CRUISE REPORT

ALPHA HELIX CRUISE 245

4 June 2001 to 25 June 2001

Project Title: Foraging Habitats of Steller Sea Lions in the Aleutian Islands: Bottom-up Controls of Prey Availability and the Presence of Killer Whales

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National Marine Mammal Laboratory NMML

II. Scientific Purpose: Due to a continuing population decline, the western stock of Steller sea lions (*Eumetopias jubatus*) is listed as endangered. Hypotheses to explain declines in populations from Kodiak Island, the Alaskan Peninsula and the Aleutian Island Arc include: 1) Commercial fisheries are competitors for prey; 2) There is significant predation by killer whales (*Orcinus orca)*; and 3) changes in climate have affected the productivity of sea-lion habitat, thus diminishing the abundance or availability of prey, particularly in the western portion of their range. Management actions necessary to mitigate the possible effects of fisheries have severely restricted the inshore portion of the commercial groundfish fishery. To improve the basis for future management decisions, more information is required about how killer whales and climate variations impact the ecosystem on which Steller sea lions depend. Therefore, we conducted an integrated multidisciplinary examination of the possible effects of killer whales and climate change on Steller sea lions in the Aleutian Islands. To this end, in Aleutian passes where sea lions continue to decline and in passes where their populations are stable or growing, we characterized and quantified 1) the physical regime, 2) nutrient availability, 3) primary production, 4) the distribution and abundance of zooplankton and micro-nekton, 5) the foraging ecology of marine birds as indicators of prey availability, and 6) the distribution and relative abundance of killer whales, and where possible, obtained identification-quality photographs and biopsy samples from them. This study is the first multi-disciplinary, integrated examination of the ecosystem in the critical habitat of the western populations of Steller sea lions. It provides initial tests of two of three hypotheses most likely to explain the decline of the sea lions, and has the potential to provide information of significant value for the future management of sea lion recovery and the fisheries of the region.

III. Personnel

George Hunt	Chief Sci.	UCI	USA	Ornithology
Steve Zeeman	Co-PI	U. New England	USA	Primary Production
Ken O. Coyle	Co-PI	U. AK, Fairbanks	USA	Zooplankton
Sue Moore	Co-PI	NMML	USA	Killer whales
Sigrid Salo	Res. Assoc.	PMEL	USA	Phys. Oceanogr.
Lucy Vlietstra	Student	UCI	USA	Ornithology
Jaime Jahncke	Student	UCI	PERU	Ornithology
Nancy Black	Assistant	NMML	USA	Killer Whales
Jack Swenson	Assistant	NMML	USA	Killer Whales
Joseph Sullivan.	Student	U. New England	USA	Primary production
Chris Stark	Technician	U. AK Fairbanks	USA	Zooplankton
Leandra DeSousa	Student	U. AK Fairbanks	USA	Zooplankton
Amy McKenzie	Technician	U. AK Fairbanks	USA	Zooplankton

IV. Cruise Schedule and Activities

DATE ACTIVITY

04-06 June In transit from Seward to the Study area

Mammal Surveys all daylight hours
4 June, 11:45, Resolution Bay: Killer Whale photography
4 June, 20:30, Lower Kenai Peninsula: Killer Whale photography

07-08 June South Side of Aleutians to Seguam Pass

7 June, 06:02, Station at KRES-2: CTD, CalVET
7 June, 06:40, KRES-2 to KRES-3: Acoustic Survey, Bird and Mammal Survey
7 June, 08:51, Station at KRES-3: CTD, CalVET
7 June, 09:24, KRES-3: Killer whale photography and biopsy
7 June, 13:30, KRES-3 to UNAS-2: Bird and Mammal Survey
7 June, 19:18, Station at UNAS-2: CTD, CalVET
7 June, 20:06, UNAS-2 to UNAS-3: Acoustic Survey, Bird and Mammal Survey
7 June, 22:12, Station at UNAS-3: CTD, CalVET
7 June, 22:34, Killer Whale photography

8 June, 04:03, Station at UMNS-1: CTD, CalVET
8 June, 04:37, UMNS-1 to UMNS-2: Acoustic Survey

8 June, 06:29, Station at UMNS-2: CTD, CalVET, Prod Water collected
8 June, 07:30, UMNS-2 to UMNS-3 to MT4S-1: Bird and Mammal Survey
8 June, 11:41, Station at MT4S-1: CTD, CalVET
8 June, 12:42, MT4S-1 to MT4S-2: Acoustic Survey, Bird and Mammal Survey
8 June, 14:04, Station at MT4S-2: CTD, CalVET
8 June, 14:20, MT4S-2 to YUNS-1: Bird and Mammal Survey
8 June, 17:23, Station at YUNS-1: CTD, CalVET
8 June, 18:06, YUNS-1 to YUNS-2: Acoustic Survey, Bird and Mammal Survey
8 June, 21:07, Station at YUNS-2: CTD, CalVET

9-11 June Seguam Pass Region

9 June, 10:21, Seguam Pass: Killer Whale Photography
9 June, 15:15, Inshore Survey Seguam Island, north and west sides
9 June, 17:24, Seguam Pass X-line CTDs SGX01 to SGX-04
9 June, 20:51, 3 NIO deployments for Plastics

10 June, 00:10, MOCNESS Tows at SGY-09, SGY-11, SGY-13, SGY-15
10 June, 08:06, Seguam Pass Y-line, CTDs and CalVETs, SGY-14 to SGY-01; Prod. Water at SGY-14; Bird and Mammal Surveys
10 June, 21:30: Ran south from SGY-01 for 15 nautical miles
10 June, 23:55: MOCNESS Tow at SGY-01

11 June, 01:17, MOCNESS Tows at SGY-03, SGY-05
11 June, 06:30, Seguam Pass: Killer Whale Photography
11 June, 10:38, Seguam Pass, Y-line, Acoustic Survey, Bird and Mammal Surveys, from SGY-15 to SGY-01

11-12 June Amukta Pass

11 June, 21:12, Amukta Pass: X-line, CTDs from AMX-05 to AMX-01

12 June, 07:05 Amukta Pass: Y-line, CTDs, CalVETs from AMY-14 to AMY-01; Bird and Mammal Surveys

13-14 June North of Aleutians from Amukta Pass to Akutan Pass

12 June, 23:58, Station at YUNN-2: CTD, CalVET
13 June, 01:04, YUNN-2 to YUNN-1: Acoustic Survey
13 June, 02:35, Station at YUNN-1: CTD, CalVET
13 June, 05:44, Station at MT4N-2: CTD, CalVET
13 June, 06:23, MT4N-2 to MT4N-1: Acoustic Survey, Bird and Mammal Surveys
13 June, 08:24, Station at MT4N-1: CTD, CalVET
13 June, 09:00, MT4N-1 to UMNN-3: Bird and Mammal Surveys
13 June, 10:29 – 12:00: Killer Whale Photography
13 June, 15:00 – 16:27: Killer Whale Photography
13 June, 17:02, Station at UMNN-3: CTD, CalVET

13 June, 17:38, UMNN-3 to UMNN-2: Acoustic Survey, Bird and Mammal Surveys
13 June, 19:33, Station at UMNN-2: CTD, CalVET (2)

14 June, 01:32, Station at UNAN-2: CTD, CalVET (2)
14 June, 02:41, UNAN-2 to UNAN-1: Acoustic Survey
14 June, 04:41, Station at UNAN-1: CTD, CalVET
14 June, 06:30, UNAN-1 to AKY-18: Bird and Mammal Surveys

14-20 June Akutan Pass and Unimak Pass Region

14 June, 11:30, Akutan Pass Y-line: CTDs, CalVETs, AKY-18 to AKY-08; Bird and Mammal Surveys
14 June, 18:15, South End Akutan Pass: Collecting Foraging Shearwaters
14 June, 19:28, AKY-08 to AKY-18: Acoustic Survey

15 June, 00:07, MOCNESS Tows at AKY-19, AKY-18, AKY-17, AKY-16, AKY-15, AKY-14
15 June, 06:55, Akutan Pass Y-line: CTDs, CalVETs, AKY-19 to AKY-06; Bird and Mammal Surveys
15 June, 14:30, North of Unalaska Island: Killer Whale photography

16 June, 00:44, MOCNESS Tows at AKY-11, AKY-10, AKY-09, AKY-08, AKY-07, AKY-06
16 June, 08:51, Akutan Pass: Acoustic Survey through foraging Shearwater flock
16 June, 15:05, Akutan Pass: Deployment of NIO net near foraging Shearwaters
16 June, 16:30, Akutan Pass: Collecting Shearwaters
16 June, 17:09, Akutan Pass to Makushin Bay: searching for Killer Whales

17 June, 06:55, Makushin Bay to Unimak Pass: Searching for Killer Whales
17 June, 09:30, North of Unalaska Island: Photographing Killer Whales
17 June, 15:32, North of Unalaska Island: Underway for KREN-3, Mammal Survey
17 June, 21:00, North of Akutan Island: Brief Diversion for Killer Whales
17 June, 22:00, Station at KREN-3: CTD, CalVET
17 June, 23:43, KREN-3 to KREN-2: Acoustic Survey

18June, 02:00, Station at KREN-2: CTD, CalVET
18 June, 02:25, KREN-2: NIO Tow for plastics
18 June, 03:57, MOCNESS Tows at UNY-28, UNY-30
18 June, 06:29, Unimak Pass Y-line: CTDs and CalVETs at UNY-30, 28, 27, 26, 24, 22, 20, 18, 16, 14, 12, 10, 08, with Bird and Mammal Surveys
18 June, 17:14, Unimak Pass Y-line: Acoustic Survey, UNY-12 to UNY-30, with Bird and Mammal Surveys until 22:00

19 June, 04:36, MOCNESS Tows at UNY-25, UNY-22
19 June, 06:30, Unimak Pass to Akutan Pass: Searching for Killer Whales
19 June, 16:00, Akutan Pass: Herring Ball, Deploy NIO for Neuston (3 runs)
19 June, 17:40, Akutan Pass to Unimak Pass: Looking for Killer Whales

19 June, 23:38, MOCNESS at UNY-20

20 June, 01:12, Unimak Pass: Work suspended because of fire in E-lab
20 June, 06:48, Unimak Pass: Collected Prod water at UNY-10
20 June, 07:00, Unimak Pass: Searching for Killer Whales

20 – 24 June In Transit to Seward

20 June, 09:45, Unimak Pass: broke off due to rough seas; Coastal Survey for Killer Whales along Alaska Peninsula
21 June, 07:45, Shumagin Islands: Survey for Killer Whales
21 June, 23:48, Shumagin Islands: MOCNESS in area with Fin Whales
22 June, 01:18, Shumagin Islands: CTD survey the length of trench where Fin Whales were foraging
23 June, 07:30, Shumagins to Mitrofania Island and Shelikof Strait: Mammal Survey
24 June, In Transit to Seward

V. Summary Of Results

Overview

To accomplish our goals, we conducted 117 CTD casts for determination of hydrographic structure and chlorophyll abundance, 9 ^{14}C-based studies of primary production and 2 ^{15}N-based studies of new production, and collected 483 samples of phytoplankton for cell counts. Zooplankton sampling included 78 tows of a CalVET net for zooplankton community composition, 26 deployments of a MOCNESS multiple opening-closing net for zooplankton abundance, and 400 km of acoustic surveys. In addition, we conducted 1,177 km of marine bird surveys, collected 16 short-tailed shearwaters for determination of food habits, completed 265 hours of marine mammal surveys, conducted photo-ID encounters with 10 pods of killer whales and obtained one biopsy sample from a killer whale in the study area.

In our investigations of bottom-up processes that might account for differences in population trends of Steller sea lions in the eastern and central/western Aleutian Islands, we found that water south of the Aleutian Islands west of Umnak Island (Samalga Pass) was colder than that east of the pass, and that standing stocks of chlorophyll and zooplankton were lower in the western than in the eastern portion of the study area. There was also an apparent shift in the species composition of both zooplankton and seabirds, suggesting structural differences in the ecosystems of the two regions. This interpretation fits with known changes in sea lion diets from haul outs in the eastern and western Aleutian Islands. In Akutan Pass, we observed balls of herring feeding at the surface on euphausiids and convergence zones in which euphausiids were concentrated at the surface. If herring and other forage fish regularly aggregate in areas of convergence in the passes and around the islands, these areas could be useful to foraging sea lions. In our investigations of killer whales, we found pods present from the region of Unimak Pass to Seguam Pass.

Physical Oceanography

To quantify the differences in the physical habitats of Steller sea lions in the eastern and central Aleutian Islands, we conducted conductivity, temperature, depth (CTD) casts along the north and south sides of the Aleutian Islands (Fig. 1-3), through four passes (Unimak [Fig. 4], Akutan [Fig. 5], Amukta [Fig. 6] and Seguam [Fig. 6]), and across two passes (Seguam and Amukta [Fig. 6]) to measure flow through the pass. Local tidal currents were taken into consideration in timing surveys through the passes (fig. 7-10).

Variability of near-island conditions:

During HX245 we measured temperature, salinity and fluorescence near the Aleutian Islands at five pairs of positions south of the islands and five pairs of positions north of them. Near-shore temperature and fluorescence were higher and salinity was lower near the eastern islands than the western islands. Temperature was lower and salinity generally higher north of the Aleutians than to the south.

South of the Aleutians, the transition between warm and cool water occurred quite abruptly where there was an increase in depth between Umnak Island and the Islands of Four Mountains. In the shallow region east of the transition, surface temperatures were usually greater than 7° C, there was a thermocline near 20 or 25 m, and bottom temperature was near 5° C. Salinity was 31.8‰ to 32.2‰ near the surface, and 32.3‰ to 32.6‰ at depth. West of the transition the water was well mixed and temperatures were 4-5° C. By Yunaska Island, salinity was near 33.4‰ throughout the water column. Fluorescence was 3-4 times greater in the surface layer east of the transition than to the west. The abrupt change in physical conditions south of the islands was similar to one observed in a composite SeaWiFS image from 11-12 September 2000 assembled by S. Salo of PMEL (Fig.11). This change between east and west may be the result of going from an area of large islands and small passes in the east to small islands and large passes in the west.

Unlike the area south of the islands, north of the Aleutians there wasn't a clear dividing point between eastern and western conditions. Instead, the depth of isotherms and isohalines gradually increases toward the east. In the north, the bottom drops off more steeply close to the islands, so few of the CTD positions were as shallow as the eastern stations south of the islands. Even at the shallowest sites, the water was not well mixed; although there generally wasn't a strong pycnocline; temperature gradually decreased and salinity gradually increased with depth.

Conditions within the Passes:

All assessments of oceanographic conditions, including geostrophic currents, in the passes must take into account that tidal currents in the passes are high. We do not have an estimate of current strength in Seguam Pass or Amukta Pass, but maximum currents in Yunaska Pass were roughly 1m/s (3.6 km/hr) and in Akutan Pass and Unimak Pass maximum current is greater than 2 m/s (7.2 km/hr). These currents create strong mixing in the passes and at the edges of the passes, and displace water to one side or the other depending on the cycle of the tide.

Water structure in the passes was always distinct from conditions to either side of the pass, although a tongue of water from one side or the other was often present. This tongue, and a front associated with it, must move through the pass to the north and south during each tidal cycle. The surface water at Seguam Pass (Fig. 12, 13) was colder than the surface water to the north or south, possibly because deeper water had been mixed in. Surface water in the other passes studied (Amukta [Fig. 14, 15], Akutan [16, 17] and Unimak [Fig. 18]) was warm, although lower layers in Amukta Pass did show signs of mixing with deeper water. The highest chlorophyll was generally not seen in the passes themselves; it was usually just to the Bering Sea side of the pass. A CTD section of a trench in the Shumagin Islands where fin whales were seen foraging was heavily stratified (Fig. 19).

To determine rates of water transport through the passes, we occupied transects across Seguam Pass (Fig. 13) and Amukta Pass (Fig. 15). Although we haven't done the actual calculations to determine transport, the density difference across Seguam Pass is small, suggesting that transport is also small, although the characteristics of the water in the pass resemble the water north of the pass. In Amukta Pass, the density surfaces suggest northward flow in the eastern part of the pass, but little transport in the west. Temperature and salinity agree, suggesting that water in the eastern channel is from the south, and water in the western channel is from the north. Phyllis Stabeno reported in an e-mail that the Alaska Stream was strong during the time of the cruise, with speeds of 60 cm/s. Based on satellite images and altimetry, she found no evidence of transport through the passes at the time of our measurements.

Productivity and Nutrient Studies

At each of the three main passes (Unimak, Akutan and Seguam), we performed primary production experiments at the south and north ends of each pass. Additional productivity experiments were conducted north and south of the Aleutian Islands at stations not associated with passes. Production was measured with both ^{14}C and ^{15}N uptake experiments to determine new production as well as standard production. ^{14}C uptake experiments were conducted on triplicate subsamples, in an artificial light, sea-surface temperature incubator at 8 light intensities. The incubation times were 2 hrs. These measurements were made at 9 stations for a total of 486 samples. The ^{15}N uptake experiments were made at 2 stations. Samples were collected from the 100, 50, 25, 12.5, 6.25, 3, and 1.5 % light depths and incubated in a natural light, sea-surface temperature incubator with appropriate neutral density screening for 24 hours. These samples will be analyzed by mass spectrometry at the Colorado Plateau Stable Isotope Laboratory of Northern Arizona University (http://www2.nau.edu/~bah/cpsil.html). Nutrient concentrations will be determined at PMEL from samples collected by Sigrid Salo.

To determine the amount of chlorophyll present in the water column and to calibrate the fluorometer on the CTD, at 75 CTD stations we collected and processed 492 chlorophyll samples from representative depths. Chlorophyll was determined from 30 ml samples. Samples were filtered on GF/F glass fiber filters, the filters frozen for several hours, after which they were extracted in 90% acetone for eight hours in a dark freezer. The extracts were read with a Turner TD-700 fluorometer. Although the chlorophyll concentrations have not been calculated yet, the raw fluorescence values tended to be higher on the northern side of the Aleutian Islands than south of them. Raw fluorescence numbers ranged upward of 600-700 at several of the northern stations, while remaining in the 100-200 values in the southern stations. There was also a trend of increasing chlorophyll fluorescence values from West to East. Seguam pass having the lowest fluorescence (around 200 raw fluorescence units) and increasing towards Unimak pass (around 700 raw fluorescence units).

We obtained 483 cell-count samples to assess the relative abundance of different species of phytoplankton. Cell count samples (50 ml) were preserved with neutral Lugol's solution for counting by inverted microscopy. The brownish coloration of the filters and plankton nets would indicate that diatoms were a large component of the communities on both sides of the Aleutians.

Satellite imagery will be obtained for the study period. If cloud-free areas are found they will be examined for frontal zone evidence and other oceanographic phenomena. This analysis will rely on the *in situ* optical measurements, and CTD data.

Zooplankton

The goal of the zooplankton and acoustics component of the Aleutian Passes Project was to characterize the abundance, biomass, species composition and distribution of major zooplankton and micronekton taxa in the region around the Aleutian passes. Since zooplankton are the primary food of forage fishes, characterization of the zooplankton resources is central to understanding processes influencing the concentration, distribution and composition of Steller sea lion forage species in critical sea lion habitat. Samples were taken both north and south of the passes as well as in the passes. In addition, acoustic and zooplankton samples were taken at selected sites on the north and south sides of the Aleutian ridge to characterize the habitat in Pacific and Bering Sea waters.

Zooplankton samples were collected with a CalVET (CalCOFI vertical egg tow) net and a MOCNESS (Multiple Opening Closing Net and Environmental Sampling System) system. The CalVETs were equipped with 0.15 mm mesh nets and General Oceanics digital flow meters to monitor volume filtered. The nets were fished vertically from 100 m depth to the surface or from 5 m above the bottom to the surface in shallower regions. The MOCNESS sensors measured volume filtered, net angle, depth, salinity, temperature and fluorescence. The MOCNESS was equipped with nine 0.500 mm mesh nets, which were fished at discrete depths to obtain depth distributions of the major taxa.

The acoustic equipment consisted of an HTI (Hydroacoustics Technology Inc.) model 244 digital echosounder with transducer frequencies of 43, 120, 200 and 420 kHz. The 43, 120 and 200 kHz transducers are split beam and therefore collected target strength data in addition to volume scattering. The transducer array was towed beside the vessel at 5-6 knots during surveys. In addition, acoustic data were taken during each MOCNESS tow to aid in scaling the acoustic data.

CalVET samples were taken at the start and end of five transect lines run north and south of the Aleutian ridge. Approximately 20 km of acoustic transect data were collected between each pair of CalVET tows. In addition, CalVET samples were collected at CTD

(Conductivity Temperature Depth) stations taken on transect lines through Seguam, Akutan and Unimak passes. MOCNESS samples were taken at stations along the transect lines through Seguam and Akutan passes and on the north side of Unimak Pass. Acoustic transects were run through Sequam, Akutan and Unimak passes. The above sampling plan has generated sufficient material to provide an initial characterization of the zooplankton resources in the passes, on either side of the passes and on the north and south sides of the Aleutian ridges.

Attached are figures (Fig. 20-22) showing the distribution of volume scattering through the passes for each of the four frequencies. Preliminary observation of volume scattering suggests that considerably higher densities of sound scattering organisms may occur in the Akutan – Unimak regions relative to the Seguam-Amukta area. Much of the scattering in the Akutan – Unimak area appears to be from euphausiids, which were often the dominant organisms by weight in the MOCNESS samples. Zooplankton in the Seguam region seemed to be dominated by copepods. Zooplankton samples in both regions contained high amounts of phytoplankton.

The zooplankton samples will be returned to the laboratory for analysis. Information from the samples will include the species composition, life history stages of the copepod taxa, the abundance and wet weight biomass of all the taxa and stages. The acoustic data will be analyzed using analytical and empirical sound scattering models and correlation techniques. Statistical comparisons of the distribution, composition, abundance and biomass of the zooplankton in each of the passes should help document any consistent differences in zooplankton resources between the eastern and central Aleutian ridge and between the north and south sides of the ridge.

Marine Birds

The goal of the marine ornithology component was to use seabirds as indicators of the potential of different regions to support upper trophic level organisms, including Steller sea lions. The rationale was that birds, depending upon species, forage on the prey of sea lion prey, or share the use of small fishes consumed by sea lions. Thus regions or processes that support high densities of seabirds might be expected to also be favorable foraging areas for sea lions. Thus, the objective of the seabird component of this study was to assess whether there were greater numbers of foraging seabirds in Pacific versus Bering Sea waters, and whether passes with certain characteristics, such as those with shallow sills, might support more birds. We also wished to determine whether there were certain physical oceanographic processes that might enhance the foraging opportunities of top predators within or near the passes.

Seabird observations were made during daylight when the ship was underway at speeds of 5 knots or greater within the study area. All birds within an arc of 90° from the bow to the side with the best visibility were counted from the bridge, and were recorded on a laptop computer for analysis. Behaviors of all birds were recorded

Short-tailed Shearwaters were collected at two foraging aggregations (8 at each) in Akutan Pass. Stomach contents were removed from birds within 1 hour of collection, and stored in 80% ETOH. Samples of tissue were obtained for stable isotope analyses. All birds had been eating euphausiids. Details of prey species and stage composition will be determined by microscopic examination in the laboratory.

During the cruise, we surveyed a total of 1,177.4 kilometers: 252.6 km on the northern side of the Aleutian Islands, 391 km on the southern side and 533.7 km within the passes. We counted a total of 42,654 seabirds between Seguam Pass (western survey limit) and Unimak Pass (eastern survey limit); 27,111 of them were feeding or sitting on the water. The most abundant seabird species were short-tailed shearwater (17,164 individuals, 63% of birds observed feeding or on the water), northern fulmar with (5,402 individuals, 20% feeding or on the water) and small auklets (whiskered, crested, least, Cassin's with 3,316 individuals and 12% feeding or on the water).

Seabird abundance was greater (39.1 birds/km^2) on the Pacific Ocean side of the Aleutians than on the Bering Sea side (10.0 birds/km^2) (Fig. 23). On both sides of the Aleutian Archipelago, northern fulmars and small auklets where the most common birds. The biggest concentrations occurred as we crossed tiderips associated with nearby passes. Thus these averages do not reflect the densities of seabirds in the shelf waters away from the influence of passes.

Within the passes surveyed, seabird abundance was higher in the shallower passes (Fig. 24-27). Mean seabird abundance in Akutan Pass (Fig. 25), the shallowest pass investigated was 425.5 birds/km^2, in Unimak Pass, 40.2 birds/km^2 (Fig. 24), and in Seguam Pass, 47.6 birds/km^2 (Fig. 27). In comparison, Amukta Pass, over 250m deep at its shallowest, supported only 0.9 birds/km^2 (Fig. 26).

There was a marked difference in the species composition of the seabirds encountered in the passes. In the western passes (Seguam and Amukta Passes) fulmars were the dominant species, whereas in the eastern passes (Akutan and Unimak passes) short-tailed shearwaters were the dominant species. In Seguam and Amukta passes fulmars comprised 84.5 and 43.6% of the birds feeding or sitting on the water, while shearwaters represented only 0.2 and 0%, respectively. In Akutan and Unimak passes, fulmars represented only 0.1 and 0.7% the birds feeding or sitting on the water, while shearwaters represented 88.9 and 92.3%, respectively. The Tufted puffin, a piscivorous bird, also presented similar differences in its distribution with higher densities in the eastern passes than in the western passes.

Within the Seguam, Akutan and Unimak passes, both northern fulmars and short-tailed shearwaters were observed foraging at frontal regions that crossed the ends of the passes. These were presumably tidal fronts where either stratified Pacific Ocean or Bering Sea waters were interacting with the well-mixed waters of the passes. Shearwaters collected at these features in Akutan Pass were foraging on adult euphausiids (mostly or all *Thysanoessa inermis*?). Shearwaters and fulmars were also found foraging in patches along the sides of the passes with lines of foraging flocks parallel to the long axis of the pass. We were not able to determine if there was a physical mechanism that was organizing these foraging aggregations, although it seems possible that they may be the result of processes in a shear zone that could be separating the fast moving water in the center of the pass from the slower flowing water at the sides. In Unimak Pass these foraging flocks were about 2 to 3 miles off Akun Island. Most of these side patches feel outside of our transect zone and were not included in the data set.

The charts of the distribution of foraging juvenile sea lions made available before the cruise showed many returns from animals foraging close to shore along the sides of Unimak and Akutan passes. It would be of interest to know whether they were taking advantage of prey that was concentrated in shear zones along the passes. On our last day in Akutan Pass, we encountered several large schools of herring foraging on euphausiids that were concentrated near the surface. There appeared to be convergence zones and a number of discrete patches, some of which seemed to be lined up more parallel to the current than perpendicular to it. Next year it might be profitable to investigate what happens along the long axis of the passes in terms of mechanisms that might concentrate zooplankton and thereby attract aggregations of fish. Similar shear zones may also occur along the north and south sides of the islands away from the passes.

Marine Mammal Studies

The decline of Steller sea lions (*Eumatopeas jubatus*) in the central and western areas of the North Pacific/Bering Sea has precipitated a number of research projects seeking to investigate possible causal factors. One of these is the Aleutians Passes project, focused on two fundamental goals: (1) examination of productivity near sea lion rookeries and haul outs and (2) documentation of the number and ecotype of killer whales (*Orcinus orca*) in waters between Unimak and Seguam Passes in the central Aleutian chain. Preliminary results of the first field season of marine mammal observations are presented here.

Marine mammal surveys were conducted en route to and from and within the study area (Fig. 28-33). As the name suggests, the study is focused on the relative productivity and occurrence of killer whales at four Aleutian passes: Seguam, Amukta, Akutan and Unimak (Fig. 34-38). Thus, surveys were focused on transect lines along and across the passes (Fig. 28). The four passes are distinctly different in physiography: Seguam – about 30 km wide by 134 m deep; Amukta – 68 km by 500 m; Akutan – 7 km by 30 m; Unimak – 19 km by 52 m. Thus, they provide a baseline for a suite of comparisons of hydrography and productivity at dynamic centers of seawater exchange between the North Pacific and the Bering Sea. The passes border Steller sea lion rookeries and haul outs where populations are either in decline or holding steady, none are increasing.

Marine mammal observers maintained a watch from the port and starboard sides of the bridge (height 9.67 m) of the R/V ALPHA HELIX daily from early morning (0600 -0700) to late evening (2000 to 2200; hours shifted depending on light conditions) when conditions were suitable (i.e. Beaufort <05; visibility > 1 km). Observers at port and starboard stations searched with naked eye and 7X (or higher) binoculars with reticules. Observers scanned for one hour at each station, followed by a one-hour break. The two primary observers were assisted in finding marine mammals by seabird researchers conducting surveys from either the port or starboard side (depending on glare) and by the ship's crew. Data were recorded by the starboard observer using WinCruz software on a laptop interfaced directly to the ship's

Global Positioning System (GPS). Positions along the cruise track were updated at 2-minute intervals. When marine mammals were seen, bearing and reticule to the sighting, species, number and the animals' course and speed were recorded. During the transit to the study area, only killer whales were approached for photographs from the ship's bow. All other sightings were recorded in passing mode. After reaching the study area, other cetaceans were sometimes approached for positive identification.

When killer whales were seen within the study area, the marine mammal team moved to the bow of the ALPHA HELIX to photograph whales as the ship was maneuvered as close to the whales as possible. During calm sea conditions, a rigid hull inflatable boat (RHIB) was deployed to provide close access to the whales for high-quality photographs and biopsy attempts using a cross bow. To obtain standard identification photographs of their dorsal fins and saddle patches, whales were approached from behind on their left sides. On two occasions, close approaches were made from the RHIB to obtain biopsy tissue samples using a crossbow to deliver a hollow-tipped dart. A tissue sample was obtained on the first occasion, and on the second, the whales proved elusive. Attempts were made to biopsy individuals that were distinctive, but this was not accomplished due to the tight spacing of the whales. The tissue biopsy was split to two samples: a skin sample, stored in DMSO for DNA and isotopic analysis; and a blubber sample, frozen for analysis of contaminants. Attempts to biopsy whales were limited to two occasions by several factors: (1) sea conditions, at times when oceanographic work was not underway, limited work from the RHIB to two occasions; (2) emphasis was placed on obtaining identification-quality photographs prior to biopsy attempts from the bow of the ALPHA HELIX, which required biopsy efforts to be moved to the end of the encounter when whales were harder to approach closely; (3) the need to pass on killer whale sightings made while oceanographic work was underway.

Provisional Results:

A total of 265 hours of survey for marine mammals was completed, including transit to (81.5 h) and survey in (183.5 h) the study area (Table 1; Fig. 28). Viewing conditions were usually good to excellent, with little disruption to surveys by rain or fog. Ten marine mammal species were seen, with Stellers sea lions the most common pinniped (when animals hauled out on land were included) and Dalls porpoise (*Phocoenoides dalli*) the cetacean seen most often (Table 2). Fin whales (*Balaenoptera physalus*) were seen during transits to and from the study area, but not <u>in</u> the study area (Figs. 29, 31, 33). Regions of high fin whale sighting rates included waters near the Semidi Islands on the outbound leg, and at the Shumagin Islands on the return passage. Fin whales usually were seen in groups of 2-10 whales and were often near humpback whales (*Megaptera novangliae*), although the two species did not appear to interact. While seen with fin whale, humpbacks were also seen as singletons and pairs, often along the coast, or near islands (Fig. 31-34). Minke whales were seen as singletons throughout the cruise; two to three animals that seemed "resident" in Akutan pass. Although ubiquitous, Dalls porpoise were particularly common near Samalga Pass, where counts were an order of magnitude higher than in any other region (Fig. 36). Surprisingly, sperm whales (*Physeter macrocephalus*) were common north of Seguam Island and in Seguam Pass, but were not seen elsewhere (Fig. 38).

Killer Whale Encounters and Sightings:

There were 40 sightings of roughly 295 killer whales (summation of best estimates of group size) over the course of the cruise (Table 2; Fig. 29, 34). Fifty killer whales were seen as the ship was departing Seward (Resurrection Bay and Kenai Peninsula), with the remaining 245 whales counted in the study area. Overall, when "best" and "high" counts were tallied, the number of killer whales seen ranged from 295-332 for the cruise and from 245-276 whales for the study area. These provisional counts likely under-represent the total number of animals present because the counts made while in passing-mode are probably low. Both when going to and returning from the study area, there was a clear hiatus of sightings between the Kenai Peninsula and Unimak Pass.

There were 10 encounters with killer whales where the cruise schedule permitted approach and focused efforts to obtain identification photographs, and 10 sightings where counts-only were obtained while the ship was in passing-mode (Table 3). Fifty-five rolls of black and white film, and three 90"digital video tapes were shot during the 10 encounters. Each encounter usually started with the sighting of a comparatively small group of animals (2-5 whales, often including one adult male), but after approach of the first-identified animals, additional whales were usually seen. The first two encounters occurred as the ship was leaving Seward, and likely involved whales that are well known to Alaskan researchers that have been photographing whales offshore the Kenai Peninsula and in Prince William Sound for 10-15 years. The remaining eight encounters occurred in the study area, at locations ranging from Seguam to Unimak Pass.

Killer whales were often seen in regions where they previously had been photographed during the 1992 and 1993 surveys, including Makushin Bay along the north coast of Unalaska Island, where the largest group was encountered (Fig. 34). Waters southwest of Unimak Pass and north of Seguam Island also appeared to be areas of concentration for killer whales. While there was no concerted attempt to cross-match killer whales seen on our cruise to those photographed in the study area in 1992 and 1993 (Dahlheim, 1997), we observed at least 4 whales (AK 160-163) that appeared to be individuals photographed during the earlier surveys. In addition, several males had very distinctive dorsal fins that should aide in group identification on surveys later this summer

Killer Whale Predation:

We did not witness an attack by killer whales on any marine mammal. Nor did we see killer whales near Steller sea lion haul outs. We did see killer whales swimming near Dall's porpoise on two occasions, and on one of these a large male made a lunging leap that seemed directed at the porpoise. On both these occasions we were in passing-mode and did not watch the encounter in detail. Thus, no conclusions should be drawn from these observations other than killer whales may have been pursuing Dall's porpoise. In Unimak Pass, three humpbacks near Akun Island were seen repetitively flipper slapping as a killer whale group passed them and one male killer whale turned back for a closer approach. Again, no attack was witnessed. While fish eating by killer whales could not be determined with certainty, whales encountered north of Seguam Island (Encounter 3) appeared to be feeding on fish, as determined by tracks on the ship's echosounder when they dived.

Acknowledgments

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Reference Cited

Dahlheim, M.E. 1997. A photographic catalog of killer whales, *Orcinus orca*, from the central Gulf of Alaska to the Southeastern Bering Sea. NOAA Technical Report NMFS 131, 54 pp.

Table 1. Aleutians Passes Cruise: Marine Mammal Survey Effort

DATE	BEGIN-END	HOURS	
6/04/01	1300-2000	7	
6/05/01	0530-2000	14.5	Transit to study area
6/06/01	0600-2000	14...........................	
6/07/01	0600-2000	14	Study area
6/08/01	0630-2100	14.5	
6/09/01	0700-2030	13.5	
6/10/01	0700-2030	13.5	
6/11/01	0630-2130	15	
6/12/01	0800-2100	14	
6/13/01	0700-2100	14	
6/14/01	0630-2230	16	
6/15/01	0630-2200	15.5	
6/16/01	0700-2000	10.5*	
6/17/01	0700-2200	15	
6/18/01	0630-2030	14	
6/19/01	0630-2030	14..............................	
6/20/01	0900-2100	10.5**	Transit from study area
6/21/01	0700-2330	16.5	
6/22/01	0700-2100	14	
6/23/01	0700-1900	12	
TOTAL HOURS		265	81.5 = transit; 183.5 = study area

* no survey during seabird work; **survey delay/fire report

Table 2. Aleutian Passes Cruise: Marine Mammal Sightings. Number of Sightings:Number of Animals Counted

DATE	KW	DP	HP	SP	FW	HW	MW	UnID-L	UnID-S	FS	HS	SSL	Comment
4 June	4:50	4:26	0	0	0	4:19	0	0	0	0	0	2:16	leaving Seward/Kenai
5 June	0	10:49	0	0	9:16	1:2	0	8:24	0	11:11	0	3:3	Shelikof St./Semidi Is.
6 June	0	4:19	3:3	0	3:10	1:1	0	2:9	1:1	2:2	0	0	AK Penin./False Pass
7 June	2:43	1:2	1:2	0	0	4:7	1:1	0	0	1:1	0	0	Krenitzin Is.
8 June	0	10:61	0	0	0	0	1:1	2:2	0	3:3	0	0	S. Umnak Is.
9 June	5:34	4:14	0	2:4	0	0	0	1:2	0	0	0	2:400	Seguam Is.
10 June	1:8	5:29	0	1:1	0	0	2:2	0	0	0	0	0	Seguam Pass/CTD
11 June	6:13	9:45	0	6:11	0	0	0	0	0	0	0	0	Seguam Pass HTI Tow
12 June	0	1:5	0	3:7	0	0	0	0	0	0	0	0	Amukta Pass
13 June	6:37	42:306	0	0	0	0	5:5	0	0	0	0	0	Samalga-N Umnak Is.
14 June	2:5	12:60	1:1	0	0	0	0	0	0	0	0	2:400	Akutan Is./Pass
15 June	5:23	4:24	0	0	0	2:2	4:4	0	0	1:1	0	2:401	Akutan Is./Pass
16 June	0	2:5	0	0	0	0	2:2	0	0	0	0	0	Akutan Pass/shearwater day
17 June	5:65	14:75	0	0	0	1:1	0	0	0	0	4:8	0	Unalaska/Makushin Bay
18 June	4:17	3:10	0	0	0	4:7	0	0	0	1:1	0	1:1	Unimak Pass/CTD
19 June	0	9:35	0	0	0	2:6	1:1	2:2	0	0	0	1:350	Akun Is./Akutan Bay & Pass
20 June	0	0	0	0	0	0	0	0	0	0	0	2:2	Unimak-to-Volcano Bay
21 June	0	1:4	0	0	7:31	9:19	0	0	0	4:4	0	0	Shumagin Is.
22 June	0	5:19	1:2	0	12:18	2:5	1:1	2:4	0	6:6	0	0	Shumagins - Mitrofania
23 June	0	9:32	0	0	7:10	0	0	1:1	0	2:2	1:1	1:1	Shelikof Strait-AK Peninsula
TOTALS 40:295	149:820	6:8	12:23	38:85	30:69	17:17	18:44	1:1	31:31	5:9	16:1,574		

Table 3. Aleutians Passes Cruise: Killer Whale Encounters (E) and Sightings (SI).
* = encounter truncated

DATE	*E #	LOCATION	NO. WHALES	#PHOTOS
4 JUNE	1	Resurrection Bay	12-14	1 roll+
4 JUNE	2	Gore Pt./S. Kenai Penin.	38-42	6 rolls
7 JUNE	SI	Kres #1-Kres #2 HTI tow	1 – male	None
7 JUNE	3	Krenitzin Is.	42-46	15 rolls
9 JUNE	4	NW Seguam Is.	34-38	8 rolls
10 JUNE	SI	Seguam Pass/CTD line	8 whales	None
11 JUNE	5	NW Seguam Is.	4 whales	2 rolls
11 JUNE	6	Seguam Pass	7 whales	1 roll
11 JUNE	SI	Seguam Pass/HTI tow	2 whales	None
13 JUNE	*7	Samalga Pass	22-25	4 rolls
13 JUNE	*8	NW Umnak Is.	5-6	2 rolls
13 JUNE	SI	N Umnak Is./HTI tow	10-12 (min)	None
14 JUNE	SI	N. Akutan Pass/CTD line	4 whales	None
14 JUNE	SI	Akutan Pass/CTD line	1-male	None
15 JUNE	SI	N. Akutan Pass/CTD line	5 whales	None
	9	Unalaska Bay – Dutch	18-22	4 rolls
17 JUNE	10	Unalaska/Makushin Bay	50-55	12 rolls
17 JUNE	SI	N. Akutan Is.	15-18	None
18 JUNE	SI	Unimak Pass/CTD line	12-15	None
	SI	Unimak Pass/CTD	5-7	6 frames (male)
TOTAL	10-E		295-332	55 rolls+
	10-SI	Study Area:	245-276	

APPENDIX I: List of Stations and Activities

CTD#	Station	GMTIME	ADTIME	Position	Depth	
1	GAK1	6/4/01 20:43	6/4/01 8:43	59 50.78 149 28.00	272	
	GAK1	6/4/01 20:00	6/4/01 9:00	59 50.78 149 28.00	272	CalVET 1
	EnRoute	6/5/01 04:30	6/4/01 20:30	59 07.46 151 02.29		Orca Study
2	KRES2	6/7/01 14:04	6/7/01 6:04	54 2.98 164 51.91	77	
	KRES2	6/7/01 14:15	6/7/01 6:15	54 2.97 164 51.98	78	CalVET 2
3	KRES2	6/7/01 14:34	6/7/01 6:34	54 3.28 164 51.84	75	Prod Stn
	KRES2	6/7/01 14:44	6/7/01 6:44	54 3.24 164 51.96		start Bird Study
	KRES2-KRES3			HTI,Bird,Whale Observations		
4	KRES3	6/7/01 16:53	6/7/01 8:53	53 58.92 165 10.00	94	
	KRES3	6/7/01 17:00	6/7/01 9:00	53 58.94 165 10.01	94	CalVET 3
		6/7/01 17:24	6/7/01 09:24	53 58.01 165 11.37		start Orca study
		6/7/01 21:12	6/7/01 13:12	54 02.60 164 59.80		end Orca Study
5	UNAS2	6/8/01 3:19	6/7/01 19:19	53 29.94 166 30.12	94	
	UNAS2	6/8/01 3:30	6/7/01 19:30	53 29.95 166 30.12	94	CalVET 4
	UNAS2-UNAS3			HTI, Birds, Whale Observations		
	UNAS3	6/8/01 6:05	6/7/01 22:05	53 22.02 166 43.98		end Bird study
6	UNAS3	6/8/01 6:14	6/7/01 22:14	53 22.09 166 44.11	92	
	UNAS3	6/8/01 6:26	6/7/01 22:26	53 22.09 166 44.11	92	CalVET 5
		6/8/01 6:34	6/7/01 22:34	53 22.19 166 44.70		Orca study
7	UMNS1	6/8/01 12:05	6/8/01 4:05	52 59.51 168 11.26	100	
	UMNS1	6/8/01 12:20	6/8/01 4:20	52 59.51 168 11.25	100	CalVET 6
	UMNS1-UMNS2			HTI, Bird, Whale Observations		
8	UMNS2	6/8/01 14:30	6/8/01 6:30	52 55.04 168 27.15	98	
	UMNS2	6/8/01 14:45	6/8/01 6:45	52 55.05 168 27.15	98	CalVET 7
9	UMNS2	6/8/01 14:56	6/8/01 6:56	52 55.06 168 27.07	98	Prod Stn
10	UMNS2	6/8/01 15:08	6/8/01 7:08	52 54.99 168 27.45	98	N15
	UMNS2	6/8/01 15:16	6/8/01 7:16	52 55.02 168 27.00		start Bird study
11	MT4S1	6/8/01 19:42	6/8/01 11:42	52 42.83 169 43.58	94	
	MT4S1	6/8/01 19:55	6/8/01 11:55	52 42.87 169 43.52	94	CalVET 8
	MT4S1-MT4S2			HTI, Bird, Whale Observations		
12	MT4S2	6/8/01 22:36	6/8/01 14:36	52 39.93 170 3.10	360	
	MT4S2	6/8/01 23:00	6/8/01 15:00	52 39.93 170 3.10	360	CalVET 9
13	YUNS1	6/9/01 1:24	6/8/01 17:24	52 28.01 170 41.48	289	
	YUNS1	6/9/01 1:50	6/8/01 17:50	52 28.02 170 41.82	289	CalVET 10
	YUNS1-YUNS2			HTI, Bird, Whale Observations		
	YUNS2	6/9/01 5:05	6/8/01 21:05	52 25.02 171 9.00		end Bird Study
14	YUNS2	6/9/01 5:14	6/8/01 21:14	52 25.27 171 8.43	330	
	YUNS2	6/9/01 5:40	6/8/01 21:40	52 25.27 171 8.42	330	CalVET 11
		6/9/01 18:20	6/9/01 10:20	52 19.24 172 46.63		start Orca Study
		6/9/01 23:15	6/9/01 15:15	not given		end Orca Study
15	SGX01	6/10/01 1:25	6/9/01 17:25	52 17.55 172 40.57	109	East SGX
	SGX01	6/10/01 1:38	6/9/01 17:38	52 17.88 172 40.68		start Bird Study
16	SGX02	6/10/01 2:22	6/9/01 18:22	52 14.60 172 46.34	150	
17	SGX03	6/10/01 3:22	6/9/01 19:22	52 11.63 172 52.39	132	
	SGX04	6/10/01 4:04	6/9/01 20:04	52 8.52 172 58.08		end Bird Study
18	SGX04	6/10/01 4:07	6/9/01 20:07	52 8.42 172 58.01	93	West SGX
	SGX04	6/10/01 4:51	6/9/01 20:51	52 8.01 172 57.30		start NIO tow
		6/10/01 5:05	6/9/01 21:05	52 7.99 172 57.21		end NIO tow
	SGX04	6/10/01 5:10	6/9/01 21:10	52 7.95 172 56.96		start NIO tow
		6/10/01 5:45	6/9/01 21:45	52 7.86 172 53.08		end NIO tow
	SGX04	6/10/01 6:00	6/9/01 22:00	52 8.10 172 51.45		start NIO tow
		6/10/01 6:28	6/9/01 22:28	52 8.66 172 48.50		end NIO tow
	SGY07	6/10/01 7:20	6/9/01 23:20	52 07.24 172 37.85		start MOCNESS 1

		6/10/01 8:10	6/9/01 00:10	52 09.3	172 32.4		end MOCNESS 1
	SGY09	6/10/01 9:41	6/10/01 01:41	52 10.5	172 44.1		start MOCNESS 2
		6/10/01 10:16	6/10/01 02:16	52 8.9	172 39.7		end MOCNESS 2
	SGY11	6/10/01 11:42	6/10/01 03:42	52 14.6	172 50.3		start MOCNESS 3
		6/10/01 12:15	6/10/01 04:15	52 13.4	172 48.2		end MOCNESS 3
	SGY13	6/10/01 13:19	6/10/01 05:19	52 19.0	172 55.9		start MOCNESS 4
		6/10/01 13:48	6/10/01 05:48	52 18.81	172 54.9		end MOCNESS 4
	SGY15	6/10/01 14:34	6/10/01 06:34	52 23.29	173 1.71		start MOCNESS 5
		6/10/01 14:58	6/10/01 06:58	52 24.09	173 00.65		end MOCNESS 5
19	SGY14	6/10/01 16:07	6/10/01 8:07	52 21.05	172 59.06	847	North SGY
	SGY14	6/10/01 16:30?	6/10/01 8:30?	52 21.05	172 59.06	847	CalVET 12
20	SGY14	6/10/01 16:47	6/10/01 8:47	52 21.31	172 59.62	847	Prod Stn
	SGY14	6/10/01 16:53	6/10/01 8:53	52 21.30	172 59.58		start Bird study
21	SGY13	6/10/01 17:23	6/10/01 9:23	52 18.98	172 56.28	595	
	SGY13	6/10/01 17:50	6/10/01 9:50	52 18.98	172 56.27	595	CalVET 13
22	SGY12	6/10/01 18:28	6/10/01 10:28	52 16.78	172 53.43	287	
	SGY12	6/10/01 18:45	6/10/01 10:45	52 16.77	172 53.42	287	CalVET 14
23	SGY11	6/10/01 19:17	6/10/01 11:17	52 14.81	172 50.58	172	
	SGY11	6/10/01 19:30	6/10/01 11:30	52 14.88	172 50.59	172	CalVET 15
24	SGY10	6/10/01 20:04	6/10/01 12:04	52 12.74	172 48.01	178	
24	SGY10	6/10/01 20:15	6/10/01 12:15	52 12.72	172 48.03	178	CalVET 16
25	SGY09	6/10/01 20:51	6/10/01 12:51	52 10.76	172 45.06	159	
	SGY09	6/10/01 21:10	6/10/01 13:10	52 10.76	172 45.06	159	CalVET 17
26	SGY08	6/10/01 21:38	6/10/01 13:38	52 8.53	172 42.35	154	
	SGY08	6/10/01 21:50	6/10/01 13:50	52 8.54	172 42.30	154	Calvet 18
27	SGY07	6/10/01 22:25	6/10/01 14:25	52 6.49	172 39.65	132	
	SGY07	6/10/01 23:00	6/10/01 15:00	52 6.50	172 39.56	132	CalVET 19
28	SGY06	6/10/01 23:15	6/10/01 15:15	52 4.48	172 36.89	125	
	SGY06	6/10/01 23:29	6/10/01 15:29	52 4.48	172 36.84	125	CalVET 20
29	SGY05	6/11/01 00:15	6/10/01 16:15	52 2.27	172 34.61	133	
	SGY05	6/11/01 00:20	6/10/01 16:20	52 2.33	172 34.30	133	CalVET 21
30	SGY04	6/11/01 01:13	6/10/01 17:13	52 0.42	172 31.33	135	
	SGY04	6/11/01 01:30	6/10/01 17:30	52 0.42	172 31.29	135	CalVET 22
31	SGY03	6/11/01 02:07	6/10/01 18:07	51 58.43	172 28.36	240	
	SGY03	6/11/01 02:20	6/10/01 18:20	51 58.43	172 28.38	240	CalVET 23
32	SGY03	6/11/01 02:38	6/10/01 18:38	51 59.11	172 29.72	184	Prod Stn
33	SGY02	6/11/01 03:17	6/10/01 19:17	51 56.36	172 25.55	566	
	SGY02	6/11/01 03:40	6/10/01 19:40	51 56.41	172 25.75	566	CalVET 24
34	SGY01	6/11/01 04:27	6/10/01 20:27	51 54.25	172 22.73	195	South SGY
	SGY01	6/11/01 05:00	6/10/01 21:00	51 54.45	172 22.60	195	CalVET 25
		6/11/01 06:08	6/10/01 22:08	51 48.06	172 16.14		end Bird Study
	SGY01	6/11/01 07:55	6/10/01 23:55	51 54.26	172 27.75		start MOCNESS 6
		6/11/01 08:32	6/11/01 00:32	51 54.54	172 21.79		end MOCNESS 6
	SGY03	6/11/01 09:20	6/11/01 01:20	51 58.57	172 28.04		start MOCNESS 7
		6/11/01 09:52	6/11/01 01:52	51 59.76	172 26.30		end MOCNESS 7
	SGY05	6/11/01 10:37	6/11/01 02:37	52 02.69	172 33.24		start MOCNESS 8
		6/11/01 11:09	6/11/01 03:09	52 03.60	172 30.41		end MOCNESS 8
	SGY15	6/11/01 18:38	6/11/01 10:38	52 23.17	173 02.00		start HTI
	SGY15	6/11/01 18:38	6/11/01 10:38	52 23.17	173 02.00		start Bird study
	SGY01	6/12/01 02:39	6/11/01 18:39	51 54.07	172 22.52		end Bird study
	SGY01	6/12/01 02:39	6/11/01 18:39	51 54.07	172 22.52		end HTI
		6/12/01 02:49	6/11/01 18:49	51 54.18	172 22.56		start Bird study
		6/12/01 05:21	6/11/01 21:21	52 21.78	172 14.10		end Bird study
35	AMX05	6/12/01 05:24	6/11/01 21:24	52 21.89	172 14.17	313	West AMX
36	AMX04	6/12/01 06:29	6/11/01 22:29	52 22.91	172 2.27	419	
37	AMX03	6/12/01 07:33	6/11/01 23:33	52 23.75	171 49.99	282	
38	AMX02	6/12/01 08:29	6/12/01 0:29	52 24.56	171 38.02	470	

39	AMX01	6/12/01	09:34	6/12/01	1:34	52 25.46	171 26.07	382	East AMX
40	AMY14	6/12/01	15:06	6/12/01	7:06	52 37.14	171 50.15	797	North AMY
	AMY14	6/12/01	15:20	6/12/01	7:20	52 37.16	171 50.15	797	CalVET 26
41	AMY14	6/12/01	15:45	6/12/01	7:45	52 36.89	171 50.60	818	Prod Stn
	AMY14	6/12/01	15:53	6/12/01	7:53	52 36.84	171 50.64		start Bird Study
42	AMY13	6/12/01	16:10	6/12/01	8:10	52 34.66	171 49.52	697	
	AMY13	6/12/01	16:35	6/12/01	8:35	52 34.50	171 49.71	697	CalVET 27
43	AMY12	6/12/01	17:04	6/12/01	9:04	52 32.02	171 48.86	649	
	AMY12	6/12/01	17:20	6/12/01	9:20	52 32.02	171 48.86	649	CalVET 28
44	AMY11	6/12/01	18:14	6/12/01	10:14	52 29.34	171 48.47	578	
	AMY11	6/12/01	18:30	6/12/01	10:30	52 29.34	171 48.47	578	CalVET 29
45	AMY10	6/12/01	19:07	6/12/01	11:07	52 26.69	171 47.50	542	
	AMY10	6/12/01	19:45	6/12/01	11:45	52 26.69	171 47.64	542	CalVET 30
46	AMY09	6/12/01	20:13	6/12/01	12:13	52 24.01	171 46.80	297	
	AMY09	6/12/01	20:20	6/12/01	12:20	52 24.02	171 46.80	297	CalVET 31
47	AMY08	6/12/01	21:08	6/12/01	13:08	52 21.28	171 46.25	257	
	AMY08	6/12/01	21:20	6/12/01	13:20	52 21.24	171 46.20	257	CalVET 32
48	AMY07	6/12/01	21:58	6/12/01	13:58	52 18.58	171 45.65	312	
	AMY07	6/12/01	22:00?	6/12/01	14:00?	52 18.97?	171 45.57	312	CalVET 33
49	AMY06	6/12/01	22:47	6/12/01	14:47	52 15.88	171 44.93	373	
	AMY06	6/12/01	23:20	6/12/01	15:20	52 15.89	171 44.93	373	CalVET 34
50	AMY05	6/12/01	23:40	6/12/01	15:40	52 13.24	171 44.34	403	
	AMY05	6/13/01	00:07	6/12/01	16:07	52 13.32	171 44.34	403	CalVET 35
51	AMY04	6/13/01	0:37	6/12/01	16:37	52 10.58	171 43.85	484	
	AMY04	6/13/01	1:02	6/12/01	17:02	52 10.37	171 44.27	487	CalVET 36
52	AMY04	6/13/01	1:18	6/12/01	17:18	52 10.28	171 44.55	491	Prod Stn
53	AMY03	6/13/01	1:43	6/12/01	17:43	52 7.93	171 43.00	618	
	AMY03	6/13/01	2:10	6/12/01	18:10	52 7.80	171 43.18	618	CalVET 37
54	AMY02	6/13/01	2:36	6/12/01	18:36	52 5.32	171 42.45	751	
	AMY02	6/13/01	3:00	6/12/01	19:00	52 5.32	171 42.44	751	CalVET 38
	AMY01	6/13/01	3:27	6/12/01	19:27	52 2.82	171 41.82		end Bird study
55	AMY01	6/13/01	3:31	6/12/01	19:31	52 2.66	171 41.94	497	South AMY
	AMY01	6/13/01	3:56	6/12/01	19:56	52 2.68	171 41.87	497	CalVET 39
56	YUNN2	6/13/01	7:59	6/12/01	23:59	52 38.15	171 10.70	513	
	YUNN2	6/13/01	8:40	6/13/01	00:40	52 38.22	171 10.08?	513	CalVET 40
	YUNN2-YUNN1					HTI, Bird, Mammal transect			
57	YUNN1	6/13/01	10:37	6/13/01	2:37	52 40.07	170 52.93	241	
	YUNN1	6/13/01	11:05	6/13/01	3:05	52 40.13	170 53.00	241	CalVET 41
58	MT4N2	6/13/01	13:45	6/13/01	5:45	52 56.02	170 12.85	200	
	MT4N2	6/13/01	14:00	6/13/01	6:00	52 56.06	170 12.79	200	CalVET 42
		6/13/01	15:31	6/13/01	7:31	52 57.72	170 2.64		start Bird study
	MT4N2-MT4N1					HTI, Bird, Mammal transect			
59	MT4N1	6/13/01	16:27	6/13/01	8:27	52 58.90	169 54.91	126	
	MT4N1	6/13/01	16:38	6/13/01	8:38	52 58.96	169 54.74	126	CalVET 43
60	UMNN3	6/14/01	1:03	6/13/01	17:03	53 17.07	168 43.73	182	
	UMNN3	6/14/01	1:18	6/13/01	17:18	53 17.18	168 43.56	182	CalVET 44
	UMNN3-UMNN2					HTI, Bird, Mammal transect			
61	UMNN2	6/14/01	3:35	6/13/01	19:35	53 24.98	168 30.96	88	
	UMNN2	6/14/01	4:08	6/13/01	20:08	53 25.02	168 30.92	88	CalVET 45
	UMNN2	6/14/01	5:50	6/13/01	21:50	53 25.02	168 30.92		end Bird study
62	UNAN2	6/14/01	9:33	6/14/01	1:33	53 57.61	167 9.77	592	
	UNAN2	6/14/01	10:00	6/14/01	2:00	53 57.94	167 9.38	592	CalVET 46
	UNAN2-UNAN1					HTI, Bird, Mammal transect			
63	UNAN1	6/14/01	12:42	6/14/01	4:42	54 3.13	166 53.42	647	
	UNAN1	6/14/01	13:15	6/14/01	5:15	54 3.28	166 53.22	647	CalVET 47
64	AKY18	6/14/01	19:31	6/14/01	11:31	54 8.00	166 26.41	794	N Akutan
	AKY18	6/14/01	19:56	6/14/01	11:56	54 7.99	166 25.67	794	CalVET 48

65	AKY18	6/14/01 20:21	6/14/01 12:21	54 8.04	166 26.50	794	Prod Stn
66	AKY18	6/14/01 20:32	6/14/01 12:32	54 8.03	166 26.17	787	N15
	AKY18	6/14/01 20:43	6/14/01 12:43	54 8.04	166 25.92	start Bird study	
67	AKY17	6/14/01 20:58	6/14/01 12:58	54 6.83	166 22.30	108	
	AKY17	6/14/01 21:10	6/14/01 13:10	54 6.84	166 22.25	108	CalVET 49
68	AKY16	6/14/01 21:36	6/14/01 13:36	54 5.66	166 18.13	88	
	AKY16	6/14/01 21:47	6/14/01 13:47	54 5.66	166 18.14	88	CalVET 50
69	AKY15	6/14/01 22:12	6/14/01 14:12	54 4.52	166 14.02	77	
	AKY15	6/14/01 22:18	6/14/01 14:18	54 4.54	166 13.88	77	CalVET 51
70	AKY14	6/14/01 22:47	6/14/01 14:47	54 3.35	166 9.89	76	
	AKY14	6/14/01 22:51	6/14/01 14:51	54 3.34	166 9.79	76	CalVET 52
71	AKY13	6/14/01 23:20	6/14/01 15:20	54 2.09	166 5.55	56	
	AKY13	6/14/01 23:28	6/14/01 15:28	54 2.05	166 5.58	56	CalVET 53
72	AKY12	6/14/01 23:44	6/14/01 15:44	54 0.9	166 1.33	55	
	AKY12	6/14/01 23:53	6/14/01 15:53	54 0.86	166 1.19	55	CalVET 54
73	AKY11	6/15/01 00:09	6/14/01 16:09	53 59.83	165 57.42	98	
	AKY11	6/15/01 00:25	6/14/01 16:25	53 59.82	165 57.41	98	CalVET 55
74	AKY10	6/15/01 00:42	6/14/01 16:42	53 58.66	165 53.33	93	
	AKY10	6/15/01 00:51	6/14/01 16:51	53 58.64	165 53.23	93	CalVET 56
75	AKY09	6/15/01 01:15	6/14/01 17:15	53 57.45	165 49.11	72	
	AKY09	6/15/01 01:24	6/14/01 17:24	53 57.43	165 49.08	72	CalVET 57
	AKY08	6/15/01 01:43	6/14/01 17:43	53 56.30	165 45.07	end Bird study	
76	AKY08	6/15/01 01:46	6/14/01 17:46	53 56.30	165 45.07	91	S Akutan
	AKY08	6/15/01 02:00	6/14/01 18:00	53 56.37	165 45.08	91	CalVET 58
	Akutan	6/15/01 02:15	6/14/01 18:15	53 55.83	165 49.20	Bird Collection	
	AKY08	6/15/01 03:28	6/14/01 19:28	53 56.28	165 44.74	start HTI	
	AKY08	6/15/01 03:28	6/14/01 19:28	53 56.28	165 44.74	start Bird Study	
		6/15/01 06:13	6/14/01 22:13	54 04.50	166 14.04	end Bird study	
	AKY18	6/15/01 07:44	6/14/01 23:44	54 08.19	166 26.87	end HTI	
	AKY19	6/15/01 08:10	6/15/01 00:10	54 09.24	166 30.88	start MOCNESS 9	
		6/15/01 08:41	6/15/01 00:41	54 09.39	166 31.49	end MOCNESS 9	
	AKY18	6/15/01 09:12	6/15/01 01:12	54 08.03	166 26.52	start MOCNESS 10	
		6/15/01 09:42	6/15/01 01:42	54 08.67	166 27.00	end MOCNESS 10	
	AKY17	6/15/01 10:20	6/15/01 02:20	54 06.76	166 22.52	start MOCNESS 11	
		6/15/01 10:44	6/15/01 02:44	54 06.85	166 23.28	end MOCNESS 11	
	AKY16	6/15/01 11:18	6/15/01 03:18	54 05.69	166 18.35	start MOCNESS12	
		6/15/01 11:38	6/15/01 03:38	54 05.65	166 19.06	end MOCNESS 12	
	AKY15	6/15/01 12:11	6/15/01 04:11	54 04.51	166 13.94	start MOCNESS 13	
		6/15/01 12:33	6/15/01 04:33	54 04.56	166 14.19	end MOCNESS 13	
	AKY14	6/15/01 13:02	6/15/01 05:02	54 03.27	166 10.03	start MOCNESS 14	
		6/15/01 13:24	6/15/01 05:24	54 03.37	166 10.31	end MOCNESS 14	
77	AKY19	6/15/01 14:57	6/15/01 6:57	54 9.11	166 30.71	918	N Akutan-2
	AKY19	6/15/01 15:30	6/15/01 7:30	54 9.12	166 30.71	918	CalVET 59
	AKY19	6/15/01 15:30	6/15/01 7:30	54 9.12	166 30.71	start Bird Study	
78	AKY18	6/15/01 15:49	6/15/01 7:49	54 7.90	166 26.41	809	
	AKY18	6/15/01 16:10	6/15/01 8:10	54 8.0	166 26.47	809	CalVET 60
79	AKY17	6/15/01 16:39	6/15/01 8:39	54 6.87	166 22.30	110	
	AKY17	6/15/01 16:45	6/15/01 8:45	54 6.87	166 22.31	110	CalVET 61
80	AKY16	6/15/01 17:13	6/15/01 9:13	54 5.68	166 18.23	90	
81	AKY15	6/15/01 17:41	6/15/01 9:41	54 4.51	166 14.11	82	
82	AKY14	6/15/01 18:07	6/15/01 10:07	54 3.37	166 9.94	76	
83	AKY13	6/15/01 18:34	6/15/01 10:34	54 2.27	166 5.92	57	
84	AKY12	6/15/01 19:06	6/15/01 11:06	54 1.09	166 1.71	77	
85	AKY11	6/15/01 19:33	6/15/01 11:33	53 59.81	165 57.40	105	
86	AKY10	6/15/01 19:59	6/15/01 11:59	53 58.62	165 53.35	95	
87	AKY09	6/15/01 20:26	6/15/01 12:26	53 57.51	165 49.41	78	
88	AKY08	6/15/01 20:55	6/15/01 12:55	53 56.36	165 45.02	93	

88	AKY08	6/15/01 21:15	6/15/01 13:15	53 56.39	165 45.02	93	CalVET 62
89	AKY07	6/15/01 21:34	6/15/01 13:34	53 55.30	165 40.84	101	
	AKY07	6/15/01 21:50	6/15/01 13:50	53 55.30	165 40.84	101	CalVET 63
90	AKY06	6/15/01 22:12	6/15/01/14:12	53 54.14	165 36.74	95	S Akutan 2
	AKY06	6/15/01 22:12	6/15/01/14:12	53 54.14	165 36.74		end Bird study
	AKY06	6/15/01 22:23	6/15/01/14:23	53 54.14	165 36.75	95	CalVET 64
	AKY11	6/16/01 08:47	6/16/01 00:47	53 59.85	165 56.35		start MOCNESS 15
		6/16/01 09:08	6/16/01 01:08	53 59.67	165 56.35		end MOCNESS 15
	AKY10	6/16/01 09:32	6/16/01 01:32	53 58.75	165 53.43		start MOCNESS 16
		6/16/01 09:57	6/16/01 01:57	53 58.76	165 54.26		end MOCNESS 16
	AKY09	6/16/01 10:31	6/16/01 02:31	53 57.66	165 49.34		start MOCNESS 17
		6/16/01 10:52	6/16/01 02:52	53 57.89	165 50.14		end MOCNESS 17
	AKY08	6/16/01 11:21	6/16/01 03:21	53 56.29	165 44.82		start MOCNESS18
		6/16/01 11:50	6/16/01 03:50	53 55.93	165 43.46		end MOCNESS 18
	AKY07	6/16/01 12:08	6/16/01 04:08	53 55.17	165 40.52		start MOCNESS 19
		6/16/01 12:36	6/16/01 04:36	53 54.87	165 39.14		end MOCNESS19
	AKY06	6/16/01 12:54	6/16/01 04:54	53 54.08	165 36.39		start MOCNESS 20
		6/16/01 13:16	6/16/01 05:16	53 53.84	165 35.41		end MOCNESS 20
	*Akutan	6/16/01 16:51	6/16/01 08:51	54 00.48	166 02.21		start HTI
		6/16/01 16:51	6/16/01 08:51	54 00.48	166 02.21		start Bird study
		6/16/01 17:45	6/16/01 09:45	53 59.09	166 00.42		end Bird Study
		6/16/01 17:45	6/16/01 09:45	53 59.09	166 00.42		end HTI
	*Akutan	6/16/01 23:05	6/16/01 15:05	54 01.50	166 05.03		start NIO tow
		6/16/01 23:19	6/16/01 15:19	54 01.60	166 05.32		end NIO tow
	*Akutan	6/16/01 23:35	6/16/01 15:35	54 01.60	166 06.02		start NIO tow
		6/16/01 23:45	6/16/01 15:45	54 01.80	166 06.04		end NIO tow
	*Akutan	6/17/01 00:00	6/16/01 16:00	54 02.17	166 06.56		start NIO tow
		6/17/01 00:11	6/16/01 16:11	54 02.18	166 06.59		end NIO tow
	*Akutan	6/17/01 00:30	6/16/01 16:30	54 02.20	166 05.86		start bird coll
		6/17/01 01:03	6/16/01 17:03	54 01.97	166 08.55		end bird collect
91	KREN3	6/18/01 6:02	6/17/01 22:02	54 16.08	166 0.95	134	
	KREN3	6/18/01 6:15	6/17/01 22:15	54 16.09	166 0.89	134	CalVET 65
	KREN3	6/18/01 6:36	6/17/01 22:36	54 16.37	165 59.93		NIO tow(30 min)
	KREN3	6/18/01 7:26	6/17/01 23:26	54 16.02	166 0.97	134	CalVET65-rep
	KREN3-KREN2						HTI, Bird, Mammal transect
92	KREN2	6/18/01 10:01	6/18/01 02:01	54 20.21	165 40.74	90	
	KREN2	6/18/01 10:15	6/18/01 02:15	54 20.23	165 40.82	90	CalVET 66
	KREN2	6/18/01 10:25	6/18/01 02:25	54 20.43	165 40.86		start NIO tow
		6/18/01 10:47	6/18/01 02:47	54 21.14	165 40.85		end NIO tow
	UNY28	6/18/01 12:00	6/18/01 04:00	54 31.41	165 39.65		start MOCNESS 21
		6/18/01 12:28	6/18/01 04:28	54 32.31	165 40.34		end MOCNESS21
	UNY30	6/18/01 13:05	6/18/01 05:05	54 33.48	165 48.05		start MOCNESS 22
		6/18/01 13:27	6/18/01 05:27	54 33.92	165 48.35		end MOCNESS 22
93	UNY30	6/18/01 14:32	6/18/01 06:32	54 33.45	165 47.86	423	N Unimak
	UNY30	6/18/01 14:45	6/18/01 06:45	54 33.41	165 47.83	423	CalVET 67
94	UNY30	6/18/01 15:07	6/18/01 07:07	54 33.35	165 47.81	422	Prod Stn
	UNY30	6/18/01 15:14	6/18/01 07:14	54 33.33	165 47.76		start Bird Study
95	UNY28	6/18/01 15:47	6/18/01 07:47	54 31.15	165 39.55	308	
	UNY28	6/18/01 16:03	6/18/01 08:03	54 31.14	165 39.56	308	CalVET 68
96	UNY27	6/18/01 16:29	6/18/01 08:29	54 30.01	165 35.39	134	
97	UNY26	6/18/01 17:00	6/18/01 09:00	54 28.74	165 31.19	96	
	UNY26	6/18/01 17:08	6/18/01 09:08	54 28.80	165 31.22	96	CalVET 69
98	UNY24	6/18/01 17:45	6/18/01 09:45	54 26.53	165 22.82	145	
	UNY24	6/18/01 17:56	6/18/01 09:56	54 26.45	165 22.73	145	CalVET 70
99	UNY22	6/18/01 18:34	6/18/01 10:34	54 24.25	165 14.39	168	
	UNY22	6/18/01 18:45	6/18/01 10:45	54 24.24	165 14.38	168	CalVET 71
100	UNY20	6/18/01 19:22	6/18/01 11:22	54 22.03	165 6.14	140	

	UNY20	6/18/01	19:30	6/18/01	11:30	54 22.03	165 6.14	140	CalVET 72
101	UNY18	6/18/01	20:16	6/18/01	12:16	54 19.73	164 57.54	100	
	UNY18	6/18/01	20:28	6/18/01	12:28	54 19.75	164 57.54	100	CalVET 73
102	UNY16	6/18/01	21:11	6/18/01	13:11	54 17.41	164 49.34	64	
	UNY16	6/18/01	21:19	6/18/01	13:19	54 17.44	164 49.32	64	CalVET 74
103	UNY14	6/18/01	22:06	6/18/01	14:06	54 15.12	164 41.08	77	
	UNY14	6/18/01	22:14	6/18/01	14:14	54 15.12	164 41.08	77	CalVET 75
104	UNY12	6/18/01	23:00	6/18/01	15:00	54 12.88	164 32.71	114	
	UNY12	6/18/01	23:10	6/18/01	15:10	54 12.85	164 32.68	114	CalVET 76
105	UNY10	6/18/01	23:58	6/18/01	15:58	54 10.55	164 24.29	92	
	UNY10	6/19/01	00:07	6/18/01	16:07	54 10.56	164 24.36	92	CalVET 77
106	UNY08	6/19/01	0:53	6/18/01	16:53	54 8.28	164 15.87	77	S Unimak
	UNY08	6/19/01	1:02	6/18/01	17:02	54 8.28	164 15.87	77	CalVET 78
	UNY08	6/19/01	1:14	6/18/01	17:14	54 08.25	164 15.57	start HTI	
		6/19/01	5:39	6/18/01	21:39	54 17.04	164 48.00	end Bird study	
	UNY28	6/19/01	11:38	6/19/01	03:38	54 31.30	165 39.99	end HTI	
	UNY25	6/19/01	12:38	6/19/01	04:38	54 27.74	165 27.26	start MOCNESS 23	
	UNY25	6/19/01	13:00	6/19/01	05:00	54 27.92	165 28.11	end MOCNESS 23	
	UNY22	6/19/01	14:05	6/19/01	06:05	54 24.39	165 14.79	start MOCNESS 24	
	UNY22	6/19/01	14:26	6/19/01	06:26	54 24.64	165 15.52	end MOCNESS 24	
	#Akutan	6/20/01	00:11	6/19/01	16:11	54 06.53	166 08.92	start NIO tow	
	''	6/20/01	00:25	6/19/01	16:25	54 06.74	166 08.42	end NIO tow	
	#Akutan	6/20/01	00:54	6/19/01	16:54	54 05.91	166 09.30	start NIO tow	
	''	6/20/01	01:05	6/19/01	17:05	54 06.08	166 09.30	end NIO tow	
	#Akutan	6/20/01	01:18	6/19/01	17:18	54 05.99	166 08.77	start NIO tow	
	''	6/20/01	01:28	6/19/01	17:28	54 06.05	166 08.37	end NIO tow	
	UNY20	6/20/01	07:49	6/19/01	23:49	54 22.21	165 06.54	start MOCNESS25	
		6/20/01	08:08	6/20/01	00:08	54 22.53	165 07.26	end MOCNESS 25	
	UNY18	6/20/01	09:02	6/20/01	01:02	54 19.85	164 57.98	start MOCNESS26	
							(tow aborted,	number re-used)	
107	UNY10	6/20/01	14:48	6/20/01	06:48	54 10.55	164 24.30	90	Prod Stn
	Shumagins	6/22/01	05:58	6/21/01	21:58	55 10.92	160 15.18	start HTI	
		6/22/01	07:26	6/21/01	23:26	55 15.34	160 06.04	end HTI	
	Shumagins	6/22/01	07:48	6/21/01	23:48	55 14.18	160 08.67	start MOCNESS26	
		6/22/01	08:20	6/22/01	00:20	55 13.83	160 10.24	end MOCNESS 26	
108	Whale1	6/22/01	09:23	6/22/01	01:23	55 15.36	160 06.00	58	
109	Whale2	6/22/01	09:38	6/22/01	01:38	55 14.51	160 08.01	107	
110	Whale3	6/22/01	10:02	6/22/01	02:02	55 13.67	160 09.54	204	
111	Whale4	6/22/01	10:29	6/22/01	02:29	55 12.80	160 11.49	224	
112	Whale5	6/22/01	10:58	6/22/01	02:58	55 11.89	160 13.40	224	
113	Whale6	6/22/01	11:23	6/22/01	03:23	55 11.03	160 15.11	181	
114	Whale7	6/22/01	11:49	6/22/01	03:49	55 10.16	160 16.84	204	
115	Whale8	6/22/01	12:12	6/22/01	04:12	55 9.25	160 18.77	214	
116	Whale9	6/22/01	12:37	6/22/01	04:37	55 8.32	160 20.58	164	
117	Whale10	6/22/01	12:55	6/22/01	04:55	55 7.46	160 22.28	86	

* Akutan Bird Foraging area

\# Akutan Herring feeding area

Shumagins Fin Whale foraging area

List Of Figures

CAUTION: Chart Printouts should not be used as the primary navigational means.

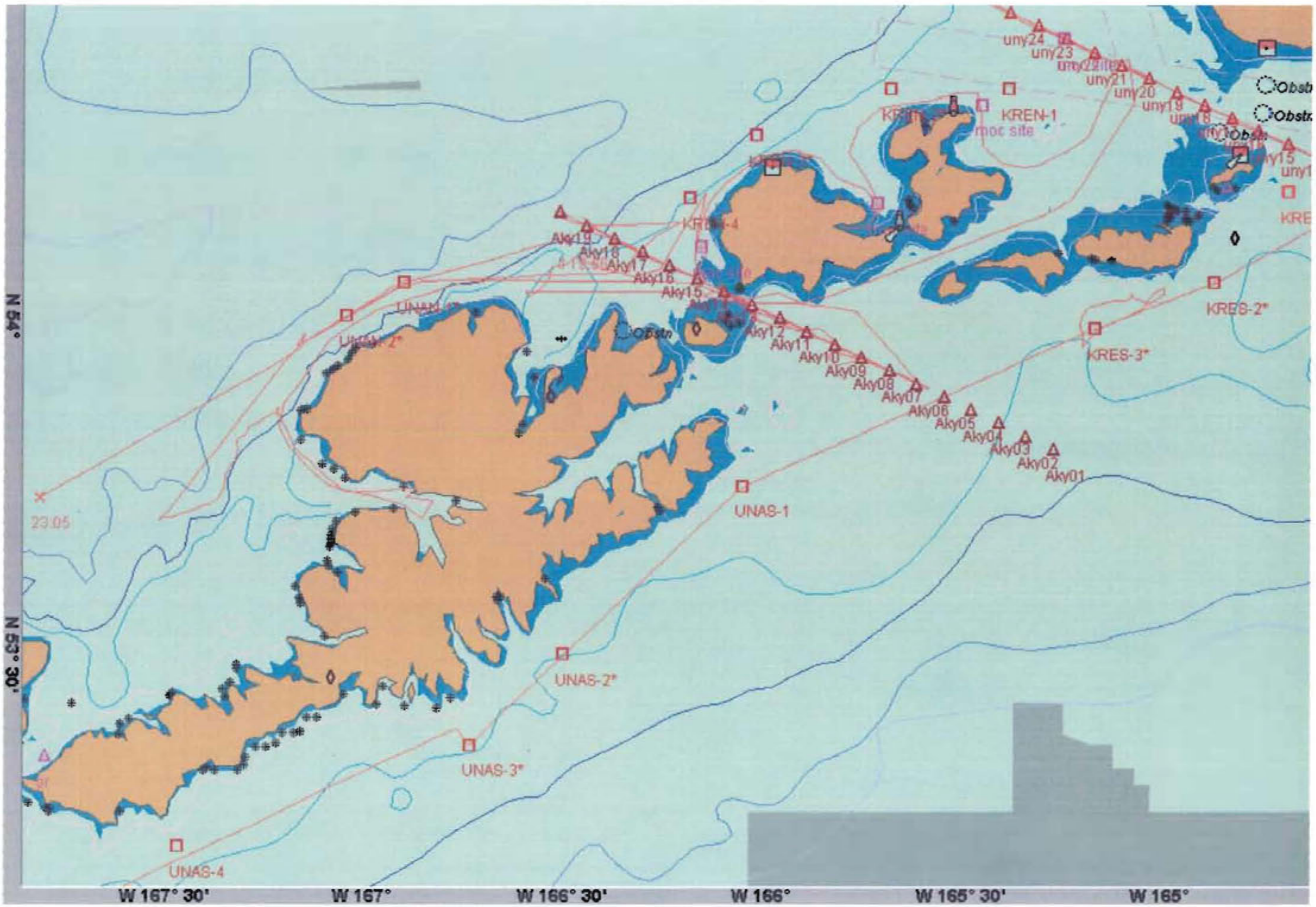


Fig. 1

CAUTION: Chart Printouts should not be used as the primary navigational means.

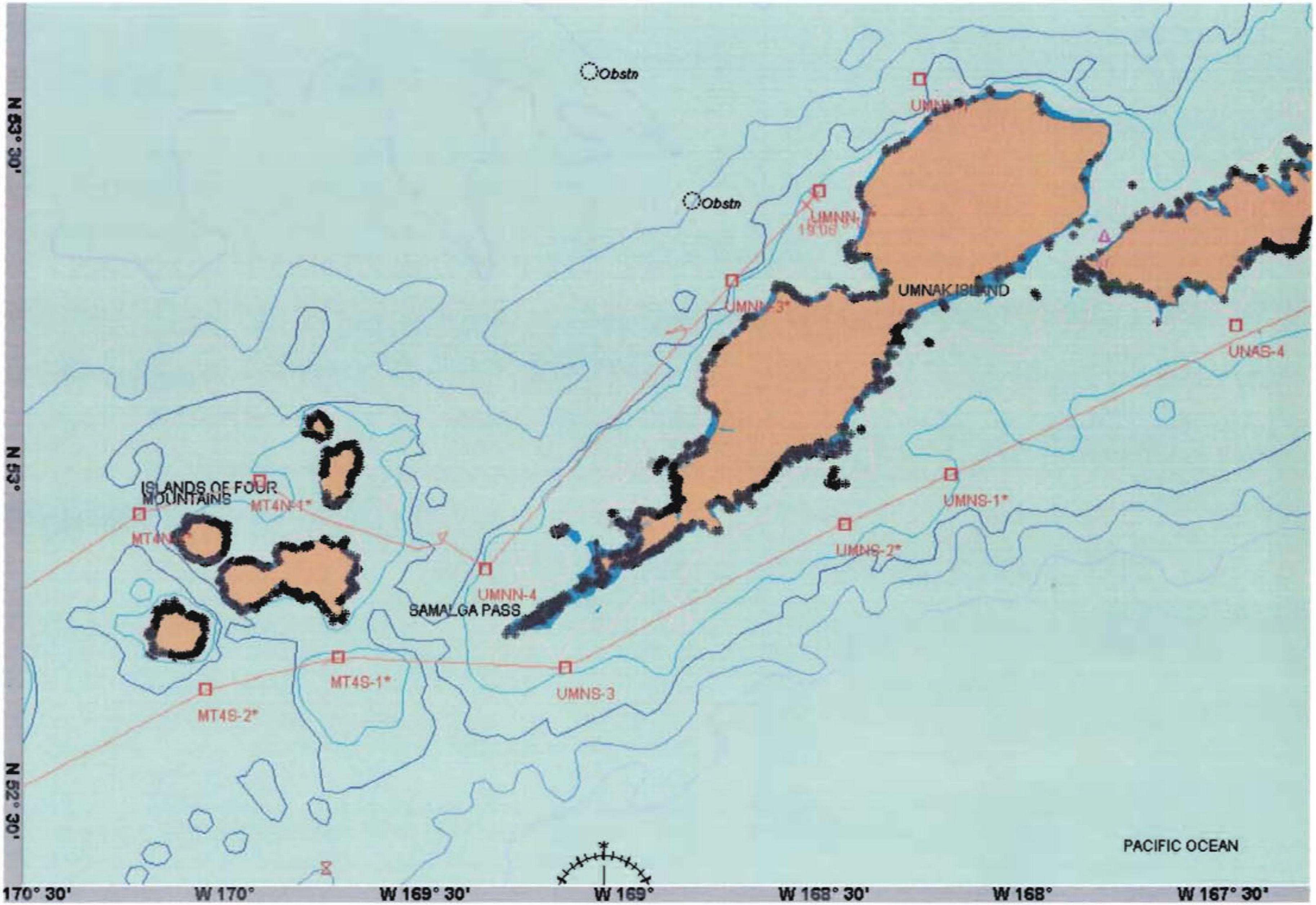


Fig. 2

CAUTION: Chart Printouts should not be used as the primary navigational means.

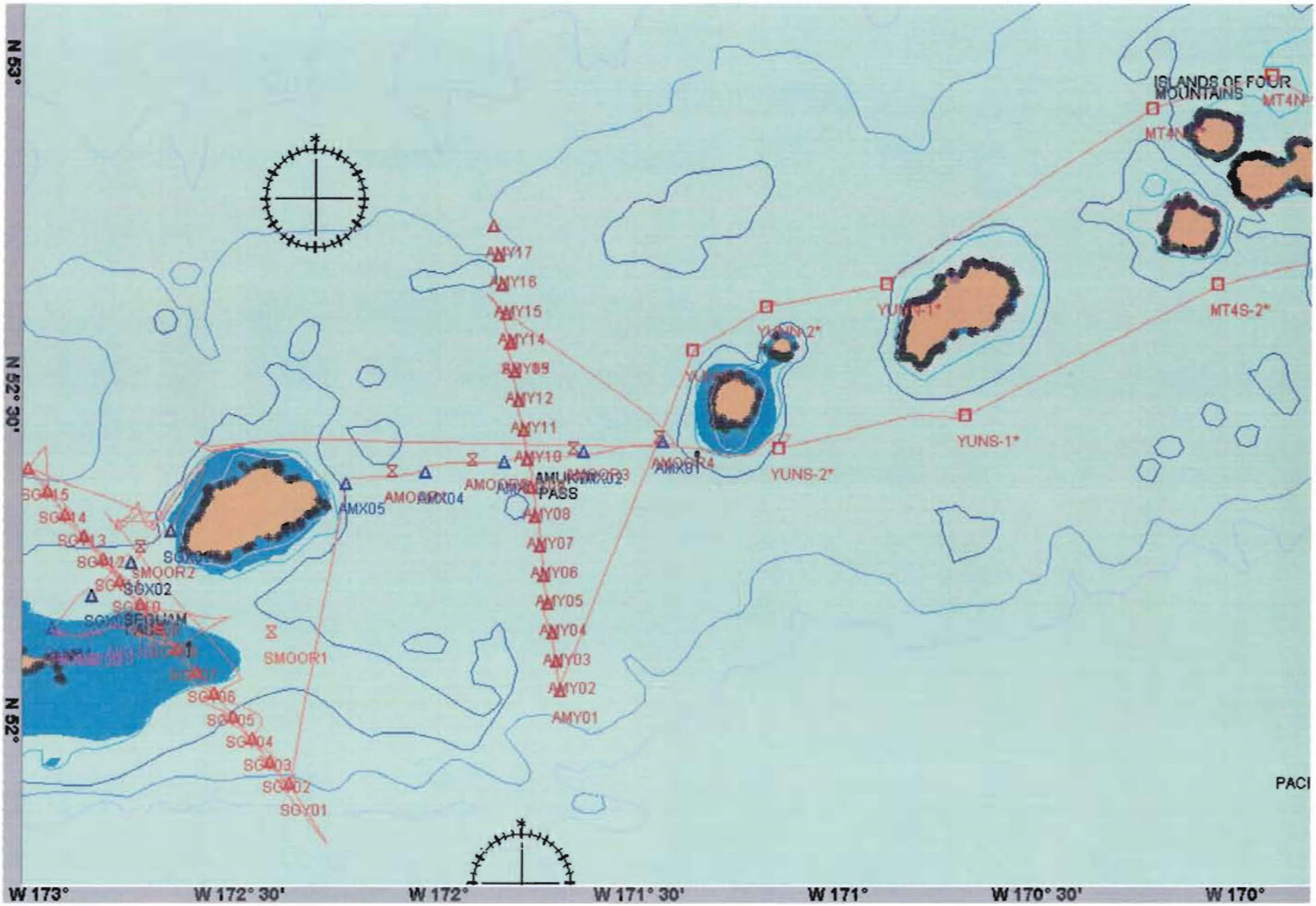


Fig. 3

06/17/01 INStar - 18:31:03

Scale: 45.5NM 1:370000 Chart: Coastal UNDER

CAUTION: Chart Printouts should not be used as the primary navigational means.

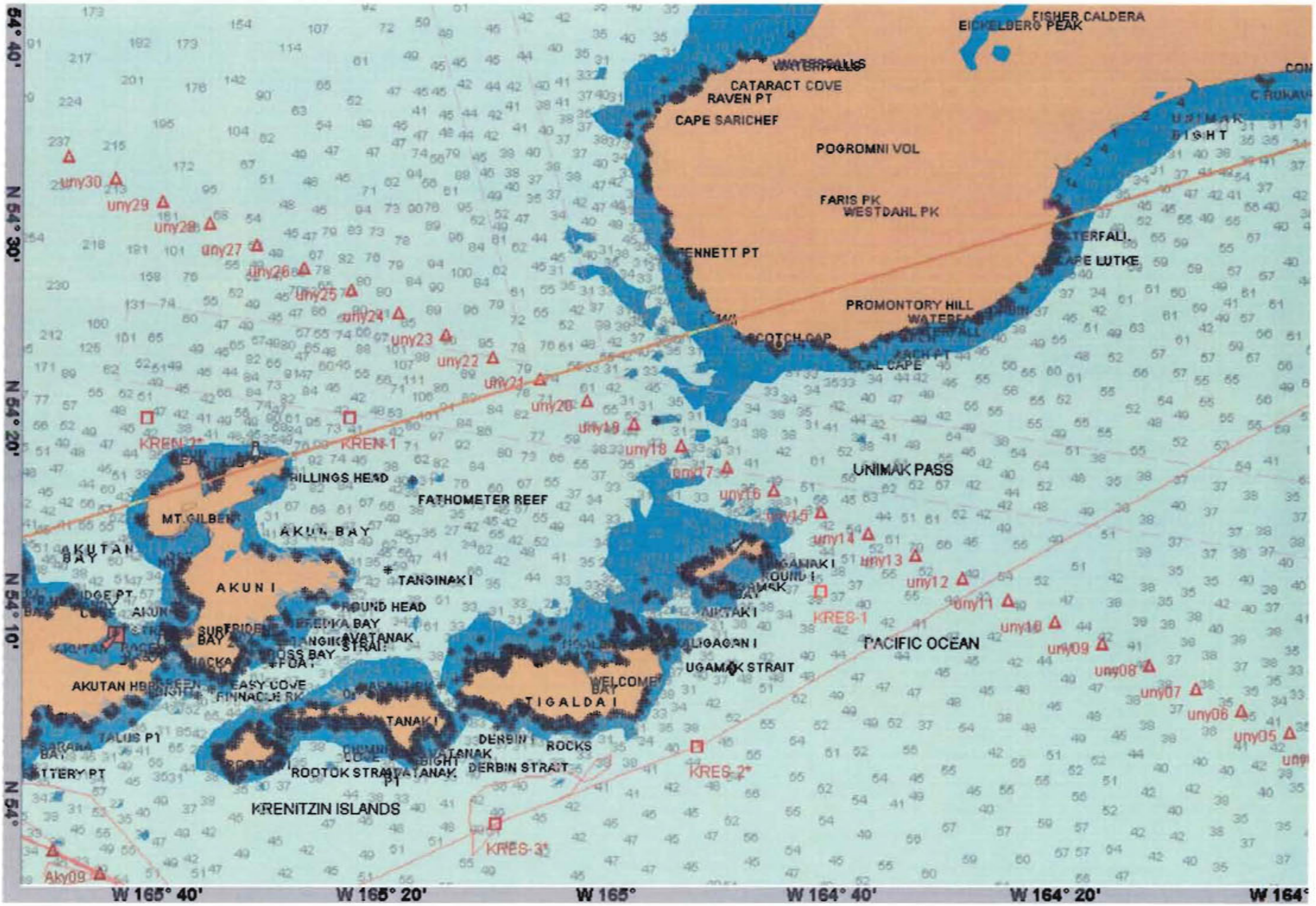


Fig. 4

06/13/01 INStar - 21:29:15

Scale: 35.9NM 1:292000 Chart: Coastal UNDER

CAUTION: Chart Printouts should not be used as the primary navigational means.

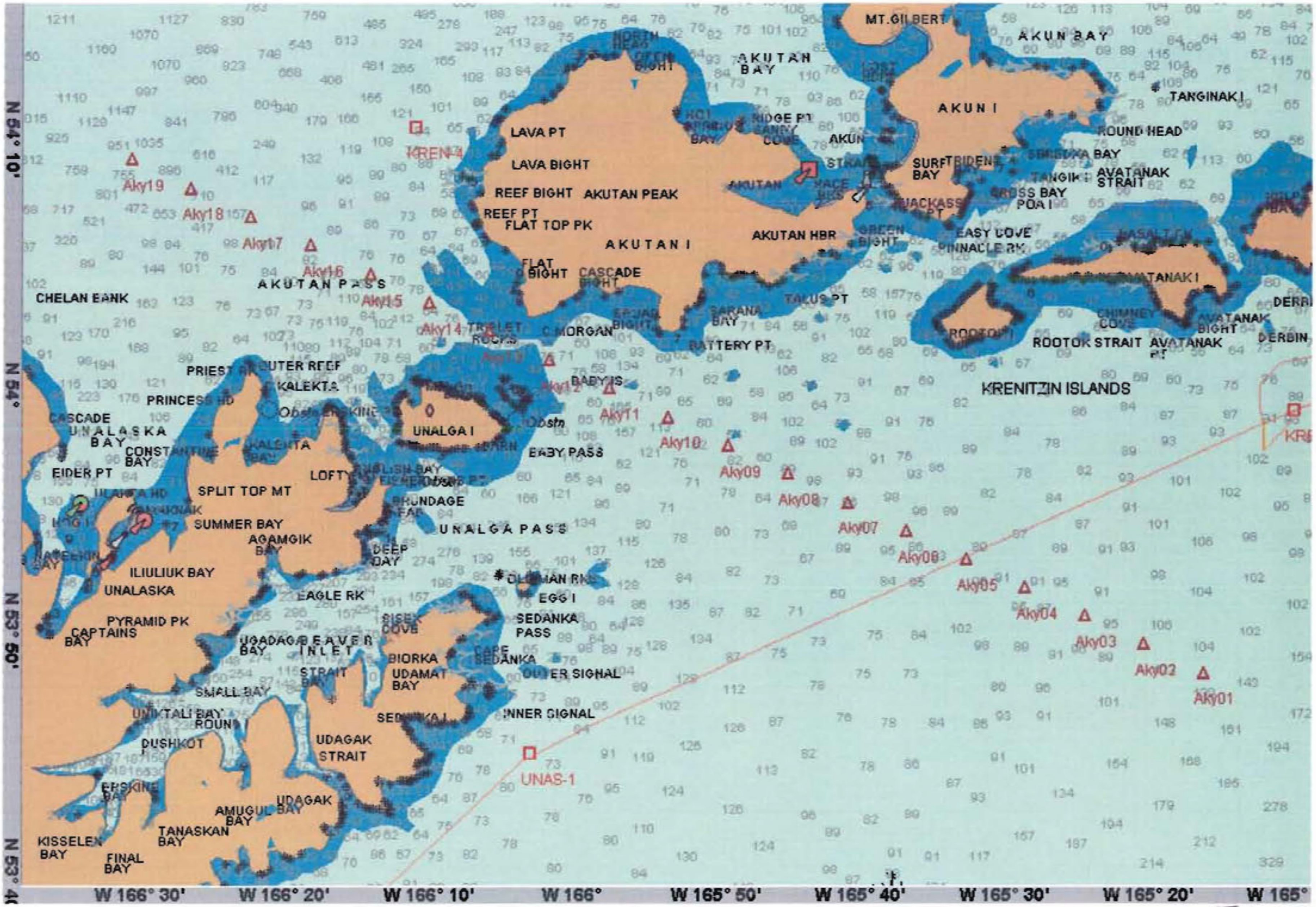


Fig. 5

06/13/01 INStar - 21:41:42

Scale: 55.1NM 1:474000 Chart: Coastal OVER

CAUTION: Chart Printouts should not be used as the primary navigational means.

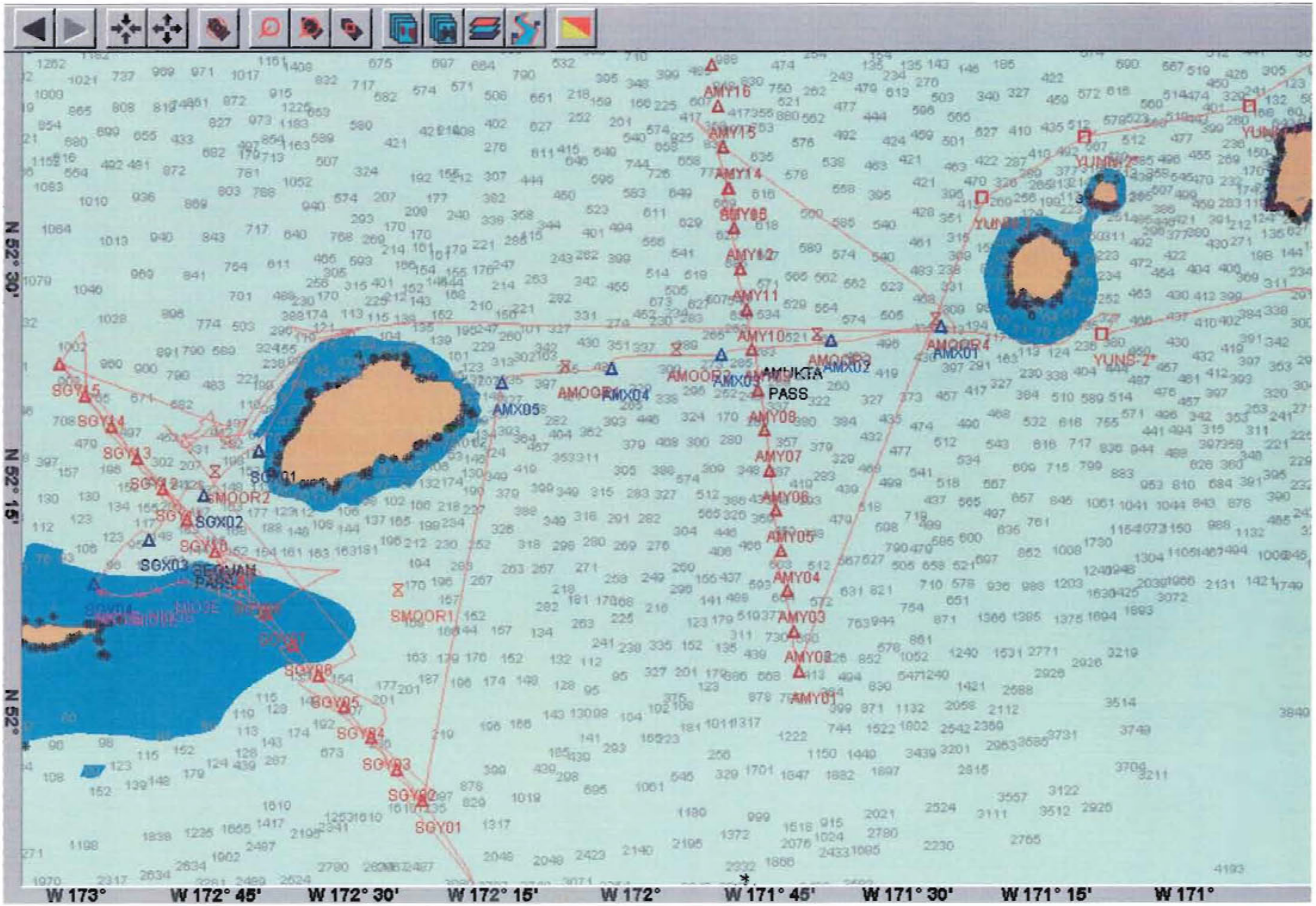


Fig. 6

Currents-UNIMAK PASS (off Scotch Cap)

Harmonic station (NOAA)
54° 22 N 164° 48 W

Monday, June 18, 2001

Average Currents	
Min Before Flood:	0.0 kt - -
Avg Max Flood:	3.4 kt 295°
Min Before Ebb:	0.0 kt - -
Avg Max Ebb:	3.0 kt 105°

Slack	Max	Flood & Ebb
	01:35	3.1 kt 295° fld
05:06	08:48	3.9 kt 105° ebb
12:16	15:39	3.5 kt 295° fld
21:00	21:31	0.1 kt 105° ebb
22:02		

Moonrise 05:16
Moonset 20:37

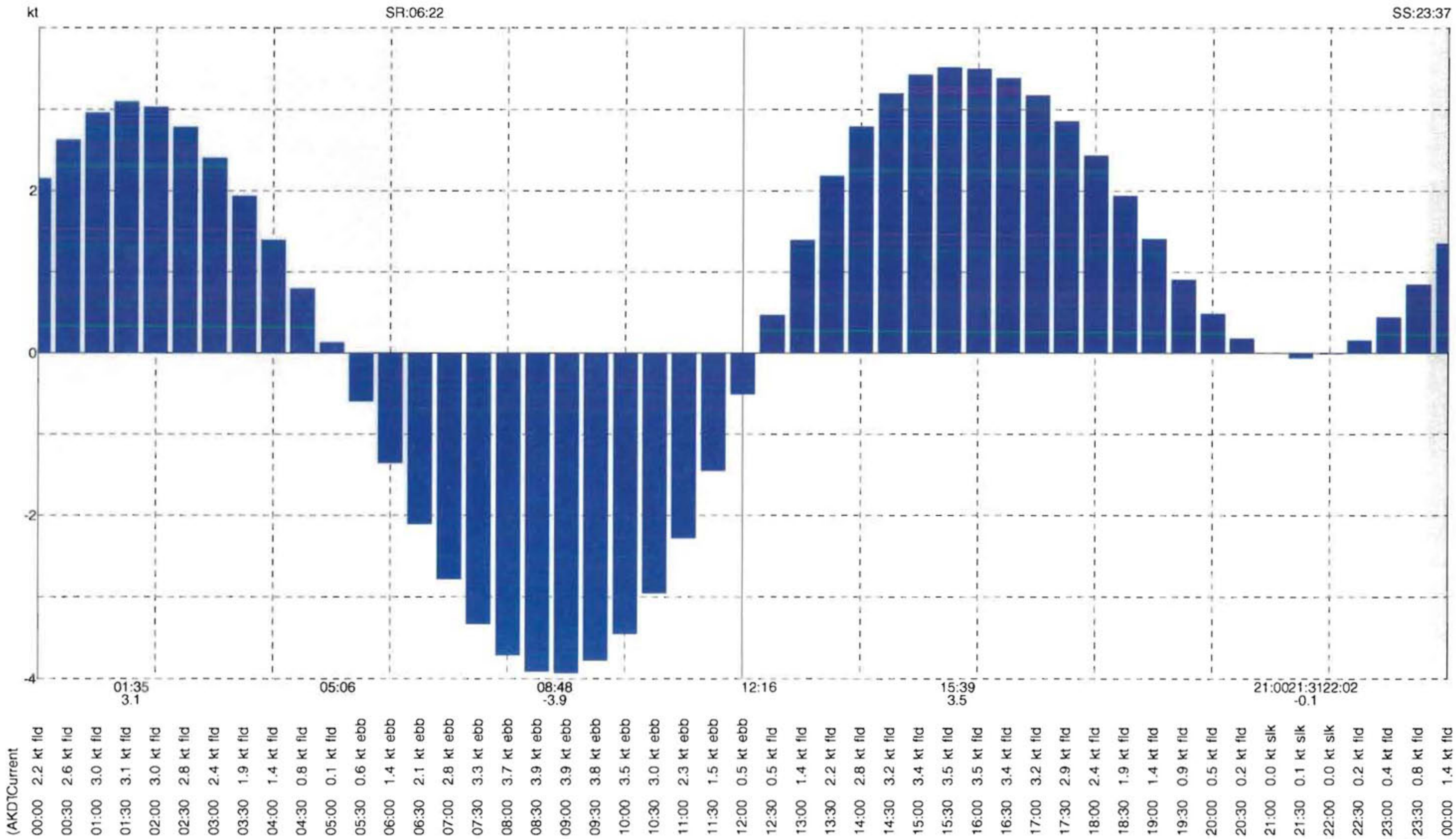


Fig. 7

Currents-AKUTAN PASS

Harmonic station (NOAA)
54° 1 N 166° 3 W

Thursday, June 14, 2001

Average Currents
Min Before Flood: 0.0 kt --
Avg Max Flood: 5.8 kt 294°
Min Before Ebb: 0.0 kt --
Avg Max Ebb: 5.3 kt 113°

Slack Max Flood & Ebb
01:49 04:14 3.8 kt 113° ebb
07:40 10:12 3.3 kt 294° fld
13:24 16:06 4.2 kt 113° ebb
19:21 22:37 5.6 kt 294° fld

Moonrise 04:12
Moonset 15:48

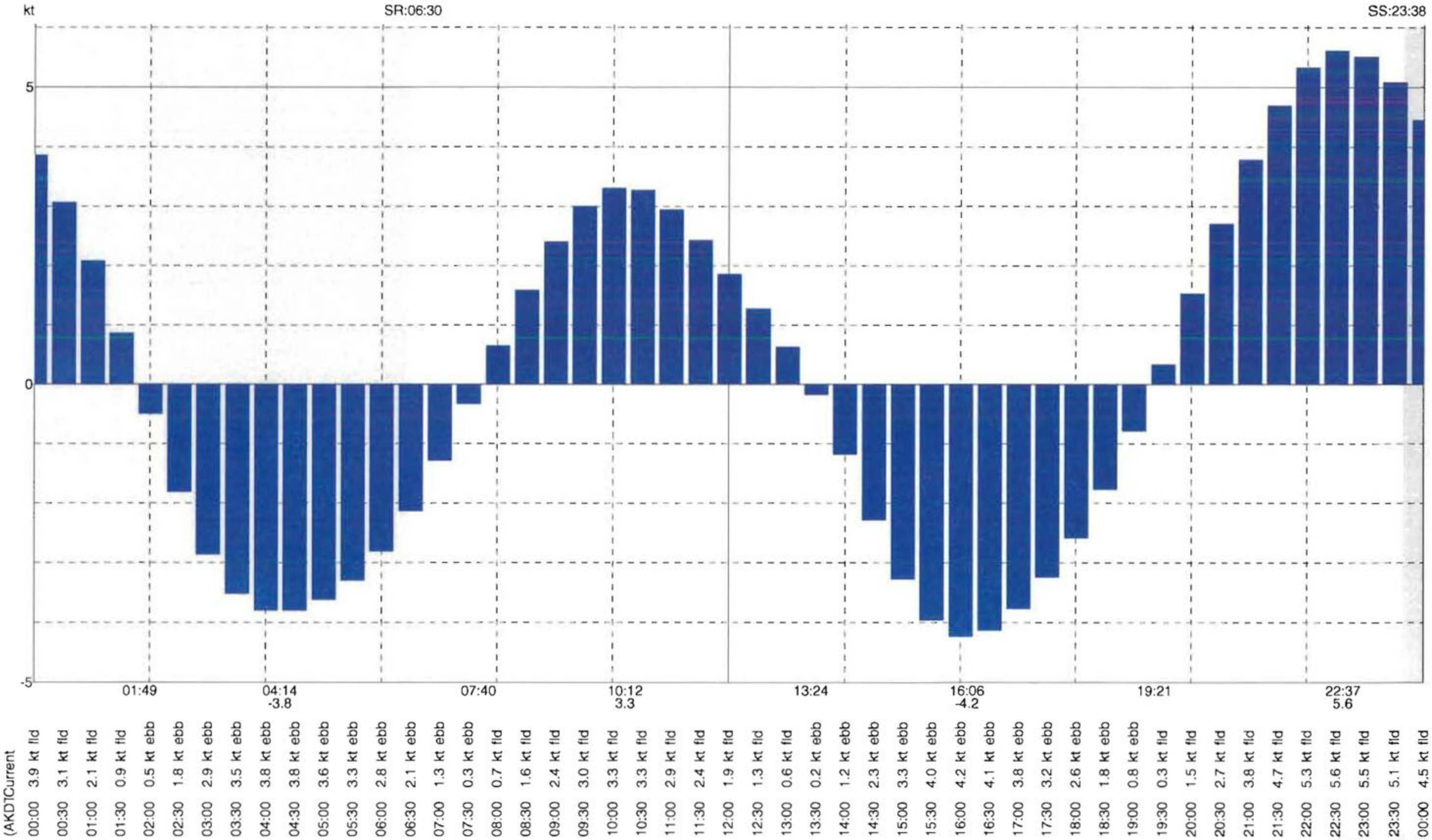


Fig. 8

Currents-AKUTAN PASS

Harmonic station (NOAA)
54° 1 N 166° 3 W

Friday, June 15, 2001

Average Currents
Min Before Flood: 0.0 kt --
Avg Max Flood: 5.8 kt 294°
Min Before Ebb: 0.0 kt --
Avg Max Ebb: 5.3 kt 113°

Slack Max Flood & Ebb
02:23 05:02 4.6 kt 113° ebb
08:38 11:15 3.8 kt 294° fld
14:46 17:04 3.5 kt 113° ebb
20:08 23:23 5.3 kt 294° fld

Moonrise 04:27
Moonset 17:01

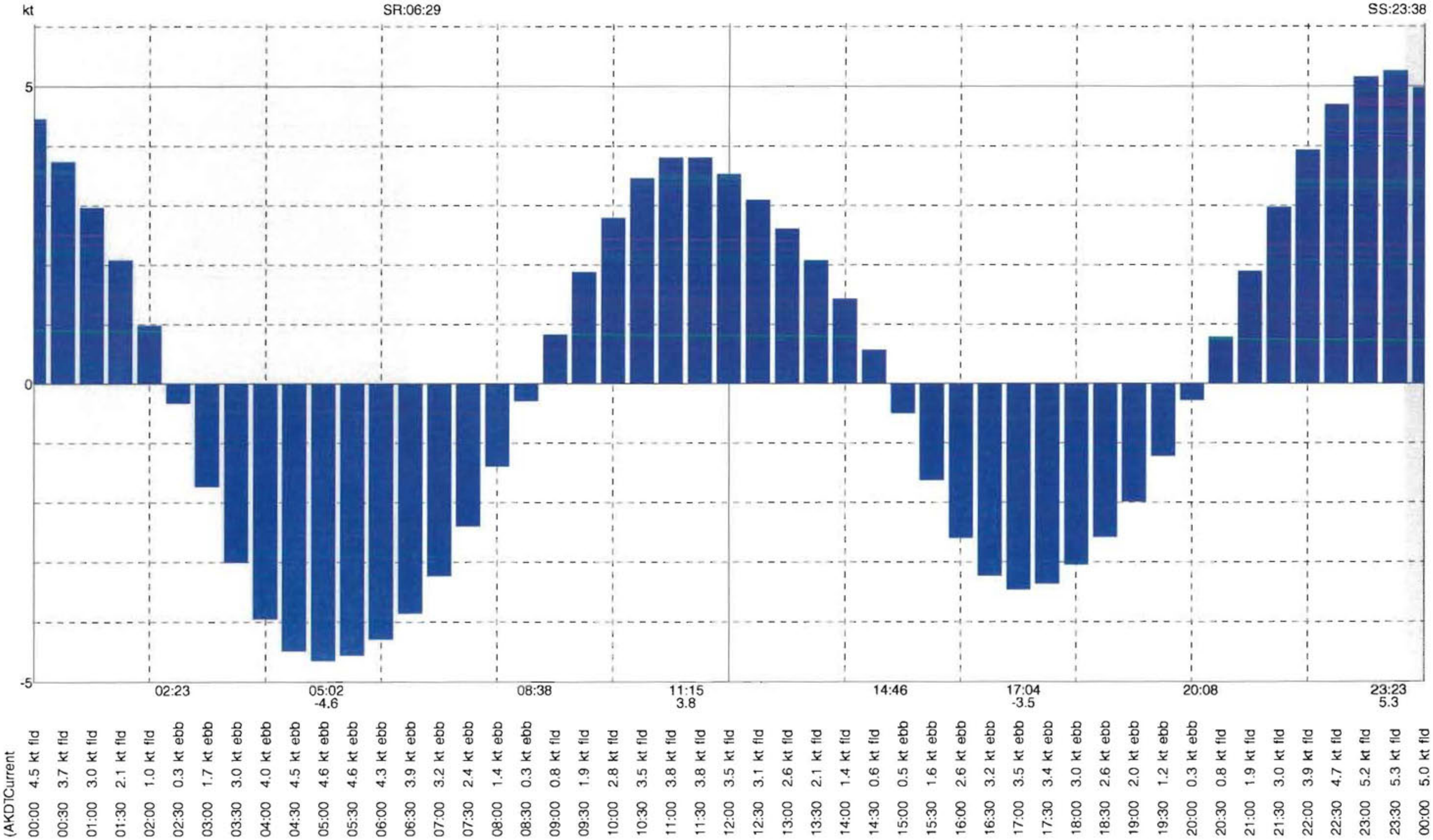


Fig 9

Currents-AKUTAN PASS

Harmonic station (NOAA)
54° 1 N 166° 3 W

Saturday, June 16, 2001

Average Currents
Min Before Flood: 0.0 kt --
Avg Max Flood: 5.8 kt 294°
Min Before Ebb: 0.0 kt --
Avg Max Ebb: 5.3 kt 113°

Slack Max Flood & Ebb
02:55 05:49 5.6 kt 113° ebb
09:31 12:17 4.7 kt 294° fld
16:03 18:06 2.9 kt 113° ebb
20:58

Moonrise 04:42
Moonset:18:11

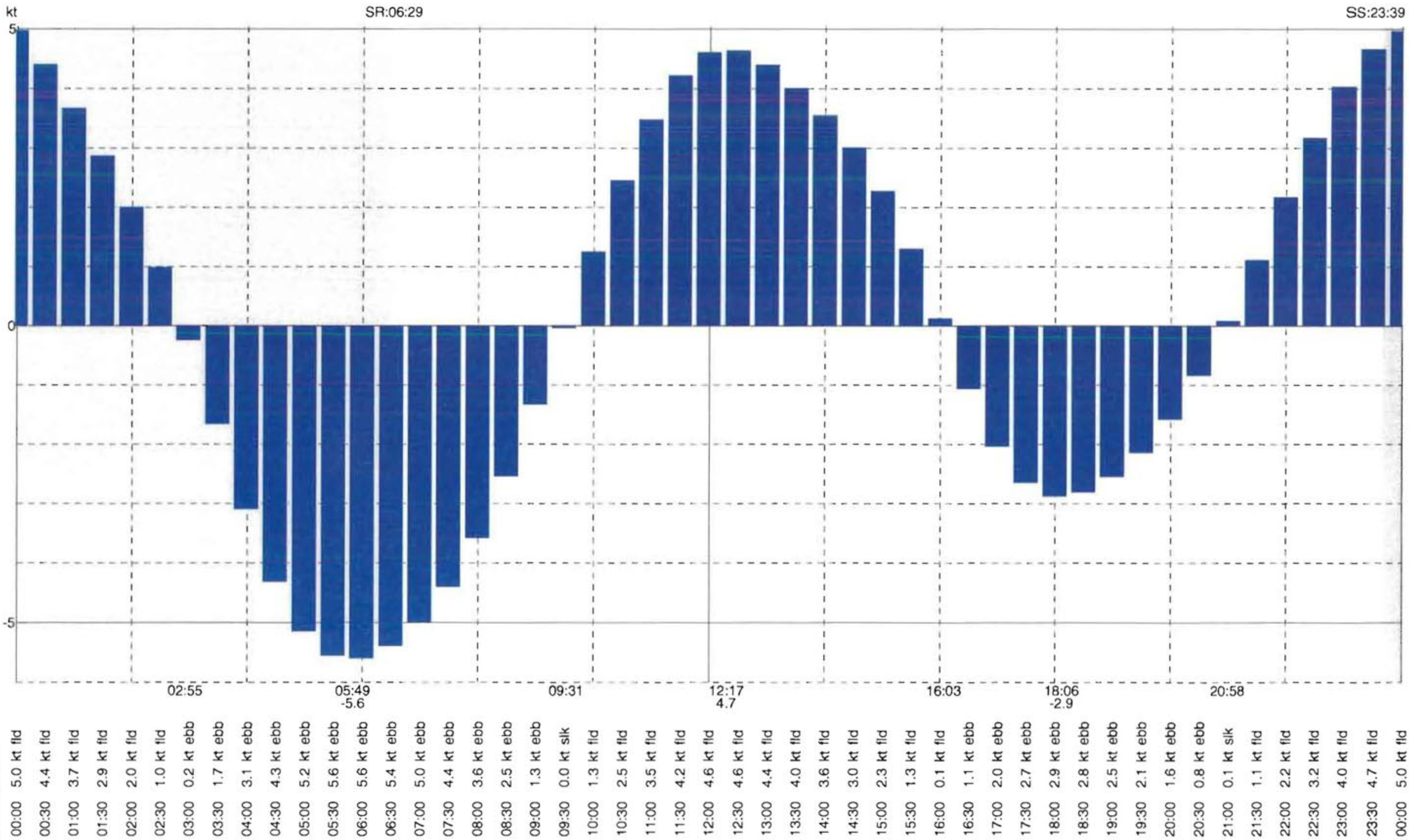


Fig. 10

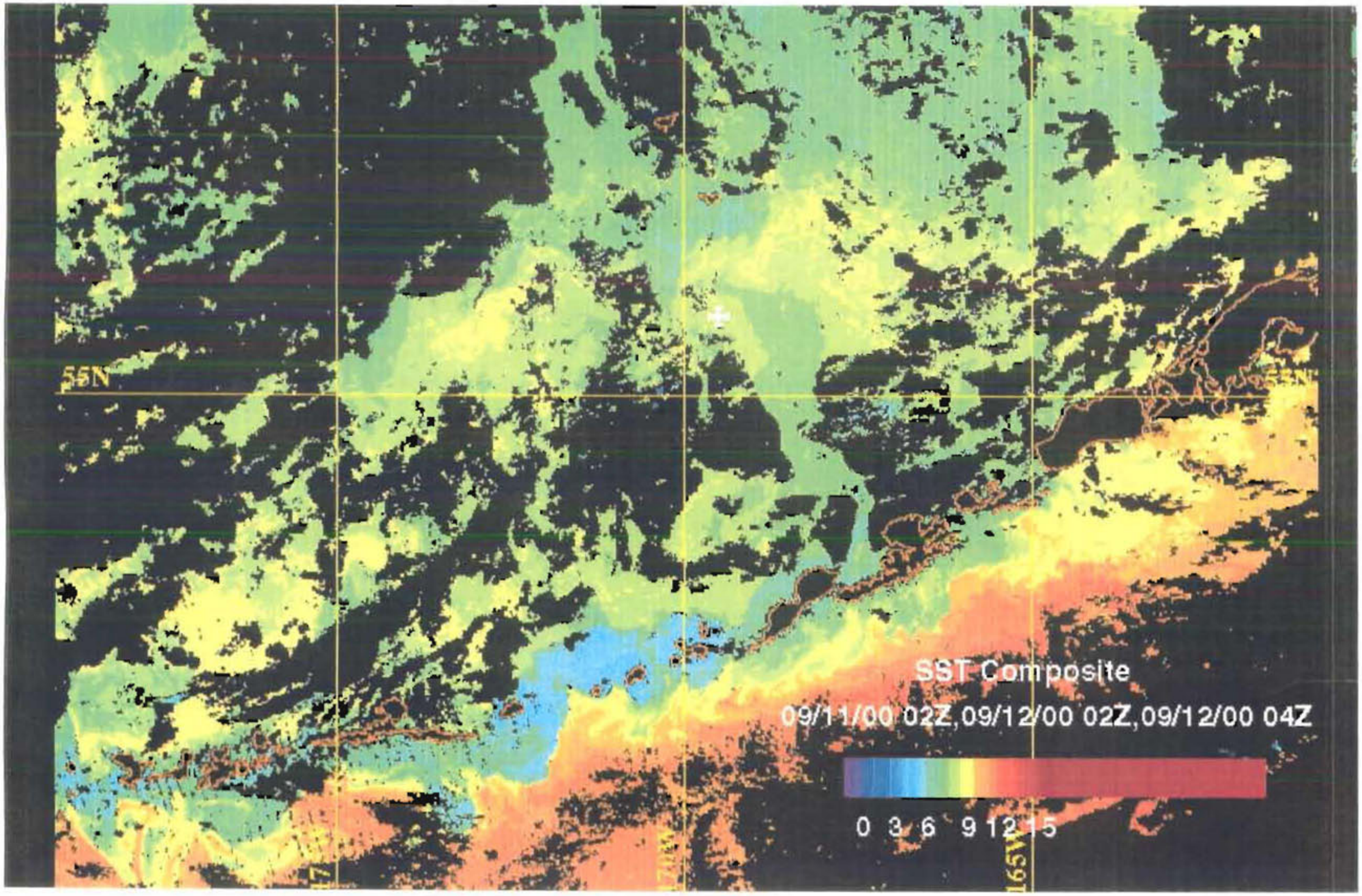

55N
170W
165W
SST Composite
09/11/00 02Z,09/12/00 02Z,09/12/00 04Z
0 3 6 9 12 15

Fig. 11

HX245; Seguam Pass, North-South

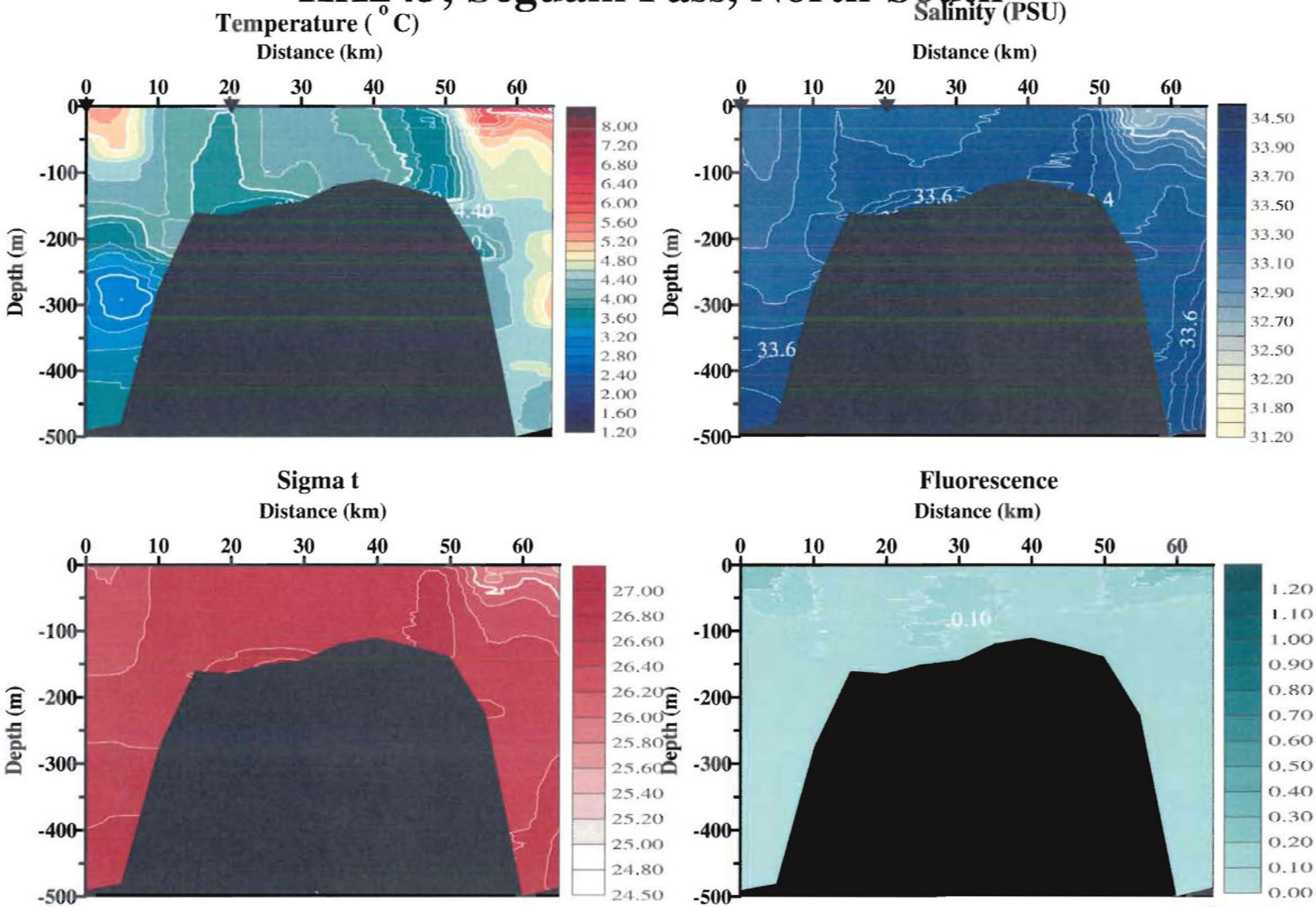
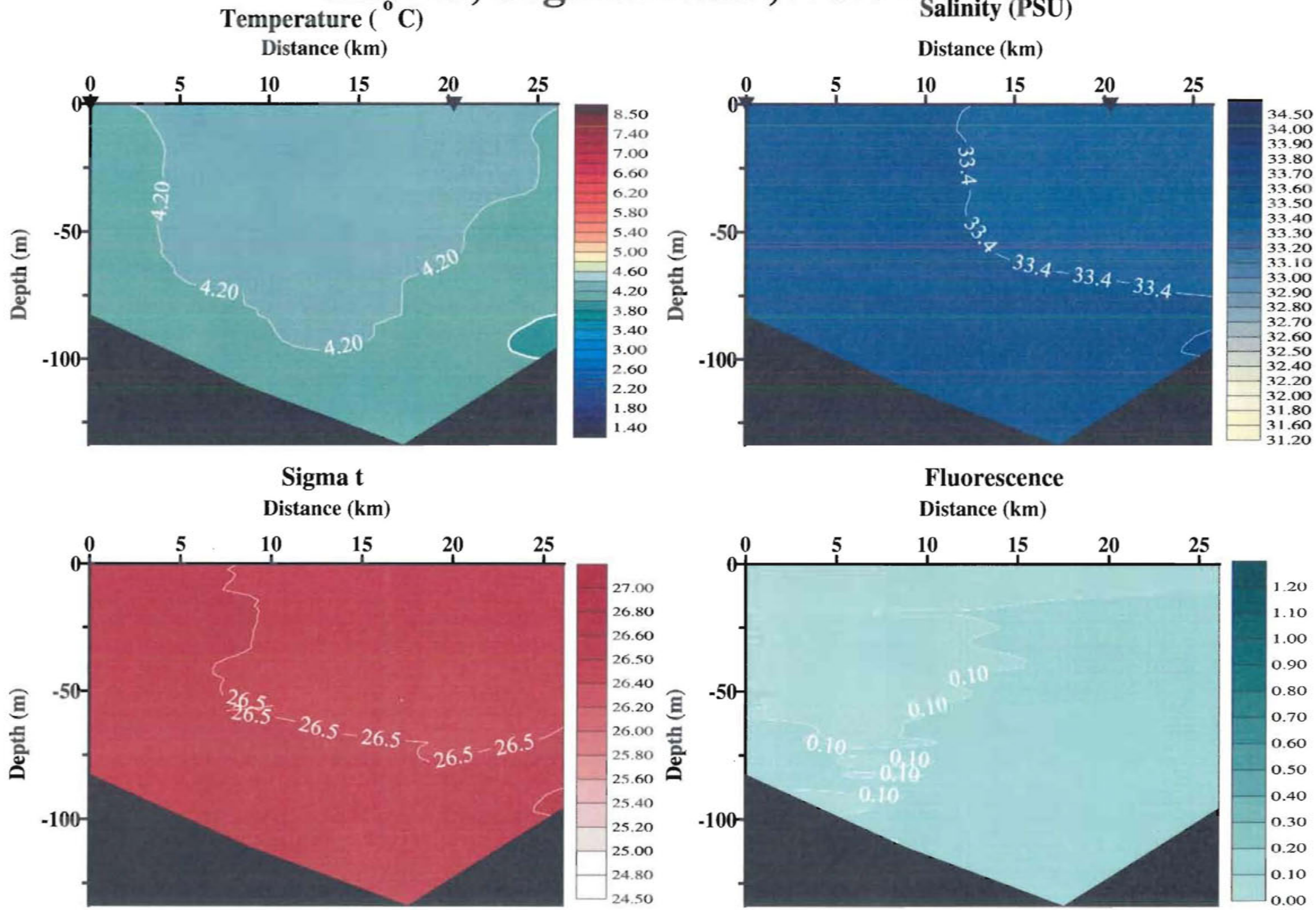


Fig. 12

HX245; Seguam Pass ,West-East



Fig, 13

HX245; Amukta Pass , North - South

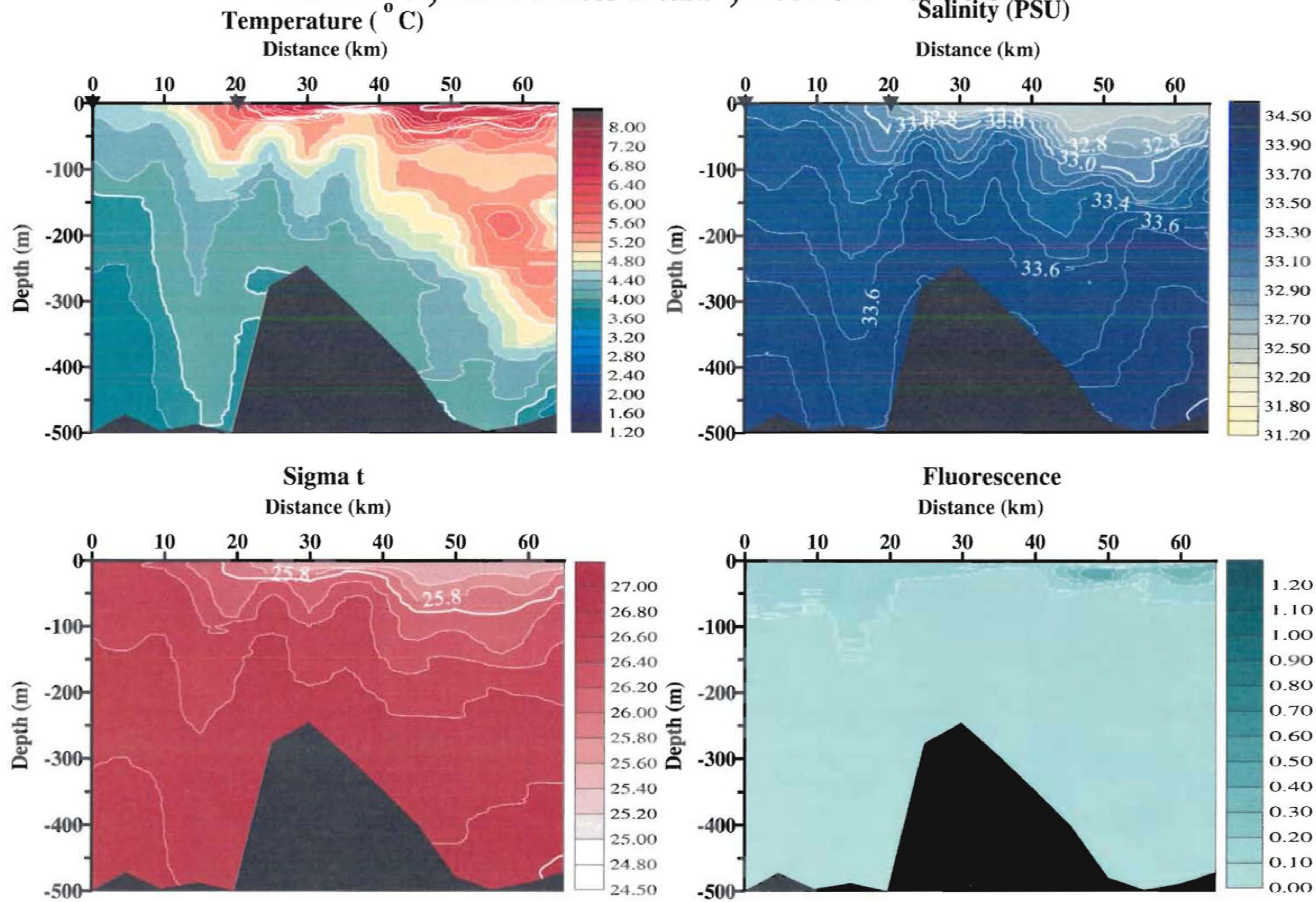


Fig. 14

HX245; Amukta Pass ,West-East

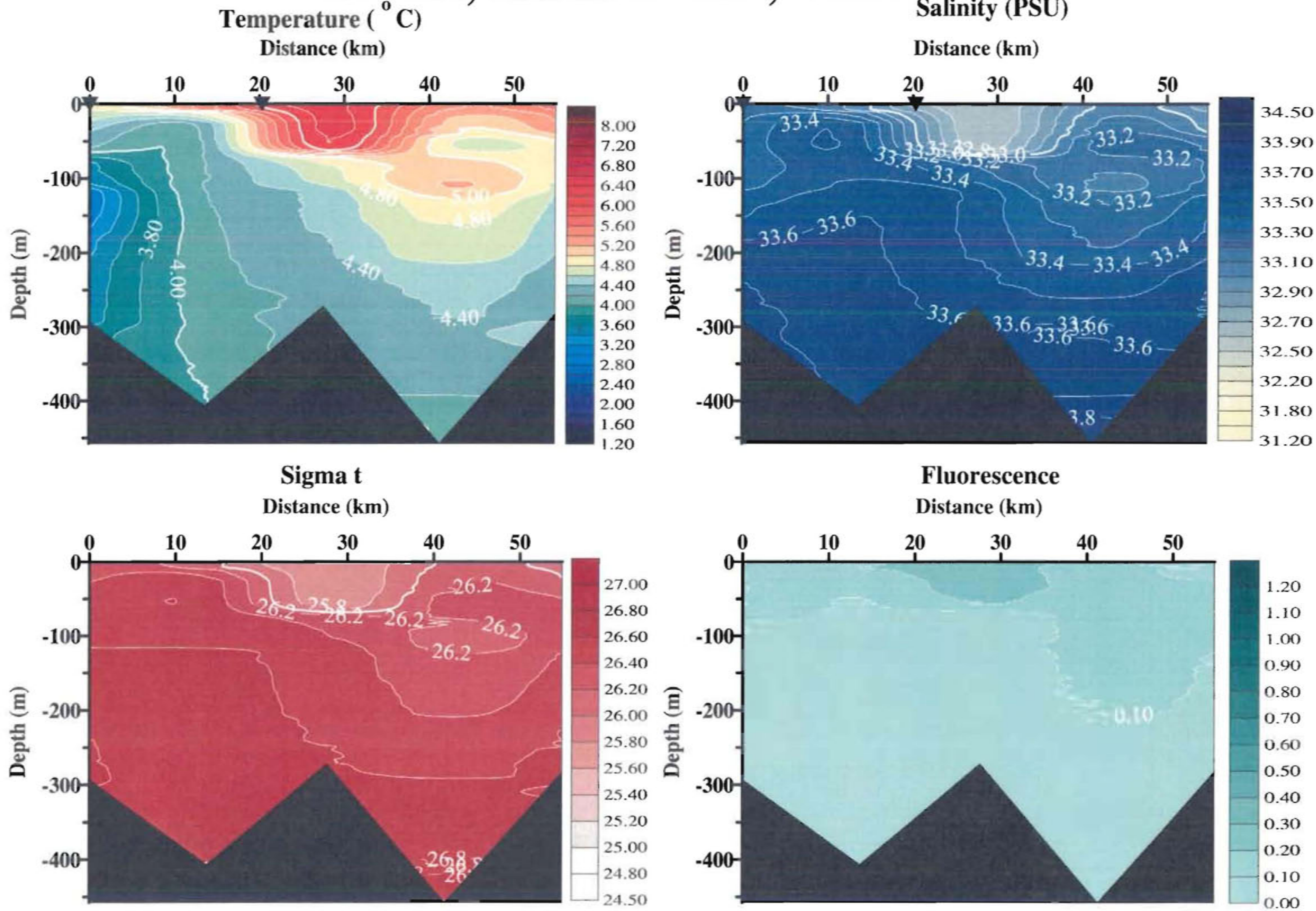


Fig. 15

HX245; First Akutan Transect, North-South

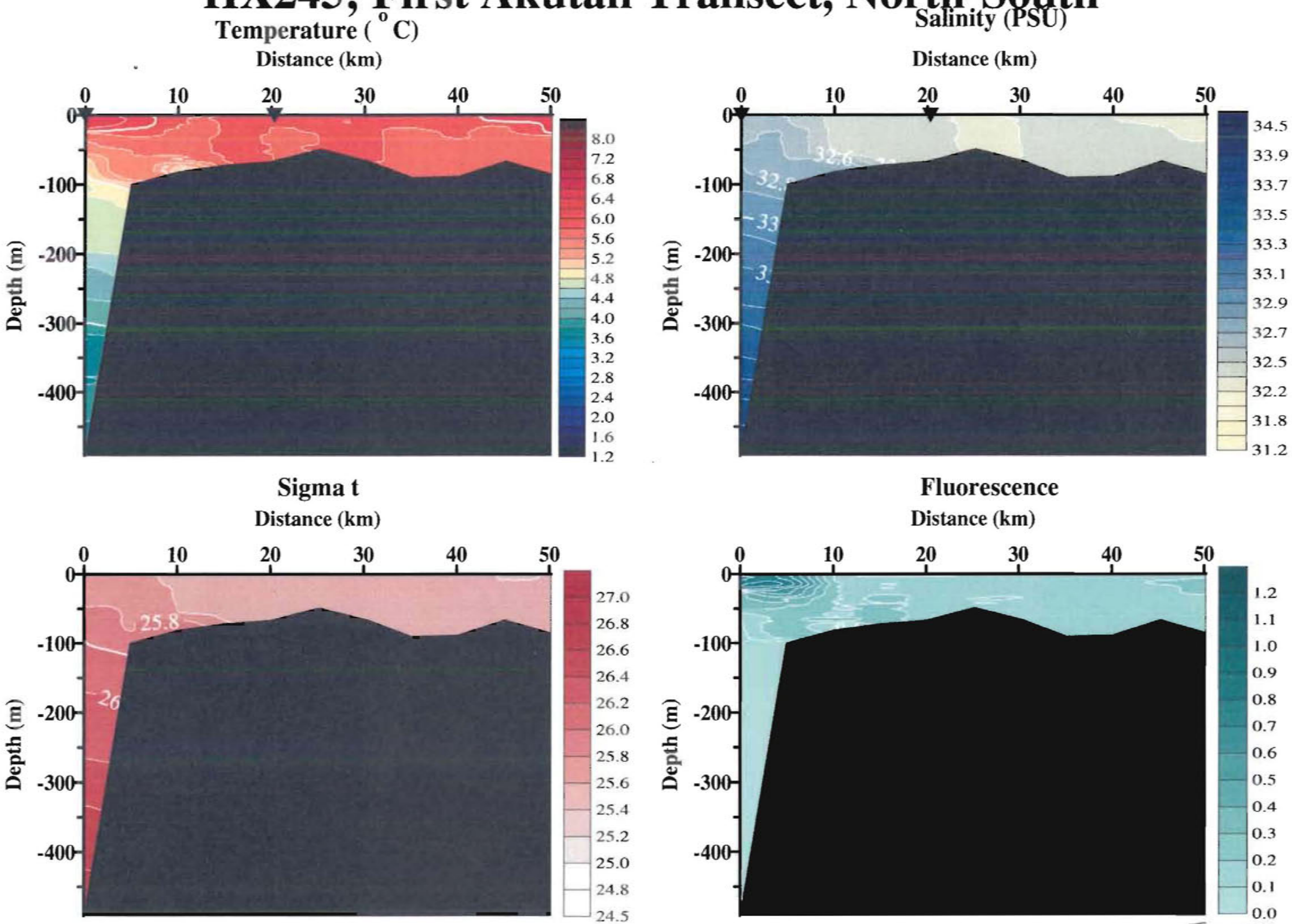


Fig. 16

HX245; Akutan2, North-South

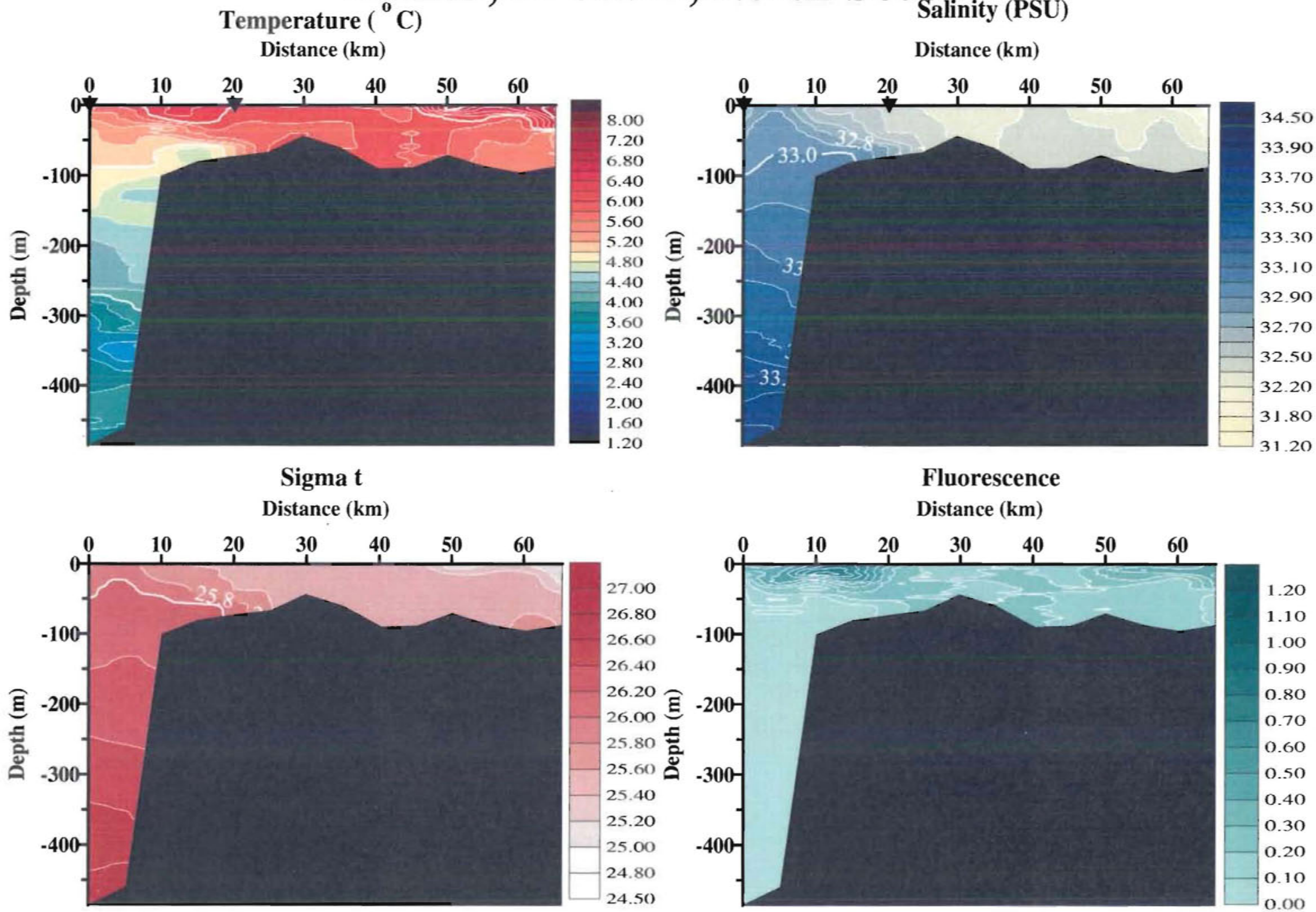


Fig. 17

HX245; Unimak Pass, North-South

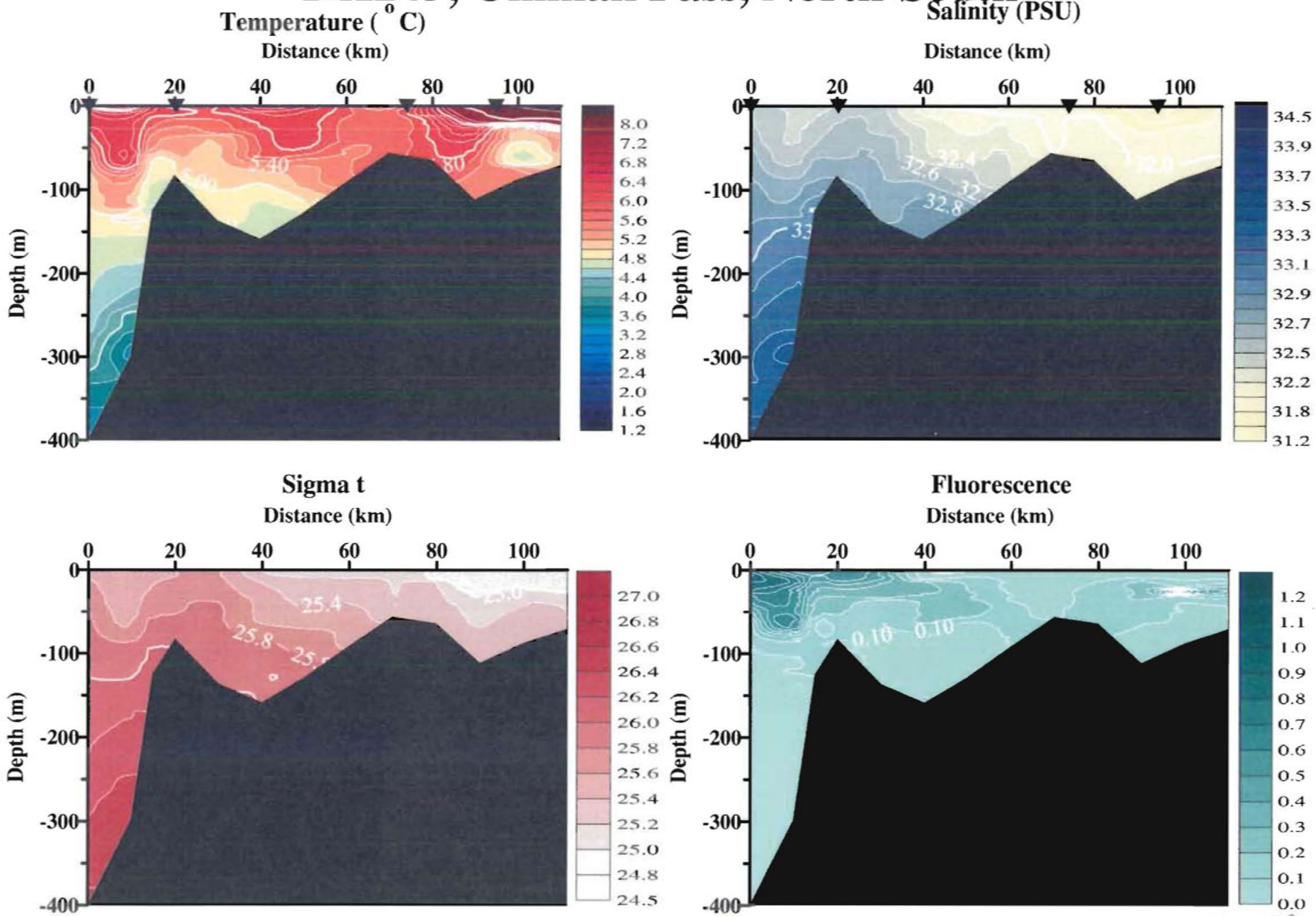


Fig.18

HX245; Shumagin Whales, North-South

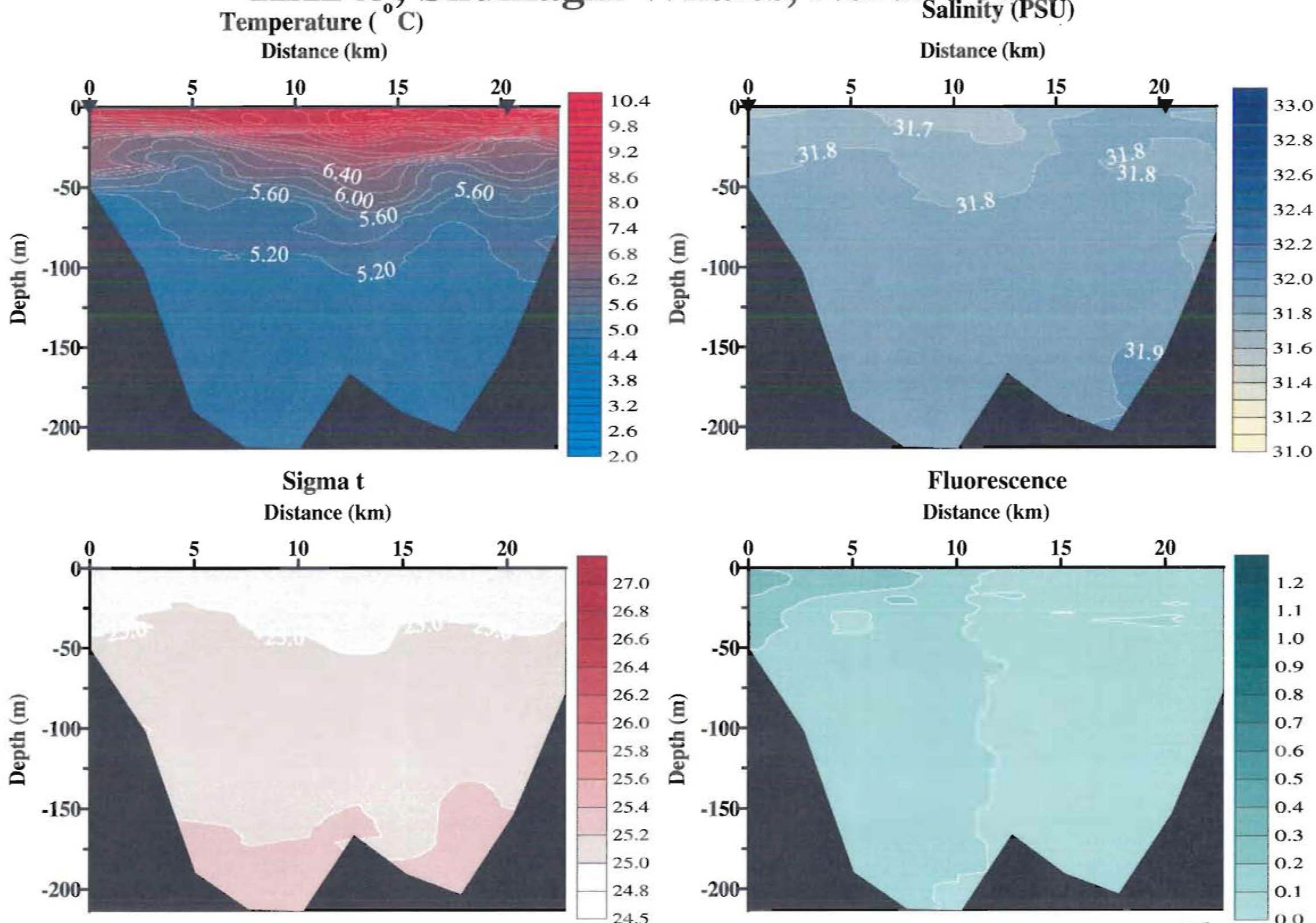


Fig. 19

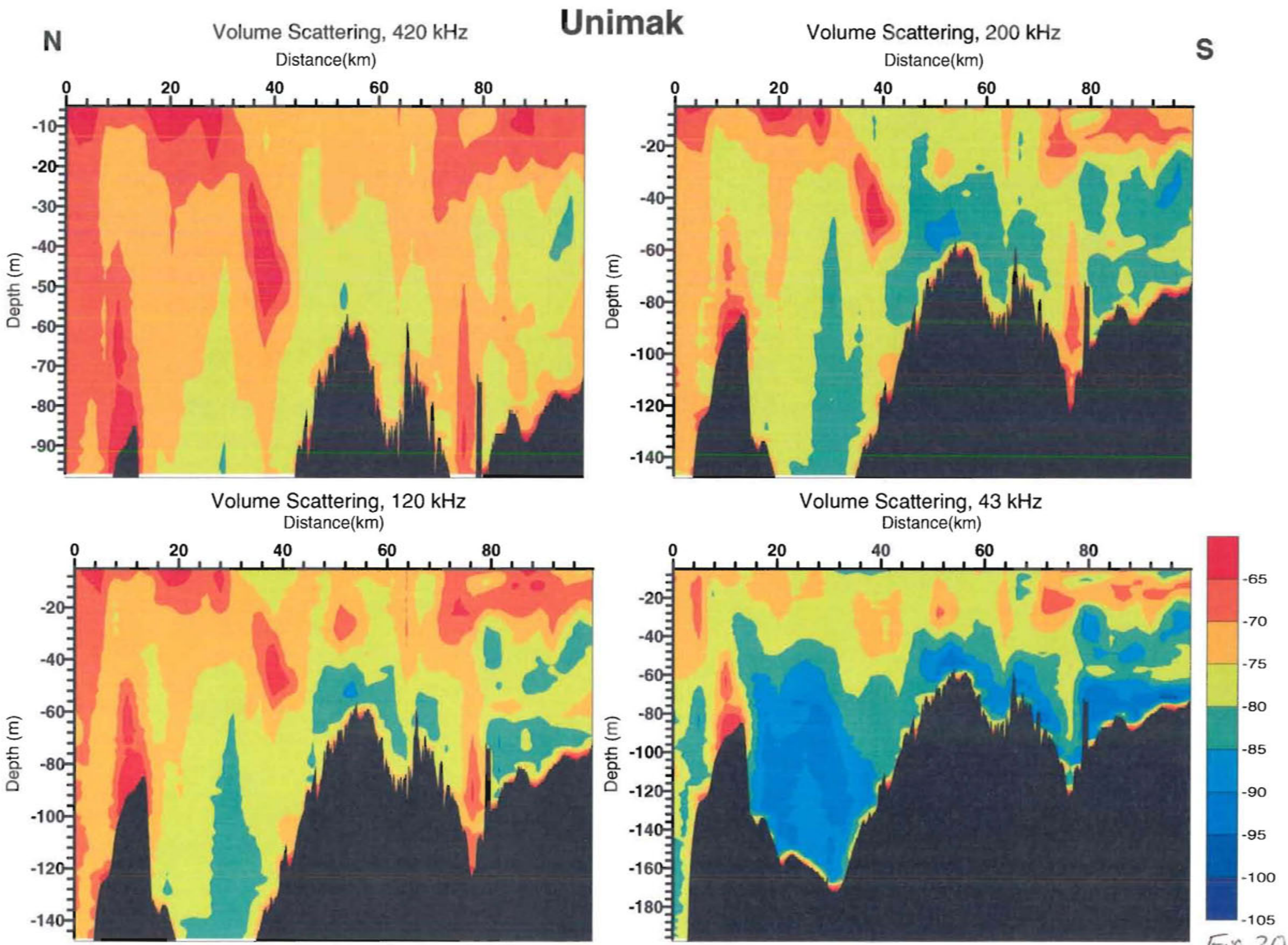

Unimak
N
S
Volume Scattering, 420 kHz
Volume Scattering, 200 kHz
Volume Scattering, 120 kHz
Volume Scattering, 43 kHz
Distance(km)
Depth (m)
-65
-70
-75
-80
-85
-90
-95
-100
-105

Fig. 20

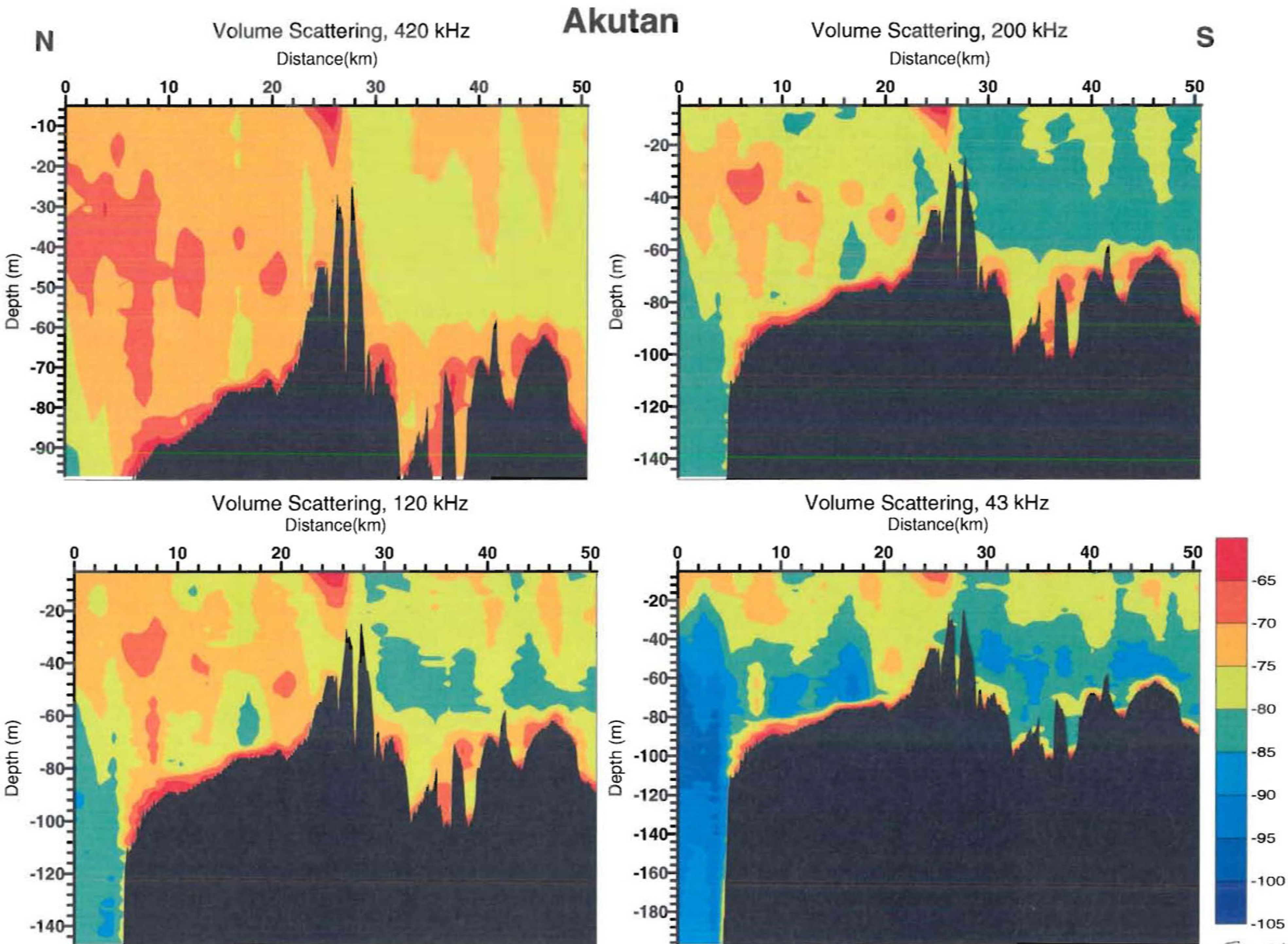

Akutan
N
S
Volume Scattering, 420 kHz
Volume Scattering, 200 kHz
Volume Scattering, 120 kHz
Volume Scattering, 43 kHz
Distance(km)
Depth (m)
-65
-70
-75
-80
-85
-90
-95
-100
-105

Fig. 21

Seguam

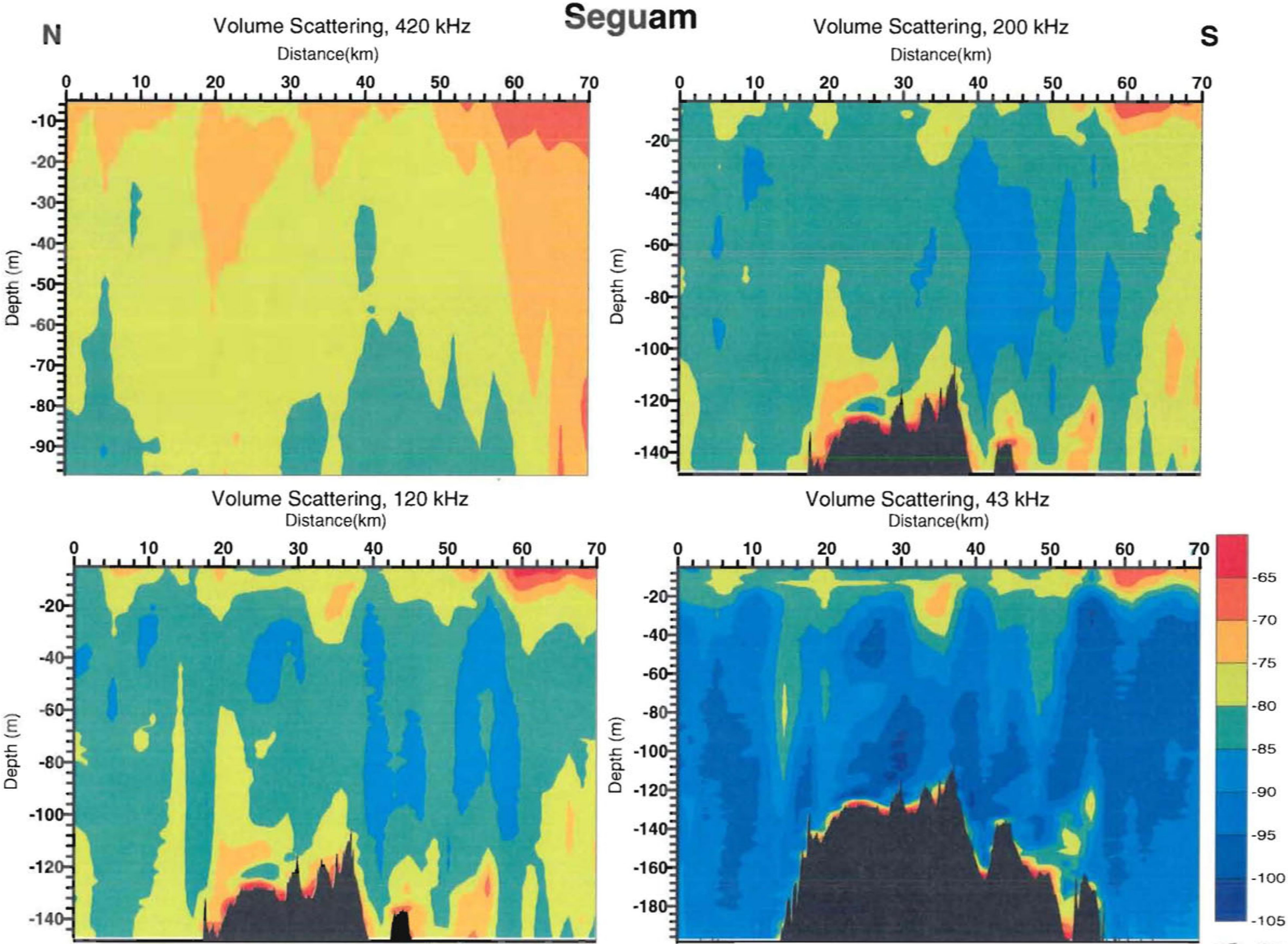


Fig. 22

Abundance of birds along the Aleutian Islands (June, 2001)

(only birds feeding and sitting on the water)

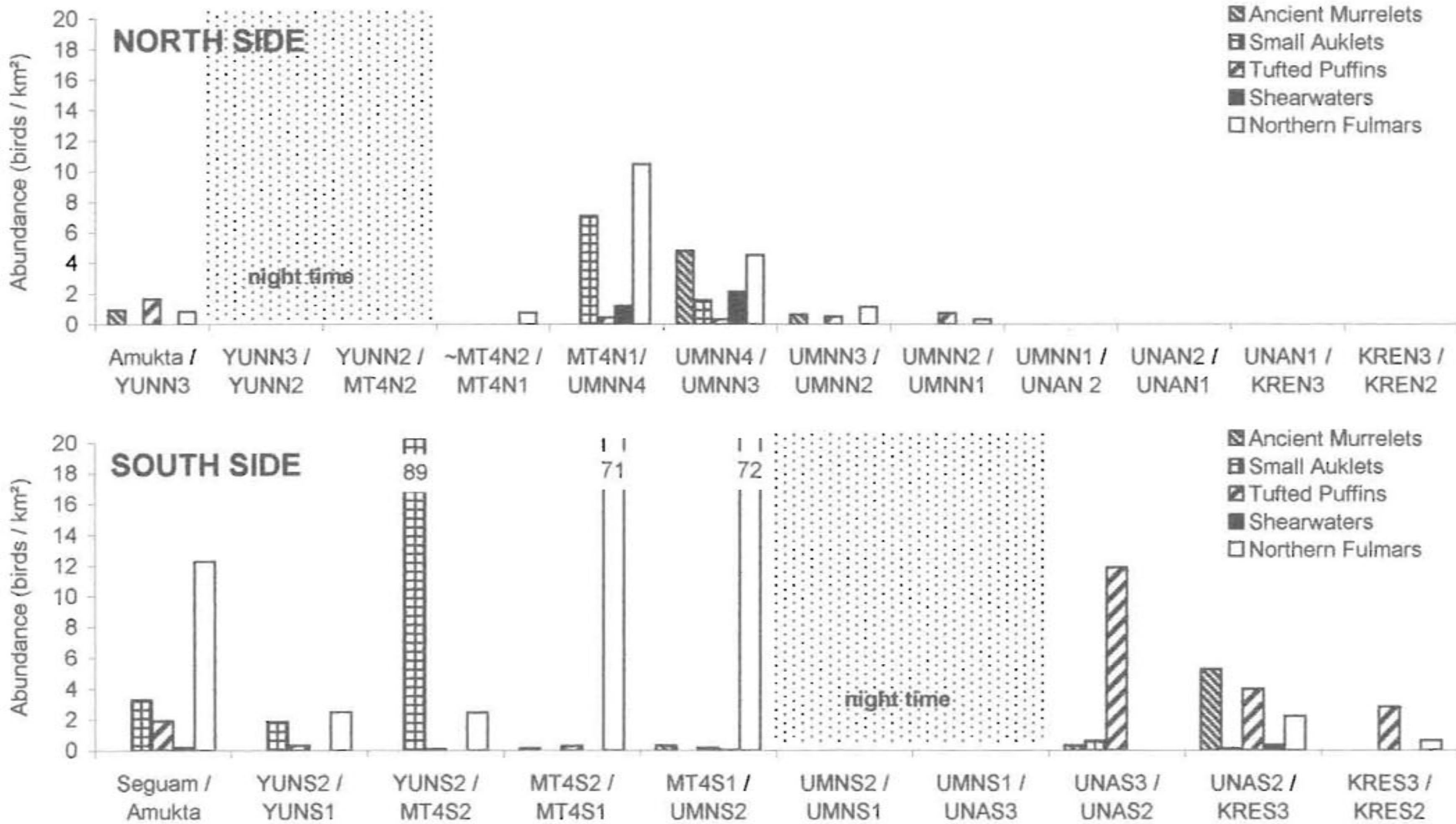


Fig. 23

Abundance of birds along the Unimak Pass Y-line transect (June 18, 2001)

(only birds feeding and sitting on the water)

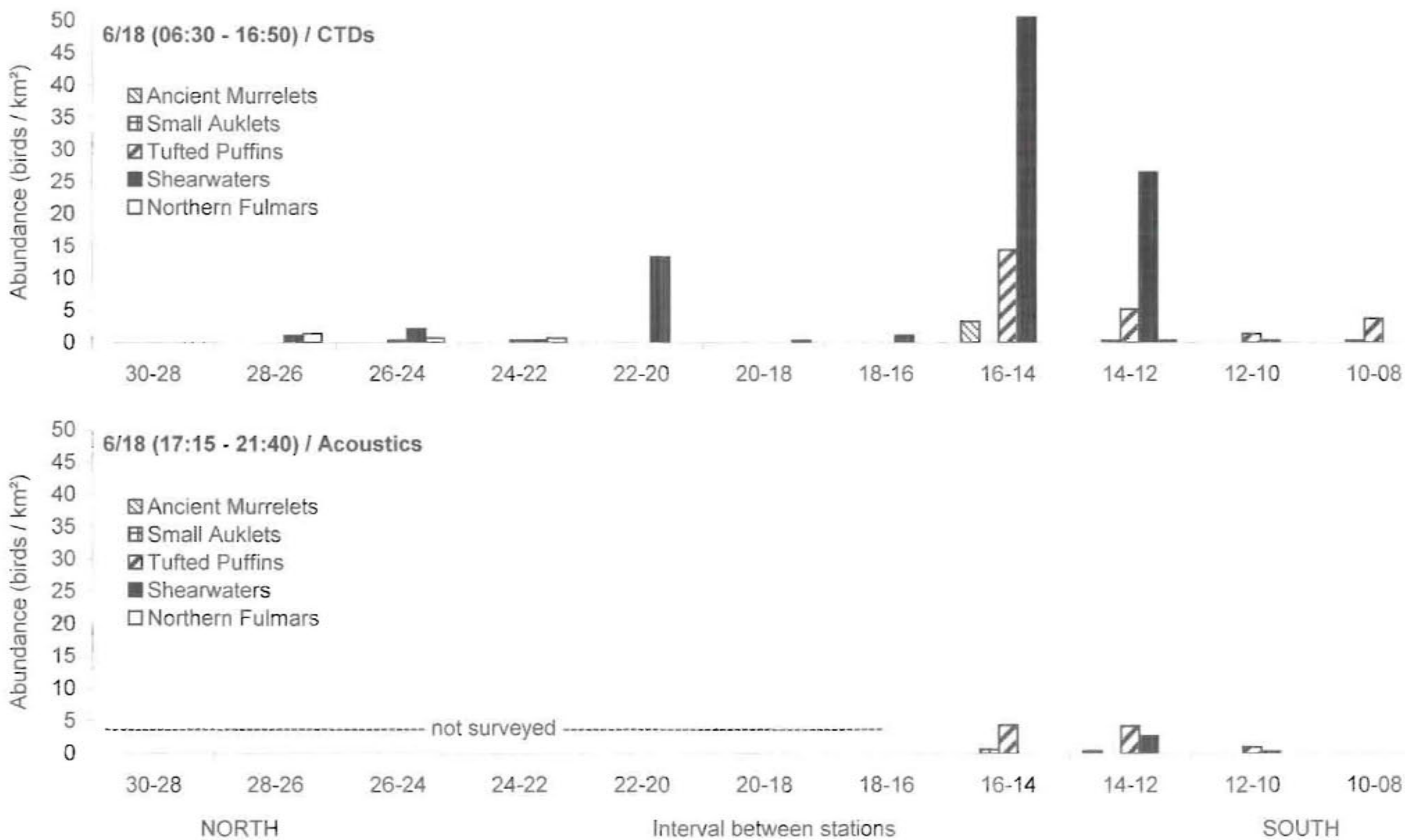


Fig. 24

Abundance of birds along the Akutan Pass Y-line transect (June 14-15, 2001)

(only birds feeding and sitting on the water)

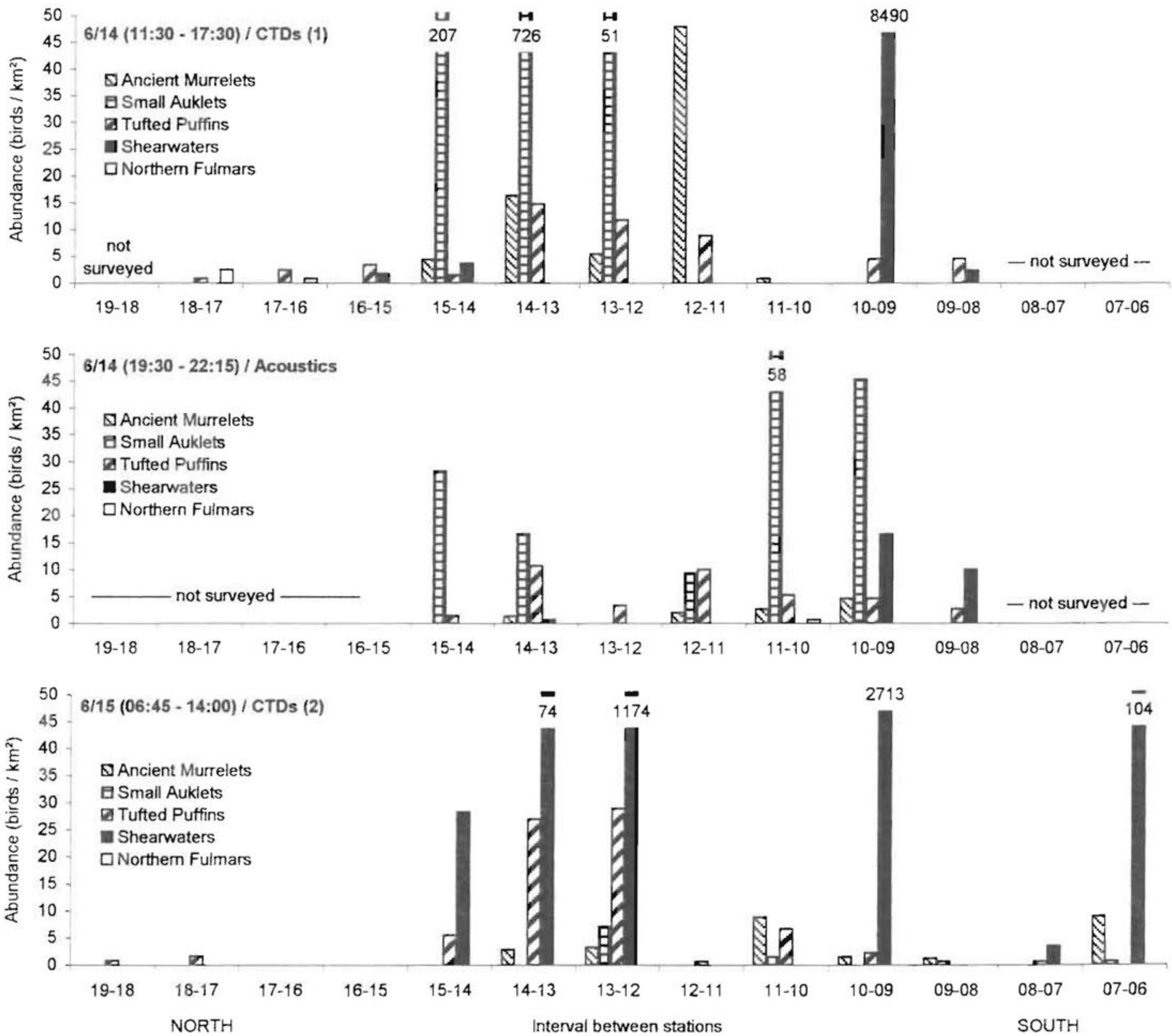


Fig. 2

Abundance of birds along the Amukta Pass Y-line transect (June 12, 2001)

(only birds feeding and sitting on the water)

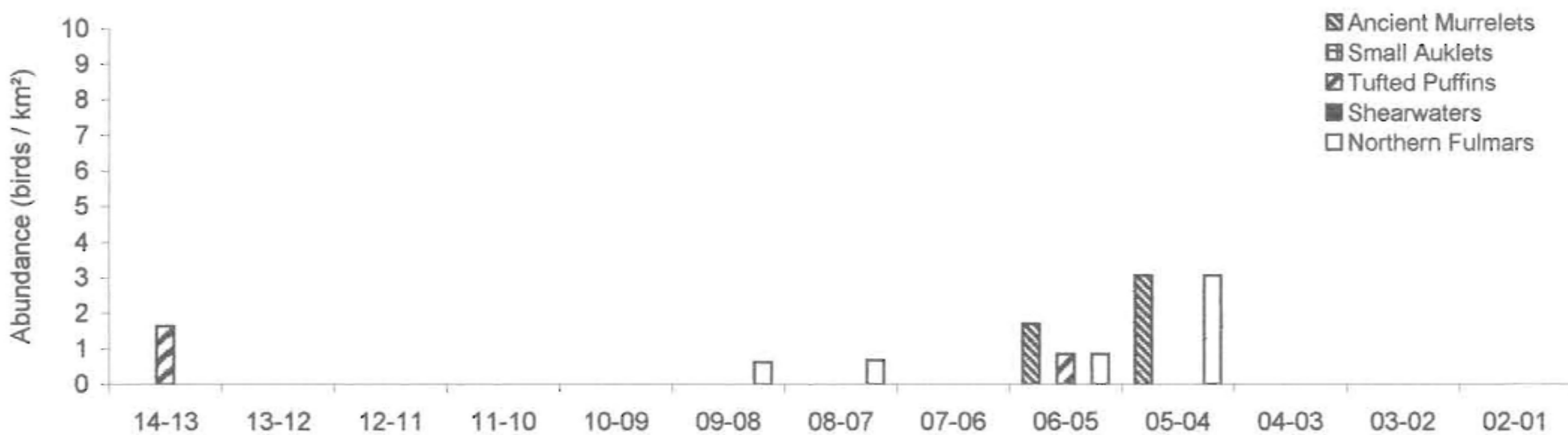


Fig. 26

Abundance of birds along the Seguam Pass Y-line transect (June 10-11, 2001)

(only birds feeding and sitting on the water)

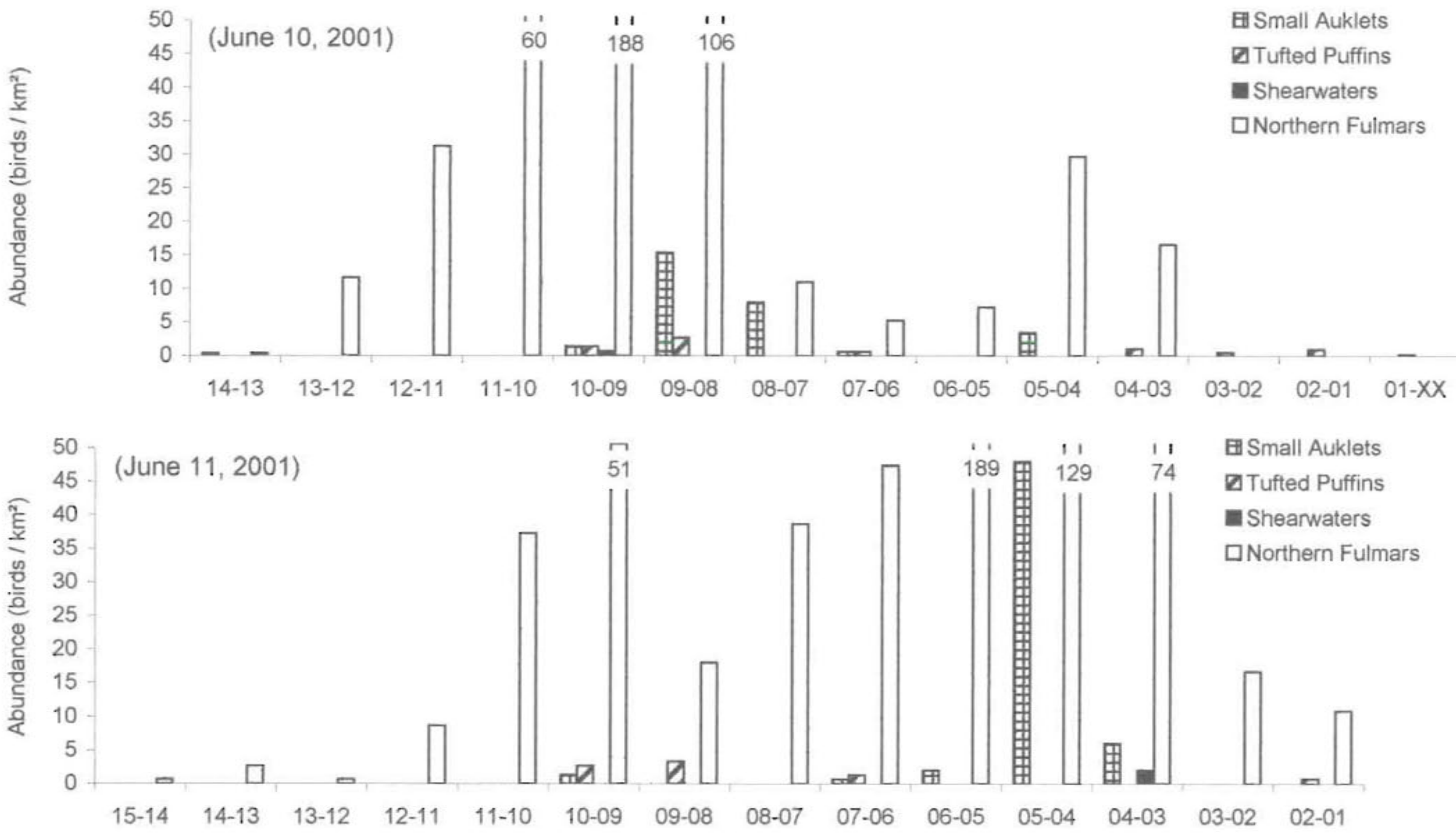


Fig. 27

HX245 Marine Mammal On Effort Transects

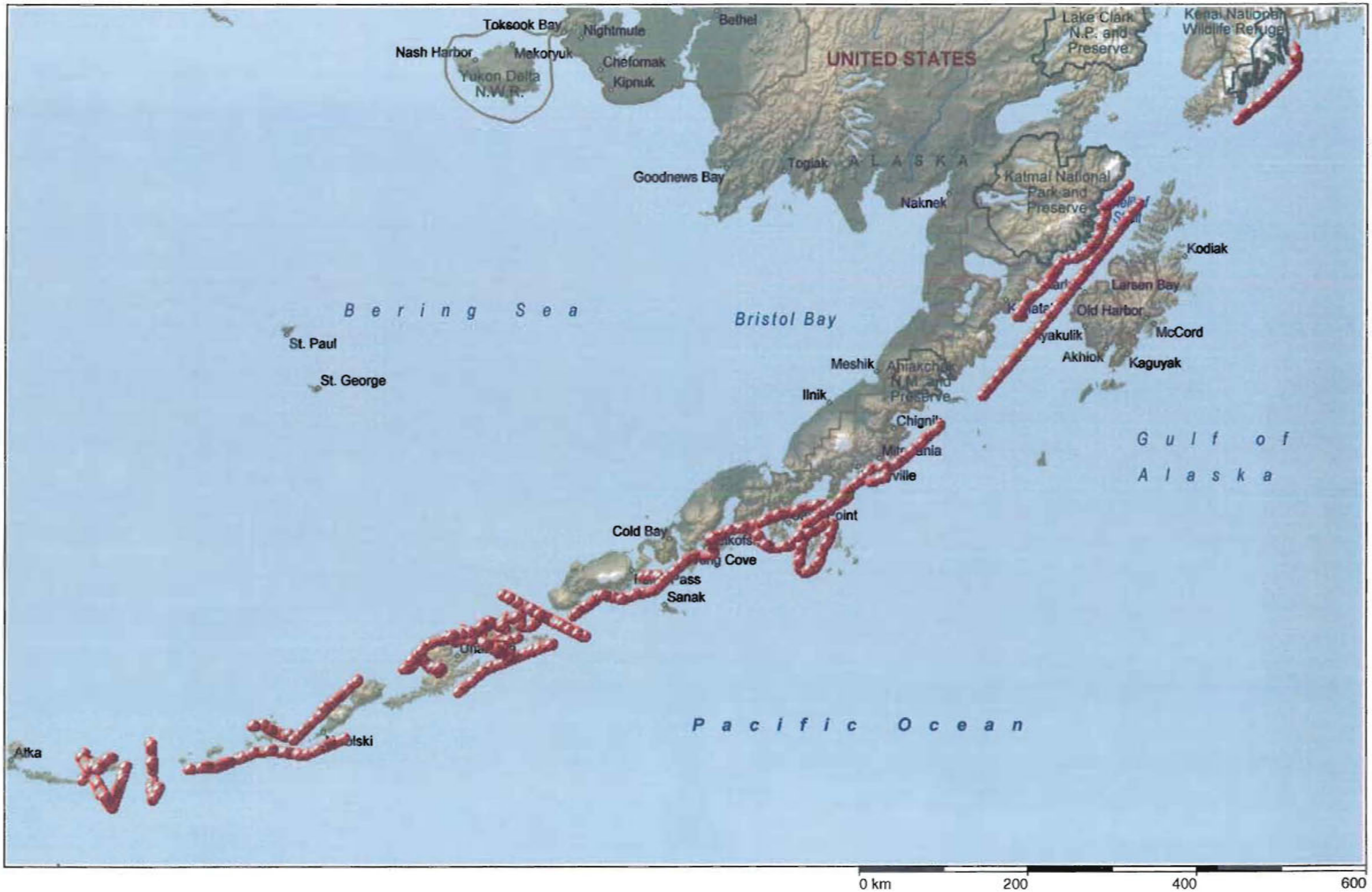


Fig. 28

HX245 Marine Mammal On Effort Sightings

Pushpins
- killer_whale
- sperm_whale
- humpback_whale
- Fin Whale
- Dalls Porpoise

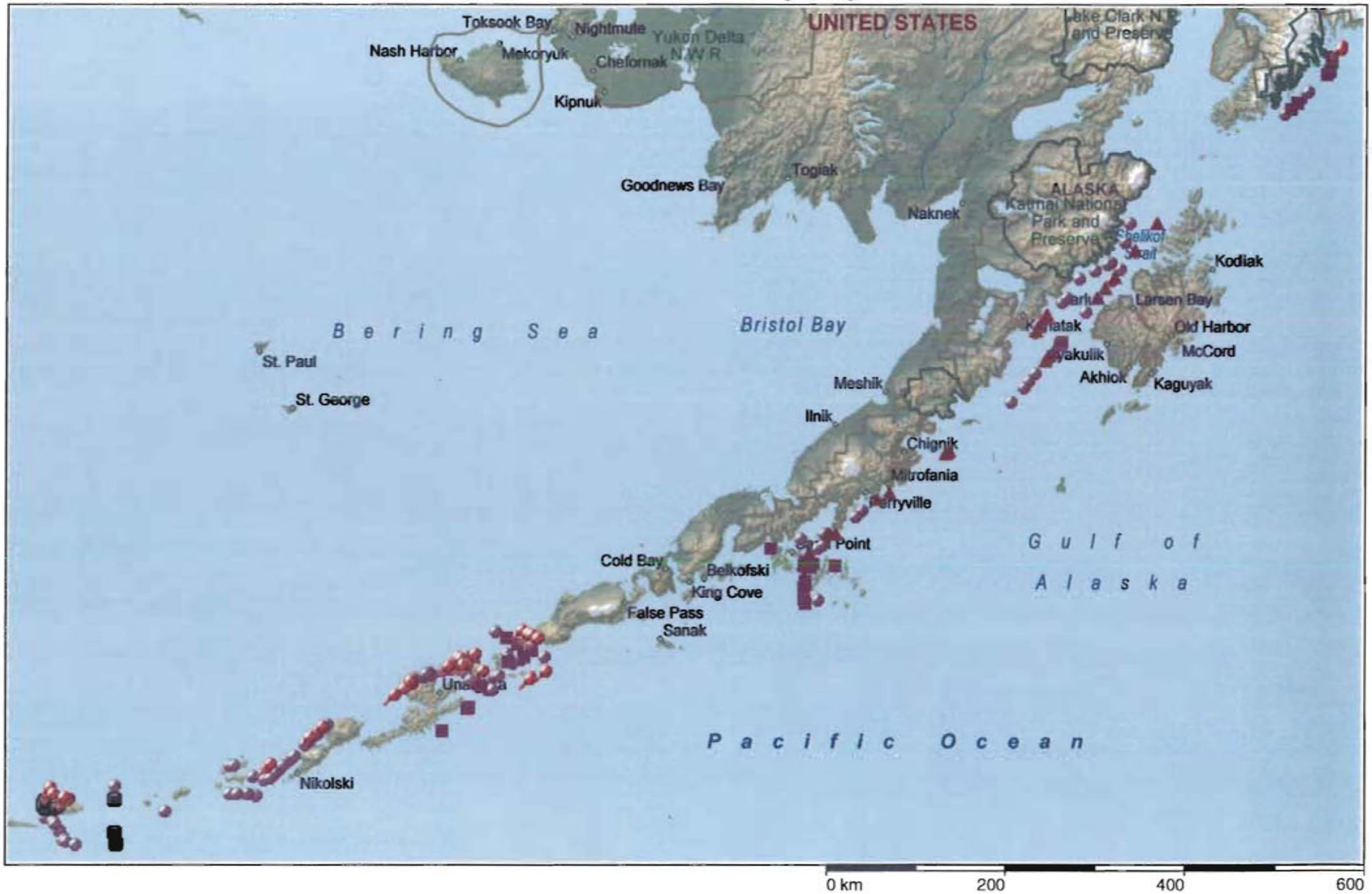


Fig. 29

HX245 Marine Mammal On Effort Shelikof Strait

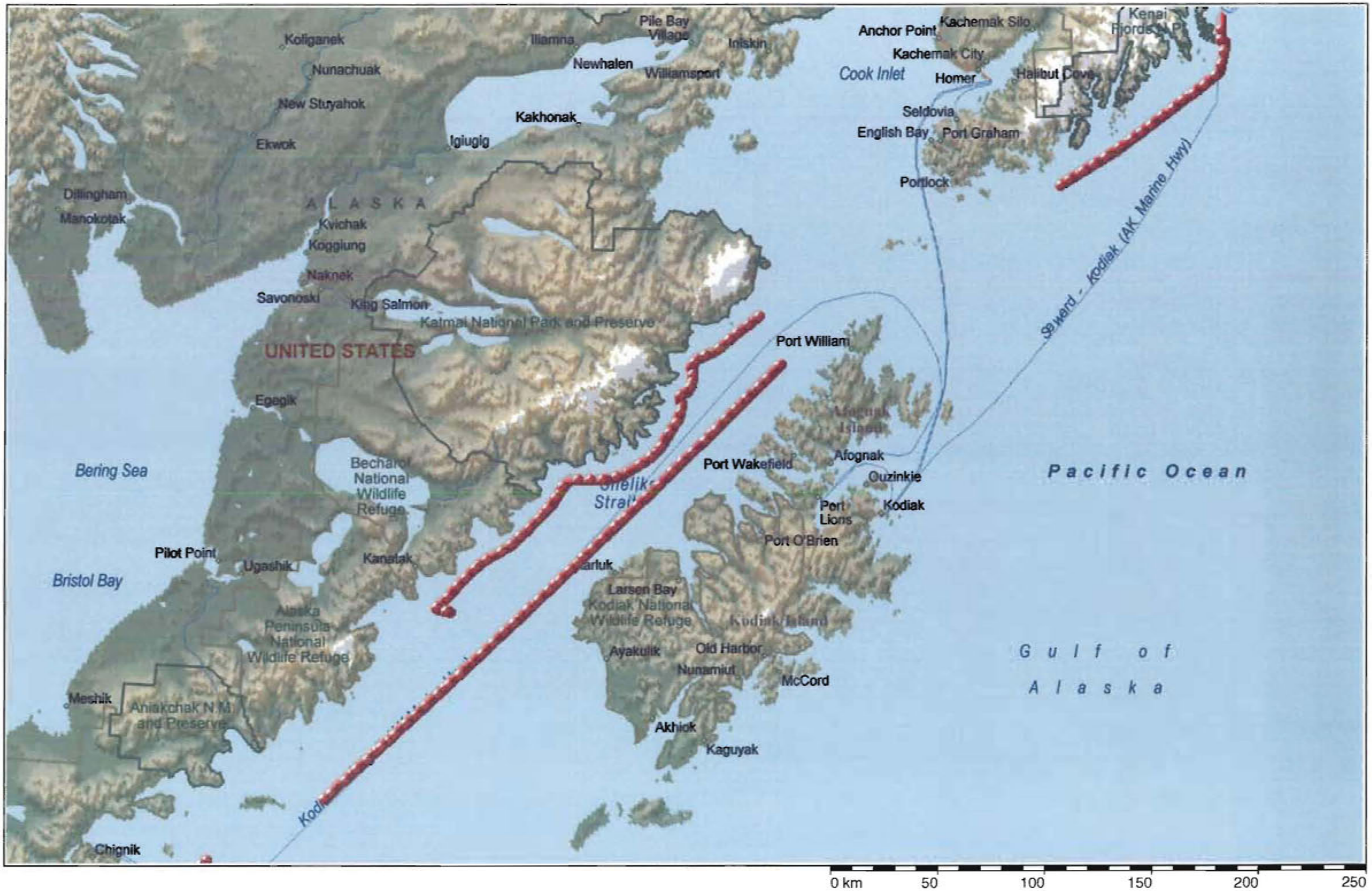


Fig. 30

HX245 Marine Mammal On Effort Shelikof Strait

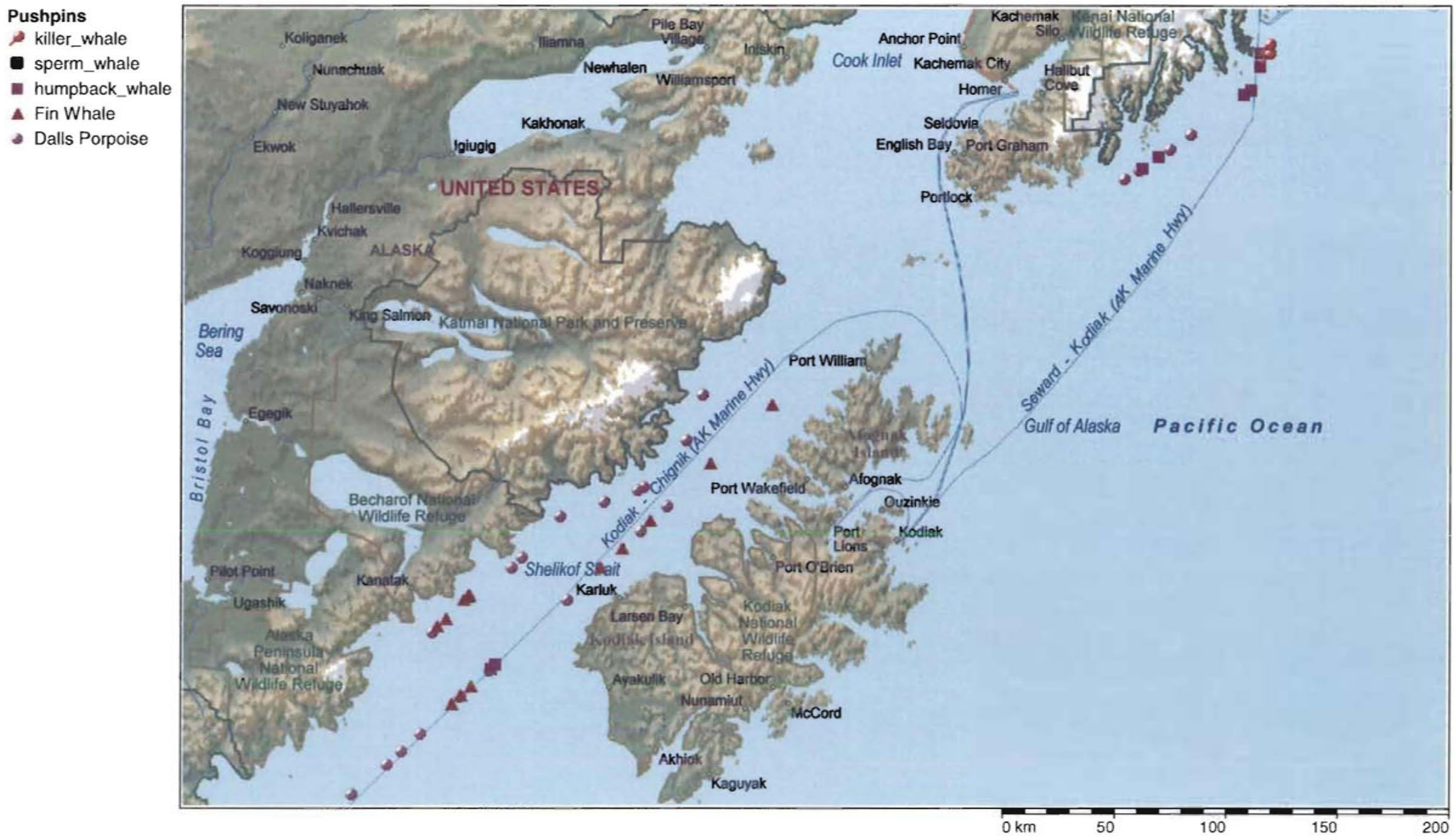


Fig. 31

HX245 Marine Mammal On Effort Alaska Peninsula

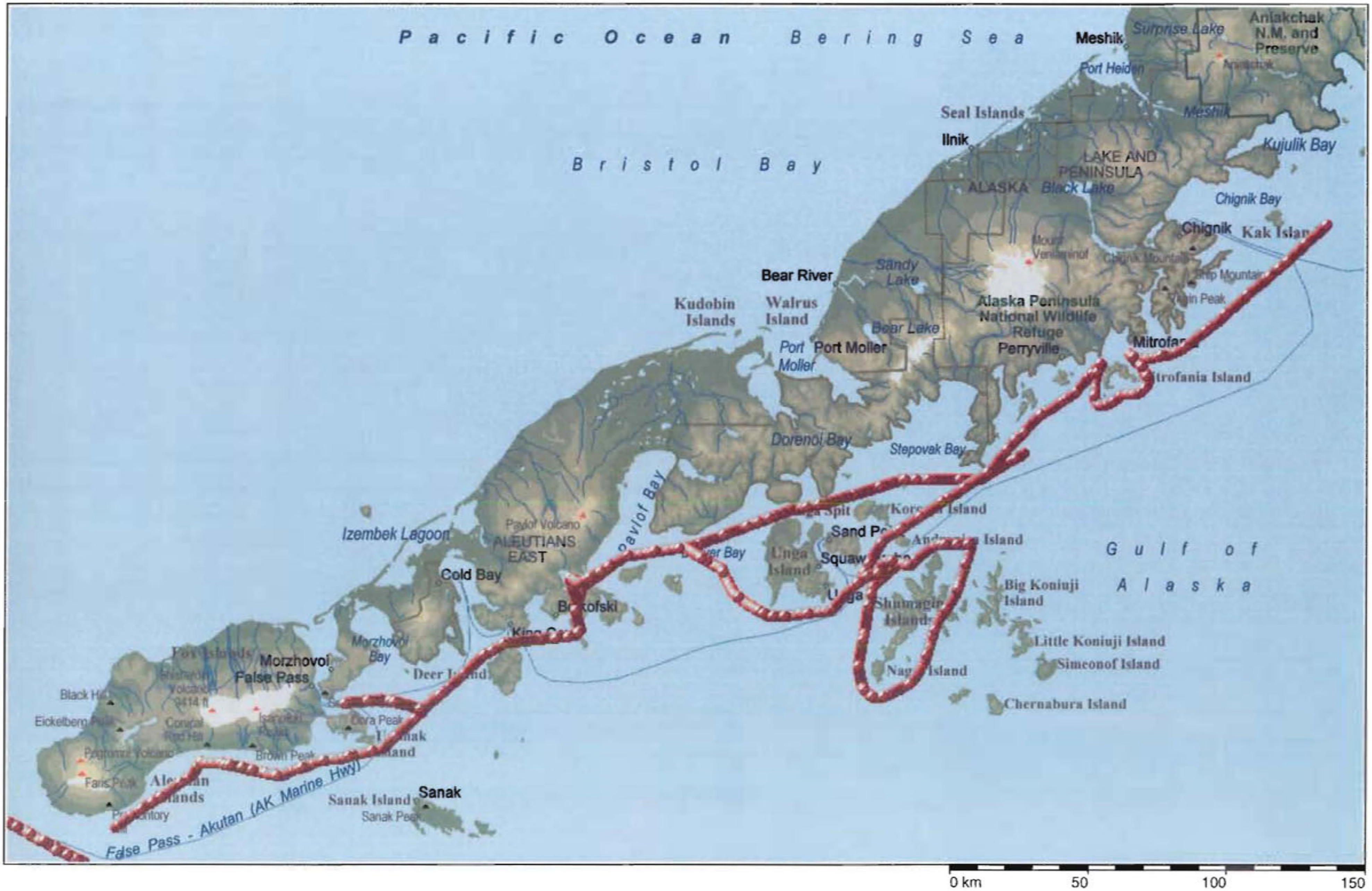


Fig. 32

HX245 Marine Mammal On Effort Sightings   Alaska Peninsula

Pushpins
- killer_whale
- sperm_whale
- humpback_whale
- Fin Whale
- Dalls Porpoise

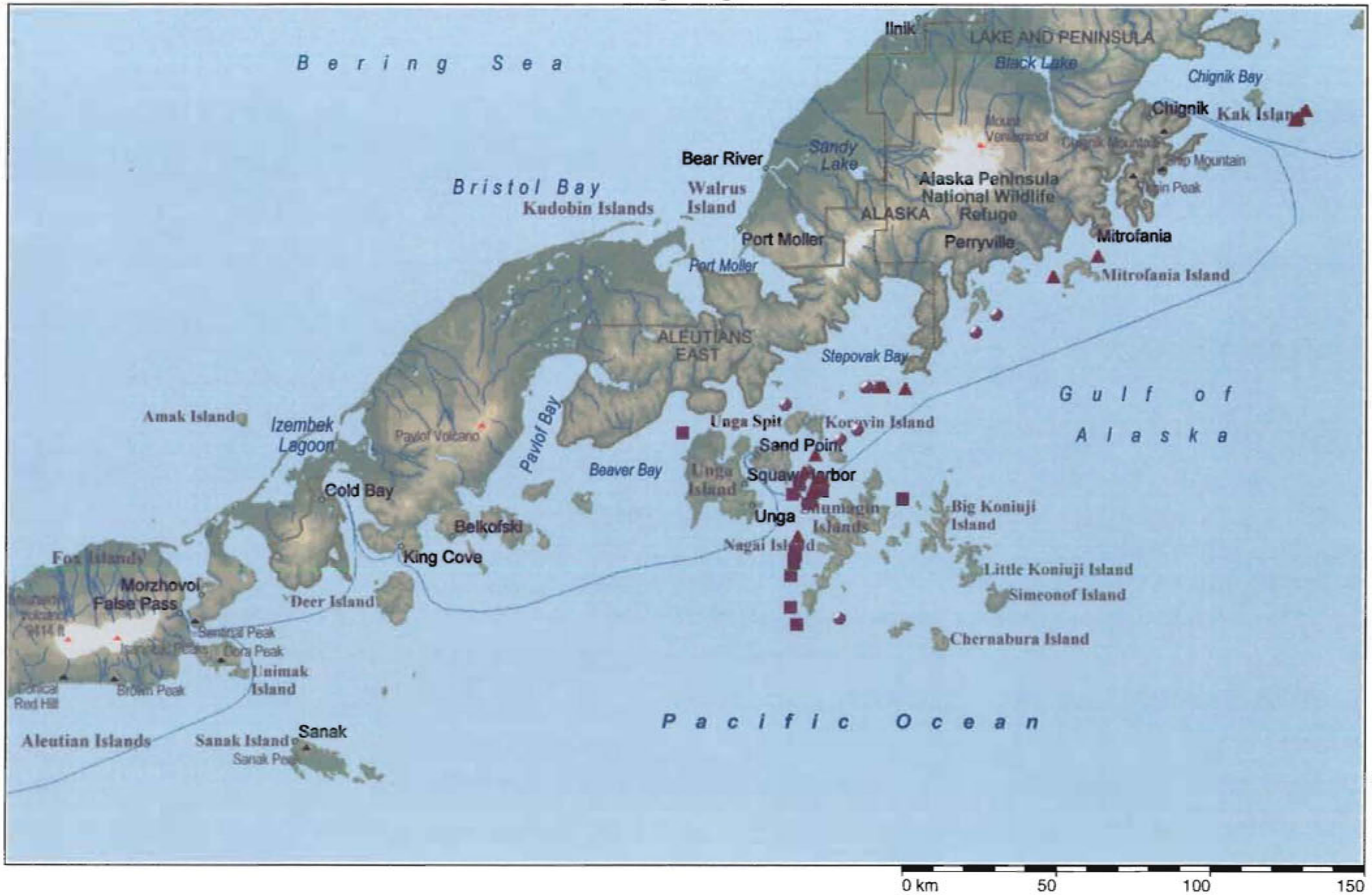


Fig. 33

HX245 Marine Mammal On Effort Unalaska Island & Akutan-Unimak Passes

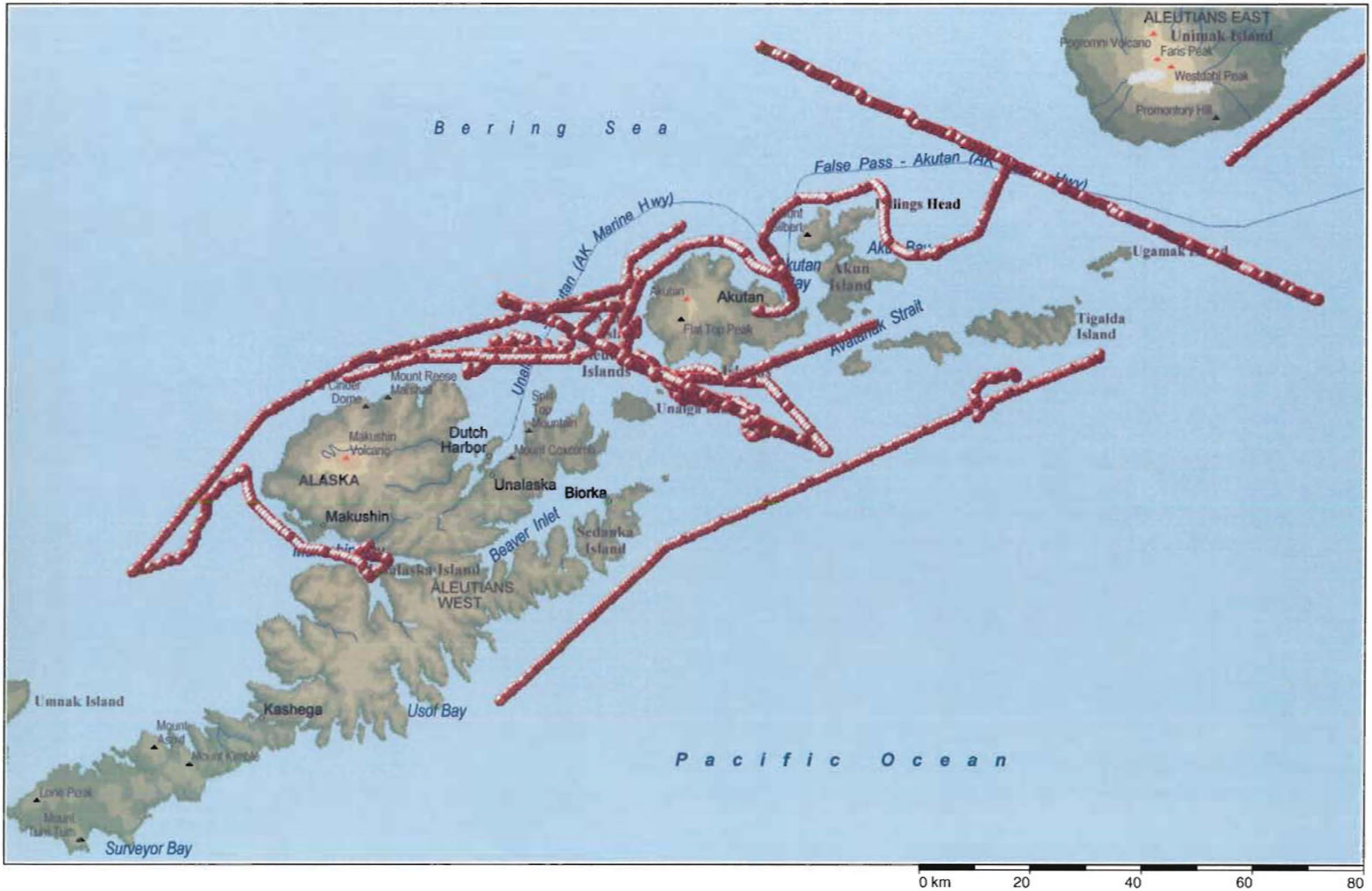


Fig. 34

HX245 Marine Mammal On Effort Sightings   Unalaska Is & Unimak Pass

Pushpins
- killer_whale
- sperm_whale
- humpback_whale
- Fin Whale
- Dalls Porpoise

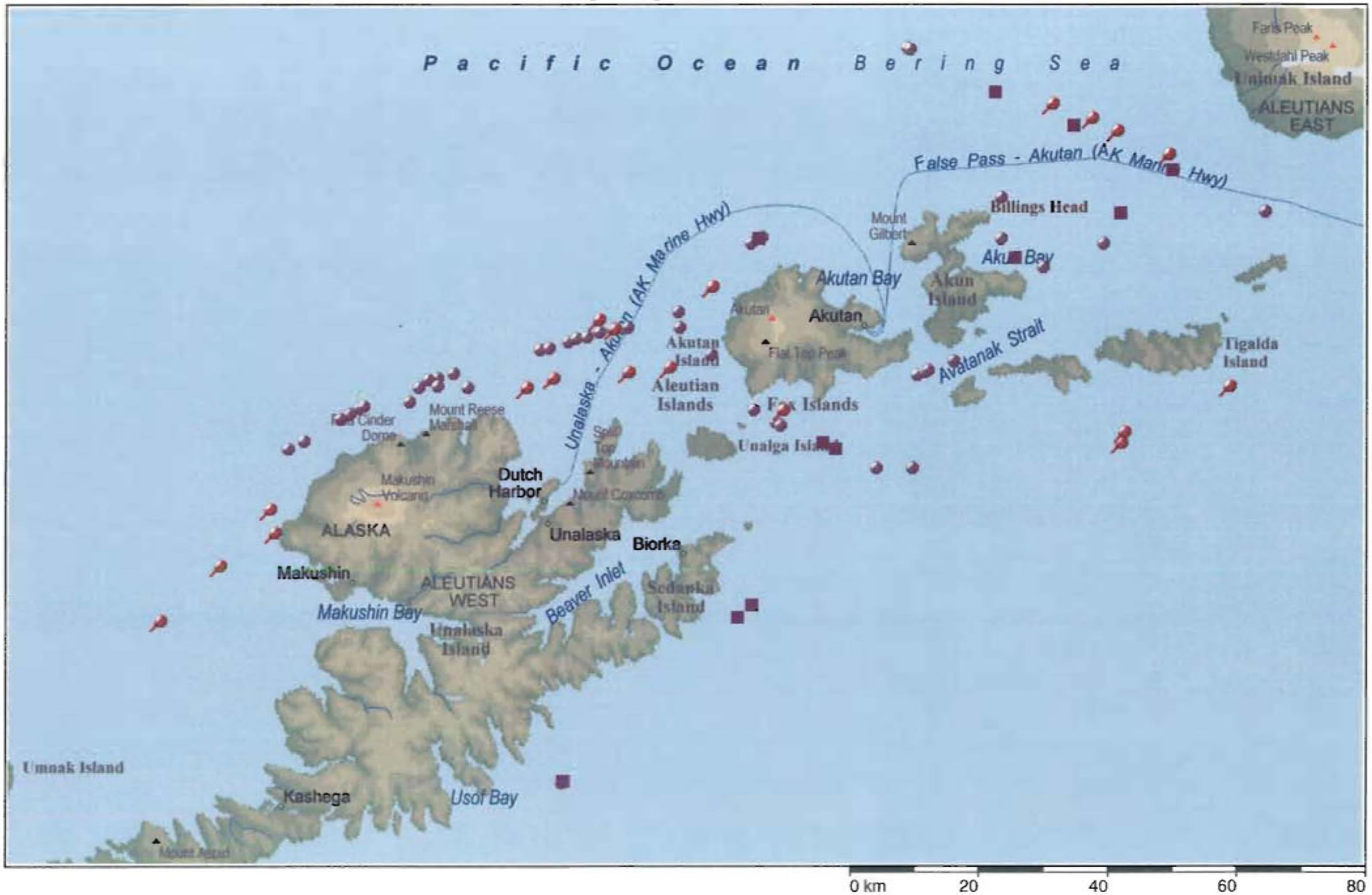


Fig. 35

HX245 Marine Mammal On Effort Island of Four Mountains

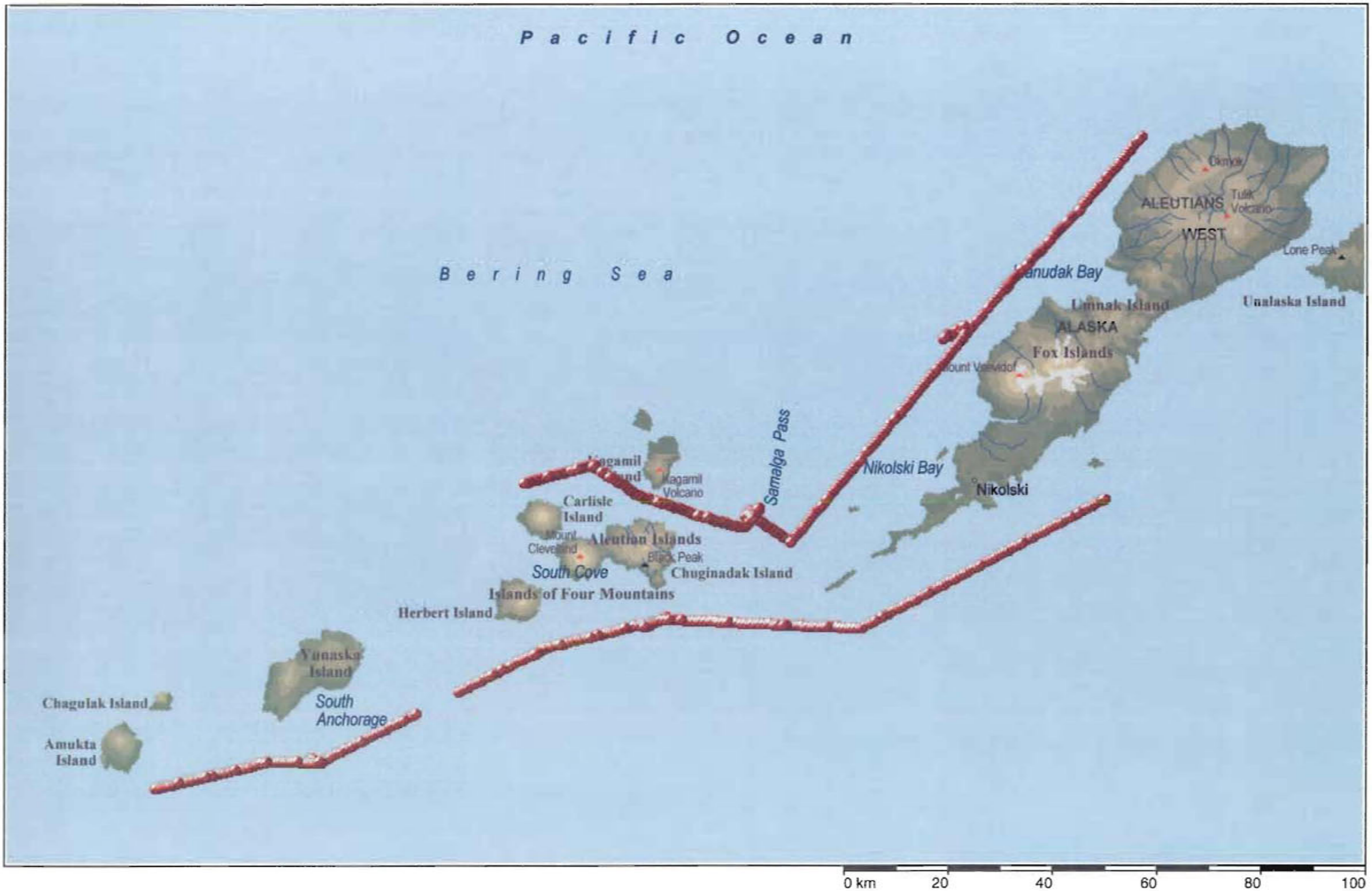


Fig. 36

HX245 Marine Mammal On Effort Sightings   Islands of Four Mountains

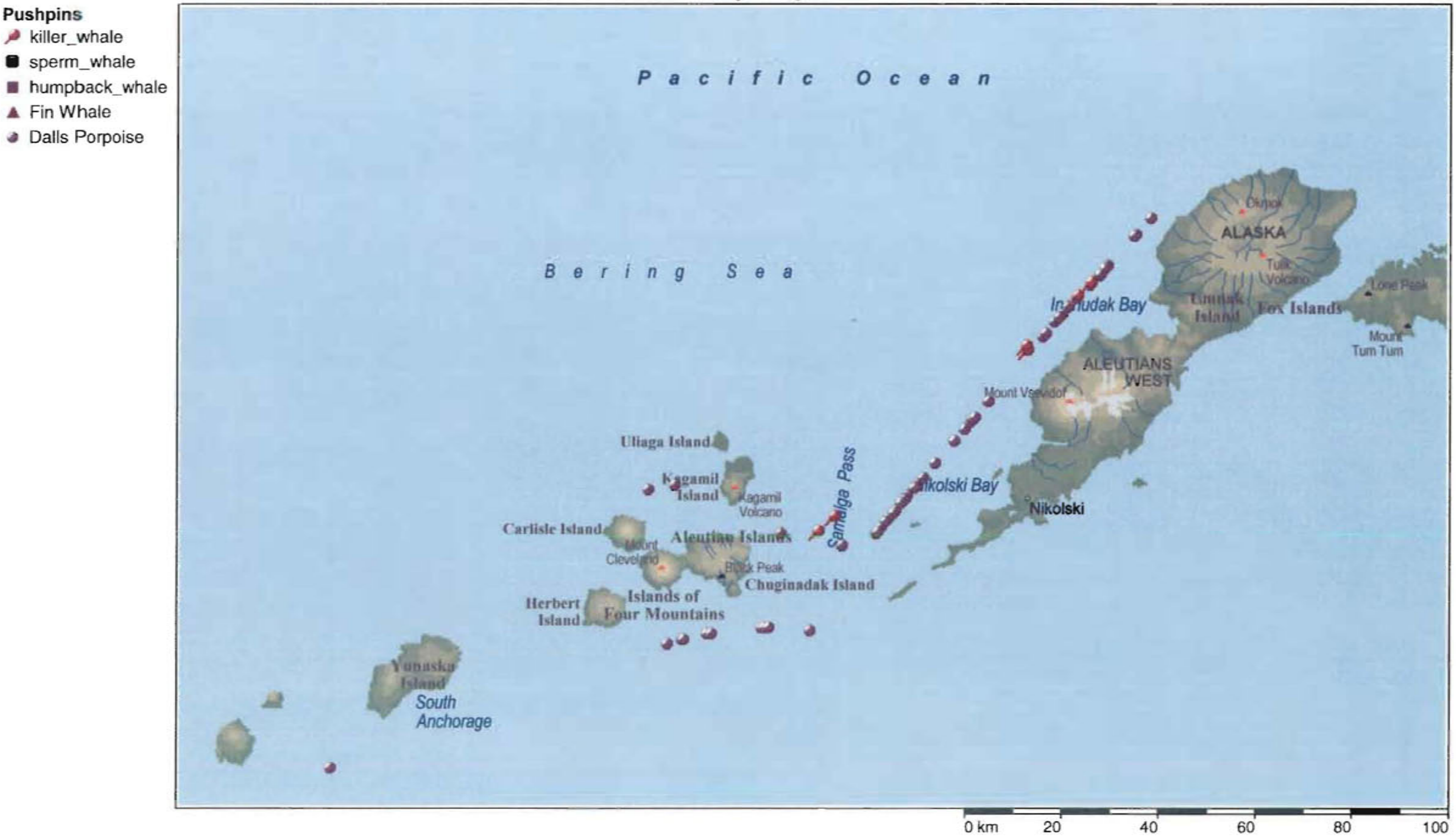


Fig. 37

HX245 Marine Mammal On Effort Seguam and Amukta Passes

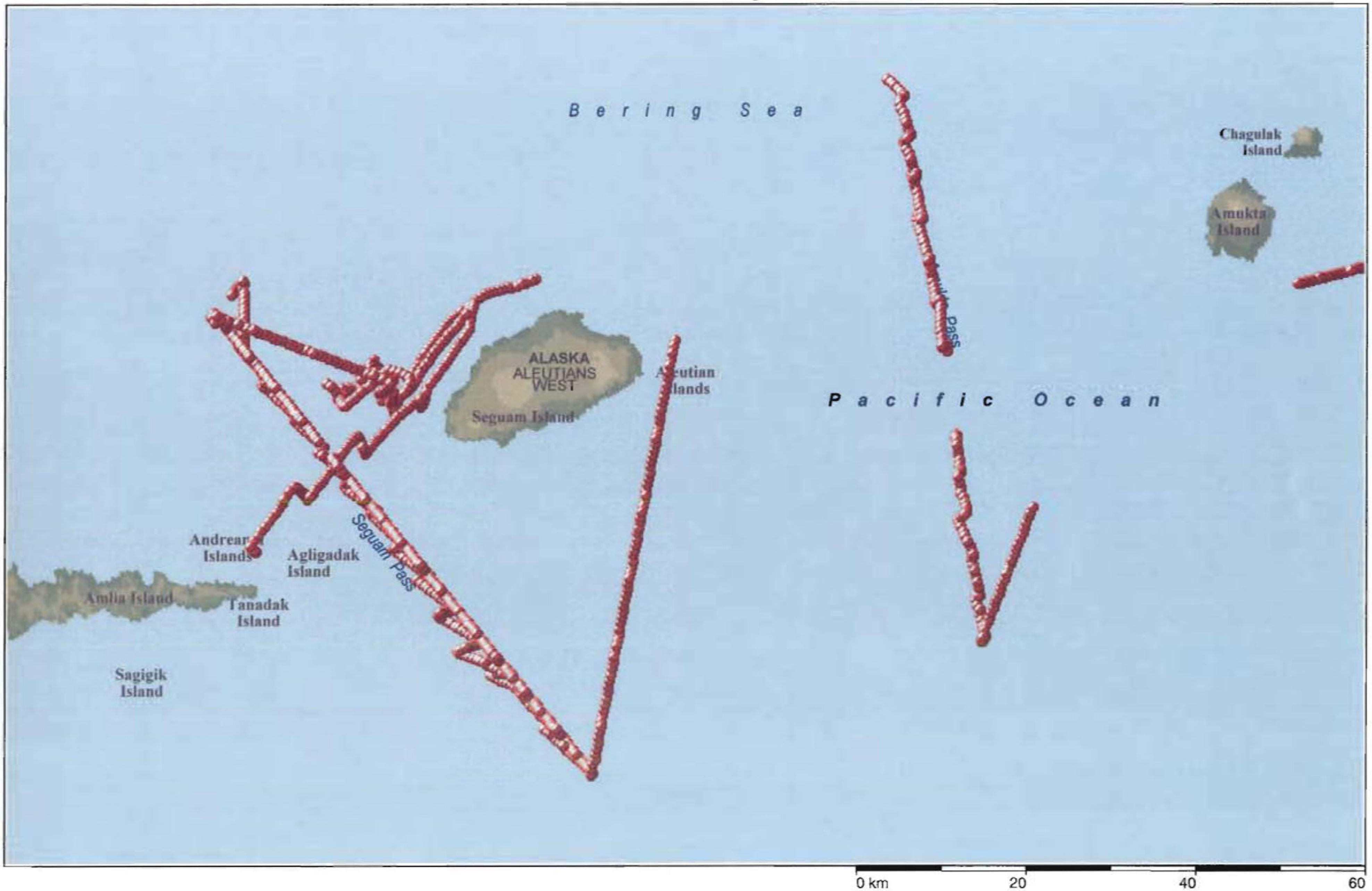


Fig. 38

HX245 Marine Mammal On Effort Sightings   Seguam & Amukta Passes

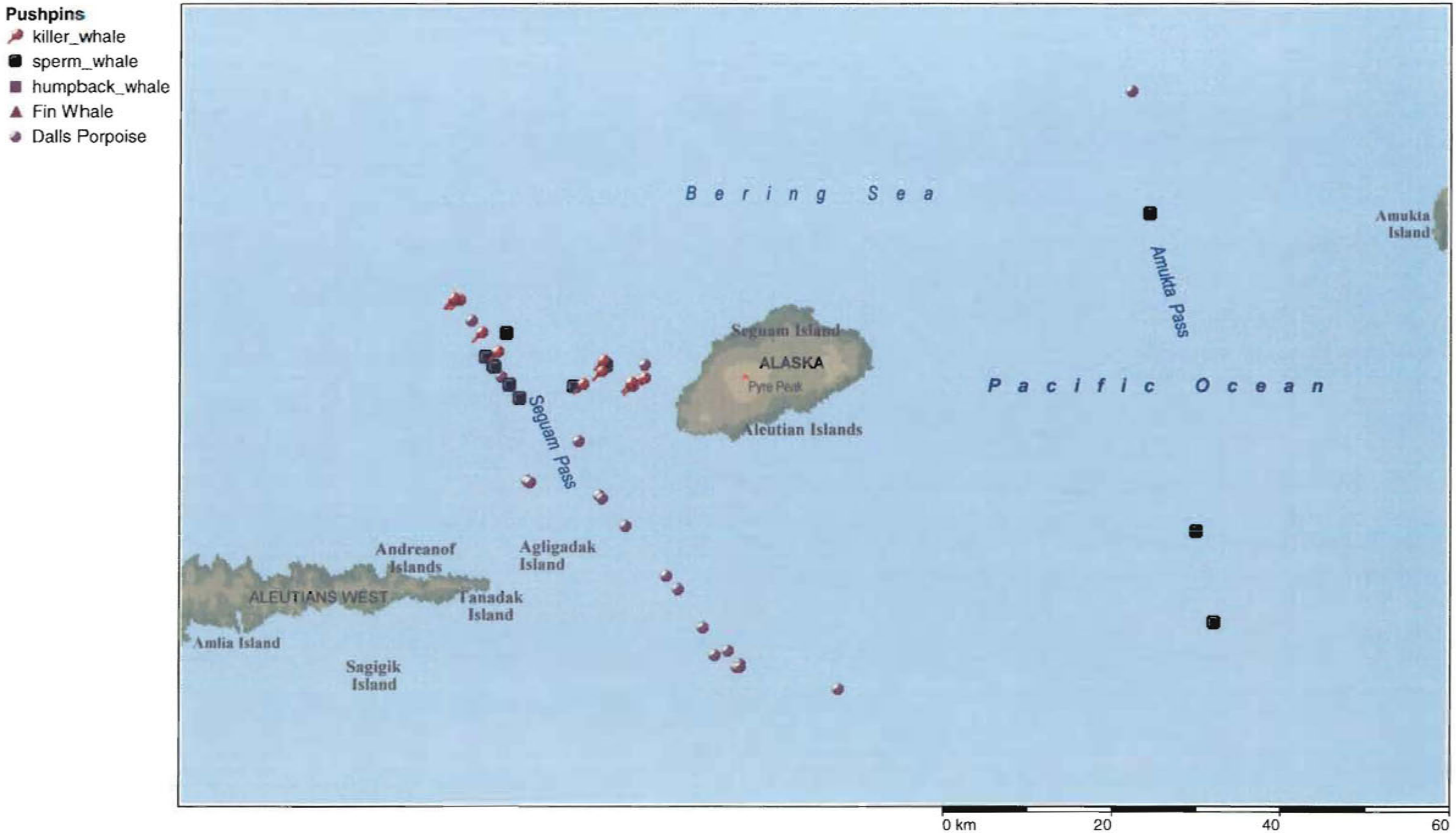


Fig. 39