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U.S. DEPARTMENT OF COMMERCE
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ABSTRACT

Ichthyoplankton was collected by oblique bongo net tows at 67 stations in the eastern Gulf of Alaska in May 1990. Stations ranged from nearshore to 230 km offshore. Larvae of 20 families (53 genera, 88 species) and eggs of 4 families (12' species) of fish were identified. Rockfish (Sebastes spp.) were the most diverse and abundant group of larvae. Rockfish larvae were caught at a11 stations and made up 56% (5,053) of the larvae sampled. Highest abundances of rockfish larvae (>400/10 m^2) were at stations beyond the continental shelf. All rockfish larvae were in the preflexon stage, making identification at the species level difficult. The most commonly occurring rockfish larvae were probably ***Sebastes flaidus,*** based on pigment patterns. The relatively high offshore abundance of larvae of inshore rockfish and other shallow-dwelling fishes supports the hypotheses of offshore transport by anticyclonic circulation of the Sitka Eddy, or by freshwater or wind-driven transport in the absence of the Sitka Eddy.

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INTRODUCTION

Ichthyoplankton surveys in the eastern North Pacific Ocean have been conducted primarily off the coasts of Baja California, California, Oregon, and Washington and to a lesser extent British Columbia (Fiedler 1986, Dunn 1986, Doyle et al. 1993). In Alaska waters, most ichthyoplankton surveys have been in the eastern Bering Sea and western Gulf of Alaska, especially in Shelikof Strait and the Shumagin Islands area (Dunn 1986, Reed et al. 1988, Napp et al. 1996). Notably lacking are published data from the eastern Gulf of Alaska, including Prince William Sound and offshore waters of southeastern Alaska. Limited studies from southeastern Alaska include a survey of ichthyoplankton in the northern inside waters of southeastern Alaska (Mattson and Wing 1978), and studies in Auke Bay near Juneau associated with the spring bloom (Haldorson et al. 1990), Pacific herring ***(Clupea pallasi)*** (Jones 1978, McGurk 1989), and walleye pollock ***(Theragra chalcogramma)*** (Salveson 1984, Krieger 1985).

Environmental conditions, in particular oceanographic currents, may influence the distribution, growth, and survival of marine fish larvae and juveniles (Reed et al. 1988, Schumacher and Kendall 1995, Hermann et al. 1996). In May 1990, we conducted an oceanographic survey of the eastern Gulf of Alaska to determine the presence or absence of the Sitka Eddy, which is believed to have significant influence on pelagic and bottom fisheries of Alaska and British' Columbia (Tabata 1982, Mysak 1985, Hamilton and Mysak 1986, Karinen and Wing 1987). This paper reports ichthyoplankton catches from bongo net sampling during May 1990 off the coast of southeastern Alaska.

MATERIALS AND METHODS

Ichthyoplankton samples were taken by the NOAA ship ***Townsend Cromwell,*** 7-22 May 1990, at 67 of 95 oceanographic stations occupied along 8 east-west transects from Dixon Entrance (lat. 54º30'N) to Cross Sound, Alaska (lat. 58°00'N) (Fig. 1). Transects extended from the coast to long. 136º00'W in the south and to long. 14OºOO'W in the north. Stations were spaced approximately 14.8 km (8 nautical miles [nmi]) apart on the continental shelf on east-west transects. Seaward of the continental shelf, stations were approximately 3 1.5 km (17 nmi) apart. Transects were 55.6 km (30 nmi) apart north to south.

Sampling began at Dixon Entrance (Station 94) on 7 May but was terminated on 8 May due to equipment loss. Sampling was restarted on 10 May off Cross Sound (Station l), and stations were occupied from north to south through 22 May 1990. Sampling at the 9 stations occupied on 7-8 May was repeated on 21-22 May, and day-night comparison tows were made at Station 44 on 22 May.

Ichthyoplankton were collected by oblique tows with a 60-cm diameter bongo net array fitted with two 505-pm-mesh nets and cod ends. A General Oceanics model 2030 flowmeter was installed in the mouth of each net, and a Benthos model 1170-E-l 000 bathykymograph (BKG) was suspended 0.5 m below the nets. The array was set at 45-50 m per minute and retrieved at 30-35 m per minute. Wire angles were monitored visually and electronically with an inclinometer and were used to judge depth during a tow. Vessel speed was varied from 2.8 to 3.7 km/h (1.5 to 2.0 knots) to maintain a 45º wire angle and uniform towing profile. Maximum sampling depth was targeted for 300 m, but varied according to bottom depth while over shallower depths, wire angle, currents, and weather conditions. The departure from the standard Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) depth of 200 m (Jossi et al. 1975) assured sampling through the permanent pycnocline and increased the probability of capturing eggs and larvae of fish spawning along the continental slope.

Following net retrieval, the catches were gently rinsed from the cod ends into sample bottles and preserved in 5% formaldehyde-seawater solution buffered with sodium tetraborate. Preserved samples were sorted in the laboratory under dissecting microscopes at magnifications of 7X-40X. After being sorted, eggs were stored in 5% buffered formaldehyde and larvae in 40% isopropyl alcohol at Auke Bay Laboratory. Eggs and larvae were identified to the lowest taxonomic level possible using current literature (Kendall and Lenarz 1987, Matarese et al. 1989) and comparative specimens. Counts of fish eggs and larvae were converted to numbers per 10 m^2 of surface area based on flowmeter readings, depth of tow, and duration of tow (Smith and Richardson 1977). Catches from the paired nets were combined for counts at each station.

Rockfish ***(Sebastes*** spp.) larvae are difficult to identify to species, especially the preflexon larvae, because they are a specious group with many sibling species and the characteristics used for identification vary with size and between similar-sized individuals of the same species (Kendall and Lenarz 1987, Kendall 1991, Seeb and Kendall 1991, Moreno 1993). For this reason, subsamples of larvae (4-13 mm standard length [SL]) from 10 stations were sorted for ***Sebastes*** spp. larvae before being fixed, and these larvae were frozen on plastic petri plates for electrophoretic allozyme analysis (Seeb and Kendall 1991, Seeb 1993). Forty larvae were analyzed for allozyme activity and compared to adult tissue samples from 10 species of ***Sebastes*** (Seeb 1993).

RESULTS

A total of 8,972 larval and juvenile fish were sorted from the samples, of which 8,914 were identified to species or genus, 26 identified to family, and 32 not identified (Table 1). Four distinct taxa of fish larvae could not be placed in known families. Overall, twenty families represented by more than 90 species in 53 genera were present in the samples. The most diverse group ***was the*** rockfish genus ***Sebastes*** (family Scorpaenidae) with 27 types (putative species) separated on the basis of morphology, size, and pigment patterns of preflexon larvae (Table 2). The families Pleuronectidae and Cottidae were represented by 14 and 12 species, respectively. Other families were represented by l-4 species each. Planktonic fish eggs of eight species of Pleuronectidae and one species each of Bathylagidae, Gadidae, Icosteidae, Macrouridae, and one unidentified family were sampled (Table 3).

Abundances and Distribution

Twenty-two of the 67 ichthyoplankton stations were occupied after sunset and before sunrise. Day-night differences in abundance were not statistically significant ($t_{0.95(63)} < |2.00|$, $P > 0.05$) for 14 taxa collected at both day and night stations.

Scorpaenidae

Rockfish larvae occurred at all stations and comprised 56% of the fish larvae identified (Fig. 2, Table 1). All rockfish larvae collected were in the preflexon stage of development. The formaldehyde-preserved specimens of ***Sebastes*** were separated into 27 species "types" based primarily on pigmentation patterns. The most abundant type closely resembled yellowtail rockfish ***(S. fravidus)*** as described by and illustrated by Matarese et al. (1989). This species accounted for 30% of the rockfish and 17% of all fish larvae, and was found at all stations (Table 2). The second most numerous rockfish larvae (11% of the rockfish, and 6.3% of all fish larvae) most closely resembled harlequin rockfish ***(S. variegatus)*** larvae. The third most abundant rockfish larvae (10% of the rockfish, and 5.7% of all fish larvae) most closely resembled sharpchin rockfish (S. ***zacentrus).***

Forty ***Sebastes*** larvae from two stations (44 and 85) were analyzed for allozyme activity and compared to adult tissues of 10 species of ***Sebastes*** (Seeb 1993). Although positive identification was not possible for most of these larvae, nine specimens were identified as probable Pacific ocean perch ***(S. alutus)*** and one specimen as rougheye rockfish ***(S. aleutianus).*** Other probable species included shortraker rockfish ***(S. borealis),*** dusky rockfrsh ***(S. ciliatus), canary*** rockfish ***(S. pinniger),*** and redstripe rockfish ***(S. proriger).*** The allozyme comparisons also excluded four species from consideration: redbanded rockfish ***(S. babcocki),*** quillback rockfish ***(S. maliger),*** tiger rockfish (S. ***nigrocinctus),*** and yelloweye rockfish (S. ***ruberrimus)*** (Table 3 in Seeb 1993).

Ammodytidae

Pacific sand lance ***(Ammodytes hexapterus)*** nearly tied putative yellowtail rockfish at 16% of the total fish larvae, but they were abundant at only two stations (Fig. 3). The large catches of Pacific sand lance juveniles at these two night stations accounted for 95% of the Pacific sand lance taken. The remaining 5% of the Pacific sand lance larvae were from 15 day stations and 9 night stations.

Myctophidae

Lanternfish larvae, juveniles, and adults were represented by six species. The northern lampfish ***(Stenobrachius leucopsarus),*** the most abundant and widely distributed lanternfish, ranked third in abundance of all fish larvae and was found at 61 stations

(Fig. 4). The bigeye lampfish ***(Protomyctophum thompsoni),*** found at 40 stations, ranked eighth in abundance of total larvae (Fig. 5). California headlight&h ***(Diaphus theta) was*** taken at five day and five night stations (Fig. 6). Blue lanternfish ***(Tarletonbeania crenularis)*** was taken at only two stations. Juvenile pinpoint lampfish ***(Lampanyctus regazis)*** and broadfin lampfish ***(L. ritteri)*** were taken once each.

Bathylagidae

Larvae of three species of deepsea smelts were found in the bongo net samples. Larvae of northern smoothtongue ***(Leuroglossus schmidti),*** the most abundant bathylagid, were identified from 16 stations and ranked 10th in abundance (Fig. 7). Larvae of the Pacific blacksmelt ***(Bathylagus pacificus)*** were identified from 29 stations, and ranked 11th in abundance (Fig. 8). Single robust blacksmelt ***(Bathylagus milleri)*** larvae were found at three stations.

Gadidae

Gadid larvae were sparsely distributed among the samples. Walleye pollock ***(Theragra chalcogramma)*** was the most numerous gadid, ranking sixth in abundance, but was found at only 22 stations (Fig. 9). Pacific tomcod ***(Microgadus proximus)*** and Pacific cod ***(Gadus macrocephalus)*** occurred at only four and five stations, respectively (Fig. 10).

Anoplopomatidae

Sablefish ***(Anoplopoma fimbria)*** larvae were found at 39 stations, ranking fifth in overall abundance. Most sablefish larvae were distributed offshore at stations beyond the continental slope (Fig. 11). Mean abundance of sablefish larvae was also highest in neuston tows at stations seaward of the continental slope (Wing 1997).

Cyclopteridae

Snailfishes were represented by the genus ***Liparis.*** At least two species were present. Most specimens were a form with inflated integument surrounding the head and forward portion of the body (bubblemorph), more closely resembling slipskin snailfish ***(Liparis ficensis)*** larvae described by Marliave and Peden (1989) than by Ambrose (1996) in intensity of pigmentation. Liparid larvae were found at both near-shore and offshore stations (Fig. 12).

Clupeidae

Pacific herring ***(Clupea pallasi)*** ranked ninth in abundance. Pacific herring spawn intertidally and subtidally in the sounds and bays along the southeastern Alaska coast adjacent to our survey area (Skud 1959). The occurrence of herring larvae at six offshore stations (Fig. 13) may be the result of offshore transport of surface waters in the spring of 1990.

Pleuronectidae

Flatfish larvae were represented by 14 species. Arrowtooth flounder (Atheresthes ***stomias)*** was the most abundant flatfish and ranked fourth in overall abundance (Fig. 14). Dover sole ***(Microstomus pacificus)*** and flathead sole ***(Hippoglossoides elassodon)*** ranked 12th and 13th, respectively. Flathead sole larvae were found at 8 stations (Fig. 15), whereas Dover sole occurred at 18 stations (Fig. 16). Rex sole ***(Errex zachirus)*** occurred at 14 stations and ranked 16th in abundance (Fig. 17). The geographic distributions of these flatfish larvae broadly overlap and show extensive offshore distribution.

Cottidae

Fourteen species of cottid larvae were identified, reflecting the high diversity of sculpins in the northeastern Pacific Ocean. Most of the cottid larvae collected were species believed to spawn and reside as adults intertidally or in relatively shallow nearshore waters. None of the cottids was abundant (Table 1). The various cottids were represented by single specimens at 19 of 20 stations. Brown Irish lord ***(Hemilepidotus spinosus;*** eight specimens) were collected at three stations (Fig. 18). In contrast, red Irish lord ***(H. hemilepidotus)*** and yellow Irish lord ***(H. jordani),*** occurring as single individuals at four stations in the bongo net samples, were frequently encountered in neuston samples during the same cruise (Wing and Kamikawa 1995).

Other Families and Species

Forty-two species were present at six or fewer stations, and 23 species were represented by single individuals (Table 1). Many of these species, especially the cottids, are believed to spawn intertidally or in relatively shallow nearshore waters. Others represent pelagic midwater species or benthic species residing below the shelf break, whose larvae may rarely occur above 300 m depth.

Eggs

Fish eggs were not abundant in our samples and showed little diversity. Of the 12 species of eggs identified, only 3 species were found in more than 10% of the samples or at more than six stations (Table 3). The most abundant and frequently occurring of these eggs were Dover sole eggs, present at 52 stations (Fig. 19). Rex sole eggs, present at 22 stations (Fig. 20), did not have a discernible pattern of distribution or abundance. Larvae of Dover sole and rex sole were present at few stations where their eggs were found. Other flatfish eggs were rare (Table 3) and widely scattered (Fig. 21). Ragfish ***(Icosteus aenigmaticus)*** eggs were present at 48 stations (Fig. 22), with highest concentrations in the southern offshore portions of the survey area. We found no planktonic ragfish larvae in our samples, although advanced embryos were in the eggs at several stations.

DISCUSSION

Species Assemblages

The ichthyoplankton of the eastern Gulf of Alaska can be grouped into three spawning assemblages: pelagic midwater spawners, slope spawners, and shelf spawners. Pelagic midwater species were represented in our samples by lanternfishes, deepsea smelts, and viperfish. Although these species spawn at varying times and depths, their eggs and larvae are widely distributed both within the water column and throughout the area. The northern lampfish and northern smoothtongue are characteristic of this group and are among the most frequently occurring and abundant species in our survey area. Both species are also common in ichthyoplankton samples from the inside waters of southeastern Alaska in April through November (Mattson and Wing 1978).

Benthic slope species with pelagic eggs and larvae were represented in our samples by several flatfishes, primarily the Dover sole, rex sole, arrowtooth flounder, and Pacific halibut ***(Hippoglossus stenolepis).*** Sablefish and some of the rockfishes that either reside on the slope or move to the slope for parturition (larval release) (O'Connell 1987) may be placed in this group.

Shelf-spawning species were represented in our samples by Pacific herring, sculpins, snailfish, and flatfishes. This assemblage includes species with demersal eggs and species with planktonic eggs, although the larvae of some nearshore and intertidal spawning fishes are seldom found offshore. The resident rockfishes of the nearshore areas may be considered as a subgroup of the shelf species.

The neustonic larvae form a distinctive behavioral group that has species from the slope- and shelf-spawning assemblages. The neustonic fish larvae of the eastern Gulf of Alaska are dominated by the sablefish, greenlings, and cottids (Wing and Kamikawa 1995). Sablefish were the most abundant larvae in neuston samples from this cruise (Wing and Kamikawa 1995, Wing 1997). Low abundance and low frequency in oblique or vertical net tows and moderate to high abundance in neuston tows are characteristic of this group (Wing 1997).

Distribution Influences

Eggs and larvae of fish may rise or sink through the water column as they develop. Density structure and associated temperature, salinity, and light gradients influence the vertical distribution of fish eggs and larvae, and the depth distribution varies with developmental stage (Kendall and Kim 1989, Olla and Davis 1990). If there is significant vertical variation in current direction and velocity, late developmental stages are expected to have wider and more varied spatial distribution than early stages. Although age and size determinations were not attempted in our analyses, the wide oceanic distribution of some shelf and slope species in our samples may be the result of older stages being carried offshore from spawning areas as they rise through the water column.

Preliminary analysis of the physical oceanographic data indicated that the Sitka Eddy was not present in the survey area during May 1990 (Musgrave and Wing 1991, Wing and Kamikawa 1995), although a very complex current system with four or more small eddies was present in the upper 250 m of the water column.' The strongest current velocities were observed along the 56º30'N transect, where five alternating north and south flows were observed in the upper 50 m of the water column. The northward geostrophic current exceeded 20 cm set^{-1} at Station 48, and the southward geostrophic flow was over 17 cm set^{-1} at Station 50. Three to six alternating north and south flows were observed on the other transects. This complex of eddies and currents may be the mechanism for transport of fish larvae and eggs offshore from spawning areas on the continental shelf and continental slope. It may also be the mechanism for returning the fish larvae to inshore nursery areas.

The peak spawning, hatching, and parturition periods of most fish in Alaska are poorly known. Abundant species during this survey may indicate proximity to peak spawning periods, but sampling before and after May is needed to confirm peak spawning. Because planktonic larvae are expected to be carried away from spawning sites by currents and mixing processes, they may be more widely distributed than planktonic eggs. An indication that we sampled before or during a peak spawning period is the wider distribution of Dover sole and rex sole eggs than of their larvae.

In addition to the environmental factors influencing survival of fish larvae and fish eggs, behavioral traits contribute to the abundance of several species in our samples. Some nearshore and intertidal species (e.g., Pacific sandfish ***Trichodon trichodon)*** hatch at an advanced stage and seek benthic habitats shortly after hatching (Marliave 1980, Bailey et al. 1983), and thus never truly enter the ichthyoplankton community. Recently, a deep-dwelling snailfish, ***Careproctus*** sp., also was found to hatch as advanced larvae with

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[1]D. Musgrave, Institute of Marine Sciences, University of Alaska Fairbanks, Fairbanks, AK 997751080; pers. commun., June 1995.

bottom-seeking behavior (Love and Shirley 1993). Various snailfishes, sculpins, eelpouts, pricklebacks, etc. which appear common in benthic habitats, but rare in ichthyoplankton, may have similar behavior (Marliave 1986).

In contrast to the bottom-seeking species are the neustonic species, which although rare in standard oblique tows, are occasionally numerous and dominant in neuston samples. Greenlings, Irish lords, sablefish, and perhaps some salmonids appear adapted to dwell near the surface, where they are susceptible to neuston nets but only infrequently taken in oblique tows (Wing and Kamikawa 1995, Wing 1997). This limited distribution within a small portion of the water column in combination with schooling behavior at an early stage may result in under-representation of those species in ichthyoplankton surveys.

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TABLES

Table l.-Number, rank, and frequency of fish larvae collected in bongo net tows in the eastern Gulf of Alaska, May 1990.

Taxon	Number	Rank	Stations
Sebastes spp.	5053	1	67
Ammodytes hexapterus	1439	2	21
Stenobrachius leucopsarus	903	3	61
Atheresthes stomias	401	4	40
Anoplopoma fimbria	252	5	39
Theragra chalcogramma	130	6	22
Protomyctophum thompsoni	111	7	40
Liparis spp.	108	8	31
Clupea pallasi	66	9	11
Leuroglossus schmidti	52	10	16
Bathylagus pacificus	49	11	29
Microstomus pacificus	44	12	18
Hippoglossoides elassodon	40	13	8
Ronquilus jordani	39	14	7
Bathymaster sp.	37	15	14
Errex zachirus	32	16	14
Chaulodius macouni	30	17	21
Microgadus proximus	21	18	5
Zaprora silenus	19	19	6
Diaphus theta	11	20	10
Hexagrammos decagrammus	10	21.5	6
Hippoglossus stenolepis	10	21.5	7
Pleurnoectes sp.(?*peracuatus*)	9	23.5	6
Ophiodon elongatus	9	23.5	6
Pleuronectes isolepis	8	25.5	4
Hemilepidotus spinosus	8	25.5	3
Unidentified Bathylagidae	6	28	3
Gadus macrocephalus	6	28	4
Lycodapus sp.	6	28	2
Unidentified Myctophidae	5	30	2
Unidentified Zoarcidae	4	31	1
Unidentified Agonidae	4	31	4
Bathylagus milleri	3	37	3
Hexagrammos lagocephalus	3	37	3
Eopsetta jordani	3	37	2
Tarletonbeania crenularis	3	37	2
Artedius meanyi	3	37	2
Hemilepidotus hemilepidotus	3	37	3
Radulinus asprellus	3	37	2

Table 1 .-Continued.

Taxon	Number	Rank	Stations
Lumpenus maculatus	3	37	3
Unidentified Stichaeidae	3	37	3
Stichaeus punctatus	2	44.5	2
Hexagrammos stelleri	2	44.5	1
Artedius sp.	2	44.5	2
Embassichthys bathybius	2	44.5	2
Psettichthys melanostictus	2	44.5	2
Unidentified Pleuronectidae	2	44.5	2
Lampanyctus regalis	1	58.5	1
Lampanyctus ritteri	1	58.5	1
Unidentified Gadidae	1	58.5	1
Albatrossia pectoralis	1	58.5	1
Unidentified Macrouridae	1	58.5	1
Apodichthys flavidus	1	58.5	1
Cryptacanthodes aleutensis	1	58.5	1
Anarrhichthys ocellatus	1	58.5	1
Hexagrammos octogrammus	1	58.5	1
Artedius harringtoni	1	58.5	1
Blepsias bilobus	1	58.5	1
Enophrys diceraus	1	58.5	1
Hemilepidotus jordani	1	58.5	1
Icelinus sp.	1	58.5	1
Malacocottus zonurus	1	58.5	1
Oligocottus maculosus	1	58.5	1
Paricelinus hopliticus	1	58.5	1
Psychrolutes paradoxus	1	58.5	1
Agonopsis vulsa	1	59.5	1
Bathyagonus nigripinnis	1	59.5	1
Bathyagonus sp.	1	59.5	1
Odontopyxis trispinosa	1	59.5	1
Xeneretmus sp. (?*latifrons*)	1	59.5	1
Platichthys stellatus	1	59.5	1
Pleuronichthys coenosus	1	59.5	1
Unident. Species A	2		1
Unident. Species B	4		2
Unident. Species C	23		7
Unident. Species D (black)	3		2

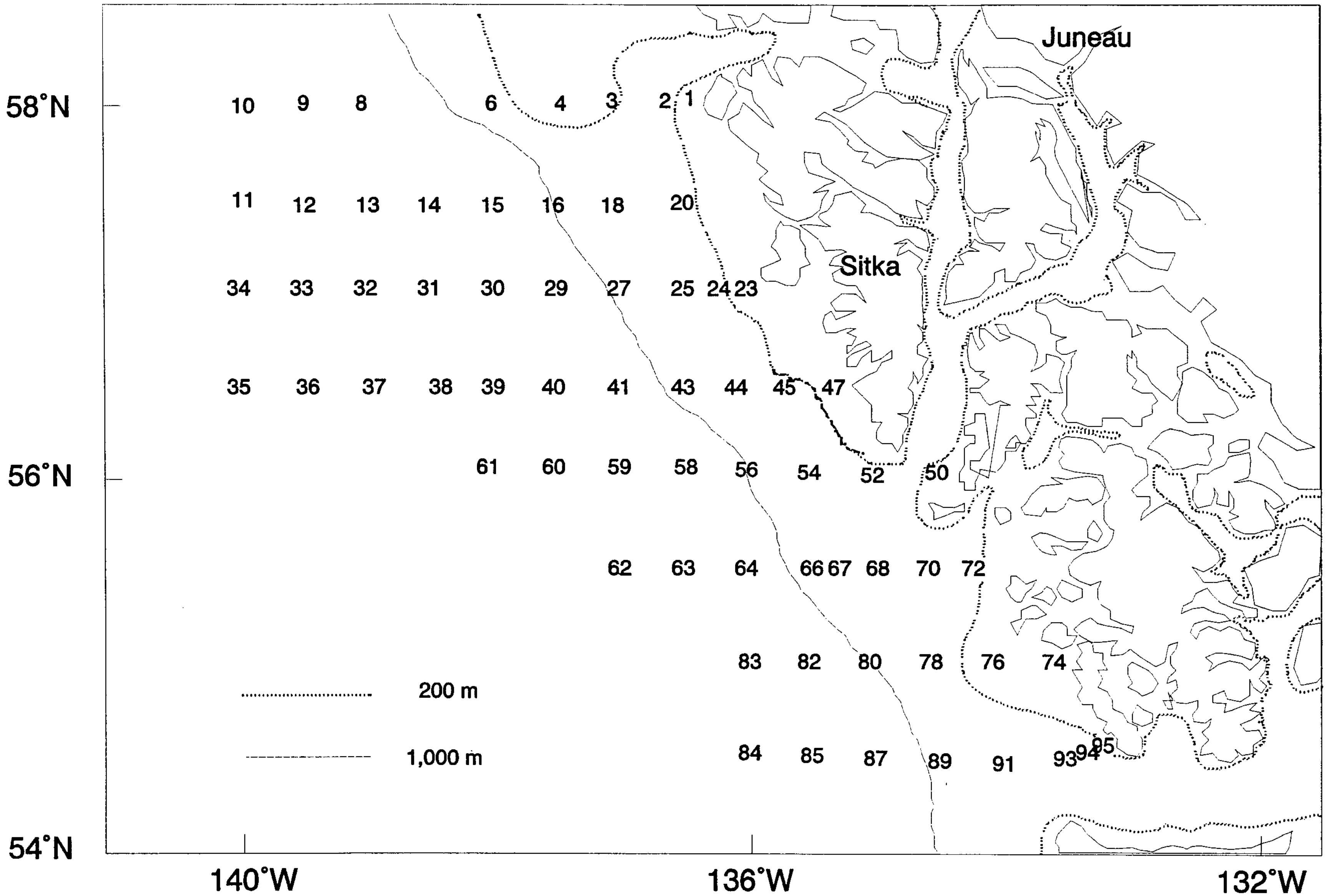
Table 2.-Number, rank, and frequency of rockfish larvae ***(Sebastes*** spp.) collected in bongo net tows in the eastern Gulf of Alaska, May 1990.

Pigment pattern (Suspected species)	Number	Rank	Stations
Sebastes flavidus	1461	1	67
S. variegatus	562	2	43
S. zacentrus	514	3	44
Sebastes sp. 1	397	6	49
S. alutus	354	5	11
S. caurinus	238	6	30
S. elongatus	230	7	22
Sebastes sp. 2	208	8	25
S. aleutianus	179	9	25
S. melanostomus	111	10	17
S. brevispinis	95	11	17
S. entomelas	93	12	12
S. jordani	65	14	12
Sebastes sp. 3	64	13	8
S. maliger	59	15	8
S. proriger	46	16.5	11
S. ruberrimus	46	16.5	4
S. miniatus	43	18	5
S. diploproa	36	19	5
S. saxicola	32	20	7
S. ciliatus	30	21	8
S. babcocki	26	22	9
S. polyspinis	23	23	3
S. pinniger	14	24	4
S. crameri	13	25	5
S. reedi	10	26	3
S. helvomaculatus	3	27	2
Sebastes spp.(dried)	34		1

Table 3.-Number, rank, and frequency of fish eggs collected in bongo net tows in the eastern Gulf of Alaska, May 1990.

Taxon	Rank	Number	Stations
Microstomus pacificus	1	660	52
Icosteus aenigmaticus	2	299	48
Errex zachirus	3	91	22
Theragra chalcogramma	4	15	1
Eopsetta exilis	5	11	4
Leuroglossus schmidti	6	8	3
Hippoglossoides elassodon	7	5	5
Unidentified Macrouridae eggs	8	3	3
Pleuronichthys decurrens	9.5	2	2
Pleuronectes quadrituberculatus	9.5	2	1
Eopsetta jordani	11.5	1	1
Pleuronichthys coenosus	11.5	1	1
Unidentified Pleuronectidae eggs		2	1
Unidentified fish eggs		10	7

FIGURES


Juneau
Sitka
58°N
56°N
54°N
140°W
136°W
132°W
200 m
1,000 m
10 9 8 6 4 3 2 1
11 12 13 14 15 16 18 20
34 33 32 31 30 29 27 25 24 23
35 36 37 38 39 40 41 43 44 45 47
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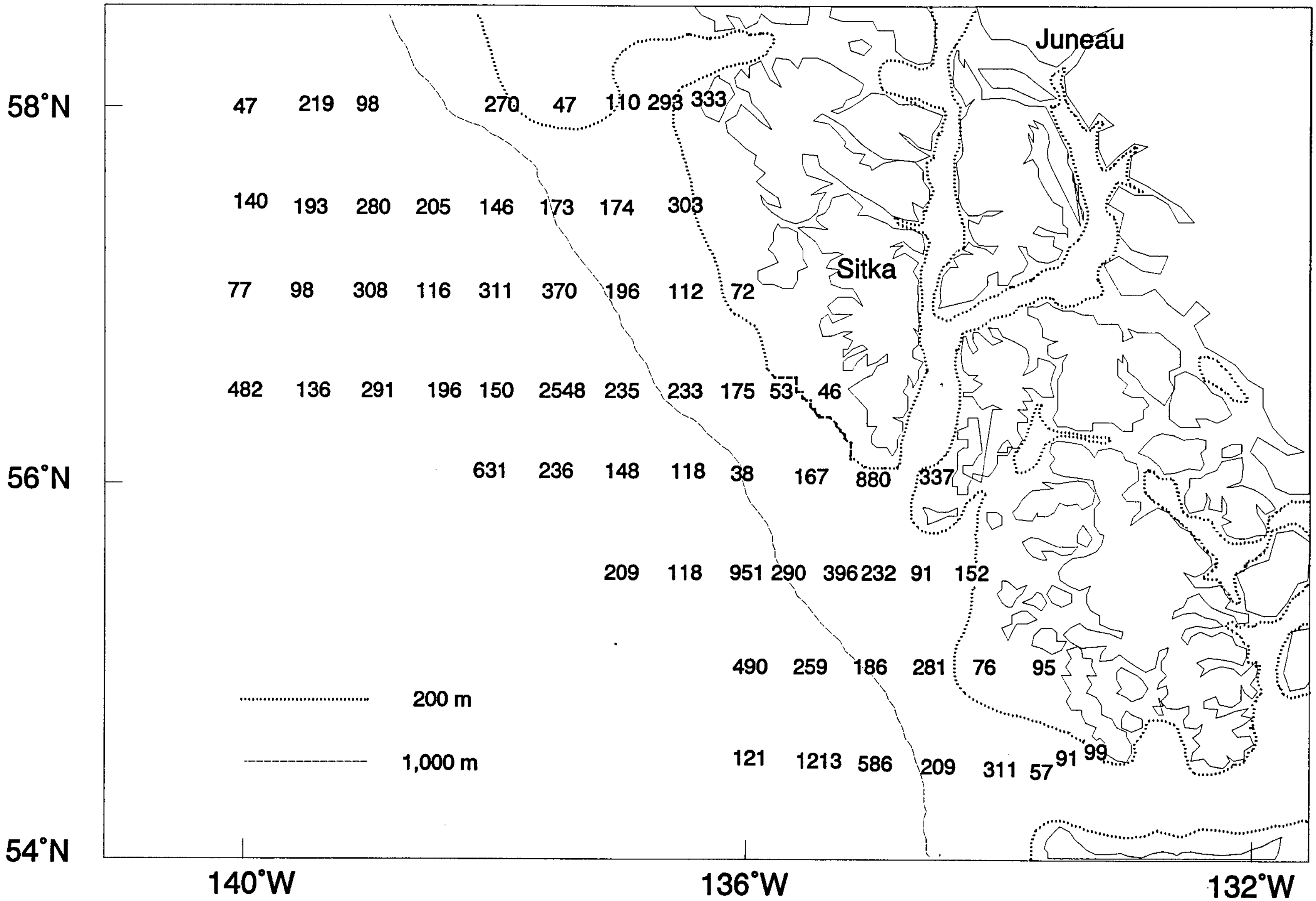

Figure 2.—Distribution of *Sebastes* spp. larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

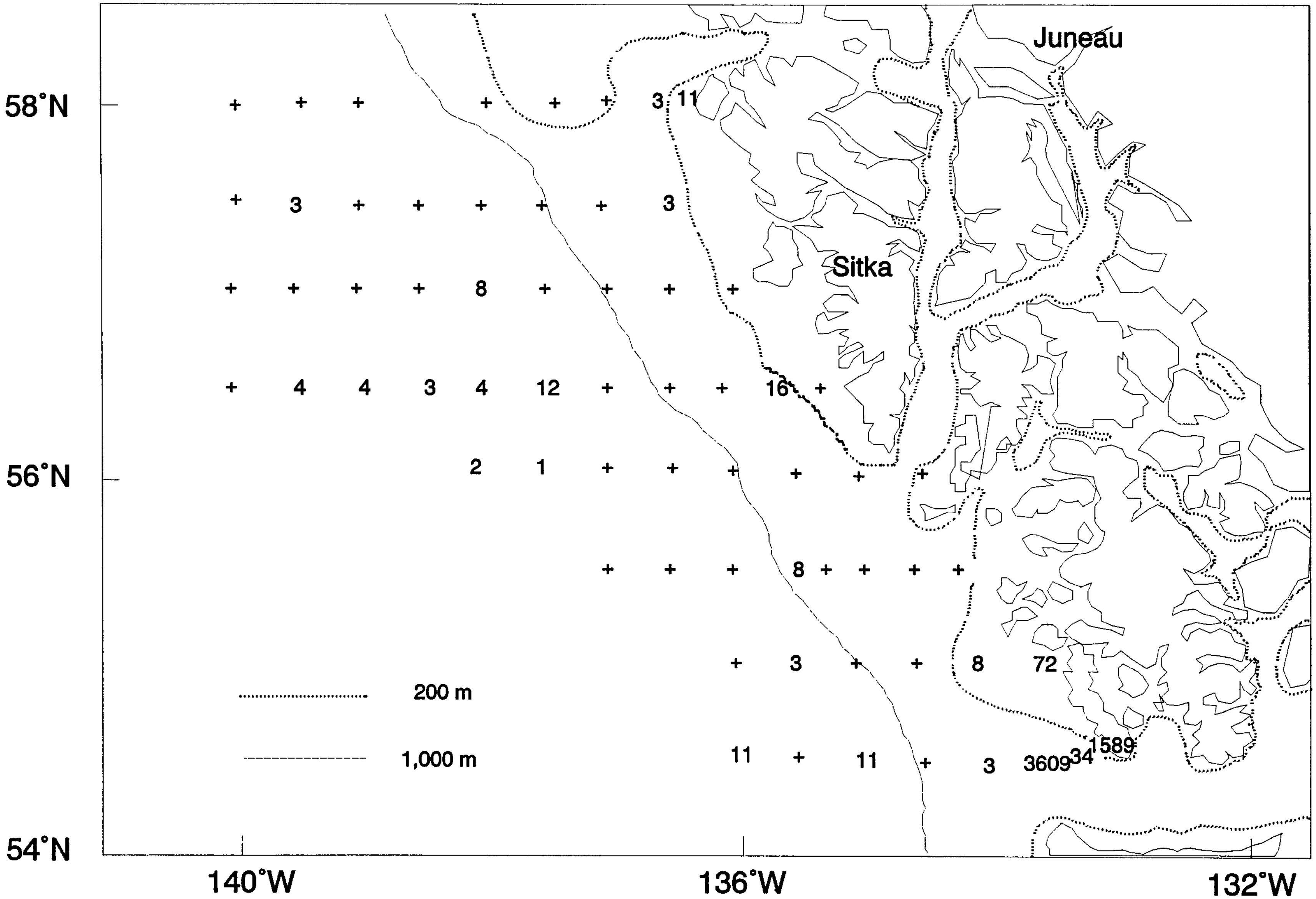

Figure 3.-Distribution of Ammodytes ***hexapterus*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

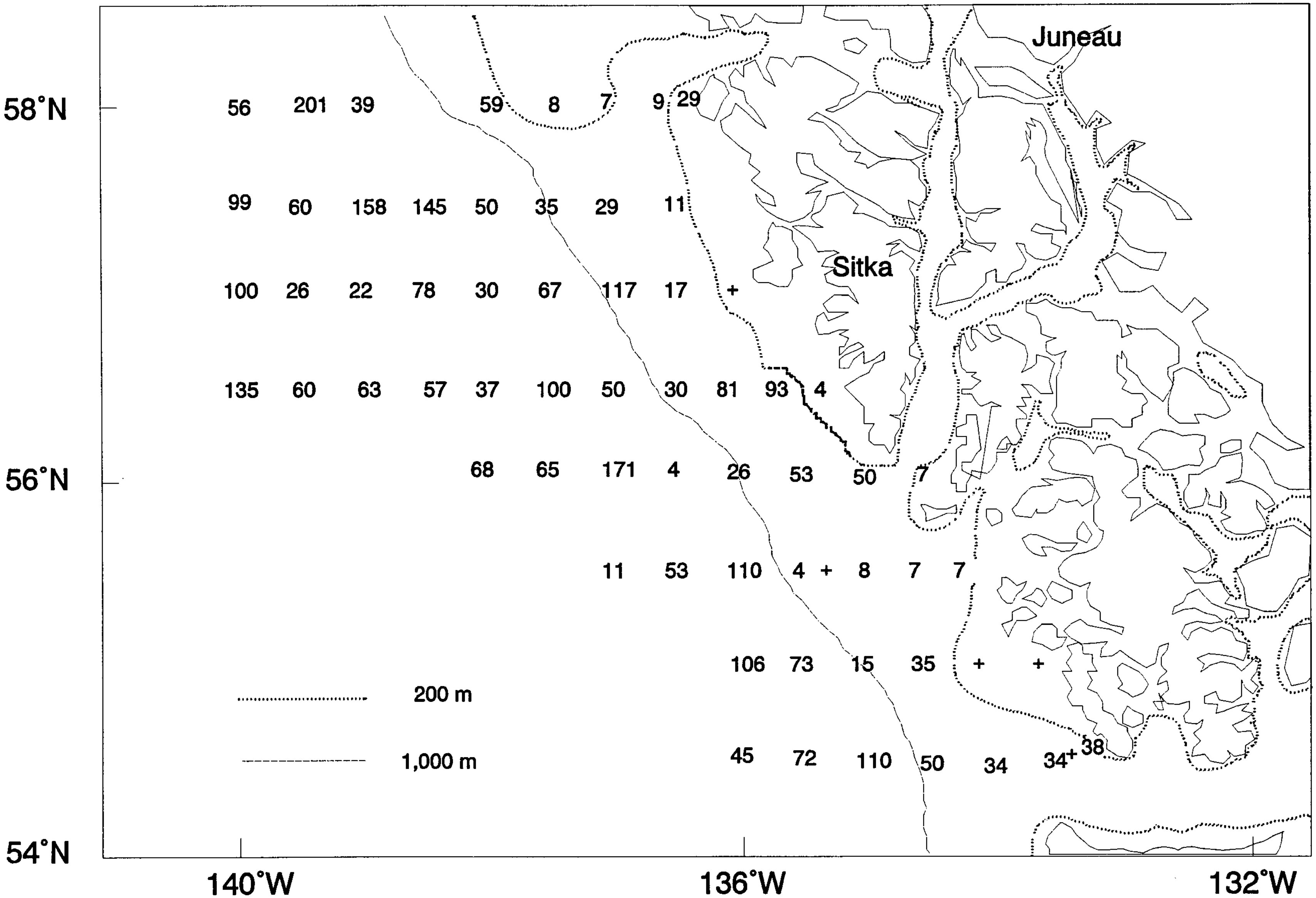

Figure 4.—Distribution of *Stenobrachius leucopsarus* in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

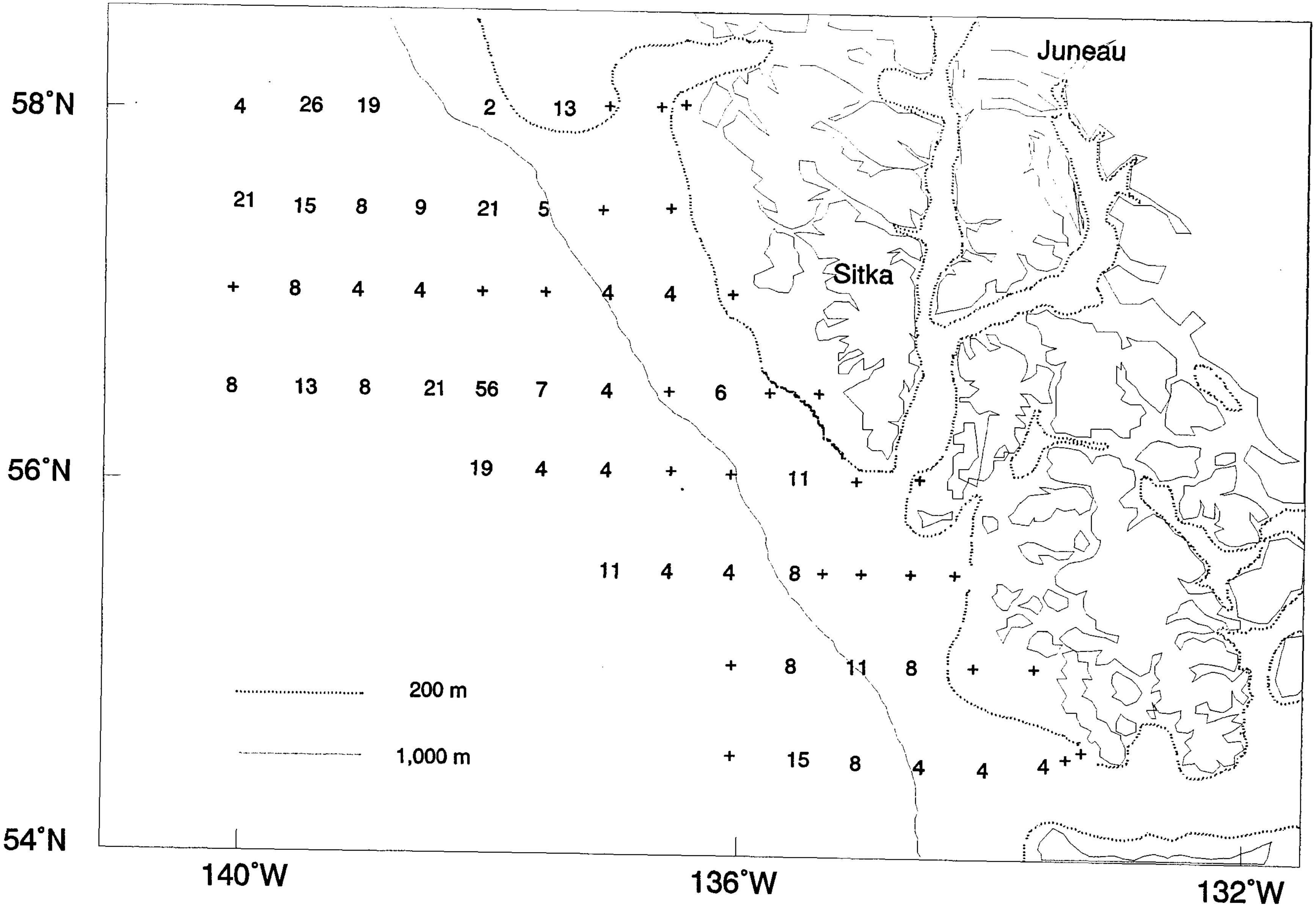

Figure 5.—Distribution of *Protomyctophum thompsoni* larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

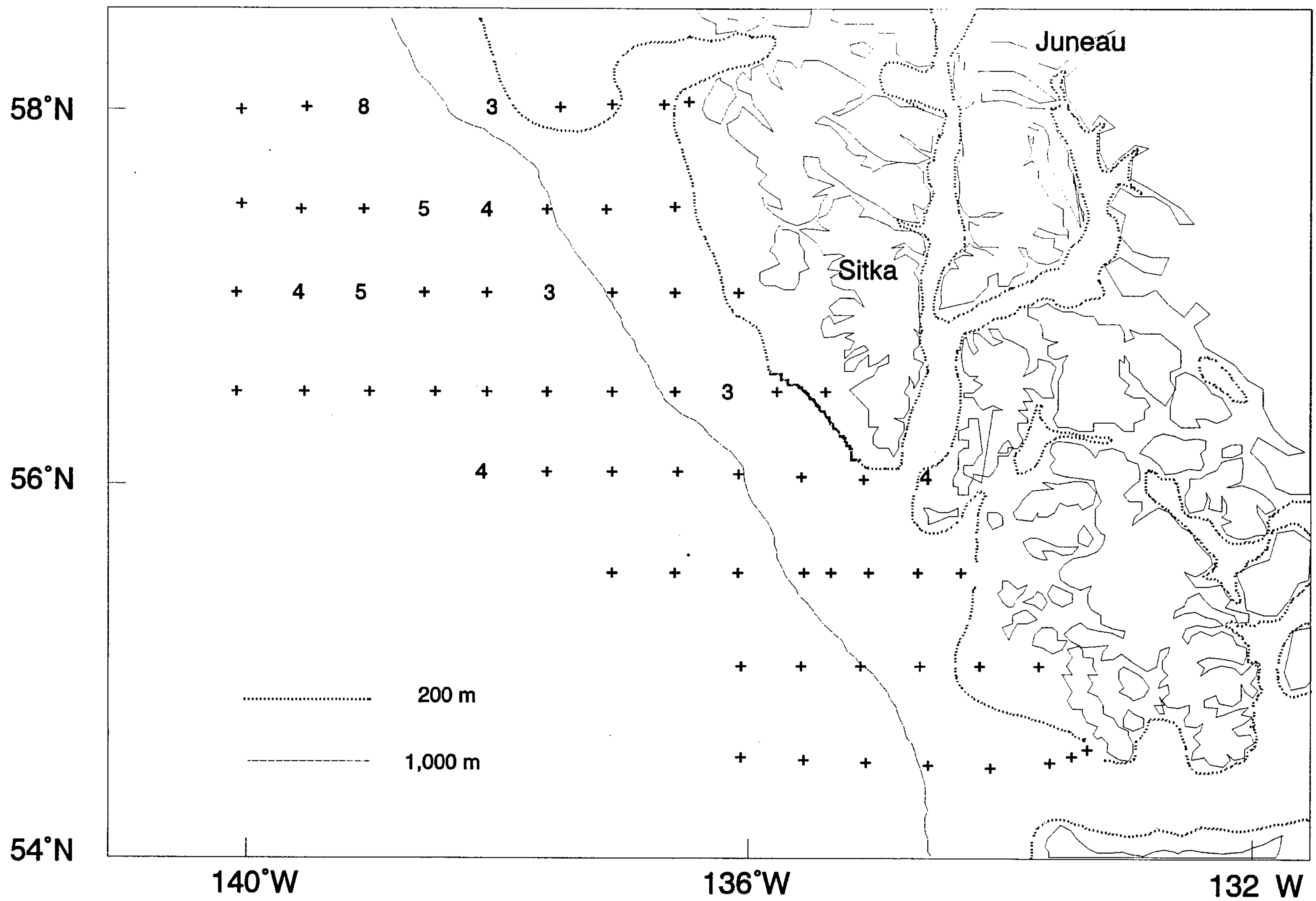

Figure 6.—Distribution of *Diaphus theta* larvae and juveniles in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

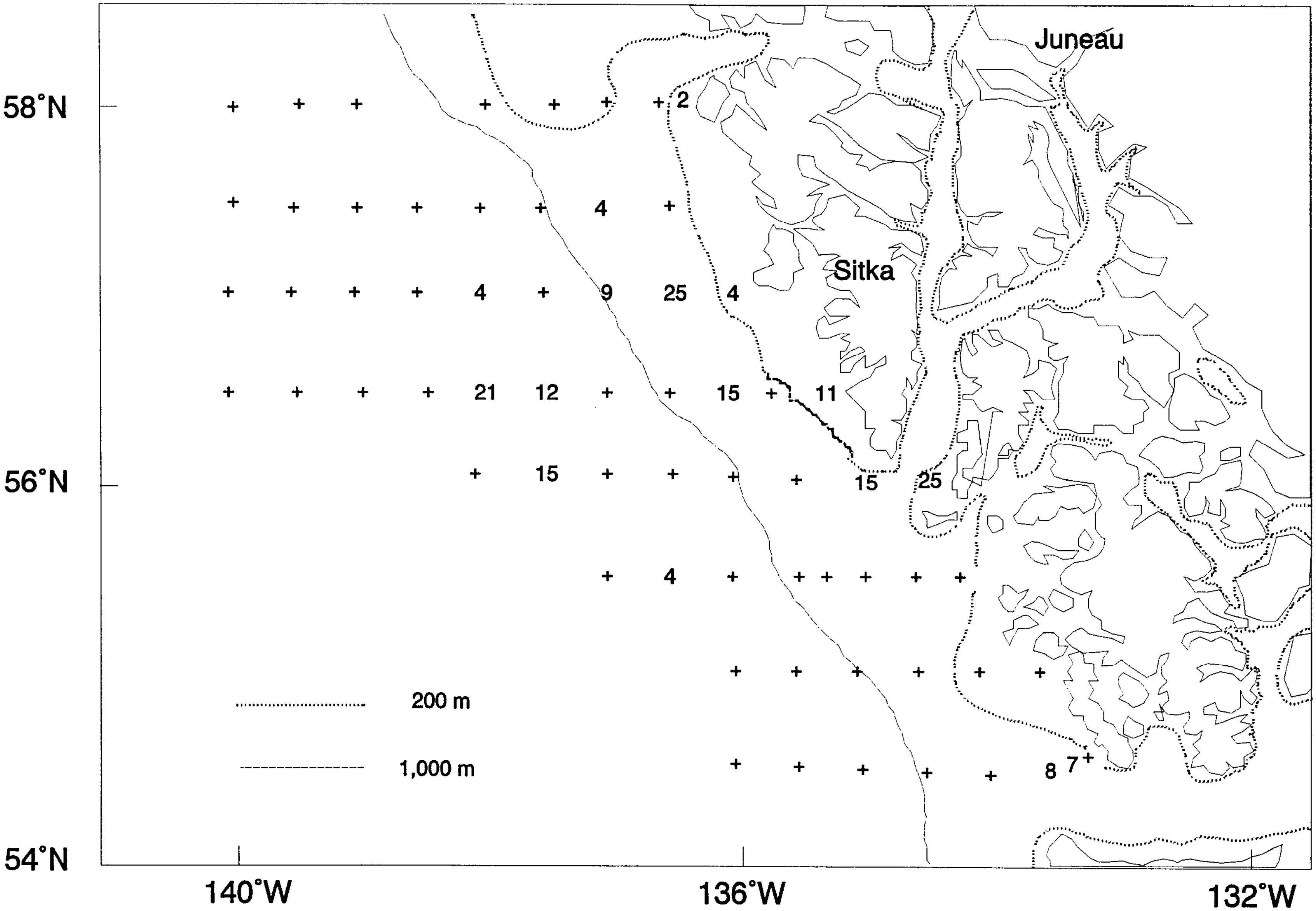

Figure 7.-Distribution of ***Leuroglossus schmidti*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

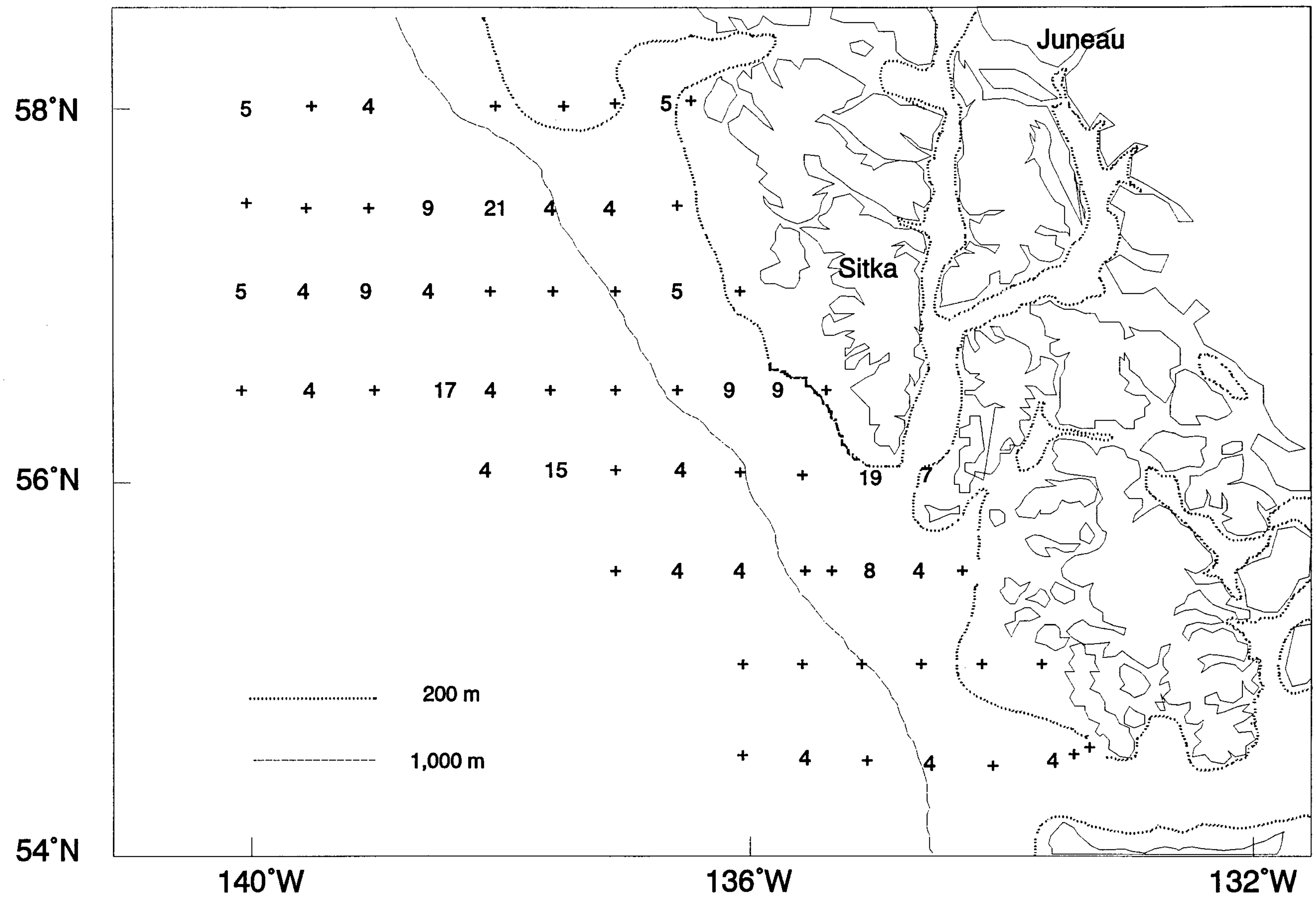

Figure 8.—Distribution of *Bathylagus pacificus* in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

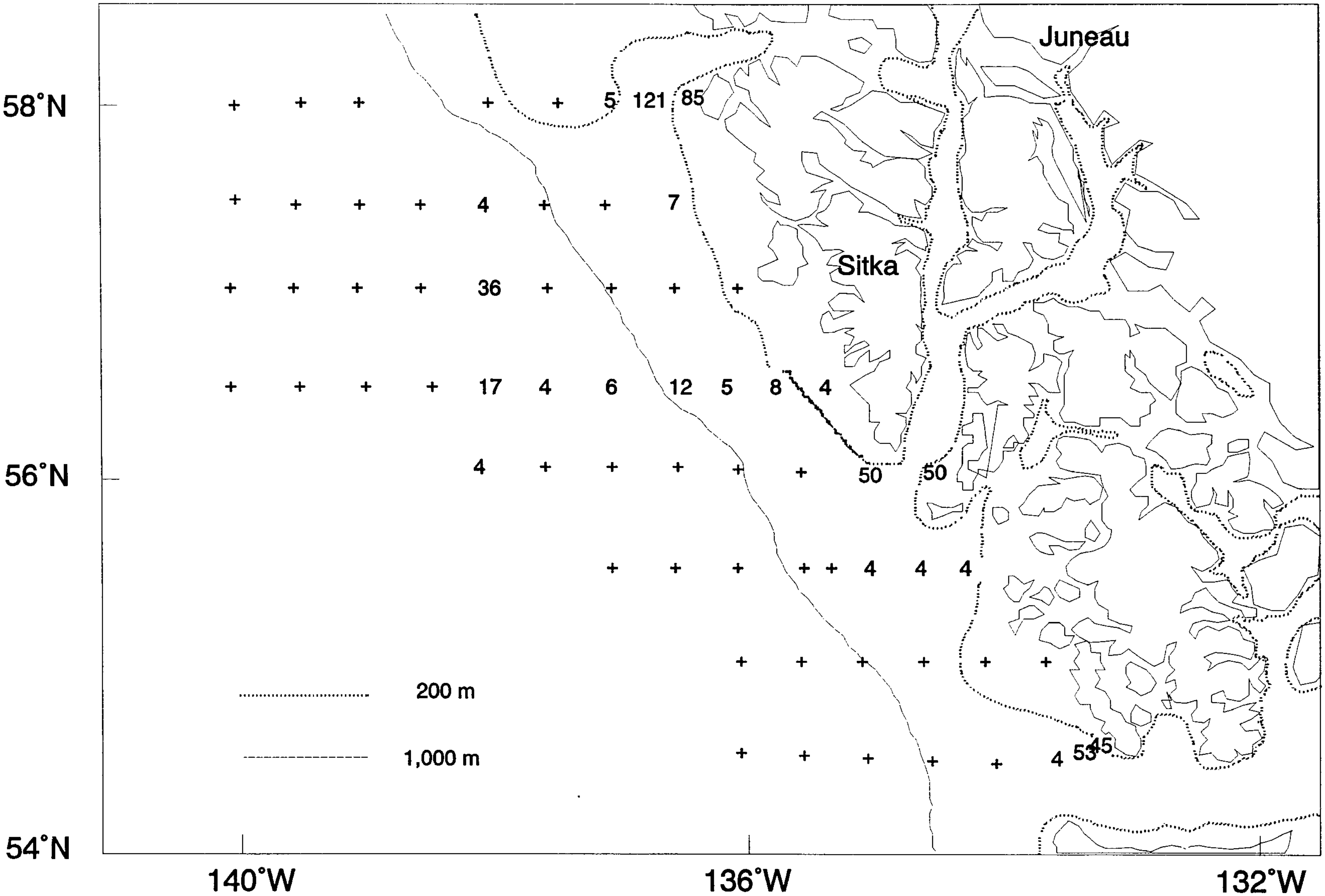

Figure 9.—Distribution of *Theragra chalcogramma* larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

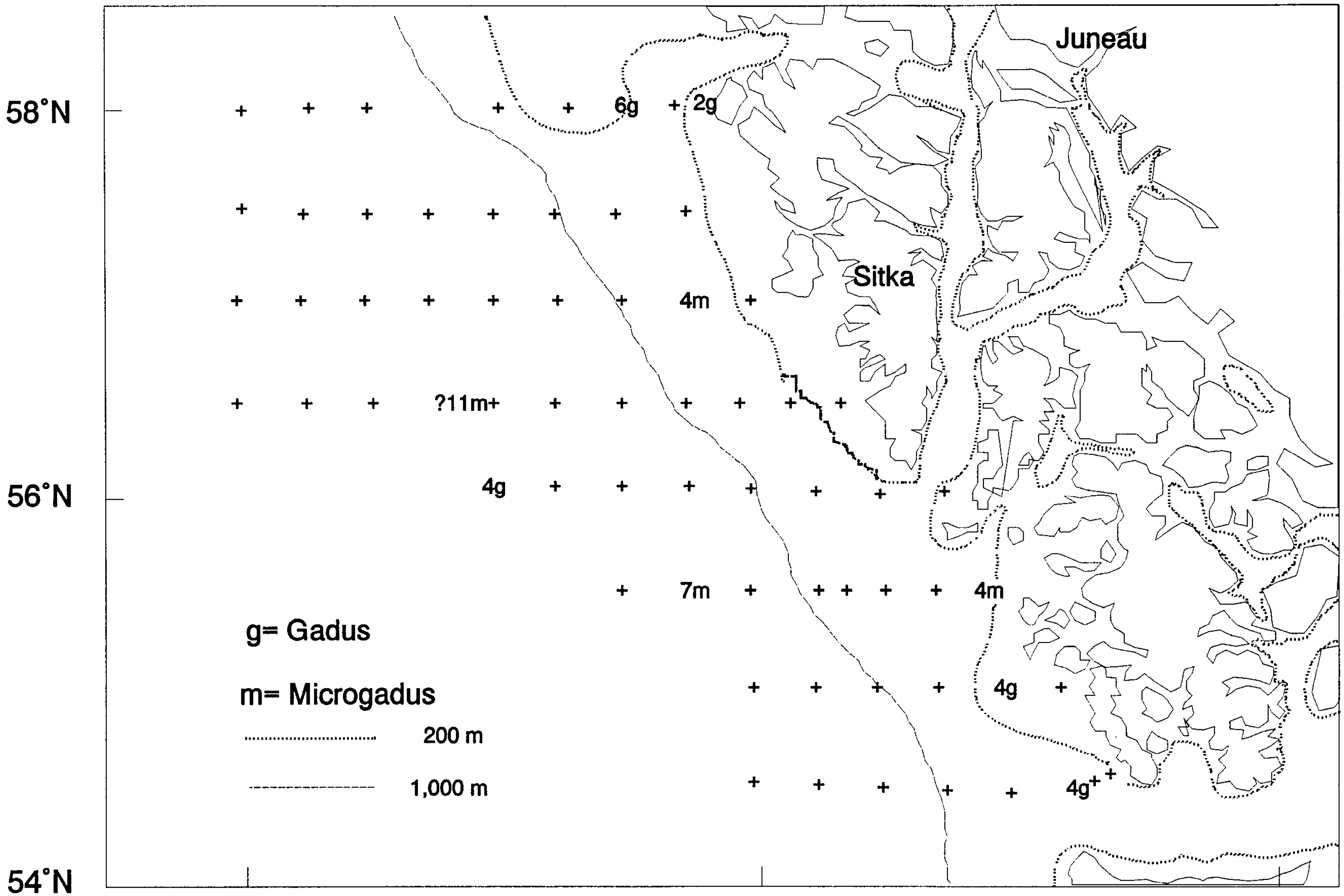

Figure l0.-Distribution of ***Microgudus proximus*** and ***Gadus macrocephalus*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

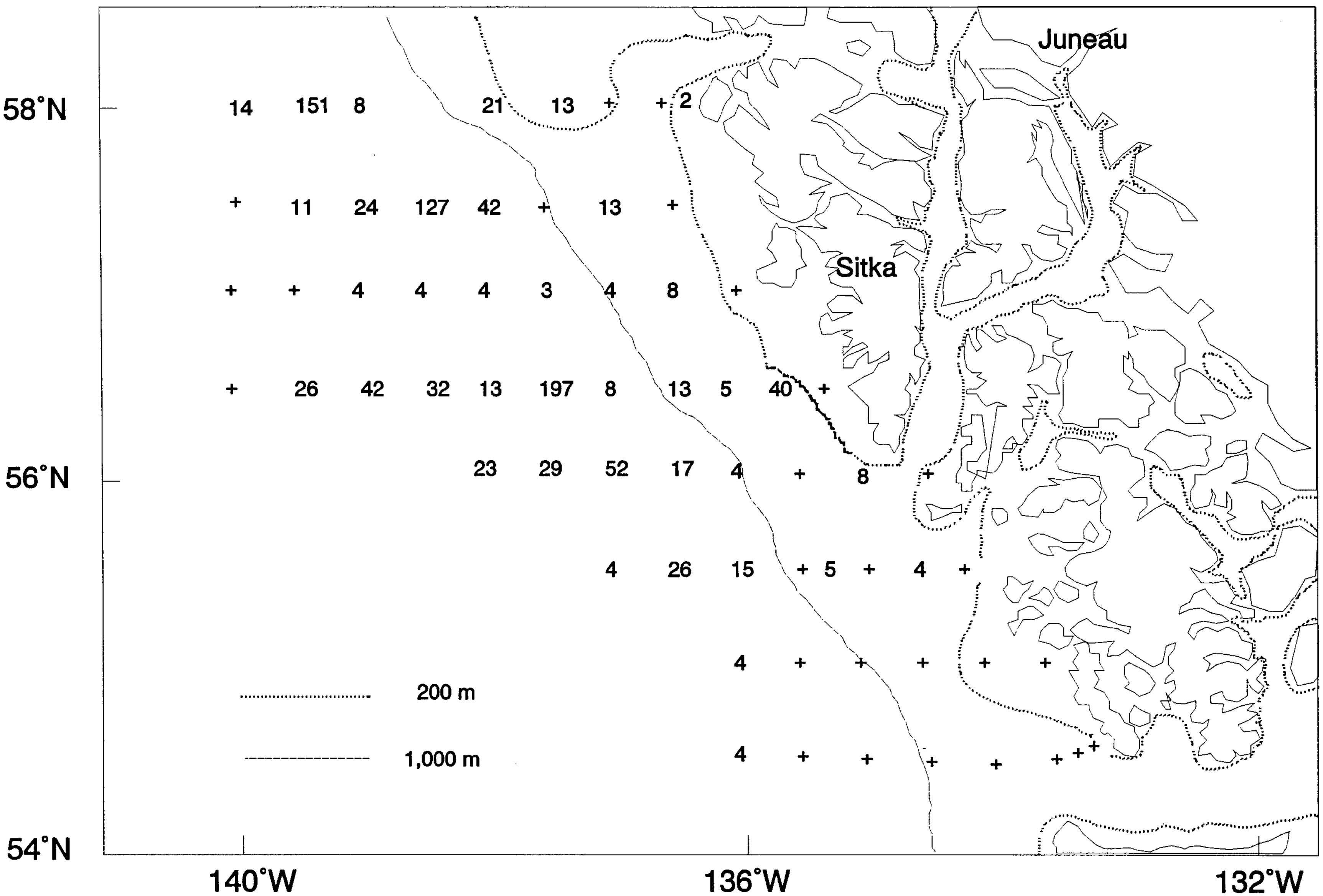

Figure 11.—Distribution of *Anoplopoma fimbria* larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

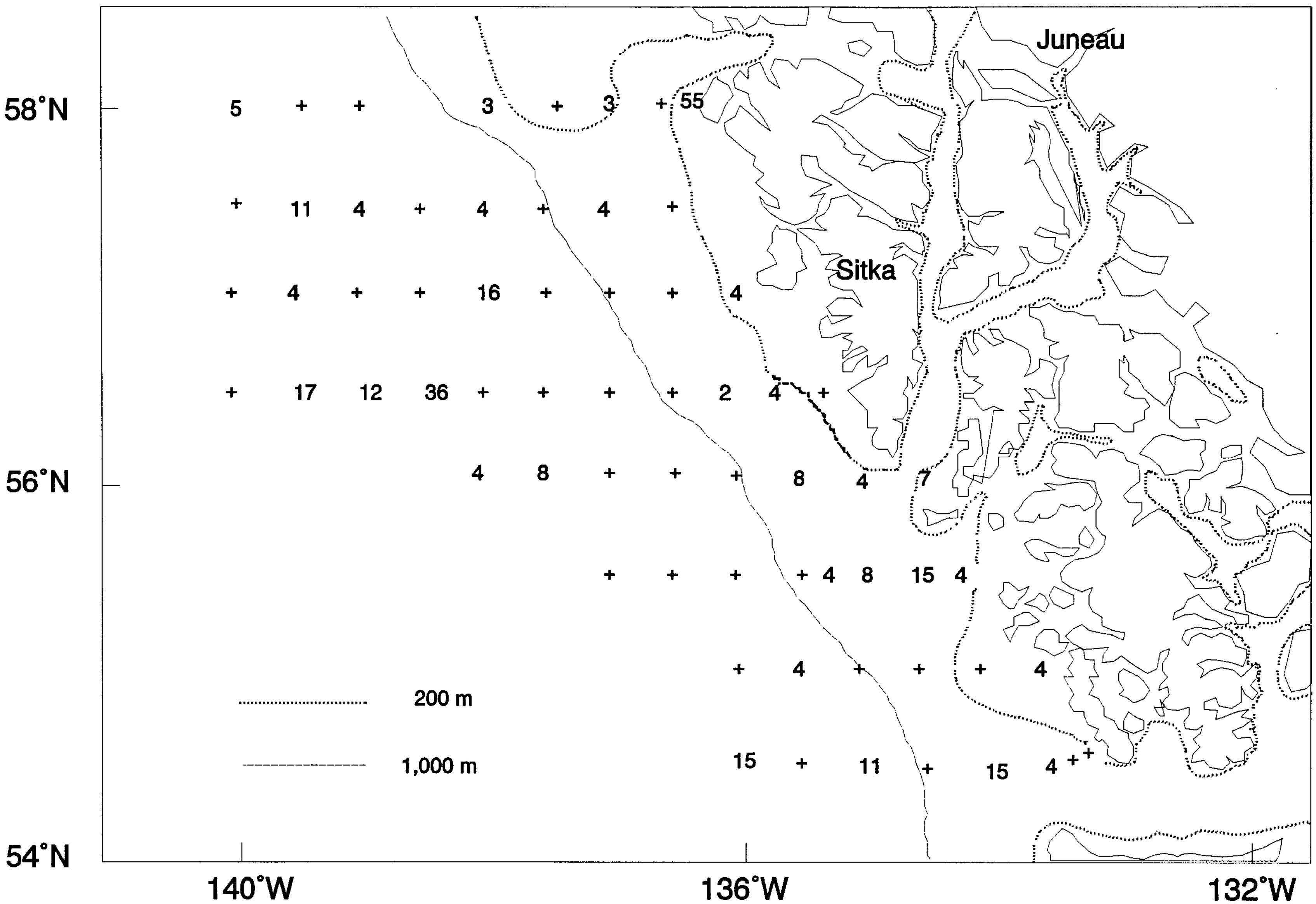

Figure 12.—Distribution of *Liparis* spp. larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

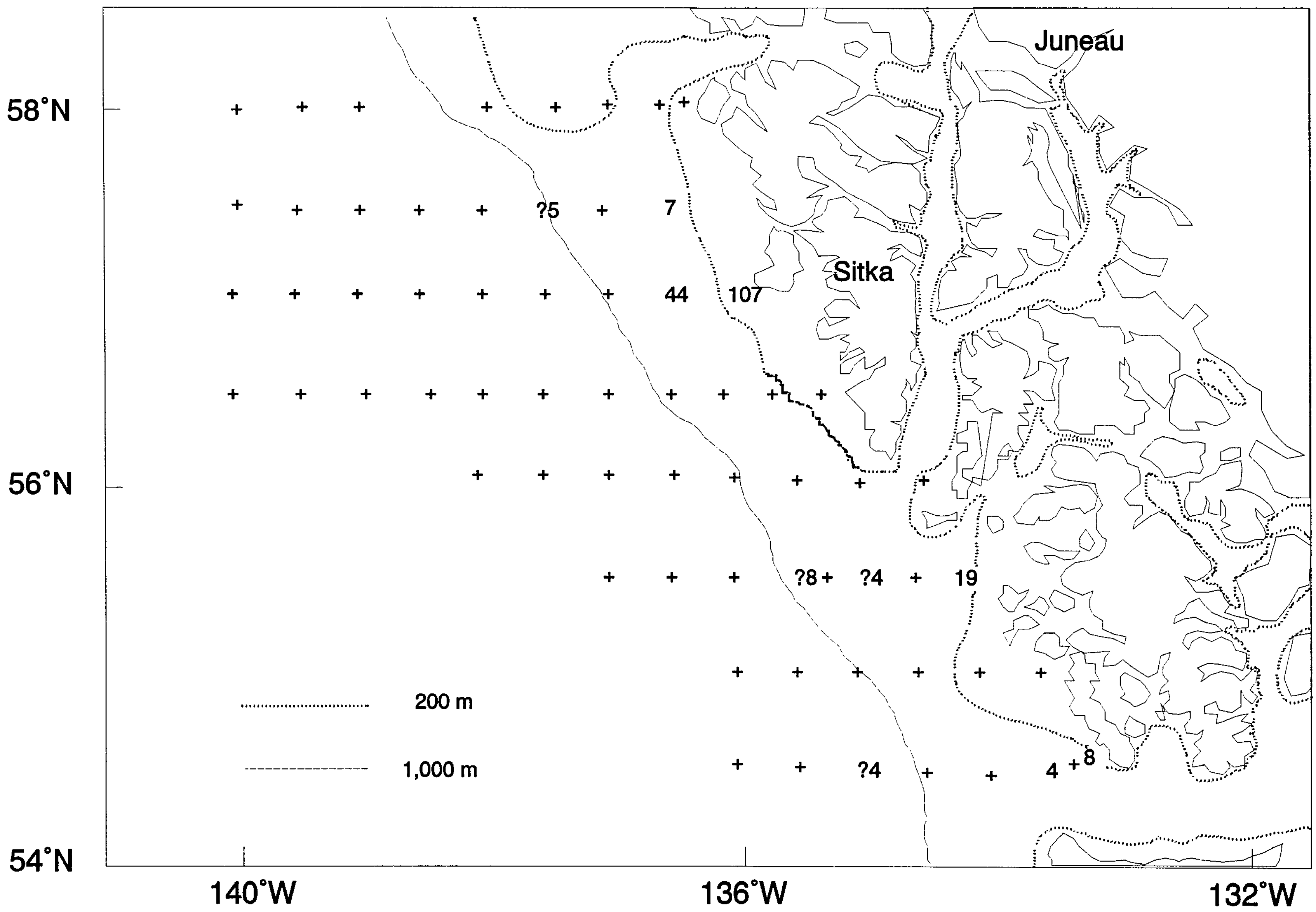

Figure 13.-Distribution of ***Clupea pallasi*** in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

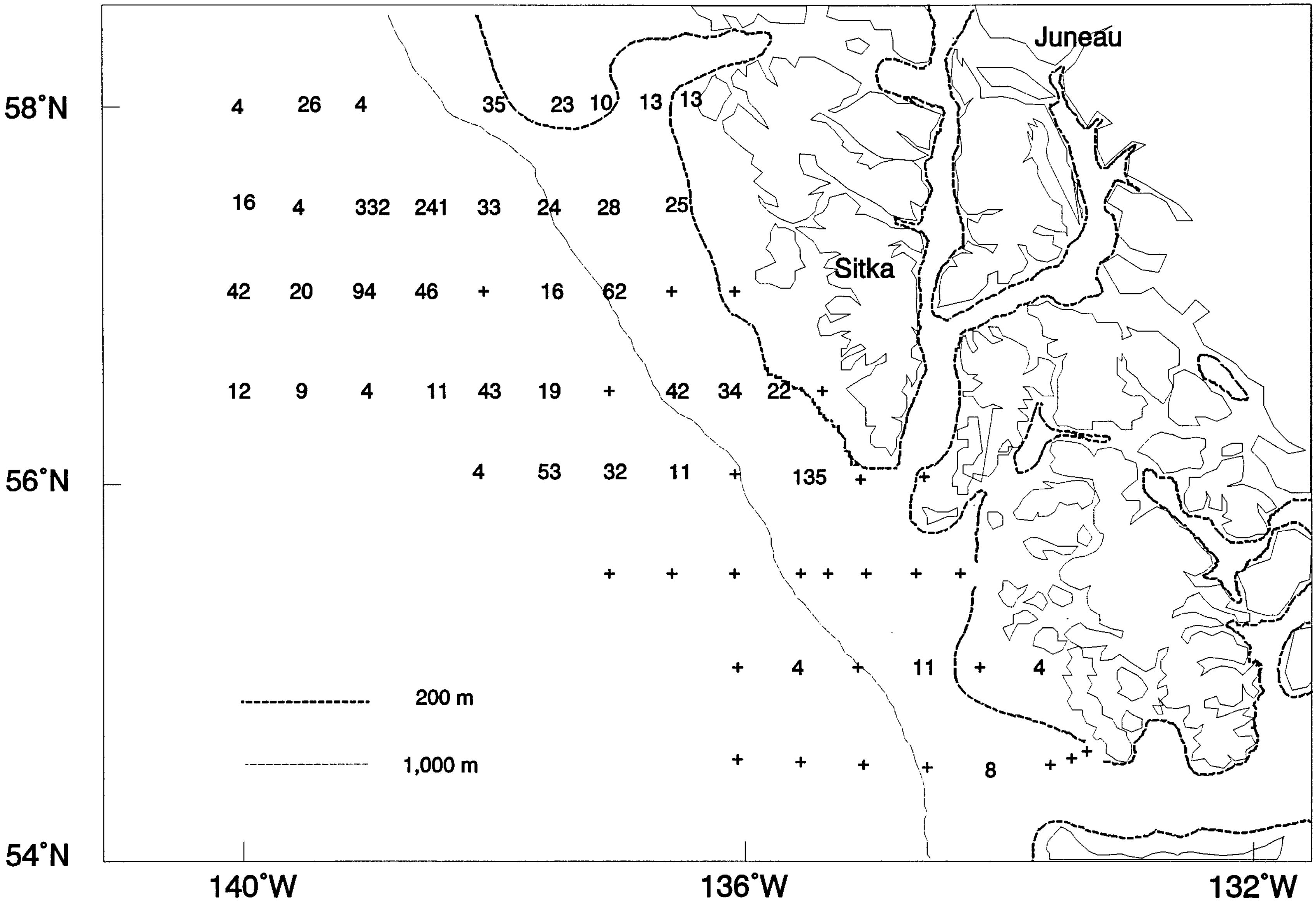

Figure 14.-Distribution of ***Atheresthes stomias*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

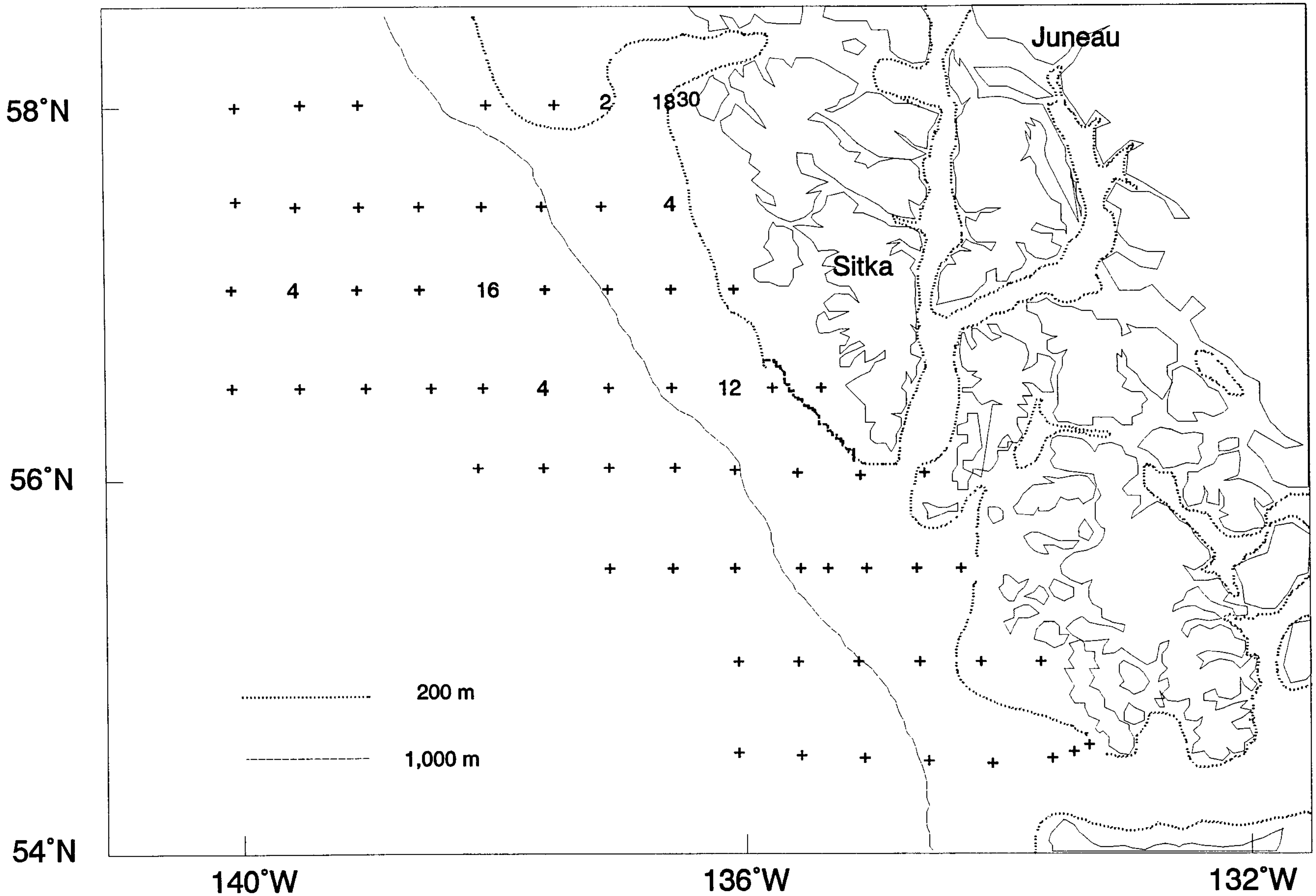

Figure 15.-Distribution of ***Hippoglossoides elassodon*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

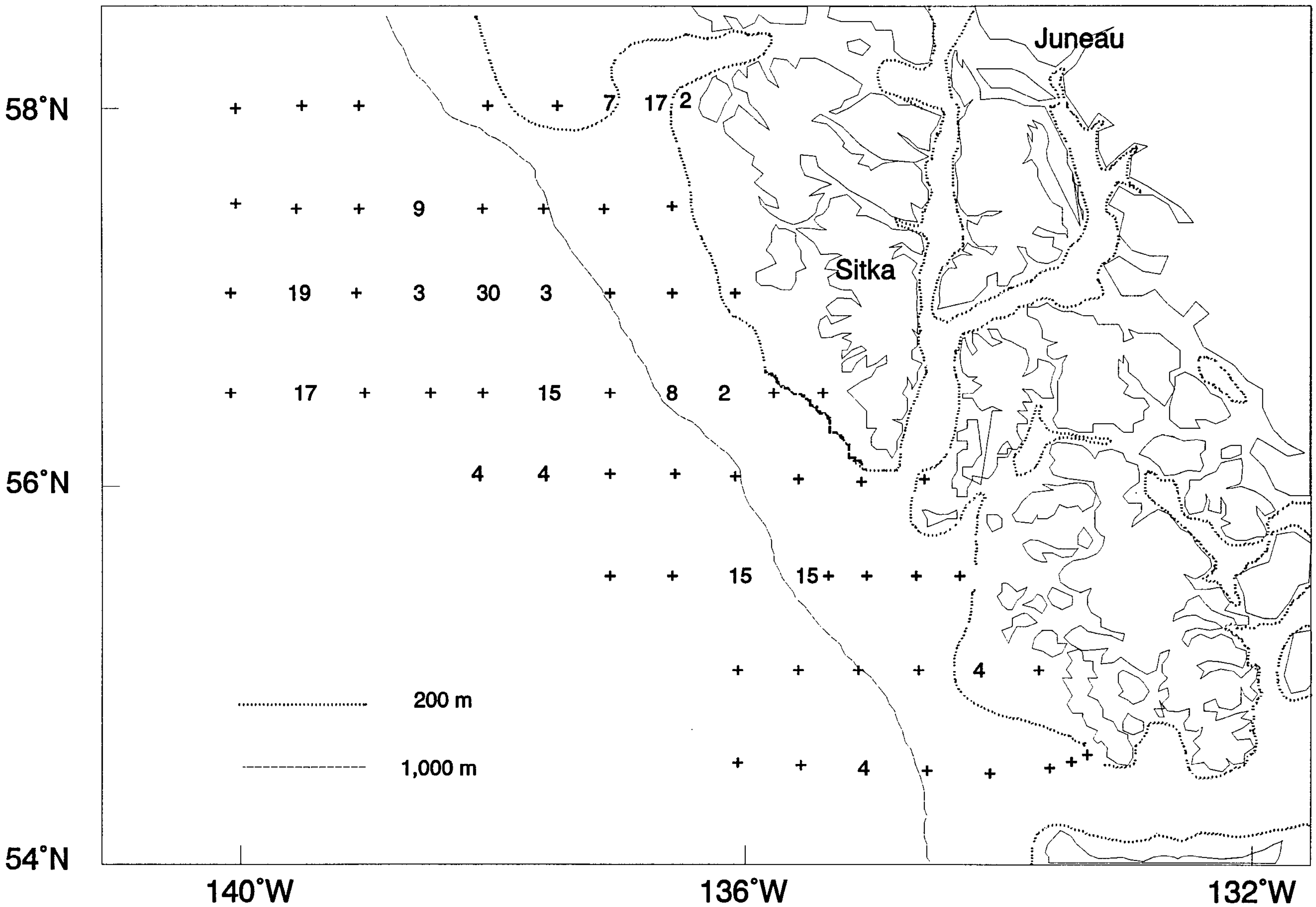

Figure 16.-Distribution of ***Microstomus pacificus*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

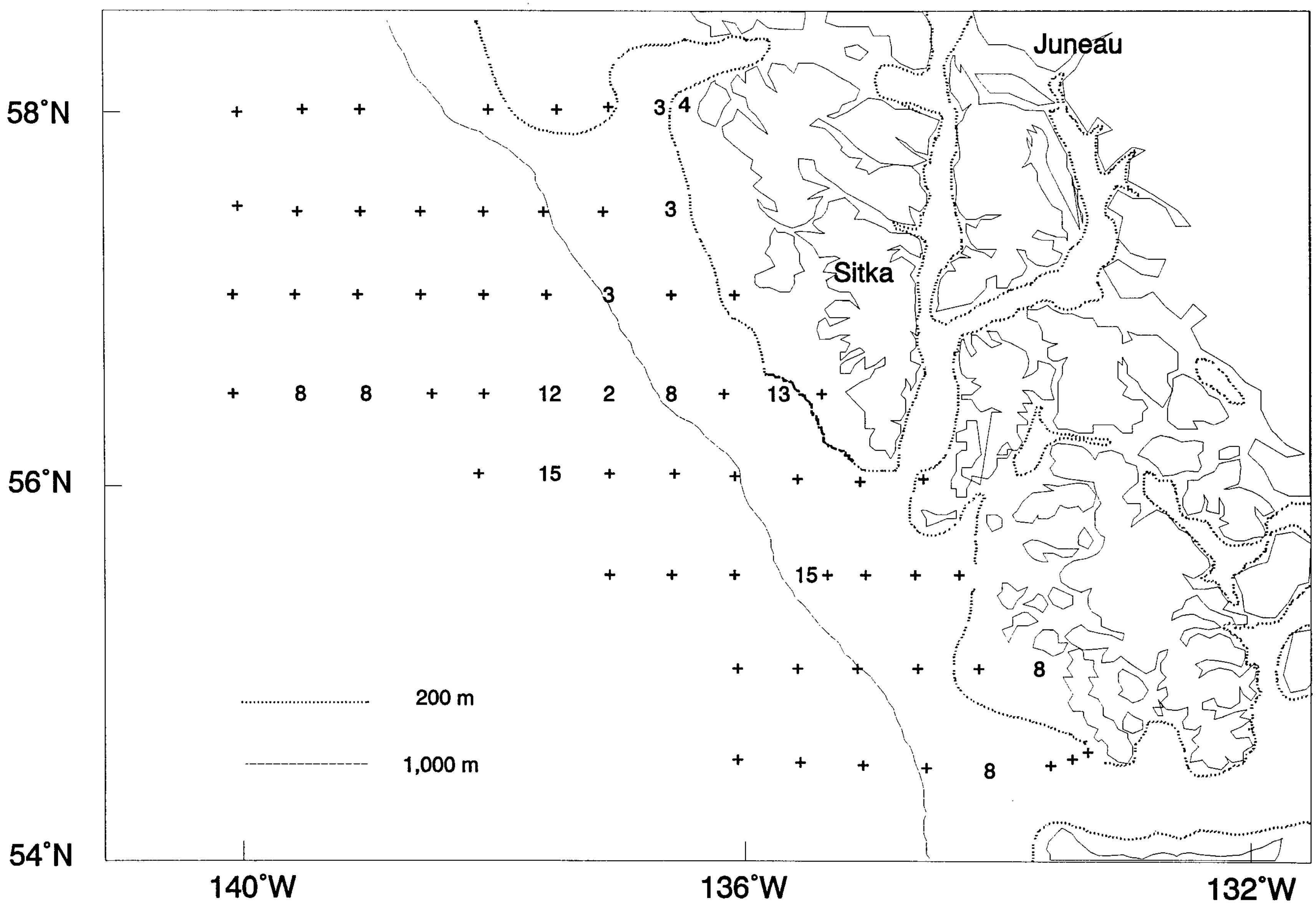

Figure 17.-Distribution of ***Errex zachirus*** larvae in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

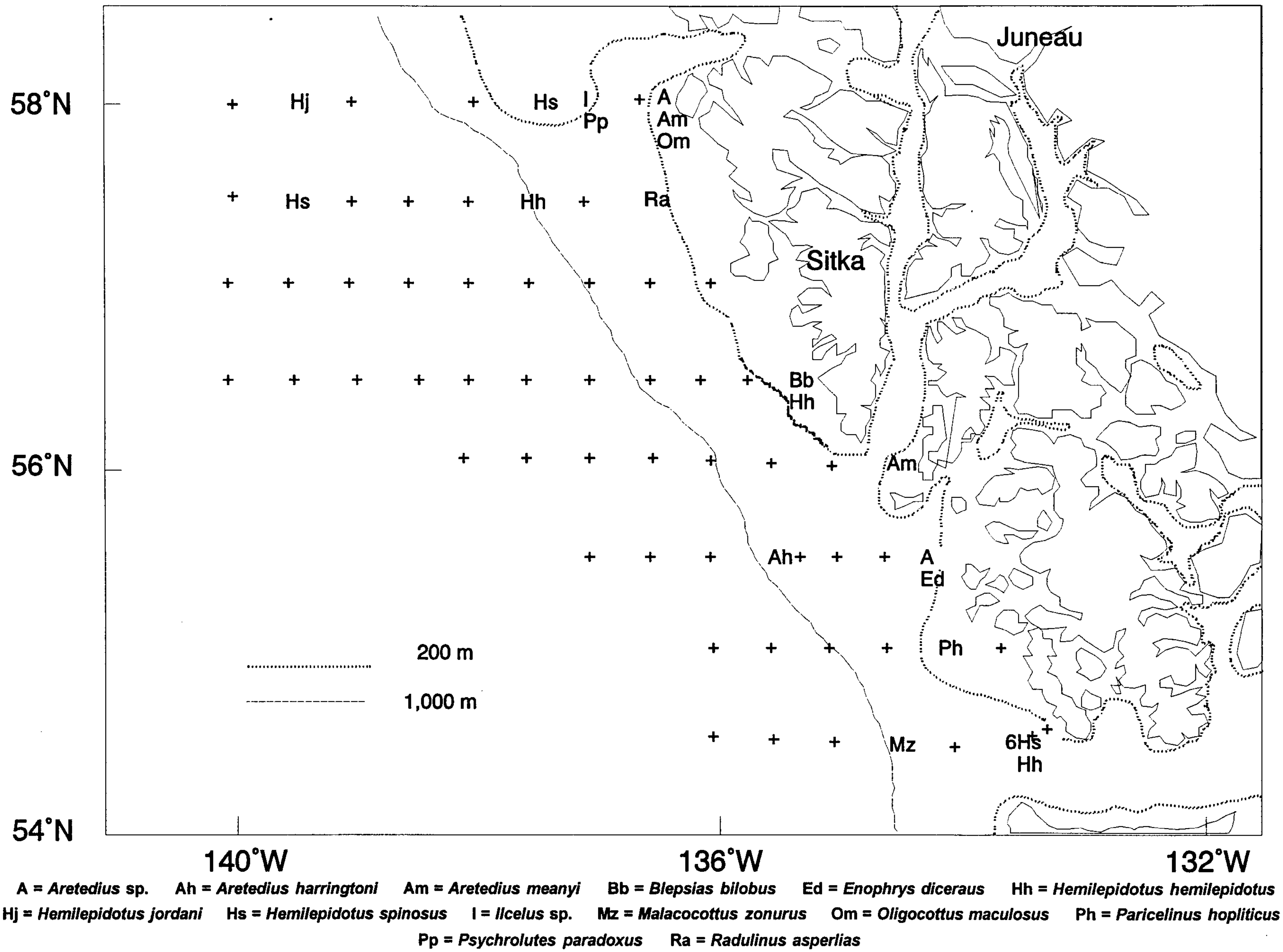

Figure 18.-Distribution of sculpin (Cottidae) larvae in the eastern Gulf of Alaska, May 1990.

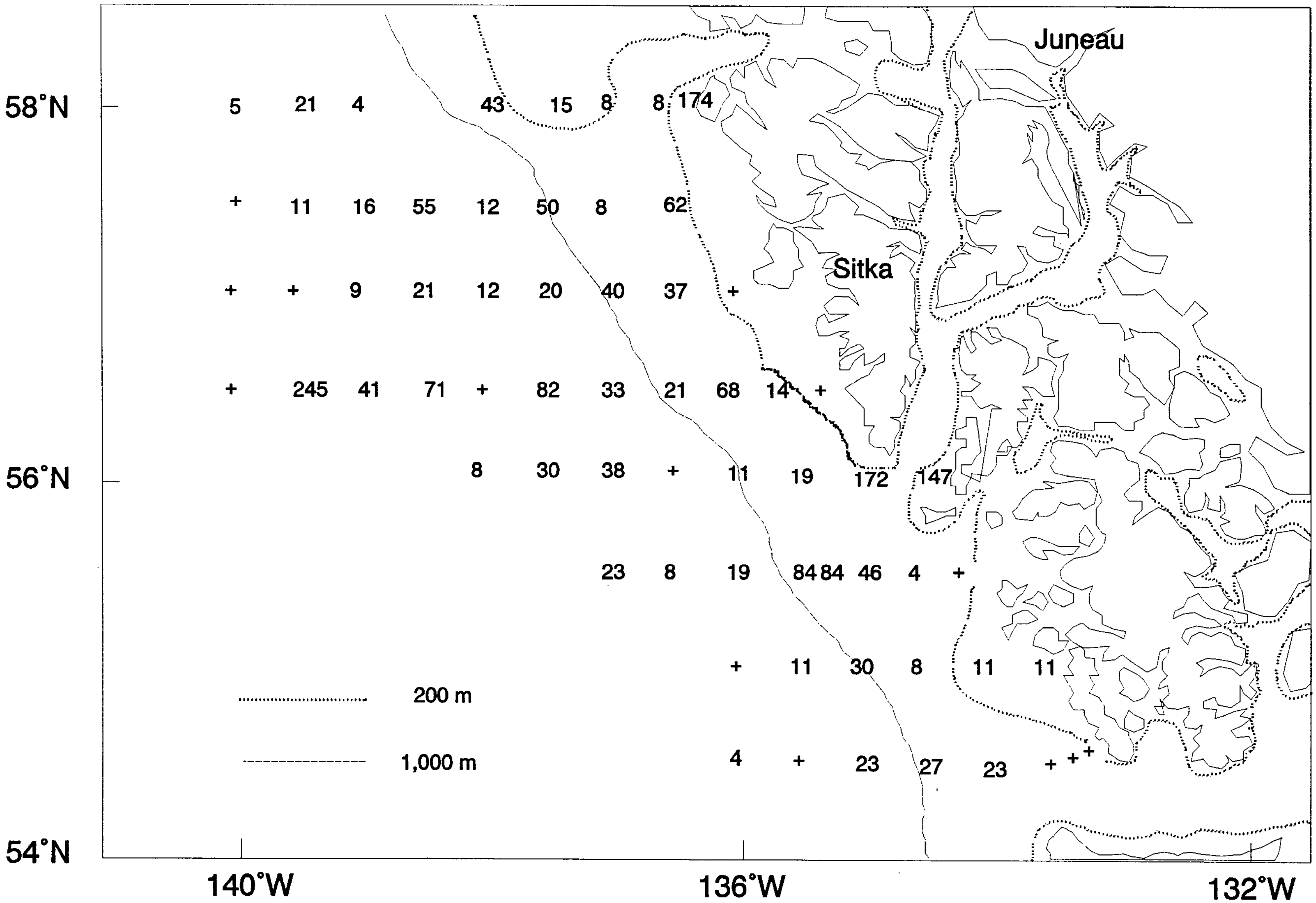

Figure 19.-Distribution of ***Microstomus pacificus eggs*** in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

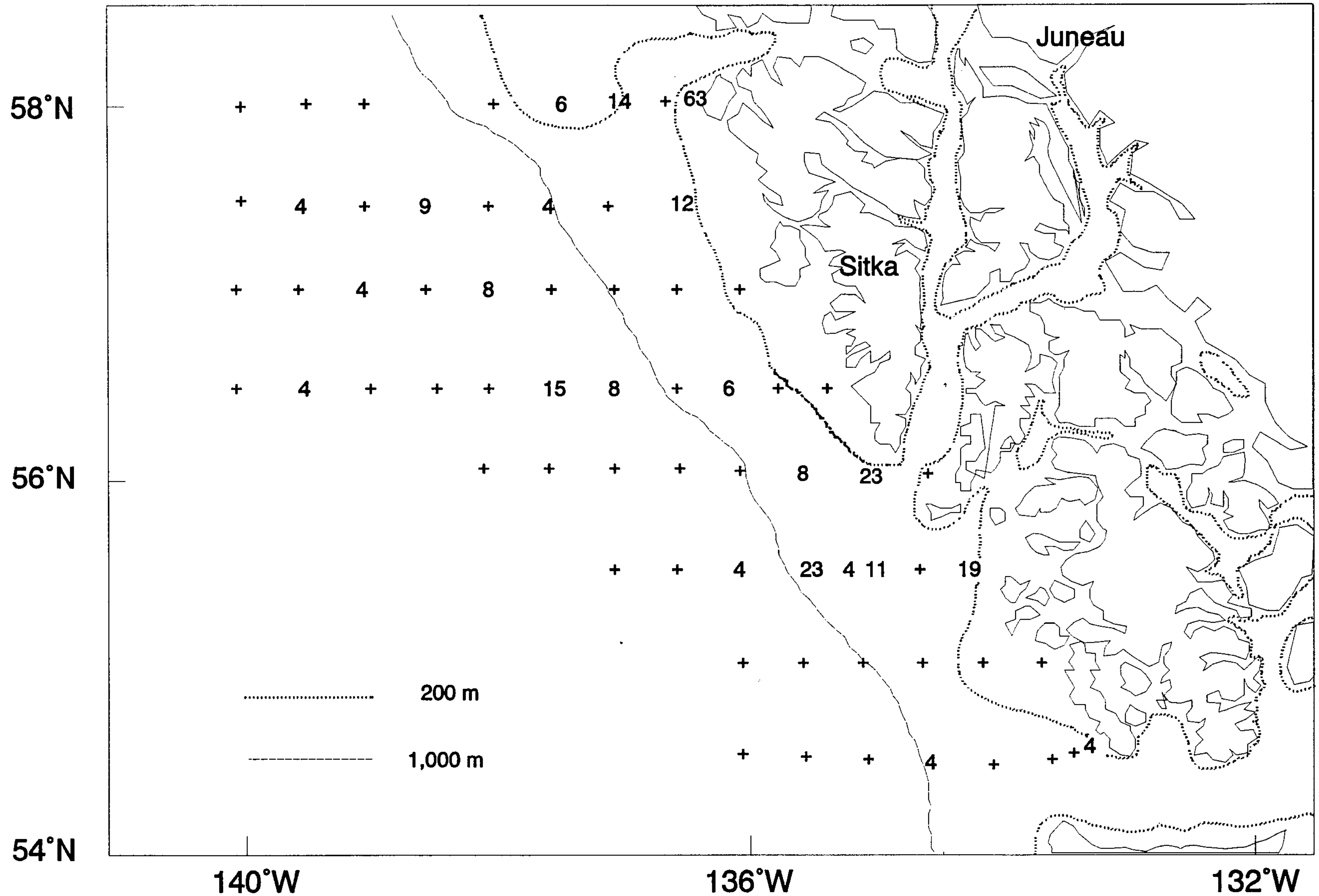

Figure 20.—Distribution of *Errex zachirus* eggs in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

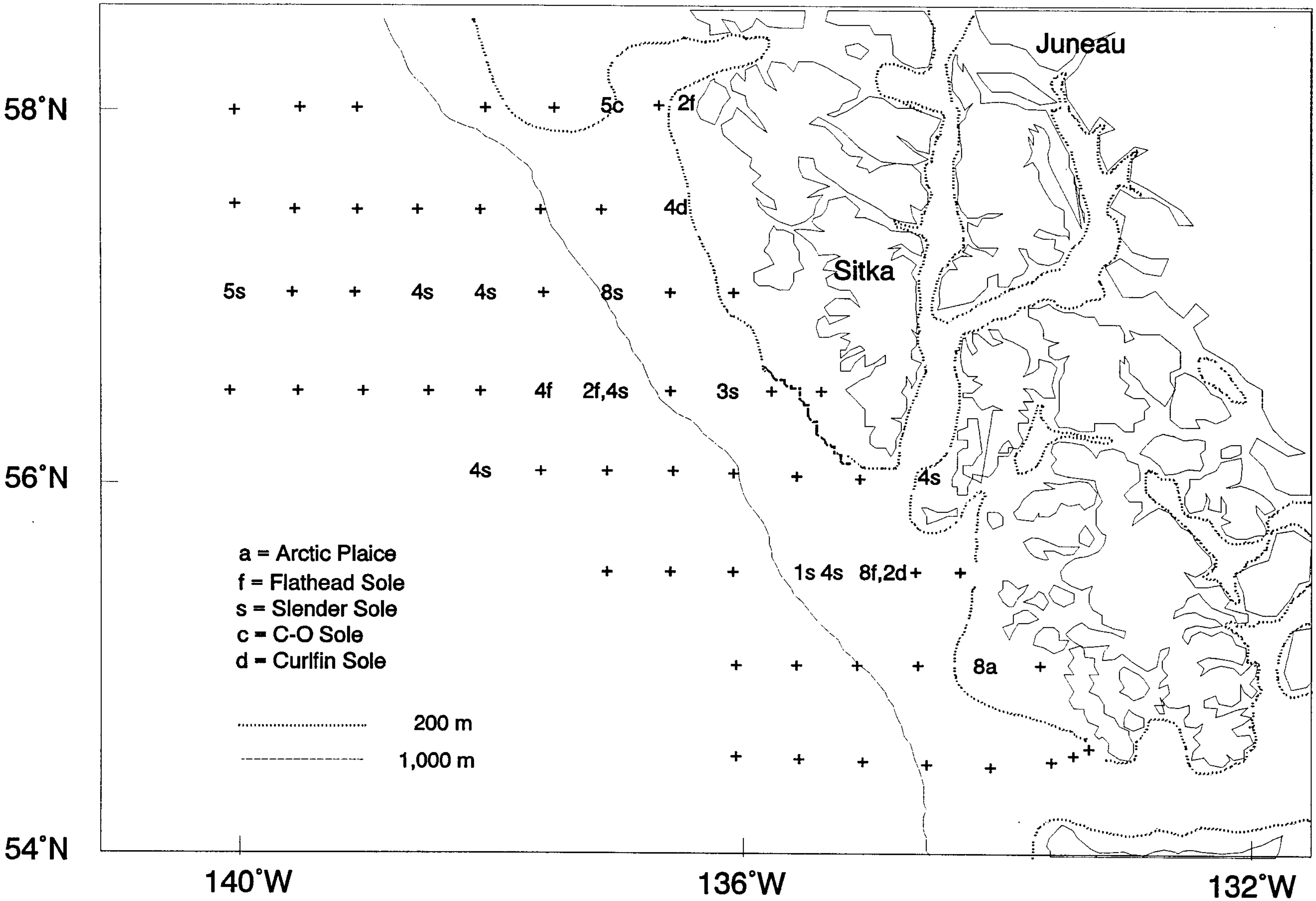

Figure 21.—Distribution of five species of flatfish eggs in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

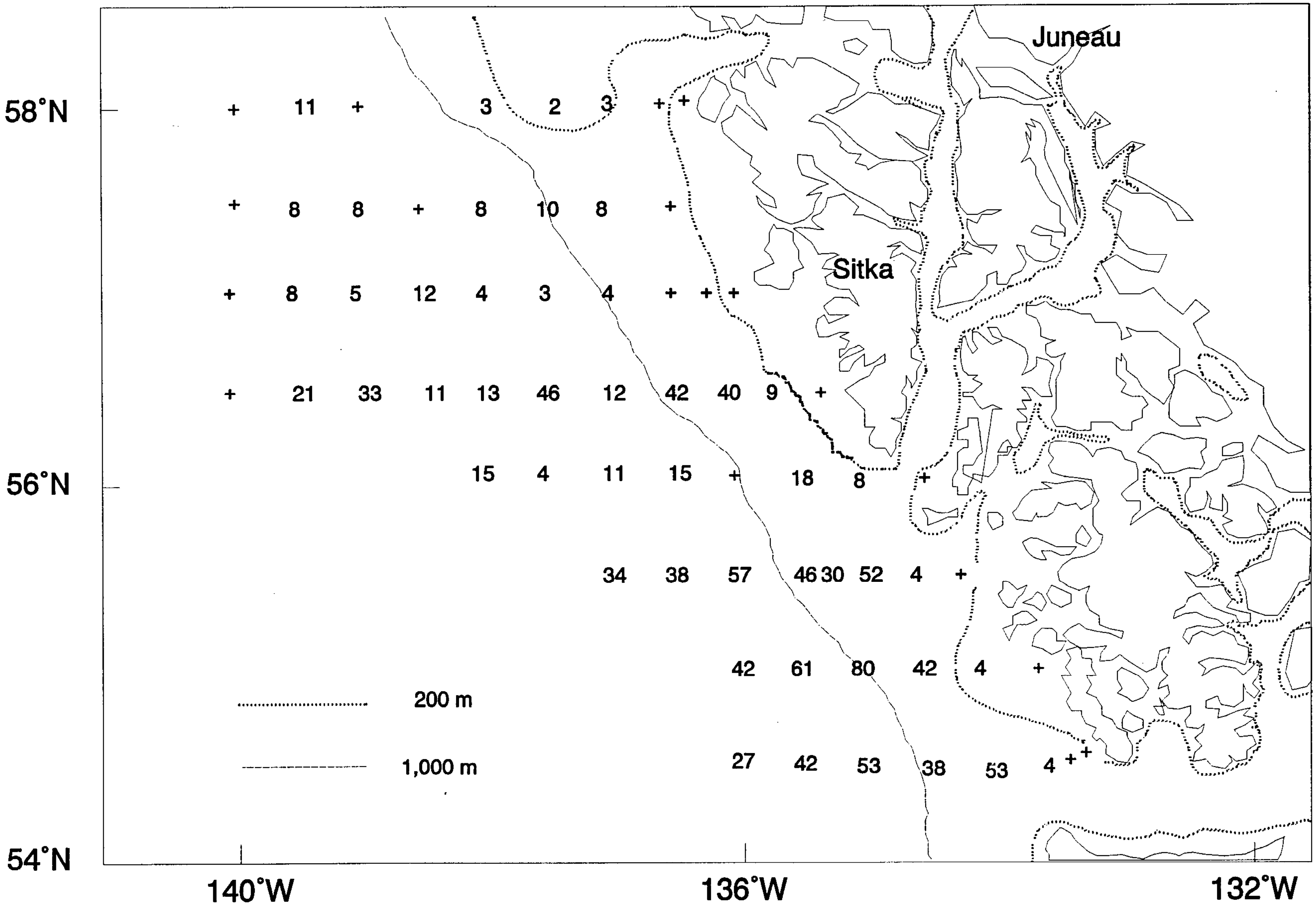

Figure 22.-Distribution of ***Icosteus aenigmaticus*** eggs in the eastern Gulf of Alaska, May 1990. Abundance expressed as number per 10 m^2.

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