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Marine Mammal Protection Act and Endangered Species Act Implementation Program 2001

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Annual Reports of research carried out on the population biology of marine mammals by the National Marine Mammal Laboratory to meet the 1994 amendments to the Marine Mammal Protection Act and the Endangered Species Act

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Preface

Beginning in 1991, the National Marine Mammal Laboratory (NMML) has been partially funded by the National Marine Fisheries Service's (NMFS) Office of Protected Resources to determine the abundance of selected species in U.S. waters of the eastern North Pacific Ocean. On 30 April 1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act (MMPA). Interactions between marine mammals and commercial fisheries are addressed under three new Sections. This new regime replaced the interim exemption that had regulated fisheries-related incidental takes since 1988. The 1994 MMPA amendments continue NMFS' responsibility to carry out population studies to determine the abundance, distribution and stock identification of marine mammal species that might be impacted by human-related or natural causes.

The following report, containing five papers, is a compilation of studies carried out with fiscal year 2001 (FY01) funding as part of the NMFS MMPA/Endangered Species Act (ESA) Implementation Program. The report contains information regarding studies conducted on beluga whales, cetaceans, harbor seals, humpback whales, and Steller sea lions.

This report does not constitute a publication and is for information only. All data herein are to be considered provisional. Further, most of the papers included in this report may be published elsewhere. Any question concerning the material contained in this document should be directed to the authors, or ourselves. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Anita L. Lopez
Sue E. Moore

MMPA/ESA Implementation Program
Report for 2001

Reporting Center: National Marine Mammal Laboratory
Alaska Fisheries Science Center

Administrative Office: Office of Protected Resources
National Marine Fisheries Service

AERIAL SURVEYS OF BELUGA IN COOK INLET, ALASKA, JUNE 2001

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Abstract

The National Marine Fisheries Service (NMFS) conducted an aerial survey of the beluga population in Cook Inlet, Alaska, during 5-12 June 2001. The 55 hour survey was flown in a twin-engine, high-wing aircraft at an altitude of 244 m (800 ft) and speed of 185 km/hr (100 kt), consistent with NMFS' annual surveys conducted each year since 1993. The flights in June 2001 included one or more surveys of coastal areas (flown 1.4 km offshore) around the entire Inlet and 1186 km of transects across the Inlet. Paired, independent observers searched on the coastal (left) side of the plane, where virtually all beluga sightings occur, while a single observer was on the right. A computer operator/data recorder was on the left side. After finding beluga groups, a series of aerial passes were made with two pairs of primary observers each making four or more counts of each group. Median counts made in optimal viewing conditions on five different days were 44-114 beluga in the Susitna Delta (between the Beluga and Little Susitna Rivers), 60-127 in Knik Arm (there appeared to be exchanges of whales between the Susitna area and Knik Arm),12-34 in Chickaloon Bay, and 0-10 in Turnagain Arm (the whales in Turnagain are thought to exchange with whales in Chickaloon). This sighting distribution has been consistent each June or July since 1996. In addition, two belugas were found in Kachemak Bay, an area where belugas have not been seen during our surveys since 1994. The sum of the median aerial estimates (not corrected for missed whales) for June 2001 is 211. This is below index counts for years prior to 1998 (305 in 1993, 281 in 1994, 324 in 1995, 307 in 1996, and 264 in 1997), but it is essentially the same as counts made during the past 3 years (193 in 1998, 217 in 1999, and 184 in 2000).

Introduction

Beluga whales (*Delphinapterus leucas*) are distributed around most of Alaska from Yakutat Bay to the Alaska/Yukon border (Hazard 1988). Five stocks are recognized in this region: Cook Inlet, Bristol Bay, Eastern Bering Sea, Eastern Chukchi Sea, and the Beaufort Sea (Angliss et al. 2001; O'Corry-Crowe et al. 1997). The most isolated of these is the Cook Inlet stock, separated from the others by the Alaska Peninsula (Laidre et al. 2000). Beluga in Cook

Inlet are very concentrated in a few river mouths and bays during parts of the year (Rugh et al. 2000a). The geographic and genetic isolation of the whales in Cook Inlet, in combination with their strong site fidelity, has made this stock vulnerable to impacts from large or persistent harvests, as occurred prior when the hunt was first regulated in 1999 (Mahoney and Shelden 2000).

NMFS's National Marine Mammal Laboratory (NMML) and the Alaska Regional Office have conducted annual aerial surveys to study the distribution and abundance of beluga in Cook Inlet each June/July since 1993 (Withrow et al. 1994; Rugh et al. 1995, 1996, 1997a, 1997b, 1999, 2000b, 2001) in cooperation with the Alaska Beluga Whale Commission (ABWC) and the Cook Inlet Marine Mammal Council (CIMMC). Aerial surveys are proven to be the most efficient method for collecting distribution and abundance data for beluga in Cook Inlet and have been used for many years prior to the NMFS surveys (e.g., Klinkhart 1966, Calkins et al. 1975, Murray and Fay 1979, Calkins 1984). The most recent studies have been some of the most thorough and intensive (Rugh et al. 2000a). The primary objective for the current study is to maintain continuity with preceding studies, allowing for inter-year trend analysis while still making minor modifications that might improve abundance estimates. The project's focus is on documenting the distribution and counts of belugas in Cook Inlet.

Methods

Aircraft and Data

The survey aircraft, an Aero Commander 680 FL (*N7UP*), has twin-engines, high-wings, and 10-hour flying capability. It is equipped with seating for five passengers and one pilot. There are bubble windows at each of the four observer positions, maximizing the search area. An intercom system provided communication among the observers, data recorder, and pilot. A selective listening control device was used to aurally isolate the observer positions. Location data were collected from a portable global positioning system (GPS) interfaced with the laptop computer used to enter sighting data. Data entries included routine updates of locations, percent cloud cover, sea state (Beaufort scale), glare (on the left and right), and visibility (on the left and right). Visibility was documented in five subjective categories from excellent to useless; conditions rated poor or worse were considered unsurveyed. Each start and stop of a transect leg was reported to the recorder. Observer seating positions were recorded each time they were changed, generally every 1-2 hours to minimize fatigue.

Tides

There was an attempt to synchronize flight timings with low tides in the upper Inlet. This was primarily to minimize the effective survey area (at low tide, large areas of mudflats are exposed that would otherwise have to be surveyed). However, the broad geographical range of these surveys in conjunction with highly variable tide heights made it impractical to survey at specific tidal conditions throughout the Inlet. Synchronizing with the tide at locations where most whales have been seen in the past (the Susitna Delta and Knik Arm) was accomplished by departing from Anchorage 3 hours prior to the predicted low tide at the Anchorage Station (near Ship Creek). The survey trackline went from Anchorage south to East Foreland, crossed the Inlet

to West Foreland, and then proceeded north to the Susitna Delta, arriving just before low tide. Circling for an hour over a whale group there allowed the survey to arrive in Knik Arm just before low tide. When the survey was completed in Knik Arm (usually taking an hour if there were several groups of whales), low tide would be progressing up Turnagain Arm. However, the change of tides in Turnagain can be so rapid that tide rips compromise visibility. Accordingly, it proved best to refuel and take a rest break in Anchorage before continuing the survey into Turnagain Arm and Chickaloon Bay. When the tide was very low in Chickaloon Bay, the whales seemed to disperse away from shore and were harder to count. At higher tides, whales in Chickaloon were sometimes found close to shore or in Chickaloon River where they were relatively easy to count.

Tracklines

Coastal surveys were conducted on a trackline approximately 1.4 km offshore. The objective was to search nearshore, shallow waters where beluga are typically seen in summer (Rugh et al. 2000a). The trackline distance from shore was monitored with an inclinometer such that the waterline was generally 10° below horizontal while the aircraft was at the standard altitude of 244 m (800 ft). Ground speed was approximately 185 km/hr (100 knots). This coastal survey included searches up rivers until the water appeared to be less than 1 m deep, based on the appearance of rapids or riffles.

In addition to the coastal surveys, systematic transects were flown across the Inlet. Two tracklines were designed to run the length of Cook Inlet, and many incidental crossings of the Inlet provided additional offshore sampling effort (Fig. 1). Each year there has been an attempt to alter the offshore sampling effort to conduct as broad an array of searches as is practical.

Counting Protocol

Immediately upon seeing a beluga group, each observer independently reported the sighting to the recorder. As the aircraft passed abeam of the whales, the observer informed the recorder of the inclinometer angle, whale travel direction, and notable behaviors but not group size. With each sighting, the observer's position (left front, left center, etc.) was also recorded. An important component of the survey protocol was the independence of the paired observers (i.e., that they not cue each other to their sightings). They had visual barriers between them, and their headsets did not allow them to hear each other. After a group of whales was reported, the trackline was maintained until the group was well behind the aircraft; then the aircraft returned to the group and began the circling routine. This allowed each observer full opportunity to independently sight and report whale groups. The pilot and data recorder did not call out whale sightings or in any way cue the observers to the presence of a whale group until it was out of sight.

The whale group location was established at the onset of the aerial counting passes by flying a criss-cross pattern over the group, recording starts and stops of group perimeters.

The flight pattern used to count a whale group involved an extended oval around the longitudinal axis of the group with turns made well beyond the ends of the group. Whale counts were made on each pass down the long axis of the oval. Because groups were circled at least four times (four passes for each of two pairs of observers on the right side of the aircraft), there

were typically eight or more separate counting opportunities per whale group. Counts began and ended on a cue from the right front observer, starting when the group was close enough to be counted and ending when it went behind the wing line. This provided a precise record of the duration of each counting effort. The paired observers made independent counts and wrote down their results along with date, time, pass number, and quality of the count. The quality of a count was a function of how well the observers saw the location of a group, not how many whales were at the surface on the respective pass. Ratings were A (if no glare, whitecaps or distance compromised the counting effort) through F (if it was not practical to count whales on that pass). Only Quality A and B estimates were used in the analysis. Only whales that were at the surface during the counting period were included; whale tracks in the muddy water or ripples were not included in the analysis. Count records were not exchanged with anyone else on the aerial team until after all of the aerial surveys were completed. This was done to ensure the independence of each observer's estimates.

Video Cameras

Two digital video cameras were operated on each counting pass. The pair of cameras were mounted together on a common board: magnification on the "standard" camera (Sony Digital 8 DCR-TRV103) was adjusted to keep the entire group of belugas in view, but magnification was kept constant throughout a pass; the other camera (a Sony DSR PD100a) was kept at maximum zoom (12×). Images from the "standard" camera will be studied in the laboratory for whale counts relative to the infield counts, and images from the camera kept at maximal zoom will be examined for color ratios (white adults vs. dark juveniles) within the respective groups (Litzky 2001). Analysis of both the aerial counts and counts from the video-tapes are detailed in Hobbs et al. (2000a) for 1994-2000 data.

Results

Survey Effort

A total of 55 hours of aerial surveys were flown around Cook Inlet from 5-12 June 2001. All of these surveys (16 flights ranging from 0.8 to 6.5 hours) were based out of Anchorage, sometimes with refueling stops in Homer. Systematic search effort was conducted for 29.4 hours, not including time spent circling whale groups, deadheading without a search effort, or periods with poor visibility. Visibility and weather conditions interfered with the survey effort during only 1.5 hours (5% of the effective search time) when the left-front observer considered the visibility poor or worse. All of the primary observers (the authors of this report) also flew with this project in 1998-2000, and three of the four observers have participated in this project almost every season since it began in 1993.

Upper Inlet Surveys

On the first 3 days of this survey (5-7 June) and the last 3 days (10-12 June), standard coastal tracklines were flown around upper Cook Inlet for a total of six times. The route proceeded from Anchorage, around Fire Island, south to Pt. Possession, then to East Foreland and across the Inlet to West Foreland (5-7 June only; 10-12 June the route went from Pt.

Possession west to North Foreland), north to the Susitna Delta (including flights up the MacArthur, Beluga, Susitna, and Little Susitna Rivers), Knik Arm (up Knik River as far as Eklutna), Turnagain Arm, and Chickaloon Bay (including Chickaloon River). There were two flights on each of these 6 days, with 5.9 to 7.3 flight hours per day. Ideal counting conditions and thorough coverage of the upper Inlet occurred on most of five surveys on 5-7 and 10-11 June. On the sixth survey, 12 June, winds in Turnagain Arm, a dispersal of whales in Chickaloon Bay, and difficulties with dense aerial traffic in Knik Arm made for poor survey conditions. Therefore, the upper Inlet is considered to have been sampled five times.

Beluga groups were found in the Susitna Delta (particularly from the west mouth of the Susitna River to the mouth of the Little Susitna), Knik Arm (mostly along coastal areas south of Goose Bay and Eagle Bay at low tide), in Turnagain Arm (the first time our surveys have found beluga here since 1994), and in Chickaloon Bay (concentrated in Chickaloon River or on the south shore of the bay, but scattered when away from shore). Beluga in Turnagain and Chickaloon are assumed to mingle and separate easily between days. It is also assumed that beluga mingle easily between the Susitna Delta and Knik Arm, but we assume there is relatively little mingling between whales north and south of Anchorage, at least not during our 9-day survey period. Sighting locations were nearly identical to those made in most years except for a small group (~10 by count) in Turnagain Arm, seen one day in a whirlpool near Bird Point, one day near Potter's Marsh (south of Anchorage), and later that day seen midway across the mouth of Turnagain Arm. On other days, no beluga were seen in Turnagain, but counts in Chickaloon Bay were sometimes higher by an equal amount, indicating that whales seen in Turnagain sometimes joined the group in Chickaloon.

Harbor seals (*Phoca vitulina*) were the only other marine mammals seen in upper Cook Inlet. They were seen on almost every flight, with concentrations on the west side of the Susitna River (70, 210, or 253 seals on different days) and in the Chickaloon River (37 or 120 seals on different days).

Lower Inlet Surveys

On 8 and 9 June, the lower Inlet was surveyed by following the east coast from Pt. Possession south to Elizabeth Island (including a flight up the Kenai River and around Kachemak Bay). Then an offshore trackline was flown north to Anchorage along the east third of the Inlet. On the following day, an offshore trackline was flown south from Anchorage along the west third of the Inlet. After reaching Cape Douglas, the survey continued north up the west side of Cook Inlet as far as West Foreland, then an offshore transect was followed back to Anchorage (Fig.1). Refueling and rest stops were made in Homer on each of these 2 days.

For the first time since June 1994, beluga whales were seen by our observers in Kachemak Bay. An adult and young whale (not a calf) were near the north central shore of the bay in shallow, clear water. They appeared to be eating or nosing the seafloor. No other beluga were seen on this day except at the end of the flight in Chickaloon Bay. Other marine mammals seen on 8-9 June in lower Cook Inlet were 33 sightings of 795 harbor seals (of which 448 were at Fox River, 217 in Iniskin Bay, and 79 in Redoubt Bay), 25 sightings of 66 sea otters (*Enhydra lutris*, all coastal and south of 59°41'N), 5 sightings of 35 Steller sea lions (*Eumetopias jubatus*, ~10 on Elizabeth Island and 20 on Shaw Island), 22 sightings of 25 harbor porpoise (*Phocoena*

phocoena, all seen south of Kalgin Island), 2 gray whales (*Eschrichtius robustus*, at Elizabeth Island), 2 fin whales (*Balaenoptera physalus*, midway across the southern boundary of Cook Inlet), 26 humpback whales (*Megaptera novaeangliae*, along the southern boundary of Cook Inlet), and 15 killer whales (*Orcinus orca*, in one pod west of Seldovia, swimming into Kachemak Bay). All of these species were seen in the relatively clear water south of Kalgin Island. During our 9-day survey period, the only marine mammals seen north of Kalgin Island were beluga and harbor seals.

Coverage

The composite of these aerial surveys provided a thorough coverage of the coast of Cook Inlet (1,388 km) for most of the area within approximately 3 km of shore (Fig. 1). In addition, there were 1,186 km of systematic transects flown across the Inlet. Assuming a 2.0 km transect swath (1.4 km on the left plus 1.4 km on the right, less the 0.8 km blind zone beneath the aircraft), the cumulative survey tracklines covered roughly 5,200 km^2, which is 26% of the 19,863 km^2 surface area of Cook Inlet; however, these surveys covered virtually 100% of the coastal areas. Most of upper Cook Inlet was surveyed six times, especially areas where large groups of beluga have consistently been found in the past, such as the Susitna Delta, Knik Arm, and Chickaloon Bay.

Summary Counts

Medians of counts of belugas are shown in Table 1, and sighting locations are shown in Figure 1. Typically, there were four good counts made by each observer for each group; therefore, 16 counts were made on each flight, but because whale groups were fairly constant from day to day through the survey period, there could be over 320 counts of a single group, not including counts made on the video tapes. These counts are represented by medians of each of the four observers' median counts on multiple passes over a group. The process of using medians instead of maximums or means reduces the effect of outliers (extremes in high or low counts) and makes the results more comparable to others' surveys which lack multiple passes over whale groups. Medians are also more appropriate than maximums when counts are corrected for missed whales. Observers' summary counts ranged from 209 to 241, depending on observer. The median index count for all observers was 211. This summary count does not reflect any correction for missed whales. Calculations for whales missed during these aerial counts and an estimate of abundance will be developed in a separate document (e.g., Hobbs et al. 2000b). The median index of counts in June 2001 (211) is higher than the previous year (184 in 2000), but it is essentially the same as counts in 1998 (193) and 1999 (217) (Table 2).

Discussion

In Cook Inlet, beluga concentrate near river mouths during spring and early summer across the northernmost reaches of the Inlet, especially in the Susitna Delta, Knik Arm, and Chickaloon Bay (Fig. 1; Rugh et al. 2000a). These concentrations of beluga apparently last from mid-May to July or later and are very likely associated with the migration of anadromous fish,

particularly eulachon (*Thaleichthys pacificus*) and several species of Pacific salmon (Moore et al. 2000) .

Historically many beluga were seen in both upper and lower Cook Inlet in June and July (Rugh et al. 2000a), but since 1993, when the NMFS surveys began, only 0-4% of the annual sightings have occurred in the lower Inlet (Table 2). Furthermore, from 1996 to 2000 only single or dead whales were seen south of North Foreland, until the pair of beluga was seen in Kachemak Bay in June 2001. Sighting conditions have generally been ideal during the searches of coastal and offshore waters, but the only places where beluga were seen consistently were in the upper Inlet (Table 1, Fig.1). Many sea otters, harbor seals, harbor porpoise, gray, and humpback whales were seen in the lower Inlet, so the lack of beluga sightings there was not due to poor visibility.

Sighting data in the 1970s and 1980s indicate a proportional shift from the upper Inlet in June to the lower Inlet in July, a shift which was no longer apparent in the 1990s (Rugh et al. 2000a). However, in 2001 this shift might have occurred again: the whales found 5-12 June were mostly where they have been found throughout the 1990s in the upper Inlet, but a survey on 2 July resulted in a median count of only 37 belugas (NMFS, unpubl. data). It seems possible, that whales may had moved offshore or into parts of the lower Inlet in July, as they have done in the past.

The uncorrected sum of median estimates made from the June 2001 aerial observations in Cook Inlet was 211 beluga. Using the same procedure of summarizing median estimates from the highest seasonal counts at each site for each year 1993-2000, there were, respectively, 305, 281, 324, 307, 264, 193, 217, and 184 beluga (Table 2). Calculated abundances, including corrections for whales missed within the viewing range of observers and whales missed because they were beneath the surface, were 653, 491, 594, 440, 347, 367, and 435 for 1994-2000, respectively (Hobbs et al. 2000b). There was an apparent decline in whale distribution, counts, and abundance estimates until 1998. After this, whaling ceased, and the declines seem to have stopped.

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Table 1. Summary counts of beluga made during aerial surveys of Cook Inlet in June 2001. Median counts are from the four observers doing multiple counts of each group of whales. Highest counts are shown in parentheses. Best estimates are the highest median counts for the respective sites. Dashes indicate no survey, and zeros indicate that the area was surveyed but no whales were seen. Sites are listed in a clockwise order around Cook Inlet.

Location	5 June med	6 June med	7 June med	8-9 June med	10 June med	11 June med	2001 best
Turnagain Arm (north and east of Chickaloon Bay)	8 (10)	0	0	--	0	10 (20)	**34**
Chickaloon Bay/ Pt. Possession	22 (30)	14 (28)	12 (14)	--	**34** (52)	21 (33)	
Pt. Possession to East Foreland	0	0	0	0	--	--	**0**
Mid-Inlet east of Trading Bay	--	--	--	0	--	--	**0**
East Foreland to Homer	--	--	--	0	--	--	**0**
Kachemak Bay	--	--	--	**2**	--	--	**2**
West side of lower Cook Inlet	--	--	--	0	--	--	**0**
Redoubt Bay	--	--	--	0	--	--	**0**
Trading Bay	0	0	0	--	--	--	**0**
Susitna Delta (N. Foreland to Pt. Mackenzie)	**48** (67)	44 (82)	97 (118)	--	114 (138)	71 (111)	**175**
Knik Arm	**127** (171)	107 (162)	72 (98)	--	60 (120)	61 (107)	
Fire Island	0	0	0	--	--	0	**0**
						3 =	**211**

Table 2. Summary of beluga sightings made during aerial surveys of Cook Inlet in June or July 1993-2001. Medians were used when multiple counts occurred within a day, and the high counts among days were entered here.

			Percent Sightings		
Year	Dates	Counts	Lower Cook Inlet	Susitna Delta	Elsewhere in Upper Cook Inlet
1993	June 2-5	**305**	0	56	44
1994	June 1-5	**281**	4	91	5
1995	July 18-24	**324**	4	89	7
1996	June 11-17	**307**	0	81	19
1997	June 8-10	**264**	0	28	72
1998	June 9-15	**193**	0	56	44
1999	June 8-14	**217**	0	74	26
2000	June 6-13	**184**	0	62	38
2001	June 5-12	**211**	1	35	64

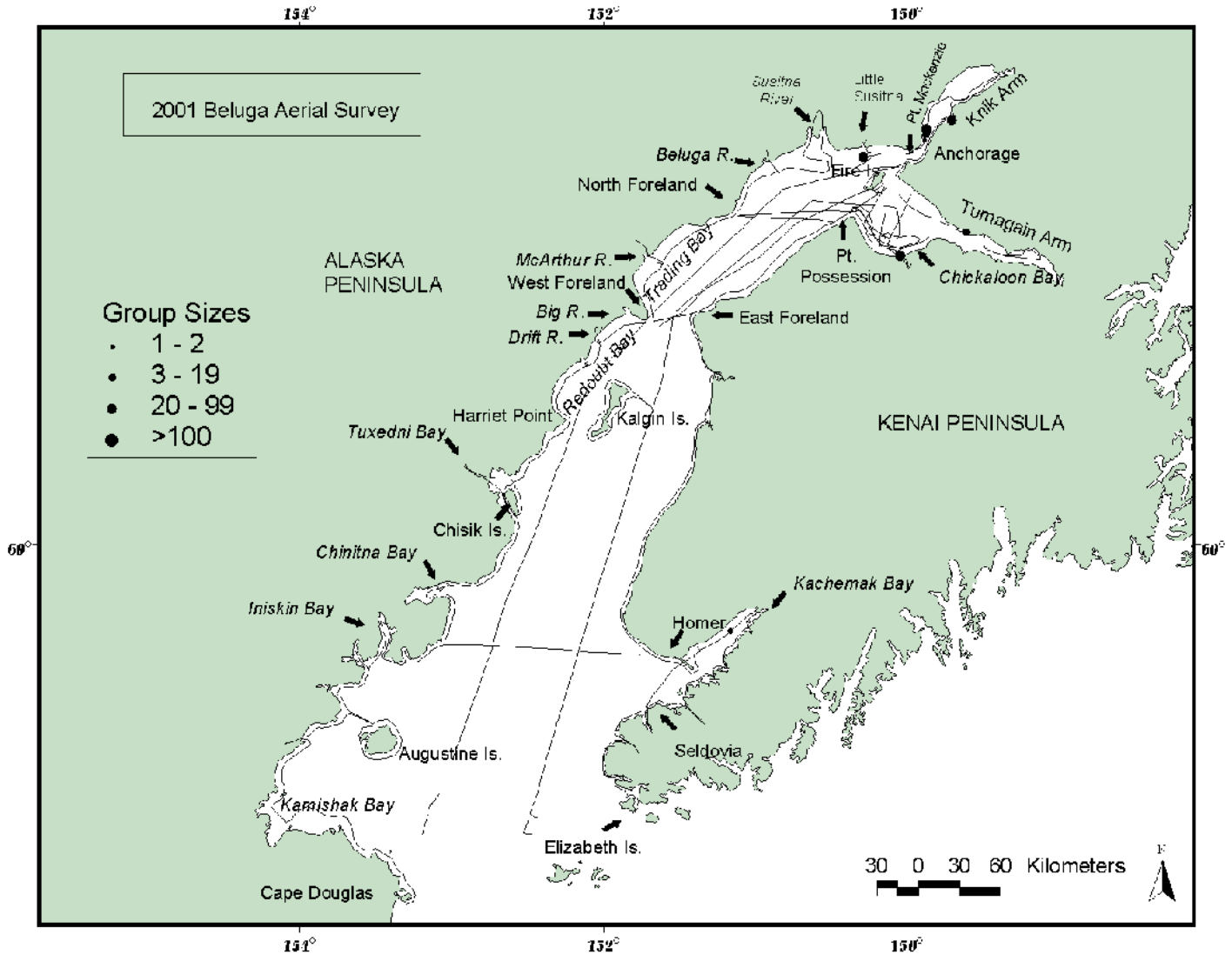

Figure 1. Aerial survey effort and beluga groups seen in Cook Inlet during flights conducted 5-12 June 2001. All but two whales (found near Homer) were near river mouths or in shallow coastal waters of the northern part of the inlet. The survey covered all coastal areas and 1,186 km of offshore waters. The northern part of the inlet was surveyed six times, but only one representative trackline is shown here.

CETACEAN DETECTION AND ASSESSMENT VIA PASSIVE ACOUSTICS, 2001

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Abstract

During FY01, the second of a 3 year study to advance the use of passive acoustics for detection of large whales, the National Marine Mammal Laboratory (NMML) collaborated with researchers from three institutions to leverage their expertise in underwater acoustics and apply it to cetacean research. Two (of four) autonomous recorders deployed in the eastern Bering Sea in October 2000 were recovered in late August 2001; the two remaining instruments were subsequently recovered from a beach and by a fisherman. These recorders were emplaced to monitor waters where critically endangered North Pacific right whales (*Eubalaena japonica*) have been seen each July since 1996. Two additional recorders, fabricated by NOAA/Pacific Marine Environmental Laboratory (PMEL), were deployed southeast of Kodiak Island near an area where one North Pacific right whale was seen in July 1998; analyses of data from one of these instruments continued in 2001. In addition, NMML collaborated with researchers using the U.S. Navy's SOund SUrveillance System (SOSUS) assets to locate blue whales in the North Pacific to conduct a provisional seasonal habitat analysis by integrating the call location data with bathymetry and remotely sensed data (i.e., sea surface temperature (SST), chlorophyl a, altimetry) using a geographic information system (GIS). Results of these analysis were presented at the 13th Biennial Marine Mammal Conference in 2000 and were submitted for publication in *Oceanography* in 2002.

Introduction

Throughout FY01, the National Marine Mammal Laboratory collaborated with scientists at NOAA's PMEL in Newport, OR; Scripps Institution of Oceanography (SIO) in La Jolla, CA; and Woods Hole Oceanographic Institution (WHOI) in Woods Hole, MA, and to leverage their expertise in underwater acoustic techniques and analysis. The focus of acoustic studies at NMML was on long-term deployment of autonomous acoustic recorders to monitor the Southeast Bering Sea and waters offshore Kodiak Island for mysticete whale (especially, North Pacific right whale) calls.

North Pacific right whales were a species of particular focus due to their status as a critically endangered species and the on-going photo-identification studies conducted by the Southwest Fisheries Science Center (SWFSC) in the eastern Bering Sea. The sighting of a lone

right whale among humpback whales southeast of Kodiak Island in 1998 provided impetus for placement of two recorders there also. In addition, NMML was able to collaborate on an on-going acoustic study of blue whales in the North Pacific basin using the U.S. Navy's SOSUS, and to augment that work though application of GIS technology. Finally, collaboration with a graduate student at the University of Michigan provided an opportunity to analyze recordings of humpback whale calls recorded in Southeast Alaska. A brief synopsis of each collaborative project is provided below.

Acoustic Monitoring for Right Whales in the Eastern Bering Sea: Collaboration with SIO

Early in FY01, NMML transferred funds to SIO to support recovery of four acoustic recording packages (ARPs). The autonomous recorders were deployed on 1 October 2000 in the eastern Bering Sea at locations where SWFSC researchers have photographed North Pacific right whales (*Eubalaena japonica*) during aerial surveys each July since 1998 (Fig. 1: NMML/SIO). The ARPs sample acoustic data at 500 Hz and have 36 GB of data storage capacity. Two of the four ARPs were recovered and two replacement recorders deployed in late August 2001. Out of necessity, this was a particularly shallow-water deployment (~ 70 m) and it was uncertain if storms or drag by fishing gear had caused the 'loss' of two of the instruments. Subsequently, both "lost instruments" were recovered; one on the beach at Nelson Lagoon (Alaska Peninsula) and one by a fisherman working near the International Date Line in the central Bering Sea. So, although two ARPs were recovered in an unconventional way, data from four instruments are now available for analysis. Data analysis is ongoing, via contract to Dr. Mark McDonald and SIO graduate student Lisa Munger (under the direction of Dr. John Hildegrand). Dr. McDonald is using calls recorded from North Pacific right whales in 1999 (McDonald and Moore, in press) to aid in the detection and enumeration of recorded calls.

North Pacific Right Whales in the Gulf of Alaska: Collaboration with NOAA/PMEL

After a North Pacific right whale was sighted off Kodiak Island in July 1998, an acoustic search for right whales was conducted (Waite et al. in press). In May 2000, an autonomous recorder, similar to instruments used by PMEL for seismicity detection (Fox et al. 2001), was placed on the seafloor at the location of the sighting, 57° 08.20 N and 151° 51.00 W. A second recorder was deployed farther offshore to listen for right whales and to complement a broad array of six recorders deployed in the Gulf of Alaska by PMEL (Fig. 1: NMML/PMEL). The first instrument was recovered in early September 2000, but sea conditions have thus far prevented recovery of the second recorder. The first instrument recorded sound continuously to a magnetic disk from 26 May to 11 September 2000. After recovery of the instrument, all sounds that could potentially be right whale calls were detected by a computer. This was done by measuring energy in the frequency band of right whale calls, 50 Hz to 400 Hz. Whenever the total energy was above the background noise level for at least 0.6 seconds (so short thumps and clicks would not be detected), but not more than 3 seconds (so long tones would not be detected), the sound was extracted and saved as a separate sound file.

A total of 10,729 potential right whale sounds were detected and extracted using this method. Next, a spectrogram of each sound file was examined visually to determine whether it was similar to other up-type calls that have been recorded from North Pacific right whales

(McDonald and Moore, in press). Upon examination, 6,364 (59%) were found to be humpback whale (*Megaptera novaeangliae*) sounds, with most of the rest being various sounds from fish and other, unknown sources. A few sounds were somewhat similar to right whale calls but could not be identified with certainty because some of the calls made by humpbacks that summer were very similar to right whale up-type calls. This made it difficult to determine with certainty what species produced these calls, especially since the right whale seen in 1998 was among humpbacks. Improvements to the algorithm used to detect right whale calls in 2001, resulted in 10 seconds of calls, recorded during the last week of deployment being identified as being from right whales. While calls were few, it is cause to re-double efforts to find right whales near Kodiak Island, a former 'key' whaling ground for the species.

Blue Whales in the Northwest Pacific Ocean: Collaboration with WHOI

Dr. Bill Watkins at WHOI heads an on-going study (since 1995) of mysticete whale calls in the North Pacific, based upon SOSUS signal reception at the U.S. Navy NAVFAC/Whidbey Island (Watkins et al. 2000a, b). In FY00, NMML contracted with GIS-analyst Jeremy Davies to construct call-maps for blue whales in the North Pacific and collate call location and seasonal occurrence with bathymetry and remotely-sensed data (e.g., SST, chlorophyl a). Preliminary results of this analysis were first provided in an oral presentation at the 13th Biennial Marine Mammal Conference, December 1999. In FY01, a manuscript was prepared and submitted to *Oceanography* (Moore et al. 2002). Here, the focus was on blue whale call detection in the Northwestern Pacific, an area of the ocean virtually un-surveyed for large whales since the era of commercial whaling. The strong seasonal signal of blue whale calling corresponds with seasonal changes in SST and chlorophyl a, although it is the association with ocean height (altimetry) and eddys that appear the strongest. This paper is designed to augment an earlier presentation of seasonal occurrence of blue, fin and humpback whales in the North Pacific, as derived by SOSUS reception of calls (Watkins et al. 2000a).

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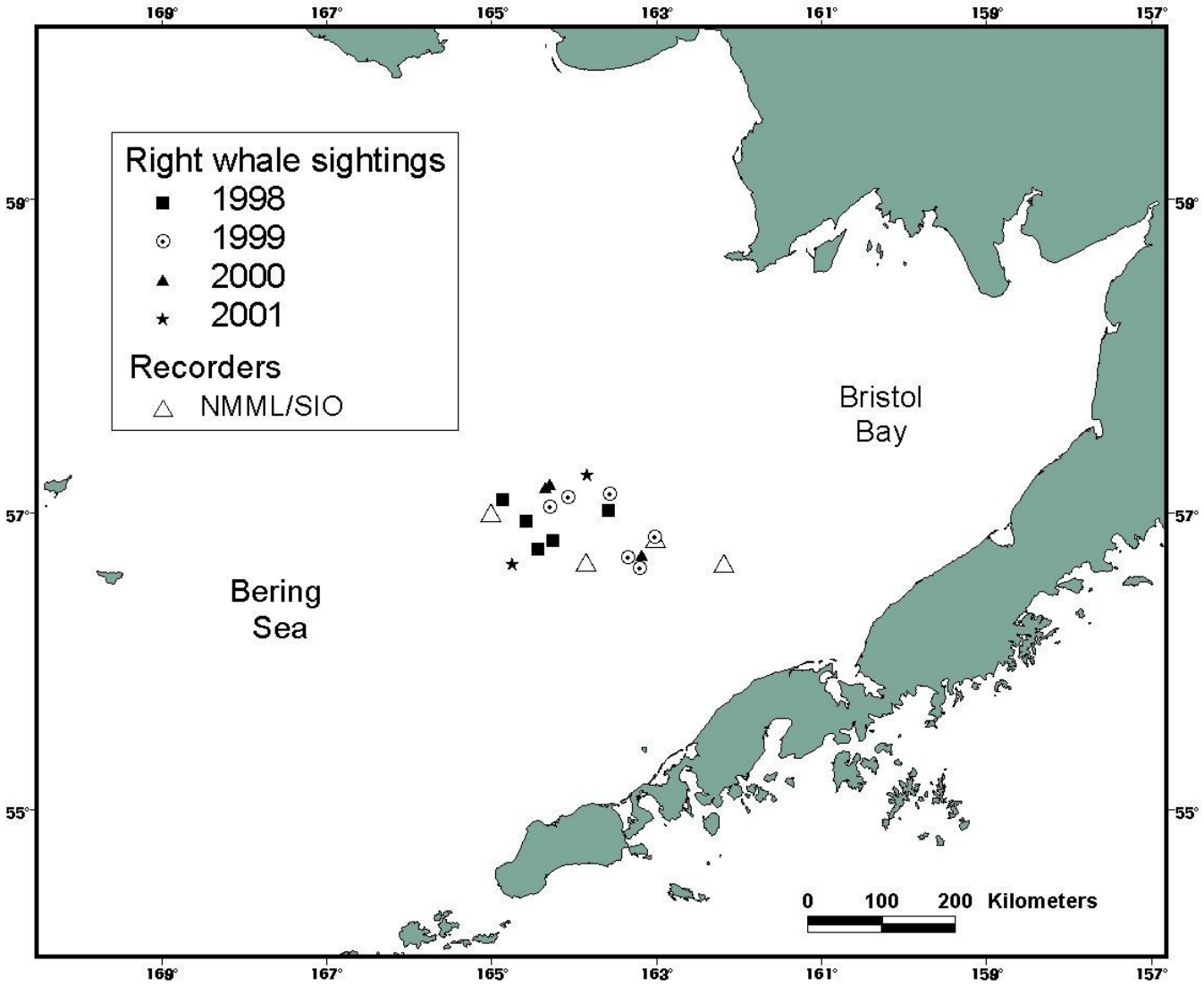
Figure 1. Locations of autonomous acoustic recorders deployed to monitor areas for North Pacific right whale (and other mysticete whale) calls in the eastern Bering Sea (NMML/SIO) and in the northern Gulf of Alaska (NMML/PMEL). The two recorders in the Gulf of Alaska complement six recorders deployed by PMEL to monitor deep-water areas for blue whales.



ABUNDANCE AND DISTRIBUTION OF HARBOR SEALS (*Phoca vitulina*) IN THE GULF OF ALASKA (INCLUDING THE SOUTH SIDE OF THE ALASKA PENINSULA, KODIAK ISLAND, COOK INLET AND PRINCE WILLIAM SOUND) DURING 2001.

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Abstract

Minimum population estimates were obtained for harbor seals, *Phoca vitulina richardsi*, in the Gulf of Alaska region between Unimak Pass in the west to Kayak Island (Cape Suckling) in the east, including the south side of the Alaska Peninsula and offshore islands, Kodiak Island, Cook Inlet, Kenai Peninsula and Prince William Sound. The study area was subdivided into 13 zones such that each section was surveyed by separate observers at about the same time. Zones 1 and 2 were flown from 12 to 20 August 2000 and Zones 3-13 were flown from 12 to 25 August 2001. A total of 556 haulout sites were identified with seals present. The mean number of seals counted was 24,428 with a 95% confidence interval between 23,265 and 25,591. The coefficient of variation (CV) of the mean was equal to 2.4%.

Introduction

Background

Declines in harbor seal, *Phoca vitulina richardsi*, abundance have been observed in several locations throughout Alaska (e.g., Pitcher 1990). Amendments to the Marine Mammal Protection Act (April 30, 1994, Public Law 103-238) required the U.S. Secretary of Commerce to reduce the overall mortality and serious injury to marine mammals caught incidental to commercial fisheries, to levels below a zero mortality rate goal. In order to evaluate the status of incidentally caught marine mammals, certain key parameters are required for each stock. These parameters include an estimate of population size and CV of abundance, net productivity rates, and current takes by commercial fisheries and subsistence hunters. The purpose of our study is to provide an estimate of the population size of seals throughout Alaska.

Harbor seals range from throughout coastal Alaska from southern Kuskokwim Bay southward (Frost et al. 1982). We have arbitrarily subdivided the state into five regions for

census purposes: (1) northern Southeast Alaska, (2) southern Southeast Alaska, (3) the Gulf of Alaska (from Prince William Sound to the Shumagin Islands), (4) the Aleutian Islands, and the (5) north side of the Alaska Peninsula to southern Kuskokwim Bay. These regions roughly follow the putative management areas, and can be surveyed safely. The National Marine Mammal Laboratory (NMML), with funding from the NMFS Office of Protected Resources, has censused each of these regions at least twice since: Loughlin (1992) [Bristol Bay, Prince William Sound, and Copper River Delta], Loughlin (1993) [Gulf of Alaska and Prince William Sound], Loughlin (1994) [Southeastern Alaska], Withrow and Loughlin (1995a) [Aleutian Islands], Withrow and Loughlin (1996a) [Bristol Bay],Withrow and Loughlin (1997a) [Gulf of Alaska], Withrow and Cesarone (1998) [northern southeast Alaska], and Withrow et al. (1999) [southern southeast Alaska], Withrow et al. (2000) [Aleutian Islands], Withrow et al. (2001) [Bristol Bay and North side of Alaska Peninsula]. This report describes the results of the third abundance survey of the Gulf of Alaska region. The objective of this study was to derive a minimum population estimate of harbor seals along the Gulf of Alaska from Unimak Pass in the west to Kayak Island (Cape Suckling) in the east.

Methods

Study Area

The Gulf of Alaska region runs from Unimak Pass in the west to Kayak Island (Cape Suckling) in the east including the south side of the Alaska Peninsula and offshore islands, Kodiak Island, Cook Inlet, Kenai Peninsula and Prince William Sound (Fig. 1). This time of year corresponds to the harbor seal's annual molt period when most animals are thought to be hauled out on land and visible to observers. The study area was subdivided into 13 zones (Figs. 1-14) such that each section was surveyed by separate observers (Table 1) at about the same time. Zones 1 and 2 were flown from 12 to 20 August 2000 and Zones 3-13 were flown from 12 to 25 August 2001. Table 1 lists the observers, dates and aircraft used to survey each area. All known harbor seal haul-out sites in each area were surveyed. In previous surveys of the Gulf of Alaska region (1990, 1991, and 1996) Prince William Sound was not completely censussed. The Alaska Department of Fish and Game (ADF&G) surveyed selected sites in central Prince William Sound along a route they termed Trend Route "A". John Burns, representing Exxon, conducted surveys of selected sites in northeastern Prince William Sound, primarily composed of ice sites. ADF&G has called this route Trend Route "B". In 2001, we surveyed the entire Prince William Sound region using six observers and survey aircrafts.

The Gulf of Alaska region was divided as follows: Zone 1 includes the area along the south side of the Alaska Peninsula from Unimak Pass to Chignik; Zone 2 includes the offshore islands from Unimak Pass to Chignik; Zone 3 runs along the south side of the Alaska Peninsula from Chignik north and east to Cape Douglas; Zones 4-6 encompass Kodiak Island with Zone 4 running from the town of Kodiak west on the south side of the island to Cape Trinity and Tugidak Island; Zone 5 runs from Cape Trinity north and east to Cape Uganik and Zone 6 runs from Cape Uganik east and south back to the town of Kodiak (including Afognak Island); Zone 7 goes from Cape Douglas (including the Barren Islands) east along the north side of Cook Inlet to Anchorage; Zone 8 runs along the south side of Cook Inlet and the Kenai Peninsula to Seward

(Resurrection Bay); Zones 9-13 encompass Prince William Sound with Zone 9 running from Resurrection Bay north and east to Falls Bay; Zone 10 continues from Falls Bay north to Pigot Bay and Zone 11 goes east then south from Pigot Bay over to Olsen Bay (including College Fjord and Valdez Arm); Zone 12 is the ADF&G trend route "A" which runs from Olsen Bay south to Hinchenbrook Island and areas in central Prince William Sound; Zone 13 runs west out of Cordova along the south sides of Hinchenbrook and Montague Islands and southeast out of Cordova to Kayak Island (including the Copper River Delta and Middleton Island offshore).

Survey Methods

Fixed-wing aircraft were used to photograph harbor seals while they were on land. The molt period is the optimal period to obtain minimum population estimates because that is when the greatest number of harbor seals spend the greatest amount of time hauled out (Pitcher and Calkins 1979, Calambokidis et al. 1987).

At locations that are affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide. Aerial surveys were timed such that haul-out sites were flown within 2 hours on either side of low tide, when available daylight and weather permitted. At least four repetitive photographic counts were planned for each major haul-out site within each study area over the 2 week survey period. Four or more repetitive surveys are necessary to obtain estimates of coefficient of variation (CV; standard deviation of the counts divided by the mean count) less than 30%. Four to five surveys resulted in the desired results in past harbor seal surveys in Alaska and have proven to be an effective way of counting the maximum number of animals (Loughlin 1992, 1993; Pitcher 1989, 1990).

Harbor seals on land or in the water adjacent to the haul-out sites were photographed with 35 mm cameras with a 70-210 mm or 35-135 mm zoom lens using ASA 400 color slide film or high resolution 5 megapixel digital cameras. Transparencies were later projected onto a white background and the number of seals counted. Generally, two counters score the number of seals on the photographs for each site and the arithmetic mean is calculated. This year, one counter scored each slide twice and then took the average count. The largest arithmetic mean obtained for each area was used as the minimum population estimate. Visual estimates of abundance were also recorded at the time of the survey. Small groups of seals (generally less than 10) were counted as the plane passed by (no photographs were taken), while larger groups were circled and photographed. Digital images were enhanced and counted manually using a variety of photographic and/or image analysis software packages.

Data Analysis

The maximum number of animals counted on one day for each zone was accepted as that area's minimum number of seals, which were then summed for a minimum population estimate for the Aleutian Islands. The maximum number for each zone did not occur on the same day, resulting in the possible double counting of some animals if they moved from one area to another. The number of seals moving between areas was assumed to be small considering each area's large geographic size.

The mean and standard deviation (SD) of the mean for each zone were also calculated. Estimates of the number of animals hauled out during the survey were calculated by summing

the mean number of harbor seals ashore at each site. The CVs were calculated for all sites with two or more counts. The SD for sites with only one count was estimated to be 1.0 (based on the average maximum of the calculated CVs of the mean multiplied by the count for that site). The variance of the total for the Aleutian Islands was calculated as the sum of the individual variances and the SD as the square root of that variance. This method of estimating the expected total and its variance assumes that there is no migration between sites and that there was no trend in the number of animals ashore over the survey period. The assumption that seals did not move between sites may not be valid (as mentioned above) and a small number of seals may have been counted twice. All areas that could be surveyed were censussed, given weather and safety constraints.

Results

Zone 1

Dana Seagars surveyed from Unimak Pass along the south side of the Alaska Peninsula to Chignik Bay. This area contained 22 sites. Six surveys were flown from 12 to 19 August 2000 resulting in two or more surveys for most sites. A maximum count of 853 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 2, Table 2). The sum of means was x = 636 harbor seals (SD = 27.5) with a CV = 4.3%.

Zone 2

Peter Olesiuk surveyed the offshore islands from Unimak Pass along the south side of the Alaska Peninsula to Chignik Bay. This area contained 108 sites. Nine surveys were flown from 12 to 20 August 2000 resulting in two or more surveys for most sites. A maximum count of 2,479 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 3, Table 3). The sum of means was x = 1,755 harbor seals (SD = 52.7) with a CV = 3.0%.

Zone 3

Mike Simpkins surveyed from Chignik Bay along the south side of the Alaska Peninsula to Cape Douglas. This area contained 76 sites. Nine surveys were flown from 16 to 25 August 2001 resulting in three or more surveys for most sites. A maximum count of 4,190 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 4, Table 4). The sum of means was x = 2,941 harbor seals (SD = 103.6) with a CV = 3.5%.

Zone 4

Kate Wynne surveyed from the town of Kodiak west on the south side of Kodiak Island to Cape Trinity and Tugidak Island. This area contained 31 sites. Five surveys were flown from 21 to 25 August 2001 resulting in four or more surveys for most sites. A maximum count of 6,846 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 5, Table 5). The sum of means was x = 4,834 harbor seals (SD = 342.0) with a CV = 7.1%.

Zone 5

Lisa Baraff surveyed the island of Kodiak from Cape Trinity north and east to Cape Uganik. This area contained 24 sites. Eight surveys were flown from 16 to 25 August 2001 resulting in four or more surveys for most sites. A maximum count of 1,880 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 6, Table 6). The sum of means was x = 1,339 harbor seals (SD = 49.6) with a CV = 3.7%.

Zone 6

Lisa Hiruki-Raring surveyed the island of Kodiak from Cape Uganik east and south back to the town of Kodiak (including Afognak Island). This area contained 57 sites. Nine surveys were flown from 15 to 25 August 2001 resulting in five or more surveys for most sites. A maximum count of 1,654 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 7, Table 7). The sum of means was x = 909 harbor seals (SD = 51.2) with a CV = 5.6%.

Zone 7

Derrick Campbell surveyed the north side of Cook Inlet and the Barren Islands. This area contained 57 sites. Eleven surveys were flown from 15 to 25 August 2001 resulting in two or more surveys for most sites. A maximum count of 4,530 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 8, Table 8). The sum of means was x = 2,977 harbor seals (SD = 223.8) with a CV = 7.5%.

Zone 8

Anita Lopez surveyed along the south side of Cook Inlet and the Kenai Peninsula to Seward (Resurrection Bay). This area contained 27 sites. Ten surveys were flown from 15 to 25 August 2001 resulting in three or more surveys for most sites. A maximum count of 2,428 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 9, Table 9). The sum of means was x = 1,418 harbor seals (SD = 135.8) with a CV = 9.6%.

Zone 9

John Jansen surveyed the following islands in northwestern Prince William Sound: Knight, Latouche, Elrington, Evans, and Bainbridge Islands. This area contained 25 sites. Seven surveys were flown from 17 to 25 August 2001 resulting in four or more surveys for most sites. A maximum count of 593 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 10, Table 10). The sum of means was x = 326 harbor seals (SD = 29.8) with a CV = 9.1%.

Zone 10

John Moran surveyed along the west side of Prince William Sound from Resurrection Bay (Seward) north to Pigot Bay. This area contained 23 sites. Four surveys were flown from 22 to 25 August 2001 resulting in four surveys for most sites. A maximum count of 392 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 11, Table 11). The sum of means was x = 265 harbor seals (SD = 135.8) with a CV =6.4%.

Zone 11

Dave Withrow surveyed along the north and east sides of Prince William Sound from Pigot Bay to Olsen Bay (including College Fjord and Valdez Arm). This area contained 32 sites. Nine surveys were flown from 17 to 25 August 2001 resulting in five or more surveys for most sites. A maximum count of 680 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 12, Table 12). The sum of means was x = 408 harbor seals (SD = 55.6) with a CV = 13.6%.

Zone 12

Peter Olesiuk surveyed the ADF&G trend route "A" which runs from Olsen Bay south to Hinchenbrook Island and areas in central Prince William Sound. This area contained 24 sites. Thirteen surveys were flown from 12 to 25 August 2001 resulting in nine or more surveys for most sites. A maximum count of 1,133 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 13, Table 13). The sum of means was x = 617 harbor seals (SD = 25.9) with a CV = 4.2%.

Zone 13

Jack Cesarone surveyed west out of Cordova along the south sides of Hinchenbrook and Montague Islands, and southeast out of Cordova to Kayak Island (including the Copper River Delta and Middleton Island offshore). This area contained 61 sites. Ten surveys were flown from 15 to 25 August 2001 resulting in three or more surveys for most sites. A maximum count of 8,074 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 14, Table 14). The sum of means was x = 4,956 harbor seals (SD = 373.3) with a CV = 7.53%.

Zones 1-13 Combined

In the Gulf of Alaska region, from Unimak Island in the northwest to Kayak Island in the southeast, there were a total of 556 sites identified with seals present in 2001. On average, each site was observed 4 times during the 12 to 25 August 2001 survey window. A maximum count of 37,219 harbor seals was obtained by combining the maximum count for each area regardless of day censussed (Fig. 1, Table 15). The sum of means was x = 24,428 harbor seals (SD = 592.9) with a CV = 2.43%

Discussion

The principle objective of this research is to calculate a minimum estimate of the number of harbor seals for each region/stock to update the Alaska Marine Mammal Stock Assessments as required by Public Law 103-238 under the Marine Mammal Protection Act.

The 2001 harbor seal census surveys were conducted in a similar manner to those of 1996 (Withrow and Loughlin 1997a), 1991 and 1992 (Loughlin 1992, 1993). An opportunity occurred in 2000 which allowed us to survey the southern section (Zones 1 and 2) between Unimak Pass and Chignik Bay a year early. This large area, which includes the Sanak and Shumagin Islands, was not thoroughly covered in 1996. In fact, a small section of coast (about 25 km) was missed

completely. This route was obviously too large for a single observer to cover, so we took advantage of extra funding in 2000 (plus planes were already contracted for other surveys and were already on location) and surveyed this section of coast in August 2000. A few locations at the fringe of Zones 1 and 3 were sampled in both years and were remarkably similar. Another major difference in 2001 was the thorough coverage of Prince William Sound. We utilized six survey aircraft to thoroughly cover the entire Prince William Sound region. Previously, we utilized counts provided by the ADF&G who regularly surveyed the central Sound along their Trend Route "A", and by John Burns (Exxon) who surveyed Trend Route "B" along the northeastern Sound, which is primarily composed of ice sites. These two routes covered much of Prince William Sound, but not the entire Sound, and it was unknown what proportion of the Sound they represented.

Table 15 shows the individual mean estimates, 95% confidence intervals, SD and CVs of the mean, for each zone and for the entire Gulf of Alaska (all zones combined). The mean reported here (24,428 seals) should be considered a minimum estimate only and it reflects the number of seals actually observed hauled out. If a correction factor were applied, which accounts for those seals not hauled out (and available for counting) during the actual surveys, a more realistic estimate would be obtained. In Alaska, we found from tagging studies (Withrow and Loughlin, 1995b, 1996b, 1997b; Withrow and Cesarone 1999) that approximately 57-60% of the seals are actually hauled out during our surveys which yields a correction factor estimate between 1.73 and 1.91. If we apply the more conservative correction factor of 1.73 to the mean estimate of 24,428, we calculate an estimate of 42,260 harbor seals in the Gulf of Alaska region. A more rigorous technique to determine the abundance of harbor seals has been completed by Boveng et al. (in press) for the Gulf of Alaska region using data from our 1996 surveys and by Frost et al. 1999 for surveys along Trend Route "A". Covariates such as tide, time of day, weather, and time of year are known to influence the propensity of seals to haul out. Boveng et al. (in press) used a regression model to adjust the counts to an estimate of the number of seals that would have been ashore during a hypothetical surveys conducted under "ideal conditions" for hauling out (something unlikely to occur nature). Their method produced an estimate of 35,982 for the number of seals in the Gulf of Alaska region in 1996. A similar analysis will be performed for all regions in Alaska, including the data presented here for the Gulf of Alaska in 2001, to provide an estimate of the number of harbor seals for the entire state of Alaska.

Acknowledgments

This report is a summary of surveys conducted by the people listed in Table 1 and who are gratefully acknowledged for their time and effort. The pilots and support staff of the following air charter services: Commander NW, Highline Air, Andrew Airways, Kodiak Air, Regal Air, Jim Air, Cordova Air and Fishing and Flying. Their expertise and attention to safety were greatly appreciated.

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Table 1. Zone number, city from which surveys originated, name of observer, dates, and aircraft type for harbor seal surveys in Bristol Bay and along the north side of the Alaska Peninsula during August 2000.

Zone	City	Name	Dates	Aircraft	Aircraft Vendor
1	Cold Bay	Dana Seagars	12-19 August 2000	Aero Commander	Commander NW
2	Cold Bay	Peter Olesiuk	12-20 August 2000	Aero Commander	Commander NW
3	Kodiak	Mike Simpkins	16-25 August 2001	Aero Commander	Commander NW
4	Kodiak	Kate Wynne	21-25 August 2001	Cessna 206 on floats	Kodiak Air Service
5	Kodiak	Lisa Baraff	16-25 August 2001	Cessna 206 on floats	Andrew Airways
6	Kodiak	Lisa Hiruki-Raring	15-25 August 2001	Cessna 206 on floats	Highline Air
7	Anchorage	Derrick Campbell	15-25 August 2001	Cessna 185 on floats	Regal Air
8	Anchorage	Anita Lopez	15-25 August 2001	Cessna 185 on floats	Regal Air
9	Cordova	John Jansen	17-24 August 2001	Cessna 206 on floats	Jim Air
10	Anchorage	John Moran	15-25 August 2001	Cessna 206 on floats	Jim Air
11	Cordova	Dave Withrow	17-25 August 2001	Cessna 206 on floats	Cordova Air
12	Cordova	Peter Olesiuk	12-25 August 2001	Cessna 185 on floats	Fishing & Flying
13	Cordova	Jack Cesarone	15-25 August 2001	Cessna 206 on floats	Cordova Air

Table 2. 2000 The number of seals counted for each site for Zone 1. [Seagars]

(Zone 1 includes the area along the south side of the Alaska Peninsula from Unimak Pass to Chignik)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/12/00	8/13/00	8/14/00	8/15/00	8/16/00	8/17/00	8/18/00	8/19/00	8/20/00
Amagat I.	R	54.89294	162.87724	15	6	10				15		0	0	
Bear Bay Reef	R	55.18618	161.99036	47	26	12	29			47	15	30	25	
Big Lagoon	S	55.11124	163.15925	91	78	86						57	91	
Bird I. S.	R	54.6632	163.28729	37	26	15				37				
Bobrovia Pt.	R	55.35554	161.225344	27	20		27			20	17	20	16	
Brother I. E	R	55.9234	158.82219	5	4						2	5		
Clarks Bay I.	R	55.785872	159.99496	8	5					8	4	5	4	
Elephant Pt. Rocks	R	55.700147	160.044073	22	18		16			18	19	13	22	
Flat I.	R	55.389082	161.615069	20	15		20						10	
Grub Gulch outer I.	R	55.789444	159.928724	23	13		23			18	12	11	1	
Gull I.	R	55.49239	161.61997	133	124		109			133		129	123	
Gull Rocks	R	55.84828	159.75166	87	60		38			48	60	68	87	
Ivan I.	R	55.51527	161.648371	8	7		7			4		8	8	
Kinzarof Lagoon	S	55.27482	162.63794	145	124	97					145	130		
Long John Rock	R	55.22373	161.86983	12	3		12			0		0	0	
Pinnacle Rock S.	R	54.60145	163.58791	26	14	15				26			0	
Rock Wall Shelf	R	55.73313	159.84279	35	16		35			6	13	11	13	
Round I.	R	55.545995	161.599576	17	10		9					17	4	
Sankin I.	R	54.81213	163.27134	40	30	27				40	25		27	
Settlement Point Rock	R	55.504869	161.46313	20	8		7			4		20	1	
Volcano Bay N end	R	55.23249	161.98228	6	2		1			0		6	0	
West Pt. Cove W	R	55.63881	160.27202	29	29		29			28				

MAX	MEAN
853	636

95 % Confidence Interval			
581	=LOW	691	=HIGH

CV	COUNT	SD
4.33	22	27.55

Table 3. 2000 The number of seals counted for each site for Zone 2. [Olesiuk]

(Zone 2 includes the offshore islands from Unimak Pass to Chignik)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/12/00	8/13/00	8/14/00	8/15/00	8/16/00	8/17/00	8/18/00	8/19/00	8/20/00
Acheredin Bay E	R	55.1695	160.4105	25	23			18			24	25	25	
Acheredin Bay W	R	55.1556	160.4622	12	6			6			5	12	0	
Andronica I. SE	R	55.0245	160.0272	13	9				5		8	9	13	
Bendel I. SE	R	55.0579	159.4627	20	8				1		10	20	0	
Big Koniuji I. S	R	55.0509	159.3772	45	39				30		45	45	35	
Bird I. NW	R	54.8222	159.8106	2	1						2	0	0	
Blind Breaker	R	55.1702	160.2919	9	6			9			9	6	0	
Buyan I.	R	54.8724	162.0716	4	2					4		1	1	
Buyan I. SE	R	54.8675	162.0536	22	11		6			6				22
Cape Devine	R	55.0362	160.0843	19	11						10	19	5	
Cape Wedge SE	R	55.2737	159.5098	16	9						4	16	7	
Caton I. NW	R	54.3915	162.2978	12	7	12				0				10
Caton I. W	R	54.3891	162.3037	8	5	8				0				6
Chemi I. E	R	54.6343	162.2147	18	11		6			10				18
Chemi I. N	R	54.6532	162.2309	26	15		26			5				15
Chemi I. W	R	54.6336	162.2474	3	2		3			1				1
Chicago Pt. SW	R	54.3745	162.4294	28	19	28				12				17
Clifford I. SE	R	54.3571	162.4460	60	34	8				33				60
Clifford I. SW	R	54.3574	162.4891	9	4	9				2				0
Clubbing Rocks N	R	54.7368	162.2809	3	2		2			0				3
Dodds Bay S	R	54.3868	162.4330	8	4	8				0				4
Dolgoi Cape	R	55.0529	161.4586	3	1			3		0		0	0	
Dolgoi I. E	R	55.1502	161.4201	26	16			14		6		26	17	
Eagle I.	R	54.6218	162.2063	29	17		18			4				29
Egg I.	R	55.2216	161.2082	6	6								6	
Elephant Rock S	R	55.1562	160.3012	20	15			20			18	11	11	
Enton Pt. W	R	54.3733	162.3414	10	4	10				0				3
Entrance I.	R	55.0860	161.4907	27	17			19		27		8	15	
Falmouth Harbor	R	55.0670	160.0598	67	62						67	57	62	
Fawn I.	R	54.8206	162.2156	24	22		20			24				
Fox I.	R	54.9528	162.2636	26	25		24			26				
Goose I. N	R	54.6858	162.1366	16	12		12			9				16
Goose I. S	R	54.6757	162.1343	13	9		6			9				13
Goose Outer Reef	R	54.6889	162.1464	40	29		25			22				40
Hay I. S	R	54.6353	162.0795	20	16		11			18				20
Haystacks	R	55.2760	160.0329	9	5				2		3	6	9	
Hunt I.	R	54.7520	162.1538	12	10		12			9				9
Hunt I. SE	R	54.7390	162.1214	1	0		1			0				0
Hunter I.	R	54.9700	161.4624	27	18		19			19		27	8	
Iliasak I. Outer E	R	55.0001	161.5353	40	22		40			23		8	18	
John Rock	R	54.9841	161.3800	20	15			18		20		12	10	
Kennoys I.	R	55.1513	161.0616	67	46			67			41	45	32	
Koniuji I. NE	R	55.2239	159.2989	2	1				1		2	0	0	
Korovin I. E.	R	55.4068	160.0879	1	1							1	0	
Korovin I. N	R	55.4574	160.1356	4	1						4	0	0	
Korovin I. NW	R	55.0410	160.1669	6	2						1	0	6	
Let I.	R	54.8340	162.2621	3	3		3			3				
Lida I.	R	54.4272	162.4851	2	1	1				2				0

Little Goose I. SE	R	54.6731	162.1221	23	17		20			8				23
Little Goose I. SW	R	54.6726	162.1249	22	13		22			6				11
Little Goose Reefs E	R	54.6845	162.0993	4	3		4			2				4
Little Goose Reefs S	R	54.6544	162.1283	5	5		5			5				4
Long I. NE	R	54.4339	162.5110	10	3	10				0				0
Long I. SE	R	54.4021	162.4687	10	6	10				6				2
Lookout Pt. S	R	54.3734	162.2117	28	26					28				23
Midun I.	R	54.8334	162.1071	5	3		1			5				2
Midun I. S	R	54.7908	162.1063	6	4		6			5				2
Murphy's Cove	R	54.4873	162.7804	24	16	24				11				14
Nagai I. NE	R	55.2212	159.5261	24	17				12		24	15	15	
Nagai I. SE	R	54.9672	160.0754	60	52						60	44		
Nagai I. SW	R	55.0389	160.0821	45	39						39	33	45	
Omega I.	R	55.2391	161.1416	3	3								3	
Patton I.	R	54.8925	162.0892	53	45		40			53				42
Pavlof Harbor	R	54.4586	162.4192	7	3	2				0				7
Paw Cape	R	54.8523	162.2309	60	55		60			49				
Peninsula I. SW	R	55.1707	159.4034	81	63				60		35	81	74	
Peterson I.	R	54.3336	162.3704	14	11	5				14				13
Pinnacle Rock NW	R	54.8037	161.4937	1	0		1			0			0	
Pinnacle Rock W	R	54.7565	161.5463	12	9		12			6			8	
Popof Head W	R	55.2545	160.2312	11	7				9		11	1	8	
Popof I. S	R	55.2851	160.2543	18	14				18		13	14	12	
Porpoise Rocks	R	55.2384	159.5617	21	16				21		17	16	11	
Pt. Petrof NW	R	54.4917	162.5180	8	6	8				6				5
Sanak I. NW	R	54.4564	162.5047	26	13	10				26				2
Sanak Reefs E	R	54.3058	162.3948	14	9	4								14
Sanak Reefs N	R	54.3039	162.4081	8	5	2				5				8
Sanak Reefs NE	R	54.3002	162.3898	13	11	10				9				13
Sanak Reefs NW	R	54.4555	162.5305	3	2	2				1				3
Sanak Reefs SE	R	54.2911	162.3865	15	7	15				3				2
Sandman Reef Inner NW	R	54.7696	162.0494	3	1		3			1				0
Sandman Reef mid.	R	54.6847	162.1872	7	4		7			2				4
Sandman Reef N	R	54.6894	162.1849	6	3		3			6				1
Sandman Reef Outer NW	R	54.7736	162.0334	9	7		4			9				9
Sandman Reef S	R	54.6725	162.1740	1	0		1			0				0
Sarana I.	R	54.9689	161.5367	42	26		42			0		41	19	
Scotland Pt.	R	55.4431	160.0843	14	6						14	4	0	
Simenof I. S	R	54.8549	159.1608	77	53				50		28	55	77	
Simenof I. W	S	54.9017	159.1964	135	98				46		135	92	118	
Sombrero Pt.	R	55.2001	160.5141	15	14			15			12	13	14	
Southwest I.	R	54.6198	162.2427	17	16		15			17				
Sozavanika I.	R	54.8515	162.3175	76	61		46			76				
Spectacle I. NE	R	55.0075	159.4252	20	14				11		20	12	11	
Sushilonoi I.	R	54.8676	161.5047	32	24		26			32			15	
Sushilonoi I. SW	R	54.8238	161.5784	11	7		11			3			7	
Trinity I. N	R	54.4254	162.5252	39	31	30				24				39
Trinity I. S	R	54.4383	162.5336	25	12	25				9				3
Turner I. N	R	55.0540	159.5103	34	23				25		34	20	14	
Turner I. NW	R	55.0384	159.5159	25	15				25		0	10	23	
Twin I.	R	54.9534	159.5217	5	2				2		2	5	0	
Ukolnoi I. E	R	55.2264	161.3214	55	27			15			25	13	55	
Ukolnoi I. NE	R	55.0221	161.3377	32	23			20			10	32	31	
Ukolnoi I. SE	R	55.0190	161.3239	6	4			3			6	5	2	

Table 3.

Ukolnoi Rocks	R	55.2391	161.2790	65	51			21			55	62	65	
Umga I.	R	54.8023	162.4328	32	22		4			32				30
Umla I. S	R	54.3390	162.2800	10	9	8				10				10
Whale Pt.	R	54.4039	162.2356	15	6	4				0				15
Wosnesenski I. NW	R	55.0013	161.2760	2	1			1			2	2	0	
Zachary Bay	R	55.3052	160.3956	152	108			71	125		64	126	152	

MAX	MEAN
2,479	1,755

95 % Confidence Interval			
1,651	=LOW	1,858	=HIGH

CV	COUNT	SD
3.00	108	52.65

Table 3.

Table 4. The number of seals counted for each site for Zone 3. [Simpkins]

(Zone 3 runs along the south side of the Alaska Peninsula from Chignik north and east to Cape Douglas)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Aghiyuk I. N.E.	S	56.2128	156.7783	64	39							0	53		64	
Aghiyuk I. N.W.	S	56.2038	156.7985	81	61								40		81	
Agripina Bay	R	57.1106	156.4495	75	52				75				40	58	32	55
Aiugnak Columns-1	R	56.8789	156.5733	8	4										8	0
Aiugnak Columns-2	R	56.8834	156.5748	255	149				161				30	255	160	138
Alinchak Bay	R	57.7681	155.2778	42	17				0					0	25	42
Alinchak Bay N.	R	57.8536	155.1581	0	0				0					0	0	0
Alinchak Bay N.-2	R	57.8505	155.1825	10	3									10	0	0
Alinchak Bay N.-3	R	57.8371	155.2039	53	29									53	0	35
Amber Bay	R	56.8293	157.4458	24	10				1				3	0	24	23
Amber Bay E.	R	56.8377	157.3900	34	16								20	34	5	3
Aniakchak Bay	R	56.7538	157.4575	51	33								34	51	31	15
Anowik I.-1	R	56.0825	156.6731	0	0							0				
Anowik I.-2	R	56.0708	156.6422	7	2							0	0		7	
Cape Aklek	R	57.6744	155.5783	0	0				0					0	0	0
Cape Douglas Reef S	R	58.7592	153.2831	323	246		152			215				293		323
Cape Douglas Rock S.	R	58.7261	153.3500	2	1		0			0				2		0
Cape Kumliun	R	56.4717	157.9567	61	42			40					44	53	12	61
Cape Nushak	R	58.4159	153.9857	162	132		120			115				130		162
Cape Nushak S.	R	58.3714	153.9917	0	0					0				0		0
Chankliut I.-1	S	56.1467	158.1328	123	99			82					98		93	123
Chankliut I.2	R	56.1414	158.1578	15	6			13					0	0	15	2
Chiginagak Bay	R	56.9483	156.6045	5	2				5				0	0	4	
Chignik Bay	R	56.4342	158.2669	165	134			155					165	106	127	117
Chignik Bay nearshore	R	56.4074	158.4527	5	1			5					0	0	0	0
Chirikof E.	R	55.8144	155.5544	79	51							29	45		79	
Chirikof E. Nagai	R	55.8275	155.7478	42	18							6	42		7	
Chirikof N. House	R	55.8047	155.7500	100	71							38	100		74	
Chirikof S.	R	55.7754	155.6746	10	8								10		5	
Chirikof S. House	R	55.7997	155.7292	12	6							0			12	
Chirikof S.E.	R	55.7931	155.5536	8	7							8	8		6	
Dakavak Bay W.-2	R	57.9990	154.7724	9	7									9		4
Eagle I.	R	56.7594	157.3395	80	62				48				56	60	80	67
Hallo Bay	R	58.4675	154.0187	113	81		113			97				113		0
Hydra I.	R	56.7453	157.0133	118	72				69				19	62	118	91
Jute Bay	R	57.5475	155.8592	21	12				21					15	13	0
Kashvik Bay-1	R	57.9468	155.0554	14	4				0					14	0	0
Katmai Bay E.	R	58.0075	154.7619	12	7				0					9		12
Kinak Bay-1	R	58.1400	154.4575	26	24									22		26
Kinak Bay-2	R	58.1536	154.4406	7	4									0		7
Kinak Bay-3	R	58.0794	154.4125	0	0									0		0
Kiukpalik I.-N.E.	R	58.6075	153.5539	36	21		16			29				36		3
Kujulik Bay-1	R	56.5378	157.8044	7	3			6					7	0	0	0
Kujulik Bay-2	R	56.5872	157.9089	81	59			42						59	55	81
Kujulik Bay-3	R	56.5378	157.8044	50	29			7					50	24	37	27
Kukak Bay	R	58.3161	154.2114	59	39		31			59				7		57
Kukak Bay S.	R	58.2867	154.1006	17	14		10			15				17		12
Kuliak Bay	R	58.1933	154.1586	20	14					8				14		20
Kumlik I. Rock E.	R	56.6506	157.3181	4	2									4	1	1
Little Alinchak Bay	R	57.7754	155.3099	112	76				100					112	74	18
Missak Bay	R	58.1228	154.2778	9	7		9			8				5		6
Nakalilok Bay S.	R	56.9052	156.9580	21	7				5				0	8	0	21
Nakchamik I. S.W. Beach	S	56.3333	157.8972	119	93										119	66
no name	R	56.7456	157.0290	60	42				30				22	43	54	60
Portage Bay	R	57.5367	156.0300	0	0									0	0	0
Portage Bay middle	R	57.5574	156.0205	3	1				3					0	0	0
Puale Bay Rocks	R	57.6924	155.4239	56	43				19					46	49	56

Shakun Islets-1	R	58.5692	153.6639	0	0					0				0		0
Shakun Islets-2	R	58.5738	153.7134	36	11		36			0				8		0
Shakun Islets-middle	S	58.5656	153.7261	175	162		161			151				175		
Sutwik I. N.W.	R	56.5870	157.2466	32	24								14	29	32	20
Sutwik I. Reef N.	R	56.5944	157.3283	1	1								0	1	1	0
Sutwik I. S.	R	56.5192	157.1374	39	29								35	39	23	20
Sutwik Island	R	56.5876	157.0864	26	20								15	26	20	
Takli I.	R	58.0486	154.5453	20	9		6						2	20		6
Takli I. Rocks W.	R	58.0512	154.4296	24	23									22		24
Toee Reef	R	56.7619	156.8611	14	6				0				4	0	12	14
Ugaiushak I.	R	56.7941	156.8533	203	126				98				26	187	203	114
Ugaiushak I. Rock	R	56.8015	156.8656	96	49				51				96	0	53	46
Unavikshak I. N.E.	R	56.5028	157.6945	81	61			39					78	65	81	44
Unavikshak I. Reef N.W.	R	56.5537	157.5566	102	71			48					48	61	97	102
Unavikshak I. Reefs	R	56.4530	157.7297	23	13			19					0	13	23	12
Wide Bay mouth	R	57.4443	156.1787	2	1				1					0	2	0
Wide Bay N.-1	R	57.4611	156.1997	1	1										0	1
Wide Bay N.-2	R	57.4574	156.1828	119	85				24					119	82	115
Wide Bay S.	R	57.3393	156.2767	312	284				237						304	312
Yantari Bay I. S.E.	R	56.8003	156.9935	14	8				5				0	14	11	12

MAX	MEAN
4,190	2,941

95 % Confidence Interval			
2,736	=LOW	3,145	=HIGH

CV	COUNT	SD
3.52	70	103.64

Table 5. The number of seals counted for each site for Zone 4. [Wynne]

(Zone 6 runs from the town of Kodiak west on the south side of Kodiak Island to Cape Trinity and Tugidak Island)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Aiaktalik I.	R	56.7103	154.1083	162	112							52	140	100	162	106
Aiaktalik Ledge S.E.	R	56.6761	153.9900	32	19								32	28	11	5
Barnabas Rks	R	57.1856	152.9219	57	37								35	0	55	57
Black Point	R	57.0072	153.3603	277	209								105	202	277	253
Broad Point	R	57.6714	152.3944	11	6								0	11	8	4
Cliff Point	R	57.7114	152.4328	32	26								22	26	32	25
Geese I. (Mid)	R	56.7222	153.8856	115	42								18	15	115	20
Geese I. N.	R	56.7203	153.9258	609	394								544	423	609	0
Geese I. S.	R	56.7203	153.9111	41	23								33	41	7	12
Gull Point Lgn.	S	57.3369	152.6478	104	84								104	78	79	74
Kaguyak (Inner)	R	56.8256	153.7919	61	37								26	35	61	24
Kaguyak (Outer)	R	56.8303	153.7447	10	3								0	10	1	0
Kalsin Bay	S	57.6447	152.3614	160	135								160	128	151	99
Kiliuda Bay (Upper)	R	57.3192	153.1628	91	61								0	65	89	91
Long I.	R	57.7894	152.2200	66	63								59	62	64	66
Pasagshak W.	R	57.4344	152.5756	183	152								143	128	183	155
Portage Bay	R	57.4580	152.6423	0	0								0	0	0	0
Rolling Bay	R	57.0450	153.3736	45	35								38	18	45	38
Saltery Cove	R	57.4923	152.7530	42	11								0	0	0	42
Shearwater Bay	S	57.2947	152.8911	128	119								128	128	122	96
Sitkinak I. S.E.	S	56.5022	153.9714	452	238								452	0	420	78
Sitkinak Lgn. N.	S	56.5578	154.0336	84	49								84	60	46	7
Sitkinak Lgn. S.	S	56.5578	154.0336	169	130								153	69	169	127
Sundstrom I. Ledge N.E.	R	56.6803	154.1061	32	20								16	10	32	21
Sundstrom I. N.	R	56.6847	154.1319	31	21								20	12	31	21
Tugidak Bar S.E.	S	56.5228	154.4172	376	265								261	235	376	189
Tugidak Lgn. (Inside)	S	56.5458	154.4731	340	209								340	170	273	51
Tugidak N.	S	56.6044	154.4786	0	0								0	0	0	0
Tugidak N.E.	S	56.5722	154.3831	1020	687								1020	738	988	0
Tugidak S.W.	S	56.4547	154.7783	1244	929								621	961	1244	891
Two-Headed I	R	56.9010	153.5667	0	0								0	0	0	0
Ugak Bay (Upper)	S	57.4775	152.8769	110	90								110	64	92	92
Ugak I.	R	57.3756	152.2572	698	580								698	497	551	574
Womans Bay	R	57.7383	152.4328	64	52								37	64	63	43

MAX	MEAN
6,846	4,834

95 % Confidence Interval			
4,154	=LOW	5,513	=HIGH

CV	COUNT	SD
7.08	31	342.00

Table 6. The number of seals counted for each site for Zone 5. [Baraff]

(Zone 5 runs from Cape Trinity north and east to Cape Uganik on Kodiak Island)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Alf I.-Uyak Bay	S	57.4083	153.8259	34	11			29		34			0	0	0	0
Alitak Reef	R	56.9009	154.0425	64	54				29				62	64	58	59
Alitak-Hawk Pt. reef	R	56.8070	154.0930	88	60				28				64	48	88	71
Ayakulik I.	R	57.2091	154.5714	215	181				147				215	171	162	209
E of Rocky Pt.	R	57.6537	154.0686	3	1					3			0	0	0	0
Fox I. Ledges	R	56.9834	154.0524	48	37				39				24	26	48	47
Kizhuyak Bay S	R	57.7580	152.8667	47	31		24			17			46	21	47	28
Middle Cape 1	R	57.3408	154.8094	75	59				49				52	57	60	75
Middle Cape 2	R	57.3530	154.8168	4	1									4	0	0
Mink Pt.	S	57.7259	153.5527	148	100			65		73			143	46	122	148
Olga Bay E.	R	57.1186	154.1402	18	11				3				11	12	18	11
Olga Bay W. 1	R	57.0667	154.4551	22	12				5					1	20	22
Olga Bay W. 2	R	57.0565	154.4368	78	62				33				63	60	78	75
Spiridon Bay	R	57.6513	153.6535	117	98			74		117			92	88	114	105
Sukhoi R.	S	56.9500	154.3538	105	73				38				48	76	99	105
Sulua Bay	R	56.9532	153.9071	213	144				79				129	168	213	133
Sulua Bay upper	R	56.9913	153.8501	54	24				29				54	27	8	0
Thistle Bay	R	57.6544	153.7923	1	0			1		1			0	0	0	0
Uganik I.	R	57.8043	153.2872	77	41			42		77			57	17	12	
Uganik I. beach	S	57.8030	153.2834	112	96										79	112
Uyak Bay S. Arm	R	57.3598	153.7747	174	130			76		124			174	124	148	134
Viekoda Bay head	R	57.8355	153.0886	94	50		36			32			52	37	94	
Zachar Bay 1	R	57.5365	153.7575	32	10			9		32			2	7	0	
Zachar Bay 2	R	57.5354	153.7367	57	55										52	57

MAX	MEAN
1,880	1,339

95 % Confidence Interval			
1,240	=LOW	1,437	=HIGH

CV	COUNT	SD
3.71	24	49.64

Table 7. The number of seals counted for each site for Zone 6. [Hiruki-Raring]

(Zone 6 runs from Cape Uganik east and south back to the town of Kodiak, including Afognak Island)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Andreon Bay E1	R	58.50778	152.39222	0	0			0		0			0	0	0	0
Andreon Bay E2	R	58.5104	152.39435	47	16			0	12	20			47	31	0	2.5
Andreon Bay Middle	R	58.50944	152.40216	10	2			0	1	0			0	0	10	2
Andreon Bay W	S	58.51567	152.40976	24.5	5			0	0	0			8		0	24.5
Big Bay	S	58.58214	152.62145	10	2			0		4			0	0	0	10
Big Bay E	S	58.57534	152.61425	15	9			2		10			13	12	15	0
Duck Bay - SW of Selezen Pt	R	58.11305	152.41795	19.5	16				11	14			17	16	19	19.5
E of Tetrekof Pt 1	R	58.52656	152.35281	64	39			23		38			30	47	64	34
E of Tetrekof Pt 2	R	58.52903	152.32109	7	3			5		7			0	6	2.5	0
Foul Bay E	R	58.36167	152.78889	0	0			0		0			0	0	0	0
Foul Bay NE	R	58.36081	152.81548	40.5	14			0		0			0	9	33.5	40.5
Foul Bay W	R	58.3619	152.84089	8	3		0	0		2			4	0	3.5	8
Izhut Bay E	R	58.19071	152.21369	4	2				4	3			3	0	0	0
Izhut Bay N	R	58.24508	152.29674	3	1				3	2			0	0	0	0
Kazakof - Parrot I	R	58.08692	152.57774	7	3				2	7			3	7	0	0
Latax R	R	58.69251	152.48077	19	10			1		3			6	15	19	17.5
Malka Bay	R	58.19424	153.00184	11.5	5		0	2		0			11	8	11.5	3
Marmot I E	R	58.21115	151.79547	18	11				7	8			10	12	18	12
Marmot I N	R	58.25639	151.8575	0	0				0	0			0	0	0	0
Marmot I NE	R	58.24257	151.78778	7	4				0	6			3	7	4	4.5
Marmot I NW	R	58.25541	151.86807	27	20				17	14			27	27	21.5	11
N of Posliedni Pt 1	R	58.43716	152.30032	4	1				0	4			0	0	0	0
N of Posliedni Pt 2	R	58.4499	152.32044	0	0				0	0			0	0	0	0
N of Posliedni Pt 3- middle-north	R	58.44081	152.30235	52	17				37	52			0	0	13.5	0
NE of Posliedni Pt	R	58.44227	152.28216	210	146				68	72			146	190	190.5	210
Perenosa Bay N	R	58.43759	152.4669	38	15			0	0	20			17	38	29	2
Perenosa Bay W1	R	58.42264	152.47925	0	0			0	0	0			0	0	0	0
Perenosa Bay W2	S	58.42507	152.46309	291	212			115	114	169			267	291	283	248
Perenosa Bay W3	R	58.43094	152.4583	6	2			0	5	6			0	0	0	0
Perenosa Bay W4	R	58.42449	152.45299	11	3			0	0	11			10	0	0	0
Perenosa-Cape Current	R	58.46215	152.47433	4	1			0	4	0			0		0	0
SE of Cape Kazakof	R	58.0577	152.59059	89	51				29	27			51	89	63	46
Seal Bay -Duck Cape N	R	58.39762	152.23463	35	22				15				7	35	30	22
Seal Bay -Duck Cape NW	R	58.39594	152.24408	30	14				10	30			26	0	0	17
Seal Bay N- Vantage Rock	R	58.39097	152.17657	1	0				0	1			0	0	0	0
Seal Bay NW	R	58.40216	152.20941	1	0				0	1			0	0	0	0
Seal I	R	58.40793	152.2559	1	0				0	1			0		0	0
Shuyak I N- Carshan Pt	R	58.62525	152.43843	3	1			3		3			0	0	0	0
Shuyak I W1	R	58.54857	152.36716	10	2			0		0			10	0	0	0
Shuyak I W2	R	58.54929	152.35619	45.5	13			0		3			16	14	45.5	0
Shuyak I W3	R	58.55301	152.34308	35	15			0		35			30	0	15	7
Shuyak N -SE of Shangin Rk	R	58.63623	152.42432	4	1					1			0	0	4	2
Skipwith Reefs 1	R	58.02528	152.68005	100	58				53	55			100		67.5	15.5
Skipwith Reefs 2	R	58.0309	152.68133	4	2				0	0			4		3.5	0
Skipwith Reefs 3	R	58.03733	152.66559	76.5	30				12	32			28		76.5	0
Skipwith Reefs 4	R	58.0367	152.68726	34	10				0	0			3		34	11
Skipwith Reefs-Big Rock	R	58.01951	152.66656	27	16				19	27			1		25	5.5
The Triplets	R	57.98967	152.46636	18	6	18				6			0	1	5	7
Tolstoi N	R	58.39298	152.13799	86	69				81	80			63	86	73	33.5
Tolstoi Pt	R	58.38722	152.15672	40	15				4	5			16	14	9.5	40
Tonki Bay	R	58.32637	152.06686	27	15				27	25			0	8	18.5	12.5
Tonki Bay N	R	58.36065	152.0753	5	1				0	5			0	0	0	0
Tonki Bay NW	R	58.35331	152.09319	2	0				2	0			0	0	0	0
Tonki Bay WNW	R	58.34344	152.10491	2	0				2	0			0	0	0	0
W of Sea Otter I	R	58.51926	152.28797	3.5	1			0					0		3.5	0
WNW of Sea Otter I	R	58.55183	152.28313	10	5				0	5			8	10	7	0

WNW of Sea Otter I- south	R	58.54505	152.27978	6	1				1	6			0	0	0	0

MAX	MEAN
1,654	909

95 % Confidence Interval			
808	=LOW	1,010	=HIGH

CV	COUNT	SD
5.63	52	51.17

Table 7.

Table 8. The number of seals counted for each site for Zone 7. [Campbell]

(north side of Cook Inlet and the Barren Islands)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Augustine N. 1	S	59.4136	153.4484	25	21						25		25	12		
Augustine N. 2	R	59.4189	153.4240	12	12								12	12		
Augustine N.N.E. 1	R	59.4143	153.4020	100	90						100		80			
Augustine N.N.E. 2	R	59.4155	153.4046	120	55						30		120	15		
Augustine N.N.E. 3	R	59.4201	153.4192	25	25									25		
Augustine N.N.E. 4	R	59.4181	153.4092	22	22									22		
Augustine N.N.E. 5	R	59.4175	153.4090	39	39									39		
Augustine Rocks S.S.E	R	59.3204	153.4110	14	10						9		6	14		
Augustine S.S.E	S	59.3286	153.4029	289	250						200		289	261		
Augustine S.W.	R	59.3208	153.4492	17	12								17	6		
Ayakulik I.	R	57.2091	154.5714	215	181				147				215	171	162	209
Big River	S	60.6292	152.0092	342	140	100	63		342	37		276			21	
Big Rock	R	59.6115	153.3380	31	31								31			
Big Susitna R. E. channel	S	61.3037	150.5654	69	42					69		0			57	
Big Susitna R. W. channel	S	61.6046	150.6718	27	16					22		0			27	
Douglas R. Reef mid	R	59.0918	153.8130	12	8						9		4	12		
Douglas R. Reef mid E.	R	59.0990	153.7792	104	77						80		104	48		
Douglas R. Reef N.	R	59.1192	153.8683	161	111						60		161			
Douglas R. Reef N.E.	R	59.1060	153.6886	88	69						40		88	78		
Douglas R. Reef W 1	R	59.0994	153.9036	168	79						40		28	168		
Douglas R. Reef W 2	R	59.1070	153.9178	32	32								32			
E of Akumwarik Bay	R	59.0983	154.1155	24	24								24			
E of Amakdedori	R	59.2753	154.0011	66	43						20		66			
E of Horseshoe Cove	R	59.1070	154.1277	101	76						50		101			
E of Iniskin I.	R	59.6258	153.4064	80	80								80			
E of Iniskin I. 1	R	59.6260	153.4112	15	15								15			
Iniskin R. N.	S	59.7400	153.4230	37	37								37			
Iniskin R. S.	S	59.7216	153.4186	65	40						65		14			
Johnson R.	S	60.0075	152.5812	94	42		60		0		94		15			
Juma Reef N.	R	59.1929	154.0734	40	39						40		38			
Juma Reef S.	R	59.1881	154.0709	85	53						20		85			
Kalgin I. N.E. sand bar	S	60.2760	152.0152	143	79						66	143	0		106	
Kalgin I. N.W. sand bar	S	60.2669	152.0239	124	40						18	16	124		0	
Kalgin I. S.E. sand bar	S	60.2052	152.0851	102	75						102	33	90		76	
Kalgin I. S.W. sand bar	S	60.1972	152.0840	106	30						12	106	0		0	
Laney Reef 1	R	59.2955	153.8821	60	60								60			
Laney Reef 2	R	59.2883	153.8848	41	41								41			
Little Jack Slough	S	60.5140	152.2239	71	32	53	1		48	9		71			8	
Little Susitna R. mouth	S	61.2526	150.2600	8	3	8			0	6		0			3	
McArthur R.	S	60.9014	151.6683	20	7					20		0			0	
McNeil Head	R	59.1345	154.1345	66	58						50		66			
Mushroom I.	R	59.6413	153.4469	20	20								20			
N of Big River	S	60.6544	151.9804	300	131	300			0	29		159			167	
No Name Rock	R	59.7422	153.0187	12	4		12		3		0		0			
Nord I. S.	S	59.1500	154.0711	51	51											51
Scott I. S. 1	R	59.6317	153.4328	66	56						45		66			
Scott I. S. 2	R	59.6320	153.4364	11	11								11			
Shaw I. E.	R	59.0037	153.3795	39	24						11		23	39		
Shaw I. N.	R	59.0108	153.3949	280	143						70		80	280		
Shaw I. N.E.	R	59.0074	153.3741	96	50						15		38	96		
Shaw I. N.W.	R	59.0061	153.3971	55	31						13		55	24		
Shaw I. S.W.	R	59.0015	153.3944	23	22								21	23		
Shaw I. W.	R	59.0068	153.3986	44	33								44	21		
Spiridon Bay	R	57.6513	153.6535	117	98			74		117			92	88	114	105
Ushagat I. W.	S	58.9156	152.3612	11	11											11
Vert I.	R	59.6291	153.4518	51	51								51			
Viekoda Bay head	R	57.8355	153.0886	94	50		36			32			52	37	94	

MAX	MEAN
4,530	2,977

95 % Confidence Interval			
2,534	=LOW	3,421	=HIGH

CV	COUNT	SD
7.52	57	223.78

Table 8.

Table 9. The number of seals counted for each site for Zone 8. [Lopez]

(along the south side of Cook Inlet and the Kenai Peninsula to Seward (Resurrection Bay)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Aialik Glacier	I	59.9505	149.7379	57	28					57		0	0	35		46
Bear Glacier	I	59.9435	149.5545	26	11		3					1	0	26	9	24
Beauty Bay	S	59.5514	150.6447	2	1						2	2	0	0	0	0
Berger Bay	R	59.3435	150.7694	18	15								13	15		18
Bradley R.	S	59.7771	150.9950	919	601	125			386			919	807	716	649	606
Chickaloon	S	60.9177	150.0854	148	41	23						148	27	17	14	17
Chugach I.	S	59.1264	151.5099	40	40											40
Chugach I. E.	S	59.1092	151.4487	99	49						17				32	99
Eldarado Narrows	R	59.8910	149.5300	1	1		1									
Hive I.	R	59.8849	149.3532	7	4		7					0				
Home Cove-Nuka Passage	R	59.3868	150.7180	93	57								25		53	93
McCarty Fiord	S	59.6303	150.3176	255	94						77	255	226	1	0	5
McCarty Glacier	I	59.7416	150.2287	272	136						33	102	128	103	272	179
Mike's Bay	R	59.3615	150.7401	18	10						1				18	
N Arm Ledge	R	59.5453	150.5395	27	13						27		0	0	24	13
Nuka I. E side	S	59.3095	150.6774	58	44						30		32	58	49	51
Nuka I. N	R	59.3990	150.6232	2	2								2			1
Nuka I. S.W.	S	59.3037	150.7377	13	8						13					2
Nuka I.-Hardover Pt.	R	59.4174	150.7010	62	21						2		0	62		
Nuka I.-Nuka Pt.	S	59.2943	150.7091	26	16						10			26	16	13
Nuka I.-SW Dahl Cove	R	59.3138	150.7824	22	22								22			
Nuka I.-W Dahl Cove-E rock	R	59.3281	150.7772	35	21								35	22	6	
Nuka I.-W Dahl Cove-E rock 2	R	59.3288	150.7812	14	14										14	
Pedersen Glacier	I	59.8828	149.7700	171	144					109		126	162	150		171
Sixmile Creek	S	60.9095	149.4467	20	7					20		0	0	8	14	2
Touglaalek Bay	R	59.2051	151.2160	22	20										18	22
Yukon I.	Y	59.5136	151.5058	1	0								1		0	0

MAX	MEAN
2,428	1,418

95 % Confidence Interval			
1,148	=LOW	1,689	=HIGH

CV	COUNT	SD
9.58	27	135.82

Table 10. The number of seals counted for each site for Zone 9. [Jansen]

(the following islands in northwestern Prince William Sound: Knight, Latouche, Elrington, Evans, and Bainbridge Islands)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Bainbridge Passage E	R	60.1460	148.0955	35	25							34	30	0	35	
Bay of Isles	R	60.4046	147.6430	18	13			15				12	2	18	18	
Chase I.-Drier Bay	R	60.3261	147.7930	13	11				12			11	5	13	13	
Danger I. W.	unk	59.9285	148.0862	70	18							0	0	0	70	
Danger Island	R	59.9290	148.0758	20	6							0	3	20	0	
Eleanor I. E.	R	60.5453	147.5477	13	3			13			1	0	0	1	2	
Eleanor I.-Pt. Eleanor	R	60.5696	147.5477	8	2			0				0	4	8	0	
Evans I. W.	R	60.0769	148.0823	6	4				5			4	4	0	6	
Evans I.-Guguak Bay	R	60.0936	148.0620	41	20				10			23	25	41	0	
Flemming I. N.	R	60.1845	148.0160	37	30							37	34	21	26	
Herring Bay	R	60.4436	147.7458	35	26				35			27	17	32	19	
Hogg Bay	R	60.0667	148.2080	16	13							9	16	16	12	
Iktua Rocks	R	60.1212	148.0318	45	30				16			38	15	36	45	
Knight I.-Little Bay	R	60.1848	147.7869	4	1				1			0	0	4	0	
Knight I.-Pt. Helen	R	60.1518	147.7635	7	2			5				0	0	7	0	
Latouche Island	R	59.9412	148.0503	90	43							26	42	13	90	
Mummy I.	R	60.2916	147.9382	37	17				8			0	17	37	24	
N. of Squirrel I.	R	60.3465	147.8994	46	38				46			33	34	43	35	
Pleiades I.	R	60.2238	148.0120	1	0				1			0	0	0	0	
Procession Rocks	R	60.0078	148.2872	10	7							2	9	10		
Short Arm, Bay of Isles, Knight I.	R	60.3824	147.6716	23	10			5			10	0	12	7	23	
Squire Island	R	60.2523	147.9713	9	5				9			4	0	5	7	
Twin Bay N.	R	59.9595	148.2074	3	1							0	3	0	0	
Unnamed Cove	R	60.4443	147.6314	4	2			4			0	0	4	4	0	
Verdant I., Knight I. Pasage	R	60.2700	148.1988	2	1							2	0	0	0	

MAX	MEAN
593	326

95 % Confidence Interval			
267	=LOW	385	=HIGH

CV	COUNT	SD
9.14	25	29.78

Table 11. The number of seals counted for each site for Zone 10. [Moran]

(along the west side of Prince William Sound from Resurrection Bay north to Pigot Bay)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Anchor Cove N.	R	60.0016	149.0892	16	12								16	9	14	7
Bainbridge Passage W	R	60.1759	148.1257	2	1										2	0
Bay N. of Nellie Juan glacier	R	60.4918	148.3876	0	0								0	0	0	0
Cape Fairfield	R	59.9222	148.8233	46	28								0	46	41	25
Cape Puget	R	59.9398	148.4371	20	12								0	15	14	20
Cape Resurection	R	59.8896	149.3019	0	0								0	0	0	0
Cheval I.	R	59.7747	149.5240	8	5								3	2	8	5
Cochrane Bay E.	R	60.6567	148.3523	17	10								0	15	17	8
Cochrane Bay W.	R	60.6864	148.3752	10	4								0	10	4	0
Crafton Island	R	60.5020	147.9511	0	0								0	0	0	0
Crafton Island W.	R	60.4890	147.9430	24	13								24	11	2	14
Culross Passage N	R	60.7196	148.2403	20	12								14	13	1	20
Culross Passage-Goose Bay	R	60.6869	148.2264	0	0								0	0	0	0
Day Harbor N.	R	60.0419	149.0841	11	5								0	2	5	11
Day Harbor N.E.	R	60.0266	149.0539	1	0								1	0	0	0
Day Harbor N.W.	R	60.0388	149.1221	74	61								60	66	74	44
Eshamy Bay E.	R	60.4432	147.9735	16	13								13	12	12	16
Eshamy Bay W.	R	60.4425	147.9881	5	2								0	0	2	5
Excelsior Glacier	I	59.9761	148.7698	39	31								31	37	39	18
Hive I.	R	59.8866	149.3596	11	4								0	3	11	0
Hive I. S.E.	R	59.8763	149.3859	1	0									0	1	0
Junction Island	R	60.3910	147.9903	47	37								35	35	32	47
McClure Bay	R	60.5403	148.1763	0	0								0	0	0	0
Nellie Juan glacier	I	60.4671	148.3376	16	13								15	16	16	5
Nellie Juan N.	R	60.4862	148.2853	0	0								0	0	0	0
Passage Canal	R	60.8198	148.4181	0	0								0	0	0	0
Port Bainbridge N.W.	R	60.0759	148.3589	1	1								1	0	1	0
Port Bainbridge S.	R	60.0064	148.3924	1	1								1	0	0	1
Puget Bay	R	60.0201	148.5229	2	1								0	2	0	0
Whale Bay S.	R	60.1410	148.2065	4	2								4	1		0

MAX	MEAN
392	265

95 % Confidence Interval			
231	=LOW	299	=HIGH

CV	COUNT	SD
6.40	23	16.95

Table 12. The number of seals counted for each site for Zone 11. [Withrow]

(along the north and east sides of Prince William Sound from Pigot Bay to Olsen Bay (including College Fjord and Valdez Arm)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Bryn Mawr	I	61.2289	147.7970	0	0									0		
Columbia	I	61.1117	147.0696	7	7			7								
Coxe	I	61.1199	148.1561	0	0									0		
Eaglet Bay NE 1	R	60.9019	147.7343	32	22				26	26	26	32	6	19	20	18
Eaglet Bay NE 3	R	60.9016	147.7282	11	3								11	0	0	0
Eaglet Bay S	R	60.8262	147.7169	4	1					1	4	4	0	0	0	0
Eaglet Bay SW	R	60.8439	147.7310	24	14						2	24	24	14	4	18
Egg Rock	R	60.7743	147.9639	12	9						5	12	12	5	8	11
Ester Rock	R	60.8015	148.1793	2	1							2	2	1	0	0
Fairmont Bay	R	60.9014	147.4000	7	3						7	0	1	4	5	2
Fish Bay	R	60.8175	146.4378	4	1				4		0	0	0	1	2	0
Harriman	I	60.9721	148.4346	0	0									0		
Harvard	I	61.2589	147.7092	42	41									42		40
Jack Bay	R	61.0126	146.5399	17	7						7	0	0	8	17	9
Jonah Bay Inside	R	61.0089	147.6054	19	5			4		4	19	0	0	2	12	1
Jonah Bay Mouth	R	61.0004	147.6415	20	7			20		11	18	0	0	0	5	0
Long Bay NW	W	60.9937	147.2749	17	7						17	8	8	0		0
Mears #1	I	61.0066	147.4886	88	44									88	0	
Mears #2	I	61.1485	147.5327	65	43									20	65	
N of Granite Bay	R	60.9164	148.0922	0	0						0	0	0	0	0	0
Perry Island N	R	60.7364	148.0087	2	0						0	0	0		0	2
Perry Island S	R	60.6605	147.8674	13	3						0	0	0	5	0	13
Roaring	I	61.0486	148.4124	0	0									0		
Seal Island	R	61.0889	146.4134	27	10						23	27	0	0	0	
Smith	I	61.2439	147.7643	0	0									0		
Upper Wells Bay E	R	60.9605	147.4702	12	4			12			0	9	2	0	0	5
Upper Wells Bay NW	R	61.0066	147.4886	3	1			3			0		0	0	0	0
W of Golden	R	60.9680	148.0117	21	10						11	21	12	7	0	7
Wellesley	I	61.1831	147.8611	0	0									0		
Wells Bay Middle 1	R	60.9308	147.4867	37	20			12		21	3	24	28	26	10	37
Wells Bay Middle 2	R	60.9305	147.4820	16	9			15		9	9	16	15	1	6	0
Wells Bay Middle 3	R	60.9292	147.4821	68	48			40		34	44	54	48	48	51	68
Yale	I	61.2345	147.6278	110	89									110		68

MAX	MEAN
680	408

95 % Confidence Interval			
298	=LOW	518	=HIGH

CV	COUNT	SD
13.62	32	55.56

Table 13. The number of seals counted for each site for Zone 12. [Olesiuk]

(the ADF&G trend route "A" which runs from Olsen Bay south to Hinchenbrook Island and areas in central Prince William Sound)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/12/01	8/13/01	8/14/01	8/15/01	8/16/01	8/17/01	8/18/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
AGNES ISLAND	R	60.6400	146.2983	53	32	21	27	32	24	30		31	26		29	53		43
APPLEGATE ROCKS	R	60.3500	147.4033	173	107	105	121	139		173	152	63		61	126	114	39	85
BIG SMITH	R	60.5333	147.3183	45	16	15	14	20	22	20	45			5	4	6		6
CANOE PASSAGE	R	60.5233	146.1400	56	17	0	1	1	2	0			23		56	14	40	35
CHANNEL ISLAND	R	60.2333	147.3717	78	37	9	9	7	7		19	63		66	60	41	48	78
DOUBLE BAY	R	60.4700	146.4567	17	7	1	0	0	0	0			17		15	16	16	0
DUTCH GROUP	R	60.7400	147.8067	124	78	29	32	39	29	25		123	104	124	124	123		103
FAIRMOUNT	R	60.8700	147.4433	19	10	16	15	18	14	19		8	0	0	4	3		9
GRAVINA ISLAND	R	60.6400	146.2983	12	2	7	0	12	0	0	0		9	1	0	0	0	0
GRAVINA ROCKS	R	60.6550	146.2583	39	16	1	0	0	0	0	27		19	39	25	30	31	19
GREEN ISLAND	R	60.2933	147.4200	32	15	3	21	17	15	13		17			14	32	12	10
L AXEL LIND	R	60.8067	147.6450	0	0	0	0	0	0	0		0	0	0	0	0		0
LITTLE GREEN	R	60.1883	147.5383	43	33	40	42	35	27	30		23			31	30		43
LITTLE SMITH	R	60.5050	147.4267	33	16	8	7	9	8	7	7			33	24	30	18	30
MONTAGUE POINT	R	60.3700	147.0750	8	1	0	0	0	0	0				0	8	0	0	1
OLSEN BAY	R	60.7083	146.1850	75	39	0	15	22	24	38	75		36	48	41	49	59	55
OLSEN ISLAND	R	60.8567	147.5700	12	5	11	8	12	0	0			5	4	9	5		0
PAYDAY	R	60.9033	147.5050	3	1	0	0	2	1	3			0	0	0	0		0
POINT PELLEW	R	60.8517	147.6767	2	1	0	2	1	1	0			0	0	2	1		0
PORCUPINE	R	60.7133	146.6867	0	0	0	0	0	0	0			0	0	0	0	0	0
PORT CHALMERS	R	60.2250	147.2750	144	98	98	93	81	60	97				108	118	144	95	88
ROCKY BAY	R	60.3400	147.0267	50	32	21	29	28	23	24				30	44	50	24	48
SCHOONER ROCKS	R	60.3033	146.9083	18	10	10	7	5	8	15				6	14		5	18
SEAL ISLAND	R	60.4250	147.4017	37	25	22	15	25	22	37	21			25	31	28	27	26
SHEEP POINT	R	60.6133	146.0150	0	0	0	0	0	0	0	0		0	0	0	0	0	0
STOCKDALE HBR	R	60.3033	147.2033	44	15	2	1	2	0	0				25	22	38	17	44
STOREY ISLAND	R	60.7417	147.3817	16	4			9	4	16			0		0	0		0

MAX	MEAN
1,133	617

95 % Confidence Interval			
566	=LOW	668	=HIGH

CV	COUNT	SD
4.20	24	25.94

Table 14. The number of seals counted for each site for Zone 13. [Cesarone]

(runs west out of Cordova along the south sides of Hinchenbrook and Montague Islands, and southeast out of Cordova to Kayak Island (including the Copper River Delta and Middleton Island offshore)

Location	Substrate	Latitude	Longitude	MAX	MEAN	8/15/01	8/16/01	8/17/01	8/18/01	8/19/01	8/20/01	8/21/01	8/22/01	8/23/01	8/24/01	8/25/01
Bering Lake mouth	S	60.2700	144.1882	15	8									0	15	
Bering River	S	60.2384	144.1711	3	2									3	0	
Copper River Channel N. 1	S	60.7043	144.6237	102	79							102		102	34	
Copper River Channel S. 1	S	60.5724	144.8428	60	59							57		59	60	
Copper River Channel S. 2	S	60.5515	144.8557	162	112							52	140	100	162	106
Copper River Delta mount 6	S	60.3030	145.0867	321	258				321					194		
Copper River Delta mouth 1	S	60.3184	145.0519	508	383		444		424			281		508	258	
Copper River Delta mouth 10	S	60.2873	145.0872	606	421		606		235							
Copper River Delta mouth 2	S	60.3085	145.0265	957	445		247		38			957		617	364	
Copper River Delta mouth 3	S	60.3191	145.0242	164	98				164			111		19		
Copper River Delta mouth 4	S	60.3254	145.0248	347	219		67					347		244		
Copper River Delta mouth 5	S	60.3008	145.0368	534	279		534							188	116	
Copper River Delta mouth 7	S	60.3341	145.0052	243	129		12		131			243		163	98	
Copper River Delta mouth 8	S	60.2884	145.0920	235	141				46						235	
Copper River Delta mouth 9	S	60.3349	145.0174	153	86		18								153	
Copper River E. upper mouth	S	60.4348	144.8682	177	44				177			0		0	0	
Copper River E. upper mouth 2	S	60.4400	144.8576	17	9									0	17	
Copper River E. upper mouth 3	S	60.4592	144.8229	199	184									199	168	
Egg I. Channel 1	S	60.3406	145.6726	81	53		25		81							
Egg I. Channel 2	S	60.4074	145.7403	81	29				6			81		0		
Egg I. Channel 3	S	60.4066	145.7234	27	12				10			0		27		
Eyak R. mouth	S	60.4067	145.5682	24	24									24		
Hawkins I. Cutoff central	S	60.4670	146.0559	229	170	60		188		133		213	229	167		199
Hawkins I. Cutoff N.W.	S	60.4427	146.3395	307	235			250		270		237	307	304		40
Hawkins I. Cutoff S.W.	S	60.4092	146.3364	22	19					12		20	18	22		21
Hawkins I. S. central coast	S	60.5025	146.0029	135	58	70		27		32		56	17	135		66
Hawkins I. S. of Knot Pt.	R	60.5684	145.7848	11	2	11				0		0	0	0		0
Hinchinbrook I.-Garden Cove	R	60.3368	146.5370	7	2					7			0			0
Hinchinbrook I.-Phipps Pt.	R	60.3513	146.6013	23	10					23			8			0
Hinchinbrook I.-Porpoise Rocks	R	60.3170	146.6903	4	1					4			0			0
Kayak I. E. central	R	59.8930	144.4023	12	10		12					12		11	4	
Kayak I. E. central S.	R	59.8533	144.4845	38	25		12					38		27	24	
Kayak I. N.E.	R	59.9533	144.2418	68	51		68					40		30	67	
Kayak I. S. E. tip	R	59.7842	144.5597	25	14		6					9		16	25	
Kayak I. S. tip	R	59.7756	144.6100	200	50		200					0		0	0	
Kayak I. W. central coast	R	59.9063	144.4577	34	32									29	34	
Kayak I. W. central S.	R	59.8722	144.5227	71	24		5					16		71	2	
Middleton I. E.	R	59.4583	146.2693	194	123				129				11		157	194
Middleton I. E.S.E.	R	59.4347	146.2683	288	121				111				51		34	288
Middleton I. S.	S	59.4055	146.3072	210	127				89				90		210	117
Middleton I. W.	R	59.3892	146.3725	635	408				405				104		488	635
Montague I. Cape Cleare	R	59.7710	147.9170	22	9					3			22			1
Montague I. N. of Box Pt.	R	59.9919	147.3562	21	10			21					9			0
Montague I. N.E. of Cape Cleare	R	59.7873	147.7722	13	8					12			0			13
Montague I. Pt. Bazil	R	59.9753	147.7050	54	45					35			46			54
Montague I. San Juan Bay N.	R	59.8179	147.9024	34	29					29			24			34
Montague I.-Box Pt.	R	59.9586	147.3265	1	0			1		0			0			0
Montague I.-Jeanie Cove	R	59.8367	147.6257	12	6					12						0
Montague I.-S. of Jeanie Cove	R	59.8050	147.6540	8	4			1		3			5			8
Montague I.-S. of Montague Peak	R	60.1740	147.1099	17	14			17		12			11			15
Montague I.-S. of Patton Bay 1	R	59.8556	147.4521	1	0			1		0			0			0
Montague I.-S. of Patton Bay 2	R	59.8431	147.4556	186	154			104		152			186			173
Montague I.-S. of Patton Bay 3	R	59.8386	147.4522	12	10			12		10			9			
Montague I.-S. Patton Bay	R	59.9036	147.4352	15	4			15		0			0			0
Montague I.-Wooded I.	R	59.8594	147.3698	2	1					2			0			0

Montague I.-Zaikof Pt.	R	60.3033	146.9073	15	10			11		15			9			4
Observation I. N.	R	60.6238	145.7065	14	5			14						0		0
Observation I. S.	R	60.6080	145.7221	2	1			1				0	2	0		0
Orca Inlet central	S	60.5337	145.8575	61	61					61						
S. of Okalee Spit	S	59.9765	144.3735	6	2							6		0	0	
Wingham I. S.	R	60.0028	144.1248	49	33							8		42	49	

MAX	MEAN
8,074	4,956

95 % Confidence Interval			
4,219	=LOW	5,694	=HIGH

CV	COUNT	SD
7.53	61	373.27

Table 14.

Table 15. Summary statistics for the Gulf of Alaska region (all zones combined).

	Maximum	Mean	95 % Confidence Interval		No. Sites	SD	CV
			Low	High			
Zone 1	853	636	581	691	22	27.55	4.33
Zine 2	2,479	1,755	1,651	1,858	108	52.65	3.00
Zone 3	4,190	2,941	2,736	3,145	70	103.64	3.52
Zone 4	6,846	4,834	4,154	5,513	31	342	7.08
Zone 5	1,880	1,339	1,240	1,437	24	49.64	3.71
Zone 6	1,654	909	808	1,010	52	51.17	5.63
Zone 7	4,530	2,977	2,534	3,421	57	223.78	7.52
Zone 8	2,428	1,418	1,148	1,689	27	135.82	9.58
Zone 9	593	326	267	385	25	29.78	9.14
Zone 10	392	265	231	299	23	16.95	6.40
Zone 11	680	408	298	518	32	55.56	13.62
Zone 12	1,133	617	566	668	24	25.94	4.20
Zone 13	8,074	4,956	4,219	5,694	61	373.27	7.53
Zones 1-13	**37,219**	**24,428**	**23,265**	**25,591**	**556**	**592.91**	**2.43**

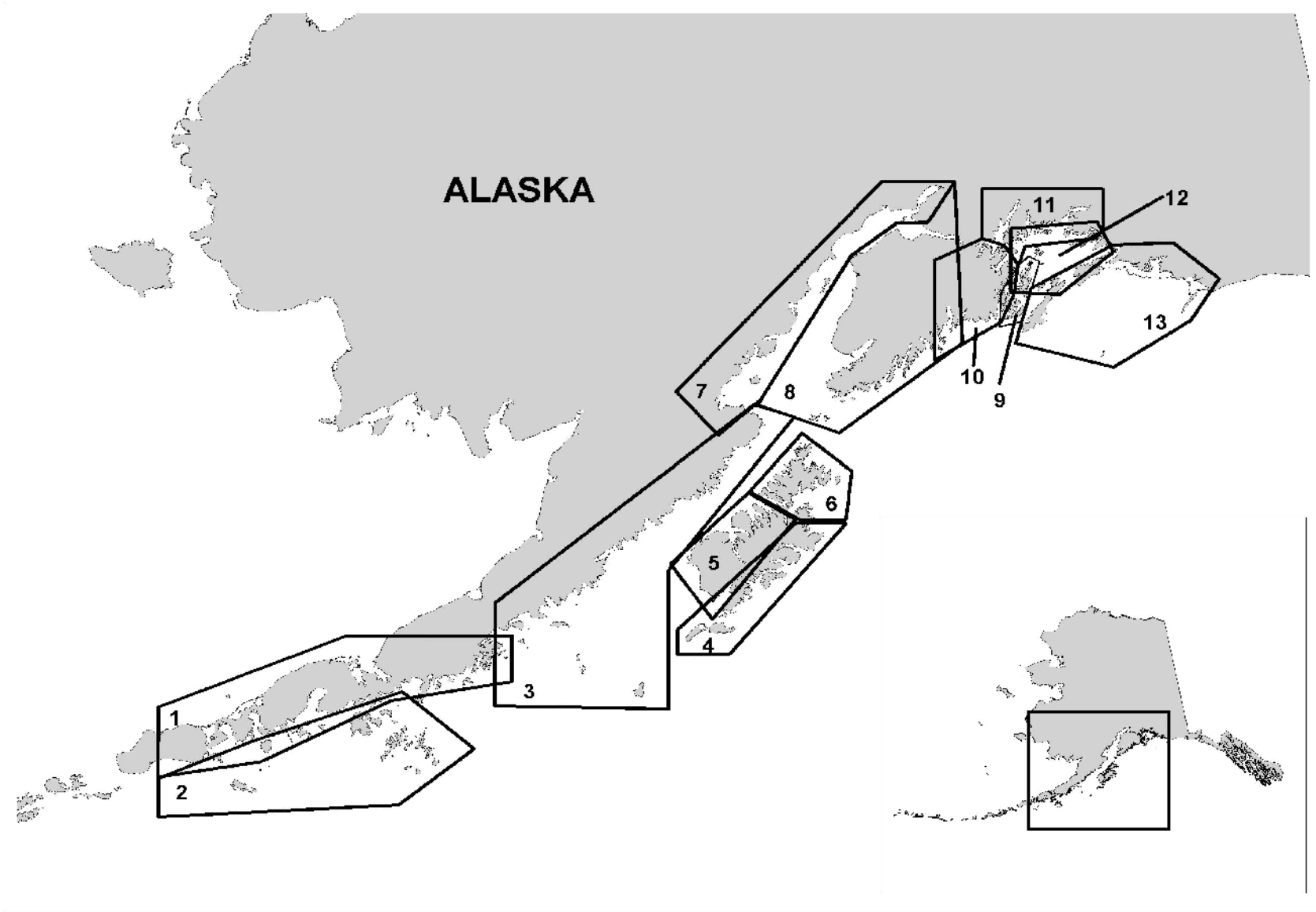

Figure 1. Chart of the thirteen survey zones for the Gulf of Alaska in 2001.

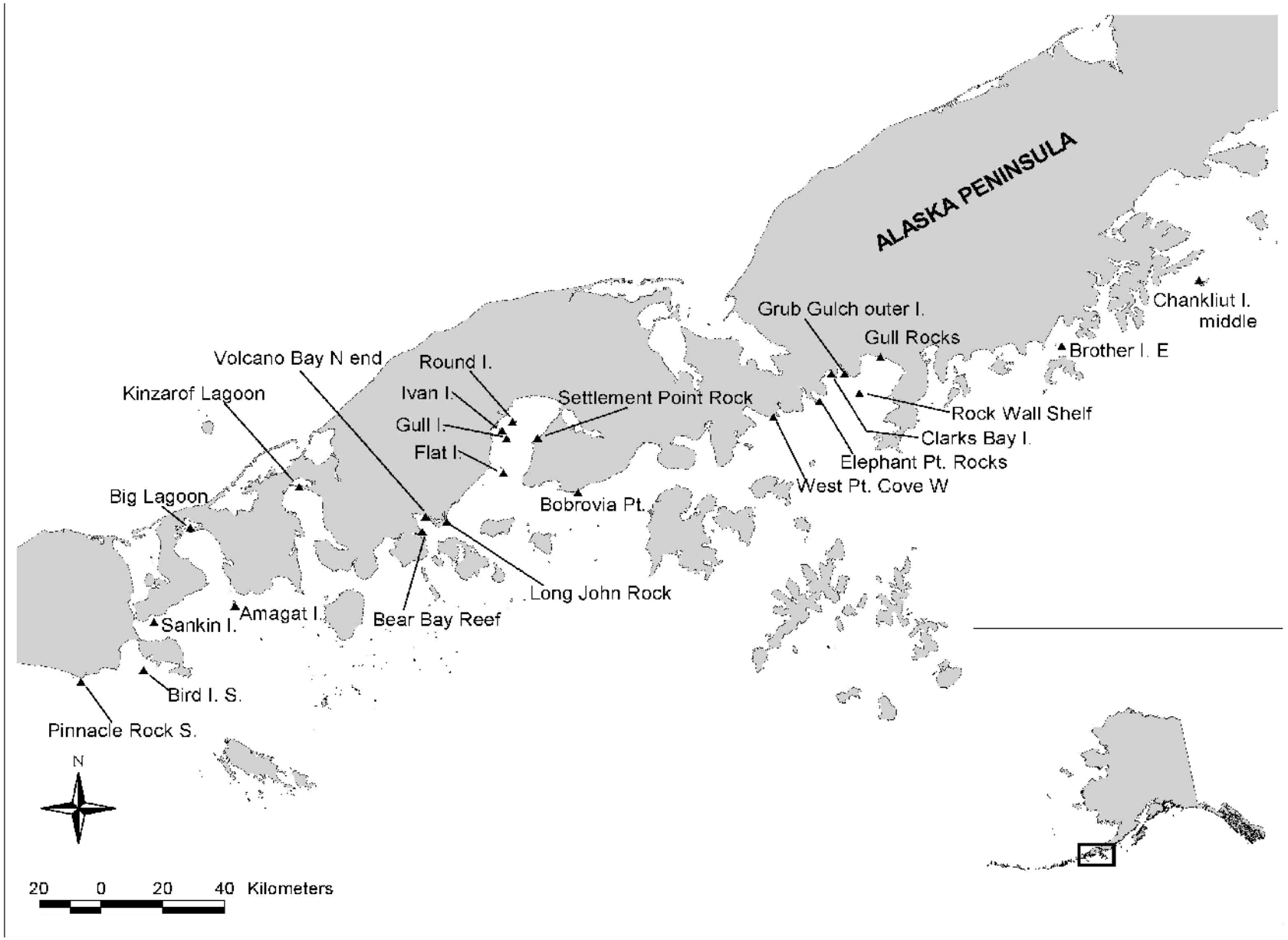

Figure 2. Zone 1. South side of the Alaska Peninsula from Unimak Pass to Chignik Bay.

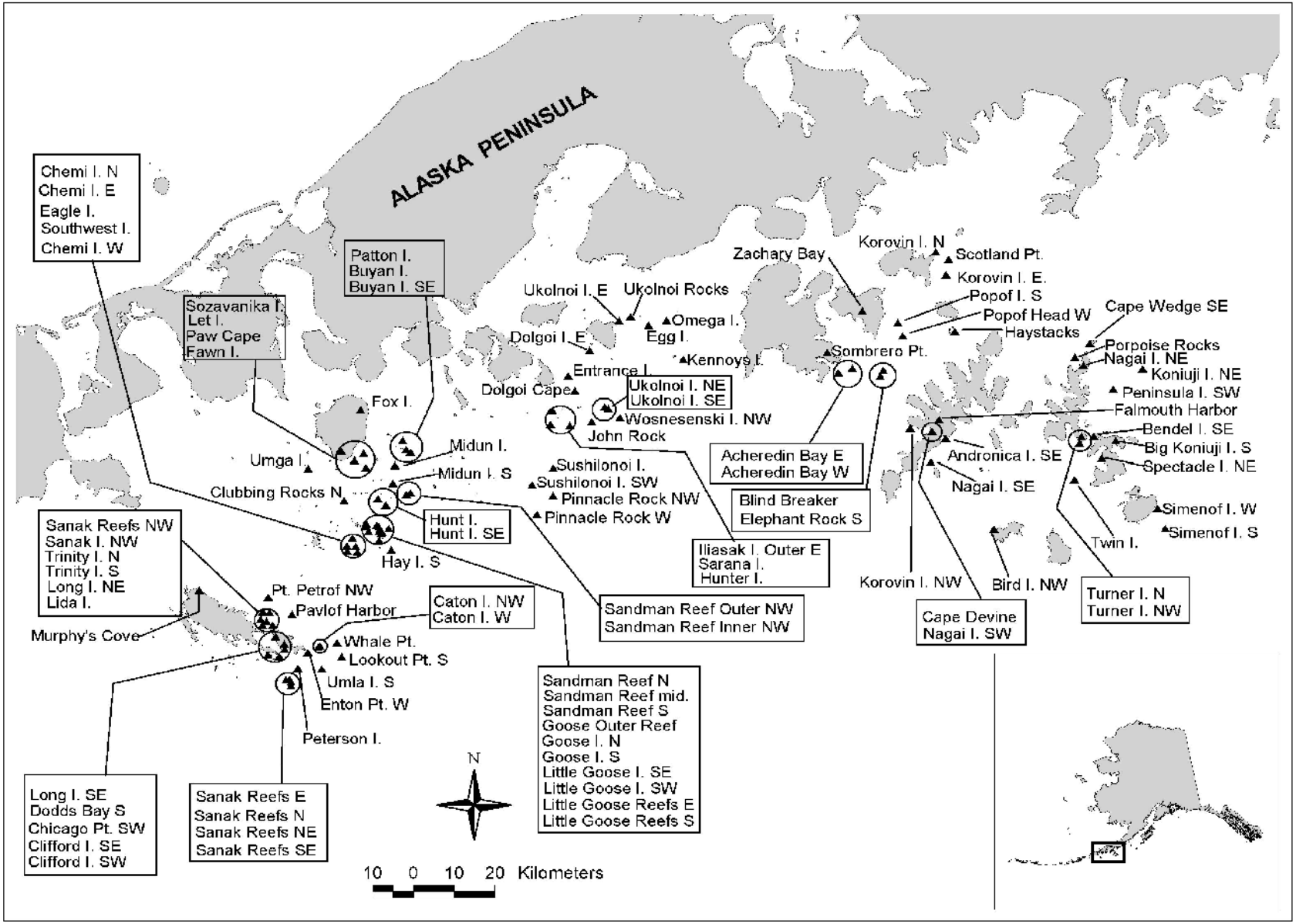

Figure 3. Zone 2. Offshore islands along the south side of the Alaska Peninsula from Unimak Pass to Chignik Bay.

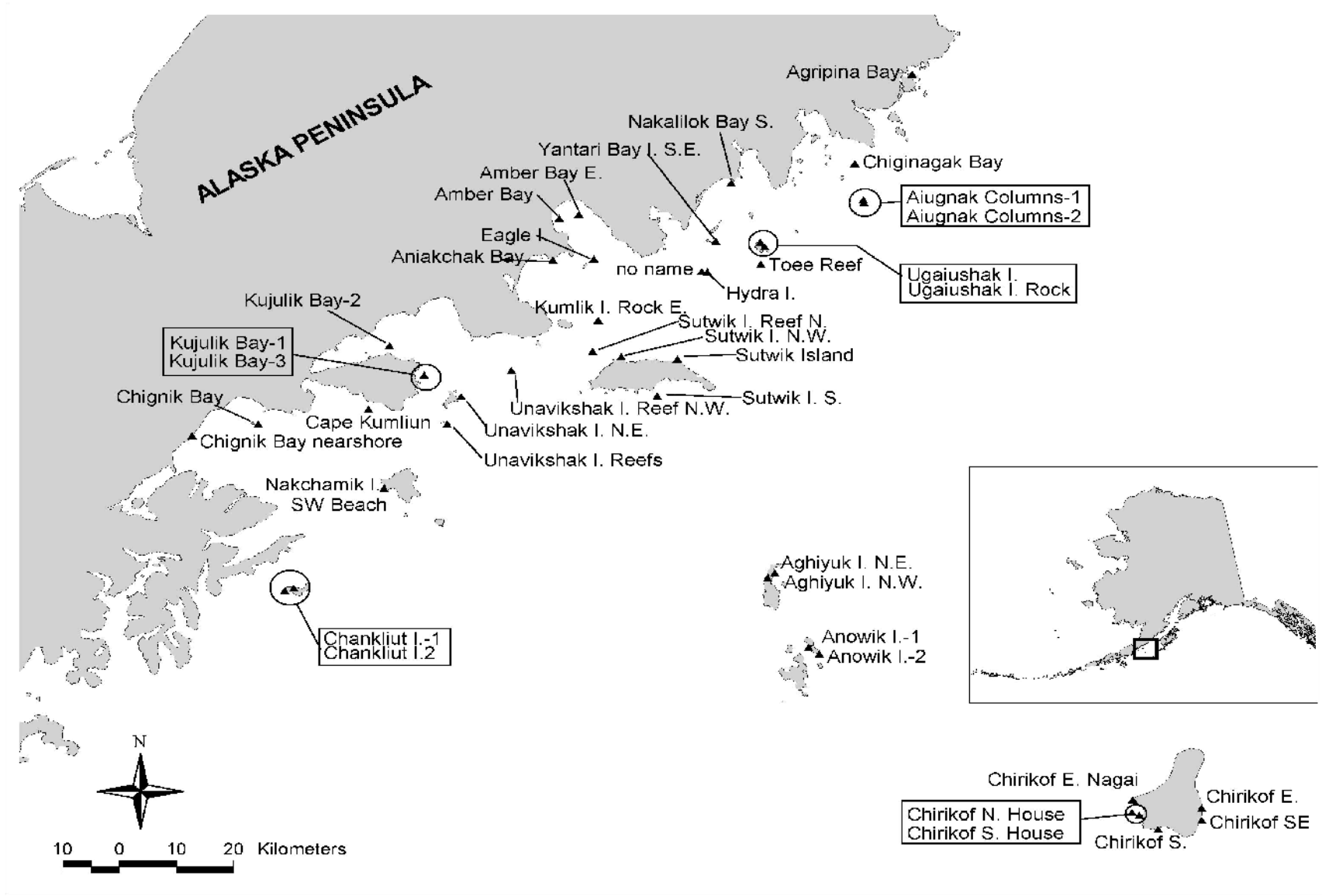

Figure 4a. Zone 3. South side of the Alaska Peninsula from Chignik Bay to Agripina Bay.

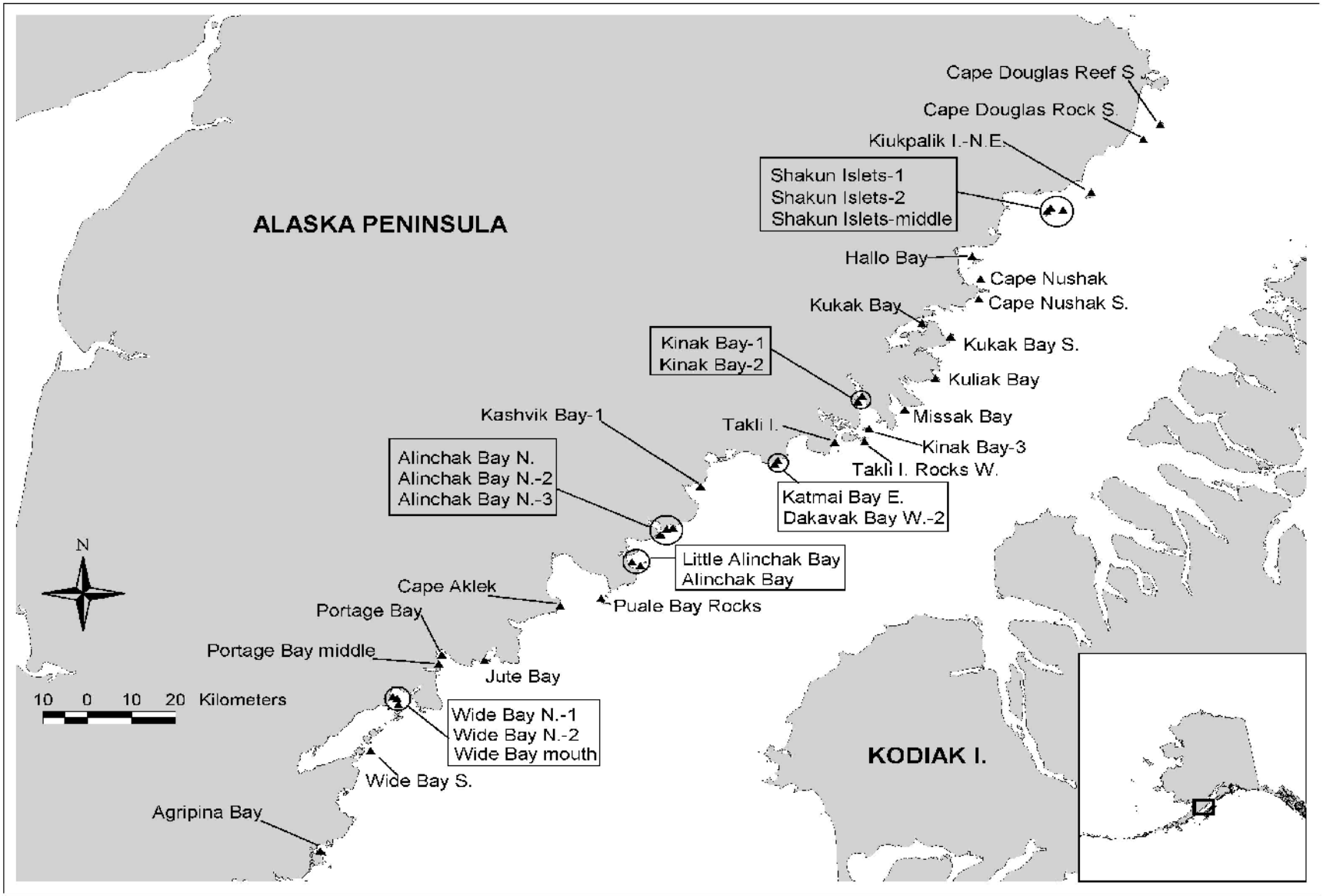

Figure 4b. Zone 3. South side of the Alaska Peninsula from Agripina Bay to Cape Douglas.

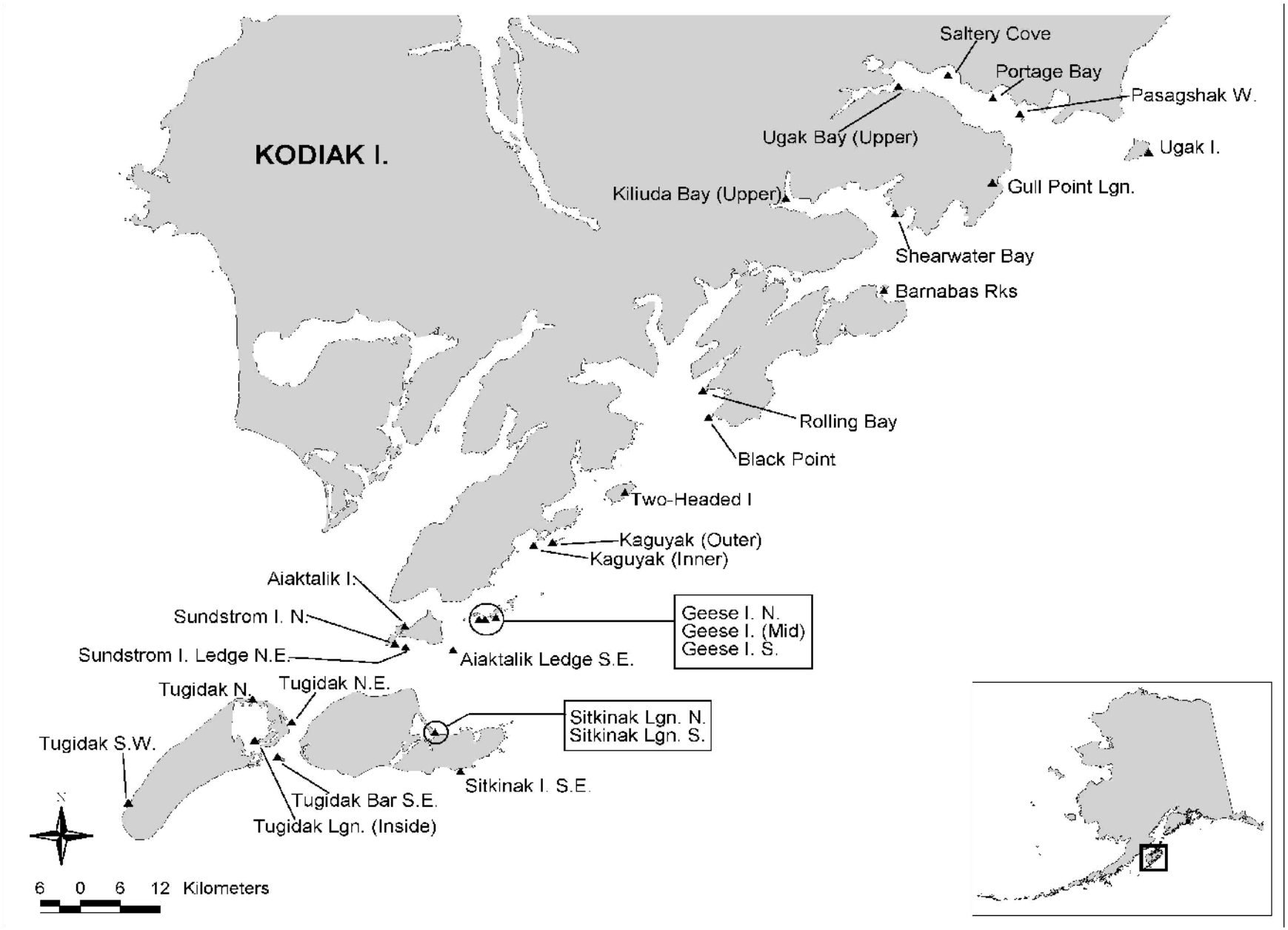

Figure 5. Zone 4. South side of Kodiak Island including Sitkinak and Tugidak Islands.

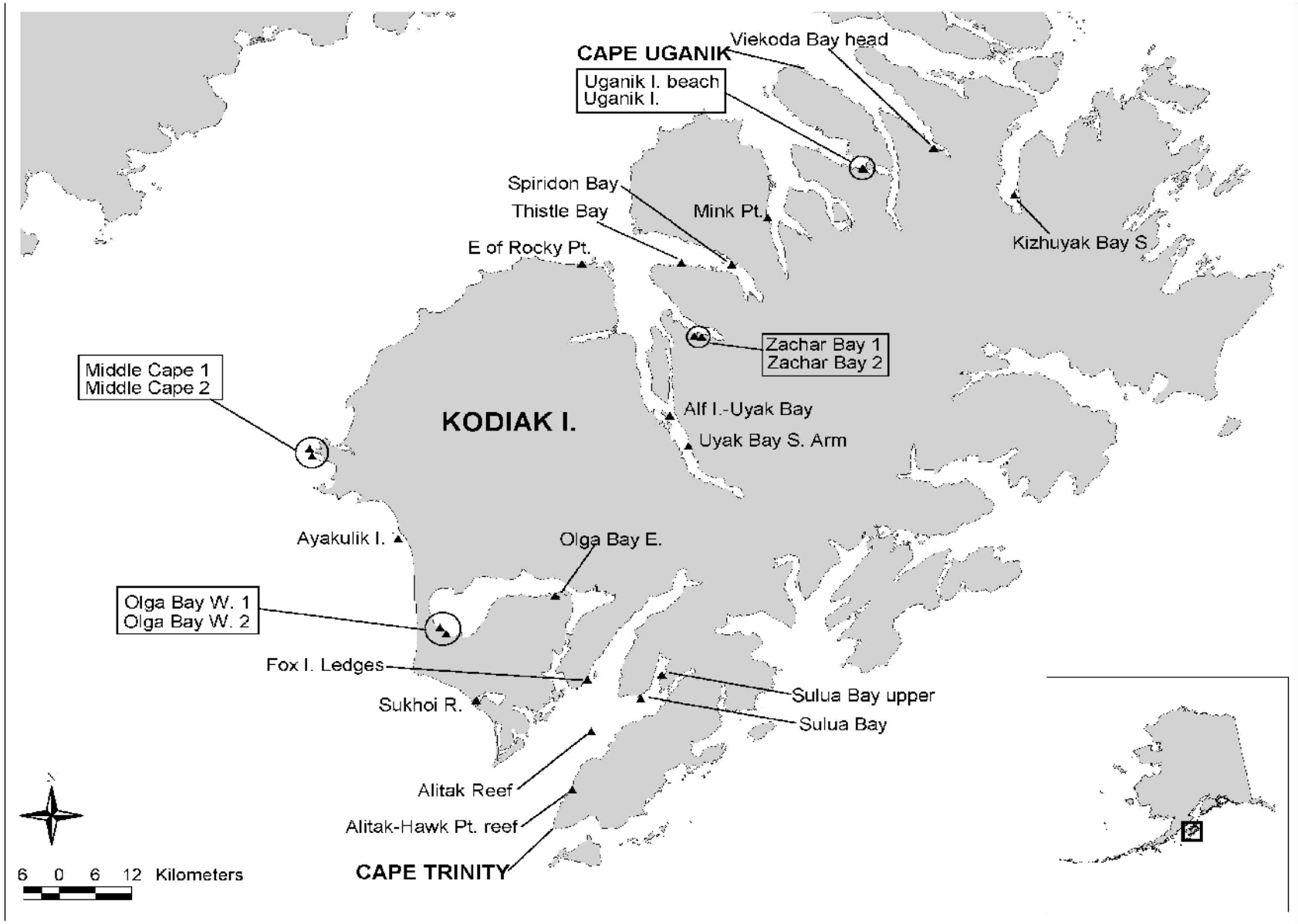

Figure 6. Zone 5. North and west ends of Kodiak Island from Cape Trinity to Cape Uganik.

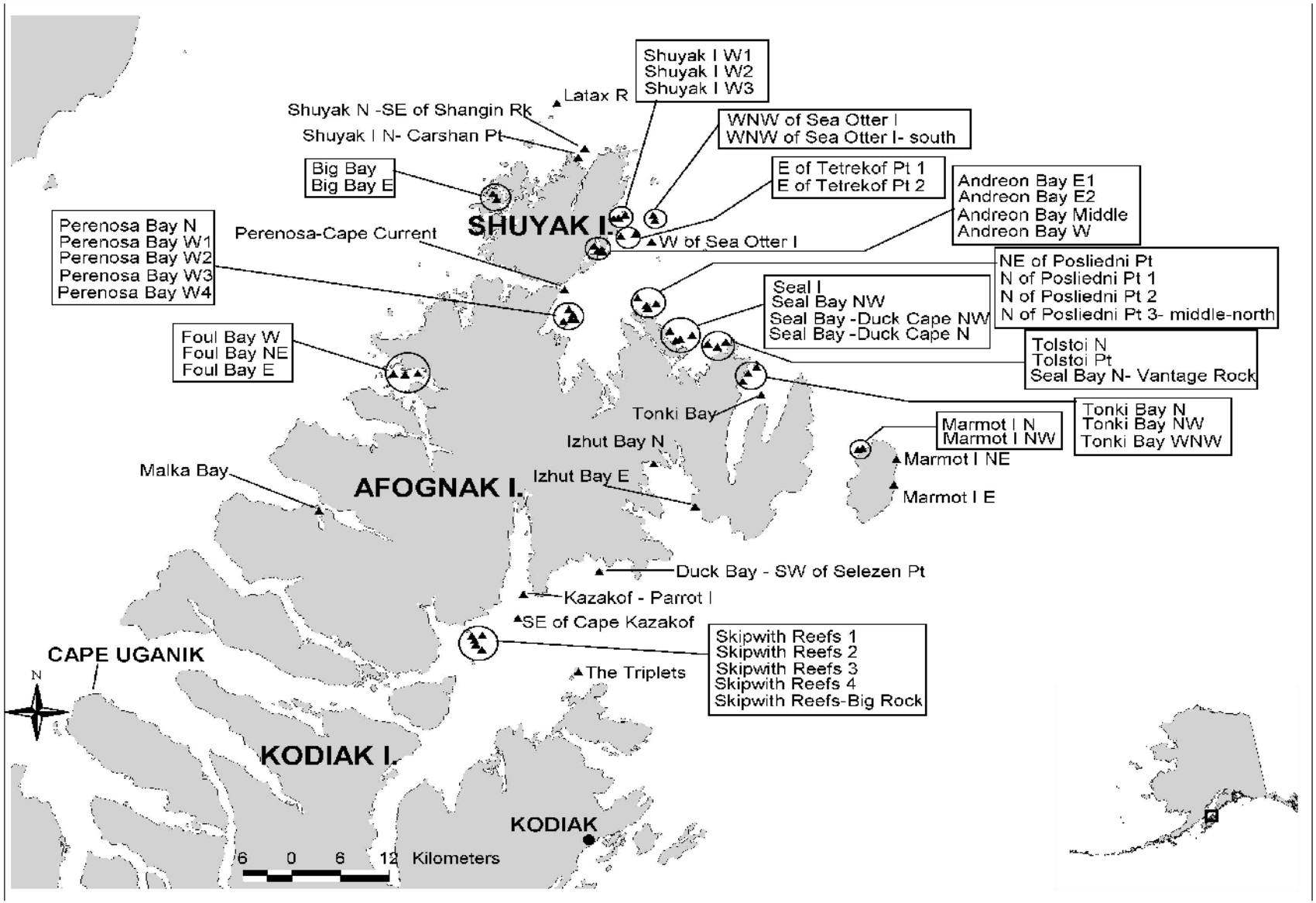

Figure 7. Zone 6. North and east ends of Kodiak Island from Cape Uganik to the town of Kodiak.

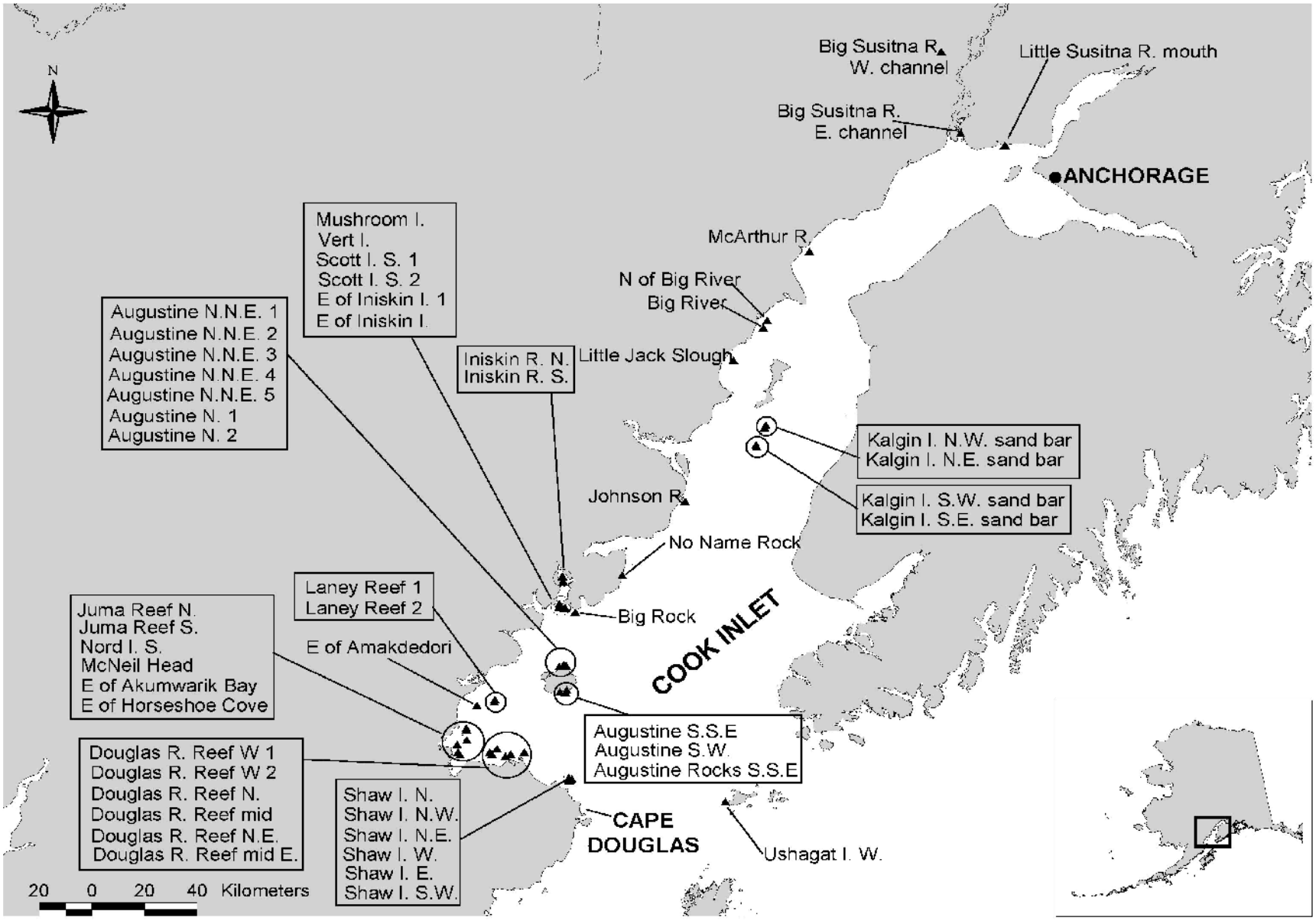

Figure 8. Zone 7. North side of Cook Inlet from Cape Douglas to Anchorage.

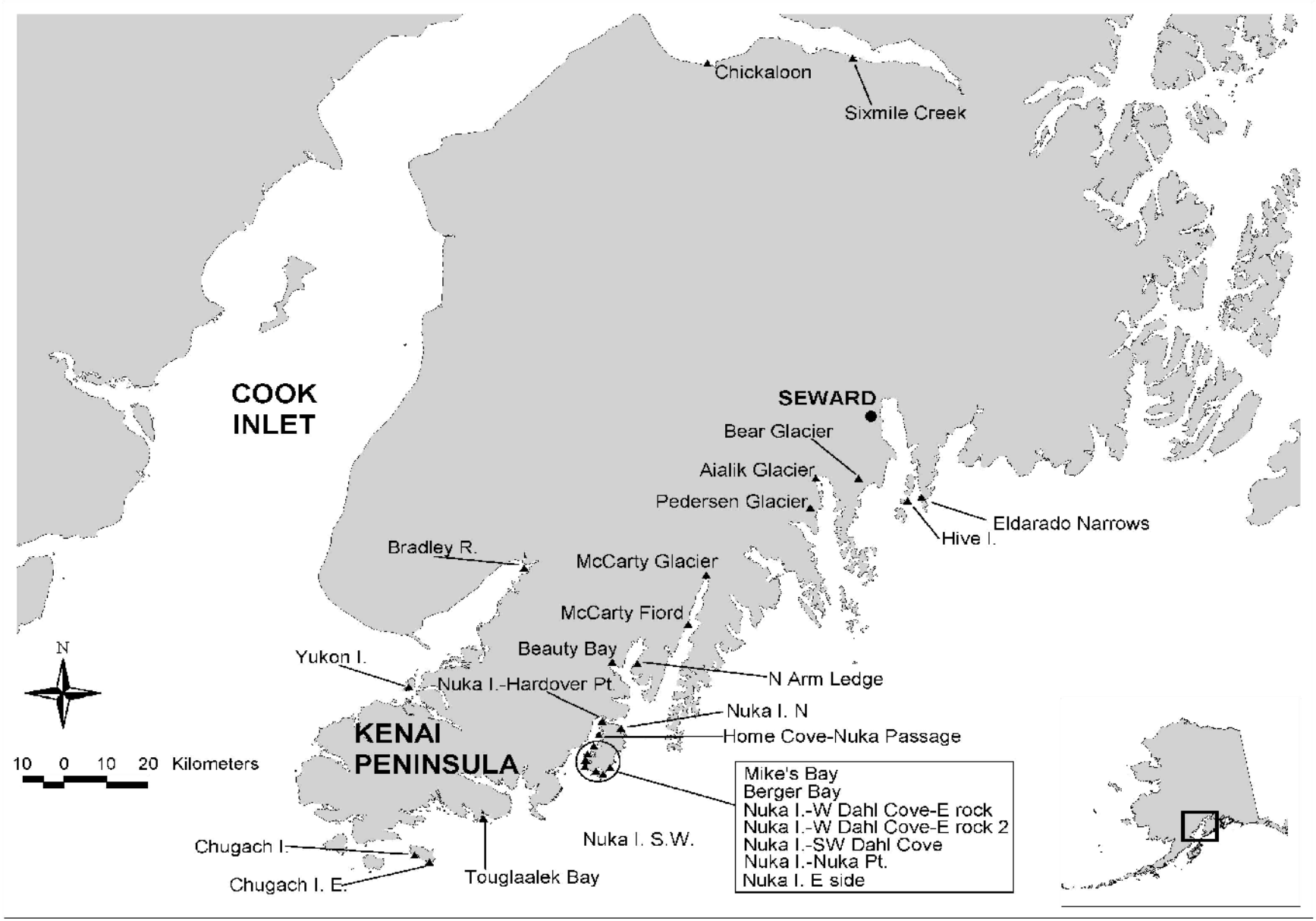

Figure 9. Zone 8. South side of Cook Inlet and Kenai Peninsula to Seward.

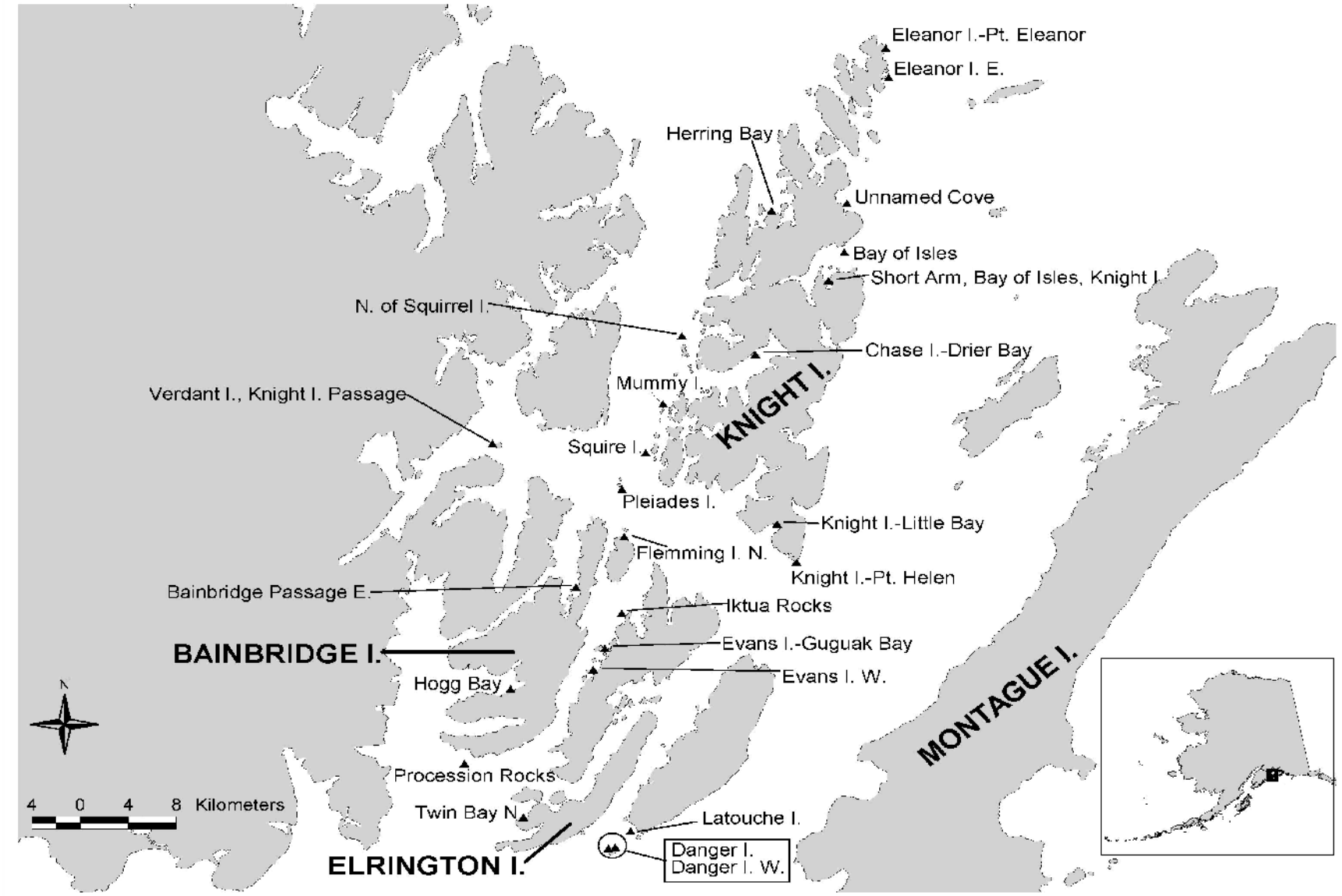

Figure 10. Zone 9. Cape Resurrection (Seward) to Pigot Bay, northwest Prince William Sound.

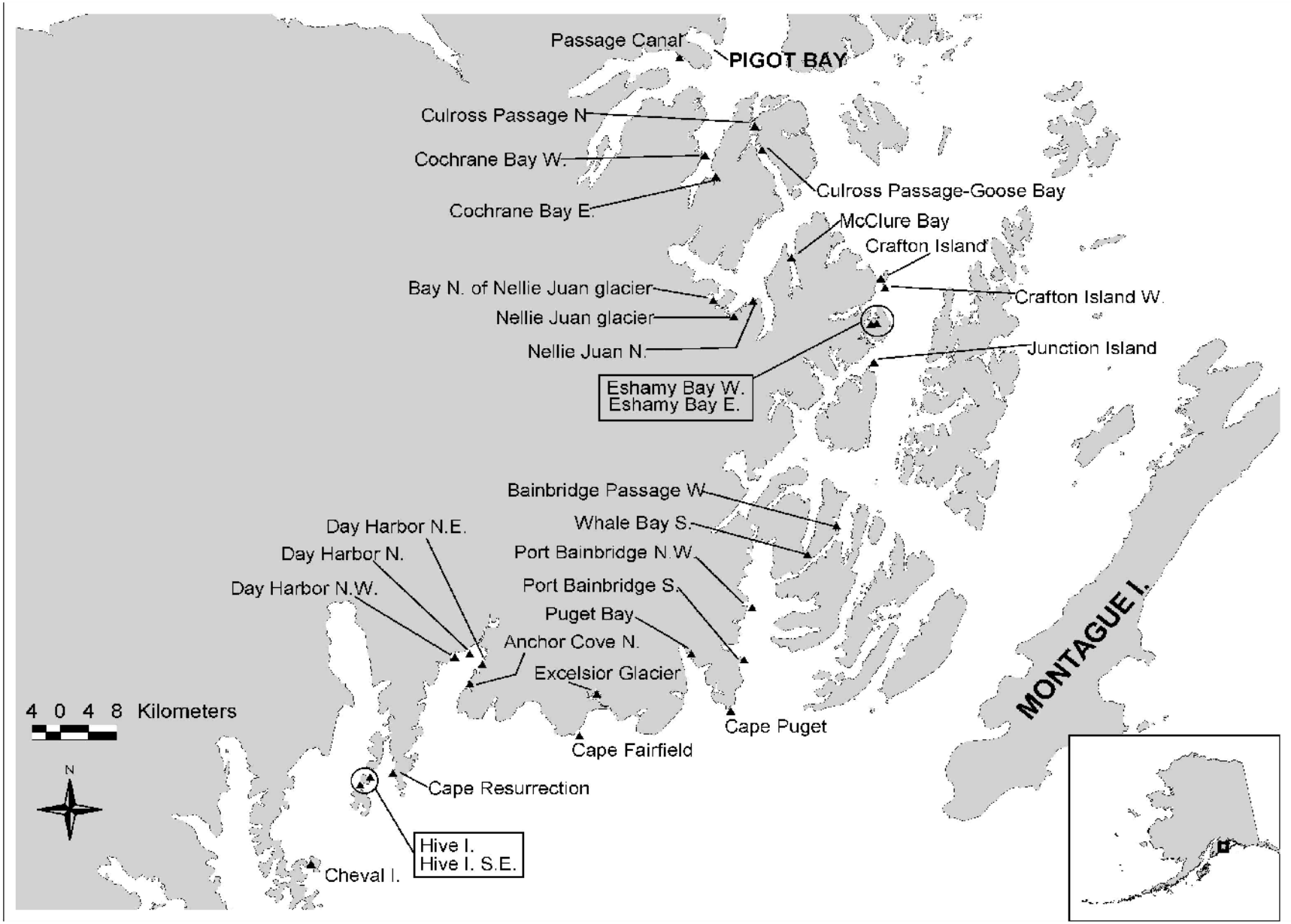

Figure 11. Zone 10. Knight, Latouche, Elrington, Evans, and Bainbridge Islands in NW Prince William Sound.

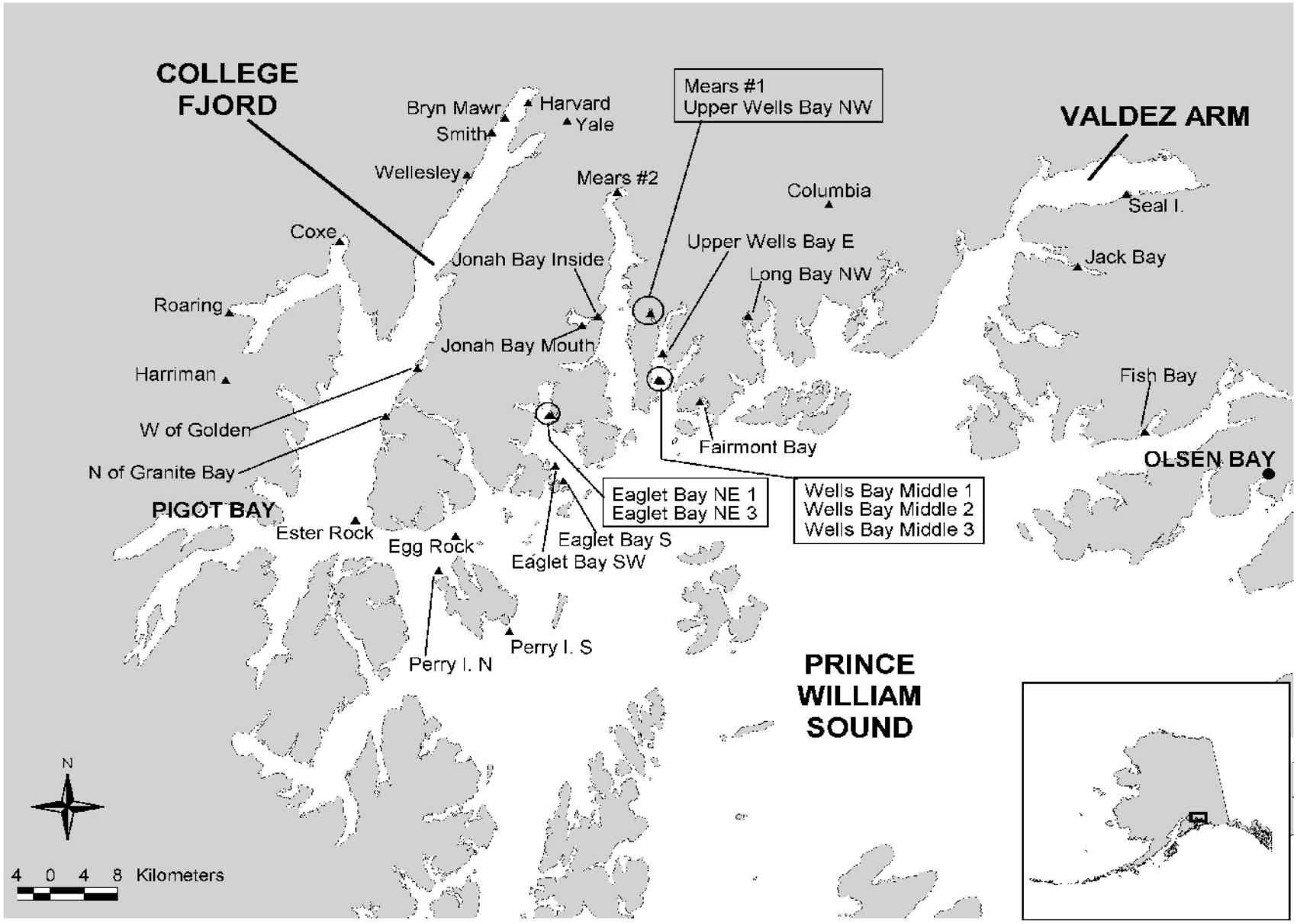

Figure 12. Zone 11. Pigot Bay to Olsen Bay, including College Fjord and Valdez Arm, in northern Prince William Sound.

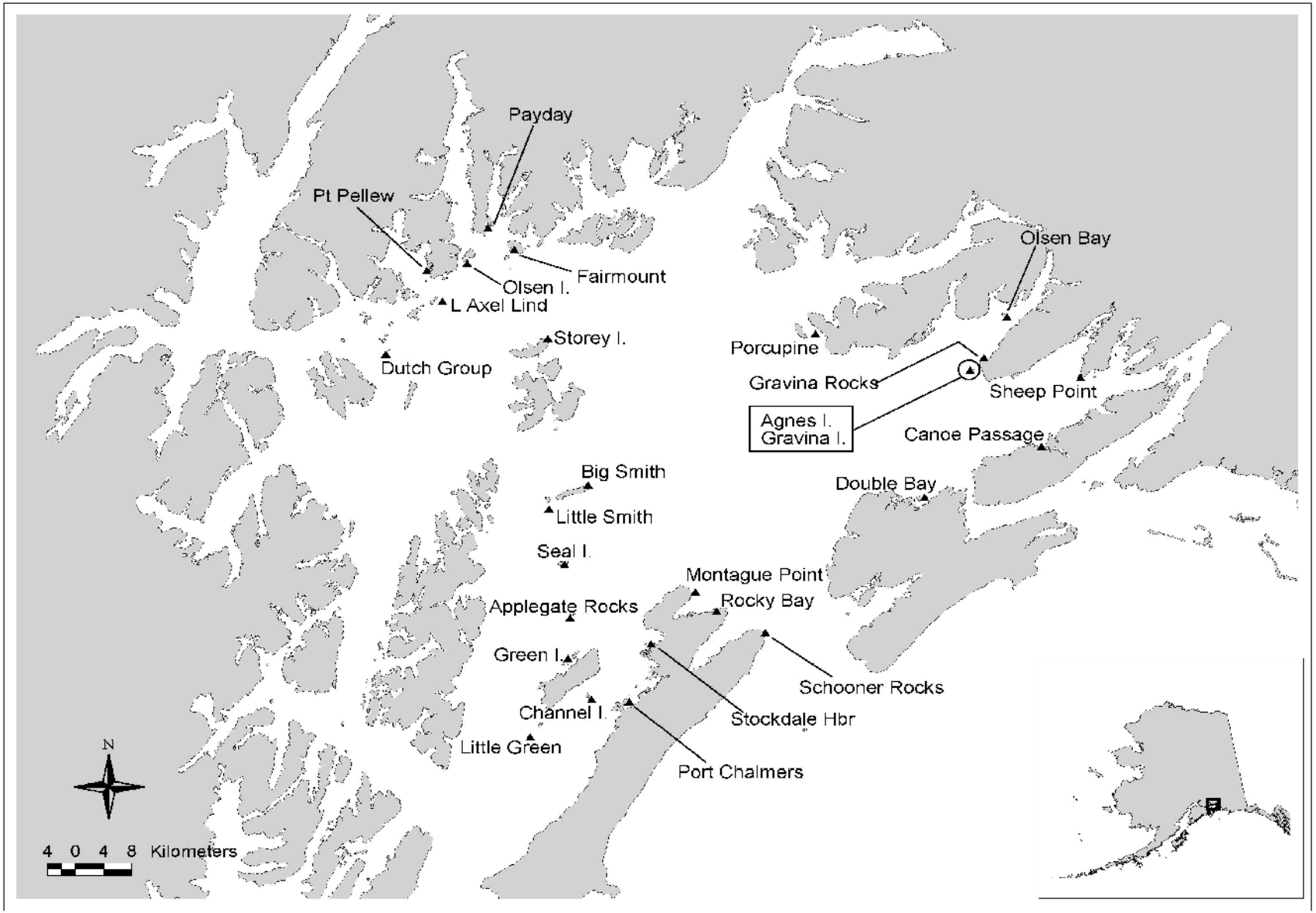

Figure 13. Zone 12. Alaska Department Fish and Game Trend Route "A", central Prince William Sound.

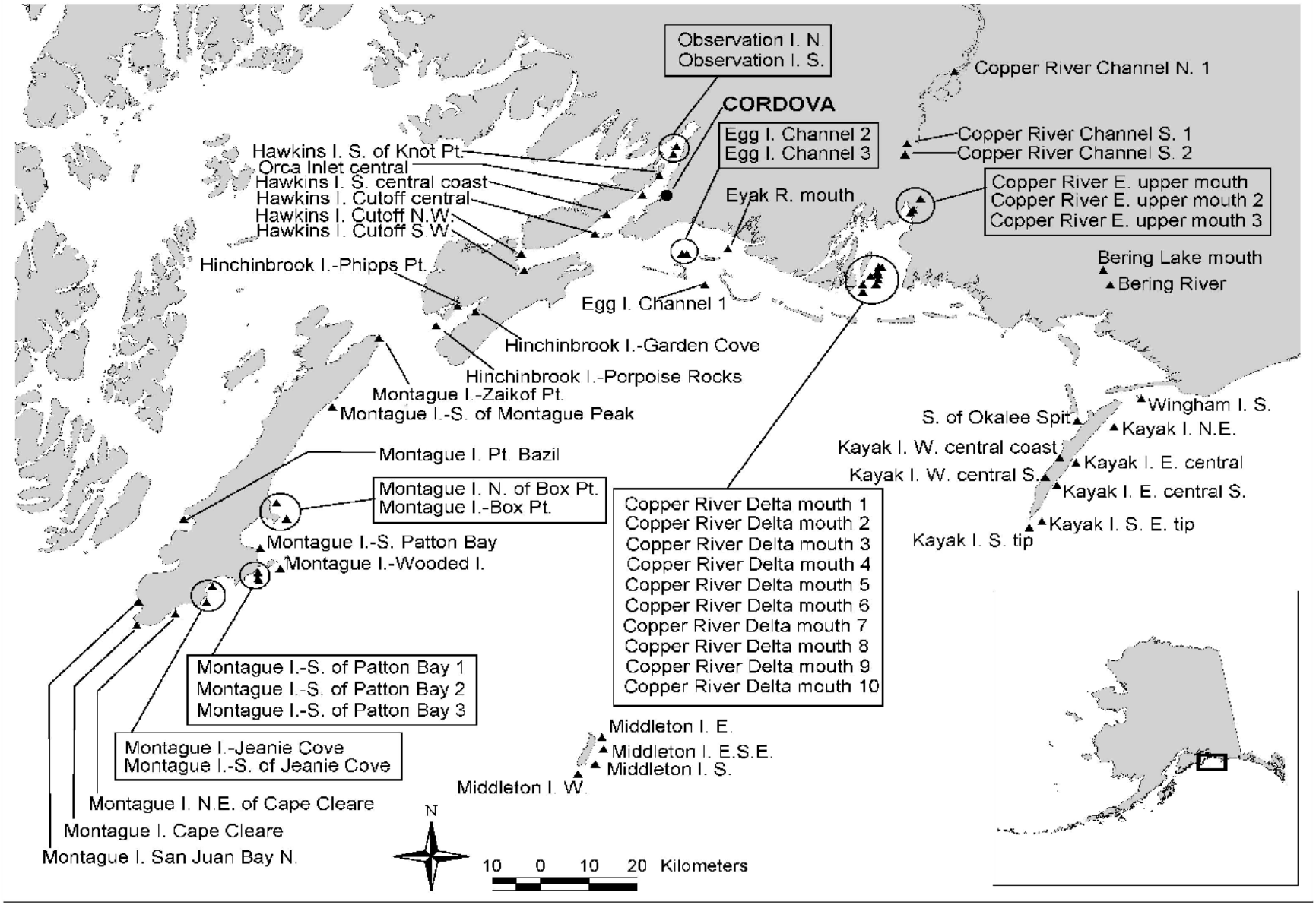

Figure 14. Zone 13. South side of Hinchinbrook and Montague Islands, Copper River, plus Middleton and Kayak Islands.

UPDATE ON THE NORTH PACIFIC HUMPBACK WHALE FLUKE PHOTOGRAPH COLLECTION, OCTOBER 2002

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Introduction

Since 1985, the National Marine Mammal Laboratory (NMML) has been developing and curating a collection of humpback whale fluke photographs taken in North Pacific waters using a computer-assisted matching system (Mizroch, et al. 1990). The collection of North Pacific humpback whale fluke photographs grew from about 750 photographs in 1986 to over 24,000 photographs in 2002, representing contributions from over 20 research groups, taken from all regions in the North Pacific (Table 1).

Matches in the Database

Unique ID numbers (NMMLID) are assigned when there are at least two photographs of a particular individual whale in the database. As of July 2002, there were 24,299 tail fluke photographs in the database: 13,441 photographs with a NMMLID (3,251 unique NMMLID numbers) and 10,858 photographs without a NMMLID (See Table 2. Note: 288 tail fluke photographs were submitted without the researcher noting a year and are not reflected on this table. Also, 47 tail flukes photographs were submitted with a year but no area specified. These photographs are not reflected in the total of 23,964 on the table). The exact number of individual whales in the database cannot be determined at this time because the database has not yet been thoroughly cross-matched between areas and different research collections. Some of the unmatched photos may be unique whales that have only one photograph in the database, and other photos may be unmatchable due to poor photo quality.

New Photos in the Database

NMML staff are processing about 14,000 newly submitted photographs from a number of research groups over the past few years (Table 3). The photographs are being mastered onto a videodisc and will be entered into the database.

Life History Parameter Studies Based on Data in the Database

Using data from the database, Mizroch presented a paper on adult survival of North Pacific humpback whales as an oral presentation at the 14th Biennial Marine Mammal Conference in Vancouver, B.C. in December 2001 and submitted the paper to the journal Ecology in October 2002 (Mizroch et al. submitted). The paper presents estimates of the annual

survival of adult humpback whales (*Megaptera novaeangliae*) for the central North Pacific stock that winters in Hawaii and migrates to discrete feeding areas in Alaska for the summer and fall. The dataset spanned the years 1979 to 1996 (17 annual periods of sightings and 34 semi-annual periods) and included 10,567 photographs of 2,400 individuals. Analysis of sight-resight data confirmed that whales from the central North Pacific stock mix in Hawaii and segregate in Alaska, so annual survival was estimated both from the Hawaii sightings only and also from sightings from Alaska and Hawaii sightings to estimate survival rates for two primary feeding areas in Alaska. If whales from the central North Pacific stock mix in Hawaii, the best apparent survival estimate for the entire stock is from the pooled Hawaii dataset. From the pooled Hawaii dataset, the CJS estimate of annual survival for the central North Pacific stock of humpback whale was 0.963 (95% CI: 0.944, 0.978) and the Pradel estimate was 0.963 (95% CI: 0.944, 0.976). The latter method estimated a population rate of increase to be 1.11 (95%CI: 1.09, 1.13).

Separate estimates of annual survival were produced for whales seen in southeastern Alaska and Prince William Sound. For each Alaskan feeding area, the dataset included Alaska encounters and Hawaii encounters (if any). In this analysis we demonstrated that we could produce better estimates for discrete feeding areas by using Barker's model and using semi-annual sightings as opportunistic resightings. By using sightings both in feeding and winter areas, we can reduce heterogeneity and get more plausible estimates with smaller confidence intervals. The best survival estimate for southeastern Alaska whales, based on Barker's model, was 0.957 (95% CI:0.943, 0.967). The best survival estimate for Prince William Sound whales, also based on Barker's model, was 0.984 (95% CI:0.954, 0.995).

Using data from the database, Jan Straley of University of Alaska presented a poster and an abstract on humpback whale birth intervals to the 14th Biennial Marine Mammal Conference, with a full manuscript on the topic to follow (Straley et al. 2001).

Other Studies

NMML hosted a workshop to examine methods to estimate abundance for humpback whales in southeastern Alaska in June 2002. Terry Quinn from the University of Alaska and Mizroch presented a review of abundance estimation techniques and recent applications of several models to humpback data. Straley and Chris Gabriele from Glacier Bay National Park and Preserve provided an overview of available data, concentrating on recent photo-ID information (1994-2000) for whales in Glacier Bay/Icy Strait, Sitka Sound and Frederick Sound. After deliberation, five methods were outlined as possible ways to estimate humpback whale abundance in Southeastern Alaska:

1. A count of all photographically identified whales in the Straley/Gabriele catalogue, multiplied by the survival rate (0.96) estimated by Mizroch et al. (in review).
2. A series of simple Lincoln- Petersen estimates between adjacent years, separately by each area and pooled across areas
3. An open Jolly-Seber model, separately by each area and pooled across areas
4. A closed multi-strata Darroch model for two consecutive time periods, and a Hilborn generalization for multiple years

5. A Barker model with multiple strata, incorporating Hawaii data from the NMML database, using software application Program MARK (White and Burnham 1999).

A workshop report was produced (NMML 2002) and a final draft of the contract report which presented results from items 2 and 4 was submitted to the NMML (Straley et al. 2002).

Citations

Mizroch, S. A., J.A. Beard, and M. Lynde. 1990. Computer assisted photo-identification of humpback whales. Rep. of the Int. Whal. Comm. (Special Issue 12):63-70.

Mizroch, S. A., L.M. Herman, J.M. Straley, D. Glockner-Ferrari, C. Jurasz, J.D. Darling, S. Cerchio, C.M. Gabriele, D.R. Salden, and O. von Ziegesar. In review. Estimating the adult survival rate of Central North Pacific humpback whales.

NMML. 2002. Southeast Alaska Humpback Whale Workshop - Final Report. National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle WA 98115.

Straley, J., Mizroch, S., Gabriele, C., von Ziegesar, O., Herman, L., Craig, A., Glockner-Ferrari, D., Baker, S., Darling, J., McSweeney, D., Jurasz, C., Cerchio, S., Salden, D., Jacobsen, J., Ellis, G. 2001 (Abstract) Birth intervals and calving rates of central North Pacific stock of humpback whales. 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada November 28-December 3, 2001. Society for Marine Mammalogy.

Straley, J. M, Quinn II, T. J., and C. Gabriele. 2002. Estimate of the abundance of humpback whales in southeastern Alaska 1994 to 2000. Contract report submitted to the: National Marine Fisheries Service, National Marine Mammal Laboratory, 7600 Sand Point Way N.E., Seattle, WA 98115. Grant number: G00000756, SFOS02-223

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 Supplement:120-138pp.

Table 1. Abbreviations and principal contact people from the major contributing research groups.

Abbreviation	Research group	Contact People
CCS	Center for Coastal Studies	D. Mattila
CRC	Cascadia Research Collective	J. Calambokidis, G. Steiger
CWR	Center for Whale Research	K. Balcomb, D. Claridge
CWS	Center for Whale Studies	D. Glockner-Ferrari, M. Ferrari
DFO	DFO, Pacific Biological Station	G. Ellis
GBNP	Glacier Bay National Park and Preserve	G. Gabriele
HWRF	Hawaii Whale Research Foundation	D. Salden
JSI	J. Straley Investigations	J. Straley
KBMML	Kewalo Basin Marine Mammal Laboratory	L. Herman, A. Craig
IMI	Island Marine Institute	J. Mobley
MLML	Moss Landing Marine Labs	S. Cerchio
NGOS/EOW	North Gulf Oceanic Society, Eye of the Whale	O. von Ziegesar, C. Matkin
NMML	National Marine Mammal Laboratory	S. Mizroch
OEA	Okinawa Expo Aquarium	S. Uchida, N. Higashi
OMC	Ogasawara Marine Center	M. Yamaguchi
OSU	Oregon State University	B. Mate
SeaSearch	SeaSearch	C, Jurasz
UABCS	Univ. Autonoma de Baja Calif. Sur	J. Urban
UAF	University of Alaska (Kodiak)	B. Witteveen
UNAM	Univ. Nacional Autonoma de Mexico	P. Lladron, J. Jacobsen
WCWRF	West Coast Whale Research Foundation	J. Darling, E. Mathews, D. McSweeney, K. Mori

Table 2. Number of humpback whale tail fluke photographs in the database, by area and year. Photos were submitted from 1997 through 2001, but most of those have not yet been entered into the database.

Year	Alaska	California	Canada	Colombia	Hawaii	Japan	Mexico	Oregon	Panama	Washington	**Total**
1966							1				1
1968	10										10
1969	4										4
1970	2										2
1972	29										29
1973	13										13
1974	50										50
1975	35				3						38
1976	65				89						154
1977	296		2		21						319
1978	267				64		84				415
1979	323				135		27				485
1980	620	2			511		68				1,201
1981	337				750		20			5	1,112
1982	190		1		246						437
1983	120	10	1		377		8				516
1984	375		1		261		10				647
1985	219	2	8		227		10				466
1986	502	95	4	1	421		103				1,126
1987	366	93	2		504	8	107				1,080
1988	252	111	16		941	18	163				1,501
1989	218	55	14	41	1,099	72	316				1,815
1990	131	115	13	2	958	122	247	23		1	1,612
1991	488	265	18		944	18	307				2,040
1992	851	398	28	8	890	15	180	5	1		2,376
1993	298	256	48		1,215	17	97				1,931
1994	545	242	88		413	37	82			13	1,420
1995	564	319			614	33	82			42	1,654
1996	25	41			946		252			34	1,298
1997	1				1		127			17	146
1998	1				41					9	51
1999	8									7	15
Total	7,205	2,004	244	52	11,671	340	2,291	28	1	128	23,964

Table 3. Number of newly submitted humpback whale tail fluke photographs to be added to the database, by research group (see Table 1) and year.

Year	CRC	CWS	DFO	GBNP	HWRF	IMI	JSI	KBMML	NGOS	NMML	OMC	OSU	UAF	UNAM	WCWRF	Total
1982														1		
1983														1		1
1984														2		2
1985														2		2
1986														15		15
1987														4		4
1988																0
1989																0
1990																0
1991		576	1													577
1992			3													3
1993			2											1		3
1994			7	20										7		34
1995	5		3	10			99	157						9		283
1996	424		22	81			202	102	77					25	250	1,183
1997	292		37	95			155	607	104	420				12	275	1,997
1998	446		79	83			348	1,365				15		28		2,364
1999	369			98	531		118	1,202				31	14	70		2,433
2000	391			119		56	152	1,028	72	68			66			1,952
2001		321		97		86		904	64	15			121			1,608
2002						119		769					18			906
Total	1,927	897	154	603	531	261	1074	6,134	317	503	580	46	219	177	525	13,948

STELLER SEA LION FORAGING ECOLOGY

Unimak Pass and Kodiak Island
26 February-14 March 2001

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Introduction

The western stock of Steller sea lions (*Eumetopias jubatus*) is declining at about 5% per year and total population numbers have dropped by over 80% since the late 1960s. The magnitude and continuous nature of the decline resulted in this stock being listed as endangered in 1997 by the National Marine Fisheries Service (NMFS). The cause of the decline is not known but likely has changed over time. During the early phases of the decline, incidental catch of sea lions in trawl fisheries and legal shooting were important sources of mortality. After the North Pacific Ocean regime shift in the 1970s, and as U.S. fishery management changed during the 1970s and 1980s, the cause of the decline was attributed to nutritional stress resulting from either environmental variability that caused a change in prey base, removal of prey by commercial fisheries, or a combination of these two factors.

The Alaska Fisheries Science Center (AFSC), developed studies to address the efficacy of management measures implemented in the early 1990s addressing the nutritional stress hypothesis; and recent Section 7 biological opinions have stressed the need for assessment data of fishery resources in the area where Steller sea lions forage. Our purpose in this study was to attach satellite dive recorders (SDRs) to young Steller sea lions in areas where the efficacy studies are being implemented and in locations where fishery data are currently being collected by both the Resource Assessment and Conservation Engineering (RACE) Division (Unimak Pass area of the southeastern Bering Sea) and the University of Alaska and NMFS (Kodiak Island area). We also collected Steller sea lion scat for prey information.

Methods

We captured free-ranging Steller sea lions of both sexes from approximately 9 months to 33 months of age at haul-out sites in the eastern Aleutian Islands and near Kodiak Island (Table 1). Sea lions in the eastern Aleutian Islands were captured on land with a hoop net and physically restrained. Sea lions in the Kodiak area were capture using SCUBA gear by Alaska Department of Fish and Game (ADF&G) personnel and the technique and equipment developed by them. SDRs were glued to the pelage on the animal's back with fast-setting epoxy resin. Either a plastic tag was attached to the trailing edge of each front flipper (eastern Aleutian Islands) or a unique number branded to the left shoulder (Kodiak Island area). For sea lions captured in the Kodiak

area a VHF transmitter (164 MHz) was glued to the back behind the SDR for on land locations during aerial surveys. The SDRs are not expected to be recovered and are expected to be shed at or before the fall molt. We collected small tissue samples from the rear flippers for genetic analysis and blood for various health and condition indices. Scats were collected opportunistically when on site to capture animals.

Instrument Description and Programming

We used 0.25 watt satellite dive recorders (SDR) packaged as ST-10 and ST-16 SDRs by Wildlife Computers, Redmond, Washington. These instruments provide 1) dive duration, 2) dive depth, 3) proportion of time at depth, 4) time line, and 5) status. Location data are not sent by the transmitter but are calculated by Service-Argos based on the received message. Each messages is sent separately at prescribed intervals. The transmission interval at sea is every 43 seconds and while on land it is every 2 minutes 28 seconds. Thus, the number of transmissions (and thus messages) while at sea depends on the duration of the instrument's exposure at the surface. Additional information on these instruments and their capabilities is in Merrick et al. (1994). The satellite tracking system (Argos) is described in detail in Fancy et al. (1988) and Stewart et al. (1989).

The SDRs stored, summarized, and transmitted dive data as histograms. Each day was divided into four 6-hour periods subdivided information into 14 bins; dive depth bins included 4-6 m; 6-10 m; 10-20 m; 20-34 m; 34-50 m; 50-74 m; 74-100 m; 100-124 m; 124-150 m; 150-174 m; 174-200 m; 200-250 m; and > 250 m. Dive duration also contained 14 bins at 1- minute intervals (e.g., 1-2 minutes, 2-3 minutes, 3-4 minutes, etc.); the 14 time-at-depth bins coincided with dive-depth bins except the first bin was zero in order to achieve dry readings on land; for example, 0-4, 4-6, 6-10, etc. and the last was > 200. Time-at-depth is the proportion of time that dives occurred within a particular depth bin of a 6 hour period while at sea (e.g., if an animal was at sea for 3 hours during a 6 hour period and spent half of its dive time in bin 50-74, the value in bin 50-74 would be 25%).

Time-line messages provide two bits of information: time-at-depth and time-line. Time-line messages provide information as to whether the instrument was wet >10 minutes of a 20 minutes period for 72 periods in a 24 hour day. Time-line messages thus allow calculation of time at sea and on land.

Status is a separate message that provides the maximum dive depth in a 24 hour period from midnight GMT to midnight GMT. The status message also provides information on transmitter status, including a pressure offset, battery status, number of transmissions to that time, at-surface data, date and time, ID of message, and saltwater conductivity reading.

Location Data

Locations were estimated based on the Service-Argos classification scheme where Class 3 is accurate to < 150 m; Class 2: 150 - 350 m; Class 1: 350 - 1000m; Class 0: > 1000 m; and Class A and B has no accuracy assigned (Service-Argos, 1984). For each trip location, data were filtered using 0-3 quality locations. These location data were then sorted by date and time-line to determine which locations occurred during each trip.

Results

We deployed 20 SDRs on young Steller sea lions between 26 February to 14 March 2001; 10 in the eastern Aleutian Islands, four at Sea Otter Island, and 6 at Long Island (Table 1). Of the 20 SDR equipped sea lions, 11 were male and 9 were female (2 males and 8 females in the eastern Aleutian Islands) and ranged in age from 9 months to 21 months. Blood and tissue samples were obtained from up to 16 of the captured sea lions (Table 2). Transmissions were received for an average of 82 days (SD=35 days), and ranged between 37 and161 days. Positions indicated near and offshore movements (Fig. 1). Data from these deployments were included in Loughlin et al. (In Press).

Prior to arrival of the RV *Tiglax* in the Kodiak area on 7 March, the ADF&G personnel (with NMML SCUBA divers in training) on the *RV Resolution* captured three sea lions at Long Island and attached SDRs to them (two on 6 March, one on 7 March). Thus, a total of 23 SDRs were deployed during the field portion of the study. Data from all these SDRs will be shared by both agencies.

Steller sea lions tagged with either plastic colored tags on the trailing edge of the front flipper, or hot branded as pups with unique numbers on the left shoulder were sighted during capture attempts in the eastern Aleutian Islands and at Sea Otter Island (Table 3). A male tagged as a pup in 1998 at Ugamak Island with red tag 996 was seen at Aiktak Island on 1 March. Numerous animals branded as pups were seen at Sea Otter Island. F 447 was a male marked at Forrester Island in 1994 and seen by us on 10 March. Six animals marked as pups at Marmot (T) and Sugarloaf (X) Islands during 2000 were seen by us at Sea Otter Island (T29, T37, T43, T91, T101, X91). We also saw two of the animals (=159, =160) at Sea Otter Island the day after the capture. The SDR was seen and judged to be in good condition as was the permanent mark. Numerous marked animals were seen at Long Island (Table 3).

Scats (189) were collected while on haul-out sites in the eastern Aleutian Islands during capture attempts (Table 2). They were shipped to the NMML for analysis in the laboratory. We did not land on the haul-out sites in the Kodiak area since all captures were accomplished using the SCUBA technique so no scats were collected there.

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Appendix I – Personnel

Scientists on Leg 1, 15 Feb.-7 March, RV *Tiglax*: T. Loughlin, J. Sterling, J. Thomason, C. Kurle, K. Call, P. Browne, V. Burkanov.

Scientists on Leg 2, 7-15 March, RV *Tiglax*: T. Loughlin, J. Sterling, J. Thomason, R. Ream, R. Towell, R. Lauth, K. Pitcher, D. McAllister, K. Wynne, T. Gelatt, B. Heath, V. Burkanov.

Scientists on Leg 2, 5-15 March, RV *Resolution*: L. Rea, B. Fadely, W. Dunlop, W. Taylor, C. Curgis, J. King

Appendix II – Anchorages

Night of:	
25 February (S)	Dutch Harbor
26 February (M)	Akun Bay
27 February (T)	Aiktak near cabin
28 February (W)	Tigalda Bay
1 March (T)	Tigalda Bay
2 March (F)	Trident Bay, Akun
3 March (S)	Tigalda Bay
4 March (S)	underway– no anchorage
5 March (M)	underway – no anchorage
6 March (T)	underway– no anchorage
7 March (W)	Kodiak –city dock
8 March (T)	Phoenix Bay, Perinosa Bay, Afognak Is.
9 March (F)	Phoenix Bay, Perinosa Bay, Afognak Is.
10 March (S)	Kizhuyak Bay, near Port Lyons
11 March (S)	Kodiak – city dock; vessel repairs
12 March (M)	Kodiak – city dock
13 March (T)	Kodiak – city dock
14 March (W)	end of charter

Table 1. Date, location, satellite dive recorder (SDR) number, and measurements for Steller sea lions captured during 26 February to 15 March 2001.

Date	Location	SDR	Sex	Est. Age (mo)	Mass (kg)	Length (cm)	Axillary Girth (cm)
26-Feb	Reef Pnt, Akutan	14112	M	2	125--approx	163	131
1-Mar	Aiktak	14113	F	9	101.2	179	112.5
1-Mar	Ugamak	14162	F	9	105.8	180	130
3-Mar	NE Rks, Tigalda	14171	F	21	102.8	169	113
3-Mar	NE Rks, Tigalda	14173	M	9	86.6	153	115
3-Mar	Aiktak	14175	F	9	87	162	104
3-Mar	Aiktak	14197	F	9	99.4	173	116
3-Mar	Aiktak	14199	F	9	107	169	132
4-Mar	Billingshead	14172	F	21	152	183	176
4-Mar	Billingshead	14201	F	9	116	169	118
9-Mar	Sea Otter	14150	M	9	102.5	165.5	120
9-Mar	Sea Otter	14151	M	9	80.5	162	101.5
9-Mar	Sea Otter	14152	M	9	88.5	166	109.5
10-Mar	Sea Otter	14153	M	9	109	179	115
12-Mar	Long	14154	M	9	92.5	163	108.5
12-Mar	Long	14155	M	9	85	162	103
12-Mar	Long	14156	M	9	123.5	175	127
12-Mar	Long	14157	M	9	126	179	123
13-Mar	Long	14158	F	21	114.5	175	124
13-Mar	Long	14159	M	9	125.5	180	129

Table 2. Date, location, estimated number (#Ej) and biological samples from Steller sea lions during 26 February to 15 March 2001 in the eastern Aleutian Islands and near Kodiak Island, Alaska.

Date	Site	Latitude	Longitude	Type	#Ej	Captures	Scats	Genetics	Blood
26-Feb	Reef Pnt, Akutan	54.13747	166.10493	offshore rock	50+	1	32	1	0
27-Feb	Tanginak			large offshore rock	50	0	0	0	0
27-Feb	Basalt			offshore rock	59	0	35	0	0
27-Feb	Aiktak			same	30+	0	0	0	0
27-Feb	Round			large rock	0	0	0	0	0
27-Feb	Ugamak			boulder beach	34	0	0	0	0
28-Feb	no survey								
1-Mar	Aiktak	54.18323	164.85244	rock slab	66	1	34	1	1
1-Mar	Aiktag	54.18323	164.85244						
1-Mar	Ugamak	54.21146	164.77923	rock slab	74	1	27	0	0
2-Mar	Basalt				no count				
2-Mar	D&D			off shore rock slab	39	0	15	0	0
3-Mar	NE Rks, Tigalda	54.15941	164.98267	off shore rock	48	2	0	2	1
3-Mar	Aiktak				no count	3	0	0	0
4-Mar	NE Rks, Tigalda				no count	0	34	0	0
4-Mar	Billingshead	54.29287	165.53241	cobble beach	65+	2	12	2	2
5-Mar	Jude			rock slab	112+	0	0	0	0
9-Mar	Sea Otter			off shore Rock	62	3	0	3	3
10-Mar	Sea Otter			off shore Rock	22	1	0	1	1
12-Mar	Long	57.4691	152.1307	off shore rock	no count	4	0	4	4
13-Mar	Long			off shore rock	no count	2	0	2	2
Totals						20	189	16	14

Table 3. Steller sea lions marked with flipper tags or brands that were seen during 26 February to 15 March 2001.

Sea lion number	Where seen	When seen	Where and when marked
T12	Long	12 March	Marmot, 2000
T21	Long	12 March	Marmot, 2000
T29	Sea Otter	9,10 March	Marmot, 2000
T37	Sea Otter	9 March	Marmot, 2000
T43	Sea Otter	9 March	Marmot, 2000
T73	Long	12 March	Marmot, 2000
T89	Long	12 March	Marmot, 2000
T91	Sea Otter	9 March	Marmot, 2000
T96	Long	12 March	Marmot, 2000
T101	Sea Otter	9,10 March	Marmot, 2000
X91	Sea Otter	9,10 March	Sugarloaf, 2000
X118	Long	12 March	Sugarloaf, 2000
F447	Sea Otter	10 March	Forrester, 1994
=159	Sea Otter	10 March	Sea Otter, 2001 (9 March)
=160	Sea Otter	10 March	Sea Otter, 2001 (9 March)
Tags:			
996-red	Aiktak	1 March	Ugamak, 1998

Figure 1. Example of the late March 2001 distribution of 20 juvenile Steller sea lions equipped with SDRs during February and March 2001 in the a) Unimak Pass area (n = 10), and b) near Kodiak Island (n = 10).