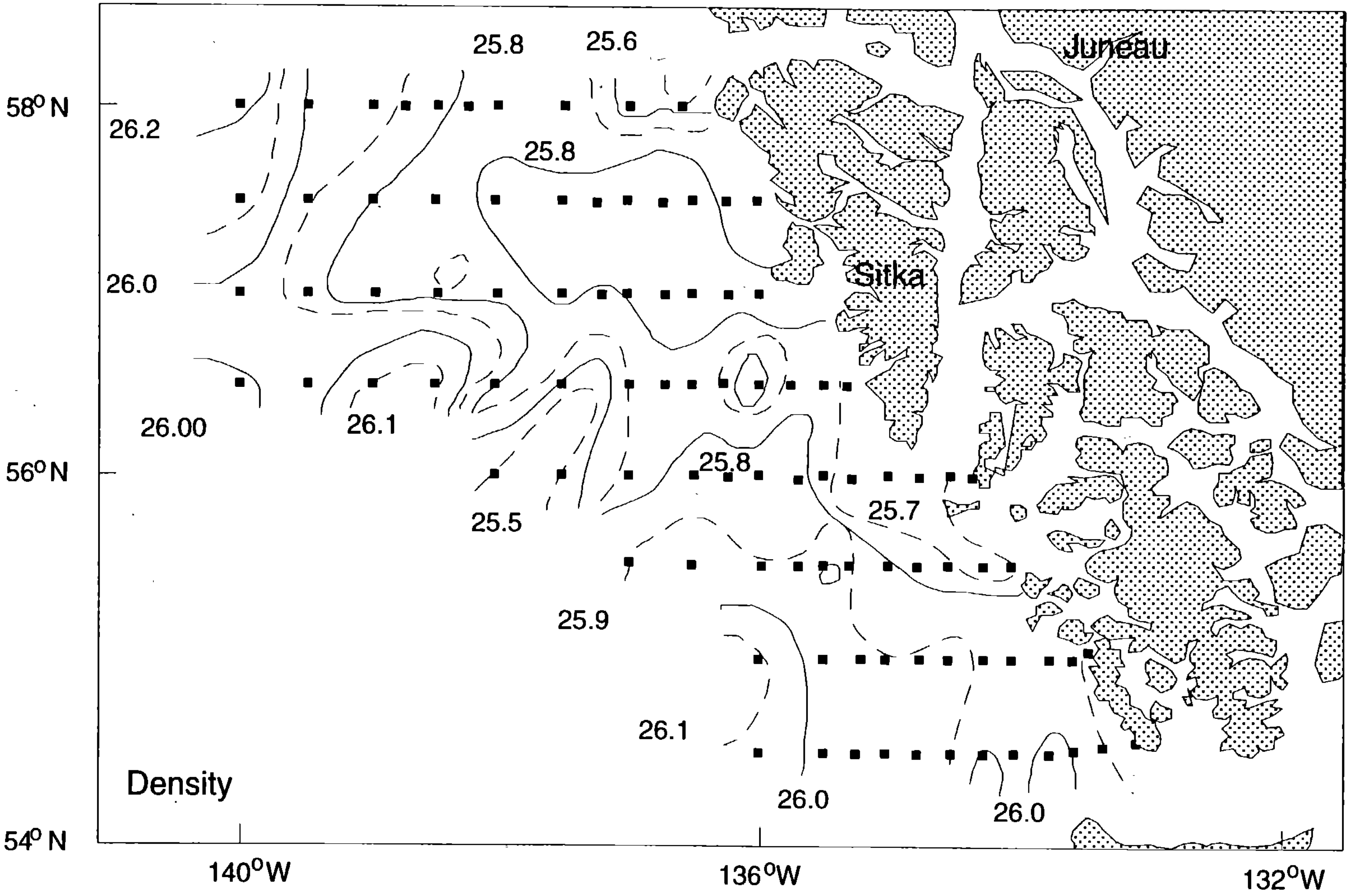

Figure 10c. -- Oceanographic properties at 100 m in the eastern Gulf of Alaska, May 1990: density (sigma-t).

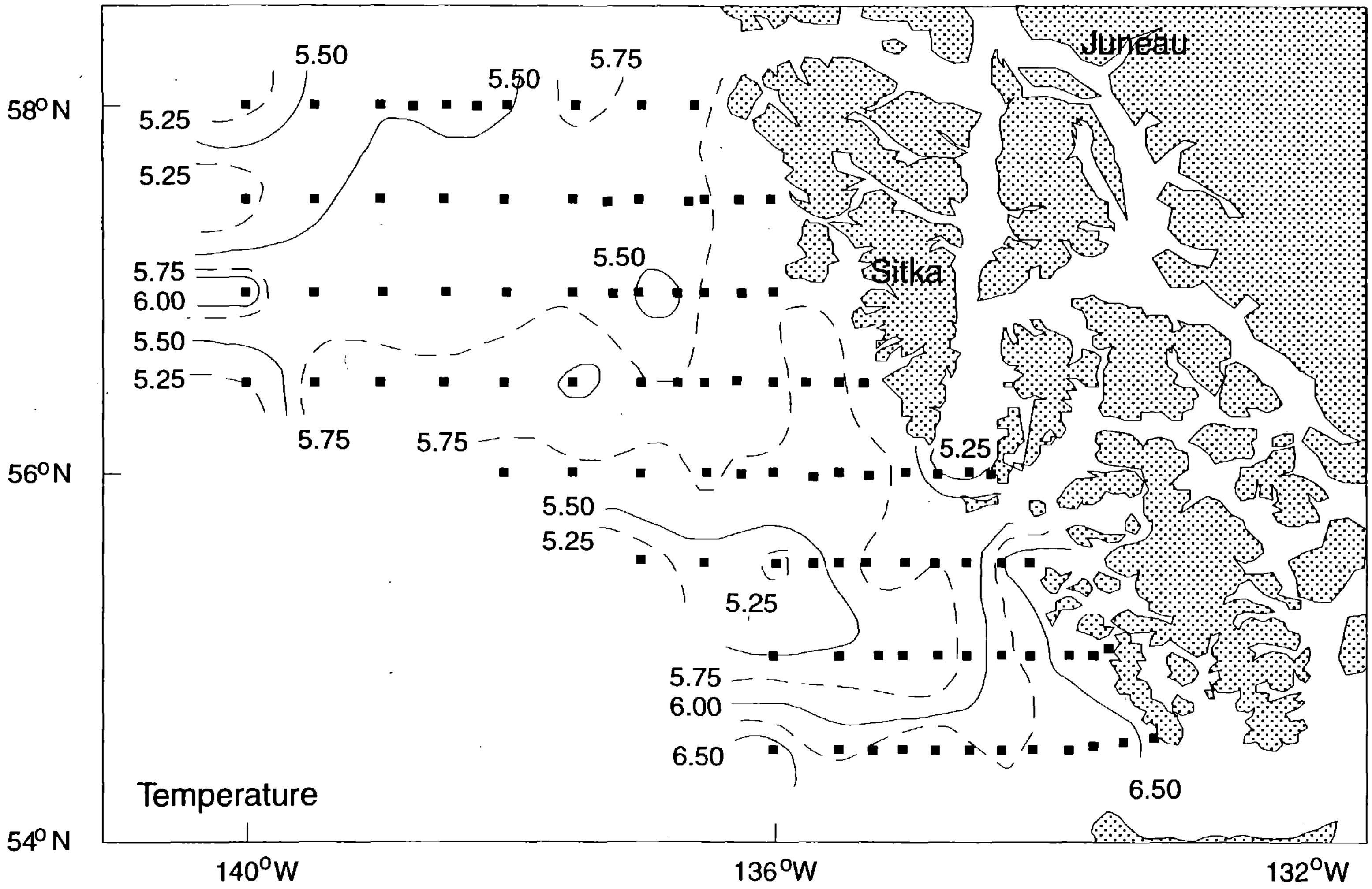

Figure 11a. -- Oceanographic properties at 200 m in the eastern Gulf of Alaska, May 1990: temperature (°C).

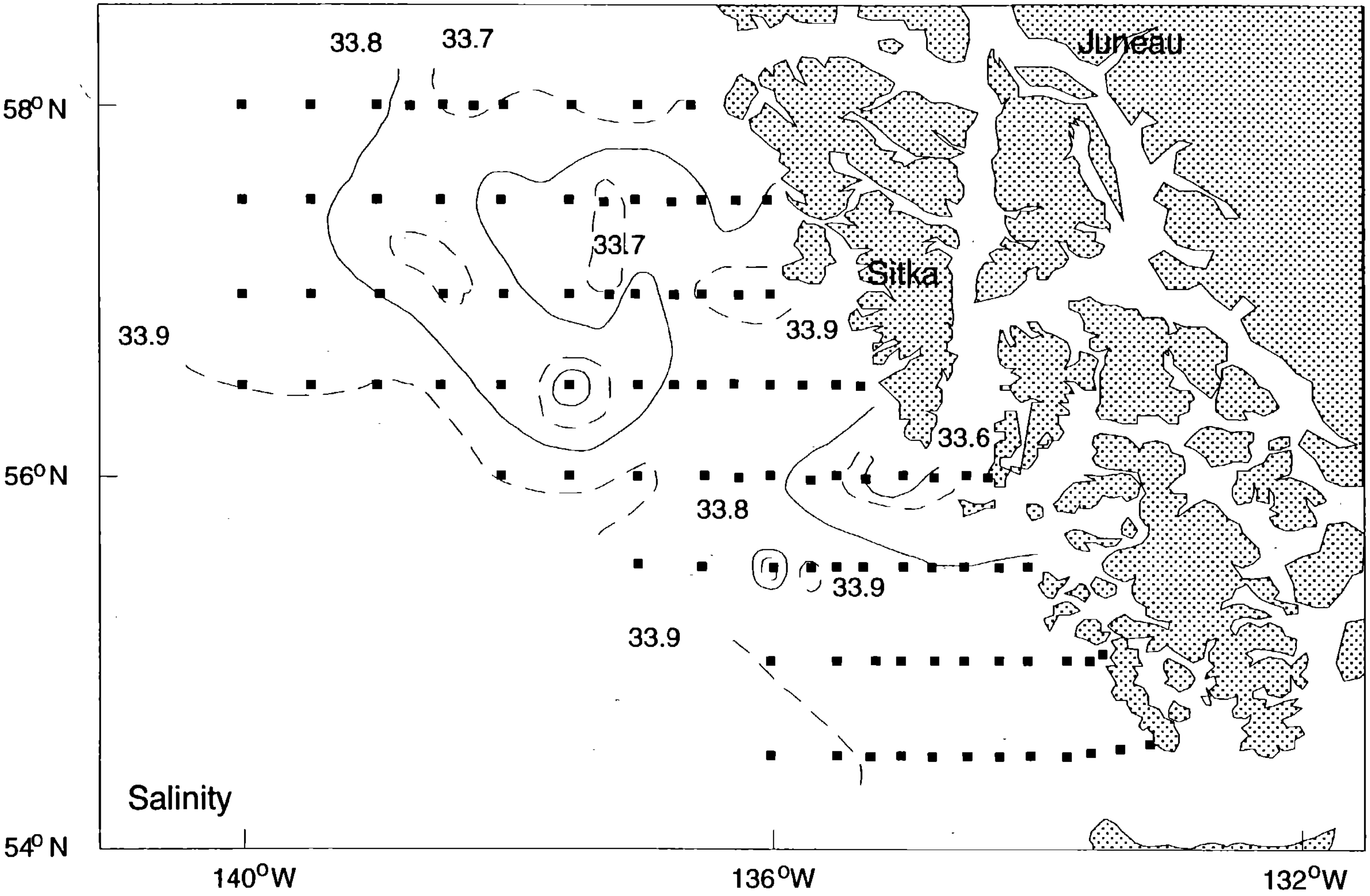

Figure 11b. -- Oceanographic properties at 200 m in the eastern Gulf of Alaska, May 1990 salinity (‰).

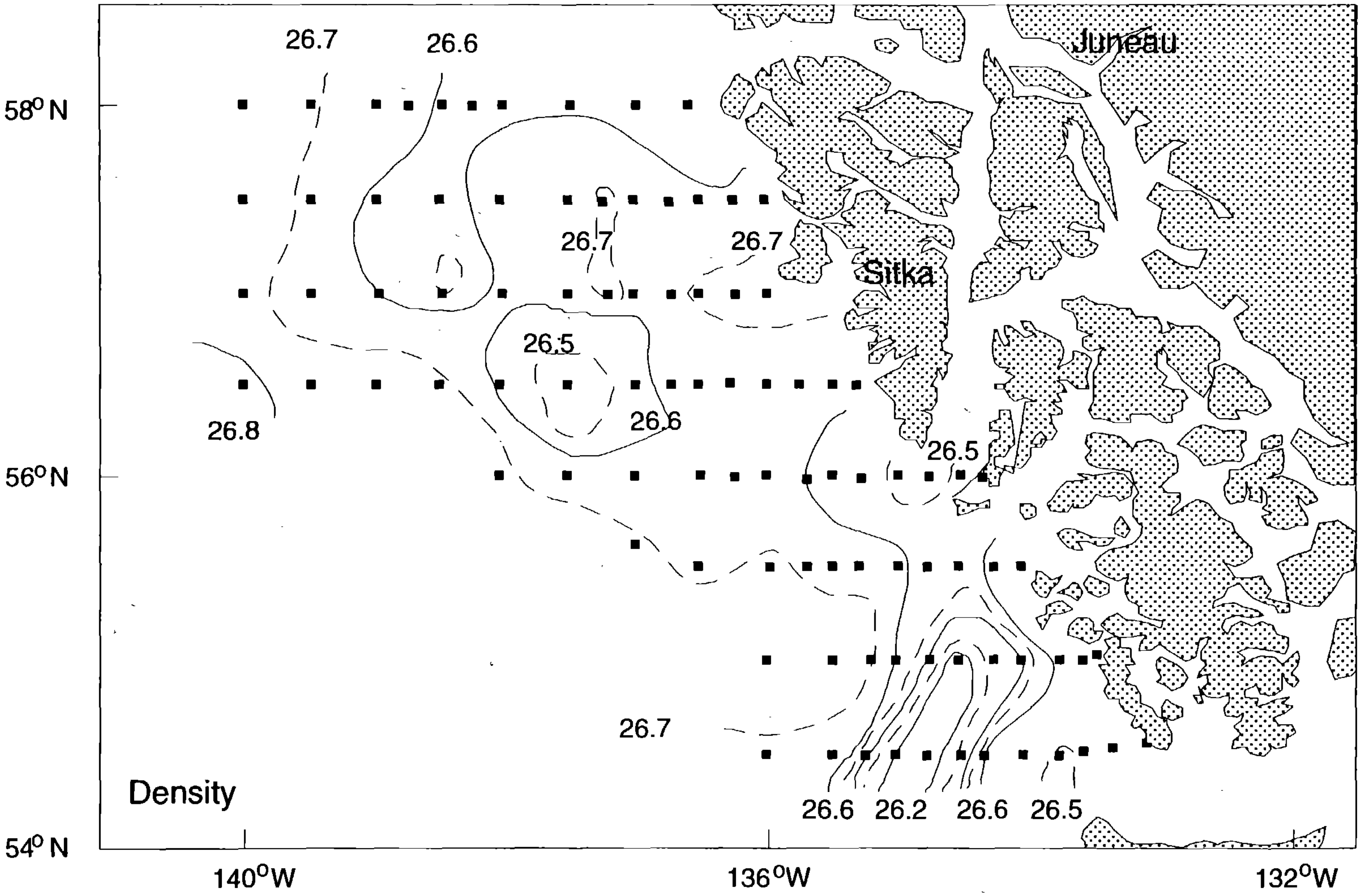

Figure llc. -- Oceanographic properties at 200 m in the eastern Gulf of Alaska, May 1990: density (sigma-L,).

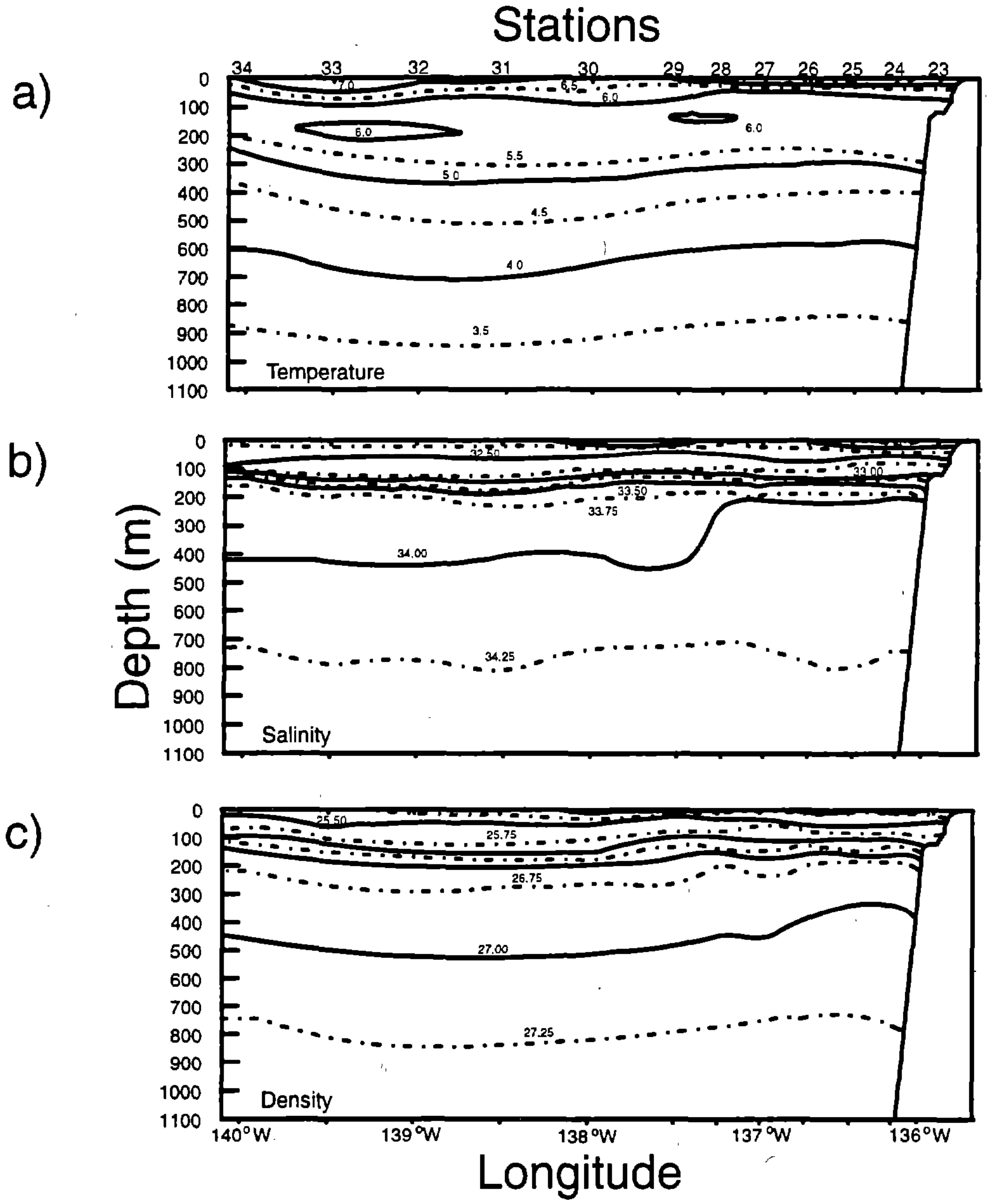

Figure 12. -- Vertical sections of oceanographic properties along lat. 57°N in the eastern Gulf of Alaska, May 1990: (A) temperature °C, (B) salinity %, and (C) density (sigma-L).

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APPENDICES

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Appendix Table 1.-- Station data for RV Townsend Cromwell Cruise No. 90-03, 7-23 May 1990. Time and positions are for start of oceanographic profiles conductivity-temperature-depth--(CTD). Bongo net tows and Sameoto neuston net tows either start or end at the CTD position.

Date	Time	Station	Lat. N	Long. W	CTD	Bongo	Neuston
07 May	2004	95	54°38'	133°00'	y	n	y
08 May	0009	94	54°37'	133°15'	y	n	y
08 May	0340	93	54°35'	133°30'	y	y	y
08 May	0611	92	54°32'	133°45'	y	n	n
08 May	0834	91	54°30'	134°00'	y	y	y
08 May	1212	90	54°30'	134°15'	y	n	n
08 May	1430	89	54°30'	134°30'	y	y	y
08 May	1757	88	54°30'	134°45'	y	n	n
08 May	1920	87	54°30'	135°00'	y	y	y
10 May	0914	1	58°00'	136°40'	y	y	y
10 May	1300	2	58°00'	137°00'	y	y	y
10 May	1500	3	58°00'	137°30'	y	y	y
10 May	1722	4	58°00'	138°00'	y	y	y
10 May	1917	5	58°00'	138°15'	y	n	n
10 May	2204	6	58°00'	138°30'	y	y	y
10 May	2333	7	58°00'	138°45'	y	n	n

Appendix Table 1.--Continued.

11 May 0054	8	58°00'	139°00'	y	y	y
11 May 0426	9	58°00'	139°30'	y	y	y
11 May 0753	10	58°00'	140°00'	y	y	y
11 May 1305	11	57°30'	140°00'	y	y	y
11 May 1641	12	57°30'	139°30'	y	y	y
11 May 2048	13	57°30'	139°00'	y	y	y
12 May 0123	14	57°30'	138°30'	y	y	y
12 May 0456	15	57°30'	138°00'	y	y	y
12 May 0812	16	57°30'	137°30'	y	y	y
12 May 1233	17	57°30'	137°15'	y	n	n
12 May 1359	18	57°30'	137°00'	y	y	y
12 May 1655	19	57°30'	136°45'	y	n	n
12 May 1813	20	57°30'	136°30'	y	y	y
12 May 2048	21	57°30'	136°15'	y	n	n
12 May 2130	22	57°30'	136°04'	y	n	y
13 May 0118	23	57°00'	136°00'	y	y	n
13 May 0341	24	57°00'	136°15'	y	n	n
13 May 0509	25	57°00'	136°30'	y	y	y
13 May 0808	26	57°00'	136°45'	y	n	n
13 May 0933	27	57°00'	137°00'	y	y	y
13 May 1240	28	57°00'	137°15'	y	n	n
13 May 1402	29	57°00'	137°30'	y	y	y
13 May 1729	30	57°00'	138°00'	y	y	y
13 May 2052	31	57°00'	138°30'	y	y	y
14 May 0035	32	57°00'	139°00'	y	y	y

Appendix Table l.--Continued.

14 May 0440	33	57°00'	139°30'	y	y	y
14 May 0753	34	57°00'	140°00'	y	y	y
14 May 1254	35	56°30'	140°00'	y	y	y
14 May 1614	36	56°30'	139°30'	y	y	y
14 May 1921	37	56°30'	139°00'	y	y	y
14 May 2247	38	56°30'	138°30'	y	y	y
15 May 0221	39	56°30'	138°00'	y	y	y
15 May 0545	40	56°30'	137°30'	y	y	y
15 May 0925	41	56°30'	137°00'	y	y	y
15 May 1336	42	56°30'	136°45'	y	n	n
15 May 1451	43	56°30'	136°30'	y	y	y
15 May 1747	44	56°30'	136°15'	y	n	n
15 May 2040	45	56°30'	136°00'	y	y	y
15 May 2200	46	56°30'	135°45'	y	n	n
15 May 2314	47	56°30'	135°30'	y	y	y
16 May 0113	48	56°30'	135°15'	y	n	n
16 May 0537	49	56°00'	134°15'	y	n	n
16 May 0628	50	56°00'	134°30'	y	y	y
16 May 0816	51	56°00'	134°45'	y	n	n
16 May 0918	52	56°00'	135°00'	y	y	y
16 May 1122	53	56°00'	135°15'	y	n	n
16 May 1321	54	56°00'	135°30'	y	y	y
16 May 1507	55	56°00'	135°45'	y	n	n
16 May 1622	56	56°00'	136°00'	y	y	y
16 May 1923	57	56°00'	136°15'	y	n	n

Appendix-Table l.--Continued.

16 May 2043	58	56°00'	136°30'	y	y	y
17 May 0008	59	56°00'	137°00'	y	y	y
17 May 0328	60	56°00'	137°30'	y	y	y
17 May 0734	61	56°00'	138°00	y	y	y
18 May 2016	62	55°30'	137°00'	y	y	y
18 May 2340	63	55°30'	136°30'	y	y	y
19 May 0321	64	55°30'	136°00'	y	y	y
19 May 0626	65	55°30'	135°45'	y	n	n
19 May 0753	66	55°30'	135°30'	y	y	y
19 Nay 1130	67	55°30'	135°15'	y	y	y
19 May 1416	68	55°30'	135°00'	y	y	y
19 May 1610	69	55°30'	134°45'	y	n	n
19 May 1708	70	55°30'	134°30'	y	y	y
19 May 1901	71	55°30'	134°15'	y	n	n
19 May 2005	72	55°30'	134°00'	y	y	y
20 May 0040	73	55°00'	133°20'	y	n	n
20 May 0122	74	55°00'	133°30'	y	y	y
20 May 0251	75	55°00'	133°45'	y	n	n
20 May 0354	76	55°00'	134°00'	y	y	y
20 May 0539	77	55°00'	134°15'	y	n	n
20 May 0655	78	55°00'	134°30'	y	y	y
20 May 0952	79	55°00'	134°45'	y	n	n
20 May 1011	80	55°00'	135°00'	y	y	y
20 May 1410	81	55°00'	135°15'	y	n	n
20 May 1539	82	55°00'	135°30'	y	y	y

Appendix Table l.--Continued,

20 May	1928	83	55°00'	136°00'	y	y	y
21 May	0010	84	54°30'	136°00'	y	y	y
21 May	0342	85	54°30'	135°30'	y	y	y
21 May	0700	86	54°30'	135°15'	y	n	n
21 May	082787	repeat	54°30'	135°00'	y	y	y
21 May	124188	repeat	54°30'	134°45'	y	n	n
21 May	135989	repeat	54°30'	134°30'	y	y	y
21 May	165390	repeat	54°30'	134°15'	y	n	n
21 May	181091	repeat	54°30'	134°00'	y	y	y
21 May	202492	repeat	54°32'	133°45'	y	n	n
21 May	212393	repeat	54°35'	133°30'	y	y	y
21 May	232394	repeat	54°37'	133°15'	y	y	y
22 May	013795	repeat	54°38'	133°00'	y	y	y
22 May	172144	repeat	56°30'	136°15'	y	y	y
22 May	230344	repeat	56°30'	136°15'	n	y	y

Appendix Table 2.-- Date, time, duration of tow (minutes) and standard haul factors for converting actual catches to standardized units. Standard Haul Factor A (SHFA) converts to catch per 10 m^2. Standard Haul Factor V (SHFV) converts to catch per 1,000 m^3 of water strained.

Date	Station	Sample	Time.	Duration	SHFA	SHFV
7 May	95	95N	2007	14.58	1.10	7.33
8 May	94	94N	0209	15.08	1.06	7.09
8 May	93	93N	0319	15.03	1.07	7.11
8 May	91	91N	1048	15.30	1.05	6.98
8 May	89	89N	1618	15.00	1.07	7.12
8 May	87	87N	2052	15.17	1.06	7.04
10 May	1	1N	0914	15.10	1.06	7.08
10 May	2	2N	1320	15.00	1.07	7.12
10 May	3	3N	1501	15.17	1.06	7.04
10 May	4	4N	1804	15.00	1.07	7.12
10 May	6	6N	2204	15.33	1.05	6.97
11 May	8	8N	0055	15.33	1.05	6.97
11 May	9	9N	0615	15.43	1.04	6.93
11 May	10	10N	0754	14.67	1.09	7.28
11 May	11	11N	1342	15.17	1.06	7.04
11 May	12	12N	1642	15.25	1.05	7.01
11 May	13	13N	2332	15.08	1.06	7.09

Appendix Table 2.--Continued.

12 May	14	14N	0123	15.37	1.64	6.95
12 May	15	15N	0642	15.00	1.07	7.12
12 May	16	16N	0814	15.00	1.07	7.12
12 May	18	18N	1539	15.17	1.06	7.04
12 May	20	20N	1931	15.50	1.03	6.89
12 May	22	22N	2131	15.67	1.02	6.82
13 May	23	23N	0205	15.10	1.06	7.08
13 May	25	25N	0646	15.13	1.06	7.06
13 May	27	27N	1109	15.00	1.07	7.12
13 May	29	29N	1544	15.08	1.06	7.09
13 May	30	30N	1905	15.08	1.06	7.09
13 May	31	31N	2238	15.67	1.02	6.82
14 May	32	32N	0108	15.08	1.06	7.09
14 May	33	33N	0622	15.02	1.07	7.11
14 May	34	34N	0755	15.02	1.07	7.11
14 May	35	35N	1425	14.50	1.10	7.37
14 May	36	36N	1616	15.17	1.06	7.04
14 May	37	37N	2102	15.02	1.07	7.11
14 May	38	38N	2248	15.08	1.06	7.09
15 May	39	39N	0403	15.00	1.07	7.12
15 May	40	40N	0548	15.02	1.07	7.11
15 May	41	41N	1007	15.12	1.06	7.07
15 May	43	43N	1625	15.17	1.06	7.04
15 May	45	45N	2040	15.00	1.07	7.12
15 May	47	47N	2348	14.97	1.07	7.14

Appendix Table 2.--Continued.

16	May	50	50N	0630	15.05	1.06	7.10
16	May	52	52N	0920	15.00	1.07	7.12
16	May	54	54N	1342	15.17	1.06	7.04
16	May	56	56N	1624	15.17	1.06	7.04
16	May	58	58N	2218	15.00	1.07	7.12
17	May	59	59N	0009	15.13	1.06	7.06
17	May	60	60N	0618	15.00	1.07	7.12
17	May	61	61N	0736	16.18	0.99	6.60
18	May	62	62N	2151	15.17	1.06	7.04
18	May	63	63N	2340	15.17	1.06	7.04
19	May	64	64N	0511	15.20	1.05	7.03
19	May	66	66N	0755	15.05	1.06	7.10
19	May	67	67N	1307	15.25	1.05	7.01
19	May	68	68N	1417	15.08	1.06	7.09
19	May	70	70N	1747	15.33	1.05	6.97
19	May	72	72N	2035	15.25	1.05	7.01
20	May	74	74N	0122	15.05	1.06	7.10
20	May	76	76N	0427	15.17	1.06	7.04
20	May	78	78N	0657	15.00	1.07	7.12
20	May	80	80N	1243	15.08	1.06	7.09
20	May	82	82N	1539	15.25	1.05	7.01
20	May	83	83N	2100	15.25	1.05	7.01
21	May	84	84N	0153	15.38	1.04	6.95
21	May	85	85N	0344	15.07	1.06	7.09
21	May	87	187N	1108	15.00	1.07	7.12

Appendix Table 2.--Continued.

21 May	89	189N	1533	15.08	1.06	7.09
21 May	91	191N	1914	15.67	1.02	6.82
21 May	93	193N	2222	15.08	1.06	7.09
22 May	94	194N	0015	15.00	1.07	7.12
22 May	95	195N	0137	14.67	1.09	7.28
22 May	44	144AN	1857	15.17	1.06	7.04
22 May	44	144BN	1920	15.00	1.07	7.12
22 May	44	144CN	1941	15.08	1.06	7.09
22 May	44	144DN	2201	15.00	1.07	7.12
22 May	44	144EN	2021	15.00	1.07	7.12
22 May	44	144FN	2041	15.17	1.06	7.04
22 May	44	144GN	2101	15.00	1.07	7.12
22 May	44	244AN	2304	15.08	1.06	7.09
22 May	44	244BN	2326	15.08	1.06	7.09
22 May	44	244CN	2346	15.00	1.07	7.12
23 May	44	244DN	0006	15.08	1.06	7.09
23 May	44	244EN	0026	15.17	1.06	7.04
23 May	44	244FN	0045	15.00	1.07	7.12
23 May	44	244GN	0105	15.00	1.07	7.12

SHFA = (1.08 * 15/Duration)

SHFV = 6.67 * SHFA

Count * SHFA = No./1,000 m2

Count * SHFV = No./1,000 m^3

Appendix Table 3-- Numbers of fish larvae and fish eggs collected by neuston tows in the eastern Gulf of Alaska, May 1990.

	Larvae																										Eggs						
Station*	Total	Anop	Hxl	Hxs	Hxd	Oph	Hhe	Hjo	Hsp	Ebi	Srp	Btm	Stc	Lsa	Cra	Crf	Onc	Seb	Ammod	Tarl	Lip	Gas	Zap	Ath	Hip	Odo	Total	Erx	Mic	Eop	Pl	Icos	Btl
1 d	4	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	142	23	119	-	-	-	-
2 d	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	8	7	-	-	-	-
3 d	11	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	102	7	95	-	-	-	-
4 d	36	27	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	163	9	154	-	-	-	-
6 n	700	644	-	-	5	22	-	-	-	-	-	1	-	5	-	-	-	2	25	-	-	-	-	-	-	-	114	7	107	-	-	-	-
8 n	408	394	-	4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	3	-	-	1	-	2	-
9 n	17	2	-	6	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	4	-	-	3	-
10 d	5	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-
11 d	31	1	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-
12 d	11	1	5	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	25	3	-	-	-	-
13 n	1421	1380	27	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	0	-	-	-	-	-	-
14 n	574	502	-	38	-	-	10	-	-	-	-	-	6	-	-	-	-	-	5	13	-	-	-	-	-	-	50	1	40	-	-	9	-
15 d	20	1	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	6	-	-	4	-
16 d	12	3	-	8	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	202	7	179	-	-	16	-
18 d	21	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	27	-	-	9	-
20 d	65	4	-	38	-	1	-	5	-	-	-	-	14	-	-	-	-	2	1	-	-	-	-	-	-	-	68	26	38	-	-	4	-
22 n	149	-	-	63	-	5	-	13	-	1	-	-	1	-	2	-	3	-	58	-	3	-	-	-	-	-	0	-	-	-	-	-	-
23 d	10	2	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	0	-	-	-	-	-	-
25 d	89	61	9	-	-	-	-	10	-	-	-	1	-	-	-	-	-	-	7	-	-	-	-	-	-	-	9	-	2	-	-	7	-
27 d	75	65	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	41	-	34	-	-	7	-
29 d	11	6	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	17	-	-	8	-
30 d	35	17	17	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	17	-	-	3	-
31 n	219	145	33	-	-	2	22	-	-	-	-	1	-	-	-	-	-	4	9	3	-	-	-	-	-	-	31	5	21	-	-	5	-
32 n	4398	4337	18	-	-	-	23	-	-	-	-	-	-	-	-	-	-	3	1	15	-	1	-	-	-	-	0	-	-	-	-	-	-
33 d	74	51	17	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	13	-	12	-	-	1	-
34 d	9	-	8	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-
35 d	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	--	-	-	2	-
36 d	8	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	2	50	-	-	30	-
37 n	244	136	10	-	-	8	15	-	-	-	-	-	-	-	-	-	-	1	74	-	-	-	-	-	-	-	66	40	26	-	-	-	-
38 n	359	291	35	-	-	-	18	-	1	-	-	-	-	1	-	-	-	-	-	13	-	-	-	-	-	-	157	138	19	-	-	-	-
39 d	1124	875	21	-	-	-	29	-	-	-	-	3	-	-	-	-	-	2	194	-	-	-	-	-	-	-	26	-	23	-	-	3	-
40 d	40	17	19	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	12	-	-	16	1
41 d	18	3	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	10	14	-	-	10	-
43 d	11	1	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	-	7	-	-	19	-
45 n	434	353	20	12	-	-	-	27	-	-	-	-	15	-	-	-	-	-	7	-	-	-	-	-	-	-	43	-	23	-	-	20	-
47 n	49	16	-	7	-	5	17	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-
50 d	75	-	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144	2	66	-	-	76	-
52 d	18	5	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	310	-	310	-	-	-	-

Appendix Table 3.--Continued.

54	d	12	2	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	12	-	-	24	-
56	d	13	5	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	28	-	-	1	-
58	n	2069	1905	24	-	-	-	54	-	-	-	-	-	76	-	-	-	-	3	5	-	2	-	-	-	-	-	32	-	20	-	-	12	-
54	d	12	2	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	12	-	-	24	-
56	d	13	5	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	28	-	-	1	-
58	n	2069	1905	24	-	-	-	54	-	-	-	-	-	76	-	-	-	-	3	5	-	2	-	-	-	-	-	32	-	20	-	-	12	-
59	d	1089	777	66	-	-	-	5	-	-	-	-	233	-	-	-	-	-	-	-	8	-	-	-	-	-	-	38	18	-	-	-	-	20
60	d	15	11	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	183	-	70	-	-	113	-
61	d	24	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	145	-	65	-	-	80	-
62	n	163	83	-	23	3	-	-	38	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	19	-	2	-	-	17	-
63	n	337	303	18	-	-	-	7	-	-	-	-	-	-	-	-	1	-	8	-	-	-	-	-	-	-	-	15	-	11	-	-	4	-
64	d	48	26	-	8	-	6	-	6	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	82	2	28	-	-	52	-
66	d	30	15	-	11	1	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	64	7	40	-	-	17	-
67	d	10	2	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	9	27	-	-	23	-
68	d	14	2	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95	2	73	-	-	20	-
70	d	13	1	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	6	7	-	-	9	-
72	n	6	-	-	-	-	2	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
74	n	14	8	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	12	-	9	-	-	3	-
76	d	47	17	18	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	30	3	12	-	-	15	-
78	d	22	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	-	-	-	-	49	-
80	d	11	1	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-	12	-	-	25	-
82	d	32	9	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	-	19	-	-	83	1
83	n	14	9	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	50	-
84	n	125	106	-	-	7	-	1	-	-	-	-	-	3	-	-	-	-	-	6	1	-	-	1	-	-	-	98	-	5	-	-	93	-
85	d	132	67	10	-	-	-	29	-	-	-	-	-	25	-	-	-	-	-	1	-	-	-	-	-	-	-	44	-	7	-	-	37	-
86	d	95	29	9	6	-	-	3	37	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	4	-	-	113	-	97	-	-	16	-
187	d	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	34	-
89	d	12	3	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235	217	18	-	-	-	-
189	d	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	151	-	-	-	-	151	-
91	d	7	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	20	16	4	-	-	-	-
191	d	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	2	11	-	-	23	-
93	n	133	34	12	1	-	19	2	-	-	-	-	-	-	-	5	-	-	-	60	-	-	-	-	-	-	-	6	-	6	-	-	-	-
193	d	301	2	-	-	-	2	23	-	-	-	-	-	-	-	1	-	-	-	272	-	1	-	-	-	-	-	0	-	-	-	-	-	-
94	n	35	7	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-	-	-	-	-	-	9	7	1	-	1	-	-
194	n	92	2	2	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	79	-	-	-	-	-	-	-	1	1	-	-	-	-	-
95	n	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
195	n	8137	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8131	-	-	-	-	-	-	1	2	2	-	-	-	-	-
144a	d	14	10	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	28	6	13	-	-	9	-
144b	d	38	27	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	32	4	21	-	-	7	-
144c	d	16	9	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	5	30	-	-	20	-
144d	d	43	29	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	54	5	24	-	-	25	-
144e	d	46	36	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-	48	8	24	-	-	16	-
144f	d	68	47	10	10	6	-	-	-	-	-	-	-	-	2	-	-	-	-	3	-	-	-	-	-	-	-	64	1	38	-	-	25	-
144g	d	44	32	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	48	5	26	-	-	17	-
244a	n	61	32	3	-	-	-	14	-	-	-	-	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-	39	-	21	-	-	18	-
244b	n	115	96	3	-	-	2	5	-	-	-	-	5	-	-	-	-	-	2	-	-	2	-	-	-	-	-	42	5	20	-	-	17	-
244c	n	60	52	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	3	-	36	-	26	-	-	10	-

Appendix Table 3.--continued.

244d n	76	57	4	-	-	-	1	-	-	-	-	6	-	-	-	-	-	3	-	1	1	-	-	-	3	-	47	-	34	-	-	13	-
244e n	48	32	3	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	7	-	-	-	-	-	-	57	7	38	-	-	12	-
244f n	135	105	15	-	-	1	2	-	-	-	-	7	-	-	-	-	-	2	-	1	-	-	-	-	2	-	52	-	33	-	-	19	-
244g n	286	241	2	3	-	2	1	-	-	-	-	32	-	-	-	-	-	3	-	-	-	-	1	-	1	-	46	-	21	-	-	25	-
Species Total	24,899	13,618	699	314	83	65	399	141	1	1	1	292	164	3	13	1	3	55	9004	75	9	1	3	4	9	1	4499	649	2386	1	1	1140	22

* d = day sample, n = night sample

Keys to abbreviations used in Appendix Table 3.

Larvae

Anop	*Anoplopoma fimbria*	Srp	*Scorpaenichthys marmoratus*	Lip	*Liparis* spp.
Hxl	*Hexagrammos lagocephalus*	Btm	*Bathymaster* spp.	Gas	*Gasterosteus aculeatus*
Hxs	*Hexagrammos stelleri*	Stc	*Stichaeus punctatus*	Zap	*Zaprora silenus*
Hxd	*Hexagrammos decagrammus*	Lsa	*Lumpenus sagitta*	Ath	*Atherestes stomias*
Oph	*Ophiodon elongatus*	Cra	*Cryptacanthodes aleutensis*	Hip	*Hippoglossus stenolepis*
Hhe	*Hemilepidotus hemilepidotus*	Crg	*Cryptacanthodes giganteus*	Odo	*Odontopyxis trispinosa*
Hjo	*Hemilepidotus jordani*	Seb	*Sebastes* spp.	Onc	*Oncorhynchus gorbuscha*
Hsp	*Hemilepidotus spinosus*	Ammod	*Ammodytes hexapterus*		
Ebi	*Enophrys bison*	Tarl	*Tarletonbeania crenularis*		

Eggs

Erx	*Errex zachirus*	Eop	*Eopsetta exilis*	Icos	*Icosteus aenigmaticus*
Mic	*Microstomus pacificus*	Pl	*Pleuronichthys decurrens*	Btl	Bathylagidae

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